

ENVIRONMENTAL & SOCIAL ANALYSIS REPORT

LEGUAN SOLAR PV PROJECT



February 2023

Table of Contents	Page
ACRONYMS.....	11
1.0 INTRODUCTION	14
1.1 Background.....	14
1.2 Objective and Scope of the ESAR.....	14
1.3 Approach	15
1.4 Methodology	16
1.4.1 Establishing the Baseline.....	17
1.4.2 Impact Analysis.....	18
1.4.3 Mitigation and Management Planning.....	18
1.5 Organisation of the ESAR.....	18
1.6 Challenges.....	19
2.0 PROJECT DESCRIPTION	20
2.1 Background.....	20
2.2 Rationale.....	21
2.3 Project Overview.....	23
2.3.1 Analysis of Alternatives.....	24
2.3.1.1 Alternative Power Generation Options.....	24
2.3.1.1 Alternative Project Locations.....	25
2.4 Project Location	26
2.5 Project Components	31
2.5.1 Main Components.....	31
2.5.2 Auxiliary Facilities	33
2.6 Project Life and Sustainability.....	33
2.7 Cost of Electricity and Main Consumers.....	33
2.8 Construction Phase	34
2.9 Commissioning and the Operational Phase	34
2.10 Project Employment.....	34
2.11 Environmental Benefits of the Project.....	35
2.12 Social Benefits of the Project.....	35
2.13 Planning Permission and Regulatory Approvals.....	36
3.0 POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK	37
3.1 National Policies and Strategies.....	38
3.1.1 Low Carbon Development Strategy	38
3.1.2 Guyana National Energy Policy	39
3.1.3 National Development Strategy	39
3.1.4 Poverty Reduction Strategy Paper.....	40
3.1.5 Hinterland Electrification Strategy.....	40
3.1.6 Guyana Power Sector Policy and Implementation Plan	41
3.1.7 Guyana Energy Agency Strategic Plan.....	41
3.1.8 National Land Use Plan	42
3.1.9 National Environmental Action Plan.....	42
3.1.10 Nationally Determined Contribution	42
3.1.11 National Biodiversity Strategy and Action Plan.....	43
3.1.12 National Action Plan to Combat Land Degradation in Guyana	43
3.2 Legislation and Regulations.....	43

3.2.1 The Constitution of the Cooperative Republic of Guyana, 1980, and 2003 Reforms	44
3.2.2 The Environment Protection Act (1996).....	44
3.2.2.1 The Environment Protection Regulations (2000, 2013)	44
3.2.2.2 Environmental Guidelines for the Preparation of an Environmental Management Plan	46
3.2.3 Sea Defence Act (1933).....	47
3.2.4 Guyana Energy Agency Act (1997)	48
3.2.5 State Lands Act (1903)	48
3.2.6 Guyana Lands and Surveys Act (2001).....	48
3.2.7 Local Democratic Organs Act (1980).....	48
3.2.8 National Trust Act (1972).....	48
3.2.9 Public Health Ordinance (1934).....	49
3.2.10 Labour Act (1942)	49
3.2.11 Occupational Health and Safety Act (1997).....	50
3.2.12 Additional Legislation	50
3.3 IDB Operational Policies	50
3.4 Institutional Framework.....	54
3.4.1 Environmental Protection Agency.....	54
3.4.2 Office of the Prime Minister.....	54
3.4.2.1 Guyana Energy Agency	54
3.4.2.2 Guyana Power and Light Inc.	55
3.4.3 Public Utilities Commission	56
3.4.4 Regional Democratic Council of Region 3 and the Leguan NDC	56
3.4.5 Sea and River Defence Board and the Sea and River Defence Department, Ministry of Public Works	56
3.4.6 Guyana Lands and Surveys Commission.....	57
3.5 International and Regional Framework.....	57
3.5.1 Sustainable Development Goals.....	57
3.5.2 United Nations Framework Convention on Climate Change and Paris Agreement.....	58
3.5.3 The CARICOM Energy Policy	58
3.5.3.1 The Caribbean Sustainable Energy Road Map and Strategy	58
3.5.4 International Solar Alliance	58
3.6 Other Codes and Guidelines	59
3.6.1 GPL National Grid Code	59
3.6.2 NFPA's National Electrical Code (NEC)	60
3.6.3 Relevant Standards of the International Electrotechnical Commission	60
3.6.4 Relevant Standards of the Institute of Electrical and Electronics Engineers	60
4.0 PROJECT ENVIRONMENT	62
4.1 Physical Environment	64
4.1.1 Geomorphology	64
4.1.2 Topography.....	65
4.1.3 Soils	68
4.1.4 Erosion and Accretion.....	70
4.1.5 Surface Hydrology	72
4.1.6 Climate.....	75
4.1.6.1 National Climate Profile.....	75
4.1.6.2 Climate Profile of the Project Site	75
4.1.7 Surface Water Quality.....	77
4.1.7.1 Methodology.....	77
4.1.7.2 Results	80
4.1.7.3 Surface Water Quality of the Lower Essequibo Watershed	80

4.1.8 Ambient Noise Levels	81
4.1.8.1 Methodology.....	81
4.1.8.2 Results	84
4.1.9 Ambient Air Quality	84
4.1.9.1 Methodology.....	84
4.1.9.2 Results	87
4.2 Biological Environment	88
4.2.1 Biogeographic Provinces	89
4.2.2 Landscapes and Ecosystems	89
4.2.2.1 Forest Ecosystems.....	89
4.2.2.2 Freshwater and Wetland Ecosystems.....	89
4.2.2.3 Coastal Ecosystems.....	90
4.2.2.4 Marine Ecosystems	91
4.2.3 Habitats and Species	91
4.2.3.1 Freshwater and Marine Biological Environment.....	91
4.2.3.2 Terrestrial Biological Environment	93
4.2.3.4 Areas of Biological Interest	96
4.3 Socio-Economic Environment.....	99
4.3.1 Access to the Project Site	99
4.3.2 Land Use.....	100
4.3.2.1 Land Uses around the Solar PV Farm Site	100
4.3.2.3 Land Uses around the Transmission Line Alignment.....	102
4.3.3 Communities	104
4.3.2.1 Population and Demographics	104
4.3.2.2 Livelihoods	106
4.3.2.3 Health.....	106
4.3.2.4 Electricity and Energy	107
4.3.2.5 Water Supply.....	107
4.3.2.6 Sanitation and Waste Disposal	107
4.3.2.7 Infrastructure	107
4.3.2.8 Crime.....	107
4.3.4 Heritage Sites	108
5.0 STAKEHOLDER ENGAGEMENTS	110
5.1 Stakeholder Engagement Approach.....	110
5.2 Stakeholder Identification	110
5.3 Stakeholder Engagement Strategy and Methods	111
5.3.1 One-on-One Engagements.....	111
5.3.2 Public Community Meeting	112
5.4 Stakeholder Feedback.....	112
6.0 IMPACT ASSESSMENT	115
6.1 Impact Assessment Methodology.....	115
6.1.1 Stage 1 - Impact Identification	117
6.1.2 Stage 2 - Impact Assessment	117
6.1.2.1 Residual Risks	118
6.2 Physical Resources	119
6.2.1 Soils and Geology.....	119
6.2.1.1 Erosion	119
6.2.1.2 Change in Topography.....	120
6.2.1.3 Loss of Topsoil	121

6.2.1.4 Compaction	121
6.2.1.5 Soil Contamination	122
6.2.2 Water Resources	123
6.2.2.1 Sedimentation	123
6.2.2.3 Contamination of Water Resources	123
6.2.3 Climate Change	124
6.2.3.1 Potential Adverse Climate Change Impacts	124
6.2.3.2 Greenhouse Gas Emissions	136
6.2.3.3 Climate Change Mitigation	136
6.2.4 Ambient Noise Levels	137
6.2.5 Ambient Air Quality	138
6.3 Biological Resources	138
6.3.1 Vegetation	139
6.3.2 Terrestrial and Aquatic Fauna	139
6.4 Socio-Economic Resources	141
6.4.1 Land Use	141
6.4.2 Economic and Community Development	141
6.4.2.1 Economic Development of Leguan	141
6.4.2.2 Access Road in Canefield	142
6.4.3 Employment and Local Content	142
6.4.4 Aesthetics and Visual Impacts	143
6.4.5 Traffic	144
6.4.6 Conflicts with Local Communities	144
6.4.7 Archaeological Resources and Cultural Heritage	144
6.5 Health and Safety	145
6.5.1 Occupational Health and Safety	145
6.5.2 Public Health and Safety	145
6.5.3 COVID-19 Pandemic	146
6.5.4 Emergency Response Services	146
6.6 Project Site Decommissioning	146
6.7 Cumulative Impacts	147
6.7.1 Energy Generation and Renewable Sources of Energy	147
6.7.2 Employment and Community Development	147
7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN	148
7.1 Physical Resources	148
7.1.1 Soils and Geology	148
7.1.1.1 Erosion	148
7.1.1.2 Loss of Topsoil	149
7.1.1.3 Compaction	149
7.1.1.4 Soil Contamination	150
7.1.2 Water Resources	150
7.1.2.1 Sedimentation	150
7.1.2.2 Contamination of Water Resources	151
7.1.3 Waste Management	151
7.1.3.1 Liquid Waste	151
7.1.3.2 Solid Waste	152
7.1.3.3 Hazardous Waste	152
7.1.4 Fuel, Lubricants and other Hazardous Materials	153
7.1.5 Climate Change	153
7.1.5.1 Measures to Build Resilience to Flood Risk	153
7.1.5.2 Measures to Build Resilience to Increased Temperatures	154

7.1.5.3 Greenhouse Gas Emissions	154
7.1.7 Ambient Noise Levels	154
7.1.8 Ambient Air Quality	155
7.2 Biological Resources	155
7.2.1 Vegetation.....	155
7.2.2 Terrestrial and Aquatic Fauna.....	155
7.3 Socio-Economic Resources.....	157
7.3.1 Land Use.....	157
7.3.2 Conflict Management	157
7.3.2.1 Conflict Prevention	157
7.3.2.2 Code of Conduct for Workers.....	158
7.3.2.3 Conflict Resolution (Grievance Mechanism)	158
7.3.3 Employment and Community Development.....	160
7.3.4 Aesthetics and Visual Impacts	160
7.3.5 Traffic	160
7.3.6 Stakeholder Engagements.....	161
7.3.7 Archaeological Finds.....	161
7.4 Health and Safety	162
7.4.1 Occupational Health and Safety	162
7.4.2 Public Health and Safety.....	163
7.5 Emergency Response	163
7.6 Summary of Impacts and Management and Mitigation Measures.....	164
8.0 IMPLEMENTATION FRAMEWORK	181
8.1 Introduction	181
8.2 Roles and Responsibilities.....	181
8.3 Construction ESMP (CESMP)	183
8.4 Environmental Monitoring	185
8.5 Reporting	187
8.5.1 Reporting During the Construction Phase	187
8.5.2 Reporting and Record Keeping during the Operational Phase.....	188
8.6 Orientation and Training	188
8.7 Mitigation and Monitoring Budget	189
CONCLUSION	191
REFERENCES	192
APPENDICES	197
Appendix A: Terms of Reference.....	197
Appendix B: Consultant Support.....	200
Appendix C: GLSC Cadastral Survey of Property	201
Appendix D: No Objections/Permissions	202
Appendix E: Water Quality Analyses Laboratory Report	211
Appendix F: Minutes of Stakeholders Engagements.....	212
Appendix F1: Personal Communication 01 – Interview with the Sea and River Defences Board (Legan Office)	212
Appendix F2: Personal Communication 02 – Interview with the Leguan Neighbourhood Democratic Council	215
Appendix F3: Personal Communication 03 – Interview with Guyana Power and Light Inc. (Legan).....	219

Appendix F4: Personal Communication 04 – Interview with Neighbouring Land Owner # 1 (Owner of Neighbouring Pasture Lands)	222
Appendix F5: Personal Communication 05 – Interview with Canefield Resident #1 (Neighbouring Residents)	224
Appendix F6: Personal Communication 06 – Interview with Canefield Resident # 2 (Neighbouring Resident)	226
Appendix F7: Personal Communication 07 – Interview with Canefield Resident # 3 (Neighbouring Resident)	227
Appendix F8: Personal Communication 08 – Interview with Canefield Resident # 4	228
Appendix F9: Personal Communication 09 – Interview with Major Projects Department, Engineering Services Division of Guyana Power and Light Inc. (Georgetown)	230
Appendix F10: Personal Communication 10 – Interview with Guyana Tourism Authority	233
Appendix F11: Personal Communication 11 – Interview with the Chief Sea and River Defence Officer	235
Appendix F12: Personal Communication 12 – Interview with Neighbouring Land Owners # 2	238
Appendix G: Minutes of Public Meeting conducted by the GEA.....	240

Table of Tables

Table 2-1: Key Specifications of the Solar Power Plant	23
Table 2-2: GPL Tariff Structure	33
Table 2-3: Potential Areas for Employment.....	35
Table 2-4: CO ₂ Savings from the Solar Power Plant.....	35
Table 3-1: Relevant Legislation, Policies and Strategies	37
Table 3-2: WHO Air Quality Standards.....	45
Table 3-3: Parameters and Maximum Allowable Limits	45
Table 3-4: Decibel Limits for Various Types of Activities.....	46
Table 3-5: Policy Directives of OP-703 – Environmental and Safeguards Compliance	51
Table 4-1: Characteristics of Soil Mapping Unit 1a (Fertile Low Humic Gleys - Front land Clays).....	68
Table 4-2: Description of Surface Water Sample Locations and other Sampling Details.....	78
Table 4-3: Results of Water Quality Analyses	80
Table 4-4: Relevant Sample Points from the Lower Essequibo Watershed Monitoring Programme	81
Table 4-5: Results of Water Quality Analyses of the Lower Essequibo Watershed	81
Table 4-6: Noise Level Measurement Locations	82
Table 4-7: Results of Noise Level Measurements.....	84
Table 4-8: Air Quality Assessment Locations and Other Details.....	84
Table 4-9: Results of PM and TSP Assessment	87
Table 4-10: Results of Gaseous Assessment	88
Table 4-11: Wetlands of Guyana.....	90
Table 4-12: Freshwater Faunal Species in the Aol	92
Table 4-13: Marine Species in Wider Project Environment.....	92
Table 4-14: Terrestrial Species within the Aol.....	94
Table 4-15: Terrestrial Faunal Species within the Aol.....	96
Table 4-16: Population of Leguan's Communities.....	104
Table 5-1: Schedule of One-on-One Engagements with Stakeholders.....	111
Table 5-2: Summary of Stakeholder Feedback	113
Table 6-1: Definitions of Types of Impacts	117
Table 6-2: Impact Significance Level Descriptors	118
Table 6-3: Impact Likelihood Levels	118
Table 6-4: Risk Assessment Matrix	118
Table 7-1: Summary of Impact Assessment.....	165
Table 8-1: Summary of Environmental related Responsibilities	182
Table 8-2: Environmental Monitoring during Construction	185
Table 8-3: Monitoring Plan for Project Operations	186
Table 8-4: Indicative Annual Budget for Mitigation during Construction.....	189
Table 8-5: Indicative Annual Budget for Monitoring during Construction	190

Table of Figures

Figure 2-1: Monthly Generation by GPL, Leguan in 2019	21
Figure 2-2: Average Hourly Load of GPL, Leguan in 2019	22
Figure 2-3: 15-Year Forecast of Peak Demand in Leguan.....	22
Figure 2-4: Location of the Leguan Solar PV Power Plant.....	28
Figure 2-5: The Initial and New Sites for the Leguan Solar PV Power Plant.....	29
Figure 2-6: Transmission Line Route	30
Figure 2-7: Proposed Layout of the Solar PV Farm	32
Figure 4-1: The Wider Environment around the Current and Initial Project Sites.....	63
Figure 4-2: The Project Site.....	64
Figure 4-3: Sections of the Transmission Line Alignment	64
Figure 4-4: Ground Survey Benchmarks and Survey Points of Previous Project Site	67
Figure 4-5: Soil Type of the Wider Project Area	69
Figure 4-6: Shoreline in 2003 located Immediately East of the Project Site.....	70
Figure 4-7: Project Site and Beach in 2014 as a result of Accretion with Signs of Vegetative Growth.....	71
Figure 4-8: Project Site and Beach in 2015 with Some Inundation of the Beach (Possibly High-Tide) and Increasing Vegetative Cover	71
Figure 4-9: Project Site and Beach in 2019 with Additional Accretion and Maturing Vegetation	72
Figure 4-10: Erosion of Coconut Trees (Left) and Boulder Face along the Northern Boundary of the Project Site (Right)	72
Figure 4-11: Over-Grown Ditch Parallel to South-Eastern Boundary	73
Figure 4-12: Major Drainage Canal in the Wider Project Area	73
Figure 4-13: Self-Acting Koker	73
Figure 4-14: Canal West of the Project Site	73
Figure 4-15: Drainage Network of the Project Area.....	74
Figure 4-16: Mean Monthly Rainfall on Leguan.....	76
Figure 4-17: Surface Water Sample Collection from the Canal West of the Project Site (Left) and the Essequibo River (Right).....	78
Figure 4-18: <i>In-Situ</i> Analysis of Surface Water Samples	78
Figure 4-19: Sampling Locations for Surface Water Quality Analysis.....	79
Figure 4-20: Noise Levels Measurement at Southern Boundary (Left) and Mid-Point (Right)	82
Figure 4-21: Noise Measurement Locations.....	83
Figure 4-22: Ambient Air Quality Measurement at the Southern Boundary (Left) and Northern Boundary (Right)	85
Figure 4-23: Ambient Air Quality Measurement Locations	86
Figure 4-24: Conduct of Biological Assessment of the Project Site	89
Figure 4-25: Some Flora Species at the Project Site	94
Figure 4-26: Piping Plover on the Beach (Left) and Great Egret in the Project Site (Right).....	95
Figure 4-27: Areas of Biological Interest in Relation to the Project Site	98
Figure 4-28: Leguan Stelling	99
Figure 4-29: Pooling of Water from Overtopping.....	100
Figure 4-30: Cows Grazing adjacent to the Project Site.....	101
Figure 4-31: Goat Pen with Squatting Residence in the Background on the Government Reserve Lands.....	101
Figure 4-32: Brown Sand Beach East of the Project Site.....	101
Figure 4-33: Access Dam (Left), Drainage Canal and Pastures (Right) West of the Project Site ..	102
Figure 4-34: Land Uses in the Wider Project Area	103

Figure 4-35: Age Distribution of Leguan's Population	105
Figure 4-36: Ethnic Distribution of Leguan's Population.....	106
Figure 4-37: St. Peter's Anglican Church	108
Figure 4-38: Statue of Lord Hanuman	109
Figure 5-1: Engagements with Leguan NDC.....	112
Figure 5-2: Engagement with GPL – Leguan	112
Figure 5-3: Engagements with Mr. Zakir Khan (Owner of Neighbouring Pasture Lands)	112
Figure 6-1: Area of Influence of the Project.....	116
Figure 6-2: Terrain Profile Comparison of DEMs and Survey Area for Survey Points A to C (Southern Boundary of the Project Site) and the Water Level.....	125
Figure 6-3: Terrain Profile of Adjusted DEMs for Survey Points A to C (Southern Boundary of the Project Site) and the Water Level	125
Figure 6-4: SRTM Interpolated Terrain Profiles IDW and NN	126
Figure 6-5: Elevation Map of Interpolated SRTM 1-Meter Elevation (IDW).....	127
Figure 6-6: Sea Surface Height at Leguan Interpolated from ECCO (Version 4, Revision 4).....	128
Figure 6-7: Sea Level Rise (17 th Percentile) for RCP 2.6, RCP 4.5 and RCP 8.5.....	129
Figure 6-8: Sea Level Rise (83 rd Percentile) for RCP 2.6, RCP 4.5 and RCP 8.5	129
Figure 6-9: Likely Range of Sea Level Rise for Leguan	130
Figure 6-10: Inundation Range for Sea Level Rise (Lower and Upper Limit Projections).....	131
Figure 6-11: Return Periods for Maximum Monthly Rainfall.....	134

ACRONYMS

AoI	Area of Influence
CESMP	Construction Environmental and Social Management Plan
CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COD	Chemical Oxygen Demand
C-SERMS	Caribbean Sustainable Energy Roadmap and Strategy
DEM	Digital Elevation Models
DO	Dissolved Oxygen
EMISDE	Energy Matrix Diversification and Institutional Strengthening of the Department of Energy
EMP	Environmental Management Plan
ENSO	El-Niño Southern Oscillation
EPA	Environmental Protection Agency
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan
ESAR	Environmental and Social Analysis Report
ESMP	Environmental and Social Management Plan
ESPF	Environmental and Social Policy Framework
GEA	Guyana Energy Agency
GIS	Geographical Information System
GLSC	Guyana Lands and Surveys Commission
GMSL	Global Mean Sea Level
GNBS	Guyana National Bureau of Standards
GoG	Government of Guyana
GPL	Guyana Power and Light Inc.

GW	Guyana Water Incorporated
H ₂ S	Hydrogen Sulphide
IEC	International Electrotechnical Commission
IDB	Inter-American Development Bank
IDW	Inverse Distance Weighted
IEEE	Institute of Electrical and Electronics Engineers
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for the Conservation of Nature
LCDS	Low Carbon Development Strategy
LCOE	Levelized Cost of Energy
LME	Large Marine Ecosystem
MDG	Millennium Development Goal
MTR	Minimum Technical Requirements
MW	Megawatt
NAP	National Action Plan
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Neighbourhood Democratic Council
NDS	National Development Strategy
NEAP	National Environmental Action Plan
NEC	National Electrical Code
NFPA	National Fire Protection Association
NLUP	National Land Use Plan
NO ₂	Nitrogen Dioxide
O ₃	Ozone
OPM	Office of the Prime Minister

PAHO	Pan-American Health Organisation
PM	Particulate Matter
PPE	Personal Protective Equipment
PRSP	Poverty Reduction Strategy Paper
PUC	Public Utilities Commission
PV	Photovoltaic
RCP	Representative Concentration Pathways
RDC	Regional Democratic Council
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDGs	Sustainable Development Goals
SLR	Sea Level Rise
SO ₂	Sulphur Dioxide
SRTM	Shuttle Radar Topography Mission
TDS	Total Dissolved Solids
ToR	Terms of Reference
TSP	Total Suspended Particles
TSS	Total Suspended Solids
UAEP	Unserved Areas Electrification Programme
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile Organic Compounds
WHO	World Health Organisation

1.0 INTRODUCTION

1.1 Background

Electricity in Guyana is generated primarily from fossil fuels and the cost is one of the highest in the Caribbean. Generally, rural or isolated communities are unserved or underserved by electricity supplied by the grid. In an effort to address this, the Government of Guyana (GoG) is implementing a Programme to expand electrification and diversify the grid with an energy mix that includes hydropower, natural gas, solar photovoltaic (PV) systems and wind. It is anticipated that this Programme will lead to more than 400MW of newly installed capacity for residential and commercial users over the next five years.

In support of this initiative, the GoG received financing from the Inter-American Development Bank (IDB) to implement a Programme titled *Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)*. The objective of the Programme is to support Guyana's evolving energy sector by: (i) investing in solar photovoltaic farms to diversify the energy matrix in the hinterland towns of Bartica (Region 7), Mahdia (Region 8) and Lethem (Region 9) while contributing to climate change mitigation; (ii) investing in the reinforcement of transmission infrastructure to improve reliability and stability of the Demerara-Berbice Interconnected System; and (iii) strengthening the Department of Energy to develop a regulatory framework, and improve institutional capacity and governance of the oil and gas sector. Execution of the EMISDE Programme has significantly advanced and Engineering, Procurement and Construction (EPC) contracts have been issued for the construction of the solar PV farms in Bartica (Region 7) and Lethem (Region 9).

Utilizing savings which have accrued under EMISDE, the GoG has requested the support of the IDB to finance an additional solar PV farm on the island of Leguan located in the Essequibo River in Region 3. If necessary, the Government will also request an extension of EMISDE to accommodate the completion of the additional solar farm. The project will utilize an EPC arrangement. The Guyana Energy Agency (GEA) is envisaged to provide technical oversight and supervision of the design-build aspect of the project. The Guyana Power and Light Inc. (GPL) will be the operator for the project.

In accordance with the IDB's Operational Policy on Environment and Safeguards Compliance (OP-703), this operation is classified as Category "B" and it is anticipated that the programme will generate moderate environmental and social impacts that could be easily mitigated through the implementation of the required mitigation measures. In order to meet the requirements of the Bank's Environmental and Social Safeguard Policies, the GoG is required to prepare an Environmental and Social Analysis Report (ESAR) inclusive of an Environmental and Social Management Plan (ESMP) for the Leguan Solar PV Farm project. This is a prerequisite for the engineering, procurement, construction, installation, commissioning and turn-key delivery of the Solar PV power plant, including battery energy storage systems. The GEA, which is the implementing agency for the project, is responsible for the preparation of the ESAR. A Terms of Reference (ToR) was prepared to guide the preparation of the ESAR, as is outlined in Appendix A.

1.2 Objective and Scope of the ESAR

In September 2021, Mr. Shyam Nokta was awarded the consultancy to prepare an ESAR inclusive of an ESMP for the Leguan Solar PV Tied Mini Grid System. The objectives of this consultancy are to¹:

- Identify, predict and evaluate the economic, environmental and social impacts of the development of a Solar PV Farm and all its associated activities in the community of Leguan
- Provide information on the environmental consequences for decision making.

¹ Adapted from Terms of Reference for the ESAR (Annex A)

- Promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.
- Carry out an Environmental and Social Analysis based on
 - the inputs of and coordination with the GEA for the construction and operation of the plant
 - information available in academic literature, and
 - field visits and consultations and campaigns.

The ESAR was carried out based on the above objectives, with the focus to identify and assess potential impacts envisaged from the construction and operation of the PV power plant and, for those adverse impacts which cannot be avoided, to identify appropriate mitigation actions. Specifically, the ESAR seeks to:

- Determine the project Area of Influence (Aoi), including areas of direct and indirect influence.
- Present a description of the project including its location, scale, components, phases, benefits, etc.
- Assess the policy, regulatory and institutional framework for the project, including identifying the relevant national and international policies, legislation, standards and guidelines that define the implementation framework of the project, as well as the responsible institutions.
- Assemble relevant physical and biological baseline information on the project area including its geology, soils, hydrology, topography, climate, water quality, air quality, noise levels and terrestrial and aquatic flora and fauna (including an indication of possible endangered, rare or threatened species and species of commercial importance).
- Assemble relevant socioeconomic baseline information on the project area including communities, population, land use, economic activities, historical and archaeological sites, etc.
- Identify and engage with key project stakeholders, and present and address their feedback and concerns, including the communities closest to the site and the project beneficiary communities.
- Identify and assess the potential impacts of the project on the physical, biological and socioeconomic environment, distinguishing construction and post construction phase impacts, as well as cumulative impacts.
- Prepare an ESMP that identifies measures to prevent or reduce adverse impacts to acceptable levels for both the construction and operation phases of the project.
- Prepare an Implementation Framework for the ESMP, including outlining roles and responsibilities, Contractor plans, monitoring and reporting requirements, stakeholders' engagement, grievances mechanism, training, etc.

1.3 Approach

This ESAR was prepared by the consultant and guided by the ToR attached as Appendix A and the EPA's Guidelines for preparing EMPs. In accordance with the requirements of the ToR, the ESAR is to be guided by the following:

- The Terms of Reference;
- Environmental Protection Act 1996;
- Environmental Protection Air Quality Regulations 2000;
- Environmental Protection Water Quality Regulations 2000;
- Environmental Protection Noise Management Regulations 2000;
- Environmental Protection Hazardous Waste Management Regulations 2000;
- Guidelines for Noise Emissions into the Environment; and
- Interim Guidelines for Industrial Effluent Discharges into the Environment.

The ESAR was prepared during the period October 2021 to March 2022, and revised in November 2022 and February 2023 based on feedback provided. The consultant was supported by a technical team in the conduct of the assessment and the preparation of the ESAR. This team is presented in Appendix B.

Prior to the commencement of the ESAR preparation process the consultant sought to gain an in-depth understanding of the project and the project environment so as to determine the best methodology to be employed. The initiatives undertaken in this regard are outlined below:

- Meetings and discussions were held with key officials from the GEA to fully understand the project. Clarifications were also sought with the GEA on aspects of the ToR to ensure there is common understanding on the issues required to be addressed by the ESAR. These engagements with GEA personnel continued throughout the ESAR preparation process.
- Information was shared by the GEA on the project and these were reviewed, including the Project Document, Plans and Maps, previous Public Consultations Reports and the ESAR for the Energy Matrix Diversification Programme in 2018 among others.

These activities helped shape the methodology for the preparation of the ESAR.

1.4 Methodology

The ESAR preparation was done in phases. Early in the process a review of the national policies, strategies, plans and legislation, as well as international agreements was done to understand the regulatory and institutional framework within which the project will be developed and operate. Applicable IDB Environmental and Social Safeguard policies were also assessed.

Thereafter, the ESAR preparation was conducted in three main phases as follows:

Phase 1	Establishing the Baseline
Phase 2	Impact Identification and Analysis
Phase 3	Mitigation and Management Planning

The preparation of the ESAR utilised Geographical Information System (GIS) to provide spatial data and analyses to aid in the conduct of field exercises, analyses of the data, and presenting information in the ESAR. GIS encompassed two types of data: (1) primary data, which is data collected from field work; and (2) secondary data, which is data extracted from existing datasets/databases. This allowed a mixed-method approach whereby both primary and secondary spatial data contained qualitative and quantitative components. Digital data was available and stored in both raster and vector models (as raster data and vector data). GIS was utilized for all phases of the ESAR preparation.

Prior to the commencement of field activities, it was essential to have a clear understanding of the Aol of the project. The primary Aol of the project is defined as the footprint of the actual facility to be constructed. The secondary Aol is defined as the route to be followed for the establishment of the

transmission line from the project site to interconnect with the proposed sub-station, and the footprint of that sub-station. The Aol includes a fringe of land extending approximately 10 metres around the project components in all directions. A map of the Aol and potential impacts of the project relative to the Aol are presented in Chapter 6.

1.4.1 Establishing the Baseline

Collection of primary and secondary data on the physical, biological and ecological resources, and the socio-economic and cultural context of the project area formed an integral part of the ESAR. This involved collecting primary and secondary data on the physical, ecological and socio- economic context of the project area. Activities included:

- Reviewing of secondary sources of information including existing reports and background documents on:
 - The Leguan Solar PV Tied Mini Grid Power System (0.6 MW) Project.
 - ESAR for the Energy Matrix Diversification Programme.
 - Applicable National Policies, Strategies, Plans and Legislation and IDB's Environmental and Social Safeguard Policies.
 - Socio-economic conditions of the Island of Leguan including a profile of the Island of Leguan, the main beneficiary of the project.
 - Geology and soils of the project area.
 - Surface hydrology of the Essequibo River in vicinity of the project area.
 - Biological survey reports on the project area and surroundings as available and relevant.
 - Climate related data relevant to the Island of Leguan.
- Analysis of maps and plans.
- Site visits to collect primary data to complement the existing data, to address gaps, and ensure updated data is available and utilized for the purpose of the ESAR. Visits were conducted between October 07-08, 2021 and on October 20, 2021 to collect baseline data on the project environment and these include:
 - Noise level assessment to determine the existing ambient noise levels in the project area.
 - Air quality assessment to determine baseline levels of particulate matter and gases in the project area.
 - Water quality analysis of various parameters with *in-situ* analyses and sample collection to facilitate laboratory analysis to assess various parameters.
 - Identification of the ecosystem and habitat types in the project area and surrounding environment and determining species present on the site based on local knowledge and observations.
 - Determining elevation of the project site to assess its flood risk potential.
 - Identification of current uses of the site and surrounding land uses.
 - Collection of socio-economic information for the area.

The methodologies employed for the execution of the baseline surveys are presented in the section addressing the respective environmental components and further details are included in the related Appendices.

During this phase stakeholder engagements were also conducted to determine the views and recommendations of stakeholders so these can be addressed in the ESAR. Details on the stakeholder engagements are presented in Chapter Five, including the methodology employed and feedback provided. Stakeholder mapping was done to identify key local stakeholders to be engaged as part of the ESAR preparation. Engagements included the Neighbourhood Democratic Council (NDC) for the

Island of Leguan to collect information on the island and to garner views on the proposed project and the representatives of the local power utility. Engagements with other key local stakeholders such as GPL, Sea and River Defence Board and neighbouring land users were also conducted in coordination with the GEA. National regulatory institutions were also engaged as necessary.

1.4.2 Impact Analysis

After establishing the baseline conditions of the project area, the potential environmental and social impacts of the project activities during the construction and operational phases were assessed. Information on the Leguan Solar PV Tied Mini Grid Power System was reviewed in order to establish a detailed description of the project and activities to be undertaken. A diagnostic of the Aol (direct and indirect) was undertaken and the potential economic, environmental and social impacts of project activities during the construction and operational phases were identified and assessed using an impact assessment matrix to predict the significance of the impacts.

This was done by establishing the potential interactions between the activities and the characteristics of the existing physical, biological and socio-economic environment and within the effective area of direct and indirect influence. The methodology employed for the impact identification and assessment is detailed in Chapter Six.

1.4.3 Mitigation and Management Planning

Mitigation and management planning were done to identify feasible and practical measures to reduce and mitigate the potential negative impacts as well as maximise the positive impacts. Procedures to be undertaken in the event of an emergency situation were examined, and a framework proposed to implement, monitor and assess the effectiveness of the mitigation measures recommended. Mechanisms to engage with project stakeholders and address grievances were also developed. An ESMP was prepared which outlines the measures to be implemented to prevent, manage and monitoring possible environmental and social impacts which may be derived from the project.

1.5 Organisation of the ESAR

The ESAR is presented in several Chapters as outlined below:

- **Introduction** – This chapter includes a background to the Leguan Solar PV Tied Mini Grid Power System (0.6 MW) Project operations, a description of the scope and format of the ESAR, a description of the approach and methodology used to conduct the assessment and preparation of the environmental and social management plan, and limitations encountered during the process. The Aol of the Project (Direct and Indirect) was also identified.
- **Project Description** – This chapter provides a description of the Leguan Solar PV Tied Mini Grid Power System (0.6 MW) Project, including an outline and description of key activities.
- **Project Environment** – This chapter provides a description of the project environment. The physical baseline includes a description of the climate, soils, water quality, surface hydrology, noise, etc. while the ecological baseline includes a description of the ecosystem and habitats of the project area and surrounding environment along with a species listing. The socio-economic description includes information on the land use, economic activities, administrative services, population, infrastructure, etc.
- **Legislative and Institutional Framework** – This chapter provides a description of the national Policies, Strategies and Plans relevant to the Leguan Solar PV Tied Mini Grid Power System

(0.6 MW) Project, the legislative framework for compliance, and the institutions with oversight of the project activities.

- **Stakeholders' Consultations** – This chapter reports on the engagements held with stakeholders during the preparation of the ESAR.
- **Environmental and Social Impact Assessment** – This chapter identifies, describes and assesses the potential impacts of the Leguan Solar PV Tied Mini Grid Power System (0.6 MW) Project on the physical, biological and socio-economic environment, as well as on health and safety.
- **Environmental and Social Management Plan** – This chapter recommends feasible and practical measures to mitigate, manage and monitor existing and potential adverse environmental impacts such as noise, waste management, and hazardous materials management. It also includes measures to ensure that the health and safety of workers and the public are maintained. An Emergency Response Plan (ERP) is also prepared outlining the procedures for responding to any emergencies which may occur.
- **ESMP Implementation Framework** – This chapter outlines the roles and responsibilities for the various institutions to ensure environmental and social compliance. Monitoring requirements to determine compliance with environmental, social and safety requirements, as well as to determine the effectiveness of the mitigation and management measures are also outlined in the form of an Environmental Monitoring Plan. In addition, an indicative budget to be followed for the execution of the Implementation Framework is included. Further, recommendations for Stakeholder Consultation and Engagements and Disclosure are included.

1.6 Challenges

The following were the key challenges which were experienced in the completion of this ESAR:

- **Key Project Details Not Available** – Most of the potential impacts of the project relate to the construction phase. However, given that the project will be executed through an EPC arrangement the detailed project design is still to be completed, and the methodology to be employed by the contractor is not available to the Consultant. This would have been beneficial to fully determine and understand the construction impacts. Not having this information available has challenged the impact assessment and management planning aspects of the ESAR since there was not a clear determination of the specifics such as quantities and sourcing of construction materials, transport of materials to the site and storage, plans for workers, etc. This, however, has been addressed through the provision of broad guidelines and recommendations for inclusion in a Construction Environmental and Social Management Plan (CESMP) to be prepared by the Contractor.
- **COVID 19 Pandemic** – The entire ESAR preparation process was done during the COVID 19 pandemic. The implementation of the national restrictions including the curfew, requirements of practicing social distancing, as well as the need to ensure the safety of the Consultant and stakeholders being engaged were all factors that collectively challenged the field work aspect of the process. Notwithstanding these challenges, all baseline surveys and stakeholder engagements were conducted with only minor adjustments to the methodology so as to ensure that all public health and safety measures were followed. As such, the pandemic did not compromise the quality and thoroughness of these activities.

2.0 PROJECT DESCRIPTION

2.1 Background

The Government of Guyana (GoG) has received financing from the IDB to implement a Programme titled *EMISDE*². The objective of the Programme is to support Guyana's evolving energy sector by: (i) investing in sustainable/cleaner energy solutions to diversify the energy matrix in the Hinterland while contributing to climate change mitigation; (ii) investing in the reinforcement of transmission infrastructure to improve reliability and stability of the Demerara-Berbice Interconnected System; and (iii) strengthening the Department of Energy to develop a regulatory framework, and improve institutional capacity and governance of the oil and gas sector. The Programme will achieve these objectives by the execution of the following three components:

- **Component 1 – Renewable Energy Solutions for the Hinterland (USD\$8.6 million):** This Component entails the installation of solar photovoltaic (PV) plants in three hinterland townships of Bartica (Region 7), Mahdia (Region 8) and Lethem (Region 9) all of which currently rely exclusively on fossil fuel for electricity generation. The installation of a 1.5 megawatt (MW) solar plant within 3.03 hectares (7.5 acres) of land is planned in Bartica; 1 MW within 2.02 hectares (5 acres) of land is planned in Lethem, and 0.65 MW within 4.65 hectares (11.48 acres) of land is planned in Mahdia. The electrification of the Dagg Point community in Bartica and the titled indigenous village Campbelltown in Mahdia are also expected under this Component. The GEA is the executing agency for this Component and a dedicated Project Coordinating Unit (PCU) has been established to facilitate implementation.
- **Component 2 – Reinforcement of Transmission Infrastructure (USD\$9.95 million):** This Component entails reinforcements at three substations of Kingston, Old Sophia and 5 km single circuit overhead 69 kV transmission line between the Kingston and Sophia substations and installing reactive power compensation at New Sophia. The Guyana Power and Light Inc. (GPL) is the executing agency for this Component.
- **Component 3 – Institutional Strengthening and Governance of the Department of Energy (USD\$4.5 million):** This Component will finance the activities to strengthen the Department of Energy. In particular, it will finance capacity building initiatives and best practice organizational structure, including high level training and coaching of Government staff and technical support for the development of the design of a new oil and gas legislative and regulatory framework. The GEA is also the executing agency for this Component.

Utilizing savings which have accrued under Components 1 and 3 of the EMISDE (USD \$0.97 million) and under the project management costs (USD \$0.23 million), the Government has requested the support of the IDB to finance an additional 0.60 MW solar PV farm with an 0.80 MW storage capacity on a land area of 1 hectare (2.48 acres) on the island of Leguan located in the Essequibo River in Region 3. If necessary, the Government will request an extension of EMISDE to accommodate the completion of the additional solar farm. A new transmission line will also be established to facilitate interconnection with the project. The total cost of the project is estimated as USD \$1,785,452.

This ESAR focuses on the Leguan Solar PV Farm to the Programme, specifically on activities related to the EPC as well as the Installation, Commissioning and Turn-key Delivery of a solar PV power plant, including battery energy storage system as well as the construction of a new transmission line.

² EMISDE Project documents are publicly available on the IDB's website: <https://www.iadb.org/en/project/GY-L1066>

2.2 Rationale

Guyana is almost entirely dependent on imported fossil fuels for its energy needs. The cost and reliability of electricity are also recognized as a major factor for profitability and efficiency in business operations. As such, the development of indigenous renewable energy resources is considered a priority and the GoG is pursuing a significant increase in deploying renewable energies to generate electricity. The transition of electricity generation to renewable sources will help to reduce fossil fuel consumption, increase energy security particularly for hinterland utilities and support the Government's developmental reorientation to a low carbon economy.

In Leguan, electricity is provided on a 24-hour basis by an isolated grid with an installed capacity of 1.23 MW that is owned and operated by the Guyana Power and Light Inc. (GPL). Power is supplied by a single power plant equipped with three diesel engines each of which has a rated nominal capacity of 410 kilowatts (kW). In 2019, GPL's annual generation was 1,833 megawatt hours (MWh). The load curve for annual generation in 2019 shows a baseline load of 150 kW. Moreover, approximately 65 percent of the time, the load is lower than 200 kW representing below 50 percent of the nominal power with consequent decreases in efficiency (Figure 2-2). However, as seen in Figure 2-1, there was an increased demand for power during the second half of the year in 2019.

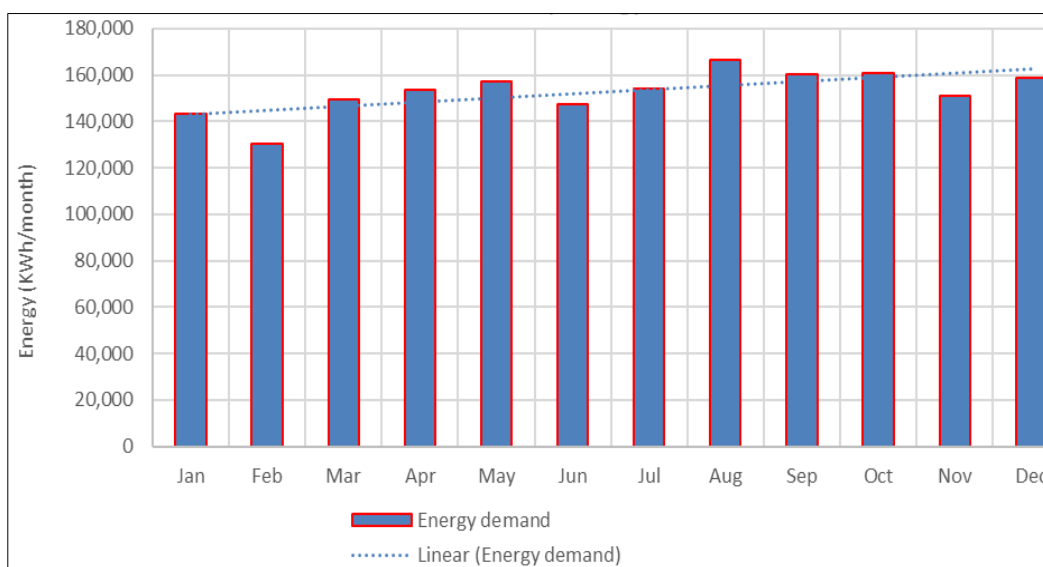


Figure 2-1: Monthly Generation by GPL, Leguan in 2019

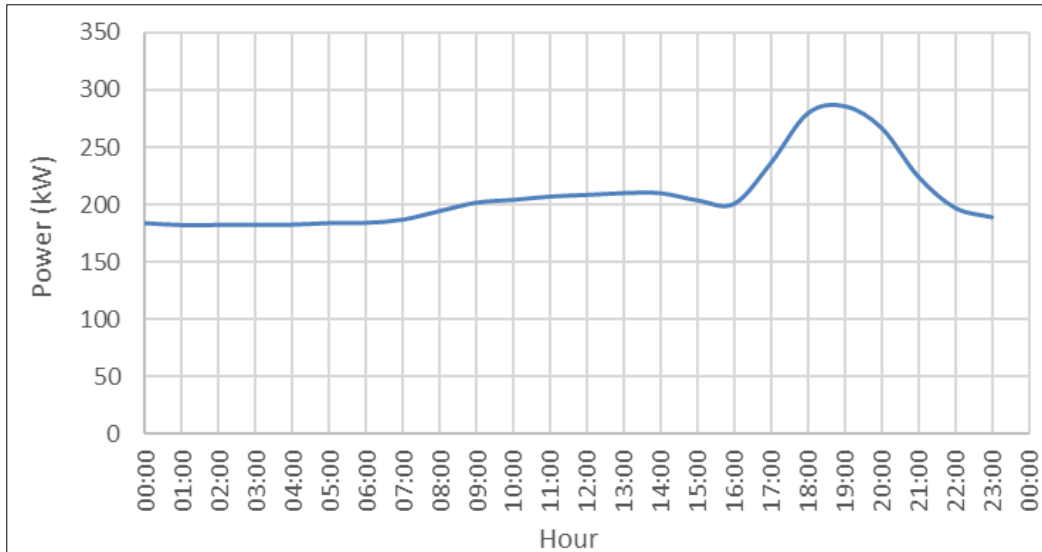
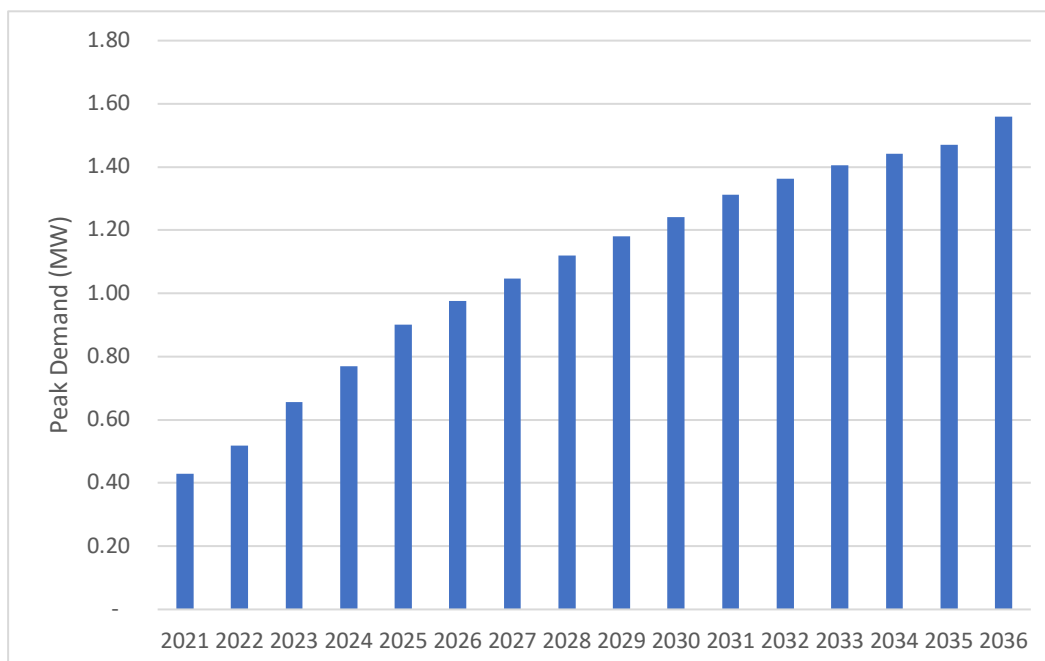


Figure 2-2: Average Hourly Load of GPL, Leguan in 2019

In 2019, peak load was 0.38 MW. According to information provided to the Consultant by GPL representatives, consumer demand for energy has been steadily increasing and by the end of October 2021 peak demand had risen to 0.43 MW. In 2021, daily load was 350 to 370 kW. Moreover, there is an expectation that consumer demand may be equivalent to the plant's maximum power generation capacity by the end of the year (Personal Communication 03 – Interview with GPL, Leguan). GPL forecasts demand to continue to triple over this next 15 years with a projected peak demand of 1.56 MW by 2036 (Figure 2-3).



Source: Prepared for this Report using forecast data provided by GPL

Figure 2-3: 15-Year Forecast of Peak Demand in Leguan

The main costs of generation include fuel (including the costs of transport/logistics), foreign and local freight, lubrication oil, employment, operation and maintenance, and transmission and distribution. Fuel is the most expensive input accounting for approximately 65 percent of GPL's total operation cost of power generation in Leguan in 2019. Total generation cost, excluding costs of transmission and distribution, is GYD \$55.09 (USD \$0.2632)³.

The main challenges encountered by GPL is providing electricity include the production cost, particularly the costs associated with fuel and fuel delivery. In addition, the initial assessment of faults on equipment (such as generator sets) indicates this is not considered to meet acceptable standards thus increasing repair time when there are serious malfunctions. GPL also encounters challenges in reliability of power supply in Leguan. Under the current system, if a network fault results in an outage, the entire island may be at risk of power loss because there is no distribution busbar. In the medium term, GPL aims to interconnect the grids of Leguan with Hogg Island and then Wakenaam via a sea-cable installed three-meters below the riverbed to improve reliability and efficiency of the system.

Overall, the existing diesel generators at Leguan have insufficient or low redundancy power generation, which makes it unreliable, unstable and costly to maintain. Given that the Leguan grid is isolated, any new source of energy (diesel, solar or wind) should be interconnected to the existing grid. Leguan is the only island grid operated by GPL that does not have any renewable energy project planned. In light of the challenges of electricity generation experienced on the island, renewable energy generation is of utmost priority to improve system reliability as well as to reduce the carbon emissions from increasing power generation.

2.3 Project Overview

The project comprises of an EPC arrangement and turn-key delivery of a 0.60-megawatt peak (MWp) solar PV power plant inclusive of battery energy storage system in Leguan. This represents 23 percent of the total installed capacity currently. The battery storage system (energy storage and battery inverter) will support the primary function of 'grid forming' and meet the demand of the Leguan grid during the periods for which solar energy is available. It is expected to be capable of supplementing existing electricity generation by GPL and also providing rapid response when the intermittent source cannot meet the energy requirement of the consumers.

The electricity generated by the project will be integrated into the existing Leguan Transmission and Distribution Grid. Accordingly, a new 13.8 kilovolt (kV) transmission line will be established for interconnecting the solar (PV) plant to the Leguan Power Station. The transmission line will cover a distance of approximately five kilometers. Table 2-1 provides an overview of some of the key specifications of the solar power plant.

Table 2-1: Key Specifications of the Solar Power Plant

Location	Oakum, Leguan, Region 3
Footprint	1 hectare (2.48 acres)
Rated Peak Capacity	0.60 MWp
Operational Hours	06:00 to 17:00 hrs
Battery Storage	Battery system will have a nominal capacity of 0.800 MWh
Electricity Generated/Year	926.4 kWh with 906.9 MW/h provided to the grid
Distribution Network	Interconnection to the Leguan grid via a new 5 kilometer 13.8kV transmission line
CO ₂ Savings	853 tons per year

³ Currency conversion utilized an exchange rate of USD \$1 to GYD \$209.29

Levelized Cost of Electricity (LCOE)	Final LCOE to be determined
Design Life of Project	20 years
Cost Estimation	USD \$1,785,452

2.3.1 Analysis of Alternatives

2.3.1.1 Alternative Power Generation Options

GEA conducted an analysis of alternative energy sources to estimate the cost of the current diesel power generation against future renewable energy alternatives and which provided the following findings:

- **Diesel Generation:** LCOE over the next 20 years has been estimated as US\$0.288/kWh. This does not include costs for generator replacements.
- **Interconnection to the Wakenaam Grid:** GPL plans to interconnect the most populated islands in the Essequibo River (Wakenaam and Leguan with an option to also interconnect Hogg Island). The cost of interconnection varies between US\$2.5 to 4.1 million. The benefits of the interconnection would be savings in purchase of new generators as well as better efficiency on the diesel generators due to a higher load. However, this is not a priority investment, and will not be implemented in the next 5 years. Moreover, any new installations in Wakenaam will have to overcome similar challenges of land availability for development as are experienced in Leguan.
- **Wind:** Wind power was assessed as an alternative during the early stages in the concept design phase, and the LCOE was calculated and was similar to the solar PV. To calculate the LCOE, a wind load factor of 31 percent was assumed (which is similar to the wind speed measured at Hope Beach). A 0.40 MW wind turbine was selected, which will produce the same amount of energy of a 0.60 MW of solar PV. Battery storage would be needed to compensate for the variability. With the above assumptions, the total investment would be USD \$2.1 million which would generate clean electricity with a LCOE of USD \$0.198/kWh, generating an Internal Rate of Return (IRR) of 8 percent. However, a solar PV farm was selected for other practical reasons. Firstly, wind has longer timeline to develop (which increased project costs), and secondly, it has higher technological risk (wind turbines have not been installed and operationalized in medium scale in Guyana, which increase the risk of cost and performance).
- **Solar PV at the Proposed Location:** The solar PV selected is a 0.60 MW solar PV installation with 0.60 MW battery storage. The solar PV system will supply 100 percent of the load during the daytime, but not at nights. The total solar PV share is below 50 percent, therefore the rest of the energy would be provided by diesel. The total investment is USD \$1.78 million, including USD \$155,400 for land preparation and USD \$275,316 for the interconnection. The LCOE is USD \$0.179/kWh, generating an IRR of 9.7 percent.
- **Floating Solar PV:** Leguan is not ideal for floating solar PV. The island does not have a water reservoir, the only possible locations for floating solar PV would be directly in the Essequibo River. The southeastern section of the island is located directly along the main channel of the Essequibo River and is exposed to wind which makes the area prone to waves. The northwestern area, between Wakenaam and Leguan, is more protected from wind but the coastline is largely covered with mangroves and the distance to GPL's power plant is greater. Therefore, there is not an ideal location for Solar PV floating in Leguan. In order to do an economic comparison, the closest solar PV floating system could be on the Essequibo River close to the Leguan Stelling and GPL power plant. The installation of a 0.60 MW floating solar

PV installation is estimated to cost approximately USD \$2.05 million (the installation cost assumes a cost of USD \$600/kWp for the floating structure, USD \$30,000 for civil works and USD \$225,000⁴ for interconnection to GPL power plant). The LCOE would be US\$0.203/kWh, generating an IRR of 7.5 percent.

- **Rooftop Solar PV:** Another alternative is the installation of rooftop solar PV panels. The solar PV proposed is with high penetration of solar PV (up to 100 percent during daytime) and therefore, smaller solar PV systems would be difficult to manage. To install 0.60 MW rooftop capacity, 65,000 square feet of space will be required. The largest public rooftop in Leguan is the secondary school building which is only approximately 6,000 square feet.

2.3.1.1 Alternative Project Locations

- **Solar PV Farm on Privately Owned Land:** Most of the lands in Leguan are privately owned and publicly owned lands are located mainly along the coastline and this limited available options for selecting the site. The key criteria in selecting the site were its easy availability for lease as public lands and its proximity to the GPL power station and feeders to limit line losses. There are alternative sites on public lands which were ruled out because it would require clearing of mangroves. The installation of a 0.60MW solar PV farm would require a land area of 1 hectare (2.48 acres) of land. The costs for which privately owned lands are sold are variable and range between GYD \$20 to 40 million per acre. Thus, acquiring private lands will increase land development costs by USD \$230,000 to 476,000. The LCOE would be US\$0.20 to 0.22/kWh, generating an IRR of 7.8 to 6.2 percent.

Public Lands

The table below identifies the other alternative public lands available that were evaluated against the proposed project location.

Name of Alternative Public lands Available	Location of Alternative Public lands Available	Justification why land was not selected
La Baggatelle	6° 55' 25.99" N 58° 24' 33.06" W	Land proposed to build an airfield. The land was previously used for rice cultivation and is flood prone.
Cornelia	6° 56' 15.24" N 58° 21' 48.18" W	Mangroves present. The land is flood prone and is located next to a koker/sluice inlet.
Dauntless Bank	6° 56' 43.81" N 58° 21' 32.62" W	Mangroves present, low-lying and flood prone.

⁴ The interconnection from the proposed location to GPL power plant was estimated as 275,000, 75% of the cost are improvements in the power plant to accommodate the solar PV power. This cost would remain independently of the location of the solar PV farm.

Enterprise (Green's Park)	6° 55' 07.96"N 58° 23' 45.60" W	Plans are in place to develop a water treatment facility at this location.
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Private Lands

The table below identifies the other alternative private lands available that were evaluated against the proposed project location.

Name of Alternative Private lands Available	Location of Alternative Private lands Available	Justification why land was not selected
Elizabeth Ann	6° 56' 11.25" N 58° 21' 55.44" W	Absence of documentation from the persons in charge of the land to allow for sale.
Amsterdam	6° 55' 26.76" N 58° 22' 58.85" W	The land was previously used for rice cultivation and is prone to flooding.
Endeavour	6° 55' 27.78" N 58° 23' 13.19"	Owner of the land was not interested in selling and only wanted to only lease or rent. This was seen as a risk due to the long life-time for the project.

- **Solar PV Farm on the Oakum Beach:** Initially, the project was located on the backshore of Oakum Beach as seen in Figure 2-5. The LCOE and IRR for this project location is the same as for the proposed location for the project. However, concerns pertaining to shoreline protection and erosion raised by stakeholders during the ESAR preparation process resulted in a westward shift of the project site.

2.4 Project Location

The project site for the installation of the 0.60 MW solar PV farm is located in Oakum, Leguan Island in Region 3. The location of the project is shown in Figure 2-4. Initially, the backshore of the beach was identified as the project site but concerns pertaining to shoreline protection and erosion raised by stakeholders during the ESAR preparation process resulted in a westward shift of the project site. The initial and new locations are shown in Figure 2-5.

A new 13.8 kilovolt (kV) transmission line will be established for interconnecting of the solar (PV) plant to the existing GPL distribution grid. The transmission line will follow the alignment of the existing transmission line connecting the solar PV power farm to the Leguan Power Station. The existing transmission line alignment runs along the roadway connecting Canefield to the Leguan Power Station and the new line will be located on the opposite side of the road. However, the section of the new transmission line connecting Canefield village to the project site is not part of the existing alignment. In total, the transmission line will cover a distance of approximately five kilometers. No section of the planned alignment will intersect privately owned lands. The route of the transmission line is shown in Figure 2-6.

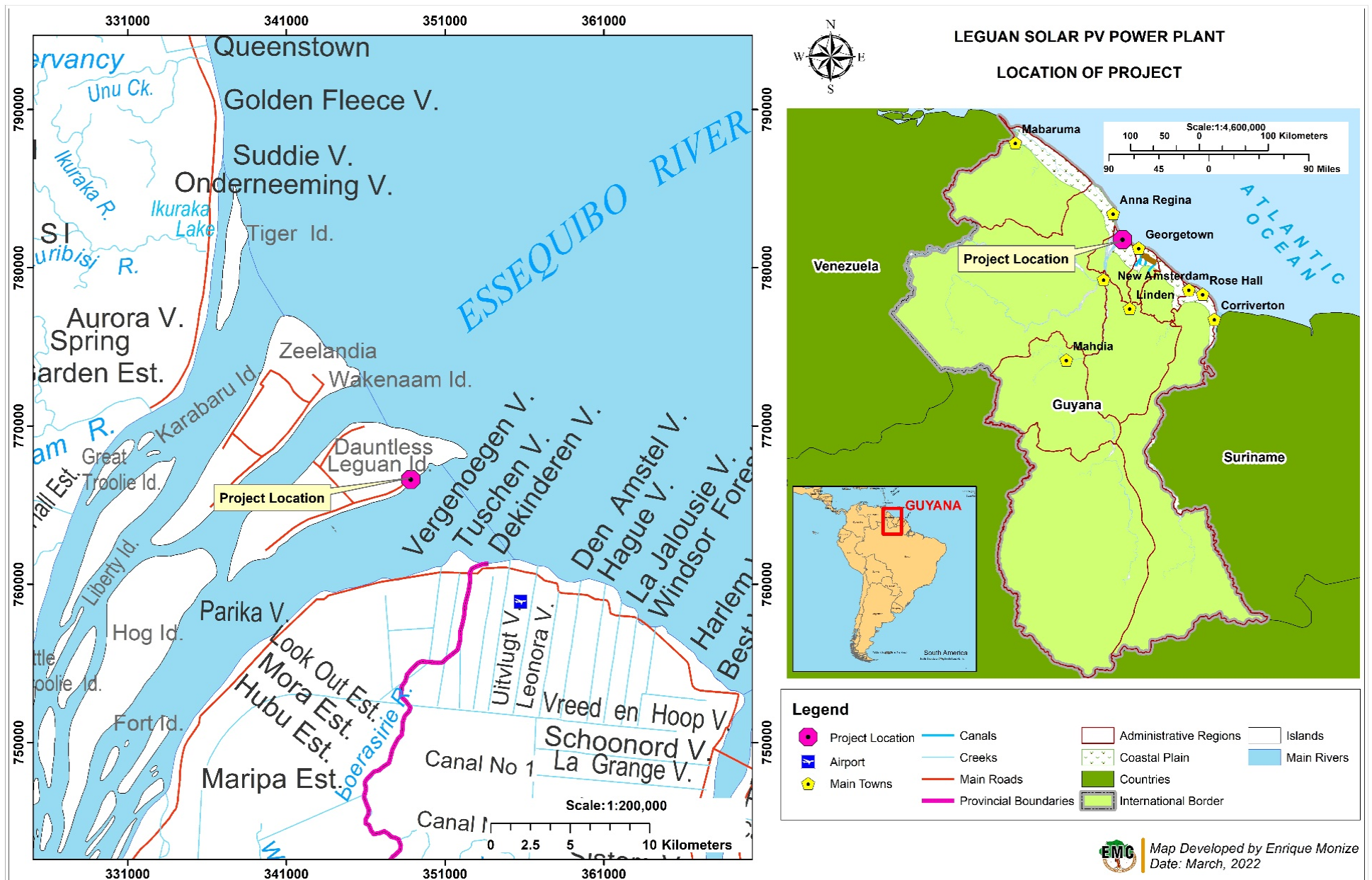


Figure 2-4: Location of the Leguan Solar PV Power Plant

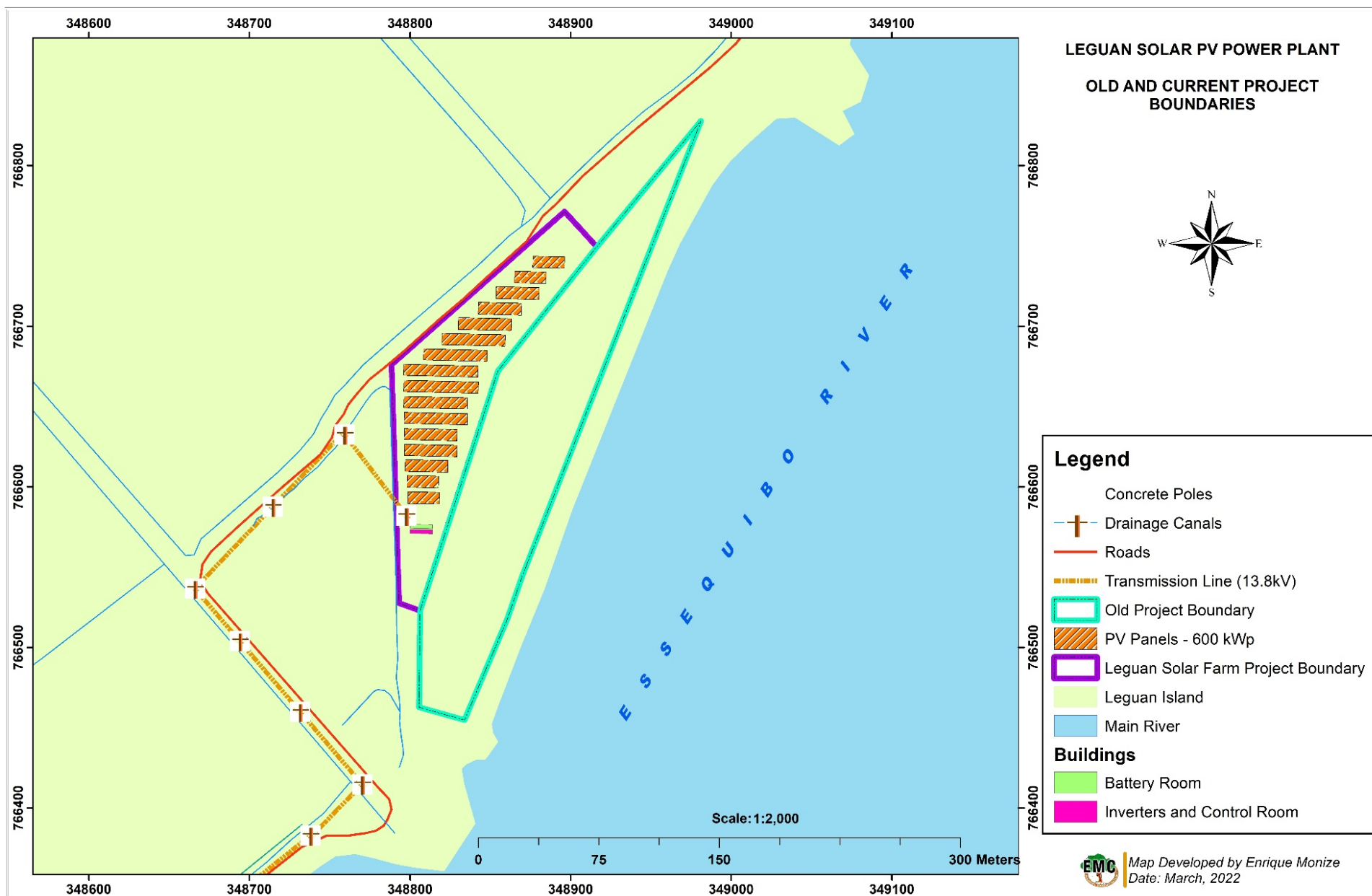


Figure 2-5: The Initial and New Sites for the Leguan Solar PV Power Plant

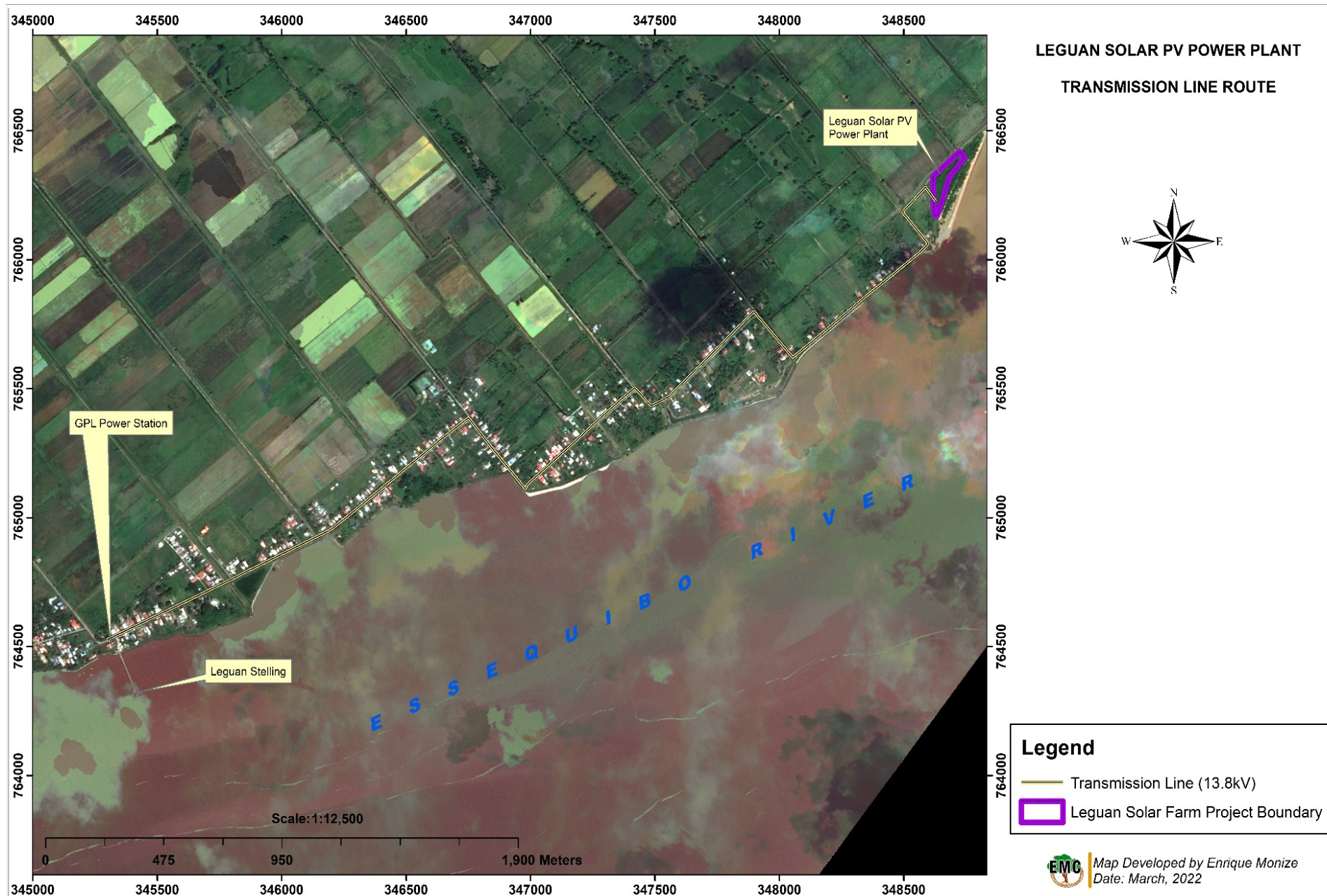


Figure 2-6: Transmission Line Route

2.5 Project Components

2.5.1 Main Components

The solar power plant will have the following main components:

- **PV Modules, Mounting Structures and Arrays:** PV modules were modeled with a rating of 430 watts at peak (Wp) and a nominal efficiency of 21.65 percent. The mounting structures were modeled with height of 0.61 meters above the ground. The azimuth of the arrays was oriented at 180 degrees facing south at a tilt of 10 degrees.
- **Inverters:** The technical specification of the inverters were modeled to determine maximum power and voltage that will be required by the installation.
- **Battery Station:** The solar PV system is being designed as a hybrid system with grid forming capabilities, with the diesel generators and the solar PV working in parallel. When the solar PV output and load ratio permit, the diesel generators will be off and the solar PV system will provide the full load. The battery storage will provide primary frequency regulation of Leguan's grid and compensate fluctuations in grid load and solar output. The battery will also be sized to be able to take over the load provided by the solar PV inverters. In the case of a sudden disconnection of those inverters (the battery inverter nominal power should be same nominal power of the PV inverters), the batteries will provide the load during the time that the new control system shift the load to the diesel engines (at least 30 min should be allowed).
- **Transformers:** Two pad-mounted step-up three-phase 60 Hz transformer will be installed at the solar PV power farm. The transformer will have a power rating of one MVA with a step-up voltage of 13.8kV and low voltage input to match the output of the inverter along with all protection switchgear, circuit breakers, cables, etc.
- **Interconnection:** The interconnection of the solar PV power farm would require upgrades to the current electrical configuration of the GPL power station in Leguan to provide a standard switchgear layout.
 - **Transmission Line:** A new 13.8kV transmission line will be installed to serve as the interconnection between the solar PV power plant and the busbar of the existing MPL distribution grid. The transmission line will cover a distance of approximately five kilometers. It will follow the route of the existing transmission line from Canefield village to the Leguan Power Station. The section of the new transmission line connecting Canefield village to the project site is not part of the existing alignment. The following are indicative specifications of the transmission line:
 - **Number and type of existing structures to be utilized:** None
 - **Number and type of new structures to be installed:** 71 reinforced pre-cast concrete poles
 - **Structure spacing:** 70 meters
 - **Height of structures:** 14 to 15 meters
 - **Voltage:** 13.8 kV
 - **Classification of Line:** Express
 - **Number of Conductors:** Three
 - **Type of Conductors:** Aluminum Conductor 336.4 MCM, Tulip

The proposed layout of the PV arrays, the housing facility for the batteries and inverters, and other project buildings are presented in Figure 2-7.

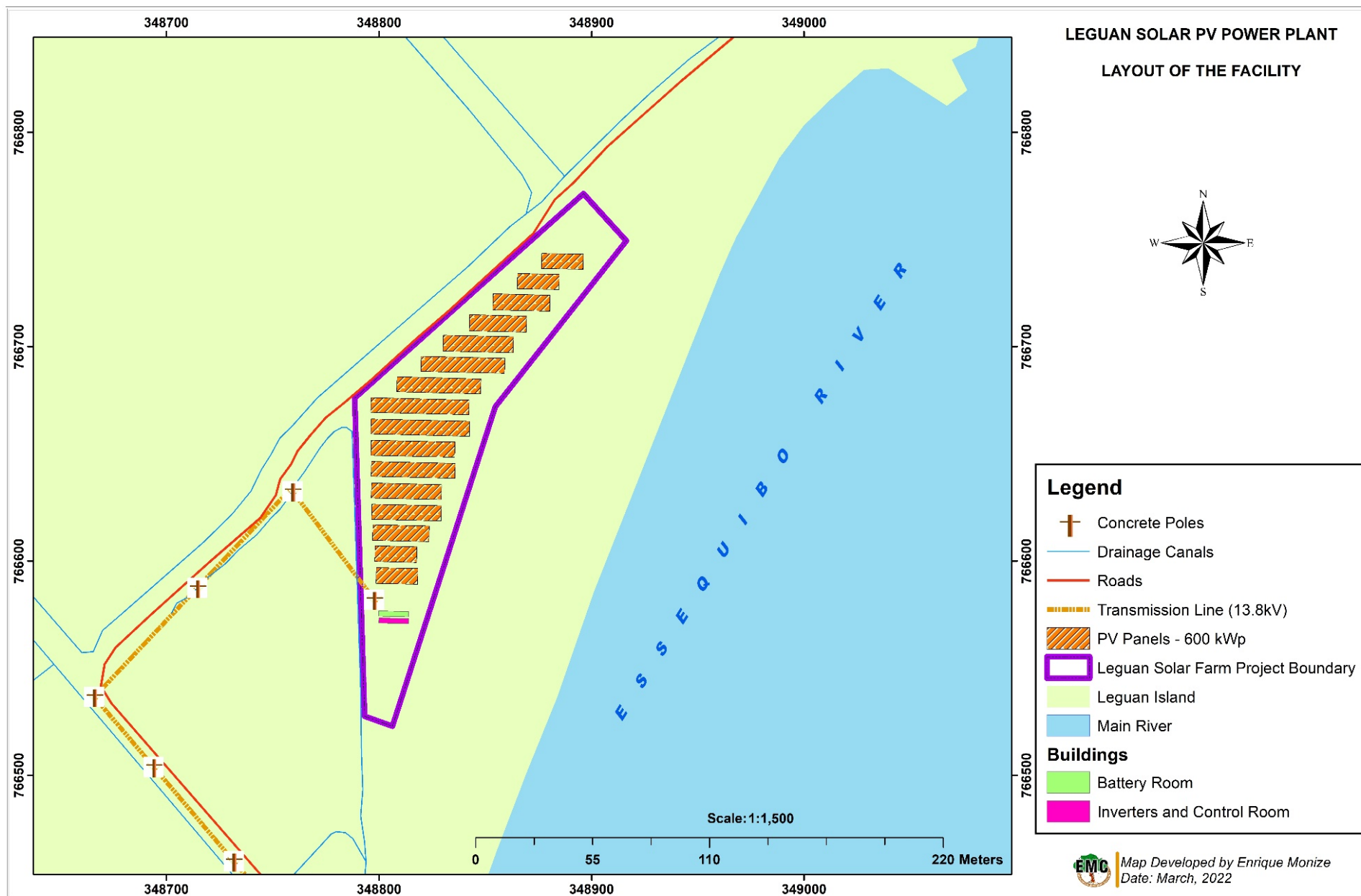


Figure 2-7: Proposed Layout of the Solar PV Farm

2.5.2 Auxiliary Facilities

The following additional facilities and equipment will also be part of the Solar Power Plant:

- Security system, electrical fence and 24-hour on-site security access control.
- Lighting system along the entire fenced area.
- Fire detection system.
- Weather monitoring equipment (rainfall, wind speed/direction, solar irradiation, air moisture) will be located inside or in close proximity to the guard house.
- Suitable drainage system incorporating erosion control and storm water management.
- PV power facility monitoring equipment and associated telecommunication links will be located inside the guard house.
- Septic Systems.

2.6 Project Life and Sustainability

The project is being installed with a life span of 20 years. GPL will be the owner/operator once operational. Medium- to long-term sustainability of the project will be supported by the warranties for various equipment/project components as well as by training of GPL personnel.

2.7 Cost of Electricity and Main Consumers

The Leguan Solar PV Farm will be capable of generating an average of 906.9MWh of electricity annually at a cost (weighted average LCOE) of USD \$0.187 per kWh. This is cheaper than the 2021 variable generation cost with diesel engines of USD \$0.2632 per kWh (excluding costs of transmission and distribution). The average variable diesel generation cost during the next 20 years is estimated as USD \$0.27 per kWh. As such, GPL is expected to have average annual savings of US\$ 214,908 during the 20 years of operation. As such, the average electricity generation cost is anticipated to decrease to US\$0.14 per kWh at the end of the project.

Currently, GPL's tariff structure in Leguan is the same as charges to all of its customers. GPL's tariff structure is influenced by two main factors. The first is ensuring that a minimum rate of return of either percent is achieved. The second depends on Government policy because economic development goals are closely aligned with energy availability and cost. Tariff structures must be approved by the Public Utilities Commission (PUC). GPL's tariff structure as of April 2021 is presented in Table 2-2.

Table 2-2: GPL Tariff Structure

Rate Category	Tariffs Category	Non-Government Energy Rate (GYD\$)
Residential: Lifeline	A (<75 kWh)	39.10
Residential	A (>75 kWh)	43.43
Commercial	B	56.38
Industrial	C	50.93
Industrial	D	48.78
Street Lights	E	43.08

The final LCOE will be determined through consultations among the utility (GPL), the Public Utilities Commission (PUC) and the GoG. The main consumers for the electricity provided by the GPL grid are residents of the Island of Leguan.

2.8 Construction Phase

The construction of the solar power plant is expected to cover a period of 300 days. Construction materials, equipment and project components may have to be transported to Leguan from Georgetown. For materials from Georgetown, road and river (by ferry) transport are available options. The sequence of the construction program is expected to be as follows:

- Pre-construction site investigations, such as a geotechnical assessment and additional flood and erosion risk and climate vulnerability assessments if deemed necessary, to inform how the panels are mounted and secured.
- Detailed design and procurement of materials.
- Site establishment and preparation for construction, including fencing, earthworks, set out and construction of access roads and sediment and erosion controls.
- Delivery of materials and equipment.
- Installation of the foundations (excavation and concrete footings) or driven piles.
- Installation of underground cabling with an option for a short section of overhead cabling.
- Assembly of the panel frames and mounts.
- Installation of the PV panels.
- Installation of the inverters, battery transformer units, including pouring of concrete pads for transformer units.
- Installation of low voltage cabling and combiner boxes.
- Works to connect the Solar Farm to the GPL grid including a new transmission line.
- Commissioning of the Solar Power Plant.
- Removal of temporary construction facilities and completion of restoration work.

2.9 Commissioning and the Operational Phase

Commissioning will involve the inspection and testing of the solar PV power plant after installation and certifying that it operates as expected and is installed in accordance with the engineering and design plans and complies with all the regulations and standards specified. At a minimum, commissioning will include:

- Complete integrity test of all equipment.
- Test and commissioning of the laid cables, according to International Electro technical Commission (IEC) standards.
- Electrical protection system commissioning, according to IEC standards.
- Perform values for Open-Circuit Voltage (Voc), and Close-Circuit Current (Imp) string testing
- Perform IV curve tracing.
- Perform thermal hotspot check with infrared images.

Once commissioned, the Leguan Solar Power Plant is expected to work on a daily basis year-round unless subject to scheduled maintenance. On an annual basis, 926.4MWh/Yr of generated electricity is expected.

2.10 Project Employment

The project is expected to generate approximately 25 direct jobs (and part-time jobs requiring 71 man-months) during construction and 12 jobs during operation. Local persons, including women, should be prioritized for employment based on their experience and skills to support the construction phase. The intention of the overall project is to support the Women's Economic Empowerment Programme through which approximately 200 women (in Bartica, Mahdia and Lethem) will be engaged in the productive use of electricity generated by the project. The potential areas for employment and the estimated

number of jobs and man-months required for each is outlined in Table 2-3. Additional opportunities for employment may be available during different phases of the project.

Table 2-3: Potential Areas for Employment

Construction Phase	Operational Phase
Laborers (31 man-months)	Operators (2)
Electricians (16 man-months)	Engineers (1)
Engineers (4)	Maintenance Personnel (1)
Masons (7 man-months)	Cleaners (2)
Carpenters (7 man-months)	Security (3)
Surveyors (1)	Electrician (1)
Security (6)	Drivers (1)
Drivers (2)	Health and Safety Personnel (1)
Cleaners (3)	
Caterers (3)	
Supervisors (2)	
Managers (1)	
Health and Safety Officers (1)	
Logistics Personnel (1)	
Accountants (1)	

2.11 Environmental Benefits of the Project

The operation of the solar power plant when compared to a diesel power plant will offset most of the fossil fuel that was previously used for the generation of electricity. A solar power plant, in general, is built for more than the projected lifetime. After the expected lifetime, a solar power plant will be typically rehabilitated for a fraction of the newly built cost. Given the continuous development of technology and price reductions for project components, it is reasonable to expect the solar power plant to continue to operate beyond the 20-year design life. The CO₂ savings shown in Table 2-4 below covers the projected lifetime of 20 years. However additional savings can be realised beyond this period if the solar power plant continues to operate.

Table 2-4: CO₂ Savings from the Solar Power Plant

Saving/Year (MWh)	906.9 MWh per year (in power supplied to the grid)
Savings/Year (tons CO₂)	Approximately 853 tons per year
Savings/Lifetime (tons CO₂)	Approximately 17,060 tons

The project will allow for independence from fossil fuels. The reduction in diesel consumption will garner further benefits to air quality as the current diesel generation does not utilize filtration systems or other exhaust gas filter. As a result, power generated from diesel releases high concentrations of nitrogen oxides and fine dust particles into the atmosphere.

2.12 Social Benefits of the Project

The solar power plant is expected to have positive socio-economic benefits through the provision of an alternative source of electricity throughout the year to the Island of Leguan. The project is estimated to complement the existing the power generation system and, should be able to satisfy the current energy demand ensuring that there is reliable and stable source of electricity with some redundant capacity.

The project also provides opportunities for employment for locals during the construction and operation phases. Additionally, the installation is also expected to improve the capacity of the local electric utility company to use this type of renewable energy technology. In addition, the introduction of redundant electricity supply may also be expected to stimulate the local cottage industries and improve operations for existing local businesses.

2.13 Planning Permission and Regulatory Approvals

The GEA has secured permission from the Guyana Lands and Surveys Commission (GLSC) to occupy the project area, including a subsequent issued a 'No Objection' to shift the project site. Copies of the GLSC Permission and 'No Objection' are attached in Appendix D.

The Regional Democratic Council (RDC) has been engaged and has issued its 'No Objection' to the project for the construction of the solar farm. A copy of this No Objection is included in Appendix D.

The Neighbour Democratic Council (NDC) has been engaged and has issued its 'No Objection' to the project for the construction of the solar farm and the new transmission line. A copy of this No Objection is included in Appendix D.

The GEA has obtained 'No-Objection' from the Sea and River Defences Board for the construction and operation of the solar PV farm on the Oakum foreshore in Leguan, including a 'No Objection' to shift the site. A copy of the Sea and River Defences Board No Objection is presented in Appendix D.

3.0 POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The 0.6 MW solar power plant, with 0.8 MW battery storage, to be established in Leguan is required to be in compliance with Guyana's national environmental and energy related policies, strategies, plans, legislation and institutional framework, and international treaties and conventions to which Guyana is signatory. These are outlined in Table 3-1 below.

Table 3-1: Relevant Legislation, Policies and Strategies

Policies, Strategies, Plans	Low Carbon Development Strategy (Draft for Consultation, 2021)
	Guyana National Energy Policy (1994)
	National Development Strategy (1997)
	Poverty Reduction Strategy Paper (2006)
	Hinterland Electrification Strategy (2007)
	Guyana Power Sector Policy and Implementation Plan (2010)
	Guyana Energy Agency Strategic Plan (2016)
	National Land Use Plan (2013)
	National Environmental Action Plan (2001)
	Nationally Determined Contribution (2016)
	National Biodiversity Strategy and Action Plan (2014)
	National Action Plan to Combat Land Degradation (2015)
Legislation	The Constitution of the Cooperative Republic of Guyana
	Environmental Protection Act (1996)
	Environmental Protection Air Quality Regulations (2000)
	Environmental Protection Water Quality Regulations (2000)
	Environmental Protection Noise Management Regulations (2000)
	Environmental Protection Hazardous Wastes Management Regulations (2000)
	Environmental Protection (Litter Enforcement) Regulations (2013)
	EPA Guidelines for Environmental Management Plans
	Sea Defence Act (1933)
	Guyana Energy Agency Act (1997)
	State Lands Act (1903)
	Guyana Lands and Surveys Act (2001)
	Local Democratic Organs Act (1980)
	National Trust Act (1972)
	Public Health Ordinance (1934)
	Labour Act (1942)
	Occupational Health and Safety Act (1997)
Other Policies	IDB's Operational Policies
Institutional Framework	Environmental Protection Agency (EPA)
	Office of the Prime Minister (OPM)
	Guyana Energy Agency (GEA)
	Guyana Power and Light Inc. (GPL)
	Public Utilities Commission (PUC)
	Regional Democratic Council of Region 3 and Leguan NDC
	Guyana Lands and Surveys Commission
	Sea and River Defence Board and Sea and River Defence Department, Ministry of Public Works
International and Regional Framework	Sustainable Development Goals
	United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement

Other Codes and Guidelines	CARICOM Energy Policy
	Caribbean Sustainable Energy Road Map and Strategy
	International Solar Alliance (ISA)
	GPL's National Grid Code
	NFPA's National Electrical Code
	Relevant Standards of the International Electrotechnical Commission
	Relevant Standards of the Institute of Electrical and Electronics Engineers

3.1 National Policies and Strategies

The importance of the environment and energy to national development is reflected in the prominence and priority of these areas in several development policy documents and strategies over the last twenty plus years.

3.1.1 Low Carbon Development Strategy

In June 2009, the GoG launched the Low Carbon Development Strategy (LCDS) with the aim of transforming Guyana's economy on to a low carbon, sustainable development trajectory, while simultaneously assisting in combating climate change. The broad goals of the Strategy were the transforming of the economy to deliver greater economic and social development by following a low carbon development path by offering forest climate services and ecosystem services to the world. A key aspect of the LCDS was a payment for forest climate services model developed between Guyana and Norway and based on Reducing Emissions from Deforestation and Forest Degradation (REDD+). The LCDS was updated in 2010 and 2013 to reflect progress achieved in REDD+ results and the transition to a low-carbon economy.⁵

In October 2021, the GoG released a draft version of an expanded LCDS⁶ for public review and consultations over a four-month period. The expanded LCDS outlines four goals which generally align with the broad goal outlined in earlier iterations of the Strategy. The second goal is related to stimulating growth through clean energy and sustainable economic activities. The Strategy anticipates significant increases in the demand for electricity over the next 20 years. As part of this goal, the Government intends to meet demand by significantly decoupling economic growth from consumption of fossil fuels, particularly heavy fuel oil and diesel. Instead, a sustainable and resilient energy mix will be pursued leveraging low-carbon energy sources like solar power (with battery storage, hydropower, wind and natural gas will be developed. Renewable sources of energy, including solar power, are poised to play a critical role in this transition as follows:

- In the period 2022 to 2027, power will be generated by the Amaila Falls Hydropower Plant coupled with solar power, with batteries, on rural networks.
- In 2027 to 2032, further increase in demand will be met by the expansion of wind power, solar power and a second large-scale hydropower plant.
- From 2032 onwards, expansion will be determined by market conditions. However, the Strategy outlines an expectation that improvements in battery technology will enable any additional capacity to be solar powered or wind powered.

Along this trajectory, electricity generated by solar power is project to increase from 5MW in 2021 to 550 MW by 2040. Moreover, in the near-term, the intermittent nature of solar power positions it as a complementary energy source especially useful for isolated grids. In addition, the Strategy also

⁵ Government of Guyana, 2013. The Low Carbon Development Strategy. Pg. 6 to 8.

⁶ Government of Guyana. 2021. Guyana's Low Carbon Development Strategy 2030. Draft for Consultation (November 2021 – February 2022). Pages 7 to 8, 52 to 54 and 60.

prioritizes the expansion of rooftop solar for households (30,000 150-watt systems) and the installation of isolated rooftop solar systems for hinterland ICT hubs. Finally, the Strategy postulates that solar power technology is approaching maturity in Guyana thus contributing to energy cost reductions and enabling the transition.

The EMISDE programme supports the Strategy's vision for diversifying energy sources so as to transition to renewable and low-carbon power generation as well as increasing the capacity and reliability of rural grids. Further, the inclusion of Leguan as an additional site for the installation of a solar farm with battery storage further supports the goals of the LCDS.

3.1.2 Guyana National Energy Policy⁷

In 1994, a National Energy Policy was prepared with policy objectives that were intended to provide stable, reliable and economic supply of energy; reduce dependency on imported fuels; promote where possible the increased utilization of domestic resources; and ensure energy is used in an environmentally sound and sustainable manner. The Policy was intended to cover the period of 1994 to 2004. At the time of the Policy's publication, the high cost of solar PV system was recognized as a significant challenge to widespread uptake of solar power system as well as to development of large-scale solar farms. In 1994, only 21 solar PV systems were operational in Guyana with capacities ranging from 0.5 to 10 kilowatts (kW), and were being used by Health Centres in remote areas for lighting and refrigeration.

The Policy aimed to increase utilization of national energy resources from 51.3 to 61.5 percent, and reduce dependence on imported petroleum products from 48.7 to 38.5 percent by 2004. In this regard, the Policy anticipated that renewable energy sources like hydropower, bagasse, solar, wood waste and rice-husk would be promoted as future energy sources and more efficient use of energy would be promoted to satisfy energy demand over a ten years period. As it regards solar power, the Policy encouraged the development of small solar power units for remote and isolated communities providing that they were a cost-effective option for power generation. The use of fixed convection and natural convection solar systems for the processing of agro-based and fisheries commodities was also encouraged.

3.1.3 National Development Strategy⁸

In 1997, the National Development Strategy (NDS) was launched and outlined objectives and fundamental policy conditions for the country's development process over the next decade. In Volume 3 (Chapters 18 and 19) an overarching national policy framework and priorities for environmental management were developed. The environmental policies promoted the sustainable management of natural resources and the preservation of a healthy environment as an integral part of Guyana's development agenda. Environmental protection was framed as a proactive undertaking in which natural resources would be managed sustainably. The Strategy incorporated guidelines for management of these resources including fisheries and forests and prioritised avoiding contamination and cleaning up of pollution. The Strategy also covered the areas of liquid and solid waste management, coastal zone management, forest management, fisheries management, mining policies, Amerindian concerns, urban water supply, pesticide management, and protection of biodiversity, among others, as well as the institutional and legal aspects related to those issues. It also proposed the establishment of the EPA through the passage of the Environmental Protection Act.

In addition, Volume 5, Chapter 39 addressed the policy framework for the energy sector. Accordingly, some of the key policy objectives include ensuring that an adequate and dependable supply of electricity is available for the country's future economic development; reducing the dependency on

⁷ Government of Guyana, 1994. Energy Policy of Guyana. Pages 10 and 35.

⁸ Government of Guyana, 1997. National Development Strategy. Volume 3: Chapter 18 and Volume 5: Chapter 39

imported petroleum products, where feasible; providing increased utilization of new and renewable domestic energy resources; using energy in an environmentally sound and sustainable manner and encouraging energy conservation practices through public awareness. The NDS recognized that although solar power represented a minimal contribution to energy potential in Guyana, there was significant potential to develop this resource over the long-term. The NDS reiterated the high-cost constraints previously highlighted by the National Energy Policy (1994) of large-scale deployment of solar power. However, the NDS anticipated that cost reductions of solar PV technology in the medium-to long-term could contribute to greater solar powered energy generation in Guyana particularly for widely dispersed communities in the interior. This aligns with the expectations expounded in the expanded LCDS more than two decades later. As such, among other targets for energy generation in the medium-term were the exploration of solar power applications in remote areas of Guyana. Further, long-term targets for the energy sectors includes larger scale deployment of solar power if it is a cost effective and sustainable option.

3.1.4 Poverty Reduction Strategy Paper⁹

In 2001, the GoG embarked on the development of a Poverty Reduction Strategy with support from the World Bank. The first Poverty Reduction Strategy Paper (PRSP) was aimed at generating economic growth, improving provision of social services, enhancing governance structures and progressing in a timely manner towards the achievement of the Millennium Development Goals (MDGs). The provision of access to electricity services to unserved rural coastal areas and communities in the hinterland interior were important areas of focus in the achievement of these objectives. Since the 2001 PRSP, Guyana has prepared three PRSP progress reports, one in 2004 and the other in 2005; and in 2008 prepared a second Poverty Reduction Strategy. A third was prepared in 2011 spurred on by changing economic and political developments that required a shift in strategy. This PRSP (2011 to 2015) focused achieving broad-based, low-carbon led job creation and economic growth and creating required infrastructure. One of the key pillars of the PRSP was the expansion and diversification of power supplies including making provision for sustainable institutional and financial schemes for hinterland electrification.

3.1.5 Hinterland Electrification Strategy¹⁰

A study of possible energy sources in the hinterland and the identification of electrification projects that would provide the basis for a comprehensive hinterland electrification programme was undertaken as part of the Hinterland Project Preparation Component of the Unserved Areas Electrification Programme (UAEP). This resulted in the preparation of the Hinterland Electrification Strategy in 2007. The goals of the Strategy were to establish some form of electrification in each village (starting with social services and communal buildings) and supplying the entire village with electricity including working in collaboration with private initiatives/ investors.

The Strategy classified hinterland villages into three groups based on their existing access to electricity, population size, number of Government services and utilities located in the villages as follows:

- **Group 1:** Villages with existing mini-grids, relatively high number of households, significant local government institutions and the prevalence of productive activities.
- **Group 2:** Villages with some potential for development, which have secondary schools, hospitals and other Government institutions.
- **Group 3:** Small villages with less than 1000 residents with primarily a subsistence economy. They have nursery and primary schools, small medical clinics and, usually, no other Government institutions.

9 Government of Guyana, 2001. Poverty Reduction Strategy Paper. Pages 1 to 5, 44

10 Government of Guyana, 2007. Hinterland Electrification Strategy. Pages 5 and 10 to 11

With respect to solar power, the Strategy focuses on the installation of Solar Home Systems in all villages which were part of the Group 3 classification given their remoteness and low, dispersed demand for electricity. The Strategy indicated that the use of Solar Home Systems would facilitate the installation of individual, isolated systems and avoid the installation of an expanded transmission and distribution grid that would be costly due to long distribution lines to serve the characteristic dispersed housing arrangement in these communities. The Strategy identified four Group 3 villages as pilots for the implementation of the Solar Home Systems programme, Yarakita (Region 1); Capoey (Region 2); Kurukabaru (Region 8) and Muritaro (Region 10). The Strategy also highlighted the potential for installing solar home systems in peripheral areas of Group 2 villages. However, the potential for interconnection or grid-tied solar projects was not examined by the Strategy.

3.1.6 Guyana Power Sector Policy and Implementation Plan¹¹

The Guyana Power Sector Policy and Implementation Strategy was prepared in 2010. The Policy and Implementation Strategy had among its objectives the supply of reliable power at the lowest possible sustainable costs with adequate energy security; utilization of local clean energy resources for electricity generation; development of efficient and environmentally sustainable energy production and consumption patterns; and increased households with access to electricity throughout Guyana. It also outlined nine strategic areas of focus for the power sector over the medium term (2010 to 2014) including the management and organization of the energy sector, regulating the sector, generation sources, national grid, distribution, hinterland electrification, cost recovery, self-generation of power and energy conservation. With respect to electricity generation, the Policy Implementation Strategy prioritized reducing the dependency on fossil fuel imports and increasing renewable energy sources, with emphasis on developing solar power as one of the clean sources of energy in a diversified grid. Moreover, the goal of electrification of hinterland communities is to contribute to socio-economic development of local populations.

The Policy and Implementation Strategy reiterated the focus of the Hinterland Electrification Strategy to develop Solar Home Systems. However, it expanded upon this goal by indicating that solar farms with potential for interconnection with the national grid will also be pursued. Further, the Implementation Strategy proposed that pilot programmes be used to determine the suitability of the various sources of renewable energy, including solar, to different hinterland areas. The Policy and Implementation Strategy also recommended the establishment of a permanent department within the Office of the Prime Minister for hinterland electrification and the periodic revision of the Hinterland Electrification Strategy.

3.1.7 Guyana Energy Agency Strategic Plan¹²

The Strategic Plan for the GEA covering the period 2016 – 2020 outlines current initiatives in the energy sector and strategic objectives for the development of different sources of energy including a mix of renewable energy including hydropower, solar power and wind power. The Plan identifies significant strides which have been made with respect to solar power including:

- Installation of 1,750 home solar systems totaling 65,125 watts as well as solar systems in schools and other community buildings in 21 hinterland villages under the UAEP.
- Provision of 16,540 home solar systems to communities without grid access under the LCDS.
- Piloting grid-tied solar projects in 2011 and 2014.
- Distribution of 507 solar powered cooking stoves in five communities in Regions 1, 7, 8 and 9.

The strategic objectives for continuing to encourage the development and utilisation of sources of energy other than those sources presently in use; and to demonstrate, research and utilize solar

11 Klass, V, 2010. Guyana Power Sector Policy and Implementation Strategy. Pages 3 and 11 to 14

12 Guyana Energy Agency 2016. Guyana Energy Agency Strategic Plan. Pages 26 to 27 and 42

photovoltaic technology as a source of renewable energy to meet energy needs where appropriate. In particular, the GEA will explore options for grid interconnection as a means of reducing investment in fossil-based generators and meeting incremental demand from renewable energy sources. Options for establishing Power Purchase Agreements (PPA) between the utilities and private power generators were also considered under the Plan.

3.1.8 National Land Use Plan¹³

The National Land Use Plan (NLUP), which was prepared in 2013 provides a strategic framework to guide land development in Guyana and is guided by a number of national policies and strategies that have a direct relevance for land use and land management. The NLUP recognized the importance of land allocation to Guyana's development and also highlighted the challenges posed by multiple land uses. The NLUP is not prescriptive and does not zone areas of the country for particular land uses. However, it proposes development options for particular areas that can guide decision-making and attract investments.

The project is located on the Low Coastal Plain and Leguan is one of the three largest islands of the Essequibo River. The NLUP does not propose any specific development options for Leguan. However, the primary development priorities for the Low Coastal Plain are related to agriculture enterprises such as crop cultivation, livestock and aquaculture and housing development. The development of energy options were also considered as one of the primary opportunities for the Low Coastal Plain including the potential for solar arrays on abandoned lands or unused backlands. Thus, the project supports the achievement of development options articulated in the NLUP. The importance of providing appropriate infrastructure for drainage and irrigation to enable the implementation of these options was emphasized. Moreover, continuing to develop transport infrastructure to improve accessibility in Essequibo such as stellingis with roll-on/roll-off facilities for vehicles was also highlighted.

3.1.9 National Environmental Action Plan¹⁴

A National Environmental Action Plan (NEAP) was first prepared in 1994 to identify the major environmental problems in Guyana and to formulate appropriate policies to address the causes and effects of the problems. A second NEAP was prepared and adopted in 2001. The second NEAP sets out the environmental management framework for Guyana in keeping with its commitment to international multilateral agreements. In addressing cross sectoral environmental issues related to land use, environmental health, integrated water resource management, and waste management, the NEAP committed to the implementation of several key actions. These include environmental education and public awareness, human resources development, institutional capacity building, inter-agency collaboration, public participation, information management and networking, acquisition of appropriate technology, and developing environmental legislation, and regulatory standards and controls. Importantly, it committed to executing environmental assessments for proposed development activities that may significantly affect the environment.

3.1.10 Nationally Determined Contribution¹⁵

In 2016, Guyana submitted its Nationally Determined Contribution to the United Nations Framework Convention on Climate Change (UNFCCC) within the framework of the Paris Agreement. The Nationally Determined Contribution outlined contributions the GoG intended to implement to contribute to the global fight against climate change. The contributions were either unconditional contributions which could be implemented unilaterally or conditional contributions for which support was required.

¹³ Guyana Lands and Surveys Commission, 2013. National Land Use Plan. Pages 1, 5, 136 to 138

¹⁴ Government of Guyana, 1994; 2001. National Environmental Action Plan.

¹⁵ Government of Guyana, 2016. Guyana's Revised Intended Nationally Determined Contribution. Pages 10 to 11

The energy sector was one of the two key sectors in which contributions were proposed. Unconditionally, Guyana indicated that options to facilitate the rapid expansion of a renewable energy supply will be examined with the goal of developing a mix of sources include wind, solar, biomass and hydropower to supply both the demand of the national grid and the energy requirements for towns and villages in Guyana's hinterland. Moreover, conditional on receiving adequate and timely financial support, Guyana would aim to develop 100 percent of its power supply from three renewable sources namely solar power, hydropower and wind energy.

3.1.11 National Biodiversity Strategy and Action Plan¹⁶

In 2014, the National Biodiversity Strategy and Action Plan (NBSAP) was revised and updated to cover the period 2012 to 2020. This Plan sets out the vision, the roles, duties and obligations of the Government and its citizens and the actions to protect, conserve, use sustainably and share equitably the benefits arising from biodiversity. It provides the guidance and support actions for sustainable utilization and conservation of biodiversity, and sets out the national priorities and the strategic objectives to be achieved. The NBSAP also allows partners at all levels to better identify how they can contribute and support Guyana in meeting its national biodiversity vision while meeting at the same time, its obligations to the United Nations Convention on Biological Diversity (UNCBD). To this end, the Plan incorporates the goals of the UNCBD Strategic Plan for Biodiversity (2011-2020) and selected Aichi Targets. The NBSAP presented Guyana's vision for biodiversity as follows *"By 2030, biodiversity is sustainably utilized, managed and mainstreamed into all sectors contributing to the advancement of Guyana's bio-security, and socio-economic and low carbon development"*.

3.1.12 National Action Plan to Combat Land Degradation in Guyana

In 2015, Guyana prepared an Aligned National Action Plan 2015-2025 that is consistent with the United Nations Convention to Combat Desertification (UNCCD) Strategic Plan 2008-2018. The Aligned National Action Plan (NAP) aims to ensure that agricultural, pasture, mining, forest, coastal and other land uses and resources are managed as sustainable, productive systems that maintain ecosystem productivity and ecological functions while contributing directly to the environmental protection, economic growth and social livelihood of the people of the country. The Aligned NAP provides consideration for the need for urgent efforts to integrate and strengthen existing national policies, strategies, action plans and the planning framework for conservation, promotion of sustainable land management and combating the exacerbated effects of degradation.

The Aligned NAP outlines the approach and roadmap towards continuing to enhance the way of managing land and resources in Guyana, and consists of and is governed by a set of overarching principles: achievement of sustainable development; land management governance and policy; education, training and awareness; knowledge, information and research; evaluation and monitoring; and partnership and financing. The Aligned NAP focuses on the primary sectors on which Guyana has depended and will depend upon in the future. In the mining areas, the focus is on reclamation of previously mined out areas while ensuring current mining practices include rehabilitation of mined out lands.

3.2 Legislation and Regulations

There are several laws which guide the energy sector in Guyana. These include the Constitution of Guyana (1980) with amendments (2003); the Environmental Protection Act (1996) and Environmental Protection Regulations and the Guyana Energy Agency Act (1997). Additional legislation is also applicable to the project including the Sea Defence Act (1933) and the Occupational Safety and Health Act (1997) among others. These laws and regulations are discussed in the section below.

¹⁶ Environmental Protection Agency and Ministry of Natural Resources, 2014. Guyana's National Biodiversity Strategy and Action Plan (2012 to 2020)

3.2.1 The Constitution of the Cooperative Republic of Guyana, 1980, and 2003 Reforms

The Constitution of Guyana is the highest governing legal document and supreme law for the country. The importance of protection and management of the environment is also well recognized and given particular attention to environmental related principles. This is outlined as follows:

- Article 25: “Every citizen must participate in activities to improve the environment and protect the health of the nation.”
- Article 36: “The wellbeing for the nation depends upon preserving clean air, fertile soils, pure water and the rich diversity of plants, animals.”
- Article 149J: (1) “Everyone has the right to an environment that is not harmful to his or her health or wellbeing.”
- Article 149(J): (2) “The State shall protect the environment, for the benefit of present and future generations, through reasonable legislative and other measures designed to:
 - Prevent pollution and ecological degradation.
 - Promote conservation.
 - Secure sustainable development and use of natural resources while promoting justifiable economic and social development.”

3.2.2 The Environment Protection Act (1996)

The Environmental Protection Act 1996 was the first comprehensive environmental legislation in Guyana. The Act, and the Environmental Protection Amendment Act 2005, establishes the basic institutional and regulatory framework within which all activities that may significantly impact on the natural, social, and cultural environments are assessed. The Act established the EPA and the goal of the Act is to *“provide for the management, conservation, protection and improvement of the environment, the prevention and/or control of pollution, the assessment of the impact of economic development on the environment, the sustainable use of natural resources and for matters incidental thereto connected therewith”*. The Act gives the EPA the mandate for the coordination of environmental management and outlines the legal process for undertaking sustainable and effective management of the natural environment.

Part V Section 19 (1) of the Act states that *“A person shall not (a) Undertake an activity that causes or is likely to cause pollution of the environment unless the person takes all reasonable and practicable measures to prevent or minimize any resulting adverse effect; (b) Discharge or cause or permit the entry into the environment of any contaminant in any amount, concentration or level in excess of that prescribed by the regulations or stipulated by an environmental authorization.”*

3.2.2.1 The Environment Protection Regulations (2000, 2013)

The Environmental Protection Act comprises several subsidiary Environmental Protection Regulations. Those of direct relevance to the Project are:

- The Environmental Protection Authorisations Regulations (2000)
- The Environmental Protection Air Quality Regulations (2000)
- The Environmental Protection Water Quality Regulations (2000)
- The Environmental Protection Noise Management Regulations (2000)
- The Environmental Protection Hazardous Wastes Management Regulations (2000)
- The Environmental Protection (Litter Enforcement) Regulations (2013)

These Regulations were developed to regulate and control the activities of development projects during construction and operation. The EPA has the responsibility to ensure the compliance of all new

and existing activities with these Regulations by issuing the required authorizations and monitoring their operations.

Environmental Protection (Authorisations) Regulations (2000)

These regulations outline the requirements for an environmental authorisation and the rules governing the issuance of such authorisation. Environment authorisations typically have specified conditions which with Permit Holders must comply so as to avoid, minimise, and mitigate environmental impacts. The EPA determines the types/categories of development that require environmental authorization.

Environmental Protection Air Quality Regulations (2000)

In accordance with these Regulations any operation that emits any air contaminant in the construction, installation, operation, modification or extension of any facility related to industry, commerce, agriculture or any institution shall apply to the EPA for an environmental authorization at least ninety days before the date on which the emission is to commence. In accordance with the Regulations the EPA shall establish the desirable air pollution limits. Currently, there are no nationally determined or established air quality standards. However, the Agency is guided by and utilises air quality guidelines from the World Health Organisation (WHO), United States Environmental Protection Agency (USEPA) allowable limits and other reputable international organisations. Table 3-2 below shows the WHO Air Quality Guidelines.

Table 3-2: WHO Air Quality Standards

Element	Averaging Period	Acceptable Limit
Particulate Matter (PM 10)	24-hour	50 g/m ³
Particulate Matter (PM 2.5)	24-hour	25 g/m ³
Sulphur Dioxide	24-hour	20 g/m ³
Ozone (O ₃)	8-hour	100ug/m ³
Nitrogen Dioxide	1-hour	40ug/m ³

Environmental Protection Water Quality Regulations (2000)

These Regulations require an environmental authorization for construction, installation, operation, modification/extension of facilities that discharge effluents. Requirements and guidelines on the discharge of effluents and disposal of sludge are provided. The EPA and Guyana National Bureau of Standards (GNBS) have developed Interim Guidelines for Industrial Effluent Discharges into the Environment and these are currently being used by the EPA. The maximum allowable limits for parameters which are deemed relevant to the project are outlined in Table 3-3.

Table 3-3: Parameters and Maximum Allowable Limits

Parameters	Maximum Allowable Limits
pH	5.0 to 9.0
Temperature	<40°C
Dissolved Oxygen	5 mg/L
Total Suspended Solids (TSS)	<50 mg/L
Total Dissolved Solids (TDS)	<200 mg/L
Turbidity	<15 NTU
Oil and Grease	<10 mg/L

Environmental Protection Noise Management Regulations (2000)

Under these Regulations operations that emit noise in the execution of various activities such as construction, transport, industry, commerce, and any institution are required to apply to the Agency for an environmental authorization. The EPA is responsible for the establishment of standards for permissible noise levels in industry, construction, and other areas. The EPA may grant authorization for noise emission unconditionally or subject to conditions and may require environmental audit procedures. The GNBS and the EPA, together with other relevant agencies, developed standards for noise emissions into the environment as shown in Table 3-4. Construction activities are required to comply with the construction limits, as is stipulated in Condition 3.2 of the Construction Permit.

Table 3-4: Decibel Limits for Various Types of Activities

Type of Activity	Day-Time Limit (dB)	Night-Time Limit (dB)
Residential, Institutional, Educational	75	60
Industrial, Transportation	100	80
Commercial	80	65
Construction	90	75
Recreational	100 (18:00 to 01:00hrs)	75 (01:00 to 08:00hrs)

Environmental Protection Hazardous Waste Management Regulations (2000)

These Regulations outline the rules and procedures for transport, storage, treatment, and disposal of hazardous wastes and are intended to ensure, through the environmental authorisation process, that all operations that generate, transport, treat, store and dispose of hazardous wastes are managed in a manner that protects human health and the environment. The Regulations allow for the provision of information on the types of facilities and quantity of hazardous waste generated, treatment standards and efforts to reduce the waste generated. These Regulations also apply to any activity that generates hazardous waste. Hazardous waste is defined, and a schedule of materials considered hazardous is provided in these regulations.

Environmental Protection Litter Enforcement Regulations (2013)

These Regulations provide for the enforcement against litter offences. It is an offence under these Regulations to place litter in a public place, permit or cause another person to litter a public place or have litter on private premises that pose a health risk. The fine for an individual found littering in a public place is GYD \$50,000, while for body corporate it is GYD \$100,000. A fixed penalty of fifteen thousand dollars (GYD \$15,000) is offered to offenders who accept liability for the offence committed. Under the Litter Prevention Regulations, the Neighbourhood Democratic Councils (NDCs) and Regional Democratic Councils (RDCs) are to provide receptacles in public places. Further, every Council shall make appropriate provision for the prompt, efficient and regular emptying of the contents of the receptacles and the removal and disposal of those contents.

3.2.2.2 Environmental Guidelines for the Preparation of an Environmental Management Plan

The EPA has established Guidelines for the Preparation of Environmental Management Plans. An EMP seeks to identify and assess potential impacts of projects and provide methods and procedures for mitigating and monitoring impacts. According to the Guidelines, an EMP can be defined as “*an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented, and that the positive benefits of the projects are enhanced*”. An EMP is recognised as a tool that can be used to provide

assurance that developers make suitable provisions for counteracting negative impacts that occur through project implementation and operation, and contains environmental objectives/targets which the developer needs to accomplish in order to reduce or eliminate negative impacts.

The objectives of an EMP are to:

- Place the proposed or existing activity in the context of the local and regional environment.
- Adequately describe all components of the proposed/ existing activity, so that the Agency can consider approval of a well-defined project, and prescribe relevant and adequate Permit Conditions for the monitoring of the activity.
- Identify the environmental issues/risks associated with the proposed/existing activity.
- Provide the basis of the developer's environment management program, which shows that the environmental impacts resulting from the proposed/existing activity, including cumulative impacts, can be acceptably managed.
- Provide a document that clearly sets out the reasons why the proposed/existing activity should be considered environmentally acceptable.

3.2.3 Sea Defence Act (1933)

The Sea Defence Act makes provisions for the construction and maintenance of sea-defences. The Act defines several types of constructed or naturally occurring structures which are considered as sea defences including:

- Any shell bank or reef, mud bank or reef, sand bank or reef, or other natural feature, which serves as a protection of the coast against the erosive action of the sea or which protects the bank of any river from the erosive action of the river current.
- All land fifty feet landward of the crest or top of any reef, bank or natural feature described above and all land on the other side thereof in the direction of the sea or river as far as the mean high-water mark.

Based on the description provided above, some sections of the beach adjacent to the project site may be considered as sea defences provided by the natural landscape of the area. The Act established the Sea Defence Board with a mandate to care, maintain, manage and construct sea defences in Guyana. This Act authorises the Chief Hydraulics Officer to take any and such actions as to secure the maintenance of sea, rivers, and outer dams of properties that abut these areas. Under the Act, there should be no deviations from the existing line of sea, river, front or outer dam without first obtaining permission. The Sea Defence Board has issued a 'No-Objection' for the construction and operation of the solar PV farm on the Oakum foreshore provided that several conditions are followed. These conditions are:

- Compliance with the requirements of other regulatory agencies which require GEA to acquire final approvals, permits and licences from all regulatory agencies including the Environmental Protection Agency, Regional Democratic Council, and the Guyana Lands and Surveys Commission.
- Protection of river defences during installation works to ensure that the structural and functional integrity of the flood defences adjacent to the project site is not compromised. In addition, all components should be installed at a minimum offset distance of 20-feet from the toe of the earthen embankment to allow ease of access for future flood protection works.
- Compliance with directives issued by the Sea and River Defence Board.

- Limit disturbance, clearing or removal of natural flood defences, including foreshore sediment, mangroves and other forms of beneficial vegetation from the Oakum foreshore to the 1 hectare (2.48 areas) project footprint area. Clearance beyond this limit requires prior approval by the Sea Defence Board and other regulatory agencies.
- Allowing officers and equipment from the Sea and River Defence Department unimpeded access to the river defences for construction works and monitoring activities.
- Inform the Sea and River Defence Department of the programme for construction works to allow intermitted monitoring from the Department's Technical Officers.

The Board also subsequently issued a 'No Objection' for a shift in the project site (see Appendix D for a copy of the No-Objections).

3.2.4 Guyana Energy Agency Act (1997)

The GEA Act 1997 (Act No. 31 of 1997) established the GEA. The GEA Act was amended in 2004, 2005, and 2011. The Act outlines the functions of the Agency and makes provisions for the Agency to exercise function under the Hydro- Electric Power Act. The GEA Act is supported by the Petroleum and Petroleum Products Regulations 2014.

3.2.5 State Lands Act (1903)

The State Lands Act provides for the proper regulation of state lands, rivers and creeks. Under the Act, the President has the authority to grant leases of State lands of Guyana subject to any terms and conditions deemed necessary. Permission may be granted to occupy lands or to utilize the resources of those lands without giving the exclusive rights of occupancy. Accordingly, GEA has obtained a 'No Objection' from the GLSC to occupy the project site for the project.

3.2.6 Guyana Lands and Surveys Act (2001)

The Guyana Lands and Surveys Act established the GLSC as a body corporate. The Act outlines the functions of the Commission with respect to land administration and management in Guyana (see Section 3.4.5 for some of the functions of the GLSC). It also makes provisions for the establishment of the Board, the management structure and staffing of the GLSC. The Act also makes financial provisions for the GLSC.

3.2.7 Local Democratic Organs Act (1980)

The Local Democratic Organs Act makes provisions for the institution of a country-wide system of local government through the establishment of organs of local democratic power including RDCs. Under the Act, RDCs are empowered to administer all services required within its boundaries (services such as health, education, public works), coordinate the activities of the Local Democratic Councils and provide such cooperation and support as required, develop regional facilities, develop economic projects and execute works necessary for the development of the region.

3.2.8 National Trust Act (1972)

The National Trust Act provides for the preservation of monuments, sites, places, and objects of historic interest or national importance. The Act also establishes the National Trust of Guyana to promote the permanent preservation of buildings of national interest or architecture, archaeological, historic or artistic interest and places of national interest, importance or beauty. The Act requires that any cultural or archaeological chance finds, particularly during the construction phase, should be

reported to the National Trust of Guyana. In such an event, the GEA and the National Trust of Guyana would need to work together to manage the resources found. If the National Trust of Guyana has reason to believe that the area contains a site of historic interest or national importance, it is in the power of the National Trust to enter the land for the purpose of excavation and assessment of the site and may restrict any works requiring construction or excavation at the site.

3.2.9 Public Health Ordinance (1934)

The Public Health Ordinance makes provisions for promoting public health concerns in Guyana. The Ordinance makes provisions for central and decentralised and local administration of health including the prevention of infectious, epidemic, endemic and venereal diseases, as well as management of public health facilities and services. The Ordinance also makes provisions for regulating 'offensive trades', that is, a trade that damages the health of the persons engaged in the trade. The Ministry of Health has convened a Committee for the management of offensive trades and this Committee is chaired by the Chief Medical Officer and is aimed at regulating activities that can damage the health of employees during their routine duties.

The Government's COVID-19 measures introduce several safety guidelines with which the Project must comply while they remain in effect. These were made under this Ordinance. The most recent version of the COVID-19 emergency measures were published in October 2021. According to these measures, public and private sector employers must ensure that appropriate COVID-19 guidelines and measures are prepared and implemented including¹⁷:

- Vaccination.
- Screening of workers.
- Preventative measures before and after work.
- Preventative measures while using transportation.
- Procedures to be adopted when there is a suspected COVID-19 case.
- Dealing with stress at the workplace during COVID-19.
- Employee education, training and capacity building related to COVID-19.
- Cleaning and disinfecting protocols.
- Personal protective equipment.
- Physical distancing guidelines.
- Client and customer interactions.
- Resumption of work after a period of quarantine or isolation.

A Public Health Bill has been drafted to supersede the Ordinance.

3.2.10 Labour Act (1942)

The Labour Act specifies the conditions that an employer must observe in the contracting employees. Part V specifies that the entire wages of the employee must be paid as money and not otherwise. However, in occupations where it is customary to make partial payment of allowances in the form of food, toiletries, housing etc. these are acceptable and not considered illegal, if both the employer and employee are agreed on such terms. The Act is relevant to the entire Project lifetime so as to ensure that workers are not mistreated, are paid adequately in accordance with the Laws of Guyana, and have proper representation.

¹⁷ The Official Gazette (Extraordinary) of Guyana. October 2021a. Subsidiary Legislation – COVID-19 Emergency Measures (No. 24)

3.2.11 Occupational Health and Safety Act (1997)

The Occupational Safety and Health Act defines the responsibilities of management and workers with respect to safety and health and applies to every workplace in Guyana. The Act makes provisions for the registration of industrial establishments, the establishment of an Occupational Safety and Health Authority, the establishment of a National Advisory Council on Occupational Safety and Health, the duties of employers, workers and other persons, treatments of accidents and occupational diseases, and occupational safety and health regulations. The Act authorises OH&S inspectors to enter and inspect workplaces.

Under this Act, the employer has a responsibility to establish a joint workplace safety committee consisting of four persons. When the workplace has more than 50 persons, the committee should consist of six persons of which at least half the numbers should be workers who do not exercise managerial functions and should be selected by the workers themselves. Employers also have duties of providing protective equipment for workers, providing instructions and supervision to ensure the safety of workers, maintaining a medicine chest and establishing an occupational health service for workers. At a construction site, employers must ensure that the requirements of the Act are implemented and that the safety and health of workers are protected onsite.

3.2.12 Additional Legislation

Other pieces of legislation which may be applicable include:

- Prevention of Discrimination Act (1997)
- Employment of Young Persons and Children Act (1983)
- National Insurance and Social Security Act (1969)
- Energy Sector (Harmonization of Laws) Act (2002)
- Electricity Sector Reform Act (1999) with amendments in 2010
- Public Utilities Commission Act (1999) with amendments in 2010.

3.3 IDB Operational Policies

In November 2021 the IDB commenced implementation of a new Environmental and Social Policy Framework (ESPF) outlined ten modernized environmental and social performance standards. The ESPF will supersede the existing environmental and social (E&S) risk and impact management sections of five policies: Environment and Safeguards Compliance Policy (OP-703); Disaster Risk Management Policy (OP-704); Involuntary Resettlement Policy (OP-710); Policy on Gender Equality in Development (OP-761); and Indigenous Peoples Policy (OP-765). However, the ESPF will co-exist with the sectoral policies it will eventually replace for existing projects. The EMISDE Programme was approved in 2018 and therefore is considered as an existing operation to which the E&S policies will apply.

The E&S policies are required to be applied during all project execution. The policies are intended to ensure that safeguards are applied to ensure that project funds are engaged in a manner consistent with the Bank's institutional policies with respect to environmental and social management. According to the project documents, the project has triggered the IDB's Environment and Safeguards Compliance Policy (Operational Policy OP-703) and has been classified as Category "B" since impacts are anticipated to be mostly local and short-term for which effective mitigation measures are readily available. Table 3-5 outlines the policy directives of OP-703 and discusses their relevance to the project.

Table 3-5: Policy Directives of OP-703 – Environmental and Safeguards Compliance

Policy Directive	Aspect (if applicable)	Relevance to the Project
B.1. Bank Policies	OP-102: The Access to Information Policy.	The IDB to determine whether this ESAR contains information subject to the Access to Information Exceptions List. If it is not on the Exceptions List, the ESAR should be posted to the Bank's website.
	OP-710: The Involuntary Resettlement Policy	This Operational Policy will not be triggered by the project. Site investigations and stakeholder engagements revealed that there are no existing settlements on the project site.
	OP-704: The Natural and Unexpected Disasters Policy	By virtue of the geographic location of the project site, the Type 1 disaster risk scenario may apply due potential exposure of fluvial flooding associated with sea level rise during operations if sea defences are not installed to mitigate erosion of the beach. As such, flood risk associated with sea level rise was assessed in this ESAR.
	OP-761: Gender and Equality in Development	Gender safeguards outlined under this Operational Policy will not be triggered by the project. Although gender responsive considerations may be mainstreamed into the project as a whole, differential needs of men and women are not a key consideration for this project given the broad base of potential beneficiaries as well as the existing implementation arrangements via GPL.
	OP-765: The Indigenous Peoples Policy	This Policy will not be triggered by the project.
OP-703: Environmental and Safeguards Compliance Policy		
B.2. Country laws and regulations	Compliance with national environmental laws and regulations and with multilateral environmental agreements.	The project must comply with national legislation on environment and occupational health and safety as stated in the ESAR. In addition, the project will support Guyana in achieving obligations under multilateral agreements.
B.3. Screening and Classification	Classification of the risk level	The project has been classified a Category B Operation by the IDB because impacts are anticipated to be mostly local and short-term for which effective mitigation measures are available.
B.4. Other Risk Factors	Capacity of executing agency for environmental governance, high	Environmental and social risks associated with the project are assessed in this ESAR, and

Policy Directive	Aspect (if applicable)	Relevance to the Project
	environmental and social risks, vulnerability to natural disasters.	management and mitigation measures to address these risks are recommended.
B5. Environmental Assessment Requirements	Requirements for various types of environmental assessments including ESMPs.	Environmental analyses are required for Category B operations in both public and private sectors. An Environmental Analysis could include a description of the proposed investment plan; an evaluation of the legal and regulatory framework applicable to the investment plan; an assessment of the potential environmental and social impacts and risk of the proposed operations, works or activities included in the proposed investment plans; and proposed management plan, including mitigation and monitoring programs to address significant impacts and risks. This ESAR satisfies the requirements for an Environmental Analysis for this project.
B.6 Consultation	Consultations with parties who may be affected by the project.	<p>Category B projects require at least one consultation with affected parties, preferably during the impact assessment in order to inform, gather comments, and adjust the assessment and the corresponding environmental and social management plan. Consultations should provide, at a minimum, information to affected parties and a dialogue regarding the project scope and proposed mitigation measures. Consultations with local stakeholders were conducted as part of the ESAR preparation process by the consultant in collaboration with the GEA. During the meetings with stakeholders, GEA representatives or the Consultant's team provided an overview of proposed project activities and stakeholders were provided with the opportunity to ask questions and share issues of concern.</p> <p>As part of this Operational Policy, the borrower should continue an applicable degree of information disclosure and consultation after IDB has provided approval for the project.</p>
B.7. Supervision and Compliance	Supervision of Construction and Operation Phase	The Bank will supervise and monitor the adequate implementation of the ESMP through the executing agency and supervisory consultants, as necessary. This may also involve an ex-post evaluation of performance on the designed indicators.

Policy Directive	Aspect (if applicable)	Relevance to the Project
B.8 Transboundary Impacts	N/A	This Policy Directive is not applicable to the project.
B9. Natural Habitats and Cultural Sites	Degradation or of critical habitats, critical cultural sites and critical cultural sites.	This Policy Directive is not applicable to the project. No critical natural habitats or critical cultural sites will be disturbed by the project.
B10. Hazardous Materials	Production, use and disposal of hazardous substances	Small quantities of hazardous materials such as waste oil may be generated during the construction phase. During the operational phase, hazardous materials may include decommissioned batteries. Management measures will guide storage, transport and disposal.
B.11. Pollution Prevention and Abatement	Water, air, noise and waste pollution management	The project will implement management and mitigation measures for any adverse impacts on water quality, air quality, noise management, hazardous waste, and litter prevention.
B.12 Projects Under Construction	N/A	This Policy Directive is not applicable to the project.
B. 13 Noninvestment Lending and Flexible Lending Instruments	N/A	This Policy Directive is not applicable to the project.
B.14 Multiple Phase and Repeat Loans	N/A	This Policy Directive is not applicable to the project.
B.15 Co-financing Options	N/A	This Policy Directive is not applicable to the project.
B. 16 In-Country Systems	Utilizing in-country systems to manage environmental and social impacts.	The IDB will decide whether the in-country safeguards systems will be used to manage potential environmental and social impacts from the project.
B.17 Procurement	Safeguards for procurement incorporated into loan agreements, operating regulations and bidding documents.	The project will not employ forced labour or child labour during any phase of project activities.

3.4 Institutional Framework

The Institutional arrangement for energy and environment straddles several Ministries of Government and Agencies. The key players that contribute to development and achievement of policy and legislative objectives relevant to energy and environment in Guyana are identified below.

3.4.1 Environmental Protection Agency

The EPA oversees the effective management, conservation, protection and improvement of the environment and takes the necessary measures to ensure the prevention and control of pollution, assesses the impact of economic development on the environment and the sustainable use of natural resources. The Agency was established in 1996 by the Environmental Protection Act and is responsible for the enforcement of national environmental legislation and regulations as well as the development and implementation of environmental policies and standards. It also undertakes the inspection and enforcement of matters dealing with the environment, conservation and natural resources and administers the environmental permitting process in Guyana. The Agency is governed by a Board of Directors.

Under the Act, the EPA is mandated to *“take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection and sustainable use of its natural resources”* (section 4 (1) (a)). The Act also provides for the EPA to have overall responsibility to ensure management of the natural environment to ensure conservation, protection and sustainable use of its natural resources; assess any developmental activity, which may cause an adverse effect on the natural environment before such activity commences; and coordinate and maintain a programme for the conservation of biological diversity and its sustainable use. The EPA is mandated to ensure that any project that may have a significant impact on the environment must acquire an Environmental Authorisation from the EPA. Projects are considered to have an environmental impact when they threaten the health, safety and natural life supporting systems of humans and other living things.

3.4.2 Office of the Prime Minister

The Office of the Prime Minister (OPM) is established under Article 100 of the Constitution of the Cooperative Republic of Guyana. According to the Official Gazette,¹⁸ the Office of the Prime Minister is responsible for matters related to energy, power generation, hinterland electrification and hydropower development among other responsibilities related to broadcasting, electronic data management, utilities, and information and communications. The OPM has principal policy-making and regulatory responsibility in the sector, including granting licenses to the public utilities and independent power producers and approval of development and expansion plans and operating standards and performance targets for the electricity sector.

Several key agencies in the energy and power generation sector fall under OPM's purview including the GEA, the Public Utilities Commission, and GPL. Two of these agencies, the GEA and GPL, will be directly responsible for the project during the design, construction and operational phases. The Public Utilities Commission will be involved in activities to set the prices at which electricity generated from the Project will be sold.

3.4.2.1 Guyana Energy Agency

The GEA falls under the purview of the Office of the Prime Minister. GEA's organization structure consists of a Board of Directors, Chief Executive Officer, Deputy Chief Executive Officer (unfilled),

¹⁸ The Official Gazette (Extraordinary) of Guyana. September 2020. Subsidiary Legislation – Notice – The Constitutional Appointments.

Secretariat and the following five Divisions: Energy & Energy Statistics Division, Legal & Licensing Division, Fuel Marking Division, Administration/Human Resource Division and Finance Division.

GEA's mission is to ensure the rational and efficient use of imported petroleum-based energy sources, while encouraging where economically feasible and environmentally acceptable, increased utilization of indigenous new and renewable sources of energy. The Act makes provisions for the core functions of the Agency, the following of which are relevant to the project:

- To advise and make recommendations to the Minister regarding any measures necessary to secure the efficient management of energy and the source of energy in the public interest and to develop and encourage the development and utilisation of sources of energy other than sources presently in use.
- To develop a national energy policy and secure its implementation.
- To carry out research into all sources of energy including those sources presently used in Guyana for the generation of energy, and securing more efficient utilisation of energy and sources of energy.
- To monitor the performance of the energy sector in Guyana, including the production, importation, distribution and utilisation of petroleum and petroleum products.
- To disseminate information relating to energy management, including energy conservation and the development and utilisation of alternative sources of energy.
- To study and keep under review matters relating to the exploration for, production, recovery, processing, transmission, transportation, distribution, sale, purchase, exchange and disposal of energy and sources of energy.
- To report and recommend to the Minister measures the Agency considers necessary or in the public interest for the control, supervision, conservation, use and marketing and development of energy and sources of energy.
- To prepare studies and reports at the request of the Minister on any matter relating to energy or any source of energy, including research into alternative sources of energy, or the application of such research, and to recommend to the Minister the making of such arrangements as the Agency considers desirable for cooperation with governmental or other agencies in or outside Guyana in respect of matters relating to energy and sources of energy.
- To advise the Minister or assigned authority on matters relating to the administration and discharge of the functions of the Electricity Sector Reform Act 1999.

The GEA was integral in the conceptualization and development of the project and is the implementing agency responsible for coordination and oversight of the construction phase of the project.

3.4.2.2 Guyana Power and Light Inc.

GPL is a state-owned utility company that engages in power generation, transmission, and distribution in the country. Prior to 1st October, 1999, the company, then named the Guyana Electricity Corporation was wholly owned by the Government and subsequently, a 50/50 equity partnership was established between the Government and a consortium of companies from the United Kingdom and Ireland which brought into being the new Company, GPL. This partnership dissolved in April 2003 and GPL reverted to 100 percent ownership by the Government. This arrangement still stands at present. GPL generates power for transmission and distribution to most of the areas along the coastal plain starting from Essequibo Coast in Region 2 and goes up to Moleson Creek in Region 6. In addition, the islands of Leguan and Wakenaam in the Essequibo River are powered by GPL. GPL supplies all its domestic customers with voltage ranging from 110 to 220 Volts depending on the location. GPL is ISO 9001 certified.¹⁹ GPL has been building its capacity to facilitate grid-tying private solar installations so

¹⁹ GPL. Undated. Who We Are.

as to sell power to the company. Interconnection codes have been prepared by GPL for facilitate such endeavours.²⁰

GPL will be responsible for the construction and maintenance of the new transmission line. In addition, GPL will manage the solar PV plant when it becomes operational.

3.4.3 Public Utilities Commission

The Public Utilities Commission (PUC) is responsible for monitoring and enforcing operators' compliance with commitments to customers. These include commitments emanating from licenses and standard terms and conditions for operations, including operating standards and performance targets and development of expansion plans; the handling of consumers' complaints; and advising the OPM on these issues. The PUC also is responsible for confirming and approving tariffs charged by public suppliers.

3.4.4 Regional Democratic Council of Region 3 and the Leguan NDC

The two main regional and local democratic organs in Leguan, the main beneficiary community, are the RDC of Region 3 and the Leguan NDC. These regional and local organs have already been engaged by the GEA and the GEA has been provided with a formal letter of No-Objection on the development of the Project by the Leguan NDC. These entities have an important role to play as a key stakeholder to be engaged in the planning and implementation of the project. The Ministry of Local Government and Regional Development (MLGRD) has responsibility for overseeing Local Government, which comprises the RDCs and NDCs. Both the RDC and the NDC have issued their 'No Objection' to the project, which are included in Appendix D.

3.4.5 Sea and River Defence Board and the Sea and River Defence Department, Ministry of Public Works

The Sea Defence Board has statutory authority to implement sea defences and to control access to vulnerable coastal lands. The Board headed by a Chairperson and comprises of 19 members, some of whom represent agencies with intersecting mandates such as the National Drainage and Irrigation Authority (NDIA), the Guyana Water Incorporated (GWI), Guyana Lands and Surveys Commission (GLSC), Civil Defences Commission (CDC), National Agricultural Research and Extension Institute (NAREI), RDC Chairpersons, and representatives from the Ministry of Public Works including the Chief Sea and River Defences Officer. Board composition was published in the Official Gazette in October 2021 and membership is valid for a one-year period²¹.

The Board works in collaboration with the Sea and River Defences Department, Ministry of Public Works. The Department oversees implementation of work to maintain, manage and construct sea defences. The Department has field offices to monitor condition of sea defences and oversee works. A field office is located in Leguan.

The Board had provided a 'No-Objection' to the construction and operation of the solar farm on Oakum beach provided that there is compliance with the conditions outlined in the No-Objection (see Section 3.2.3 and Appendix D). Given the shift of the project site the Board subsequently issued another No Objection for the installation of the PV farm at the new site. The 'No Objections are included in Appendix D.

²⁰ GPL. Undated (a). Renewable Energy.

²¹ The Official Gazette (Extraordinary) of Guyana. October 2021. Subsidiary Legislation – Environmental Protection Agency, Trade Union Recognition and Certification Board, Guyana Sea and River Defence.

3.4.6 Guyana Lands and Surveys Commission

The Guyana Lands and Surveys Commission (GLSC) is responsible for administering lands. According to the Guyana Lands and Surveys Act, the functions of the GLSC include:

- Having charge of and acting as guardian over all public lands, rivers and creeks of Guyana.
- Execute or cause to be executed geodetic, topographic, hydrographic and cadastral surveys in relation to the land and water resources
- Establish and maintain the national survey control system, set standards for the collection of photogrammetric data and specify the technical requirements for land surveys.
- Check, approve, record and where required, certify all land surveys carried out in Guyana.
- Provide access to land survey records and related information to any person, class or classes of persons.
- Receive and evaluate offers to purchase or let public lands and to issue grants, leases and permits to occupy such lands.
- Establish and liaise with all agencies involved in the registration and storage of records relating to public land in any tenure.
- Establish and liaise with all agencies to promote and monitor, in relation to public lands, the provision and maintenance of drainage and irrigation systems, access roads and other infrastructure.

The GLSC has issued Permission to the GEA for use of the project site. Given the shift in the project site the GLSC subsequently issued a 'No Objection' to the GEA for use of the area. The GLSC Permission and 'No Objection' are attached in Appendix D.

3.5 International and Regional Framework

3.5.1 Sustainable Development Goals

The Sustainable Development Goals were adopted by all United Nations Member States in 2015 and outline a shared vision for sustainable development. There are 17 specific goals and associated targets for civil society, private sector, and governments to translate into national development plans and strategies towards achieving this shared vision. However, goals 7, 12, 13 and 17 are directly relevant to the Project:

- Goal 7: aimed to ensure affordable and clean energy. It speaks to international cooperation in access to energy, increased energy efficiency and the increased investments in and use of renewable energy towards more sustainable and inclusive communities and resilience to environmental issues such as climate change.
- Goal 12: addressed sustainable consumption and production and is focused on achieving sustainable use and management of natural resources, energy efficiency, sustainable infrastructure, environmentally sound waste management, and a better quality of life. Through sustainable consumption and production strategies and plans, countries aim to reduce future economic, environmental and social costs, strengthen economic competitiveness and reduction in poverty.
- Goal 13: addressed climate change and how affordable, scalable solutions can enable countries to leapfrog to cleaner, more resilient economies for example, through renewable energy and a range of other measures to reduce emissions and increase adaptation efforts and move toward a low-carbon economy.
- Goal 17: underpins a successful sustainable development agenda through partnerships between government, the private sector and civil society at all levels. It emphasized that strong international partnerships are required to ensure countries achieve the SDGs.

3.5.2 United Nations Framework Convention on Climate Change and Paris Agreement

The United Nations Framework Convention on Climate Change (UNFCCC) was entered into force in 1994 to achieve stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. In 2015, Parties to the UNFCCC produced the Paris Agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon the Convention. Importantly, countries committed to Nationally Determined Contributions to support reach the objectives of the Convention and the Paris Agreement. The provisions of Guyana's Nationally Determined Contribution are discussed in Section 3.1.10. The Mahdia Solar Farm Project is expected to contribute to achieving these targets.

Article 6 of the Paris Agreement allows countries to cooperate with each other to achieve the climate change mitigation targets outlined in their NDCs. The article facilitates direct bilateral cooperation between parties where emission reduction measures in one country may be transferred to another country to be counted in its Nationally Determined Contribution. Alternatively, Parties to the Paris Agreement may participate in a sustainable development mechanism which will be supervised by an independent body which will verify the results of emissions reductions measures. Non-market-based approaches for cooperating to achieve the Nationally Determined Contribution targets are also being developed under the Paris Agreement²². In the longer-term, there may be an opportunity in the future to cooperate with other countries on the basis of the emissions reductions which may be achieved by generating electricity from this project.

3.5.3 The CARICOM Energy Policy²³

The CARICOM Energy Policy aims to see a fundamental transformation of the energy sectors of Member States through the provision of secure and sustainable supplies of energy, whilst minimizing energy waste in all sectors, and ensuring all citizen have access to affordable and stable, modern, clean and reliable energy supplies, and to facilitate the growth of internationally competitive Regional industries towards achieving sustainable development of the Community. The policy charts 15 broad policy actions that encourages a new climate-compatible development path that harnesses diverse domestic renewable energy resources, minimizes environmental damage, and spurs social opportunity, economic growth, and innovation. With respect to renewable energy, the policy is to diversify the energy sources through the increased use of renewable energy.

3.5.3.1 The Caribbean Sustainable Energy Road Map and Strategy

In order to translate the policy actions of the CARICOM Energy Policy, the CARICOM Secretariat commissioned the Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS), designed to build on existing efforts in the region and to provide CARICOM member states with a coherent strategy for transitioning to sustainable energy. C-SERMS provides the basis for a more targeted approach to advancing sustainable energy development under the regional policy and in so doing acts as a framework for articulating, monitoring and adjusting regional level strategies, and for securing commitments from Member States towards achievement of the targets that are established. C-SERMS suggests a regional target of 48 percent of installed power capacity by the year 2027. Regional renewable energy capacity shared targets include 20 percent by 2017, 28 percent by 2022, and 47 percent by 2027. C-SERMS also recommended a 33 percent reduction in energy intensity to be applied evenly across all member states

3.5.4 International Solar Alliance

²² UNFCCC, 2016. The Paris Agreement, Article 6.

²³ CARICOM, 2013. The CARICOM Energy Policy. Page 28.

The International Solar Alliance (ISA) is a collaborative platform to increase the deployment of solar powered technologies in tropical, developing countries. It is a joint initiative by the governments of India and France and was conceptualized in 2015 on the sidelines of the historic 21st meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change. The ISA aims to increase access to solar technology, promote energy security and drive the energy transition to low-carbon growth trajectories. Although all member states of the United Nations are eligible to join the ISA priority interventions are largely focused on states which are categorised as Least Developed Countries (LDCs) and Small Island Developing States (SIDS). There are 102 signatories to the ISA and 81 member states. Guyana has ratified the ISA and is a member country.²⁴

In 2021, the GoG signed a Grant Agreement with the ISA for a 9kW grid-tied solar demonstration project and a 37kWh battery energy storage at the Orealla Health Centre in Region 6. In January 2022, a contract valued GYD \$ 9,649,932 was signed between the GEA and a contractor for supply of materials, installation and commissioning of the project.²⁵

3.6 Other Codes and Guidelines

3.6.1 GPL National Grid Code

The National Grid Code prepared by the GPL outlines the objectives of the general conditions to ensure, as far it is possible, that the various sections of the grid code work together for the benefit of GPL and all users and to provide a set of principles governing the status and development of the grid code and related issues as approved by regulatory authority. The GPL National Grid Code is comprised of five distinct Codes as follows:

- **Planning Code:** The Planning Code defines the criteria and procedures employed by GPL in evaluating the performance of its power system and the reinforcements necessary to maintain reliability. The overarching objective of the Planning Code is to set the minimum planning criteria that will be used as the basis for the expansion of the transmission network to reliably attend current and future loads while taking into account the need to minimize operating costs and capital investments.
- **Interconnection Code:** The Interconnection Code defines the requirements and processes that any Independent Power Producers or GPL Generation Projects must comply with to interconnect new (or modified) generation to the GPL System. The Interconnection Code objective is to ensure that the interconnection of the new (or modified) generation is accomplished in a manner that maintains the reliability of the GPL System and is in compliance with GPL Planning Code, the Minimum Technical Requirements and Operations Code. The Interconnection Code also aims for providing standardized and transparent bases for interconnecting new (or modified) generation to the GPL System, including required network upgrades and their cost allocation. The Interconnection Requirements also requires compliance with international standards including the NEC and IEEE discussed in Section 3.6.2 to 3.6.4 below.
- **Operational Code:** The Operational Code includes the criteria, procedures and information requirements necessary to execute the operational planning, the generation dispatch and coordination supervision and control of integrated operation of the GPL System. The Operational Code will also define the procedures for the reporting and information exchange between the different entities connected to the GPL System. The Operational Code takes into consideration that new generation will be added to the system in compliance with the Interconnection Code.

²⁴ International Solar Alliance. Undated. About ISA

²⁵ Guyana Energy Agency. 2022. Contract Signing for the Solar PV Demonstration Project at the Orealla Health Centre.

- **Minimum Technical Requirement Code:** The Minimum Technical Requirements (MTRs) Code defines the technical specifications and requirements that must be complied with by any new generation facility that will interconnect to the GPL System. This code is critical for Renewable Generation Facilities (RGFs), since there are specific technical requirements that are required to address RGFs inherent variability, uncertainty, and limited dispatchability. On the other hand, complying with the MTRs for conventional generation resources is normally less challenging. However, they must also comply with the MTRs.
- **Metering Code:** All active and reactive power entering or exiting the transmission system and distribution systems shall be metered using one or more metering systems. Electricity delivered to consumer premises shall also be metered. Hence, the Metering Code defines the regulations and technical aspects related to metering within the GPL System.

3.6.2 NFPA's National Electrical Code (NEC)²⁶

The National Fire Protection Association (NFPA) is a US-based global self-funded non-profit organization, established in 1896, devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The NFPA publishes more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. NFPA codes and standards, administered by more than 250 Technical Committees comprising approximately 8,000 volunteers, are adopted and used throughout the world. The NFPA 70: National Electrical Code (NEC) is one such code which is used by countries around the world as the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards. Solar PV installations must be compliant with the NEC, particularly, but not limited to, Article 690 and Article 705.

3.6.3 Relevant Standards of the International Electrotechnical Commission²⁷

The International Electrotechnical Commission (IEC) was founded in 1906 in the United Kingdom with the goal of making electrical and electronic technologies safer, more efficient and reliable. It is a global, not-for-profit membership organization, whose work underpins quality infrastructure and international trade in electrical and electronic goods. The IEC brings together more than 170 countries and provides a global, neutral and independent standardization platform. It administers four conformity assessment systems whose members certify that devices, systems, installations, services and people work as required. The IEC publishes International Standards which together with conformity assessment provide the technical framework that allows governments to build national quality infrastructure and companies of all sizes to buy and sell consistently safe and reliable products in most countries of the world. IEC International Standards serve as the basis for risk and quality management and are used in testing and certification to verify that manufacturer promises are kept. Relevant Standards of the IEC to which the project should comply include IEC61215, IEC61730, *IEC 61850 and IEC 61701 among others*.

3.6.4 Relevant Standards of the Institute of Electrical and Electronics Engineers

The Institute of Electrical and Electronics Engineers (IEEE) is an association dedicated to advancing innovation and technological excellence to serve professionals involved in all aspects of the electrical, electronic, and computing fields and related areas of science and technology. IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity. Further, all interconnection equipment (inverters, charge controllers, etc.) must conform with the IEEE 1547 and be listed under the UL 1741 Standard. Additional relevant standards of the IEEE to which the project

²⁶ NFPA, 2020. NFPA 70 ® - National Electrical Code ®

²⁷ IEC, 2021. Who We Are; What We Do.

should comply includes IEEE C57.12.00, IEEE C57.12.34, IEEE C57.12.28, IEEE C57.12.29, IEEE C57.12.70, IEEE C57.12.80, IEEE C57.12.90 and IEEE C57.91 among others.

4.0 PROJECT ENVIRONMENT

The project site is located on the north-eastern coast of Leguan Island in the Essequibo River immediately west of a beach. Initially, the backshore of the beach was identified as the project site but concerns pertaining to shoreline protection and erosion resulted in an immediate westward shift of the project site. Thus, a section of the western boundary of the previous project site now forms the entirety of the eastern boundary of the new site. The environment around the site previously earmarked for development as well as the new project location can be seen in Figure 4-1. The new project site occupies an area of 1 hectare (2.48 acres) located approximately 60 to 80 meters from the shoreline. The project site is shown in Figure 4-2.

Previously, the shoreline in this area was located along the boundary of the new project site but the beach developed over time as a result of the accretion of sandy deposits. The shoreline of the project area, and of Leguan as a whole, is dynamic and fluctuates based on a cycle of erosion and accretion. The sandy deposits on the beach are stabilized by primary vegetation comprising scrubs and coconut trees. According to local stakeholders and observations in October 2021, erosion of some sections of the beach is occurring. In 2020, emergency sea defences were installed to a section northeast of the beach because of erosion was accelerating (*EMC Personal Communication 11 – Interview with the Chief Sea and River Defences Officer*).

The solar farm will be connected to the Leguan Power Station via a new transmission line. The transmission line will cover a distance of approximately five kilometers. It will follow the route of existing transmission line from Canefield to the Leguan Power Station. Sections of the alignment is shown in Figure 4-3. A new section of the transmission line will be required leading from the end point of the existing alignment in Canefield to the solar power plant. The new sections of the transmission line will not overlap privately used lands.

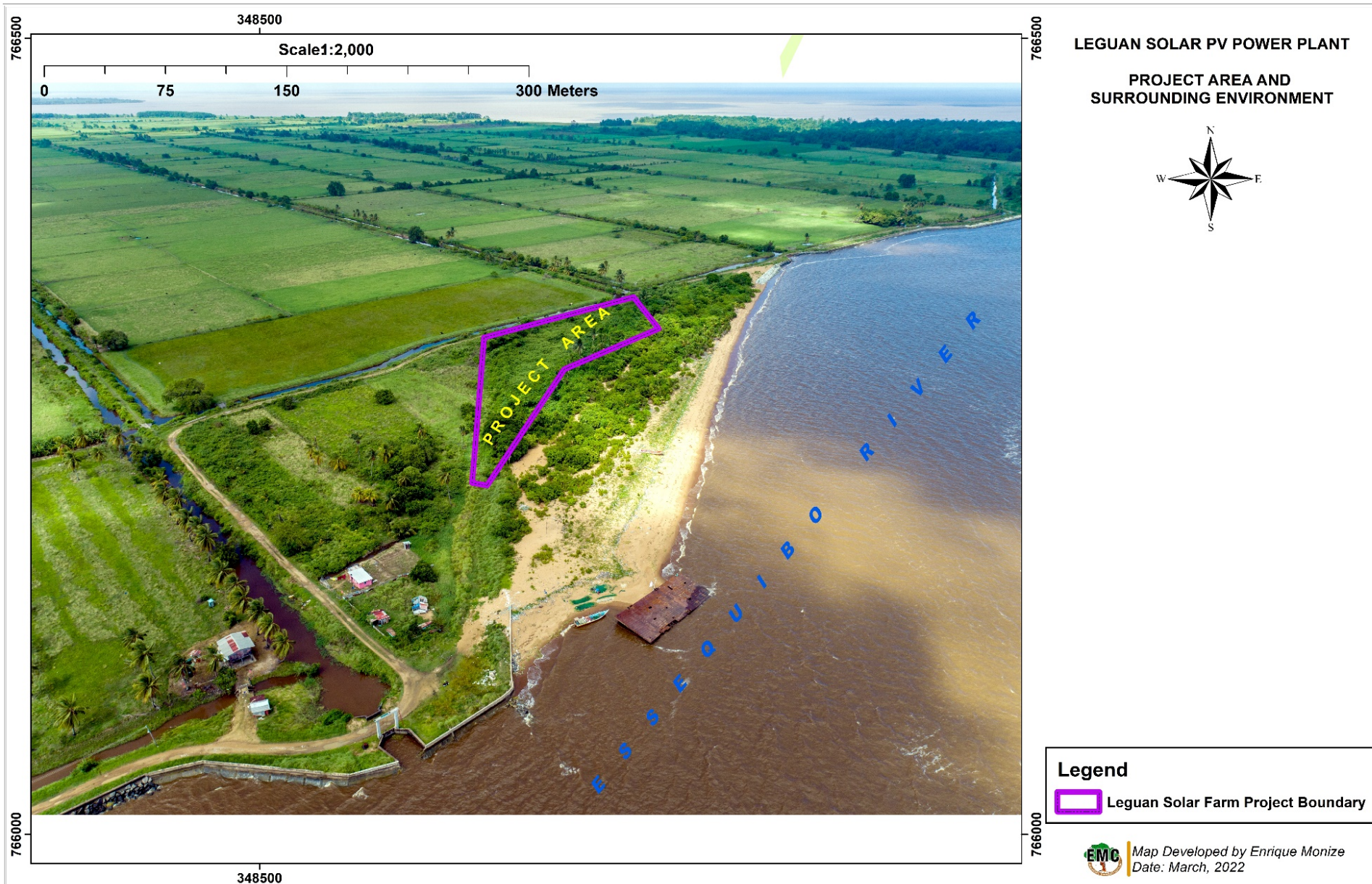


Figure 4-1: The Project Site and the Wider Environment Around



Figure 4-2: The Project Site



Figure 4-3: Sections of the Transmission Line Alignment

4.1 Physical Environment

This section describes the geological, topographical, soil and hydrological conditions at the project site based on expert observations during field exercises and a review of relevant literature. It also presents the findings of baseline assessments of surface water quality, ambient air quality and ambient noise levels at sampling locations proximate to the project site.

4.1.1 Geomorphology

The Island of Leguan is located in the estuary of the Essequibo River. The Essequibo River rises in the Acarai Mountains, located along Guyana's southern border with Brazil. Among its tributaries are several of Guyana's major Rivers including the Rupununi, Mazaruni, and Cuyuni. As a result, this river system drains more than half of Guyana. From its source, the Essequibo River flows northward for approximately 1,010 kilometers through savannahs and forests towards the Atlantic Ocean transporting large volumes of silt to the mouth of the River. The Essequibo River reaches the Atlantic Ocean approximately 21 kilometers west-northwest of Georgetown. There are 365 islands in the Essequibo and 3 of the largest islands namely, Wakenaam, Leguan and Hogg create a large tongue in the mouth of the River. The mouth of the Essequibo River is approximately 32 kilometers wide.

The project site is located in Guyana's Low Coastal Plain, a narrow belt extending along the entirety of Guyana's coast (ranging between 8 and 65 kilometers in width) stretching from the Corentyne River in the east to Waini Point in the west. It forms part of the uninterrupted low and wet coastal area of the Guianas that ranges from the Orinoco delta to the mouth of the Amazon River. Although the southern regions of Guyana are located in the Guyana Shield, the Low Coast Plain is situated in the northern margins of the Guyana Shield. The geomorphology of the wider project area is influenced by its location on the Low Coastal Plain. The areas of the Plain situated east of the Essequibo River consists of recent and old sediments with recent deltaic and fluvio-marine clays and silts occurring on the coast with silty clays and sands inland. The recent plain occurs at elevations of two meters below to three meters above sea level with sandy old beach ridges forming higher ground. The older coastal plain lies at an altitude of about three to nine meters above sea level. The normal tidal range is approximately three meters and thus, sea defences as well as drainage and irrigation infrastructure are required to for coastal protection. West of the Essequibo River the coastal plain narrows with extensive organic wetland 'pegasse' deposits inland. While these are most extensive in the west of the country, (Regions 1 and 2) they also occur scattered between the Essequibo, Demerara and Berbice Rivers. East of the Berbice River the pegasse area is small and the coastal 'frontland' and 'riverain' clays relatively wide.²⁸

Sediment deposits transported by the Essequibo River play a crucial role is the local geology of the project area. Deposition and accretion of these materials over time are expected to have been the primary forces that led to the formation of the islands of the Essequibo. Shoreline areas of the Low Coastal Plain, including the Island of Leguan and the project area, are characterized by the following:

- **Marine Tidal Clay Flats and Marshes:** Clay flats and marshes develop as a result of accretion from mudbanks. As accretion continues to build landmasses and clay flats become cut off from marine waters and desalinated, they would transform into clay marshes with freshwater forests or grass swamps covered with pegasse. Tidal marshes with mangrove growth are located well north of the project site.
- **Peat Swamps:** Peat swamps typically form above tidal clay flats. There have very poor drainage conditions and lead to the formation of homogeneous peats with swamp vegetation.
- **Natural Levees of the River and Estuaries** – Natural levees and estuarine conditions occur in the broad to narrow bands that run along the banks of rivers. Generally, these are mainly silty clay and are higher than the mean high tide levels.
- **Beach Ridges:** Beach ridges are created from narrow elongated ridges of sand or shells as a result of constant deposition from constructive waves that rise approximately two to four metres above the mean sea level. Following a cycle of coastal erosion, ridges tend to form along the edge of clay flats. According to the Sea and River Defence Board, the shoreline of the project area was, historically, immediately adjacent to the project site. As such, the beach located east of the project site was the cumulative result of the accretion of sandy materials (*Personal Communication 11 – Interview with the Chief Sea and River Defences Officer*). Moreover, bars of reef sand are known to occur in inland areas of Leguan including in the pasture lands located west of the project site (*Personal Communication 04 – Interview with Zakir Khan*).

4.1.2 Topography

The project site is generally flat and is located below sea level. A ground survey was conducted on backshore of the beach (previously identified as the project site) by the Consultant's team on October 20, 2021 to support a flood risk assessment. The survey established benchmarks (high-water mark

²⁸ Guyana Lands and Surveys Commission, 2013. National Land Use Plan. Page 21

and low-tide water levels) and survey points relative to the layout of the previous project site (Figure 4-4). The survey focused largely on the southern section of the beach because dense vegetation cover constrained access to survey point D. The survey was performed from point A and C then down to the high-water mark (HT) and low-tide water level (WL) marks to capture the change in terrain. For the northern points, the survey included measurements of point D to WL for references purposes.

The survey found relatively consistent variations in terrain in both the southern and northern sections of the beach backshore. The elevation difference of points C and D from the water level at the time of was approximately 2.97 meters and 2.88 meters respectively. The elevation change between the low-tide water levels and survey points was the main change of elevation found by the survey.

On February 09, 2022, the Consultant's team visited the new project site with the objective of conducting visual observations of any topographical changes between the previous and new project sites. The variances in elevation found in the 2021 survey between the water level relative to points C and D suggest that the southern sections of the backshore may be slightly higher than the northern sections. The survey also found that point A, located along the south-eastern boundary of the new project site, was 0.43 meters lower in elevation than point C. Visual observations of elevation differences between the backshore of the beach and the new project site indicate that the latter is approximately equivalent to the elevation of the beach foreshore. Therefore, allowing for slight variations in elevation along the backshore in a north to south orientation, the new project site is approximately 2.5 to 3 meters lower than backshore. Finally, based on visual observations, some sections of the sea dam west of the project site are approximately 1 meter higher than the project site. Thus, the depression of the project site relative to surrounding lands and the presence of ditches on its southern boundary (see Section 4.1.5) have created conditions that are akin to a swale where drainage is limited.

The new transmission lines will be erected in areas that are flat and located below sea level. The existing transmission line alignment is also situated on flat lands that generally below sea level. Hard sea defence structured are installed along most sections of the shoreline between Canefield to the Leguan Power Station.

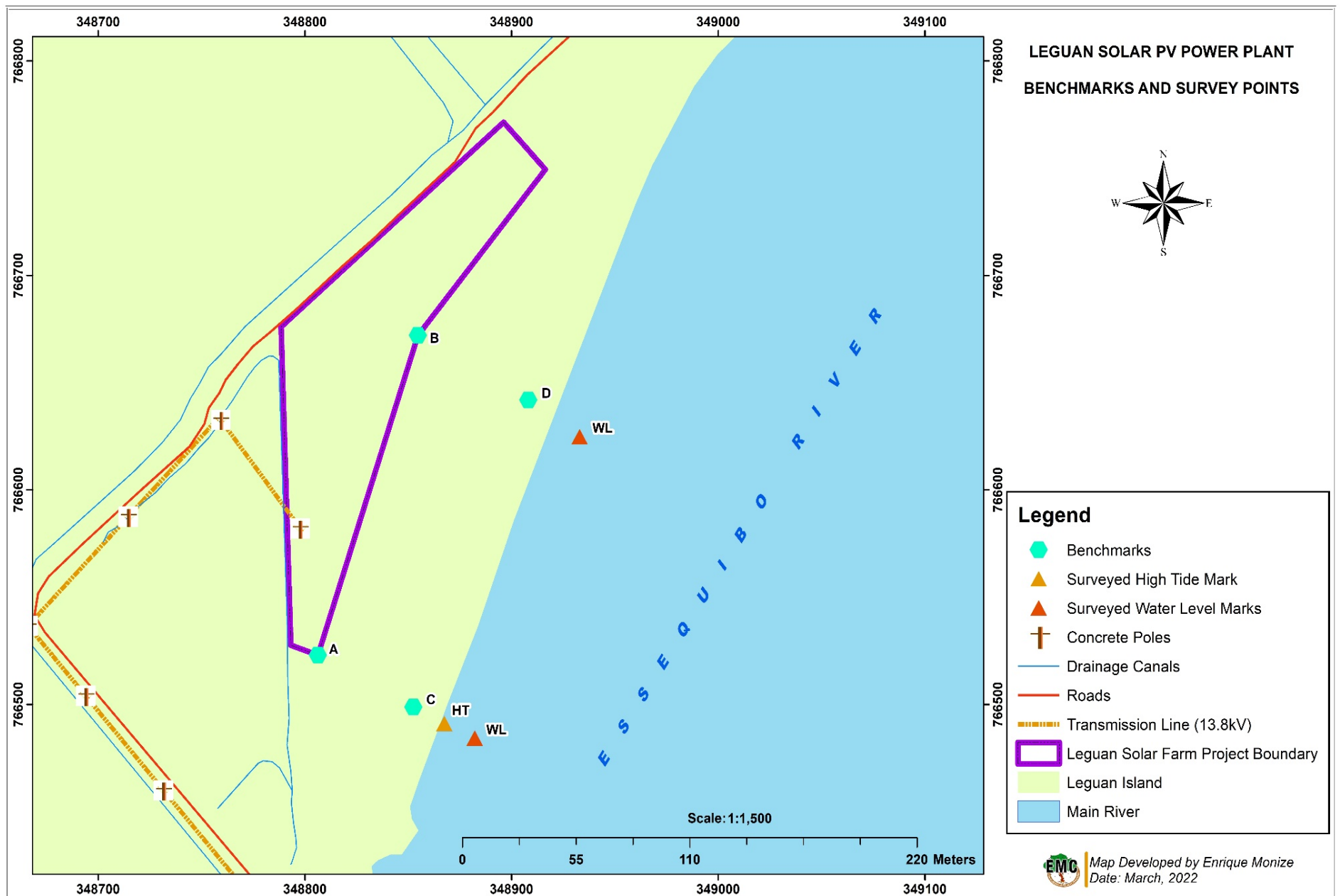


Figure 4-4: Ground Survey Benchmarks and Survey Points of Previous Project Site

4.1.3 Soils

Soils characteristic of the Coastal Plain are silty with clayey loams developed from a mix of fluvial deposits²⁹. The soils developed from recent and old sediments with deltaic and fluvio-marine clays and silts occurring on the coast with silty clays and sands inland. In Leguan, the accretion of sediment deposits from the Essequibo River created several beach areas including the High Sand Beach on the north-western shore of the island, the Dauntless Beach on the north-eastern shore, and the small beaches in Waterloo and Phoenix which appear only during low-tide.

Base soils at project site and the transmission line alignment are located on only one soil type namely, *1a. Fertile Low Humic Gleys - Frontland Clays*³⁰ mapping unit. This mapping unit can be found on the Coastal Plain of eastern Guyana from the Essequibo to the Corentyne Rivers. It generally contains relatively fertile, but poorly drained clay soils that developed on unconsolidated sediments with associated sandy 'reefs' that are old beach ridges. Some saline soils and organic 'pegasse' soils can also be found in patches. These soils are typically used for rice and sugar plantations along with coconut cultivation on the sandy reefs. Where there are no agricultural developments, the vegetation comprises mangrove, swamp forest and marshy grassland. These soils have a land capability classification of I-II which means that they are considered relatively fertile agricultural soils.⁶ The key characteristics of the 1a mapping unit are presented in Table 4-1 below.

Table 4-1: Characteristics of Soil Mapping Unit 1a (Fertile Low Humic Gleys - Front land Clays)

Soil Class*	Texture	Depth	Drainage	Fertility	Erosion Hazard	Land Capability	Limitations
Sulfaquents, Fluvaquents	C-ZC (SSL)	Deep	Poor	Medium to High	None	I-II	Drainage, (Salinity, Toxicity (AcS))

**According to the soil units and capability identified by the United Nations Food and Agriculture Organisation (FAO) as presented in the National Land Use Plan.*

A map of the soil types of the wider project area is presented in Figure 4-5.

²⁹ Government of Guyana. 2019. Green State Development Strategy. Annex A–Sustainable Management of Natural Resources. Page 7

³⁰ Guyana Lands and Surveys Commission. 2013. National Land Use Plan. Pages 36 to 40

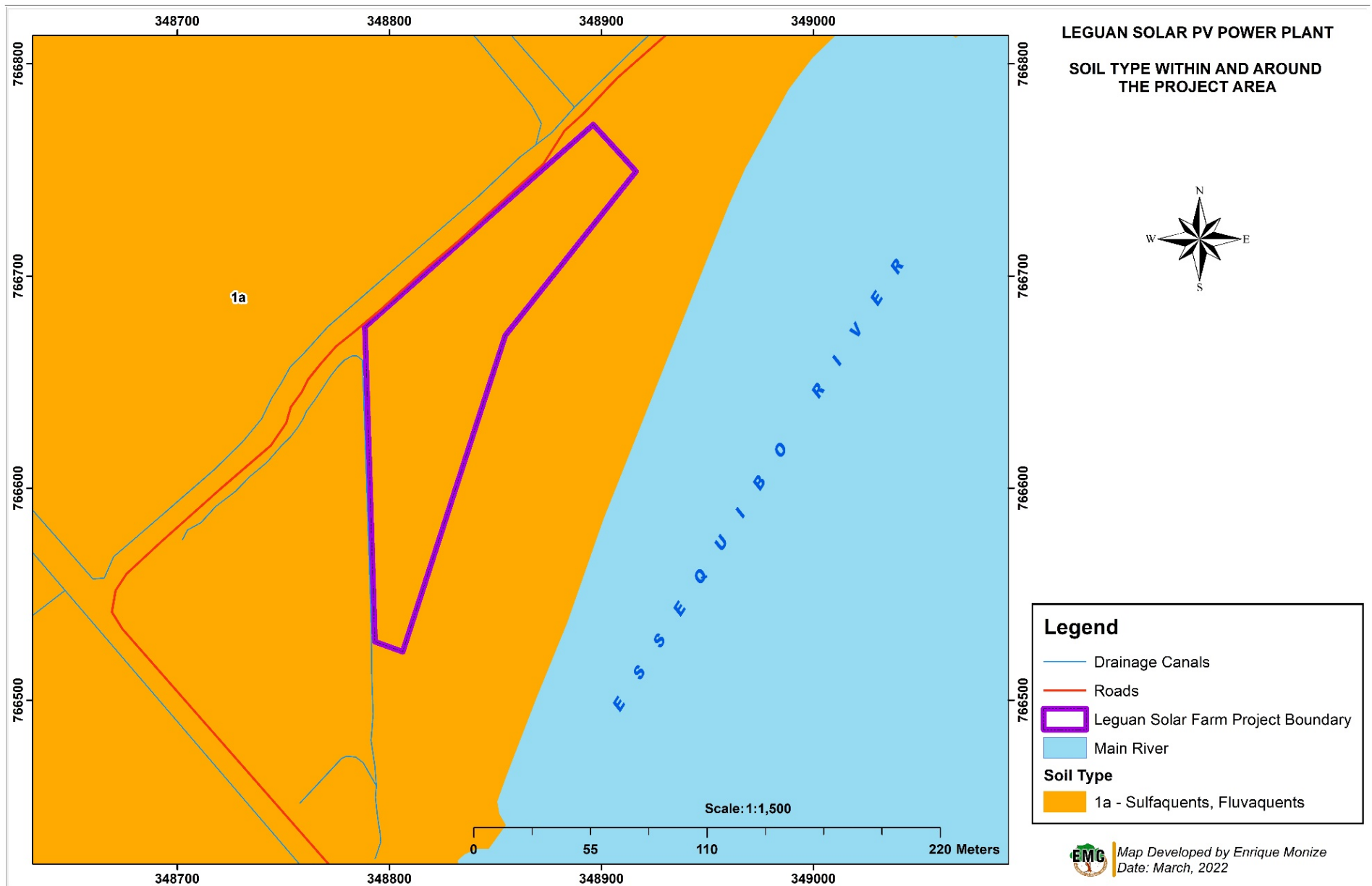


Figure 4-5: Soil Type of the Wider Project Area

4.1.4 Erosion and Accretion

The brown sand deposits constituting a large portion of the beach east of the project site is the result of accretion over time. The dynamic nature of the shoreline area over the last two decades is observed in satellite imagery available via Google Earth. As seen in Figure 4-6, the beach did not exist approximately two decades ago and the shoreline was almost immediately east of the project site. Significant accretion over the next decade established the brown sand area although along some sections may have still been inundated during high-tides (Figure 4-7 and 4-8). Over time, vegetative cover on the beach increased and this may have contributed to site stabilization and encouraging further accretion as observed in 2019 (Figure 4-9). As a consequence, this sandy beach is the buffer between project site and the shoreline.

According to locals, the erosion phase of the erosion-accretion cycle has commenced in recent years with the observable evidence such as the washing away of coconut trees which had grown along the shoreline during the accretion phase (Figure 4-10 [Left]). In 2021, a boulder face was constructed as part of emergency sea defences, in response to accelerating erosion, northeast of the beach (Figure 4-10 [Right]). Currently, there are no hard structures along the shoreline of the beach. Given the dynamic nature of the shoreline to the influences of the erosion and accretion cycle, the washing away of the beach in the long-term may occur if no hard structures are installed particularly given that erosion appears to be accelerating along the shoreline.

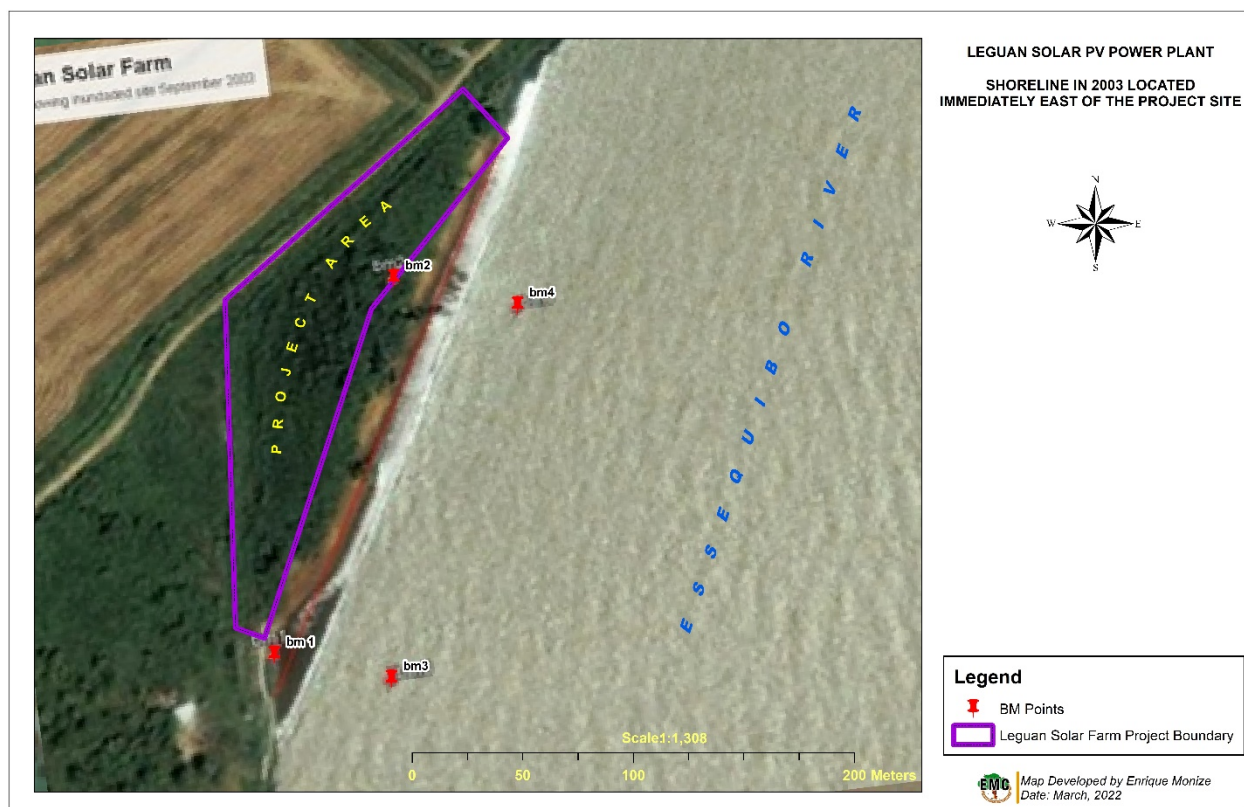


Figure 4-6: Shoreline in 2003 located Immediately East of the Project Site

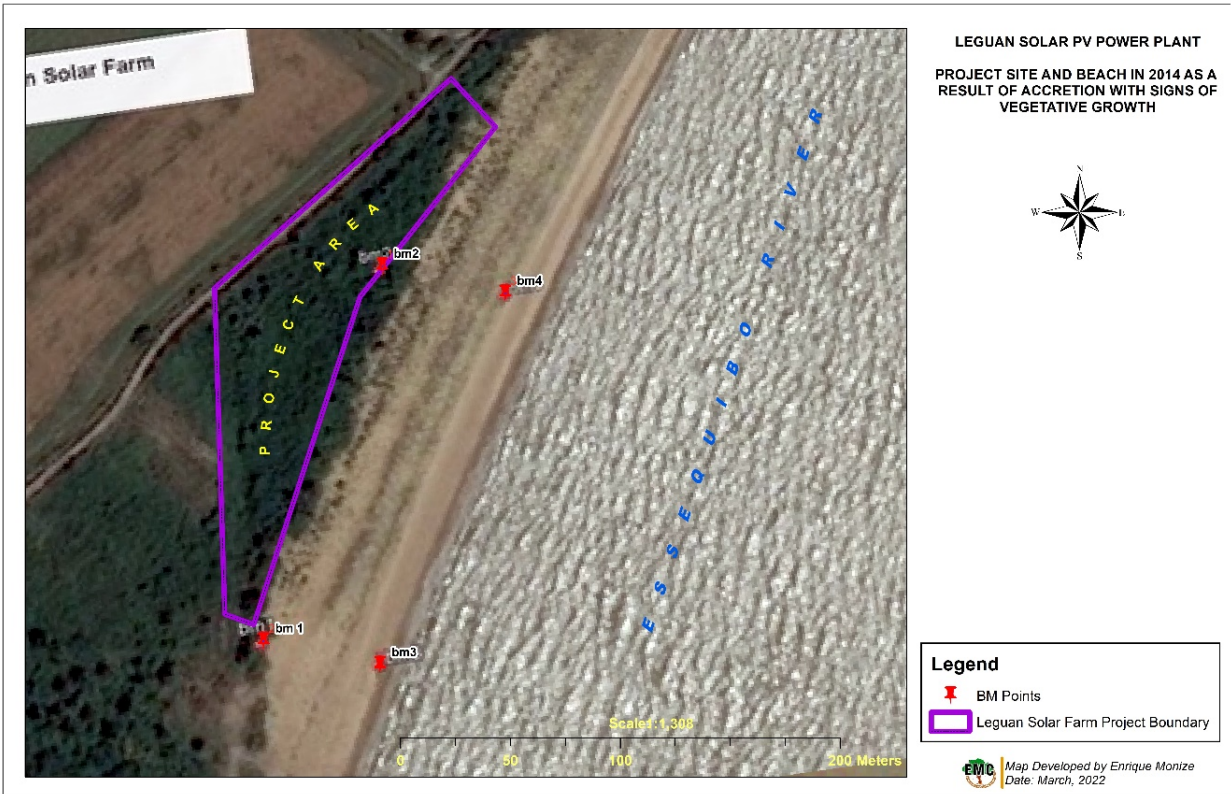


Figure 4-7: Project Site and Beach in 2014 as a result of Accretion with Signs of Vegetative Growth

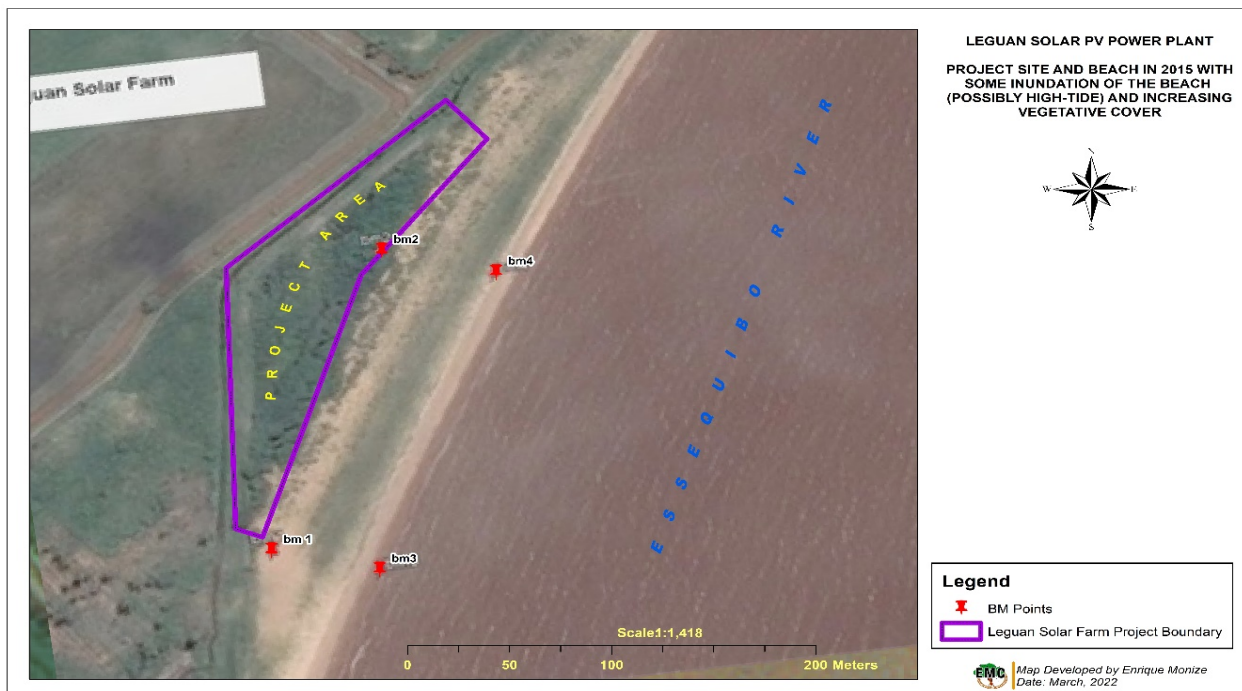


Figure 4-8: Project Site and Beach in 2015 with Some Inundation of the Beach (Possibly High-Tide) and Increasing Vegetative Cover

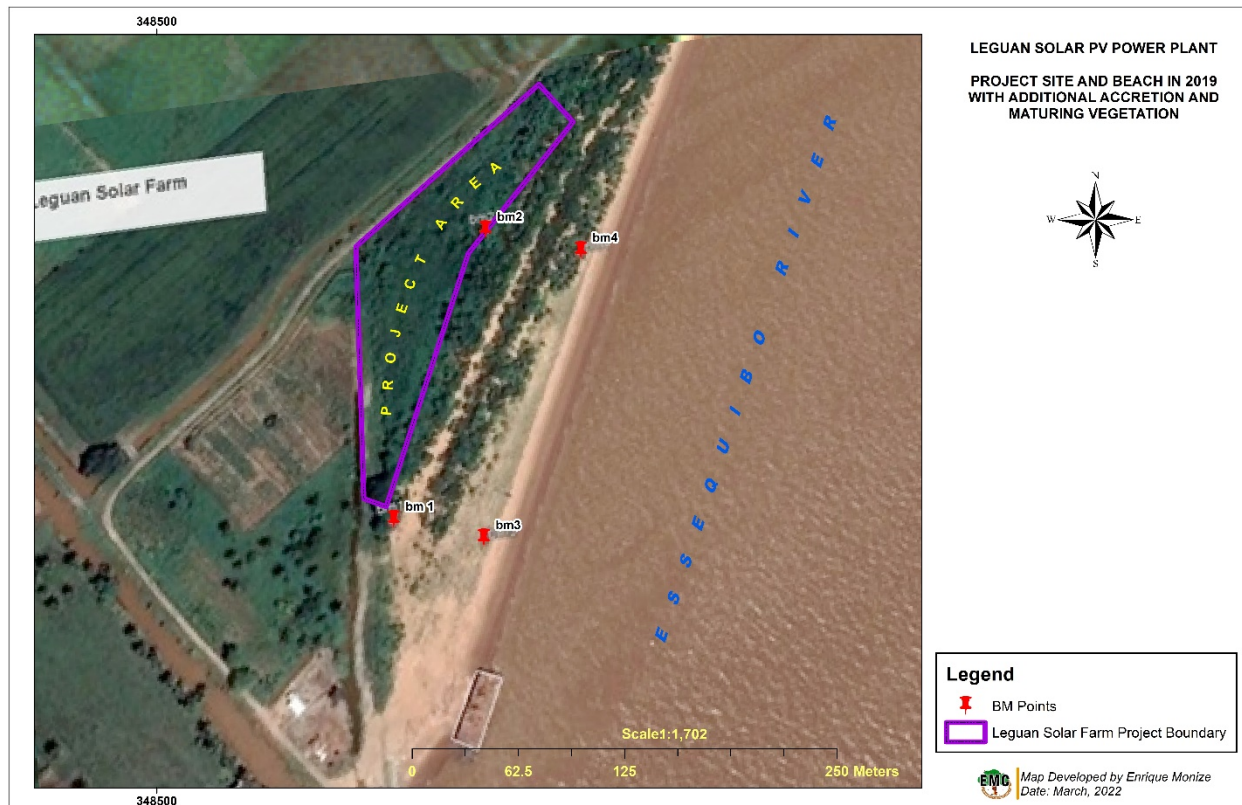


Figure 4-9: Project Site and Beach in 2019 with Additional Accretion and Maturing Vegetation



Figure 4-10: Erosion of Coconut Trees (Left) and Boulder Face along the Northern Boundary of the Project Site (Right)

4.1.5 Surface Hydrology

There are no waterways within the project site. Two ditches run along the southern boundary of the project site. The first is located along the south-eastern boundary and was overgrown with weeds during site visits conducted in October 2021 and February 2022 (Figure 4-11). This ditch extends in a south-eastern direction running parallel with the Government reserve lands. There is no visible drainage outlet and swampy conditions were observed at the eastern most end of this canal within the government reserve lands. The second ditch commences along the south-western boundary and continues along a section of the western boundary of the project site. Similarly, there is no discernable

drainage outlet for this section ditch. As a consequence, these ditches are seemingly holding ditches particularly for runoff during rainfall periods.

Further south of this small ditch, is a major drainage canal which runs in an east-west orientation (Figure 4-12). This canal discharges into the Essequibo River via a self-acting koker (Figure 4-13).

An extensive network of smaller canals, which provide drainage and irrigation for lands used as animal pastures and crop cultivation in the wider project area, are connected to the major canal. One of these smaller canals is located adjacent to the western boundary of the project site (Figure 4-12). Moreover, the small ditch located along the project site's south-western boundary is also connected to the major canal by a small drain.



Figure 4-11: Over-Grown Ditch Parallel to South-Eastern Boundary



Figure 4-12: Major Drainage Canal in the Wider Project Area



Figure 4-13: Self-Acting Koker



Figure 4-14: Canal West of the Project Site

The project site is drained via the canal located to the west of the site. This canal then flows into the main drainage canal located to the south of the site. The main drainage canal discharges into the Essequibo River via a sluice. Figure 4-15 shows the drainage network of the project site.

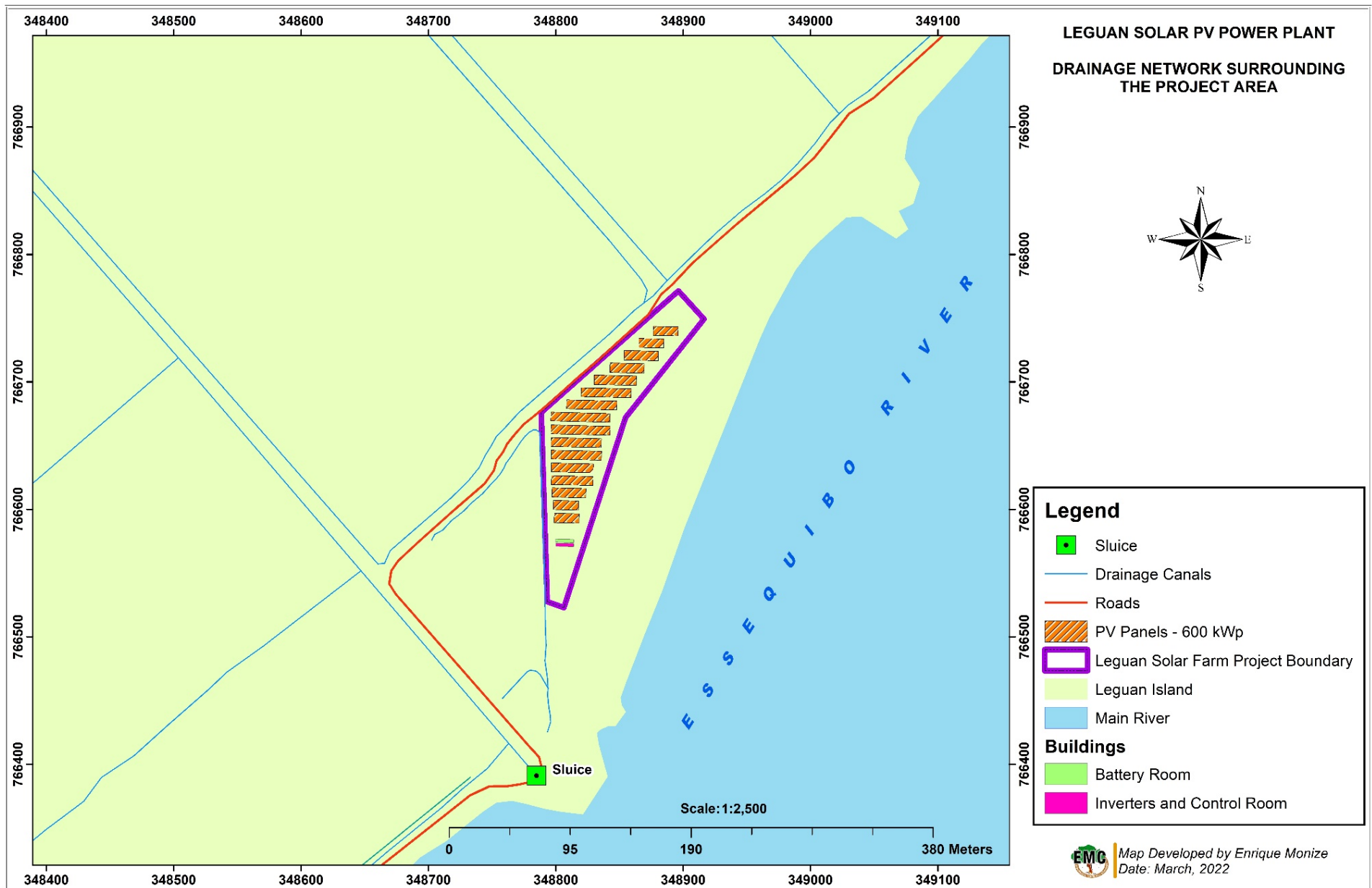


Figure 4-15: Drainage Network of the Project Area

4.1.6 Climate

4.1.6.1 National Climate Profile

Guyana is classified as a tropical rainforest country. It is located north of the equatorial line and is characterized by warm temperatures all year round. The weather is influenced by the Inter-Tropical Convergence Zone (ITCZ) which is a belt of low pressure that circles the earth at the equator. This zone is at a convergence point for trade winds of the Northern and Southern Hemispheres. This creates a zone of rain-bearing clouds and causes a great amount of precipitation. There are two different seasons observed in Guyana which are the wet and dry seasons. These two seasons are further divided into the primary and secondary seasons. During the mid-April to the end of July Guyana experiences a primary wet season. The secondary wet season would then occur from mid-November to January. The intervening periods are the primary and secondary dry seasons respectively. There is precipitation during all seasons. However, during the wet season this is more intense. On average annual rainfall ranges between 1,600 to 3,000 millimeters with spatial variation of rainfall across the country.³¹

Ambient temperatures in Guyana range between a low of 16 degrees Celsius and a high of 34 degrees Celsius. Temperatures would seldomly exceed these ranges. However, at higher altitudes in Guyana it is normal to experience lower temperatures. Wind speeds on Guyana's coastal regions ranges between 4.4 and 13.5 kilometers per hour. Wind speed would decrease at inland locations.

Guyana's climate is also influenced by the El-Niño Southern Oscillation (ENSO). During El Niño phenomena, precipitation is lessened and air temperatures are warmer. From 1997 to 1998 and 2015, El Niño episodes triggered extreme drought events in Guyana. By contrast, La Niña episodes are accompanied by wetter conditions and cooler temperatures and have been linked to flood events in Guyana. ENSO varies on an inter-annual basis in Guyana but its occurrence has been non-linear.³²

4.1.6.2 Climate Profile of the Project Site

To get an understanding of the prevailing climatic conditions on the island of Leguan, precipitation data was collected from the Ministry of Agriculture, Hydrometeorological Department. The Department collects data from a rain gauge. Data were collected for the period from January 2011 to September 2021. However, there were significant gaps in the dataset. In order to manage these gaps, mean monthly precipitation was assessed. Based on the analysis, Leguan has a bimodal precipitation regime. There are distinct seasonal patterns were very similar to patterns established in Guyana's Second National Communication to the UNFCCC with two wet and two dry seasons. The primary wet season occurs from May to July while the secondary wet season occurs from November to January. The primary and secondary dry season occurs from August to October and February to April respectively.

Figure 4-16 shows the monthly mean levels of precipitation observed for the periods for which data is available. The highest levels are observed during the primary wet season between May to July with the highest mean monthly rainfall recorded during May with an average of 352 millimetres. The secondary dry season had the lowest mean rainfall with the driest month being October with 89.4 millimeters of rainfall on average.

³¹ Government of Guyana, 2012. Second National Communication to the United Nations Framework Convention to Climate Change; Page 53

³² Government of Guyana, 2012. Second National Communication to the United Nations Framework Convention to Climate Change; Page 177

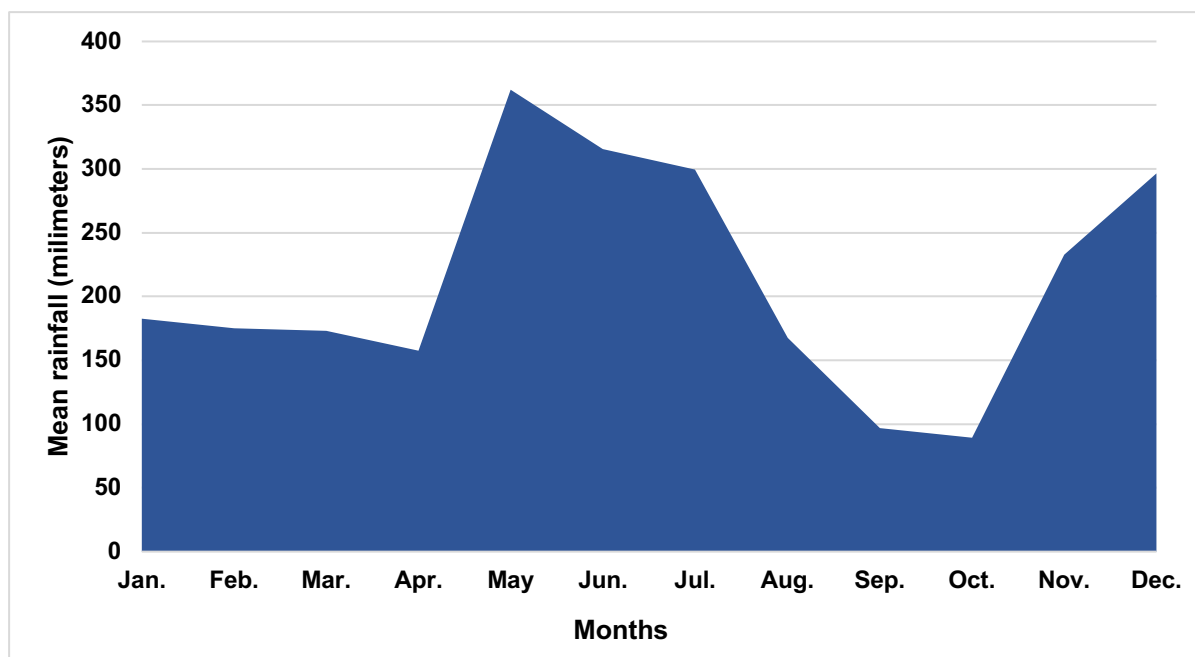


Figure 4-16: Mean Monthly Rainfall on Leguan

There were no sunshine, solar radiation or cloud-related data collected by the Hydrometeorological Department for Leguan. However, there is an established positive relationship between rainfall and cloud cover while a negative relationship exists with sunshine and cloud cover³³. As such, cloud cover during the wet seasons can affect the productivity of the solar panels during the primary and secondary wet seasons.

Due to the relative closeness to the equator of Guyana, there is also a minute variance of sunrise and sunset with there being on average a 12-hour period of sunshine with a variance of plus or minus 25 minutes. Since Guyana is in the northern hemisphere the longest day of sunshine is typically experienced on June 20 with an average of 12 hours and 26 minutes of sunlight. On the other hand, the shortest day is generally experienced on December 21 with an average of 11 hours and 49 minutes of daylight.

However, Leguan has significant potential for converting solar power to electricity. According to the Global Solar Atlas (version of July 2021)³⁴, Leguan's annual potential for solar powered electricity is as follows:

- Specific PV power output: 1629.9 kWh/kWp
- Direct normal irradiation: 1697.9 kWh/m²
- Global horizontal irradiation: 2034.4 kWh/m²
- Diffuse horizontal irradiation: 816.1 kWh/m²
- Global tilted irradiation at optimum angle: 2053.2 kWh/m²
- Optimum tilt of PV modules: 9/180°

³³ Rokonzaman, Md, Rahman, M.M. 2017. Effect of Cloud Coverage on Sunshine, Humidity, Rainfall and Temperature for Different Weather Stations in Bangladesh: A Panel Analysis.

³⁴ World Bank Group. July 2021. Global Solar Atlas.

4.1.7 Surface Water Quality

To gain a better understanding of the water quality within and around the project site, water quality sampling and analyses were conducted.

4.1.7.1 Methodology

Water quality analysis was conducted for the three surface water bodies around the previous project site namely the small ditch at the south-eastern boundary of the project site, the canal west of the project site and the Essequibo River. These sample locations are also relevant to the new project site. Two sets of samples were collected for each sampling location as follows:

- The first set of samples were analyzed *in-situ* for pH, Temperature, Turbidity, Total Suspended Solids (TSS) and Dissolved Oxygen (DO).
- The second set of samples were sent to the Guyana Sugar Corporation Inc. (GUYSUCO) Laboratory for analyses and was tested for Total Dissolved Solids (TDS), Conductivity, Oil and Grease and Chemical Oxygen Demand (COD).

The instruments utilized to conduct the water quality analyses onsite are described below:

- **pH and DO** – These parameters were analysed by a Hach HQ40D Multimeter - Portable two-channel multimeters for pH and Dissolved Oxygen. The digital meter/electrode system combines reliability, flexibility and ease of use. Interchangeable Intellical electrodes are recognized automatically and store all relevant data. Rugged, nearly indestructible outdoor versions with multiple cable lengths enable measurements even at previously inaccessible locations. The degree of accuracy for the parameters are pH (± 0.02 pH), DO (± 0.1 from 0 to 8 mg/L ± 0.2 for greater than 8 mg/L).
- **TSS** - TSS Portable Hand-held Turbidity, Suspended Solids, and Sludge Blanket Level Instrument. The Hach TSS Portable Hand-held Turbidity, Suspended Solids, and Sludge Blanket Level Instrument's unique multi-beam alternating light method with infrared diode system gives it a broad measuring range for both turbidity and suspended solids in one portable handheld instrument. It stores up to four different calibration curves for suspended solids and one for turbidity. There is no need for constant re-calibration for different locations. The accuracy of the measurement for the TSS is $< 4 \% \pm 0.001$ g/L.
- **Turbidity** - Hach's Portable Turbidimeter, the 2100Q, provides ease of use and accuracy. With an intuitive user interface, the 2100Q makes it easy to take measurements and perform calibration and verification. This device is calibrated before every field visit. It has a degree of accuracy of $\pm 2\%$.

A description of each sampling location, the date, time and weather condition at the time of sampling is presented in Table 4-2. The locations sampled can be seen in Figures 4-19.

Table 4-2: Description of Surface Water Sample Locations and other Sampling Details

Sample ID	Location	GPS Point	Time (hrs)	Date	Weather
SW1	Ditch along South Eastern Boundary of the Project Site	06°55'58.0" N 058°22'07.6" W	10:05	October 08, 2021	Overcast
SW2	Essequibo River	06°56'00.0" N 058°22'03.5" W	10:25		Overcast
SW3	Downstream of Canal West of Project Site	06°56'08.0" N 058°22'02.3" W	11:40		Cloudy

Sample collection and in-situ analysis can be seen in Figures 4-17 and 4-18.



Figure 4-17: Surface Water Sample Collection from the Canal West of the Project Site (Left) and the Essequibo River (Right)



Figure 4-18: In-Situ Analysis of Surface Water Samples

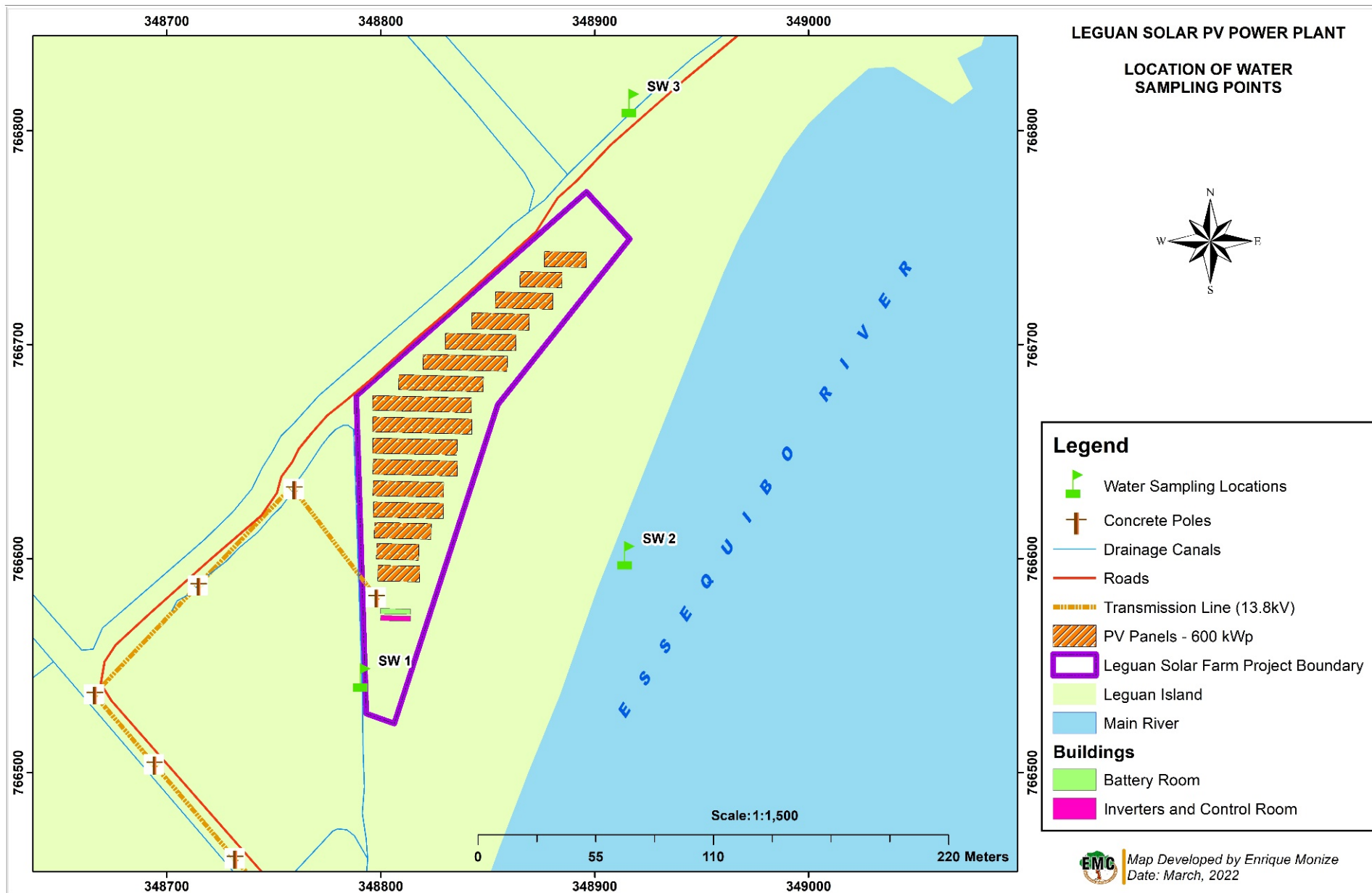


Figure 4-19: Sampling Locations for Surface Water Quality Analysis

4.1.7.2 Results

The results for the water quality analysis were compared to the limits prescribed in the GNBS Interim Guidelines for Industrial Effluent Discharge into the Environment for pH, temperature, TSS, COD, and Oil and Grease. Turbidity levels were compared with the limit prescribed in the Mining (Amendment) Regulation 2005³⁵. The prescribed levels of TDS were compared with the limits of the National Recommended Water Quality Criteria – Human Health Criteria Table of the United States Environmental Protection Agency³⁶. The laboratory analyses report is attached as Appendix E. The results of the water quality analyses are presented in Table 4-3.

Table 4-3: Results of Water Quality Analyses

Sample Locations	Parameters								
	pH 5.0–9.0	Temp (°C) <40	DO (mg/L) >4	ECw (µs/cm)	TDS (mg/L) 250	TSS (mg/L) <50	Turbidity (NTU) <50	Oil and Grease (mg/L) <10	COD (mg/L) 250
SW 1	6.84	29.1	1.78	1.25	873	7	10.6	<MDL	73.3
SW 2	6.93	30.4	6.96	7.87	5,503	106	246	<MDL	101
SW 3	6.74	31.0	7.39	7.91	5,517	14	20.4	<MDL	127

< MDL – Lower than Method Detection Limit (0.01 mg/L)

The general water quality from the three sample points reflected good quality for pH, temperature, conductivity and COD, with all the levels being in the required range. Oil and grease was not detected at any of the sample points. Turbidity and TSS were within acceptable ranges but were significantly exceeded for the samples collected from the Essequibo River. These exceedances were anticipated due to the prevailing sedimentation of the River. TDS levels were exceeded for all sample points.

DO was within acceptable ranges for two sample point but was significantly lower than the required threshold for SW 1. The low level of DO at SW1 may have been a result of its being overgrown by weeds which contributed to some stagnation of water.

4.1.7.3 Surface Water Quality of the Lower Essequibo Watershed

Available secondary water quality data for the Essequibo River was also utilized to better understand the water quality of the River. The Consultant has been working in collaboration with the Hydrometeorological Department on surface water quality monitoring of the Lower Essequibo River Watershed. Eight parameters are measured namely, pH, temperature, salinity, turbidity, conductivity, TDS, TSS and DO. Two of the sample locations being monitored are relevant to the project site since these are close to the mouth of the River. Details of these sample points are presented in Table 4-4.

³⁵ The Mining (Amendment) Regulations 2005 is the only national guideline to specify a limit for turbidity.

³⁶ United States Environmental Protection Agency. 1986. National Recommended Water Quality Criteria – Human Health Criteria Table.

Table 4-4: Relevant Sample Points from the Lower Essequibo Watershed Monitoring Programme

Sample ID	Location	GPS Point	Additional Details
LEW1	Roden Rust	06°50'20.46"N 58°27'4.38"W	Located on the eastern bank of the Essequibo River 10 kilometres upstream of Leguan
LEW2	Supenaam River	06°58'7.49" N 58°31'2.66" W	Located on the western bank of the Essequibo River

The results of water quality monitoring of these two sample points for the period July to September 2021 are presented in Table 4-5.

Table 4-5: Results of Water Quality Analyses of the Lower Essequibo Watershed

Sample Locations	Parameters							
	pH 5.0–9.0	Temp (°C) <40	DO (mg/L) >4	ECw (µs/cm)	TDS (mg/L) 250	TSS (mg/L) <50	Turbidity (NTU) <50	Salinity (PPT)
July								
LEW1	5.78	29.1	6.76	15.2	10.8	33	52	0.01
LEW2	6.18	28.8	7.25	21.1	14.9	35	52.3	0.01
August								
LEW1	6.01	28.2	7.16	13.2	9.3	15	20.9	0.01
LEW2	6.22	28.2	6.88	20.5	14.7	22	28.2	0.01
September								
LEW1	6.19	30.1	7.09	15.7	11.1	14	17.0	0.01
LEW2	6.35	30.2	6.89	24.0	17.0	32	45.0	0.01

Note: PPT = Parts Per Trillion

The results indicate significant similarity with the results of surface water quality monitoring for the Essequibo River in the vicinity of the project site for pH, temperature and DO. However, the levels of turbidity, TDS and TSS recorded at Leguan were significantly higher. The comparative spikes for these parameters at the Leguan sampling location may have been influenced by the proximity of the sample collection exercise to the shoreline.

4.1.8 Ambient Noise Levels

To determine the baseline, noise level measurement of decibel levels were conducted at various locations adjacent to the project site.

4.1.8.1 Methodology

Decibel levels were measured at three points within an around the previous project site. The noise measurement at this location is valid for the new site since the sites are adjacent to each other and there is no activity which is impacting noise level at the sites. A description and coordinates of each of the noise measurement locations are provided in Table 4-6. The noise measurement locations can also be seen in Figure 4-21.

Table 4-6: Noise Level Measurement Locations

Location ID	Locations	Co-ordinates
N1	Southern Boundary	06°55'57.3" N 058°22'06.1" W
N2	Mid-point of the Adjacent Beach	06°55'59.2" N 058°22'06.0" W
N3	North of the Project Site (Meeting Point Between the Beach and Boulder Face)	06°56'08.4" N 058°22'01.0" W

The measurements were done using a Reed Instrument R 8080 meter. This is a quick responding triple range sound level meter with backlit display, analog bargraph and built-in memory to data log up to 64,000 points. This data logging sound level meter has the ability to record samples on internal memory and keep track of registered readings with a time and date stamp. The R8080 features user selectable sampling rates and the option to track live measurements via the included PC interface software. The meter has a ± 1.5 dB degree of accuracy with real-time logging of data which can be transferred onto an excel data sheet for further analysis.

For the noise measurement the windscreen was installed on the microphone of the meter and the meter was then turned on in accordance with the manufacturer's guidelines. Thereafter, noise measurement readings were conducted for 15 minutes at each sampling point. The maximum and minimum readings obtained were recorded on data sheets along with the locations ID, coordinates, time, date, weather conditions and any other observations for each sample point. Noise measurement at two of the sampling points can be seen in Figure 4-20.



Figure 4-20: Noise Levels Measurement at Southern Boundary (Left) and Mid-Point (Right)

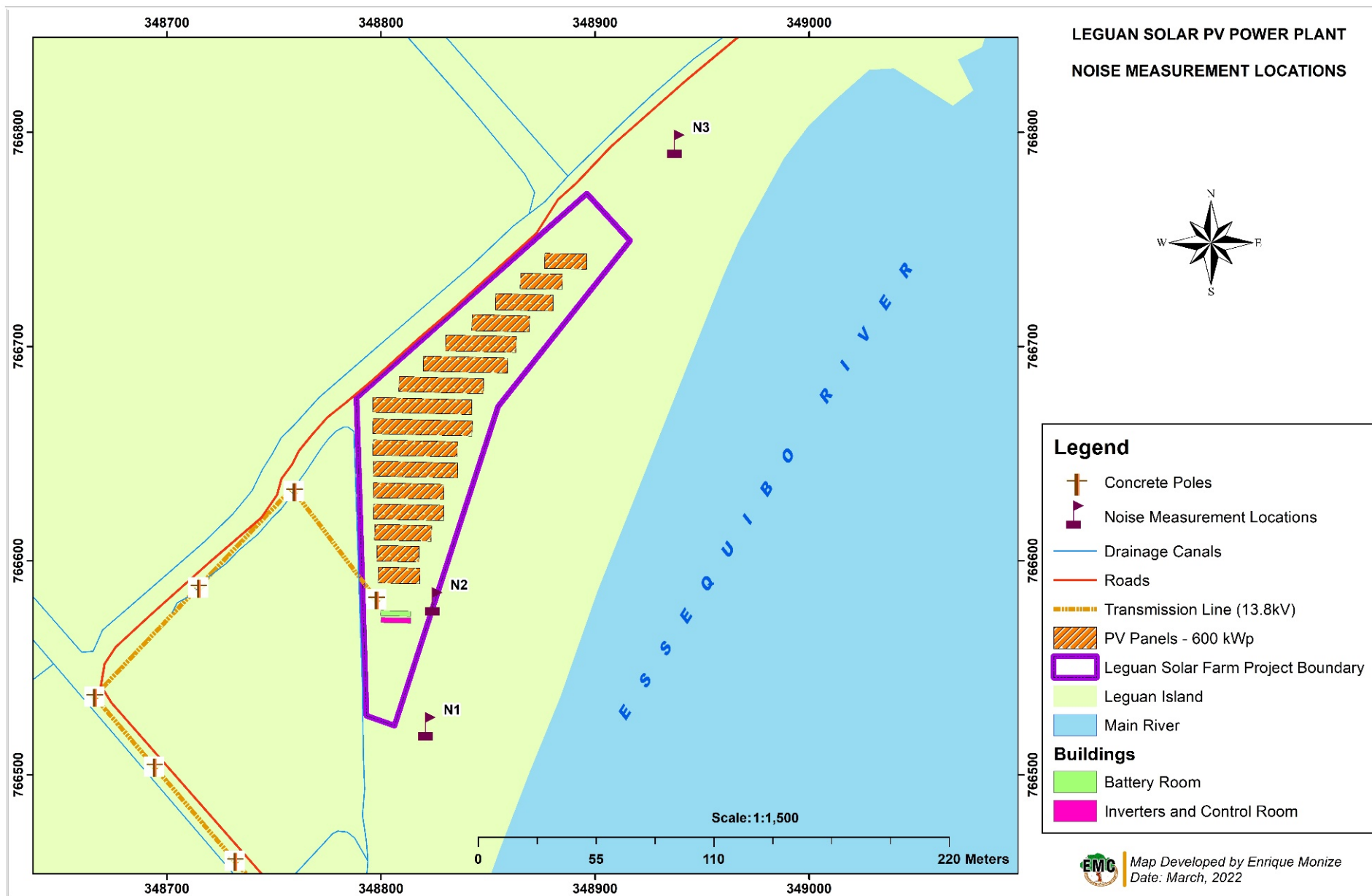


Figure 4-21: Noise Measurement Locations

4.1.8.2 Results

The results of the ambient noise level measurements for the two sampling locations are presented in Table 4-7.

Table 4-7: Results of Noise Level Measurements

Location ID	Date	Time (hrs)		Weather Conditions	Reading (dB)	
		Start	End		Max	Min
N1	October, 08, 2021	09:35	09:50	Sunny	65.2	35.3
N2		10:48	11:03	Sunny	57.8	36.5
N3		11:29	11:44	Overcast	69.2	39.4
N4		12:04	12:19	Overcast	55.7	38.3

The noise levels were well with the limits prescribed for residential activities. The principal sources of noise were from the natural environment including from wave action and the rustling of trees. However, there was also an anthropogenic influence associated with aircraft passing overhead during the measurement of N1.

4.1.9 Ambient Air Quality

Baseline ambient air quality was also measured within the area of the previous site. The results obtained are also relevant to the new site since the sites are adjacent to each other. Particles including Particulate Matter (PM) and Total Suspended Particles (TSP) levels along with the level of various gases such as Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs) Methane (CH₄), Ozone (O₃) Hydrogen Sulphide (H₂S) and Carbon Dioxide (CO₂) were measured at the project area to confirm the existing air quality.

4.1.9.1 Methodology

Ambient air quality was measured at two locations within the project site. A description and coordinates of each of the air quality measurement location is provided in Table 4-8. The air quality measurement locations can also be seen in Figure 4-23. The monitoring exercise is shown in Figure 4-22.

Table 4-8: Air Quality Assessment Locations and Other Details

Location ID	Locations	Coordinates	Time (hrs)	Date	Weather Condition
AQ1	Downwind of Project Site	06°55'57.4" N 058°22'07.0" W	09:24	October 08, 2021	Sunny
AQ2	Upwind of Project Site	06°56'08.2" N 058°22'01.2" W	11:23		Sunny

Methodology for Measuring Particulate Matter

Particulate Matter and Total Suspended Particles (TSP) were recorded using an Aerocet 831 Aerosol Mass Monitoring Meter. The Aerocet 831 is a completely portable, full-featured, battery-operated, handheld mass monitor which measures five mass ranges (PM₁, PM_{2.5}, PM₄, PM₁₀ and TSP). The meter has a ±10 % degree of accuracy with real-time logging of data which can be downloaded into MS Excel for further analysis.

At each sampling site, suitable locations for setting up the meter were determined based on several key considerations which included unrestricted and safe access, unrestricted airflow, no obstructions and avoiding topographic hollows where air circulation is restricted. The meter was turned on following the manufacturer's guidelines, after which sampling was conducted for one hour at each site. The data obtained were recorded on data sheets along with the location ID, coordinates, time, date, weather conditions and any other observations for each sample point. Sampling was conducted for one hour at each of the sample points.

Methodology for Measuring Gases

VOCs, SO₂, NO₂, CH₄, O₃, H₂S, CO and CO₂ were measured using the Aeroqual Series 500 Portable Air Quality Monitor. This air quality monitor and sensors enable accurate real-time surveying of common outdoor air pollutants, and is typically used for short- and long-term air quality studies and carrying out checks on pollution "hot spots". The device has a ± 0.2 % degree of accuracy with real-time logging of data which can be downloaded into MS Excel for further analysis.

For the exercise, the sensor heads of the gas to be monitored were inserted into the meter on an alternating basis. For each measurement, sensor heads were allowed to warm up for three minutes as per the manufacturer's guidelines after which sampling was conducted for 15 minutes. The locations used were the same for the PM and TSP readings. This gave a more comprehensive overview of the conditions in the specific localities.



Figure 4-22: Ambient Air Quality Measurement at the Southern Boundary (Left) and Northern Boundary (Right)

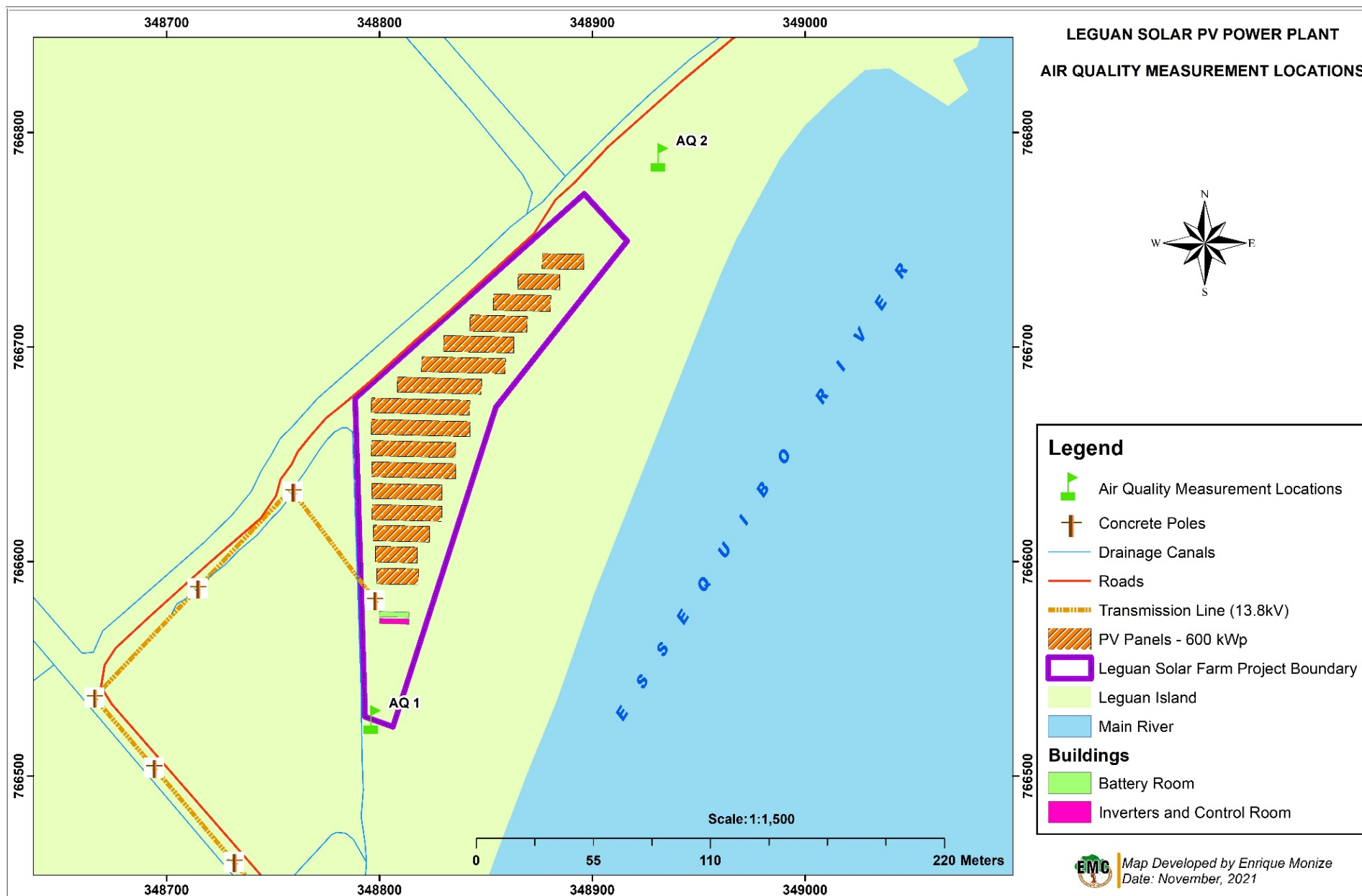


Figure 4-23: Ambient Air Quality Measurement Locations

4.1.9.2 Results

Particulate Matter

The measurements for PM_{2.5} and PM₁₀ were compared to the limits from the Environmental Protection Agency of Victoria, Australia which categorizes emissions with 1-hour mean measurements as follows:

- Good: PM_{2.5} levels lower than 27 µg/m³; PM₁₀ lower than 40 µg/m³.
- Moderate: PM_{2.5} levels between 27 to 62 µg/m³; PM₁₀ levels are between 40 to 80 µg/m³.
- Poor: PM_{2.5} levels between 62 to 97 µg/m³; PM₁₀ levels are between 80 to 120 µg/m³.
- Very Poor: PM_{2.5} levels between 97 to 370 µg/m³; PM₁₀ levels are between 120 to 240 µg/m³.
- Hazardous: PM_{2.5} levels greater than 370 µg/m³; PM₁₀ greater than 240 µg/m³.

The results of the air quality baseline assessment for particulate matter are presented in Table 4-9.

Table 4-9: Results of PM and TSP Assessment

Locations	Results (µg/m ³)		
	PM _{2.5}	PM ₁₀	TSP
AQ1	15.4	43.8	43.8
AQ2	15.6	49.6	49.6

Based on the results of the assessment, PM_{2.5} levels were well within the prescribed limits for “good” air quality. However, for PM₁₀ AQ2 can be considered “moderate” air quality. Generally, all measurements were higher for AQ2 which is upwind of the project site. However, this area also had a lower vegetation cover which may have contributed to higher values particularly for large particulates such as PM₁₀ and TSP due to the erosive action of the wind on the sandy soils.

Gases

The results of the air quality baseline assessment for gases are presented in Table 4-10 below. These values were compared to permissible limits established by the World Health Organization Air Quality Guidelines for SO₂ and NO₂; the Air Quality Index from the Environmental Protection Agency of Victoria, Australia for CO and O₃; and the US Department of Labour, Occupational Safety and Health Administration for H₂S and CO₂. There are no established permissible limits for VOCs or methane. These limits are as follows:

- WHO Air Quality Guidelines³⁷:
 - SO₂: 0.5 mg/m³ (10-minute mean)
 - NO₂: 0.2 mg/m³ (1-hour mean)
- EPA Victoria State Air Quality Index:
 - O₃ (1-hour mean)³⁸:
 - < 0.1 mg/m³ is an indicator of ‘good’ air quality
 - 0.1 to 0.2 mg/m³ is an indicator of ‘fair’ air quality
 - 0.2 to 0.3 mg/m³ is an indicator of ‘poor’ air quality
 - 0.3 to 0.6 mg/m³ is an indicator of ‘very poor’ air quality
 - > 0.6 mg/m³ is an indicator of ‘extremely poor’ air quality
 - CO (1-hour mean)³⁹:

³⁷ World Health Organization, 2005. WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Pages 16 and 18.

³⁸ EPA Victoria State. 2021a. Ozone in the Air.

³⁹ EPA Victoria State. 2021. Carbon Monoxide in the Air.

- < 34.46 mg/m³ is an indicator of 'good' air quality
- > 80.139 mg/m³ is an indicator of 'extremely poor' air quality
- US Department of Labour, Occupational Safety and Health Administration (OSHA):
 - CO₂: 126 mg/m³ (8-hour time weighted average)⁴⁰
 - H₂S: 97.57 mg/m³ (10-minute one-off exposure)⁴¹

Table 4-10: Results of Gaseous Assessment

Location ID	Time (hrs)	Date	Weather Condition	Results (mg/m ³)							
				SO ₂	NO ₂	O ₃	CO	CO ₂	H ₂ S	VOCs	CH ₄
AQ1	09:25	October 07, 2021	Sunny	0.0	0.204	0.18	281	764	0.01	3.3	19
AQ2	11:18		Overcast	0.0	0.126	0.19	93	731	0.03	2.1	8

SO₂ was not detected at either measuring location. NO₂ and H₂S were within permissible limits. Ozone levels were categorised as representing 'fair' air quality. However, CO and CO₂ significantly exceeded permissible limits. These exceedances may be associated with organic sources of emissions due to decaying vegetative matter at the project site as well as wind movement of pollution from the West Coast of Demerara.

4.2 Biological Environment

The objective of the biodiversity baseline assessment was to determine whether there are sensitive species and areas of biological interest within the project site and the wider project development landscape. The mechanism utilized to conduct this assessment consisted of the review of available information on the project AoI⁴², including a field assessment conducted during October 07 to 08 and on February 09, 2022.

The baseline assessment considered three levels: bio-geographic provinces; landscapes and ecosystems; and habitats and species. Using the data compiled, an assessment was conducted to determine the presence of threatened species, as defined in the International Union for the Conservation of Nature (IUCN) Red List, endemic and migratory species, and areas of recognized global, national or local importance to biodiversity.

⁴⁰ US Department of Labour OSHA. 2019. Permissible Exposure Limits – Annotated Tables. OSHA Annotated Table Z-1

⁴¹ US Department of Labour OSHA. 2019a. Permissible Exposure Limits – Annotated Tables. OSHA Annotated Table Z-2

⁴² The Area of Influence (AoI) includes all areas in which the Project may generate social and environmental impacts. The AoI for this Project is discussed in Chapters 1 and 6.



Figure 4-24: Conduct of Biological Assessment of the Project Site

4.2.1 Biogeographic Provinces

Four main geographical regions can be distinguished within Guyana. These are:

- The northern Coastal Plain, consisting of low-lying alluvium with a varying width up to a maximum of 65 kilometres inland (in the east).
- The lowland region of undulating land covering most of the northern and central parts of the country, generally with an elevation below 150 meters.
- The Pakaraima Mountain region in the west, an elevated table land of sandstone escarpments between 300 and 1,200 meters in elevation.
- The southern uplands consisting of a vast area mostly over 150 meters in elevation covered with undulating forest land.

The project is situated in the Coastal Plain, a narrow belt (ranging between 8 and 65 km in width with a length of 440 km) stretching from the Corentyne River in the east to Waini Point in the west, and providing most of the agricultural production in the country.

4.2.2 Landscapes and Ecosystems

The major ecosystems that falls within the landscape of the Coastal Plain are forests, freshwater, coastal, wetlands and marine ecosystems.

4.2.2.1 Forest Ecosystems

Forests in the coastal plain include mangrove forests, coastal swamp forest, seasonally flooded palm marshes and swamp forests, and forests of the old coastal plain (the Coropina formation).

4.2.2.2 Freshwater and Wetland Ecosystems

Three freshwater eco-regions exist within Guyana⁴³. These are: the Orinoco Delta and Coastal Drainages; the Essequibo; and the Guianas. The freshwater eco-systems of Guyana are home to at least 476 freshwater fish species, of which about 83 species are considered endemic.

⁴³ WWF/TNC. 2019. Freshwater Eco-Regions of the World.

The Essequibo freshwater eco-region, in particular, serves as a major biological corridor linking to the Amazon Basin and forms a continuous expanse of water during the wet seasons between the tributaries of the Rio Branco in Brazil and the Rupununi River in Guyana.⁴⁴

A WWF-Guianas study conducted in 2012 identified and characterized 23 wetlands sites within Guyana. The study focused specifically on representative freshwater and brackish water areas of open water bodies, permanently flooded vegetated lands, and seasonally flooded lands.⁴⁵ These are presented in Table 4-11 below.

Table 4-11: Wetlands of Guyana

Coastal Wetlands	Wetlands of Region 1	Rupununi Wetlands
Lake Mainstay, Essequibo Coast	Assakata Lake and wetlands, North West District (NWD)	Surama Pond, North Rupununi
Lake Tapakuma, Essequibo Coast	Baramani Lake, NWD	Airstrip Pond, North Rupununi
Lake Capoey, Essequibo Coast	Almond Beach, NWD	Oma Pond, North Rupununi
Lake Mashabo, Essequibo Coast	George, NWD	Devil Pond, North Rupununi
East Demerara Water Conservancy	Arnold Ponds, NWD	Grass Pond, North Rupununi
Mahaica-Mahaicony-Abary Conservancy	Moruca Swamp, Moruca Sub-District	Shulinab, South-central Rupununi
Manarabisi Swamp, Corentyne		South-central Rupununi
Guysuco Conservancy		
Sandaca Swamp, Corentyne		
Corentyne Sandcreek		
Halcrow Conservancy, Corentyne		

4.2.2.3 Coastal Ecosystems

Guyana is situated between the estuaries of the Amazon and Orinoco Rivers and the movement of coastal currents and shoals impacts on the siltation of outfalls and the profile of the coastline. The Coastal Plain is characterized by extensive inter-tidal mudflats, intersected by narrow sand and shell beaches, and major mangrove swamps that are bordered inland by shallow saline and brackish lagoons and swamps. The coastal ecosystem is renowned for its beaches that support the nesting and foraging grounds of migratory sea turtles and birds.

The Shell Beach Protected Area represents Guyana's remnant and receding marine ecosystem. This area represents a combination of coastal forest including mangroves and sandy coastline covering an area of 125,000 ha which is approximately 11 percent of the protected areas system and 0.58 percent of country's land mass. The Shell Beach Protected Area provides an annual nesting ground for four endangered marine turtles: the Leatherback, (*Demochelys coriacea*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*), and Green turtle (*Chelonia mydas*). The area also encompasses a unique ecosystem of mangrove forests, inland swamp forests and savannahs; and is home to an array of species including manatees (*Trichechus manatus*), tapirs (*Tapirus terrestris*), deer (*Mazama americana*), jaguars (*Panthera onca*), howler monkeys (*Alouatta seniculus*), and other large

⁴⁴ Watkins, G., Saul, W., Holm, E., Watson, C., Arjoon, D. and J. Bicknell, 2004. The Fish Fauna of the Iwokrama Forest. Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 154, pp. 39-53.

⁴⁵ WWF-Guianas. 2012. Wetlands of Guyana.

animals. The bird diversity is one of the richest in Guyana with over 200 species of coastal and migratory birds recorded and includes a variety of parrots and macaws, numerous wading birds including many scarlet ibis (*Eudocimus ruber*) and Caribbean flamingos (*Phoenicopterus ruber*), herons, egrets and the magnificent harpy eagle (*Harpia harpyja*), among a host of others.⁴⁶

Other sand and shell beaches along the wider coastal zone exist in a less pristine state primarily as a consequence of anthropogenic pressures. Mangrove forests are found in fringe communities as a band along the coast, interspersed by sandy beaches in a few places, as well as in small patches along the river mouths and rivers in proximity to the sea. There are no mangroves on the project location or along the adjacent beach and shoreline.⁴⁷

4.2.2.4 Marine Ecosystems⁴⁸

The marine habitats of the coast and the deep-sea areas of Guyana are not well known as the terrestrial habitats. The marine fishery, composed mainly of prawns and shrimp (seabob), is an important contributor to Guyana's economy.

The marine habitats of the Guianas (Guyana, Suriname and French Guiana) are highly productive. The high productivity is related to high diversity and abundance of marine species. Many river plumes enrich the marine habitats along the coast of the Guianas with nutrients, including that of the Amazon River and, to a lesser extent, other major rivers, such as the Corentyne and Essequibo. A high density of cetaceans is known to occur in the marine ecosystems of the Guianas including the Guiana Dolphin (*Sotalia guianensis*), the West Indian manatee (*Trichechus manatus*), the Sei Whale (*Balaenoptera borealis*), the Blue Whale (*Balaenoptera musculus*), the Sperm Whale (*Physeter macrocephalus*) and the Fin Whale (*Balaenoptera physalus*).

The Guyana coast, especially the Shell Beach Protected Area, has become one of the most important nesting areas for all locally occurring sea turtle species. Guyana's marine ecosystems and by extension the marine ecosystems of the Guianas are part of the North Brazil Large Marine Ecosystem (LME). The North Brazil LME is an oceanic habitat unit that extends from the Caribbean Sea south to the Parnaiba River in Brazil.

4.2.3 Habitats and Species

The biological environment of the project's Aol is a mixture of coastal terrestrial and marine coastline ecological systems. Human influence has also contributed to the species profile with cattle and other pasture species being prevalent in the Aol.

4.2.3.1 Freshwater and Marine Biological Environment

The freshwater environment that characterises the project environment is a lentic still-water system. In the wider project area, the freshwater environment comprises the canals which form the drainage and irrigation network. Within the drainage channels there are floral species including water hyacinth (*Eichhornia crassipes*) and antelope grass (*Echinochloa pyramidalis*) which are considered weed species as they usually clog the drainage system. The primary producers in waterways are comprised of plant-plankton and other microorganisms that utilize the sunlight to produce food.

Secondary consumers in this habitat comprised of several fresh water fish species. These species were not seen in the area but were reported in other studies and observations by fisherfolk in the area. The Essequibo River is generally a freshwater river with low salinity hence, mainly fishes that can

⁴⁶ Protected Areas Commission. 2013. Guyana's Protected Areas Commission Protected Areas System Plan, 2013- 2015.

⁴⁷ Environmental Protection Agency. 2014. Guyana's National Biodiversity Strategy and Action Plan. Pages 17 to 18.

⁴⁸ Environmental Protection Agency. 2014. Guyana's National Biodiversity Strategy and Action Plan. Page 18

survive brackish conditions are found around Leguan Island. These include patwa (*Cichlasoma bimaculatum*), houri (*Hoplias malabaricus*) and tilapia (*Talapia sp*). Fisherfolk in the area documented sightings of species such as cow nose ray (*Rhinoptera bonasus*), butterfly ray (*Gymnura altavela*) hammerhead shark (*Sphyrna mokarran* and *Sphyrna tudes*) and jewfish (*Epinephelus itajara*) but these fishes are not frequently encountered.

The stagnant ditch which is partly located in the project site is expected to include various amphibian species such as crapo/crapaud (*Rhinella marina*). These amphibians will feed on insects (like mosquitoes) which breed in the stagnant waters. A list of species comprising the freshwater biological environment is presented in Table 4-12.

Table 4-12: Freshwater Faunal Species in the Aol

Common Name	Scientific Name	Family Name
Fishes		
Patwa	<i>Cichlasoma bimaculatum</i>	Cichlidae
Houri	<i>Hoplias malabaricus</i>	Erythrinidae
Tilapia	<i>Talapia sp</i>	Cichlidae
Amphibians		
Crapo	<i>Rhinella marina</i>	Bufonidae

The marine environment east of the beach adjacent to the project site exhibits estuarine tendencies and is part of a wider area of interactions between the Essequibo River and the Atlantic Ocean. The primary producers in this system are comprised of plant-plankton and other microorganisms that utilize the sunlight to produce food. Primary consumers include various crustaceans such as seabob (*Xiphopenaeus kroyeri*), white belly shrimp (*Nematopalaemon schmitti*), (*Minuca sp* and *Leptuca sp*), crab species and molluscs. These organisms feed on both planktonic materials along minerals deposited by the Essequibo River.

Secondary consumers in this habitat are comprised of several fish species. The most abundant species around the Leguan Island are cuirass (*Cathorops spixii*), sea catfish (*Bagre bagre*), and laulau (*Cathorops spixii*). The tertiary consumers include larger predator species which include fishes from the family Sciaenidae such as predatory fishes as the grey snapper (*Cynoscion acoupa*), trout (*Cynoscion virescens*) and bangamary (*Macrodon ancylodon*).

A list of species comprising the marine biological environment is presented in Table 4-13.

Table 4-13: Marine Species in Wider Project Environment

Common Name	Scientific Name	Family Name	IUCN Status
Crustaceans			
Seabob	<i>Xiphopenaeus kroyeri</i>		Not Evaluated
White Belly Shrimp	<i>Nematopalaemon schmitti</i>		Not Evaluated
Fiddler Crabs	<i>Minuca sp</i> and <i>Leptuca sp</i>		Not Evaluated
Fishes			
Cuirass	<i>Cathorops spixii</i>	Ariidae	Not Evaluated
Sea catfish	<i>Bagre bagre</i>	Ariidae	Least Concern
Laulau	<i>Cathorops spixii</i>	Ariidae	Not Evaluated

Common Name	Scientific Name	Family Name	IUCN Status
Grey snapper	<i>Cynoscion acoupa</i>	Sciaenidae	Vulnerable
Trout	<i>Cynoscion virescens</i>	Sciaenidae	Least Concern
Bangamary	<i>Macrodon ancylodon</i>	Sciaenidae	Least Concern
Caribbean electric ray	<i>Narcine bancroftii</i>	Narcinidae	Least Concern
Cow nose ray	<i>Rhinoptera bonasus</i>	Rhinopteridae	Vulnerable
Butterfly ray	<i>Gymnura altavela</i>	Gymnuridae	Endangered
Hammerhead shark	<i>Sphyrna mokarran</i> and <i>Sphyrna tudes</i>	Sphyrnidae	Critically Endangered
Jewfish	<i>Epinephelus itajara</i>	Serranidae	Vulnerable

4.2.3.2 Terrestrial Biological Environment

Flora

The coastal terrestrial environment is composed of a dynamic ecosystem. The primary producers are several plant species. These includes coconut (*Cocos nucifera*), sweet sage (*Lantanna camara*), teazum (*Cyanthillium cinereum*), Glamma cherry (*Cordia obliqua*), Bamboo (*Bambusa vulgaris*), *Guilandina bonduc*, *Ipomoea sp*, and *Acer campestre*. There was also the presence a popular wild vegetable species, ban karella (*Momordica dioica*) at the project site. There are also various grasses that line the western boundaries of the project site. Fruit trees such as the plum (*Spondias dulcis*) and monkey apple (*Annona glabra*) were the major fruiting trees observed in pasture lands west of the project site. The flora species found at the project site are presented in Table 4-13 and some of the species are shown in Figure 4-25.



Figure 4-25: Some Flora Species at the Project Site with Bamboo (*Guadua sp.*) in Top-Left, Sweet Sage (*Lantanna camara*) in Top-Right, Plum (*Spondias dulis*) in Bottom-Left and Bunday Plimpa (*Guilandia bonduc*) in Bottom-Right

Table 4-13: Terrestrial Species within the Aol

Common Name	Scientific Name	Family Name
Plants		
Coconut	<i>Cocos nucifera</i>	Arecaceae
Bunday Plmpla	<i>Guilandina bonduc</i>	Fabaceae
Wild sweet potato	<i>Ipomoea sp</i>	Convolvulaceae
	<i>Acer campestre</i>	Sapindaceae
Plum	<i>Spondias dulcis</i>	Anacardiaceae
Monkey apple	<i>Annona glabra</i>	Annonaceae
Ban karella	<i>Momordica dioica</i>	Cucurbitaceae
Sweet Sage	<i>Lantanna camara</i>	Verbenaceae
Teazum	<i>Cyanthillium cinereum</i>	Asteraceae
Bamboo	<i>Guadua sp</i>	Poaceae

Common Name	Scientific Name	Family Name
Plimpla	<i>Solanum viarum</i>	Solanaceae
Glammacherry	<i>Cordia obliqua</i>	Boraginaceae

Fauna

The flora attract pollinators such as follow-me (*Polybia occidentalis*). Several pasture species were observed in the surrounding environment such as goats (*Capra hircus*), sheep (*Ovis aries*) and cows (*Bos taurus*). These ruminants would usually graze around the project site and feed on the plant species there. The salipenter (*Tupinambis teguixin*) was the only herpetofauna species observed at the project site. However, a spectacled caiman (*Caiman crocodilus*) was observed on the bed of a canal on the Island in the Bellfield to Maryville villages. Labaria (*Bothrops atrox*) was sighted by locals around the Island.

Marine birds were also observed during the baseline assessment including a piping plover (*Charadrius melodusseen*), a migratory species from North America which was observed on the beach adjacent to the project site in October 2021 (Figure 4-26 [Left]). Other species observed include the great egret (*Ardea alba*) as seen in Figure 4-26 (Right), the striated heron (*Butorides striata*), hawks belonging to the family Falconidae, snowy egret (*Egretta thula*) and scarlet ibis (*Eudocimus ruber*). Other birds expected to be found within the Aol include kiskadee (*Pitangus sulphuratus*), dove (*Columbia sp.*), yellow plantain (*Icterus nigrogularis*) and owls of the Strigidae family. A list of terrestrial faunal species is presented in Table 4-14. A detailed avian survey of the Aol will be required to support the findings of this ESAR.



Figure 4-26: Piping Plover on the Beach (Left) and Great Egret in the Project Site (Right)

Table 4-15: Terrestrial Faunal Species within the Aol

Common Name	Scientific Name	Family Name	IUCN Status
Mammals			
Sheep	<i>Ovis aries</i>	Bovidae	N/A
Goat	<i>Capra hircus</i>	Bovidae	N/A
Cows	<i>Bos taurus</i>	Bovidae	N/A
Reptiles			
Spectacled Caiman	<i>Caiman crocodilus</i>	Caimaninae	Least Concern
Salipenter	<i>Tupinambis teguixin</i>	Teiidae	
Labaria	<i>Bothrops atrox</i>	Viperidae	Least Concern
Birds			
Great Egret	<i>Ardea alba</i>	Ardeidae	Least Concern
Striated Heron	<i>Butorides striata</i>	Ardeidae	Least Concern
Kiskadee	<i>Pitangus sulphuratus</i>	Tyrannidae	Least Concern
Dove	<i>Columbia sp</i>	Columbidae	
Yellow Plantain	<i>Icterus nigrogularis</i>	Icteridae	Least Concern
Piping plover	<i>Charadrius melodusseen</i>	Charadriidae	Near Threatened
Snowy egret	<i>Egretta thula</i>	Ardeidae	Least Concern
Scarlet ibis	<i>Eudocimus ruber</i>	Threskiornithidae	Least Concern

4.2.3.4 Areas of Biological Interest

Areas of recognized global, national or local importance to biodiversity within Guyana were considered in this assessment to determine whether the project landscape is identified as a priority area for conservation interest. This includes consideration of legally protected areas, World Heritage Sites, Ramsar Sites, Important Bird Areas, Key Biodiversity Areas, Community reserves, and natural reserves.

The project site has not been identified by the GoG as a priority for conservation interest. The conservation initiatives in Guyana are largely focused on the larger forested landscapes of central and southern Guyana or in the Rupununi Savannas region. Currently, the conservation priority sites identified by the GoG include the legally protected areas of the Kanuku Mountains, the Shell Beach Protected Area, the Kaieteur National Park, the Iwokrama Rainforest Reserve, and the Community Owned Conservation Area at Konashen, and other areas of biological interest not legally protected including the Guyana Forestry Commission (GFC) Moraballi and Mabura Reserves, the Orinduik Falls and Roraima Mountains. None of the legally protected areas and other areas of biological interest are located near the project area. The closest protected is the Shell Beach Protected Area, which is well over 150 kilometers (in a straight line) east of the project site.

There are no recognized areas of global importance to biodiversity within the landscape of the project. There are no Zero Extinction Sites, proposed or listed Ramsar Wetland Sites within Guyana or officially designated areas in Guyana identified as Important Bird Areas (IBAs). The closest wetland area to the project site is Lake Mashabo which is located more than 20 kilometers (in a straight line) from the project site. Birdlife International has identified two Endemic Bird Areas (EBAs) within Guyana; the Rio Branco Gallery Forest of Brazil and Guyana; and the tepuis (or table-mountains) scattered throughout

Bolívar and Amazonas states of southern Venezuela, penetrating as far as west-central Guyana and northern Brazil. None of the two EBAs identified in Guyana are located within the project area.

At the local level, within the Island there were areas of biological importance within the wider project area. There is the presence of mangrove forests along the shoreline of the Island. However, no mangrove forest were in close proximity to the project site, as is shown in Figure 4-27. In addition, important bird habitats were identified on the Island, but not in close proximity to the project site, as is shown in Figure 4-27.

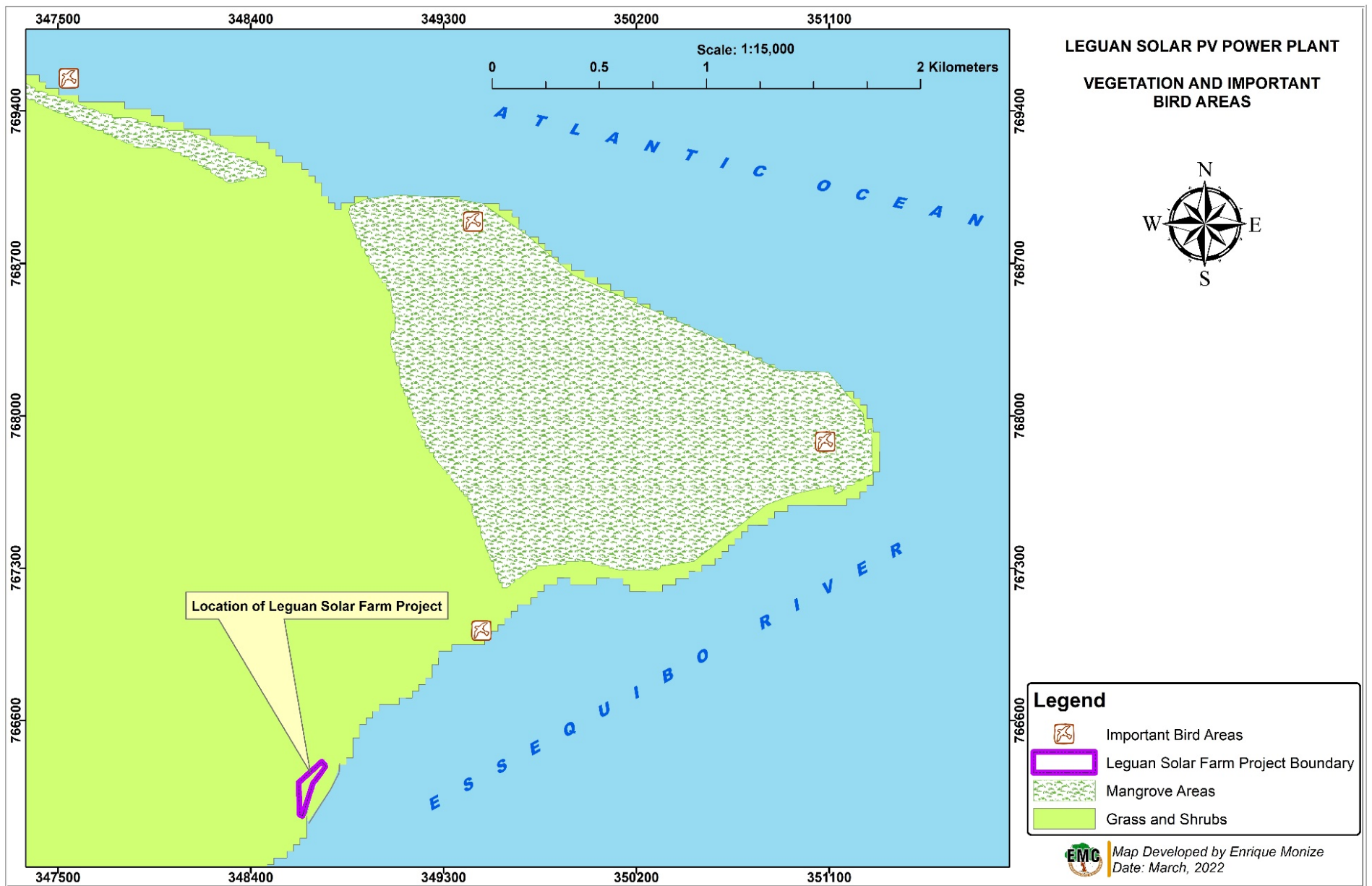


Figure 4-27: Areas of Biological Interest in Relation to the Project Site

4.3 Socio-Economic Environment

The site for the Leguan Solar PV Power Farm is located on the Island of Leguan, Region 3 one of the largest islands of the Essequibo River. The neighbouring islands include Wakenaan to the west, Hogg Island to the south, and Tiger Island (Hamburg) to the northwest.

4.3.1 Access to the Project Site

Currently, Leguan is accessible only by river transportation with most vessels landing at the Leguan Stelling (Figure 4-28). The Leguan Stelling is a roll-on/roll-off facility that facilitates movement of passenger and cargo vehicles onto the ferry. The Government is currently undertaking works to rehabilitate and extend the Leguan Stelling.

The Ministry of Public Works, Transport and Harbours Department provides a daily ferry service between Leguan and Parika, the main hub connecting the mainland coast of Regions 3 to 6 to the Essequibo Coast and Essequibo islands. Smaller boats (as seen in Figure 4-28) are also used for passenger transport to Parika as well as to the Essequibo Coast and other islands and areas in the River.

In 2012, the Government acquired private lands which were earmarked for the development of an airstrip. However, this initiative has yet to come to fruition.



Figure 4-28: Leguan Stelling

From the Stelling, the project site is accessed by overland transportation along public roadways. From the Stelling to the Canefield Village, the roads are asphalted. However, the public roadway through Canefield Village is an earthen dam which is in poor condition. Overtopping of the sea wall during high or spring tides or precipitation results in the pooling of water along the roadway and thus, contributes to further deterioration. Figure 4-29 shows pooling of water on a section of the access road due to overtopping during the spring tide on October 07.



Figure 4-29: Pooling of Water from Overtopping

4.3.2 Land Use

4.3.2.1 Land Uses around the Solar PV Farm Site

There are no authorized existing uses of the project site. However, there is occasional unauthorized grazing of ruminants that wander into the project site from surround pasture lands and this was observed by the Consultant's team during the site visit in February 2022 (Figure 4-30). The land uses surrounding the project site are as follows:

- **Northern Boundary:** Earthen embankment covered in vegetation.
- **Southern Boundary:** Immediately bounded by small drain on the south-eastern and south-western sections. There are no waterways along the section of the southern boundary connecting this drain. The lands on the other side of the canal are government reserve lands which were fenced by a resident who now claims ownership. Government reserves are located east of the fenced area where one squatter has established a private residence and another a small goat pen (Figure 4-31). Further south of the government reserve, is an access dam, a canal leading to the koker and then the residential area of Canefield Village. The backlands of the Canefield Village are used for agricultural purposes particularly crop cultivation.
- **Eastern Boundary:** Brown sand beach used primarily for recreational and worshipping purposes (Figure 4-32).
- **Western Boundary:** Immediately bounded by a canal (leading from the south-western boundary). West of the canal is an access dam, and then a drainage canal leading to a koker. Beyond the canal are pasture lands, shown in Figure 4-32. A sand reef is located in these pasture lands and, if there is demand, sand is excavated for sale to local consumers. In addition, privately owned lands west of the project site have been earmarked for the construction of an open-air restaurant and resort by a local tour operator.



Figure 4-30: Cows Grazing adjacent to the Project Site



Figure 4-31: Goat Pen with Squatting Residence in the Background on the Government Reserve Lands



Figure 4-32: Brown Sand Beach East of the Project Site



Figure 4-33: Access Dam (Left), Drainage Canal and Pastures (Right) West of the Project Site

4.3.2.3 Land Uses around the Transmission Line Alignment

A new transmission line will be established to connect the solar PV farm to the Leguan Power Station. The alignment of the new transmission line will follow the route of the existing transmission line. The existing alignment runs along the public road on the Island passing residential homes, commercial businesses (shops and restaurants among others), places of worship, and public buildings (schools, hospitals, local authority administration buildings and Government offices). The existing alignment also passes two areas of cultural importance which are the St. Peter's Anglican Church and the Hanuman murti established by the Leguan Mandir (see details in Section 4.3.4).

However, there will be a section of the new transmission line installed in areas not part of the existing alignment. This will connect the solar farm to the section of new line that will run parallel to the existing line in Canefield. The land uses surrounding this section of the new line are the same as those situated to the west and south of the project site.

The land uses of the wider project area are shown in Figure 4-34.

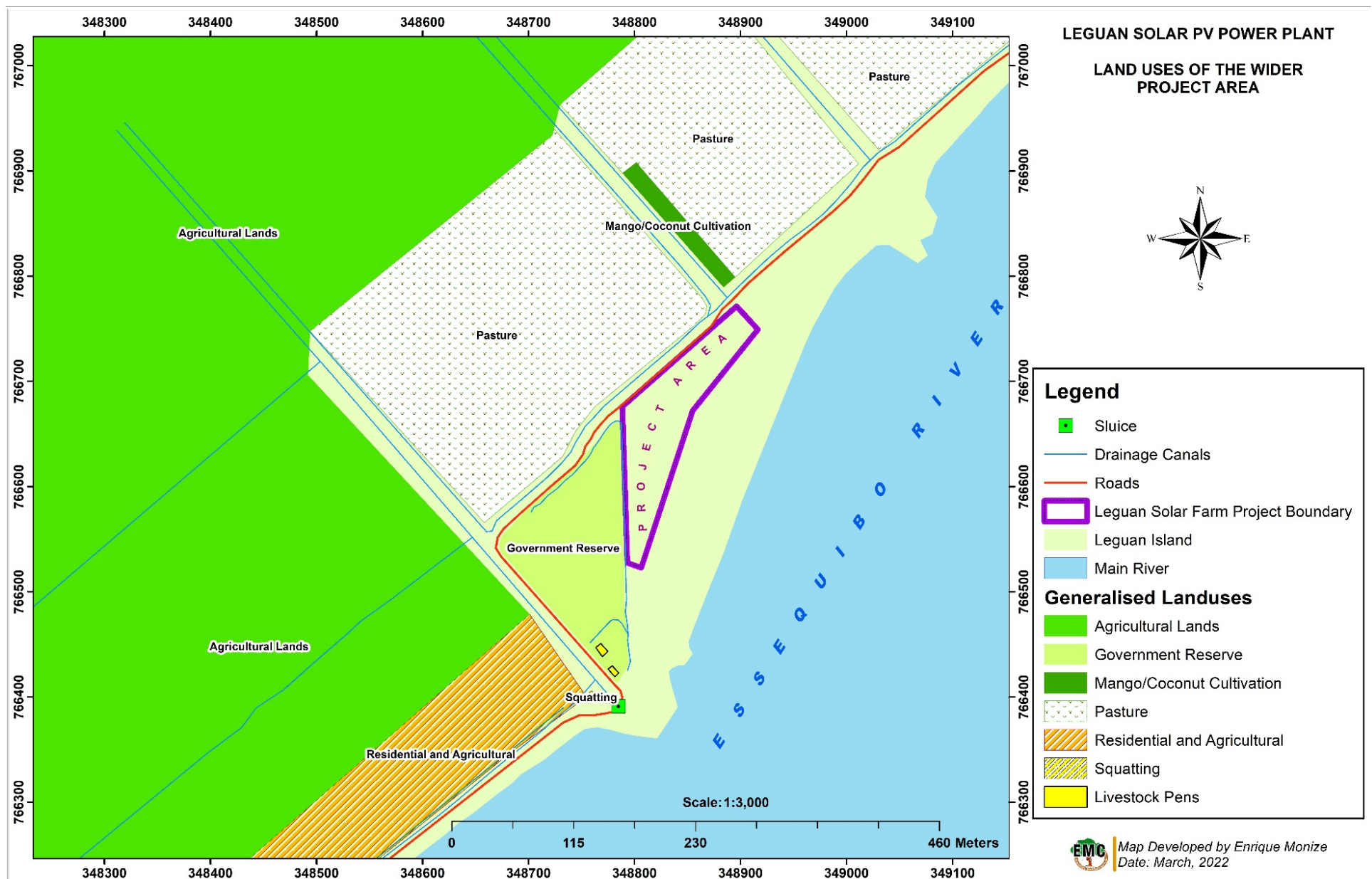


Figure 4-34: Land Uses in the Wider Project Area

4.3.3 Communities

The main beneficiary of the electricity to be generated by the Leguan Solar PV Power Farm is the Island of Leguan. Leguan is expected to benefit from the increased power generation capacity and the creation of redundant supply to the existing GPL grid which provides electricity to the local population. Leguan has a size of approximately 29 square kilometers and is popularly referenced as having the shape of a gull's wing.

Leguan was settled by the Dutch in the eighteenth century. According to popular legend, the settlers discovered an abundant population of iguanas on the island. Thus, Leguan is derived from the Dutch word for iguana, "leguaan". The Dutch were followed by other settlers from France, Great Britain, the British West Indies and Belgium. These settlers replace native vegetation with fruit and vegetable trees including indigo, oranges, cocoa and eventually, sugar cane. Subsequently, slaves were taken to Leguan to dig trenches, build sea walls, and to plant and harvest sugar cane.⁴⁹

4.3.2.1 Population and Demographics⁵⁰

Leguan has a population of 2,807 people settled in 27 communities (Table 4-16). In addition, there are other communities in which there are no settlements such as Oakum (where the solar PV farm will be installed), Reliance and Cane Garden among others. The village of Canefield, the closest settlement to the project site, is sparsely populated with a total population of 65 persons, of which 41 are male and 24 are female.

Table 4-16: Population of Leguan's Communities

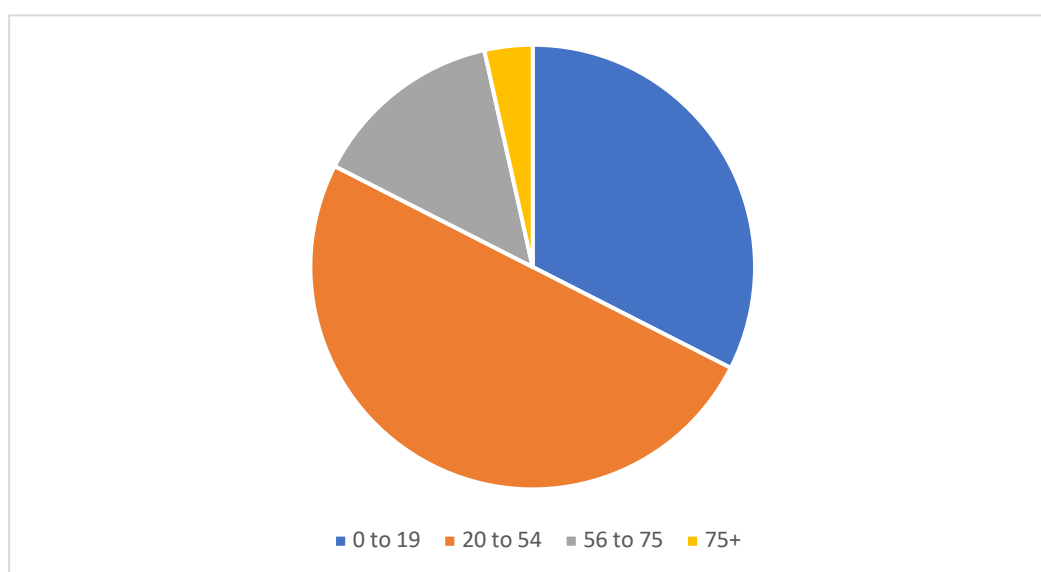
Community	Male	Female	Total
Henrietta	10	11	21
Phoenix and Louisana	73	63	136
De Witte	33	27	60
Anna Maria	55	54	109
Osterbeck	46	29	75
Success	3	3	6
Thierens (Wisselvalligheid)	55	51	106
Waterloo (Bachelors Adventure)	43	26	69
Maryville	132	111	243
Belfield	21	23	44
La Bagatelle	180	189	369
Vertrouwen	24	26	50
Doorn Haag	72	69	141
Enterprise	92	99	191
Blenheim	115	113	228
Kingston	21	22	43
Tewkesburg	35	30	65
Cheltenham	14	24	38
Endeavour	106	112	218
Richmond Hill	40	44	84
Good Intent	61	55	116
Amsterdam	70	43	113

⁴⁹ Department of Public Information. 2019. Leguan – Paradise Steeped in History. Article from January 15, 2019

⁵⁰ Bureau of Statistics. 2012. Population and Housing Census 2012.

Community	Male	Female	Total
Canefield	41	24	65
Claremont	45	48	93
Uniform	66	57	123
Pleasing Hope	1	0	1
Total	1,454	1,353	2,807

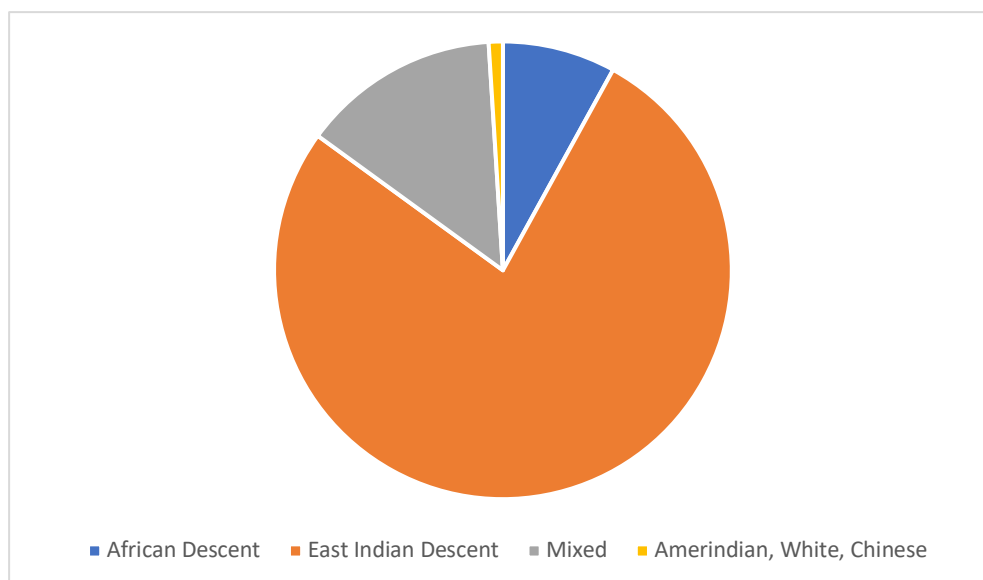
Approximately 52 percent of Leguan's population are male and the remaining 48 percent are female. According to the findings of the 2012 Census, 32.5 percent of Leguan's population is between the ages of 0 to 19. Moreover, approximately half of the population, 50 percent, is within the ages of 20 to 54 years indicating their ability to participate in the labour force. In addition, 14 percent of the population is 55 to 75 years old, and only 3.5 percent is older than 75. Further, approximately 49 percent of the population of Canefield is between the ages of 20 to 54. The age demographics of Leguan's population is presented in Figure 4-35.



Source: Prepared for this ESAR using data from the 2012 Census

Figure 4-35: Age Distribution of Leguan's Population

Leguan is a multi-ethnic and multi-racial community with a mixed population. However, people of East Indian descent are the majority representing 77 percent of the total population. The second largest demographic group is the 'Mixed' population representing 14 percent of the population. This is followed by people of African descent who comprise approximately eight percent of the population. The remaining one percent is represented by Amerindians (0.5 percent), White (0.3 percent) and Chinese (0.2 percent). The ethnic demographics of Leguan's population is presented in Figure 4-36.



Source: Prepared for this ESAR using data from the 2012 Census

Figure 4-36: Ethnic Distribution of Leguan's Population

Leguan is a multi-religious town with practicing Hindus, Christians, Muslims and Rastafarians as well as persons who do not follow any religion. Hinduism is most widely practiced with 54 percent of the population being Hindu. Muslims account for approximately 15 percent of the total population. Approximately 29 percent of the population are people of different Christian denominations. The remaining two percent are Rastafarians or persons who do not practice any religion.

4.3.2.2 Livelihoods

According to local authorities, agriculture is the most dominant livelihood of the people of Leguan particularly livestock rearing (mainly cattle) and the cultivation of rice and cash crops (*Personal Communication 02 – Interview with the Leguan NDC*). This is supported by the findings of the 2012 Census where the majority persons in Leguan were self-employed and worked in the agricultural and fisheries sectors.

The business and commercial activities in Leguan include businesses such as gas stations, small shops, supermarkets (including mobile supermarkets), hardware stores, restaurants, and other retail enterprises. In addition, there are six rice mills on the Island but only four are currently operational.

4.3.2.3 Health

There is a Cottage Hospital in Leguan which has 16 beds and is capable of dealing with minor illnesses. Currently, the Hospital is significantly understaffed with there being only one doctor who is on call 24/7. Serious illnesses are referred to the West Demerara Regional Hospital. The costs of transfer is typically borne by patients. Transportation in emergency situations and during the night is dangerous as speed boats are the only available mode of transportation. There have been positive cases of COVID-19 on the Island but no deaths have been attributed to the virus.⁵¹

⁵¹ EMC Personal Communication 02 – Interview with the Leguan NDC

4.3.2.4 Electricity and Energy

The entire Island of Leguan is connected to the GPL grid including residential and commercial areas. However, rice milling operations are not connected to the grid and instead, are powered by diesel generators (*EMC Personal Communication 02 – Interview with the Leguan NDC*). GPL commenced operations in Leguan approximately 25 years ago with electricity being provided 24/7 since 2015 (*Personal Communication 03 – Interview with the GPL Leguan*).

Most households use kerosene or gas for cooking. Only a few persons rely on firewood (*Personal Communication 02 – Interview with the Leguan NDC*).

4.3.2.5 Water Supply

Water is provided to households by Guyana Water Incorporated (GWI). However, there are concerns that the water quality is poor due to a high iron content which causes rusting (*Personal Communication 02 – Interview with the Leguan NDC*). In 2021, the Government obtained funding from the Caribbean Development Bank for the establishment of five new water treatment plants, one of which will be located in Leguan.⁵²

GWI's distribution system is also powered by the GPL grid. In the event that there is a blackout then there is no running water (*Personal Communication 02 – Interview with the Leguan NDC*). GWI's new water treatment plant is expected to contribute to increases in demand for electricity from the GPL grid (*Personal Communication 03 – Interview with the GPL Leguan*).

4.3.2.6 Sanitation and Waste Disposal

Currently, there is no dumpsite on the Island and most households burn their waste. The Leguan NDC has identified a potential location for a dumpsite but this has to be approved by the Ministry of Local Government and Regional Development.

4.3.2.7 Infrastructure

Leguan houses the Regional Sub-Office for the Essequibo Islands. The regional office serves the other populated islands of the Essequibo River delta, Wakenaam and Hogg Island. The NDC also has an office in Leguan. Other infrastructure on the Island include a Cottage Hospital, a guest house, police station, post office, five nursery and primary schools, and one secondary school. The Leguan stelling is believed to be the longest wooden stelling in Guyana.⁵³ Leguan is connected to GTT and Digicel cellular services and wireless internet.

There are 14 churches and one Kingdom Hall on the Island, and 7 mandirs (Hindu temples). There are also five mosques⁵⁴. There are two playfields for recreational purposes but the use of these facilities were curtailed by the COVID-19 pandemic (*EMC Personal Communication 02 – Interview with the Leguan NDC*).

4.3.2.8 Crime

The crime rate in Leguan is relatively low (*EMC Personal Communication 02 – Interview with the Leguan NDC*).

⁵² Guyana Chronicle. 2021. \$6 Billion Water Treatment Plants Along the Coast. Article on May 28, 2021

⁵³ Department of Public Information. 2019. Leguan – Paradise Steeped in History. Article from January 15, 2019

⁵⁴ Guyana Chronicle. 2019. Life on Leguan Island. Article on February 02, 2019.

4.3.4 Heritage Sites

According to the National Trust Guyana, the St. Peter's Anglican Church is the only heritage site located on the Island of Leguan. St. Peter's Anglican Church is located in Enterprise. It was consecrated on St Peter's Day, July 29, 1855, by His Lordship, Bishop William Piercy Austin in the presence of the Governor, P. E. Wodehouse and other prominent individuals. The stone foundation of the Church was laid just two years prior on August 1, 1853 by Lieutenant Governor Walker. The St Peter's Church and the separately standing, leaning bell tower are regarded as some the finest brick structures constructed in Guyana in this time. The church has a tiled sanctuary, asphalted floor, architectural rafters and stained-glass windows. The Church was being renovated in 2019.⁵⁵ St. Peter's Anglican Church can be seen in Figure 4-37.



Source: Guyana Chronicle (2017)

Figure 4-37: St. Peter's Anglican Church

Another site of cultural significance is the 52-foot murti of the Hindu deity, Lord Hanuman. The statue was unveiled at the Leguan Mandir in 2016. The statue is pictured in Figure 4-38.

⁵⁵ Department of Public Information. 2019. Leguan – Paradise Steeped in History. Article from January 15, 2019



Source: Stabroek News (2016)

Figure 4-38: Statue of Lord Hanuman

5.0 STAKEHOLDER ENGAGEMENTS

5.1 Stakeholder Engagement Approach

Stakeholder engagements were an important element of the ESAR preparation process. Feedback garnered from stakeholders was utilized to support the identification and assessment of potential impacts associated with planned project activities and to develop measures to mitigate or manage these impacts. Stakeholder engagements are also a key component of managing project risk since it familiarises local and regional stakeholders with the planned project activities and provides a platform for concerns to be raised and lays the foundation for a positive relationship between the project and the local communities.

The overall purpose of the stakeholder engagements conducted during ESAR preparation was to build awareness among stakeholders of the project and provide a platform for receiving feedback on issues of concern and recommendations. The specific objectives were to:

- Provide progress updated to local stakeholders including in relation to the project location, project components and planned project activities.
- Initiate open dialogue with stakeholders to provide clarifications on the project and for stakeholders to share their views, concerns and expectations.
- Receive feedback from stakeholders on environmental and social concerns associated with the project components and project activities for inclusion and consideration in the ESAR.
- Create a mechanism through which feedback from stakeholder engagements are shared with project personnel so as to ensure that stakeholder engagements are meaningful and are considered in decision-making.

The stakeholder engagement approach for this ESAR consisted of the following key elements:

- Identification of stakeholders for engagement.
- Determining the methods and tools for engagement of various stakeholders.
- Organisation of feedback received for consideration by all team members in ESAR preparation process.

5.2 Stakeholder Identification

Stakeholders identified for engagement generally comprised of representatives of local communities and local government authorities and government institutions who are expected to be impacted, either positively or negatively, by the Project. These stakeholders were:

- Leguan Neighbourhood Democratic Council.
- Sea and River Defences Board – Georgetown Head Office and Leguan Field Office.
- Guyana Power and Light Inc. (GPL) – Major Projects Department of the Georgetown Head Office and Leguan Power Station.
- Neighbouring Land Owners.
- Nearby Residents of the village of Canefield.
- Guyana Tourism Authority.

5.3 Stakeholder Engagement Strategy and Methods

The stakeholder engagement strategy was designed to utilise appropriate methods and tools to efficiently engage with stakeholders. The overarching objective was to employ methods to facilitate meaningful consultations with stakeholders to encourage the free sharing of information and views about the project.

5.3.1 One-on-One Engagements

One-on-one engagements were considered to be the most appropriate tool to effectively and transparently engage most of the stakeholders identified in Section 5.2 above. In addition, one-on-one engagements also allowed stakeholder engagements to comply with the public health restrictions associated with the COVID-19 pandemic. In most instances, stakeholders were available to facilitate in-person discussions with the Consulting Team. However, in instances where stakeholders could not participate in-person, engagements were conducted via telephone. The schedule of the one-on-one engagement with stakeholders is presented in Table 5-1 below.

Table 5-1: Schedule of One-on-One Engagements with Stakeholders

Stakeholders	Date of Engagement
In-Person Engagements	
Sea and River Defence Board (Leguan Office)	October 07, 2021
Leguan Neighbourhood Democratic Council	October 07, 2021
Leguan Power Station	October 07, 2021
Neighbouring Land Owners 1	October 07, 2021
Canefield Resident 1	October 08, 2021
Canefield Resident 2	October 08, 2021
Canefield Resident 3	October 08, 2021
Canefield Resident 4	October 08, 2021
Sea and River Defences Board – Georgetown Headquarters	October 20, 2021
Engagements via Virtual Platforms	
GPL – Major Projects Department	October 18, 2021
Guyana Tourism Authority	October 18, 2021
Neighbouring Land Owners 2	October 29, 2021

The critical first step in all of the one-on-one engagement exercises was to share information on the project to enhance stakeholders understanding on project activities and allow them to consider how they may be impacted (positively or negatively). Project information was shared with most stakeholders by GEA or by the Consultant's team at the outset of the meetings.

This then led to the second step of the stakeholder engagement strategy, where stakeholders were provided with the opportunity to engage with the project personnel to provide feedback on their concerns and to share recommendations. In addition, the Consultant's team also requested information from stakeholders relating primarily to the socio-economic conditions of the settlements which may be impacted by the project. Photos of some of the engagements of the Consulting Team with local stakeholders can be seen in Figure 5-1 to Figure 5-3.



Figure 5-1: Engagements with Leguan NDC



Figure 5-2: Engagement with GPL – Leguan



Figure 5-3: Engagements with Owner of Neighbouring Pasture Lands

5.3.2 Public Community Meeting

The GEA convened a Public Community Meeting to facilitate broad-based stakeholder consultations on the project with residents of Leguan. This meeting was held on September 24, 2021, approximately three weeks prior to the site visits led by the Consultant's team. The consultation was held at the Leguan Secondary School. The attendance of the meeting included residents of Leguan, representatives of the NDC, the Head Teacher of the Leguan Secondary School, and representatives of other government agencies such as the National Drainage and Irrigation Authority (NDIA), Ministry of Agriculture, and the Guyana Rice Development Board (GRDB).

5.4 Stakeholder Feedback

The Consultant's team conducted engagements with stakeholders in October 2021 when the project site was the backshore of the beach that borders the eastern boundary of the new project site. The principal areas of concern raised by stakeholders included the rationale for site selection and the potential to displace the existing cultural uses of the beach for recreation and Hindu religious activities. These concerns are no longer relevant given that the project site has shifted.

However, other concerns raised by stakeholders which remain relevant to this project include risks of erosion to the beach, flood risks and the potential beneficial impacts of the project including employment and reduced costs of electricity (tariffs) to consumers. The critical issues, concerns and

recommendations identified by stakeholders that remain relevant considerations for the new project site are summarized in Table 5-2. In addition, Appendix D presents detailed notes documenting all concerns and recommendations raised in each of the stakeholder engagements.

Table 5-2: Summary of Stakeholder Feedback

Themes and Issues	Stakeholder Questions, Concerns and Recommendations
Erosion and Flood Risk	<p><u>Public Community Meeting</u></p> <ul style="list-style-type: none"> Will a rip rap structure be constructed along the shoreline? <p><u>Sea and River Defence Board (Leguan Office)</u></p> <ul style="list-style-type: none"> Shorelines along the Island of Leguan are susceptible to a cycle of erosion and accretion. The project site was previously silted up during the accretion phase of the cycle but erosion is currently occurring. Significant erosion of the shoreline north of the beach required emergency construction of a 65-meter-long boulder face. The beach is considered to be highly susceptible to erosion. Erosion is expected to significantly accelerate if there is vegetation clearing. The Sea and River Defence Board prohibits locals grazing animals in the vegetation or vegetation clearing (including for firewood). Generally, Leguan is not prone to flooding provided that trenches and kokers and clear. <p><u>Leguan NDC</u></p> <ul style="list-style-type: none"> Currently, the beach is not prone to flooding. However, prior to the existing level of accretion, there was frequent flooding of the project area. <p><u>Canefield Resident 1</u></p> <ul style="list-style-type: none"> Sea defences should be installed along the high-water mark of the shoreline to prevent washing away of the beach. <p><u>Chief Sea and River Defences Officer</u></p> <ul style="list-style-type: none"> The old shore line was immediately adjacent to the project site. As such, the beach formed as a result of accretion. The shoreline of the project area is a dynamic environment which fluctuates based on the erosion and accretion cycle. The area has been stable for some time but the location faces significant erosion risk. Approximately 550 meters of sea defences costing approximately GYD\$ 300 million (at current prices) would be required along the shoreline of the sea to mitigate erosion risk in the medium- to long-term. Even on an advanced schedule, these sea defences cannot be installed in Oakum earlier than 2024.
Project Benefits: <ul style="list-style-type: none"> Employment Tariff Reduction Increased Generation Capacity 	<p><u>Public Community Meeting</u></p> <ul style="list-style-type: none"> Will there be a reduced cost of electricity (tariff rates) to consumers? <p><u>Leguan NDC</u></p> <ul style="list-style-type: none"> The main expected benefit of the project is that electricity tariffs will be reduced.

Themes and Issues	Stakeholder Questions, Concerns and Recommendations
<ul style="list-style-type: none"> ▪ Reduced Fuel Consumption ▪ Investments in Electricity System 	<ul style="list-style-type: none"> ▪ Several public buildings and other facilities are connected to GPL grid and would likely benefit from electricity generated by the project site. ▪ The project could facilitate the installation of lights at the playfield for night-time games, particularly for cricket. ▪ A plantain chip factory was constructed in Leguan but was never operationalized because of the cost electricity. Reduced electricity tariffs as a result of the project could facilitate operations of the factory. ▪ How many people will be permanently employed by the project? <p><u>GPL (Leguan)</u></p> <ul style="list-style-type: none"> ▪ GPL (Leguan) will have an increased power generation capacity. ▪ The project will reduce the quantity of fuel required to generate electricity. Savings in fuel expenditures can be invested into other projects to further develop the power generation system. <p><u>Owner of Neighbouring Lands 1</u></p> <ul style="list-style-type: none"> ▪ The project will benefit the people because it is expected that the cost of electricity will be cheaper. ▪ The Government should ensure that local people are employed by the project. <p><u>Canefield Resident 1</u></p> <ul style="list-style-type: none"> ▪ The access road leading to the project site is expected to be repaired by project activities and this will benefit residents of Canefield. ▪ More persons may visit the beach to see the solar farm. ▪ Locals should be employed by the project because many people do not have permanent jobs. <p><u>Canefield Resident 2</u></p> <ul style="list-style-type: none"> ▪ The project is expected to provide opportunities for employment which will be welcome. <p><u>Canefield Resident 4</u></p> <ul style="list-style-type: none"> ▪ The project will benefit the Island of Leguan as a whole. ▪ The access road leading to the project site is expected to be repaired by project activities and this will benefit residents of Canefield. ▪ Mr. Roopjagdai expects employment by the project (for example, as a security guard). <p><u>GPL (Major Projects Department)</u></p> <ul style="list-style-type: none"> ▪ GPL (Leguan) will have an increased power generation capacity. ▪ The project will reduce the quantity of fuel required to generate electricity. Savings in fuel expenditure would allow for investments that could help GPL to provide better service and achieve national goals. ▪ The project will also help GPL's consumer based to become more aware of renewable energy generation. <p><u>Guyana Tourism Authority</u></p> <ul style="list-style-type: none"> ▪ How many people will be permanently employed?

6.0 IMPACT ASSESSMENT

6.1 Impact Assessment Methodology

The project comprises of an EPC and turn-key delivery of a 0.6 MWp solar PV power plant inclusive of a 0.8 MW battery energy storage system in the Island of Leguan, Essequibo River. A new five-kilometer transmission line will also be established to connect the PV power plant to the existing GPL facility. The project is being developed utilizing savings which have accrued under EMISDE Programme although additional financing will need to be sourced. The electricity generated by the project will be integrated into the existing GPL (Leguan) grid to provide electricity to consumers in Leguan. In the medium- to long-term, GPL plans integrate the Leguan grid with the grids of Wakenaam and Hogg Island, neighbouring islands in the Essequibo River, and electricity generated by the project will also serve this interconnection. GPL has been granted permission to occupy 1 hectare (2.48 acres) of land in Oakum, located along the eastern coast of Leguan, for the installation of the solar farm.

This ESAR focuses on the installation of the 0.6 MWp solar PV power plant as well as the associated transmission and distribution system. It should be noted that this ESAR does not focus on an assessment of the potential impacts of the decommissioning of the project site given that the solar PV power plant is expected to continue to operate beyond the 20-year lifetime due to several factors including having infrastructure in place to replace damaged PV panels, expected enhancements to solar PV technology and the transition of Guyana's energy sources to renewable or low-emission sources.

The aim of this chapter is to identify and evaluate the potential impacts that the project may have on the environmental and social receptors. This was done by identifying and rating potential impacts which could occur as a result of the proposed project activities. The analysis includes two aspects. The first is having a clear understanding of the operational activities of the project (as detailed in Chapter 2) and the Aol of the project. The primary Aol of the project is defined as the footprint of the solar PV power plant which will be constructed by the project. The secondary Aol is defined as the route to be followed for the establishment of the transmission line from the project site to interconnect with the existing transmission network. The Aol includes a fringe of land extending 15-meters around the project components in all directions. The Aol established for the project can be observed in Figure 6-1.

The second aspect is to predict potential impacts that might reasonably be expected to occur during the construction and operational phases and their significance. Significant impacts will need to be managed, mitigated and/or monitored to reduce potential adverse impacts and enhance positive impacts.

The approach to the ESAR involves a standard impact assessment methodology as outlined below:

- **Stage 1 – Impact Identification:** To determine the potential impacts associated with project activities. This was achieved through professional judgment, field work, desk top analysis and review of relevant literature and the environmental management plans of similar projects, and consultations with project stakeholders.
- **Stage 2 – Impact Assessment:** To determine the importance of the issues identified by rating their significance and likelihood to occur.
- **Stage 3 – Mitigation and Management:** To recommend appropriate mitigation measures and management or monitoring controls to address significant negative impacts.

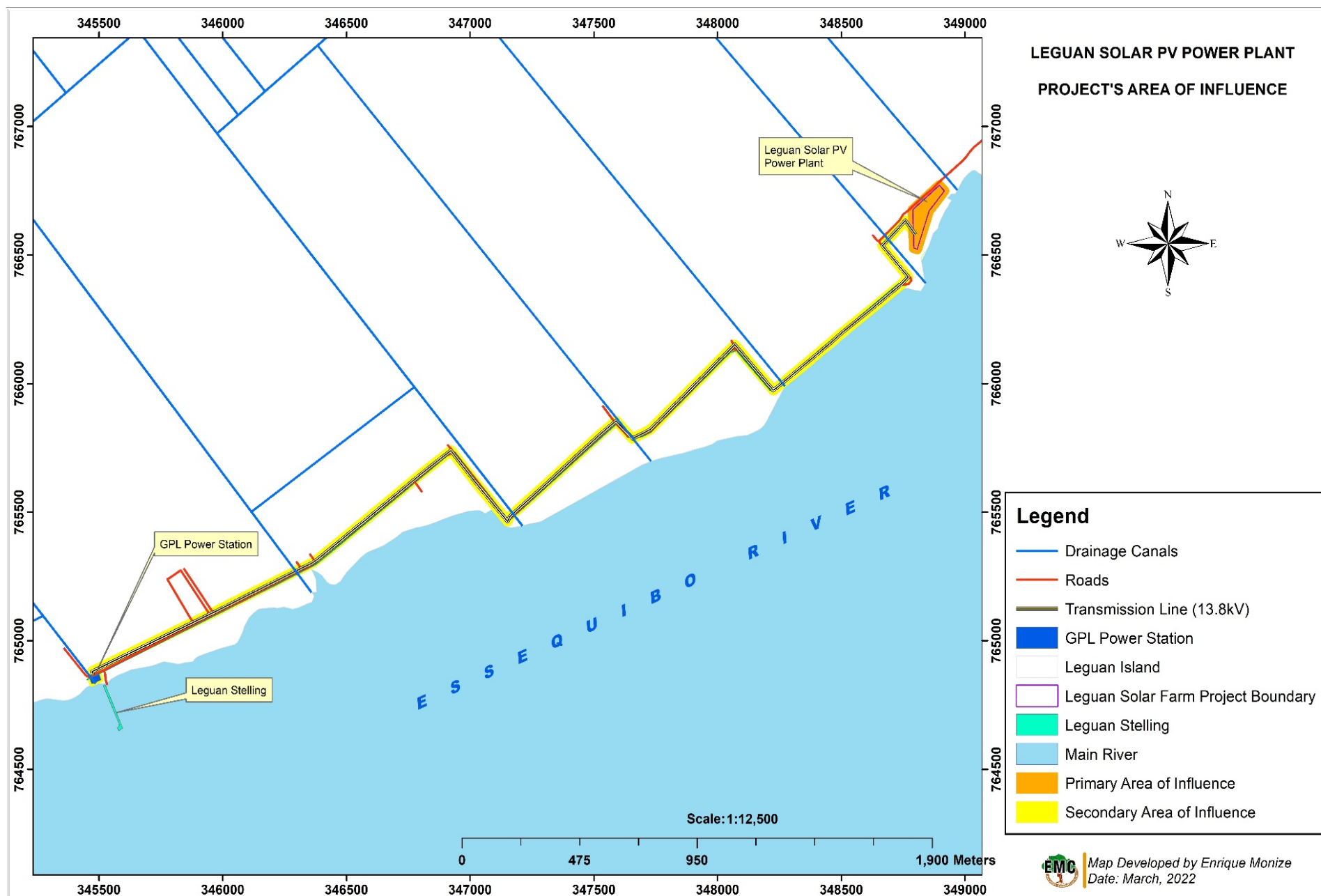


Figure 6-1: Area of Influence of the Project

6.1.1 Stage 1 - Impact Identification

The potential impacts of the project are those that change existing physical, ecological or socioeconomic conditions within the project Aol in a negative or positive way. Identifying potential impacts attributable to the project requires an understanding of the receiving environment. This understanding was achieved from the gathering and analysing of information on baseline physical, ecological and socioeconomic conditions as described in Chapter 4 of this ESAR. Further, an understanding of the project related activities was required, as is outlined in Chapter 2.

Impacts are considered as positive or negative, direct or indirect, short-term or long-term, localised or local, regional and cumulative. Table 6-1 provides definitions for each type of impact considered.

Table 6-1: Definitions of Types of Impacts

Impact Type	Definition
Positive	An impact that results in a positive effect on the receiving environment or resource from activities performed at or by the project.
Negative	An impact that results in a negative effect on the receiving environment or resource from activities performed at or by the project.
Direct	An impact created as a direct result of the project.
Indirect	An impact which may be caused by the project, but will occur in the future or outside the project's Aol.
Short-term	An impact or activity that is expected to dissipate shortly after the cause ceases
Long-term	An impact or activity that is expected to continue for significant time after the cause ceases
Cumulative	The total impact to a particular resource anticipated to occur as a result of a combination of effects produced together with neighboring projects.
Localised	Impact which is limited to the project's Aol.
Local	Impact which extends outside the project's immediate Aol, but is contained within the general vicinity of the project.
Regional	Impact which has extended beyond the vicinity of the project's Aol.

6.1.2 Stage 2 - Impact Assessment

The approach to assessing impacts can be either qualitative or quantitative, depending on available information and historical site-specific experience. Both are important in normal impact analyses. However, considering that the project is not complex, and employs well understood and widely used solar energy generation technology, the impact assessment adopted more of a qualitative approach.

The importance of an impact has been assessed by combining two impact elements:

- The **significance** of the impact on the resources should the impact occur; and
- The **likelihood** of that impact occurring.

In determining **the significance level**, consideration was given to the types of impacts from each project activity relative to existing baseline physical, environmental and socioeconomic conditions. This is described in Table 6-2.

Table 6-2: Impact Significance Level Descriptors

Significance Level to Potentially Impacted Physical, Ecological or Socio-Economic Resources				
Negligible	Minor	Moderate	Major	Extreme
Minimal impact in a localised area of little or no consequence.	Low impact in a localised or regional area with a functional recovery within one year.	Medium impact in a localised or regional area with a functional recovery of 1 to 5 years.	High impact in a localised or regional area with a functional recovery within 5 to 10 years.	Very high impact in a broad regional area or area of national significance with functional recovery in greater than 10 years, if at all.

In determining **the likelihood levels**, consideration was given to the probability of an identified physical, ecological or socioeconomic resource being impacted by the project. The anticipated likelihood of occurrence of an impact was identified to range from Rare to Certain (Table 6-3).

Table 6-3: Impact Likelihood Levels

Likelihood of Impact to Physical, Ecological or Socio-Economic Resources				
Rare	Unlikely	Likely	Almost Certain	Certain
Highly unlikely to occur but theoretically possible.	May occur within the life of the Project or activity.	Likely to occur more than once during the life of the Project or activity.	Very likely to occur during the life of the Project or activity.	Expected to occur as a result of the Project or activity.

Utilizing the outcomes of both the impact significance ranking and the identified likelihood of impact, the effect of each impact causing action on the receiving environment is evaluated. The risk level (or importance) is assessed by combining the significance column and the probability row in the following Risk Assessment Matrix (Table 6-4).

Table 6-4: Risk Assessment Matrix

		Significance				
		Negligible	Minor	Moderate	Major	Extreme
Likelihood	Rare	Low	Low	Low	Medium	Medium
	Unlikely	Low	Low	Medium	Medium	High
	Likely	Low	Medium	Medium	High	High
	Almost Certain	Low	Medium	High	High	Critical
	Certain	Low	Medium	High	Critical	Critical

Note: Where the Significance of an impact is indicated to be positive, the importance will also be positive.

6.1.2.1 Residual Risks

Residual impacts are those that are anticipated to occur after effective application of recommended mitigation measures. This typically involves repeating the process described in Stage 1 and Stage 2 to re-evaluate the potential risk rating, considering the implementation of the proposed mitigation and management measures.

The goal of this impact assessment is to ensure that there is a precautionary approach to managing risks so as to avoid negative environmental impacts and identify mitigation measures for impacts which are unavoidable. Overall, the goal of the residual risk assessment aims to eliminate or reduce **Critical, High or Medium Risks** by recommending appropriate mitigation and management measures. As such, all residual risks may not be **Low** but the recommended measures will help to ensure that the risks are being managed as effectively and efficiently as practicable.

In addition, for risks that are rated **Low** without consideration of potential mitigation or management measures, no residual risks are assessed.

6.2 Physical Resources

The potential impacts to physical resources of the project are related to interactions with local soils and geology, surface and ground water resources, ambient noise levels, as well as ambient air quality. In addition, the vulnerability of the project to adverse climate change impacts, including sea level rise, are anticipated to occur and are also assessed.

6.2.1 Soils and Geology

Potential impacts of planned project activities include erosion, loss of topsoil, topographical changes, compaction and pollution.

6.2.1.1 Erosion

Solar PV Power Farm

Erosion risk at the project site is influenced by several factors. The type of soil prevalent at the project site does not present any erosion hazard and it is poorly drained. Although the project site is situated on flat terrain its plain is akin to a swale given its depression relative to the beach (east) and dam (west) and the swamp like conditions that exist along its southern boundary. By virtue of its location, surface ponding of water is anticipated particularly during inclement weather thus increasing erosion risk. Project construction activities will require the clearing of vegetation and earthworks which will also increase the risks of erosion.

Based on feedback provided by stakeholders and by observations of the consultant's team during field visits, the beach adjacent to the project site is experiencing erosion by wave action along the high-water mark. For example, the Sea and River Defences Department installed a boulder face north of the project site to mitigate erosion in that area and also, erosion is accelerating along the foreshore as evidenced on the washing away of mature coconut trees. The Department anticipates that erosion of the shoreline area will continue but the rate of erosion is reduced due to the stabilization provided by the existing vegetative cover on the backshore of the beach (east of the project site).

According to the Department, the installation of hard sea defence structures along the high-water mark of the beach (east of the project site) is planned to occur within the next five years because the rate of erosion in this area does not necessitate critical intervention. If vegetation from the backshore of the beach is removed prior to the installation of hard structures, the beach located east of the project site may erode entirely under the natural, dynamic forces of the erosion and accretion resulting in a westward shift of the shoreline, closer to the project site. Erosion risk of the beach is exacerbated due to its sandy nature, both from wind and surface runoff. The beach is a buffer between the project site and the Essequibo River and therefore, no vegetation should be cleared from its backshore during project construction given its crucial role in erosion management and site stabilization. If the beach remains undisturbed, the potential risks of erosion of the project site are not anticipated to be elevated above present levels. As such, the potential impacts of erosion at the landing site are **negative, direct,**

short- to long-term and **localized**, of **moderate significance** and **likely** to occur. As such, this is a **Medium Risk** of project activities. However, these risks can be managed through the implementation of erosion control measures including raising the elevation of the project site, filling in the ditches (in consultation with the Sea Defences Department) and installing a permanent system for drainage. With these measures in place, potential erosion impacts are anticipated to be of **minor significance** and **unlikely** to occur. As such, residual risk of erosion remains **Low**. Moreover, in the medium to long-term, erosion risk along the foreshore of the adjacent beach may be managed by the installation of sea defence structures. However, the installation of sea defences is outside the scope of the project and is the responsibility of the Ministry of Public Work, Sea Defences Department.

There is only limited potential for erosion occurring during the operational phase of the project given that no soil disturbing activities will be conducted routinely. During operations, potential for erosion will be associated mainly with the surface runoff during periods of heavy rainfall but is not significant given the limited footprint of the facility. The potential impacts of erosion during project operations can also be managed by conducting in-depth studies of erosion risk prior to design, and during the design and construction phases of the project by ensuring that the surface area of the project site is stabilized (for example, via the installation of a base that is suitable to local conditions on the entire facility). In addition, risks of erosion during can be prevented by ensuring that an adequate drainage system is installed and kept clear to facilitate runoff.

Transmission Line

The nature of the soils prevalent on Leguan Island and occurring along the alignment of the transmission line, both along the alignment of the existing transmission line and the new section of the line in the Canefield village, do not present erosion hazards. During the construction phase, erosion risk from the establishment of the associated facilities is only anticipated as a result of runoff during rainfall events. Further, there will be no routine soil disturbing activities during the operation of the transmission and thus erosion is not expected to be significant. Potential risks of erosion during the construction and operational phases of the transmission line are **negative, direct, short-term** and **localized**, of **negligible significance** and **unlikely** to occur resulting in a **Low Risk**.

6.2.1.2 Change in Topography

Solar PV Power Farm

The project site is situated in a swale-like area that is bordered by a brown sand beach to the east and a sea dam to the west. Visual inspections conducted by the Consultant's team indicated that the most significant changes in elevation were between the brown sand beach and the project site. Construction activities may require excavation of soils and the construction of site foundations which may require topographical elevation and filling in the existing ditches along the southern boundary of the project site. Ultimately, the extent of topographical changes required will be determined by detailed geotechnical studies and erosion risk studies for the project site. In turn, this will inform the foundation design and requirements for further increasing site elevation and installing a drainage system to manage flood risk associated with heavy rainfall.

Changes in topography will have aesthetic implications for the contiguous physical systems and are likely to permanently change the natural landscape. In addition, topographical changes to increase the elevation of the project site are expected to manage other potential risks including erosion and flood risk. Overall, any topographical changes during the construction phase are expected to be limited to the relatively small footprint of the installation. Potential impacts of changes in topography during the construction phase of the project are **negative, direct, long-term** and **localised**. Given the limited footprint of the project, this potential impact will be of **negligible significance** and is **likely** to occur. As such, this is a **Low Risk** of the project.

No topographical changes are anticipated to occur during project operations.

Transmission Line

No topographical changes are anticipated to occurring during the construction or operation of the transmission line.

6.2.1.3 Loss of Topsoil

Solar PV Power Farm

The disturbance of topsoil is a certainty within the area which will be used for the construction of project components which require excavation of topsoil to facilitate the construction of site foundations and fixed structures such as the PV mounting units, the battery room, inverter storage area and control room. Topsoil loss from these activities is inevitable. The extent of topsoil removal from the site will also depend on the findings of geotechnical studies which will inform the design of the project site by the EPC contractor.

Generally, topsoil is considered to be a valuable natural resource that could be stockpiled for use in site rehabilitation following the decommissioning of a facility. However, the project is expected to continue well beyond its stated 20-year lifetime and topsoil may deteriorate during prolonged storage. As such, GEA and the contractor may engage with the Sea and River Defence Board to agree on an appropriate use of any excavated topsoil including its potential use to spread in other areas of the project site to manage erosion risk.

Given the limited footprint of the project site and the potential for alternative uses of cleared topsoil, topsoil loss is not expected to be significant. Potential impacts of topsoil loss during the construction phase of the project are **negative, direct, long-term** and **localised**. Given the limited footprint of disturbance, this impact is of **negligible significance** and is **unlikely** to occur. As such, this is a **Low Risk** of the project.

Loss of topsoil is not anticipated to occur during project operations.

Transmission Line

Limited clearing of topsoil is also required to erect transmission poles but, in these instances, a common practice is to place the removed soils around the base of the pole for additional support. As such, these potential impacts are not considered significant.

6.2.1.4 Compaction

Solar PV Power Farm

The nature of the soil within the project site makes it susceptible to compaction which can ultimately contribute to soil subsidence. The use of heavy machinery and the stockpiling of construction materials can result in compaction of soils beyond their permeable limits. Potential risks of compaction are likely to be greatest along routes utilized by heavy machinery leading to the project site and, at project site where heavy machinery is used and construction materials are stockpiled. In these areas, ponding of water can occur after rainfall and continuous compaction throughout the construction process may increase risks of erosion of the surface. The potential impacts of soil compaction from construction activities are **negative, direct, short-term** and **localised**, of **negligible significance** but are **certain** to occur in some areas. As such, this is a **Low Risk** of project activities. Several measures may be

implemented to manage compaction risks including establishing routes to movement of heavy vehicles to and from the project site and designating areas for stockpiling of construction materials.

There are no anticipated risks of compaction during the operational phase of the project.

Transmission Line

The transmission line will be established along the alignment of the existing system and therefore no potential impacts of compaction are anticipated during the construction or operational phases of the project.

6.2.1.5 Soil Contamination

Soils at the project site and at the locations of the associated facilities may be accidentally or intentionally contaminated by the discharge of fuels, waste oils, lubricants or other hazardous materials or wastes during the construction and operational phases of the project.

Solar PV Power Farm

During the construction phase of the project, several waste streams are anticipated. These include general solid waste (including construction wastes), hazardous waste (oily wastes, solvents and used batteries), and liquid waste (sewage from latrines or portable lavatories at the construction site). During the operational phase of the project, improper disposal of damaged, malfunctioning or decommissioned solar PV panels or lithium-ion batteries within the project site can result in the leaching of heavy metals. There is also potential for the improper management of sewage from permanent facilities established to support the operational phase to contribute to soil contamination. Improper disposal of waste may also cause soil pollution during both the construction and operational phases of the project. These potential impacts are **negative, direct, long-term, localised**, of **moderate significance** and **almost certain** to be generated by project activities. Without mitigation, soil contamination is a **High Risk** of both the construction and operational phases.

The implementation of good waste management measures during the construction and operation phases of the project can mitigate these risks. These include the implementation of appropriate waste management practices during the handling, transport, use and storage of hazardous materials and wastes particularly during the construction phase of the project. In addition, the implementation of appropriate waste management measures can entirely prevent these measures from occurring. In addition, GPL has measures in place to facilitate the transportation of defunct equipment to power stations in Anna Regina or Georgetown for disposal. Moreover, special measures should also be put in place by GPL to facilitate the proper storage and disposal of damaged or defunct PV panels and lithium-ion batteries as no there are limited existing options for final disposal. Potential impacts of soil contamination of **moderate significance** but are **unlikely** to occur if appropriate management measures are implemented. As such, the residual risk of this soil contamination from project activities is **Medium**.

Transmission Line

No waste streams are anticipated to be generated during the installation or operation of the transmission line. Generally, pre-cast poles and transmission lines will be transported to each site along the alignment. In addition, topsoil removed to facilitate installation of the poles will be placed around the base of the transmission pole to provide support and add to stability.

6.2.2 Water Resources

There are potential impacts to surface and groundwater resources including sedimentation and contamination of water resources during the construction and operational phases of the project.

6.2.2.1 Sedimentation

Solar PV Power Farm

The removal of vegetative cover and the disturbance of soil will result in an increase of sediments being transported in storm water runoff into waterways to be developed to facilitate drainage of the project site. It is normal for sediment loads to increase during heavy rainfall though such events are brief and tend not to have lasting effects. During the operational phase there will be no soil disturbing activities and this will reduce the potential for sedimentation resulting from surface water runoff. The runoff from the project site will not be used for irrigation purposes and will ultimately drain into the Essequibo River which is heavily sedimented. Potential impacts of sedimentation are **negative, direct, short-term** and **localised**, of **negligible significance** but are **almost certain** to occur, particularly during the periods of heavy construction during the construction phase. As such, this is a **Low Risk** of project activities. These risks may be managed by the establishment of an adequate drainage system, limiting vegetation clearance and nature based solutions like landscaping.

Transmission Line

The transmission line will be situated in proximity to canals in some sections. However, soil disturbance activities for the installation of transmission poles will be minimal. The construction of the transmission line may impact sedimentation of surrounding waterways only if poles are planted during rainfall periods when surface water runoff may contain increased sediment loads. Potential impacts of sedimentation from the transmission line are **negative, direct, short-term** and **localised**, of **negligible significance** but are **likely** to occur. This is a **Low Risk** of project activities.

6.2.2.3 Contamination of Water Resources

Surface waters within the project area may be accidentally or intentionally contaminated by the discharge of fuels, waste oils, lubricants, other hazardous wastes and non-hazardous wastes including general solid wastes during both the construction and operational phases of the project.

Solar PV Power Farm

During the construction phase of the project several waste streams are anticipated. These include general solid waste (including construction waste), hazardous waste (oily waste, solvents and used batteries), and liquid waste (sewage from latrines or portable lavatories at the construction site). Improper management of solid waste during the construction and operational phases could lead to waste dumping into surrounding canals. During the operational phase of the project, improper disposal of damaged, malfunctioning or decommissioned solar PV panels or lithium-ion batteries within the project site can result in the leaching of heavy metals into the soils and thereafter, into the surrounding waterways. There is also potential for the improper management of sewage from permanent facilities established to support project operations to also contribute to pollution of water resources. Consequently, improper disposal of waste may result in surface water contamination during both the construction and operational phases of the project. These potential impacts are **negative, direct, long-term, localised**, of **moderate significance** and **almost certain** to be generated by project activities. Without mitigation, soil contamination is a **High Risk** of both the construction and operational phases.

The implementation of good waste management measures during the construction and operational phases of the project can mitigate these risks. These include the implementation of appropriate waste management practices during the handling, transport, use and storage of hazardous materials and waste, particularly during the construction phase of the project. In addition, the waste management measures to be implemented by the project to manage liquid, solid and hazardous wastes will prevent this impact from occurring. In addition, special measures should also be put in place by GPL to facilitate the proper storage and disposal of damaged or defunct PV panels and lithium-ion batteries. Potential impacts of soil contamination of **minor significance** but are **unlikely** to occur if appropriate management measures are implemented. As such, the residual risk of this soil contamination from project activities is **Low**.

Transmission Line

No waste streams are anticipated during the installation or operation of the transmission line.

6.2.3 Climate Change

Adverse climate change impacts which could contribute to sea level rise, heavy rainfall that could lead to flooding, and variable patterns of precipitation that result in prolonged rainy conditions may negatively impact the project. In addition, the project is expected to contribute to climate change mitigation but will also be a minor source of emissions through fuel combustion during the construction phase.

6.2.3.1 Potential Adverse Climate Change Impacts

Sea Level Rise – Flood Risk

Flood risk associated with sea level rise was assessed in October 2021 under the assumption that the project site was the backshore of the brown sand beach. The topography of the project area along with present and future sea level conditions were used to assess the potential adverse impacts of sea level rise. Open-source digital elevation models (DEM) were utilized and verified against the findings of the elevation survey conducted by the Consultant's team (as presented in Section 4.1.4).

Selection and Preparation of Digital Elevation Models

Three DEMs selected for use in this assessment were:

- Multi-Error-Removed Improved-Terrain (MERIT) 90 meters⁵⁶
- Shuttle Radar Topography Mission (SRTM) 90 meters⁵⁷
- SRTM 30 meters⁵⁸

Terrain analysis performed on the raw DEMs showed that none of the three models captured the terrain profile when compared to the ground survey, as seen on the chart in **Error! Reference source not found.-2**. All DEMs were manipulated to better replicate the terrain and re-assessed. Figure 6-3 shows the SRTM 30 adjusted dataset performing the best when compared to the ground survey.

⁵⁶ Yamazaki, D., Ikeshima, D., Sosa, J., Bates, P. D., Allen, G. H., & Pavelsky, T. M. (2019). MERIT Hydro: A High-Resolution Global Hydrography Map Based on Latest Topography Dataset. *Water Resources Research*, 55(6), 5053–5073.

⁵⁷ United States Geological Service EROS Archive. Undated. Digital Elevation - Shuttle Radar Topography Mission (SRTM) Void Filled. Retrieved October 24, 2021.

⁵⁸ United States Geological Service EROS Archive. Undated. Digital Elevation - Shuttle Radar Topography Mission (SRTM) 1 Arc-Second Global. Retrieved October 24, 2021.

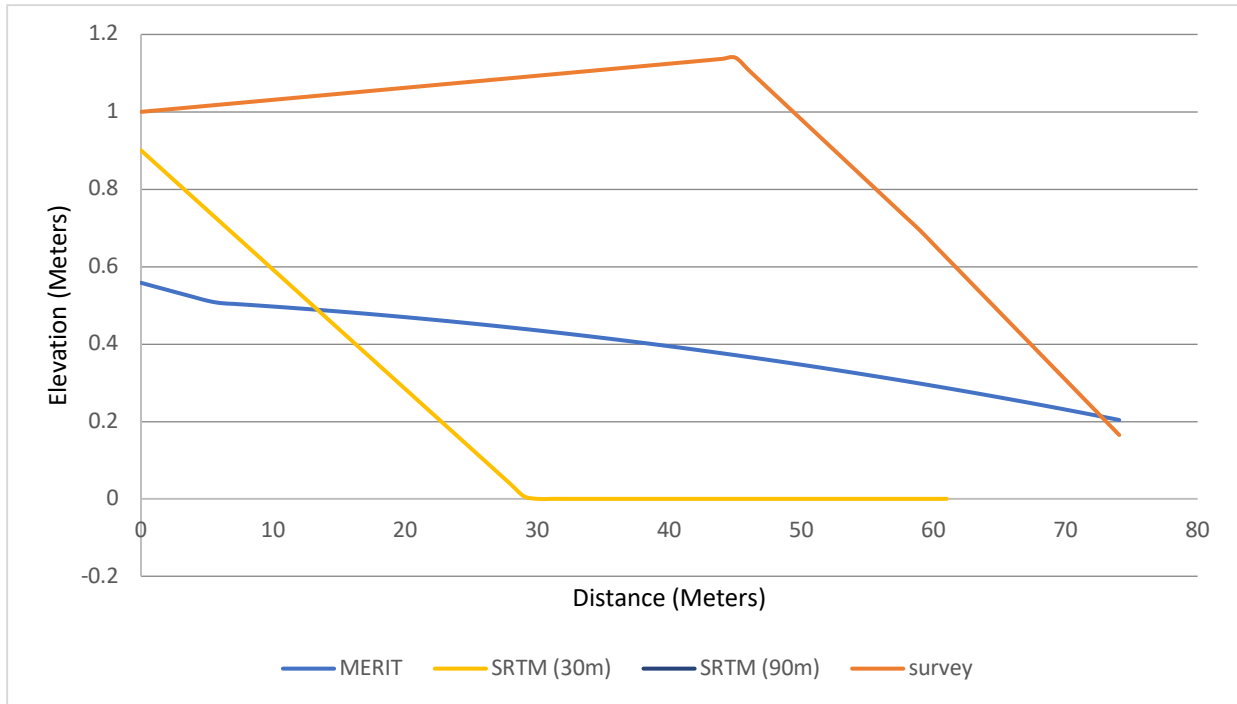


Figure 6-2: Terrain Profile Comparison of DEMs and Survey Area for Survey Points A to C (Southern Boundary of the Project Site) and the Water Level

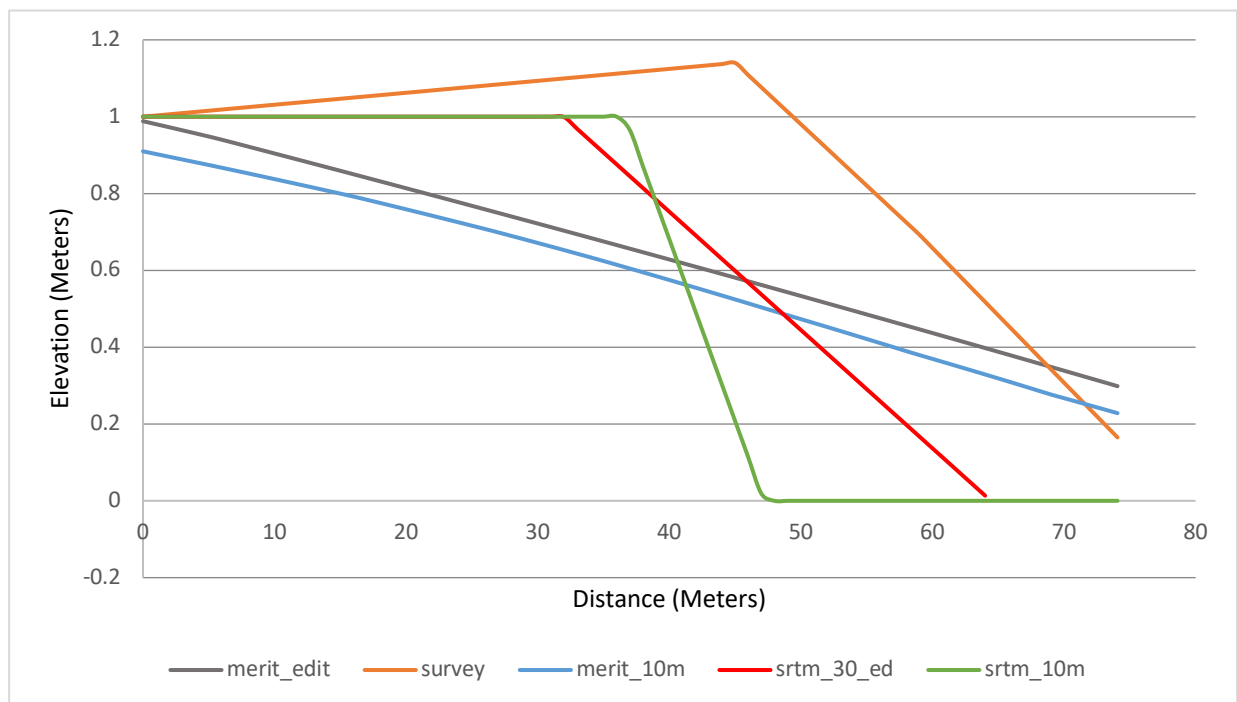


Figure 6-3: Terrain Profile of Adjusted DEMs for Survey Points A to C (Southern Boundary of the Project Site) and the Water Level

Due to the small footprint of project site, the SRTM 30 adjusted dataset was further manipulated via the Inverse Distance Weighted (IDW) and Nearest Neighbour (NN) interpolation algorithms to produce a higher resolution (1-meter) dataset which could better capture change in terrain in the area and immediate surroundings. Figure 6-4 presents terrain profiles and Figure 6-5 presents an elevation map.



Figure 6-4: SRTM Interpolated Terrain Profiles IDW and NN

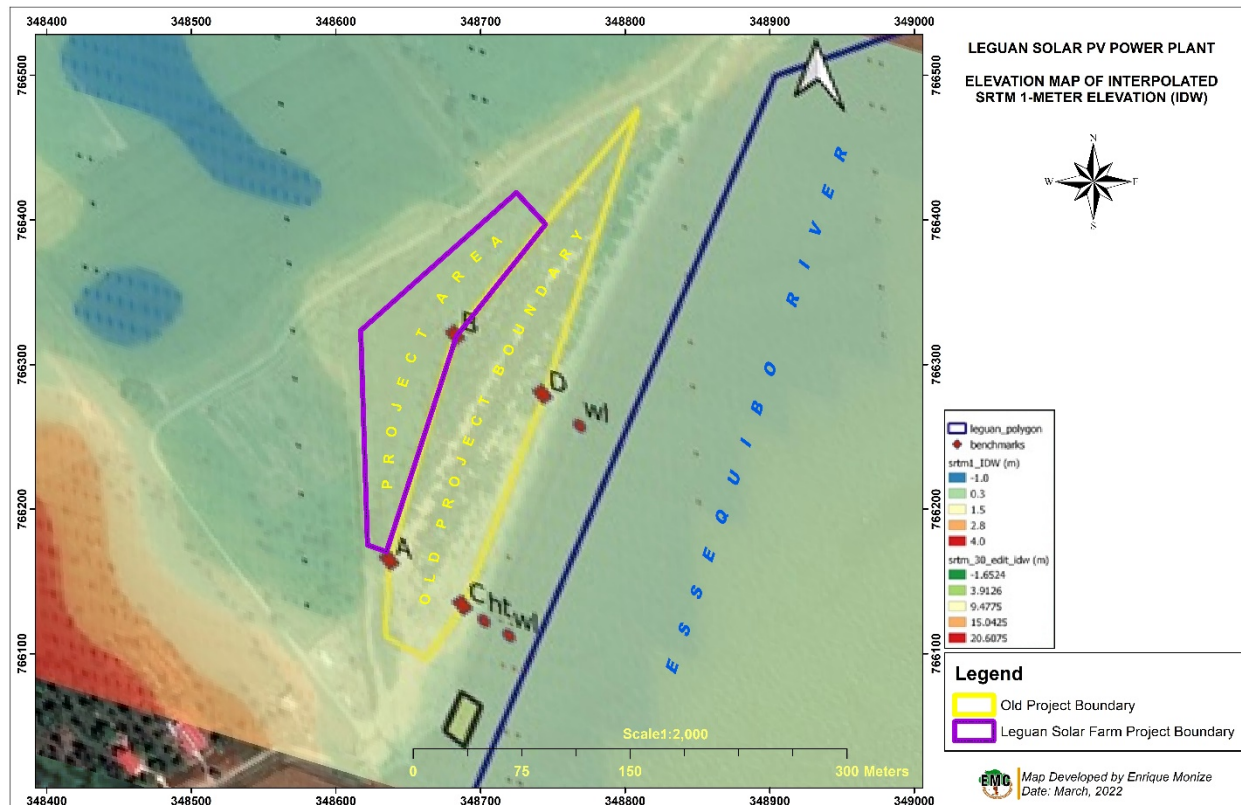


Figure 6-5: Elevation Map of Interpolated SRTM 1-Meter Elevation (IDW)

Historic Sea Levels

Local tide data was not readily accessible for the Leguan. As such, global daily-averaged dynamic sea surface height data interpolated to a regular 0.5-degree grid from datasets of the Consortium for Estimating the Circulation and Climate of the Ocean⁵⁹ was utilised. Sea surface heights for January 01 of 1992 to 2017 is presented in Figure 6-6.

⁵⁹ Fenty, I., & Wang, O. 2020. *ECCO Sea Surface Height - Daily Mean 0.5 Degree (Version 4 release 4)*. NASA Physical Oceanography DAAC.

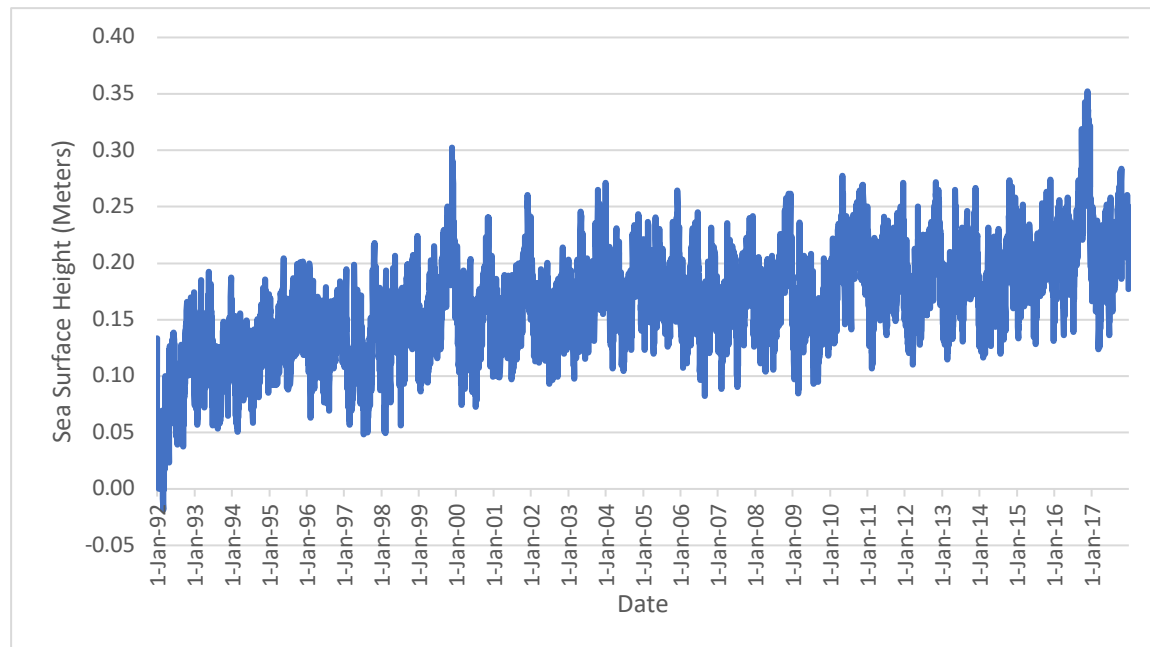


Figure 6-6: Sea Surface Height at Leguan Interpolated from ECCO (Version 4, Revision 4)

Projections of Sea Level Rise

According to the Intergovernmental Panel on Climate Change (IPCC), global mean sea level (GMSL) is rising and accelerating. GMSL from tide gauges and altimetry observations increased from 1.4 mm/year over the period 1901–1990 to 2.1 mm/year over the period 1970–2015 to 3.2 mm/year over the period 1993–2015 to 3.6 mm/year over the period 2006–2015.⁶⁰

Future rise in GMSL will be strongly influenced by greenhouse gas emissions. Four Representative Concentration Pathways (RCPs) were developed by the IPCC to describe different 21st century pathways of greenhouse gas emissions, atmospheric concentrations of greenhouse gases and air pollutants, and land use. The four RCPs were described as follows:

- RCP 2.6 is representative of a scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures. This is the most stringent scenario and is characterized by substantial net negative emissions by 2100. Under this pathway, sea levels are projected to rise 0.43 meters with a likely range of 0.29 to 0.59 meters by 2100 relative to 1986 to 2005.
- RCP 4.5 is an intermediate scenario in which emissions peak by 2040 and subsequently decline.
- RCP 6.0 is another intermediate scenario in which emissions peak by 2080 and subsequently decline.
- RCP 8.5 is considered to be the worst-case scenario and is characterized by significant levels of emissions. This scenario is considered to be useful in projecting mid-century impacts based on the current level of warming. Under this pathway, sea levels are projected to rise 0.84 meters with a likely range of 0.61 to 1.10 meters by 2100 relative to 1986 to 2005.

⁶⁰ Intergovernmental Panel on Climate Change. 2019. Special Report on the Ocean and Cryosphere on a Changing Climate. Chapter 4 – Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities.

RCP 2.6, RCP 4.5 and RCP 8.5 were utilized in this flood risk assessment. Projected sea level rise of the North Atlantic, for the 17th percentile and 83rd percentile, are presented in Figure 6-7 and 6-8 respectively.

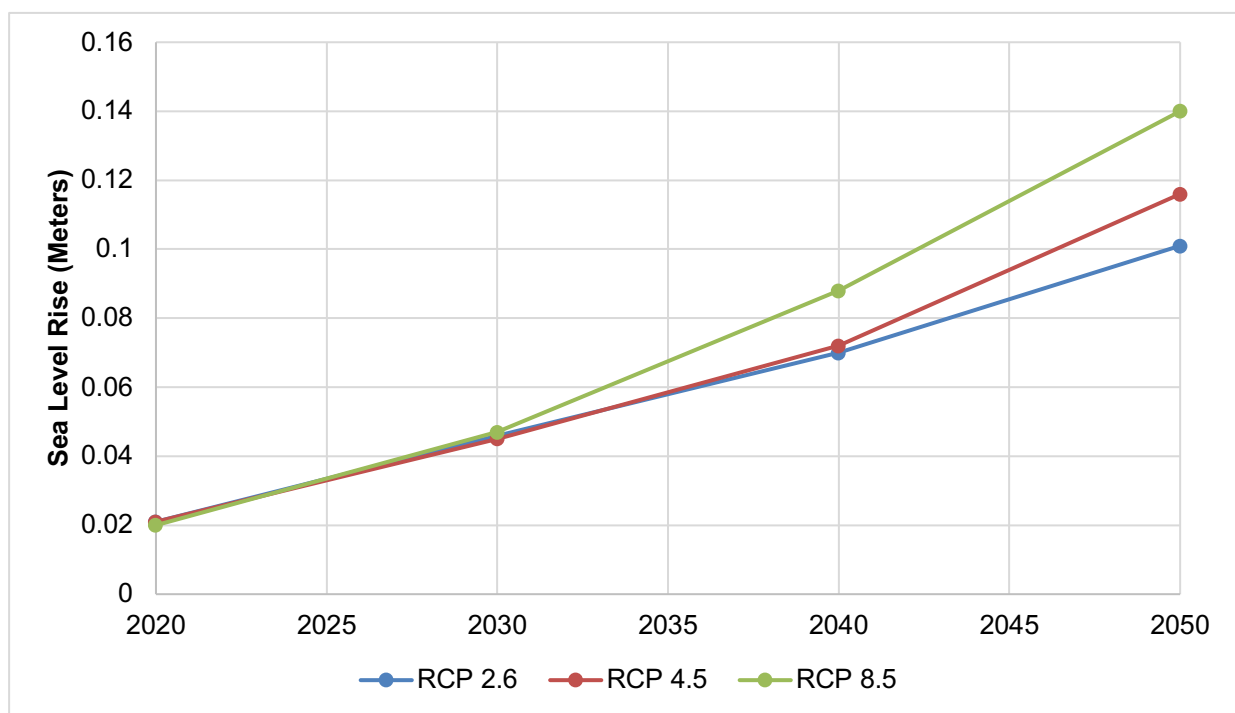


Figure 6-7: Sea Level Rise (17th Percentile) for RCP 2.6, RCP 4.5 and RCP 8.5

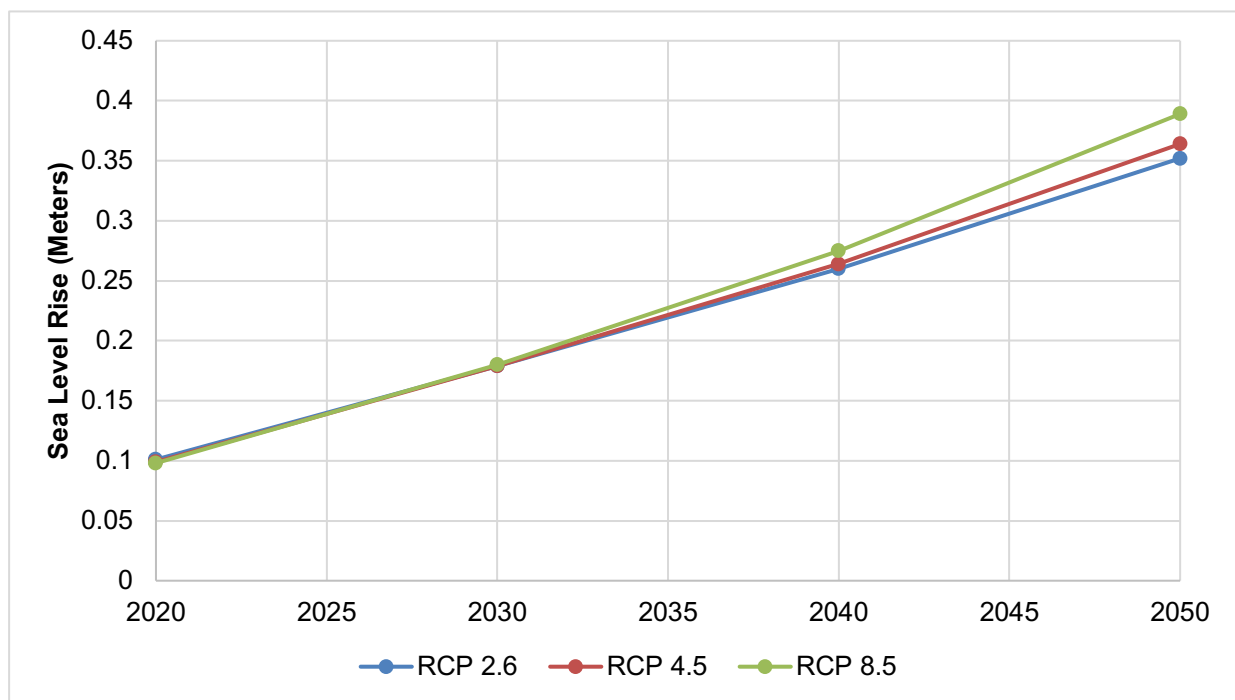


Figure 6-8: Sea Level Rise (83rd Percentile) for RCP 2.6, RCP 4.5 and RCP 8.5

The range of project sea level rise for Leguan is presented in Figure 6-9 and represents a lower limit of 0.1 meters (RCP 2.6 17th percentile) and an upper limit of 0.39 meters (RCP 8.5 83rd percentile).

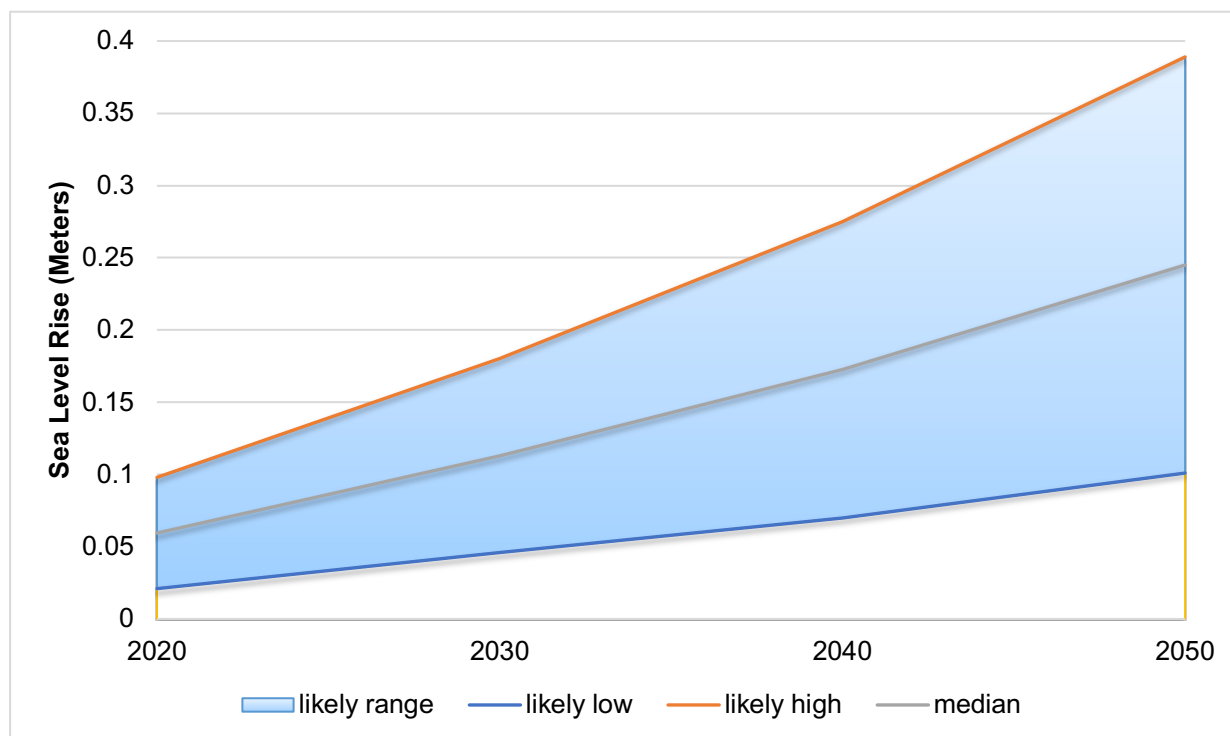


Figure 6-9: Likely Range of Sea Level Rise for Leguan

This RCP range is comparable to the national-level projections of sea level rise for Guyana of 0.21 to 0.43 meters by 2051 (relative to a 1960 to 2006 baseline) from the outputs of two Atmosphere-Ocean General Circulation Models (AOGCMs) forced by three SRES scenarios^{61,62}.

Flood Risk Assessment from Sea Level Rise

Sea Level Rise (SLR) projections of RCPs 2.6, 4.5 and 8.5 were compared against the interpolated SRTM 1-meter elevation dataset using QGIS to determine the potential inundation zones of sea level rise associated with adverse climate change impacts (Figure 6-10). The lower limit of the sea level change is largely comparable with the water levels currently observed at the project site.

⁶¹ Government of Guyana. 2012. Second National Communication to the UNFCCC. Pages 177 and 186 to 187

⁶² In 2000, the IPCC published a Special Report on Emissions Scenarios (SRES) covering a range of the main driving forces of future greenhouse gas emissions such as demographic, technological and economic changes. The A2, A1B and B1 were three of the scenarios developed by the IPCC and which were used to model projected climatic changes in Guyana.

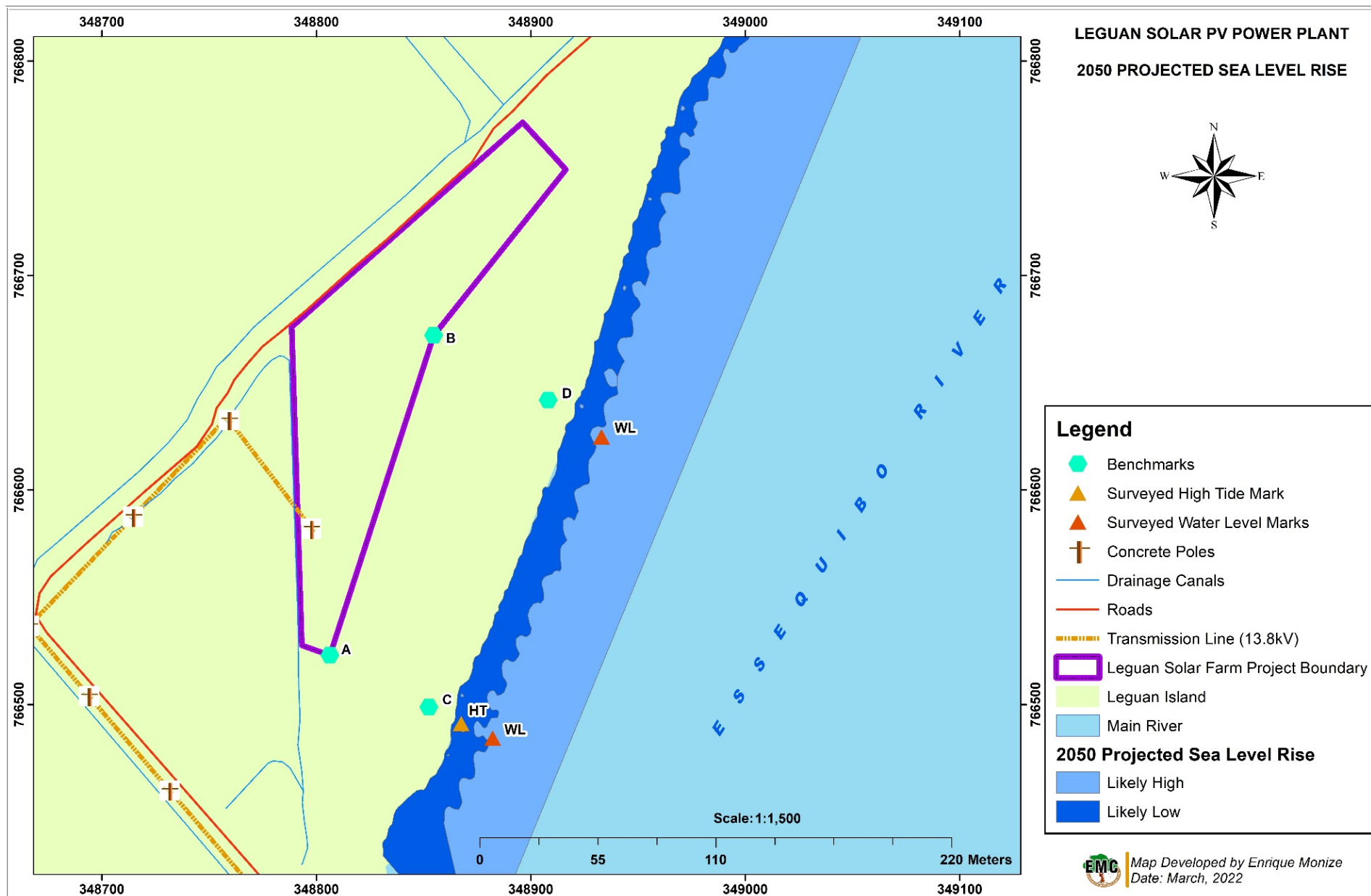


Figure 6-10: Inundation Range for Sea Level Rise (Lower and Upper Limit Projections)

The findings of the flood risk assessment indicate that no section of the previously identified site was expected to be inundated by 2050 as a result of sea level rise associated with adverse climate change impacts. However, this assessment is predicated on there being no significant terrain change or change in land stability throughout the lifetime of the project. The assessment did not consider the potential combined effect of sea level rise with other natural and anthropogenic forces associated with the following:

- Dynamism of shoreline features associated with the erosion and accretion cycle.
- Land instability and accelerated erosion associated with vegetation clearing.
- Short-term inundation associated with spring tides. Spring tides have also caused damage to drainage infrastructure (kokers and koker doors) resulting in fluvial flooding of several areas, particularly along the coastline of the villages of Success, Endeavour, Henrietta and Phoenix^{63,64,65}.
- Short-term inundation associated with potential storm surges. National level projections for Guyana indicate that storm surge heights may increase to maximum values of 5.89 to 6.09 meters by 2051⁶⁶.

Given that sea level rise is not anticipated to adversely impact the beach, the project site is not exposed to sea level rise during the 20-year lifetime of the project. In addition, the installation of hard sea defence structures along the shoreline in the medium-term will mitigate risks of beach erosion and allow for adaptation to adverse impacts associated with sea level rise. In particular, according to representatives of the Sea and River Defence Department, sea level rise is taken into consideration in the design of the height of the hard structures that are installed (*Personal Communication 01*). As a consequence, the potential impacts of sea-level rise to the project site are **negative, direct, long-term** and **localised**. These impacts are of **moderate significance** and will **unlikely** to occur during the project lifetime. As such, this is a **Medium Risk**.

Transmission Line

Flooding associated with sea level rise could adversely impact construction activities to erect transmission poles that will be located along the shoreline of some of the communities which have historically impacts when spring tides damaged koker doors. This impact is expected to be short-term and construction activities will recommence once the lands are drained. During operations, pluvial flooding could result in short-term inundation of the base of some of the transmission poles which may weaken pole foundations over time. Some decay of the section of the transmission poles submersed in saline waters may be expected. Potential impacts of flooding to the transmission line are **direct, short-term** and **localised** of **negligible significance** and **unlikely** to occur. As such, this is a **Low Risk** of the project.

Heavy Precipitation Events – Flood Risk

National-level projections for climate change in Guyana were prepared in 2010 using the outputs from several General Circulation Models following the A2, A1B and B1 scenarios⁶⁷. According to the World Meteorological Organisation (2010), the current levels of greenhouse gas emissions puts the world on a trajectory for more than 5°C of warming by end-century. This is most closely aligned with the A2 scenario and as a consequence the outputs of this scenario are considered to be most relevant to Guyana.

⁶³ Stabroek News. 2009. South Leguan Hit by Flooding. Article on June 25.

⁶⁴ Stabroek News. 2012. Leguan Flooding Receding Slowing. Article on April 09

⁶⁵ Guyana Chronicle. 2019a. CDC Monitoring Reports of Flooding on Leguan. Article on December 25

⁶⁶ Government of Guyana. 2012. Second National Communication to the UNFCCC. Page 187

⁶⁷ In 2000, the IPCC published a Special Report on Emissions Scenarios (SRES) covering a range of the main driving forces of future greenhouse gas emissions such as demographic, technological and economic changes. The A2, A1B and B1 were three of the scenarios developed by the IPCC and which were used to model projected climatic changes in Guyana.

All outputs from these models are projected changes in the mean relative to a 1960 – 2006 baseline period. The general trend from the three scenarios is that average annual precipitation will decrease but there is no clear direction of the trend as both positive and negative projections of change are generated when minimum and maximum values are considered. Moreover, the national level projections indicate that the proportion of total precipitation that falls in heavy events does not show a consistent direction of change as both positive and negative projections of change are generated indicating a future that includes risks of both flooding and drought.

The precipitation dataset for Leguan, available for analysis in this ESAR, covers the period January 2011 to September 2021. However, there are several months for which there is no data. Based on the available information, the highest monthly rainfall was 906.3 millimeters recorded in March 2011. This significantly exceeds the second and third monthly rainfall maximum of 595.5 millimeters and 581.2 millimeters recorded in February 2011 and December 2016 respectively. Indeed, February and March 2011 experienced significantly higher precipitation events than that normally recorded with the result that there was widespread flooding countrywide, including in Leguan⁶⁸. However, Leguan's total precipitation in February and March 2011 was significantly higher than rainfall records for other areas of the country. For example, monthly rainfall for Georgetown was 413.9 millimeters and 496.2 in February and March 2011.

With the exception of these anomalies, the wettest months are typically May and June which had the highest maximums in 2021 with 537.3 millimeters and 514.6 millimeters of rainfall respectively. On average, rainfall is also highest in these months with 362.2 millimeters and 315.6 millimeters in May and June respectively.

In order to further examine precipitation trends in Leguan, a log-normal distribution was prepared utilizing return periods⁶⁹ for the monthly maximum precipitation for each year of the 11-year record (Figure 6-11). Based on the findings, there is a 7 percent probability that monthly maximum rainfall will equal or exceed 900 millimeters, a 28.5 percent probability that monthly rainfall will equal or exceed 500 millimeters, and a 58 percent probability that monthly rainfall will equal or exceed 360 millimeters. Moreover, a monthly maximum of 900 millimeters has an estimated return period of 14.3 years. These trends should be considered with caution because of the limited data sets on which they are based. Ideally, robust observations on the direction and strength of any climatic changes should be based on at least 30 years of data. The data gaps and discontinuous records inherent in smaller datasets may either miss flood or drought events or amplify their effects in the observed trends.

⁶⁸ Kaieteur News. 2011. Countrywide Flooding as Heavy Rains Drench Guyana. Article on February 22.

⁶⁹ Return periods were calculated using Weibull's formula for return periods: $P = (m/(N+1))$

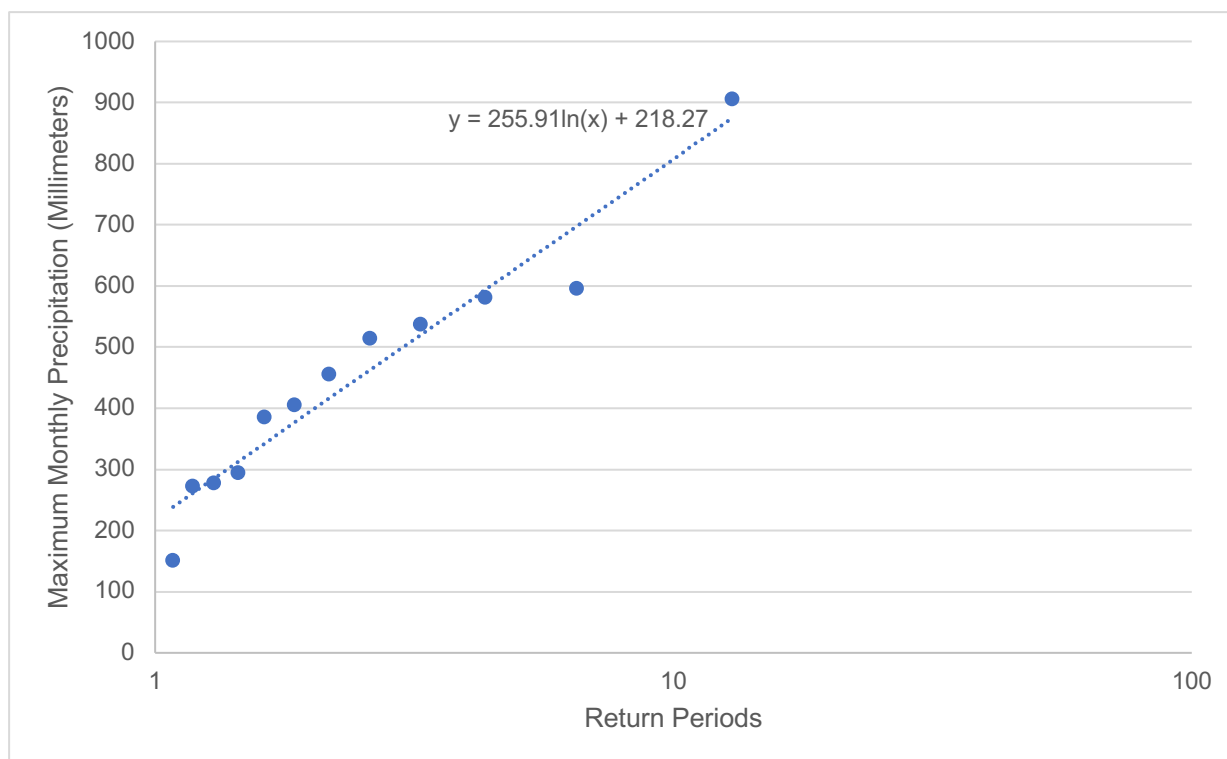


Figure 6-11: Return Periods for Maximum Monthly Rainfall

Leguan is not prone to fluvial flooding provided that all drainage structures (canals and kokers) are clear and working normally (*Personal Communication 01*). However, Leguan was flooded in February 2011 during the abnormally high rainfall experienced countrywide. Heavy rainfall events in Leguan, with precipitation surpassing 100 millimeters in a 24-hour period, resulted in significant flooding which was addressed only through Government's deployment of a mobile pump⁷⁰.

Project Site

Given the existing topographical and hydrological conditions, the project site can be susceptible to pluvial flooding. During the construction phase, heavy prolonged rainfall could adversely impact works, particularly works involving concrete such as foundation laying. Moreover, in the event of flooding during operations, solar PV panels are unlikely to be adversely impacted by flood events since they will be mounted above ground level. Potential impacts of flooding associated with heavy rainfall are **negative, direct, short-term** and **localised**. These impacts will be of **minor significance** but are **likely** to occur. As such, this is a **Medium Risk** to the project. These risks can be managed by the implementation of the measures intended to reduce the risks of erosion particularly raising the elevation of the project site and installing a drainage system to manage risks associated with pluvial flooding. With these measures, potential impacts associated with pluvial flooding are of **minor significance** but are **unlikely** to occur. As a result, the residual risk is **Low**.

In addition, mitigation and management measures which should be employed by the project to reduce risks associated with erosion and with fluvial flooding will also help to manage the risks of heavy precipitation events on the project site.

⁷⁰ Kaieteur News. 2011. Countrywide Flooding as Heavy Rains Drench Guyana. Article on February 22.

Transmission Line

Heavy precipitation during the construction of the transmission line could adversely impact activities to erect the transmission poles. Given the infrequency of pluvial flooding in Leguan, particularly flooding events that result in long-term inundated conditions, there are no anticipated impacts to the transmission line from heavy rainfall during operations. Moreover, the transmission poles will be made of concrete and thus will not be prone to decay if submerged. Potential impacts of flooding to the transmission line are **direct, short-term** and **localized**, of **negligible significance** and **unlikely** to occur. As such, this is a **Low Risk** of the project.

Variable Precipitation – Increased Shortwave Radiation

Adverse climate change impacts may also result in variable precipitation patterns. Prolonged wet season conditions which reduce shortwave radiation may marginally decrease power generation capacity of the solar PV power plant. There are no projections of changes in solar radiation for Guyana. However, national level projections do not show a clear direction of change. Annual average precipitation is expected to decrease and levels of shortwave solar radiation are lowest during rainy seasons, particularly the primary wet season. Variable precipitation patterns that reduce wet season conditions may contribute to a minute increase in shortwave radiation. The potential impact is **positive, direct, short-term** and **localised** but will be of **negligible significance**. However, the likelihood of such occurrences cannot be reasonably predicted. As such, no risk ratings can be produced for this potential impact.

Temperature

The 2010 projections indicate that average annual temperatures will continue to increase relative to the 1961 to 1990 baseline. At the national level, the mean annual temperature is projected to increase by up to 2.0°C by the 2030s, up to 3.3°C by the 2060s, and up to 5.6°C by the 2090s. According to the International Panel on Climate Change AR5, warm days and nights will increase as well as there will be increased occurrences of temperature extremes in the South American Region.⁷¹ The 2010 projections follow a consistent trend with substantial increases in the frequency of hot days and nights observed across all scenarios with the greatest increases occurring during the primary dry season. Consecutively occurring hot days can result in a heat wave.

Solar PV Power Farm and Transmission Line

Increased average annual temperatures and more frequent hot days could potentially result in heat stresses including heat strokes, heat exhaustion, heat induced cramps, heat rashes and dehydration being experienced by project staff for the solar PV power farm, and the transmission line. Indeed, mean net radiation is also greatest during the dry seasons and this may create a heat feeling for workers which exceeds ambient temperature levels. This impact may be amplified for project staff who work around heat generating machinery or who spend prolonged periods of strenuous work exposed to direct sunlight. The potential impacts associated with heat stresses to the project workforce are **negative, short-term** and **localized**, of **minor significance** but are **almost certain** to occur during both the construction phase and well as during the operational phase for maintenance of the solar PV arrays. Heat stresses present a **Medium Risk** to the project. However, heat stresses to personnel can be managed by measures to educate the workforce on the signs and symptoms of heat related illnesses, ensuring that there are cool areas for workers to rest and limiting outdoor work during hot days. Thus, these impacts are of **minor significance** but will be **unlikely** to occur resulting in residual risks that are **Low**.

⁷¹ Intergovernmental Panel on Climate Change, 2014a. AR5 Climate Change 2014: Impacts, Adaptation and Vulnerability, Chapter 27. Page 1499

During hot days, energy demand, including peak demand, may increase as locals increase the use of appliances such as fans and air conditioning units. The existing capacity of Leguan power supply may not be sufficient to meet this increased demand. As such, increased energy generation by the project – particularly during the day-time hours – will support climate change adaptation by providing a green source of energy for cooling. This potential impact is **positive, short- to long-term** and **local** of **minor significance** and **likely** to occur. As such, this provides a **Medium Likelihood of a Beneficial Impact**.

Transmission Line

Extreme temperatures and heatwaves have resulted in significant adverse impacts to electricity grids including causing the melting of power cables and sagging of transmission lines. For example, a heatwave in Oregon (United States) in June 2021, during which temperatures reached maximums of 46°C, resulted in the melting of power cables for the city's streetcars and overhead wires to sag⁷². However, temperature increases in Guyana by the end of the project lifetime are not anticipated to surpass 40°C and therefore, will not reach the levels at which transmission line damage has been observed to occur. In addition, increases in temperature results in linear changes of resistance of transmission lines which result in line losses⁷³. Potential impacts of increased line losses from temperature increases are **negative, short-term** and **localized**, of **negligible significance** and are **likely** to occur. As such, this is a **Low Risk** of the project. It is unlikely that any management measures could be deployed to manage this risk.

6.2.3.2 Greenhouse Gas Emissions

The primary direct sources of greenhouse gas emissions from the project will be emitted during the construction phase from the combustion of fuel by construction machinery and vehicles to be used by the contractor for all project components. These emissions are not expected to be significant and will be generated during the construction phase of the project. Although vegetation clearing will be required, the project site is not considered to be a forested area based on the definition of forests which has been adopted by the Guyana Forestry Commission (GFC) and instead, the vegetation comprises mainly of shrubbery and fruit trees. Greenhouse gas emissions for clearing fruit trees and shrubbery cannot be estimated as there are no emissions factors for these vegetation classifications. Based on these factors, the potential impacts to climate change from greenhouse gas emissions from this project is **negative, direct, long-term** and **localised** in extent. The significance of these impacts is **negligible** and their likelihood is **certain**. As a result, greenhouse gas emissions contributing to climate change are considered to present a **Low Risk** of contributing to increased greenhouse gas emissions at the national level.

6.2.3.3 Climate Change Mitigation

The operation of the solar power plant will offset the use of fossil fuel that would have been required to operate a diesel generator of a similar capacity. Over its 20-year lifetime, the project is expected to prevent the release of a total of 17,060 tons of carbon dioxide as compared with power generation from diesel. A solar power plant, in general, is built for more than the projected lifetime. After the expected lifetime, a solar power plant will be typically rehabilitated for a fraction of the newly built cost. Given the continuous development of technology and price reductions for project components, it is reasonable to expect the solar power plant to continue to operate beyond the 20-year design life. As such, additional emissions savings can be realised beyond this period if the solar power plant continues to operate. The project may also further contribute to climate change mitigation by reducing trips that would be required to transport fuel from Georgetown to Leguan to be used by diesel

⁷² Vox. 2021. The US Power Grid Isn't Ready for Climate Change. Article by Rebecca Heilweil on July 03.

⁷³ Ajenikoko, G. A; Adeleke, B. S. 2017. Effect of Temperature Change on the Resistance of Transmission Line Losses in Electrical Power Network. International Journal of Renewable Energy Technology Research.

generators. The potential impact of offsetting carbon emissions is **positive, direct, long-term** and **regional**. This impact is one of **moderate significance** and is **certain** to occur. As such, the project has a **High Likelihood** of contributing to a **Beneficial Impact** for climate change mitigation.

6.2.4 Ambient Noise Levels

Given the limited social and economic activities occurring around the project site, ambient noise levels measured during the baseline assessment were associated primarily with the natural systems. Noise levels and vibrations are expected to increase during the construction phase and are expected to include construction activities such as site preparation, earthworks, construction of project infrastructure; use of mobile equipment, which includes excavators and generators, and motorised vehicles for transportation of personnel, materials, and equipment to, and from the project site. During the operational phase, maintenance and repairs to project components as well as the periodic operation of various auditory safety signals such as fire alarms will also generate noise.

Solar PV Power Farm and Transmission Line

Project workers will be the main receptors of the potential noise impacts. According to the standard from the US Department of Labour, Occupational Safety and Health Administration, workers are at risk of adverse effects of noise exposure, including hearing loss, when noise exposure is at or above 85 decibels averaged over 8 working hours, or an 8-hour time-weighted average⁷⁴. However, risks of occupational exposure to high noise levels may be mitigated with the use of appropriate hearing protection. As a consequence, these potential impacts are **negative, direct, short-term, localised, of moderate significance** and **likely** to occur making it a **Medium Risk**. However, this impact will **rarely** occur if appropriate personal protection equipment (PPE) is used and all appropriate occupational health and safety procedures are followed. As such, the residual risk of noise nuisance to project workers is **Low**.

Solar PV Power Plant

The persons who reside in Canefield Village and those who practice agricultural activities are considered nearby receptors to some of the project activities including potential noise nuisance from construction activities including the movement of heavy vehicles through the village. These potential impacts could be managed by consulting with these receptors prior to the commencement of construction to inform them of planned project activities and to get feedback on any issues of concern. The contractor should also ensure noise levels during construction remain within the decibel limits established by the GNBS for construction activities which are a day-time limit of 90 dB and a night-time limit of 75dB. Potential impacts of environmental nuisances of noise from project activities are **negative, direct, short-term, localised, of negligible significance** and are **likely** to occur making it a **Low Risk** of project activities.

The main source of noise anticipated during the operations of the solar farm will be from the hum of the transformers. However, given the low capacity of the transformers and the distance from which they will be located from nearby receptors, this impact is not anticipated to be significant.

Transmission Line

The transmission line alignment intersects with several sensitive receptors including private residences, places of worship, schools, hospital and commercial enterprises. During the construction phase, noise generated will be short-lived and will cease following the planting of a pole. No noise nuisance is expected during the operation phase from the transmission line. Potential impacts of noise

⁷⁴ US Department of Labour, Occupational Safety and Health Department, undatedb. Occupational Noise Exposure.

nuisance from the construction and operation of the transmission line are **negative, direct, short-term, localised, of negligible significance** and are **unlikely** to occur. As such, this is a **Low Risk**.

6.2.5 Ambient Air Quality

Solar PV Power Plant

As discussed in Section 4.1.10, all air quality sampling locations recorded PM_{2.5} well within the threshold for “good” air quality and PM₁₀ was “moderate” based on the categorisations of the Air Quality Index developed by the Environmental Protection Agency of Victoria, Australia. This quality of the air was as a result of large particulate matter being derived from the brown sand beach and trees which would be picked up by the wind. During the construction phase of the project there is likely to be an increase of particulate matter from soil disturbance and from the use of materials such as cement which can generate some amount of dust. Further, during the construction phase pollutants associated with combustion of fuel used by construction machinery and other vehicles may be increased at the project location. However, particulate matter and gases from fuel combustion are likely to disperse rapidly given the open areas in which the project is situated. Potential impacts to ambient air quality are not anticipated during the operational phase of the project.

Project workers and residents of Canefield are considered to be the main receptors to potential impacts that affect ambient air quality. According to the standard from the US Department of Labour, Occupational Safety and Health Administration⁷⁵, workers are at risk of adverse effects of exposure to particulate matter (dust) with maximum exposure limits of 15 mg/m³. As a consequence, occupational temporary exposure to slightly elevated particulate matter are anticipated. These potential impacts are **negative, direct, short-term, localised, of minor significance** and are **likely** to occur. This is a **Medium Risk** of project activities. However, these impacts can be managed by the proper use of personal protection equipment by project workers including face masks and goggles. With these mitigation measures, potential impacts of occupational exposure are of **minor significance** and **unlikely** to occur. As such, the residual risk is **Low**.

Potential impacts of environmental exposure to high levels of particulate matter are **negative, direct, short-term, localised, of minor significance** but are **unlikely** occur. As such, these are **Low Risks** of the project.

Transmission Line

No adverse impacts to air quality are anticipated during the construction or operation of the transmission line.

6.3 Biological Resources

The beach adjacent to the project site is an accreted brown sand beach which was formed approximately 10 to 15 years previously. Since its formation, it has been dynamic with short periods of accelerated erosion and accretion. Vegetation cover grew opportunistically and is characterised mainly by shrubs and fruit trees. Given the relatively recent function of this beach, the primary ecological functions have not been well established. As a consequence, biodiversity of the project landscape has been habituated to the dynamic nature of shoreline change which is influenced principally by natural forces.

Moreover, the vegetation on the section of the project site identified for development is prevalent and widespread throughout the sections of the project site which will not be disturbed by project activities.

⁷⁵ US Department of Labour, Occupational Safety and Health Department, undated. Permissible Exposure Limits. OSHA Annotated Table Z-1.

Plant species that will be impacted by land clearing are not species of special conservation interest. Consequently, project activities are not expected to significantly transform existing habitats and or affect the long-term survivability of species present within the project landscape.

The impact assessment focuses on the site identified for the establishment of the solar PV farm. Vegetation along the route of the new of transmission line is significantly disturbed and are covered only by grass.

6.3.1 Vegetation

Project design activities will include geotechnical investigations, topographic and environmental field surveys at the project site. Personnel involve in these activities will access the project site by vehicle and by foot. Design impacts will consequently be limited to potential impacts from personnel and vehicle access to the project site. The lines for the topographic and environmental surveys will be manually cleared and limited to the space desired for the surveys. The potential impacts resulting from design activities are **negative, direct, short-term** and **localised**. These potential impacts are of **negligible significance** and are **certain** to occur. Therefore, these are **Low Risks** of the project.

Land clearing activities during project construction activities will result in the loss of vegetation cover and habitats. Land clearing will be undertaken primarily for the creation of space for the installation of project components. No vegetation clearing is required for the construction of access to the site and the installation of the transmission line. Vegetation clearing will contribute to habitat fragmentation. The habitat fragmentation may potentially contribute to a marginal weakening of ecological sub-units making the ecosystem of the impacted area more vulnerable to degradation. This potential impact is **negative, direct, long-term** and **localized**, of **negligible significance** and **likely** to occur. Therefore, these are **Low Risks** of the project.

Construction activities will also contribute to the loss of vegetation cover and habitat shelter, particularly for birds and small animals located within the project site. Resident fauna, particularly small animals will move to adjacent habitat areas to avoid construction impacts, while species habituated to existing conditions such as resident birds may easily adapt to and thrive successfully during project construction owing to their ability to adapt well to human altered environments. Consequently, it is important to preserve vegetation in areas not earmarked for project activities. Given the small footprint of the project, this potential impact is **negative, direct, long-term** and **localized**, of **negligible significance** and **likely** to occur. Therefore, these are **Low Risks** of the project.

The removal of vegetation cover and land clearing activities may result in the increase of sediment loads to receiving water bodies from eroded soil run-off during rain events resulting in the changes in water quality and increase turbidity. The loss of vegetation cover may also result in increases of nutrient loads in receiver water bodies from surface run off. Increases in nutrient loads could promote the proliferation of primary producers and lead to eutrophication and algal blooms in the canal immediately adjacent to the southern boundary of the project site. The potential for eutrophication and algal blooms are **negative, direct, short-term** and **localized**, of **negligible significance** and **unlikely** to occur. Therefore, these are **Low Risks** of the project.

There are no expected impacts on the vegetation during operations of the solar PV power farm.

6.3.2 Terrestrial and Aquatic Fauna

Vegetation clearing and the consequent habitat loss will result in some mortality to terrestrial vertebrate species, particularly those with reduced movement capabilities such as herpeto-faunal species and invertebrates. Only temporary and or localised displacement of birds and small mammals is expected due to their high mobility and the availability of alternative areas of similar suitable habitat types

adjacent to the project site. Resident fauna, particularly small mammals and birds will move to adjacent habitat areas to avoid construction impacts, while species habituated to existing conditions such as some resident birds may easily adapt to and thrive successfully during project construction owing to their ability to adapt well to human altered environments. Potential impacts of habitat loss and displacement impacts on terrestrial fauna during project construction are expected to be **negative, direct, long-term** and **localised** of **minor significance** and **likely** to occur. Therefore, these are **Medium Risks** of the project. However, these risks may be managed by the implementation of live capture guidelines for fauna with limited mobility during project construction. With the application of these guidelines, this impact will be of **negligible significance** and **likely** to occur resulting in **Low** residual risk.

The removal of vegetation cover may increase sedimentation of receiving water bodies resulting in the changes in water quality and increase turbidity. Changes in the water quality may result in temporarily reduced habitat quality for aquatic organisms, in turn resulting in temporary changes in the aquatic ecology. However, sedimentation of water bodies as a result of construction activities is not expected to be significant and can be managed with the establishment of a system for drainage. Moreover, the Essequibo River into which the drainage canals discharge is also highly sedimented and contains fauna that are habituated to these conditions. These potential impacts are **negative, direct, short-term** and **localized**, of **negligible significance** and **unlikely** to occur. Therefore, these are **Low Risks** of the project.

The physical disturbance and noise produced by equipment may impose additional stresses upon wildlife and may lead to increased migration away from impacted areas. While disturbances may be stressful for some wildlife, other species may easily adapt to and thrive successfully in the area owing to the phenomenon of habituation. These impacts are expected to be **negative, direct, short-term** and **localized**, of **negligible significance** and **almost certain** to occur. Therefore, these are **Low Risks** of the project.

During project construction, hydrocarbon contamination of the aquatic systems may occur as a result of accidental spills of lubricants and fuel and other contaminants. Hydrocarbons introduced into aquatic environments may change aquatic plant and animal growth, mortality and communities. Contaminants entering the aquatic systems could be ingested by aquatic organisms causing reproductive impairment, stunted growth, and other physiological effects. Also, as contaminants naturally break down, they use dissolved oxygen, sometimes significantly reducing the DO content of the water, which could reduce the overall habitat suitability for many aquatic organisms. Potential impacts on aquatic species of hydrocarbon spills are **negative, direct, short-term** and **localized**, of **moderate significance** and **likely** to occur. As such, this is a **Medium Risk** of project activities. However, these impacts can be managed with the implementation of a proper waste management measures. With appropriate management measures in place, this impact will be of **minor significance** and **unlikely** to occur resulting in **Low** residual risk.

The presence of workers may promulgate the presence of domestic and synanthropic species during the construction and operational phases. An increase in these species may affect native species by acting as predators, competitors and disease vectors. Synanthropic species such as mice and rats tend to increase due to the availability of food. Predator and scavenger species may also be attracted to the site for fleeing or dead animals. However, the project site and the foreshore contain significant quantities of litter which may have also served as an attractant for these species. Potential impacts of the project increasing promulgation of these species are **negative, direct, short-term** and **localized**, of **negligible significance** and **unlikely** to occur. Therefore, these are **Low Risks** of the project.

Large scale solar farms of approximately 50MW have the potential to deter, attract, or be imperceptible to individuals, all of which can lead to negative consequences during operations, including:

- Avoidance of solar facilities, which may lead to use of lower quality habitat or population fragmentation; and species attracted to solar facilities might be victims of ecological traps.
- Electromagnetic fields created by buried and aerial cables transporting energy can affect orientation of some organisms, impairing habitat use and likely causing additional physiological harm.
- Changes in albedo from vegetation removal could cause local increases in temperature and evapotranspiration, which may influence movement patterns, reproductive success, and survival.
- Species unable to detect or avoid structures (e.g., power lines, glass windows) are at risk of collision and direct mortality.⁷⁶

The Leguan Solar PV Power Farm is a small-scale facility and the potential impacts described above are not anticipated to occur. Alternatively, solar facilities may attract and provide high quality habitat for non-native or urban adapted species. Individuals might be attracted to these sites because of microclimatic conditions, cover and enhanced prey density, which could benefit species such as birds that can exploit solar facility structures for foraging, roosting or nesting. This potential impact is **positive, direct, short-term** and **localised**, of **negligible significance** and **unlikely** to occur. As such, this impact has a **Low Likelihood** of producing a **Beneficial Impact**.

6.4 Socio-Economic Resources

The project is expected to have both positive and negative socio-economic impacts during its planning, construction, and operation phases. The overall positive impacts include access to clean, cost-effective electricity, increased income and employment, and community development. If not properly managed or mitigated, negative impacts such as glare and traffic can affect nearby communities, road users, and other activities within the area. During the construction phase, the impacts may be regarded as temporary or short-term, while long-term impacts may be observed during the operation stage.

Generally, the assessment of potential socio-economic impacts consider the project as a whole. Therefore, unless specified otherwise, the potential impacts have taken consideration of all project components (solar PV farm and transmission line).

6.4.1 Land Use

There are no existing uses of the project site. Livestock, particularly cows and goats, may wander into the project site from nearby pasture lands to graze. However, the area is not actively used for grazing animals by locals. Given the lack existing activities on the project site, potential impacts of land use conflicts are expected to be **negative, direct, short-term** and **localised** of **negligible significance**. These impacts are anticipated to occur **rarely**. As such, this is a **Low Risk** of the project.

6.4.2 Economic and Community Development

6.4.2.1 Economic Development of Leguan

The project has the potential to significantly contribute to the economic development of Leguan, the project's main beneficiary community. Leguan has a history of electricity generation challenges. GPL became operational only around 25 years ago and power supply was intermittent until 2015 when expansions were made to allow for 24-hour uninterrupted service. Currently, electricity supply in Leguan is considered to be stable and reliable. This may be a function of it being both a relatively small and a new grid. However, this may be challenged in the future by increasing demand for electricity in Leguan as well as the potential expansion of the grid by interconnection with the grids of

⁷⁶ Chock, et al. 2020. Evaluating Potential Effects of Solar Power Facilities on Wildlife from an Animal Behaviour Perspective.

Wakenaam and Hogg Island. The electricity generated by solar PV power farm will diversify the grid and make an additional, alternative source of power available to address these foreseen challenges.

A stable and reliable source of electricity is expected to contribute to encouraging greater investments in the local economy. With a stable source of electricity, increased numbers of small businesses could also emerge and may also help to address the phenomenon of migration from Leguan for employment purposes. These benefits may be magnified if the project can result in lower rates of electricity. Indeed, most of the stakeholders engaged as part of the preparation of this ESAR shared expectations of reduced electricity rates particularly given that the current service provided by GPL is stable and reliable. Overall, the potential impacts of community development resulting from a clean and redundant source of power are **positive, direct, long-term and local**, of **moderate significance** and **almost certain** to occur. This is considered to result in a **High Likelihood of Beneficial Impacts**.

However, stakeholder expectations of this project need to be carefully handled. Key stakeholders such as the NDC and Leguan residents should be informed of the expected LCOE when this is determined. In addition, these stakeholders should also be informed of the near- to medium-term plans for tariff structures as well as possible rate reductions which can be reasonably delivered by the project.

6.4.2.2 Access Road in Canefield

During engagements with the Consultant's team, several residents of Canefield Village shared the expectation that the main road in the community which is used to access the project site will be constructed and repaired as a result of project implementation. The road is an earthen dam with some areas filled in by sand. Currently, the road is in poor condition and is subject to deterioration during heavy rainfall or during spring tides when overtopping causes ponding of water on the path. The use of this roadway by the project, particularly for the transportation of heavy vehicles and machines during the construction phase, may contribute to its further deterioration. This impact is **negative, direct, short- to long-term and localised**, of **minor significance** and **almost certain** to occur. As such, this is a **Medium Risk** of the project.

This impact may be managed by leveraging opportunities to contribute repairs and maintenance of this roadway during the construction phase of the project. For example, the machinery or workforce assigned to the project may help to fill potholes. In the medium- to long-term, the solar farm project in Oakum may be an incentive for Government to extend the asphalted road main road through Canefield Village leading to the project site. Potential impacts of the project incentivising the construction of an asphalted main road in Canefield are **positive of moderate significance** and **likely** to occur. This results in a residual effect that has a **Medium Likelihood** of resulting in a **Beneficial Outcome**.

6.4.3 Employment and Local Content

Positive socio-economic impacts are expected to occur whenever a project of this magnitude and duration is undertaken in remote, rural communities, especially where employment opportunities are limited. In particular, the project may provide opportunities for employment for vulnerable and marginalised groups including women and youth. Income earned from employment with the project can play a role in improving welfare and the quality of life of employees and this positive effect will be amplified if vulnerable persons have the opportunities to be employed. In particular, the project will support the Women's Economic Empowerment Programme (WEEP) through which approximately 200 women in the three EMISDE project locations namely Bartica, Mahdia and Lethem are to be involved. The number of women to participate in WEEP for the Leguan project is yet to be determined. The Programme will encourage its participants to become engaged in a productive use of electricity generated by the project by investing in small and medium scale enterprises. This, thereby, will also contribute to employment and community development. The potential impacts of project employment on local populations are **positive, direct, short- to long-term and local**. To the extent possible, the

project will prioritise employment of persons from local communities during both the construction and operational phases. As such, these impacts are expected to be of **minor significance** and **almost certain** to occur. In this regard, project employment is considered to result in a **Medium Likelihood** of creating a **Beneficial Impact**.

As part of the EPC, the contractor will be required to provide training to staff on safety, best practices, and operation and maintenance of the solar power plant. The training will be provided on-site by a certified engineer after commissioning of the solar PV power plant. GPL has highlighted the need for capacity building of its personnel to manage the solar PV power plant as well as to install and maintain 13.8 kV transmission lines. As such, the project will provide the opportunity for capacity building and skills development of GPL employees. During the operational phase of the project opportunities for training could encourage young people to seek employment with the project and to remain in Leguan since a viable and skilled livelihood option is available on the Island. Employees training by the EPC contractor may then provide training and knowledge sharing with other GPL employees and potentially with new recruits. The potential impacts of providing training to the project workforce are **positive, direct, short to long-term**, and **local**. If the project prioritizes local talent for employment, these impacts are expected to be of **moderate significance** and **almost certain** to occur. As such, project employment is considered to result in a **High Likelihood** of **Beneficial Impacts**.

In addition to local communities benefitting from direct employment with the project, there are several opportunities for the project to provide indirect employment and support local content. Specifically, the project is also expected to indirectly impact employment prospects for businesses that will provide goods and services to support the workforce including off-site accommodation, catering, and transport. This not only provides additional opportunities for local communities to benefit from the project, but will also reduce costs required to transport materials, equipment and other goods and services from Georgetown if they are available locally. The potential impacts of indirect employment and procurement from local suppliers are **positive, direct, short- to long-term**, and **local**. If the project prioritizes local content, these impacts are expected to be of **moderate significance** and **almost certain** to occur. As such, project employment is considered to result in a **High Likelihood** of **Beneficial Impacts**.

6.4.4 Aesthetics and Visual Impacts

The project will see a total transformation from the current setting and landscape of the proposed site. The elements associated with the project will have a visual impact and, in so doing, impact the landscape and potentially cause visual intrusion. Construction activities are expected to change the aesthetics of the project site as a result of clearance of vegetation, construction of buildings, power lines, worker presence and activity, dust emissions, and soil stockpiles. However, aesthetic impacts associated with project construction (construction offices, sanitary facilities, excavated lands, etc.) are temporary.

During the operation of the project, depending on the height to which they are elevated, the solar panels will reflect sunlight and could become a distraction for surrounding land users (residents of Canefield) and users of the beach. The impact can be managed by careful consideration of the position of solar PV panels so as to minimize visual disturbance while also maximizing power generation capacity. Solar PV panels with low reflectivity should also be utilised. Moreover, given that the primary purpose of the adjacent beach is for recreation, the project will irreversibly alter the aesthetics of this area. Potential aesthetic and visual impacts of the project are **negative, direct, short to long-term**, and **localized**, of **moderate significance**. Even with the implementation and mitigation measures, these impacts are **likely** to occur. As such, this is a **Medium Risk** of the project.

6.4.5 Traffic

Traffic on Leguan Island and particularly in the vicinity of the project site is not significant. When the construction phase begins, there will be a marginal increase in traffic volume, particularly of heavy vehicles used to transport equipment and construction materials to the project site. In addition, during the construction phase, the contractor may transport materials and equipment overland and via River from Georgetown or Parika. This may potentially result in related indirect impacts of deteriorating roads, increasing dust and noise levels, and safety risks. Potential impacts of increased traffic associated with project activities, particularly during the construction phase, are **negative, direct, short-term**, and possibly, **regional**. Given that information on potential traffic associated is entirely unknown, the magnitude of the impact and its associated risks are not assessed.

Transportation of materials to Leguan Island will also require transportation via river. Currently, a daily ferry service between Leguan and Parika is operated by the Transport and Harbours Department. The ferry service is the primary means of transporting cargo to and from Leguan. The use of the ferry service to transport construction materials and cargo to the project site during the construction could place pressure on this resource and may also outcompete use of this service by Islanders. Transportation of heavy machinery and materials may exceed the rated capacity of the ferry creating safety concerns. This impacts of **negative, direct, short- to long-term** and **localised**, of **moderate significance** and are **likely** to occur. These are **Medium Risks** of the project. However, these risks may be prevented either by identifying an alternative means for transportation of materials and equipment to Leguan (for example, via barge) or making multiple smaller trips by ferry to reduce pressure on this service. With these management measures in place, this potential risk is of **negligible significance** and **unlikely** to occur. Thus, this residual risk is **Low**.

6.4.6 Conflicts with Local Communities

The presence of non-local project workers during the construction phase could have a negative impact on local communities, if not properly managed. Non-local workers could lead to bad relations particularly between the male workers when the females are shown increased attention that is perhaps unwanted. Interpersonal relationships with married persons could disrupt community dynamics. There could also be cases of unwanted pregnancies particularly affecting the younger women of the community. The abuse of alcohol and other drugs can be detrimental to the community when introduced and encouraged by non-local workers. There could be an increase in the risk of transmission of sexual diseases with the migration of workers into the communities who will have purchasing power and can use that power to influence persons to engage in sexual practices. In addition, the presence of a non-local construction crew to the area can create security fears among local residents. In addition, if local communities are not provided with fair opportunities to be employed by the project, conflicts may arise due to a feeling of disenfranchisement. Potential impacts of conflicts between locals and non-local project workers are **negative, direct, short to long-term** and **localised**, of **moderate significance** and are **likely** to occur. These are **Medium Risks** of the project. If appropriate management measures are put in place this potential impact will be **unlikely** to occur. However, the residual risk rating remains **Medium**.

6.4.7 Archaeological Resources and Cultural Heritage

The project site was formed as a result of recent accretion of brown sand along the Leguan shoreline. As such, the potential for uncovering valuable artefacts is virtually non-existent. The route for the transmission line are historically disturbed areas rendering the likelihood of artefact discovery improbable. In addition, two local heritage sites are located along the route of the transmission line, the St. Peter's Anglican Church and a Statue of Lord Hanuman. Neither of these sites are located within the secondary Aol and are not expected to be impacted by installation of the transmission line, Potential impacts of loss or damage to archaeological resources during the construction phase are

negative, direct, long-term, regional, of minor significance but may **rarely** occur given the recent accretion of the project site and the history of land disturbance at the sites for the associated facilities. As such, this presents **Low Risks**.

6.5 Health and Safety

6.5.1 Occupational Health and Safety

Health and safety are key concerns at construction sites. Workers are usually exposed to situations which can result in serious accidents, some of which can be fatal, if an occupational health and safety system is not designed and properly communicated and enforced. Given the nature of this project, the occupational health and safety risks are most significant during the construction phase of the project including the establishment of the transmission and distribution system. The following are therefore possible health and safety risks which are likely to be encountered at the construction site:

- Injuries or death caused by the toppling of heavy-duty equipment.
- Injuries or death from vehicular collisions particularly project personnel travelling overland and via river from Georgetown to Leguan, as well as within Leguan.
- Injuries from slips, trips and falls.
- Injuries or fatalities from electrocution.
- Ill health caused by insect bites/stings from hostile fauna.
- Injuries or death caused by snake bites.
- Injuries or ill health caused by heat-related illnesses such as sunburn, heat stress, heat exhaustion or heat stroke as a result of working under extremely hot conditions.
- Sickness caused by continuous exposure to excessive noise from heavy duty equipment.
- Illness caused by vector borne diseases.
- Illness caused by exposure to water borne pathogens.

While training and monitoring will be conducted and can reduce the risk of any serious incidents, accidents can still occur. Risks may include accidents during land clearing operations, transporting of materials, the use of heavy-duty equipment, improper use of equipment, slip or trip while traversing the work sites, etc. In such cases, these exposures can result in physical injuries such as cuts, bruises, loss of limbs or can even be fatal. Exposure to high noise or dust levels can also result in increased stress levels.

Construction works can lead to water lodging which increases the risk of mosquito borne diseases such as malaria. Health and safety impacts could be exacerbated taking into consideration the access to immediate emergency and proper health care within the area since the Leguan Cottage Hospital is not equipped to handle serious health cases and serious cases have to be referred to the West Demerara Regional Hospital or to Georgetown. Potential impacts to workers health and safety are **negative, direct, short to long-term and local**. These potential impacts are of **major significance** and are **likely** to occur at project worksites. As such, occupational health and safety impacts are a **High Risk** of the project. However, these impacts can be mitigated if appropriate mitigation measures are put in place and are therefore are **unlikely** to occur. This presents residual risks that are **Medium**.

6.5.2 Public Health and Safety

Given that the project site is located in a very accessible area, has a proximate residential area and is popularly used as a beach, people may be curious to observe activities at the project site. This can present serious a public hazard. As such, if the sites are not secured members of the public could get too close to the activities, creating a safety risk. Traffic increase will also be seen along the roadway leading to the access site as works intensify as construction materials and workers are sourced from nearby areas. Currently, traffic within the area is minimal. There is the risk of accidents occurring

during both the construction and operation phases. Potential impacts to public health and safety are **negative, direct, short to long-term, local, of major significance** and are **likely** to occur at a worksite particularly during construction. This results in **High Risks**. However, this impact will be **unlikely** to occur if appropriate measures are put in place resulting in residual risks that are **Medium**.

6.5.3 COVID-19 Pandemic

The possibility of a COVID-19 outbreak remains high and the number of cases has continued to increase nationally. Nevertheless, it is recognized that this situation can only be partially managed by the project even if all measures are followed to prevent occupational spread, given that employees may engage in risky behaviours when not on duty. Interactions among employees coming from local communities and from other areas in Guyana, including Georgetown which is a hotspot for the virus, can increase the risk of contracting and spreading the virus. When these employees return to their homes they in turn put family members and local communities at risk of contracting the virus. Adverse health outcomes associated with the spread of COVID-19 are **negative, direct, long-term and regional**. These potential impacts are of **major significance** and are **likely** to occur. This is a **High Risk**. However, the strict adherence to public health measures, including vaccination of the project workers could significantly reduce risks making transmission of the virus **unlikely**. Thus, the residual risk of COVID-19 transmission is **Medium**.

6.5.4 Emergency Response Services

The project will rely, to some extent, on local emergency responders. However, the capacity of emergency responders in Leguan is limited, as follows:

- The Leguan Cottage Hospital is not equipped to manage serious illnesses or injuries. Currently, only one doctor is assigned to the Hospital and is on call 24 hours every-day. The costs for medical evacuations for treatment of serious cases is borne privately.
- The Leguan Fire Service is an auxiliary unit of the Guyana Fire Service and is equipped with one fire tender.
- The Leguan Police Station is capacity constrained and there is only one traffic rank on the Island. The Police Station is working with residents to resuscitate the Leguan Community Policing Group.
- The capacity of the Sea and River Defences Department and the National Drainage and Irrigation Board to manage flooding associated with extreme rainfall or breach of coastal infrastructure like kokers and sea walls.

Given the capacity constraints of the local emergency responders, any additional demand due to project activities will further strain these systems. These impacts are **negative, direct, short-term and local**. These potential impacts are of **minor significance** and are **likely** to occur during the project lifetime. As such, this is a **Medium Risk** of the project. However, this impact may be managed by implementing measures for emergency response into the project design including making provisions for first aid certification for project personnel, for medical evacuation, for first-level emergency fire response, securing the project site, ensuring that project traffic complies with all regulations and ensuring that an adequate drainage system is installed at the project site. With the implementation of these measures, this risk is **unlikely** to occur making the residual risk **Low**.

6.6 Project Site Decommissioning

Based on feedback provided by the GEA, the project site is expected to continue to operate beyond the 20-year lifetime due to the interaction of several factors. National policies have prioritized the transition of power generation to renewable and other cleaner sources of energy. With the infrastructure in place to facilitate relatively easy replacement of damaged or defunct plant components

(PV panels, batteries and inverters), it is likely that investments will be made to ensure that the solar PV facility remains operational well beyond the stated 20-year time frame. Moreover, the GEA plans, in the near- to medium-term, to expand the solar PV farm to further increase the generation capacity of this planned phase. This expansion is also intended to last well beyond a 20-year project life. Anticipated enhancements to solar PV technology may further extend functional lifetimes of any components which are replaced either during or after the lifetime of the project. As a consequence, decommissioning of the solar PV plant is not anticipated to occur within the 20-year project lifetime. Instead, the positive benefits of power generation associated with the project is expected to continue beyond this time. These impacts are **positive, direct, long-term** and **localised** of **moderate significance** and **almost certain** to occur. As such, this impact has a **High Likelihood** of producing a **Beneficial Impact**. However, if the plant will be decommissioned the future use of the site will be determined by the Government and other stakeholders.

6.7 Cumulative Impacts

6.7.1 Energy Generation and Renewable Sources of Energy

In Guyana's Nationally Determined Contribution which was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016, the country aspires to generate 100 percent of electricity from renewable sources by 2030. At the national level, the Leguan Solar PV Power Plant will contribute to the total renewable energy already being generated from multiple projects including:

- A combined capacity of 3.5 MW from EMISDE solar power projects in Bartica, Mahdia and Lethem.
- The 0.4MW solar farm in Mabaruma, Region 1.
- The Green Public Sector Programme.
- Small hydropower facilities in Hosororo, Region 1 and the ongoing construction of the Kato Hydropower Project in Region 8.
- Other plans for developing renewable energy initiatives include the Amaila Falls Hydropower Programme which is also located in Region 8, the Kumu Hydropower Project in Region 9 and the rehabilitation of the Moco Moco Hydropower Plant in Region 9.

This impact is **positive, direct, long-term, cumulative, regional**, of **moderate significance** and **almost certain** to occur. As such, this impact has a **High Likelihood** of producing a **Beneficial Impact**.

6.7.2 Employment and Community Development

As discussed above, the project is expected to contribute to the overall well-being of Leguan by providing opportunities for local employment and procurement of goods and services particularly during the construction phase of the project. Cheaper, more reliable and expanded electricity supply can also facilitate economic development and diversification with the local economy when the facility becomes operational. These positive benefits of the project, in combination with existing commercial activities and livelihood activities will likely result in economic impacts that are **positive, direct, cumulative, regional, short- to long-term**, of **minor significance** and **certain** to occur. This impact therefore has a **Medium Likelihood** of producing **Beneficial Impacts**.

Please see Table 7-1 which provides a summary of the Potential Impacts of the Project along with the Management and Mitigation Measures.

7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The activities to be conducted for the implementation of the project, particularly during the construction and operational phases, will be carried out in a manner which is in compliance with the legislation and guidelines outlined in Chapter 3. The potential impacts of the project are discussed in Chapter 6 and summarized in Table 7-1. For each impact the impact causing activities, including the phase in which the impact is likely to occur are stated, along with the impact types, likelihood of the impact occurring, the impact significance and the impact risks. Adverse impacts that pose a **Low to Medium Risk** based on the impact assessment do not require to be mitigated but require to be managed. Impacts to be mitigated are those which pose a **High to Critical Risk**. In such cases actions to avoid (remove or minimize the source of the impact by modifying project operations) or reduce (lessen the chances of adverse interaction between the project activities and receptors) the potential adverse impacts, mitigation and management measures are identified. These measures are presented in this ESMP and are grouped based on the environmental components.

This ESMP has been prepared to guide project activities by setting out measures and strategies to address the environmental and social issues related to the implementation of the project. Firstly, the ESMP identifies measures that would be considered during the construction phase to mitigate and manage potential impacts. The ESMP also identifies activities to be undertaken to mitigate and manage potential environmental and social impacts of project operations. The measures identified to prevent, minimize and manage the adverse impacts discussed in Chapter 6 are outlined.

During the pre-construction phase the GEA will be responsible for ensuring that the measures required to establish the framework to minimise and prevent project risks and impacts are implemented. The contractor will be required to prepare a CESMP which should address the measures outlined herein in greater detail and specific to the construction work programme and construction methods to be employed. The contractor is expected to implement the CESMP during the construction phase of the project. For the operational phase, GPL will be responsible for ensuring implementation of the mitigation and management measures.

7.1 Physical Resources

During the construction phase of the project there will be some activities which will affect the soil, as discussed in Chapter 6. These activities can contribute to soil erosion, loss of topsoil, compaction and pollution/contamination and which can be prevented or minimised if appropriate management measures are implemented. The measures outlined below would be implemented to reduce these impacts.

7.1.1 Soils and Geology

7.1.1.1 Erosion

The following measures should be implemented by the project to mitigate and manage the risks of erosion during the construction and operational phases of the project:

Project Site

- Conduct site specific assessments to determine:
 - Geo-Technical Profile of the Project Area.
 - Site Features and Topographical Survey Report.
 - Flood Risk Assessment that takes consideration of erosion risk, risks associated with adverse climate change impacts, and shoreline risks associated with changes in currents and wind directionality.

- Vegetation and soil disturbance should be limited to areas only where it is absolutely necessary.
- Vegetation should not be cleared from the slope of the adjacent beach or along the boundary line between the beach and project site.
- Ditches should be filled following consultations with the Sea and River Defences Board.
- The elevation of the project site should be raised to that it is approximately 1 meter higher than the adjacent sea dam.
- Traffic should be limited on disturbed areas.
- Water flows should be controlled via adequate drainage systems at temporary work areas and runoff managed on exposed soils during the construction phase.
- A permanent system for drainage of the site should be established for the operational phase of the project.
- Designing the surface footprint to ensure ground stability considering, among other options, a concrete base for the entire facility.
- Re-vegetating cleared areas with appropriate species, if applicable, based on foundations and design of the solar PV farm.
- Weather patterns should be considered before initiating major earthworks. Earthworks should be avoided during rainy seasons or other periods of heavy rainfall.
- Material stockpiles and waste debris should be located at least 10 meters away from the drainage system.
- Material stockpiles should be kept to a minimum. Stockpiles may require berming to collect sediments from runoff during periods of heavy rainfall. Wooden or other material may be used to contain stockpiled material to prevent erosion.
- Excavated materials should be reused where possible. In general, excavated materials should not remain onsite for more than two weeks and be disposed in a manner approved by the Sea and River Defences Board and/or the Leguan NDC.
- Engage with the Sea and River Defences Board to advocate for the construction of hard sea defence structures along the shoreline of the adjacent beach.

Transmission Line

- Earthworks should be avoided during rainy seasons or other periods of heavy rainfall.
- Transmission poles should not be erected during rainy seasons or other periods of heavy rainfall.

7.1.1.2 Loss of Topsoil

The measures outlined below should be implemented to ensure that risks associated with loss of topsoil as a result of project activities during the construction phase of the project are minimised:

- Removal of topsoil before development of any area where topsoil would be destroyed.
- Use cleared topsoil for landscaping of the project site, if possible.
- Avoid stockpiling topsoil on-site for use post-decommissioning of the project site.

No management measures are required for potential loss of topsoil associated the construction or operation of the transmission line. Similarly, no management measures are required for the operations of the solar farm.

7.1.1.3 Compaction

The measures outlined below should be implemented to manage the risks associated with soil compaction during the construction phase of the solar PV power farm or the substation:

- Ensure that heavy duty equipment only traverses on designated routes.
- Soils that have been compacted by heavy-duty equipment during transport of materials and also during site works should be scarified.
- Material stockpiles should be established on any impermeable surfaces, if practical and if such surfaces are available for use.
- Traffic and movement of heavy-duty equipment over open areas should be restricted and controlled and damage to these areas should be repaired as soon as possible.
- Appropriate heavy-duty equipment should be utilised for all works.

No measures for management of compaction are required for operations of the solar PV or for the construction and operation of the transmission line.

7.1.1.4 Soil Contamination

The following measures should be implemented to prevent soil contamination during the construction and operational phases:

- During construction fuel and other hazardous materials should be handled and stored in a manner to reduce spills and leaks, and to prevent contamination. Measures outlined in Section 7.1.4 should be fully implemented.
- All waste generated should be properly collected, stored and disposed. Measures outlined in Section 7.1.3 should be fully implemented.

7.1.2 Water Resources

The following measures should be implemented to reduce the potential impacts of planned project activities pose to surface and ground water resources.

7.1.2.1 Sedimentation

The following measures should be implemented to manage the risks of sedimentation of surface water resources during project construction and operations:

- Excavated materials should not be stockpiled on site but should be redistributed or disposed in according with guidance provided by regulatory authorities.
- Establish a drainage system to limit sedimentation of runoff.
- Weather patterns should be considered during construction as heavy rainfall would increase sedimentation rates in areas where vegetation has been cleared.
- Material stockpiles and waste debris should be located at least 10 meters away from the drainage system.
- Limit vegetation clearing to the footprint of project site.
- Revegetate all exposed and cleared surfaces, where possible, to prevent/minimise erosion due to runoff.
- Where possible, storm water runoff should not be directly be discharged into the drainage system or streams. This can be channelled through a vegetated area (as will be located north of the project site). Vegetated lands acts as a filter, trapping any large solid particles before the water enters the stream, thus can contribute to reducing the level of sedimentation.
- Fill in ditches located along the southern boundary of the project site following consultations with the Sea Defences Board.
- Water quality monitoring of all discharge points and water bodies should be done during the construction phase.

No measures for management of compaction are required for operations of the solar PV or for the construction and operation of the transmission line.

7.1.2.2 Contamination of Water Resources

The following measures should be implemented to prevent contamination of water resources during the construction and operational phases:

- During construction fuel and other hazardous materials should be handled and stored in a manner to reduce spills and leaks, and to prevent contamination. Measures outlined in Section 7.1.4 should be complied with.
- All waste generated should be properly collected, stored and disposed. Measures outlined in Section 7.1.3 should be complied with.
- Water quality monitoring of all discharge points and water bodies should be done during the construction phase.

7.1.3 Waste Management

Waste likely to be generated from the project includes construction waste and domestic garbage. Liquid waste will also be generated including wastewater from sanitary facilities and kitchen facilities during the construction phase if workers camp or rest facilities are established onsite. During the operational phase, sewage waste will also be generated. Hazardous waste to be generated include used batteries (including lithium-ion batteries), waste oil, filters, oil containers, contaminated soils and damaged/decommissioned solar PV panels. If not managed properly, waste can result in soil and water contamination, contribute to ill health, and affect environmental aesthetics. The improper disposal of waste can result in malodours and attract vermin and other pests. Proper waste management is especially important as the proposed site is relatively undisturbed.

Handling, storage and disposal measures vary for each category of waste. Recommended disposal frequency of each waste type will also vary, depending on rates of generation. In general, no significant amount of waste should be allowed to accumulate onsite. Outlined below are various measures that should be implemented to properly dispose of and manage waste associated with the project.

7.1.3.1 Liquid Waste

The following measures should be implemented to manage the liquid waste generated by the solar PV power farm during the construction and operational phases:

- Sewage will be generated from project activities during the construction and operational phases of the project. Adequate toilets should be provided based on the number of workers onsite.
- Portable toilets should be the first option considered by the contractor to be used during the construction phase, if feasible. Alternatively, if there are no service providers of portable toilets on the Island, pit latrines may be utilized. If pit latrines are to be utilized these should be the Ventilated Improved Type and constructed in accordance with the GNBS guidelines.
- Septic systems should be used during project operations and should be constructed as part of the permanent project infrastructure. The septic tanks should be constructed in accordance with GNBS guidelines. Septic tanks should be equipped with a filter bed and soak-away.
- Septic systems should be continuously monitored for signs of being filled to capacity. A qualified septic cleaning service should be hired to clean the tanks, as necessary.
- Explore alternative 'green' alternatives to septic systems and sanitary facilities that may be most appropriate for the coastal project site.

7.1.3.2 Solid Waste

The following measures should be implemented to manage the solid wastes generated by solar farm during the construction and operational phases:

- Waste such as paper and cardboard, empty plastic bottles, cans, etc. should be collected via bins placed at strategic points around the construction zone and work areas. The bins should be emptied on a regular basis, or once filled.
- All construction waste should be consolidated and reused as much as possible. If it cannot be reused then it should be properly disposed of. Consideration should be given to making the materials available local communities, if requested. Construction waste should not be left in the open to litter the work areas where it can also pose a safety risk and should be disposed of within 30 days.
- Garbage should not be allowed to accumulate onsite and should be collected and disposed of at an area and in a manner approved by the Leguan NDC.
- All workers should be made aware of the proper waste handling and disposal requirements and practices. This ensures that all are aware of how to dispose of the different types of wastes generated, therefore minimizing the impacts that may occur from improper disposal.
- Solid wastes associated with replacing damaged mounts (steel reinforcements, conduits and pipes, as well as timber and metal formwork) should be transported offsite for disposal at an appropriate facility or recycled for either on-site or off-site uses.

7.1.3.3 Hazardous Waste

The following measures should be implemented to manage the hazardous wastes generated by the project during the construction and operational phases:

- Waste oil from servicing of machinery and vehicles should be collected and reused/disposed in a safe and acceptable manner. Waste oil drained from vehicles and machinery should be collected by pans and transferred to storage drums located in a designated area at least 100 meters away from waterways.
- Drip pans and small seal containers in which waste oil can be stored should be carried by all crews engaged in construction of the transmission line to be used for any emergency repairs during transmission line construction.
- No machinery or machine parts should be washed in any surface waterway. This measure ensures that any oily wastes do not contaminate surface water.
- Used vehicle batteries should not be disposed in the environment. These batteries should be collected and returned to the suppliers or provided to used batteries dealers approved by the EPA.
- Special provisions should be put in place to facilitate the disposal of used lithium-ion batteries, hazardous inverter components, as well as solar PV panels that have been damaged or broken. This should build on the special provisions which are already in place by GPL (Leguan) to dispose of defunct equipment and machinery. The following measures should be considered as part of these special provisions:
 - Any hazardous plant components stored temporarily on-site or at any of GPL's other facilities in Leguan should be kept in an enclosed and covered area on an impermeable surface pending off-site disposal.
 - Include considerations in the bidding documents for a supplier who has a proven track record of supporting and facilitating disposal or recycling of these components.
 - Explore opportunities for contracting a company operating in Guyana to support disposal or recycling of these panels. Several specialised waste disposal companies operating in Guyana to support the oil and gas industry (such as Tiger Rentals or the Integrated Waste Management Facility) may have these capabilities.

- Hazardous wastes listed above should not be stored at the project site for extended periods.

7.1.4 Fuel, Lubricants and other Hazardous Materials

Special considerations should be made for the transportation, handling and storage of fuel and lubricants as these are classified as hazardous substances. To reduce the risks on the environment and human health, and to avoid contamination of the surface waterways, preventative actions should be taken and/or mitigation measures implemented. It is necessary to implement the following measures to prevent and or reduce the impacts on the environment, in particular, contamination of soil and water from leaks and spills:

- Only small quantities of fuel should be stored at the construction sites for the solar farm and substation. It should be stored within secondary containment and in an area with an impermeable surface. Fuel storage areas should be sited at a safe distance from active work areas and should not be stored within 100 meters of any waterway.
- Efforts should be made to ensure the necessary preventative and response measures such as adequate signage and fire extinguishers and/or sand buckets are placed in and around the fuel storage areas.
- Fuel storage containers should be regularly monitored for leaks.
- When handling fuel, care should be taken to prevent spillage and leaks. All nozzles and hoses should be properly secured and stored away to avoid spills and/or accidents if these are utilised. Nozzles and hoses should be placed in a drip drum after use to prevent any spills from entering the environment and should be frequently inspected for leaks.
- Regular maintenance should be conducted to ensure the proper functioning of machines, equipment and vehicles to avoid unnecessary leaks.
- Spill kits should be made available in the event of spillages. The kits should be placed in strategic locations that are accessible to key personnel who should be trained in the proper use of these kits through the executions of drills.
- Training in proper fuel handling practices should be provided to all staff who are involved in this activity.

7.1.5 Climate Change

The project may be affected by adverse impacts of climate change which can cause flooding from sea level rise and heavy precipitation, variable precipitation regimes and also increased ambient air temperatures. Fuel combustion associated with construction activities may also contribute to the emissions of greenhouse gases but the operation of the project will support climate change mitigation. The measures outlined below are intended to help to build resilience to adverse climate change impacts which may affect both the construction and operational phases, and also manage greenhouse gas emissions from project construction.

7.1.5.1 Measures to Build Resilience to Flood Risk

The following measures should be implemented to build the resilience of the project to sea level rise and heavy rainfall resulting from adverse climate change impacts during the construction and operational phases of the project:

- Design foundations and raising the elevation of the solar PV farm site.
- Design an internal drainage system at the solar PV farm that can accommodate maximum daily or monthly rainfall experienced in Leguan, in addition to excess capacities to compensate for reduced absorptive capacities of newly impermeable areas as well as potential filling in of the ditches.
- Ensure that all drainage systems are fully functional.

- Ensure that all mounting structures have suitable foundations to withstand temporary slushy conditions that may be prevailing on the project site.
- Establish footpaths to allow easy and safe movement around the facilities when conditions are slushy.
- The drainage systems should be monitored periodically, such as on a weekly basis, to ensure that they are in good condition and free of any obstructions or debris.
- Subscribe to the Weather Bulletin prepared by the Hydrometeorological Department of the Ministry of Agriculture to stay abreast of national precipitation trends and forecasts.

7.1.5.2 Measures to Build Resilience to Increased Temperatures

The following measures should be implemented during the construction and operation phases to adapt and build resilience to adverse climate change impacts:

- Build awareness of the work force of the signs and symptoms of heat stresses and measures to bring relief.
- Develop an occupational safety and health protocol for the work force to follow during periods of high temperatures including access to emergency health care should it be required, such as in the event of a heat stroke.
- Establish cool areas for rest for workers who work in hot conditions such as in heat generating equipment and machinery during both project construction and operations.
- Limit outdoor work on hot days.

7.1.5.3 Greenhouse Gas Emissions

The management measures which could be implemented to address greenhouse gas emissions from construction activities include:

- Scheduled maintenance of all engines to maximize fuel efficiency.
- Monitoring and recording, on a continuous basis, the volume of fuel used by all combustion sources.

7.1.7 Ambient Noise Levels

Noise is not expected to be a significant environmental impact given that the main source of noise will be construction activities which are temporary and short-lived. However, there is still the need to implement measures to prevent and minimise noise, especially occupational exposure of noise as well as to manage potential risks to receptors. Therefore, the following measures should be implemented to reduce the impacts of noise during the construction phase:

- Workers should be equipped with the necessary PPE including hearing protection for employees exposed to high noise levels: ear muffs and earplugs for employees who operate heavy-duty machines/equipment.
- Noisy activities should not occur in close proximity to proximate receptors during the night, on Sundays and on Holidays. It is not recommended to conduct any works after 18:00 hrs and prior to 06:00 hrs.
- Transmission pole planting should be timed to avoid any activities in proximity to sensitive receptors (schools and places of worship) during their hours of operation.
- Noise levels should be controlled at the source through installation of mufflers on exhaust system.
- Noisy equipment such as generator should be sited away from receptors.
- Contractors should ensure that machinery and equipment are working efficiently.

- Periodic monitoring of noise levels should be conducted during the construction phase of the solar PV farm and the substation.

7.1.8 Ambient Air Quality

The measures outlined below should be implemented to manage risks associated with air pollution particularly the generation of particulate matter during soil disturbing activities and fuel combustion during the construction phase:

- Workers should be equipped with the necessary PPE to combat dust nuisance. Personnel working within dusty environments should be required to use dust masks and respirators as needed.
- During dry periods, it may be necessary to soak some areas of the construction zones and routes where vehicles and equipment traverse.
- Dry materials used for construction such as sand should not be stockpiled in close proximity to receptors such as site offices, workers break/lunch areas, and neighbouring properties.
- All vehicles transporting loose materials should be covered to minimize dust emissions.
- All mechanical equipment should be adequately maintained to reduce gaseous emissions.

7.2 Biological Resources

Measures to manage impacts to flora and fauna of the project area are outlined below.

7.2.1 Vegetation

Impacts resulting from the loss of vegetation should be managed by the following measures during the construction phase:

- Vegetation clearing should be staged to minimise soil erosion and unwanted loss of vegetation cover, and that remnant vegetation should be preserved as much as is practical.
- Clearing should be conducted in a manner that maintains the aesthetics of the natural landscape and should be limited only to areas required for construction.
- Re-vegetation must utilise native vegetation, must follow the mitigation hierarchy, and enhance erosion risk reduction.

No mitigation or management measures are required for vegetation clearing during the operational phase of the project.

7.2.2 Terrestrial and Aquatic Fauna

Impacts on terrestrial and aquatic fauna during construction and operational phases should be managed by implementing the following measures:

- Conduct a biodiversity assessment study, particularly for avifauna, in the footprint of the project site.
- Cover vegetation should be maintained in areas not earmarked for construction activities to enable wildlife present in the area to relocate to adjacent areas. Prior to land clearing, the project site should be thoroughly inspected for the presence of small animals, including herpetofauna, small mammals and nesting birds.
- Animals with reduced movement capabilities should be allowed to escape if encountered or captured and released using an appropriate capture and handling method specific to the animal to be relocated.
- Live capture should adhere to the following guidelines:

- Live captured animals should be released into the adjacent areas of the project site which will not be utilized during project construction.
- Live caught animals must be released only at the sites with similar habitat characteristics to where they were captured.
- Animals should be released as soon as possible after capture to minimize behavioral or physiological stresses resulting from the conditions of captivity, or immigration of replacement individuals.
- Live captured animals must be placed in appropriate holding cages, which can include live traps if those traps are provided with adequate ventilation, food, and a source of moisture, and if they encompass sufficient space with appropriate padding and bedding to ensure the comfort of the captive animal.
- Live traps also should be positioned to permit drainage of urine produced by the captive animals.
- For injured animals care must always be taken to ensure that any additional stress to which the casualty is exposed is minimized, that no further injury is sustained and that the animal is secure from escape. At the same time precautions must also be taken to ensure that both handlers and the public are protected from any potential injury. The injured animal should be transported to a rehabilitation site, for example, the Guyana Zoological Park, or a veterinary practice.
- While being transported, captured animals should be provided with adequate food, sources of moisture (e.g., moist fruits, if water is not a practical option), and an appropriate environment for thermoregulation.
- Animals in transport should never be subjected to thermal environments that exceed their limits of tolerance.
- Cages for transporting mammals should be kept out of the sun, wind, and precipitation and at a comfortable temperature. Captives should be checked frequently.
- Consideration should be given to releasing animals at times coincident with their normal daily and seasonal activity patterns.
- Persons dealing with wild-caught animals in the field should work under the assumption that the animals they are handling pose some risk to their health and safety. The risk can be substantially reduced by common sense and good personal hygiene (e.g., wash hands often with soap and water).
- Handlers should endeavor to minimize the chances of being bitten or scratched (e.g., wear leather or fabric gloves) and should use latex gloves to avoid unnecessary exposure to blood or other body fluids and feces, which may contain parasites or pathogens that affect humans.
- Handlers who work with carnivores or bats should be careful to avoid being bitten and should be immunized against rabies and should maintain up-to-date tetanus immunizations.
- Land clearing should be conducted, to the extent practical, outside the nesting period of the animals identified onsite.
- Waste storage and disposal should be undertaken according to best practices (see Section 7.1.3).
- Measures to manage risks of erosion and sedimentation outlined in Sections 7.1.1.1 and 7.1.2.2 of this ESMP should be fully implemented.
- Vegetation cover should be maintained on site to the extent practical so as to maintain existing habitats.
- Water quality of receiving water bodies within project impacted areas should be monitored to ensure ecologically acceptable turbidity, nutrient and sediment levels are maintained during construction.

7.3 Socio-Economic Resources

The measures outlined below should be implemented to manage negative impacts and to promote the positive impacts of the project.

7.3.1 Land Use

The following measures should be implemented to manage risks associated with land use conflicts at the solar PV farm:

- Fence the boundaries of the property.
- Erect appropriate signage so as to prevent any potential occupation or use of the project site.
- Unauthorized locals should be restricted from entering the premises.
- All staff should be informed and educated to avoid direct confrontation with any visitors to the beach of residents of Canefield and to report all issues relating to such matters to the site manager.
- Design spacing of the transmission structures to avoid direct interactions between any residential, commercial or other land users located along the transmission line route.

7.3.2 Conflict Management

The measures outlined below should be implemented by the contractor and operator of the solar PV farm to manage any potential conflicts arising as a result of project activities during both the construction and operational phases of the project.

7.3.2.1 Conflict Prevention

To prevent any conflicts during construction the following should be implemented:

- Potential affected parties should be informed of the details of the project and be engaged in discussions on possible measures to reduce the negative impacts prior to commencing construction.
- The relevant authorities should be notified of any emerging problems and the contractor should work with the local authorities to address any issues.
- A Code of Conduct for Workers should be prepared and enforced.
- A Grievance Redress Mechanism should be implemented for both the construction and operational phases of the project.
- The selection and employment of project workers should be conducted in a fair and transparent manner, and according to the requirements of the project. This process should be free of any personal preference and biases, inclusive of persona characteristics, gender, location, or ethnicity. The employment program should instead be based on the principle of equal opportunity and fair treatment, with no discrimination with respect to any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, or disciplinary practices.
- Forced labour or child labour should not be employed by the project and should be a key contract consideration during the procurement of solar panels.
- In sourcing solar panels and other equipment, the contractor should ensure that these are sourced from suppliers who are compliant with labour procedures. It should be ensured that suppliers have not been reported on cases of forced labour.

7.3.2.2 Code of Conduct for Workers

A Code of Conduct for workers should be prepared to guide the behaviour of workers onsite particularly during project construction. The Code of Conduct should make the following provisions:

- Compliance with applicable laws, rules, and regulations.
- Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment, preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment).
- The prohibition of the use of illegal substances.
- Sexual harassment (for example to prohibit use of language or behavior, in particular towards women or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate).
- Violence or exploitation (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading or exploitative behavior).
- Protection of children (including prohibitions against abuse, defilement, or otherwise unacceptable behavior with children, limiting interactions with children, and ensuring their safety in the project area).
- Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by the contractor and not open areas, and avoid littering).
- Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favours, are not provided to any person with whom there is a financial, family, or personal connection).
- Respecting reasonable work instructions (including regarding environmental and social norms).
- Protection and proper use of property (for example, to prohibit theft, carelessness or waste).
- Duty to report violations of the Code.
- Non retaliation against workers who report violations of the Code.
- Respecting the rules, norms, customs and practices of the surrounding community (including for community members who visit the foreshore area for ritual or religious purposes).

7.3.2.3 Conflict Resolution (Grievance Mechanism)

Any stakeholder who believes aspects of project construction or operations are likely to have a detrimental impact on their organisation, community, day to day activities, the environment, or on their quality of life should be able to communicate their grievances. These grievances should be documented, analysed and responded to efficiently. Stakeholders should also be able to submit comments and suggestions that they feel will increase the benefits of the project and reduce or mitigate any adverse impacts.

It is envisaged that any potential grievances arising from the construction activities will be localised. As such, to ensure that the process is effective, a site level mechanism to address such grievances should be put in place.

The grievance mechanism should be coordinated by the contractor during the construction phase of the solar farm and the substation. GPL will coordinate the grievance mechanism during operations of the solar farm and the substation, and during construction and operation of the transmission line. These Parties are the respective points of contact to receive complaints and work to address all grievances in a timely, effective and satisfactory manner, and to foster positive engagement when issues arise. Information on the grievance mechanism, including contact person and contact information should be shared with stakeholders, including the schools' administration, in particular the

nearby community through notices. These can be posted at the site and at public places within the community.

Grievance Mechanism during Project Construction

The following is an outline of actions that should be taken once grievances resulting from the execution of construction works is received:

- The contractor should inform the GEA that a grievance has been received.
- The contractor and environmental personnel from the GEA should investigate the reported grievances to determine the cause for the grievance.
- It should then be determined whether the grievance can be resolved by the contractor and the GEA or whether authorities with regulatory or other responsibilities and relevant skills are to be consulted or engaged.
- Or it should be determined whether corrective action must be taken by the contractor and what those actions are.
- The contractor should prepare a grievance report, including supporting materials such as photographs. If necessary, a clear list of tasks and outcomes expected should be developed.
- If a grievance is the fault of the contractor, then the contractor should implement corrective actions immediately.
- The contractor should conduct follow-up inspection to monitor the situation and determine whether the issue is likely to recur and to put measures in place to prevent recurrence.
- The affected party should be notified within a reasonable time frame that their grievance was received and actioned. Thereafter, the affected party should be informed of the measures (if any) that were put in place to prevent recurrence of the grievance.

A register of grievances received should be maintained by the contractor and should include information such as date of complaint, by whom, nature of grievance, date investigated and by whom, validity and corrective action required, timeline for implementation of corrective action, and if the grievance was satisfactorily addressed or not. A review on the status of grievances received/addressed should be conducted by the GEA upon conclusion of the project.

Grievance Mechanism during Transmission Line Construction and Project Operations

GPL has a grievance mechanism which will be utilized during the construction of the transmission line and the operations of all project components. The use of GPL's existing grievance mechanism is particularly useful because local stakeholders in Leguan are already aware of how complaints may be filed. The hotline number used to report grievances is also publicly available on GPL's website. The following actions are followed by GPL when a grievance is received:

- The grievance is documented by GPL.
- GPL's Transmission and Distribution Crew is dispatched to investigate the reported grievance so as to determine the cause for the grievance.
- Based on the findings of the investigation, corrective measures are to be taken.
- Measures are put in place to prevent the recurrence of such a grievance. Where necessary, these measures are implemented by follow-up activities depending on the costs of the corrective measures required.

A register of grievances is maintained by GPL including information such as date of complaint, by whom, nature of grievance, date investigated and by whom, validity and corrective action required, timeline for implementation of corrective action, and if the grievance was satisfactorily addressed or not.

7.3.3 Employment and Community Development

Although the project is anticipated to contribute positively to employment and community development, some measures can be implemented to enhance the positive effect of all phases of the project. These measures include:

- The contractor should prioritise employment opportunities for persons residing in Leguan particularly in the neighbouring village of Canefield.
- The possibilities of employing women should also be considered during all phases of the project, so as to ensure that there are opportunities for both genders.
- The contractor and the GEA should track all project employment so as to monitor gender balance.
- The contractor should support local content through local procurement. This may include purchasing of agricultural products, poultry, other meats and fish from the surrounding communities. The use of local transportation providers and rentals of required equipment and machinery, if in good working condition and available locally should also be considered.
- Wages offered to local staff should be in keeping with Guyana's labour laws or higher set standards which should be competitive in all categories of workers.
- Local workers should work for standard working hours (an eight-hour work day) and be fairly remunerated.
- The Government should be encouraged to construct an asphalted road leading to the solar farm site.

7.3.4 Aesthetics and Visual Impacts

The following measures should be implemented to manage risks of aesthetics and visual impacts of the project:

- Examine options for positioning of solar PV arrays so as to maximize power generation capacity while minimizing visual distractions for visitors to the beach (foreshore) and residents of Canefield.
- Limit vegetation clearing only to areas where it is necessary.
- Remove all construction waste from the site within 30 days of generation.
- Ensure that the contractor properly demobilizes from the site at the end of the construction period. This should include removal of all of the contractor's buildings, materials, waste, and equipment. Landscaping and restoration of disturbed areas should also be done, including the contractor's stockpile and staging areas.

7.3.5 Traffic

Although the extent of the potential impact of the project on traffic was not assessed, the following measures should be implemented to manage the risks associated with project traffic particularly during the construction phase:

- Journey Risk Management Plans should be developed and implemented prior to the transporting of large equipment or materials during the construction phase.
- Considering construction materials to be transported by river should take on board the following options:
 - Transportation by ferry should be arranged over multiple trips with smaller loads to prevent undue pressure to the ferry service and prevent locals from utilizing these services.
 - Alternatively, a private form of transportation could be utilized (for example, a barge).

- All drivers and operators must be licensed in accordance with the Laws of Guyana and have the requisite experience and training.
- First Aid Kits with the requisite drugs and equipment to cater to emergencies or occurrences should be available in all vehicles.
- Drivers should be instructed to observe and respect all traffic and warning signs along the various roadways and to maintain all required speed limits.
- Appropriate safety signage should be posted leading up to the entrance of the construction site. Residents should be given adequate advance notice about the movement of heavy machinery through the Canefield village.
- All light and heavy-duty equipment and vehicles should be properly maintained and in good working condition so as to comply with the national road fitness/safety requirements and manufacturer's safety recommendation.
- Passengers should not be permitted on mobile equipment unless they are being trained to operate the machine or are required to ride on it as an unavoidable part of their duties, provided it is safe to do so.

7.3.6 Stakeholder Engagements

Stakeholder engagement is essential for the project and should be fully integrated into the various stages of the process. To achieve this the following measures should be considered particularly during the construction phase:

- GEA and GPL should engage with local stakeholders including the Leguan NDC prior to the commencement of works to provide information about the proposed works, employment opportunities, and health and safety measures. These stakeholders should also be made aware of the simple LCOE estimated by the contractor.
- Updates of progress of the operations should be periodically provided to the local authorities, if required.
- Messages from the project relating to possible employment and other opportunities should be posted or distributed in local communities thereby ensuring that all interested persons, including vulnerable groups like women and young people who are willing to work are aware. This should also include opportunities to participate in the Women's Economic Empowerment Programme.

7.3.7 Archaeological Finds

The following procedure should be followed during project construction in the event that archaeological materials or site is discovered within the project area:

- All activities in the immediate vicinity of the remains should cease immediately.
- The find location should be recorded, and all remains left in place.
- The contractor should inform the GEA who should then inform and the National Trust of Guyana of the find.
- The National Trust of Guyana should coordinate with the relevant personnel to determine the significance of the findings and assess appropriate mitigative options.
- If the significance of the remains is judged to be sufficient enough to warrant further actions which cannot be avoided, the GEA, in collaboration with the National Trust of Guyana, should determine the appropriate course of such action.
- Relocation of the artefacts for preservation and security reasons may be determined as an appropriate action.
- In the case of human remains, the appropriate authority should be contacted. In addition, a coroner and/or physical anthropologist may be involved if the remains are classified as an artefact. Options for removal and burial should be considered if the location must be disturbed.

- The National Trust of Guyana should inform the GEA of when work may recommence in the specific area.

In addition, to effectively safeguard potential archaeological finds, GEA should also ensure that the contractor provides training to employees on identifying and protecting finds by causing limited disruption and damage to archaeological materials, if found.

7.4 Health and Safety

Measures should be recommended to protect the health and safety of workers as well members of the public, as is outlined below.

7.4.1 Occupational Health and Safety

The contractor should be required to comply with provisions of Guyana's Occupational Health and Safety Act and as such, implement measures to comply so as to ensure a safe and healthy environment for all of its staff and other land and road users. The following measures should be considered. However, the project should not be limited to these measures alone as there may be others that can also be implemented:

- The contractor should have an Occupational Health and Safety Policy which should be used to guide all mobilization, construction and demobilization works. This policy should be well known to all staff and posted where it can be easily accessible.
- The contractor should have a permanent Environmental, Health and Safety Officer on site, or at least designate a senior member of staff with that responsibility. Given the challenges in accessing emergency health care services in Leguan, this individual should have training and experience in First Aid and CPR. The Health and Safety Officer should conduct daily routine checks to all active construction sites and equipment so as to ensure that all safety measures are fully in place. Checks should be guided by a simple to use checklist form. Operational areas are also to be monitored to ensure compliance with all health and safety requirements and that good health and safety practices are maintained throughout every aspect of the construction.
- A Job Safety Analysis (JSA) should be conducted for jobs that are determined to be of high risk to safety and health.
- A vehicle should be permanently available on site to be used for all emergency cases. This vehicle should be regularly serviced and be kept in a good working condition at all times.
- The contractor should establish or have in place arrangements with the Leguan Cottage Hospital for any emergency cases and medical evacuations.
- A Health and Safety Committee should be established and meet on a monthly basis to review health and safety performance and discuss measures for improvements. This Committee should include at least one member from the GEA and one member from GPL.
- All staff should undergo an induction exercise on occupational health and safety and regular training programmes on safe practices and proper handling of equipment and machinery.
- Workers operating certain equipment and conducting risky tasks should be provided with specialized training and proper skills set to allow for efficient and safe utilization of vehicles and machinery.
- All employees should be properly oriented to safety and health practices consistent with the construction activities.
- All workers should be provided with the necessary protective gear and attire (gloves, respirators, hard hats, high visibility vests, protective glasses, long boots and safety boots) as required. Employees required to work in the rain should be provided with wet weather gear.
- All employees should be required to wear safety equipment and protective clothing provided in designated areas. Employees not wearing prescribed safety clothing and associated

equipment in an area where the use of such is mandatory should be required to leave such designated area and should be subject to disciplinary action.

- Smoking should not be permitted anywhere in or near the fuel storage areas or in any other designated non-smoking area.
- First Aid Kits with the requisite drugs and equipment to cater to emergencies or occurrences should be available.
- Workers should be trained to use emergency response equipment such as fire extinguishers and first aid equipment.
- COVID-19 precautionary measures should be implemented, including requirements for vaccination. In addition, Guidelines prepared specially for construction sites such as those by PAHO should be utilized for guidance.
- Appropriate safety signage should be posted throughout the construction site and along the roadways, particularly during the construction of the transmission line.
- Potable water should be provided for all employees, thus reducing the possibility of water borne diseases.
- Swimming should be prohibited for all project staff during work hours and breaks.
- All vehicles and equipment should comply with the traffic rules while traversing the main road.
- An ERP should be prepared as part of the CESMP and made available to all relevant personnel and the necessary training and resources required should be provided.

7.4.2 Public Health and Safety

The following are measures which can be implemented to minimize harm to both project personnel as well as the general public:

- The project site should be secured to prevent access to unauthorized personnel, especially those who are visiting out of curiosity and children.
- Members of the community should be engaged prior to the commencement of works and made aware of the risks presented by the works and the precautionary measures with which they should abide when visiting the beach during project construction.
- Vehicles passing through communities should not exceed the stipulated speed limit and drivers should exercise extreme caution.
- All vehicles transporting loose materials should be covered.
- All vehicles should be in a full functional state prior to its use on the roadways, and within and outside of the project area.
- Advance warning signs should be posted along the roadway during the installation of the transmission line. Equipment and materials kept along the roadway should be clearly demarcated, including at nights. There should be no encumbrance of the roadway.
- All drivers and operators should be employed based on their experience working in similar environment and should be provided with further training, particularly in road safety practices.
- Trucks should at no time carry more materials than their rated carrying capacity.

7.5 Emergency Response

The contractor is required to prepare an ERP as part of the CESMP. The ERP should outline protocols for responding to environmental emergencies that may occur as a result of unforeseeable circumstances such as a spill of hazardous materials, accidents, medical emergencies or weather-related disasters. The ERP should describe the general types of emergency and actions to be followed should an emergency occur during the mobilization and operational phases of the project and should include:

- Emergency Contact Details
- Emergency Procedures

- Authority of Control
- Emergency Response Equipment
- Scenario Description and Response
- Incident Reporting.

All personnel should be aware of potential risks and take steps to cope with hazards in their work area. In addition, all personnel are expected to alert the correct personnel if they discover an accident, medical emergency, fire or spill. As such, the ERP should also outline the role of the various personnel in emergency response. The types of emergencies to be covered by the ERP should include fuel and other hazardous material spills, accidents to workers, traffic accidents, fire, and natural hazards (weather related emergencies), etc.

The ERP should consider the remoteness of the project site and the limitations in terms of access and services available and should outline practical measures to respond to the various types of emergencies occurring at the project location. These should include procedures to provide first aid, facilitate medical evacuations, implement on-site fire response and response to natural hazards on-site.

The EPC contractor and GPL should collaboratively develop an ERP for the solar PV plant when it is operational.

7.6 Summary of Impacts and Management and Mitigation Measures

The following Table provides the Impact Summary Table along with the Management and Mitigation Measures.

Table 7-1: Summary of Impact Assessment

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Physical Resources					
Soils and Geology					
Construction	Erosion of the solar farm site from vegetation clearing, soil disturbing activities, stormwater runoff	Moderate	Likely	Medium	<ul style="list-style-type: none">Conduct site specific assessments to determine:<ul style="list-style-type: none">Geo-Technical Profile of the Project Area.Site Features and Topographical Survey Report.Flood Risk Assessment that takes consideration of erosion risk, risks associated with adverse climate change impacts, and shoreline risks associated with changes in currents and wind directionality.Vegetation and soil disturbance should be limited to areas only where it is absolutely necessary.Vegetation should not be cleared from the slope of the adjacent beach or along the boundary line between the beach and project site.Ditches should be filled following consultations with the Sea Defence Board.The elevation of the project site should be raised to that it is approximately 1 meter higher than the adjacent sea dam.Traffic should be limited on disturbed areas.Water flows should be controlled via adequate drainage systems at temporary work areas and runoff managed on exposed soils during the construction phase.A permanent system for drainage of the site should be established for the operational phase of the project.Designing the facility to ensure ground stability considering, among other options, a concrete base for the entire facility.Re-vegetating cleared areas with appropriate species, if applicable, based on foundation and design of the solar PV farm.Weather patterns should be considered before initiating major earthworks. Earthworks should be avoided during rainy seasons or other periods of heavy rainfall.Material stockpiles and waste debris should be located at least 10 meters away from the drainage system.Material stockpiles should be kept to a minimum. Stockpiles may require berming to collect sediments from runoff during periods of heavy rainfall. Wooden or other material may be used to contain stockpiled material to prevent erosion.Excavated materials should be reused where possible. In general, excavated materials should not remain onsite for more than two weeks and be disposed in a manner approved by the Sea Defences Board and/or the Leguan NDC.
Construction and Operation	Erosion of the beach adjacent to the project site due to the erosion and accretion cycle and removal of vegetation by project construction	Moderate	Likely	Medium	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
					<ul style="list-style-type: none"> Engage with the Sea Defences Board to advocate for the construction of hard sea defence structures along the shoreline of the adjacent beach.
Construction	Erosion of minor earthworks for planting transmission poles during heavy rainfall	Negligible	Unlikely	Low	<ul style="list-style-type: none"> Earthworks should be avoided during rainy seasons or other periods of heavy rainfall. Transmission poles should not be erected during rainy seasons or other periods of heavy rainfall.
Construction	Topographical change of the solar farm site	Negligible	Likely	Low	<ul style="list-style-type: none"> The elevation of the project site should be raised to that it is approximately 1 meter higher than the adjacent sea dam. Landscape should be re-contoured prior to laying site foundations.
Construction	Loss of topsoil for construction of solar farm	Negligible	Unlikely	Low	<ul style="list-style-type: none"> Removal of topsoil before development of any area where topsoil would be destroyed. Use cleared topsoil for landscaping of the project site, if possible. Avoid stockpiling topsoil on-site for use post-decommissioning of the project site.
Construction	Compaction of soils during construction of solar farm	Negligible	Certain	Low	<ul style="list-style-type: none"> Ensure that heavy duty equipment only traverses on designated routes. Soils that have been compacted by heavy-duty equipment during transport of materials and also during site works should be scarified. Material stockpiles should be established on any impermeable surfaces, if practical and such surfaces are available for use. Traffic and movement of heavy-duty equipment over open areas should be restricted and controlled and damage to these areas should be repaired as soon as possible. Appropriate heavy-duty equipment should be utilised for all works.
Water Resources					
Construction and Operations	Sedimentation of surrounding surface waterways for the solar farm	Negligible	Almost Certain	Low	<ul style="list-style-type: none"> Excavated materials should not be stockpiled on site but should be redistributed or disposed in accordance with guidance provided by regulatory authorities. Establish a drainage system to limit sedimentation of runoff. Limit vegetation clearing to the footprint of the project site. Weather patterns should be considered during construction as heavy rainfall would increase sedimentation rates in areas where vegetation has been cleared. Material stockpiles and waste debris should be located at least 10 meters away from the drainage system. Re-vegetate all exposed and cleared surfaces, where possible, to prevent/minimise erosion due to runoff.

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
					<ul style="list-style-type: none"> Where possible, storm water runoff should not be directly be discharged into the drain system or streams. This can be channelled through a vegetated area (as will be located north of the project site). Vegetated lands acts as a filter, trapping any large solid particles before the water enters the stream, thus can contribute to reducing the level of sedimentation. Fill in ditches located along the southern boundary of the project site following consultation with the Sea Defences Board. Water quality monitoring of all discharge points and water bodies should be done during construction phase.
Waste Management					
Construction and Operations	Contamination or pollution of soils and surface water from improper management of general and hazardous wastes and hazardous materials for solar farm	Moderate	Almost Certain	High	<p>The following measures cover Liquid Waste, Solid Waste, Hazardous Waste Fuel, Lubricants and other Hazardous Materials:</p> <ul style="list-style-type: none"> Sewage will be generated from project activities during the construction and operational phases of the project. Adequate toilets should be provided based on the number of workers onsite. Portable toilets should be the first option considered by the contractor to be used during construction phase, if feasible. Alternatively, if there are no service providers of portable toilets on the Island, pit latrines may be utilized. If pit latrines are to be utilized these should be Ventilated Improved Type and constructed in accordance with GNBS guidelines. Septic systems should be used during project operations and should be constructed as part of the permanent project infrastructure for the solar farm and the substation. The septic tanks should be constructed in accordance with GNBS guidelines. Septic tanks should be equipped with a filter bed and soak-away. Septic systems should be continuously monitored for signs of being filled to capacity; a qualified septic cleaning service should be hired to clean the tanks, as necessary. Explore alternative 'green' alternatives to septic systems and sanitary facilities that may be most appropriate for the coastal project site. Waste such as paper and cardboard, empty plastic bottles, cans, etc. should be collected in bins placed at strategic points around the construction zone and work areas. The bins should be emptied on a regular basis, or once filled. All construction waste should be consolidated and reused as much as possible. If it cannot be reused then it should be properly disposed of. Consideration should be given to making the materials available local communities, if requested. Construction waste should not be left in the open to litter the work areas where it can also pose a safety risk and should be disposed of within 30 days.
Construction	Contamination or pollution of soils, surface water and ground water from improper management of general and hazardous wastes and hazardous materials for substation	Moderate	Almost Certain	High	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
					<ul style="list-style-type: none"> Garbage should not be allowed to accumulate onsite and should be collected and disposed of at an area and in a manner approved by the Leguan NDC. All workers should be made aware of the proper waste handling and disposal requirements and practices. This ensures that all are aware of how to dispose of the different types of wastes generated, therefore minimizing the impacts that may occur from improper disposal. Solid wastes associated with replacing damaged mounts (steel reinforcements, conduits, pipes, as well as timber and metal formwork) should be transported offsite for disposal at an appropriate facility or recycled for either on-site or off-site uses. Waste oil from servicing of machinery and vehicles should be collected and reused/disposed in a safe and acceptable manner. Waste oil drained from vehicles and machinery should be collected by pans and transferred to storage drums located in a designated area at least 30 meters away from waterways. No machinery or machine parts should be washed in any surface waterway. This measure ensures that any oily wastes do not contaminate surface water. Drip pans and small seal containers in which waste oil can be stored should be carried by crews engaged in construction of the transmission line to be used for any emergency repairs during transmission line construction. Used vehicle batteries should not be disposed in the environment. These batteries should be collected and returned to the suppliers or provided to used batteries dealers approved by the EPA. Special provisions should be put in place to facilitate the disposal of used lithium-ion batteries, hazardous inverter components, as well as solar PV panels that have been damaged or broken. This should build on the special provisions which are already in place by C&D (Leguan) to dispose of defunct equipment and machinery. The following measures should be considered: <ul style="list-style-type: none"> Any hazardous plant components stored temporarily on-site should be kept in an enclosed and covered area on an impermeable surface pending off-site disposal. Include considerations in the bidding documents for a supplier who has a proven track record of supporting or facilitating disposal or recycling of these components. Explore opportunities for contracting a company operating in Guyana to support the disposal or recycling of these panels. Several specialised waste disposal companies are operating in Guyana to support the oil and gas sector (such as Tiger Rentals or Guyana Integrated Waste Management Facility) may have these capabilities. Hazardous wastes listed above should not be stored at the project site for extended periods. Only small quantities of fuel should be stored at the construction site. It should be stored within secondary containment and within an area with an impermeable surface. Fuel storage

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
					<p>areas should be sited at a safe distance from active work areas and should not be stored within 100 meters of any waterway.</p> <ul style="list-style-type: none"> ▪ Efforts should be made to ensure the necessary preventative and response measures such as adequate signage, fire extinguishers and/or sand buckets are placed in and around fuel storage areas. ▪ Fuel storage containers should be regularly monitored for leaks. ▪ When handling fuel, care should be taken to prevent spillage and leaks. All nozzles and hoses should be properly secured and stored away to avoid spills and/or accidents if utilized. Nozzles and hoses should be placed in a drip drum after use to prevent any spills from entering the environment and should be frequently inspected for leaks. ▪ Regular maintenance should be conducted to ensure the proper functioning of machinery and equipment and vehicles to avoid unnecessary leaks. ▪ Spill kits should be made available in the event of spillages. The kits should be placed at strategic locations that are accessible to key personnel who should be trained in the proper use of these kits through the executions of drills. ▪ Training in proper fuel handling practices should be provided to all staff involved in the activity.
Climate Change					
Operations	Flood risk to solar PV associated future sea level rise	Moderate	Unlikely	Medium	<ul style="list-style-type: none"> ▪ Increase the elevation of the solar PV farm. ▪ Designing an internal drainage system at the solar PV farm that can accommodate maximum daily or monthly rainfall experienced in Leguan, in addition to excess capacities to compensate for reduced absorptive capacities of newly impermeable areas as well as potential filling in of the ditches. ▪ Ensuring that all drainage systems are fully functional. ▪ Ensuring that all mounting structures have suitable foundations to withstand temporary slushy conditions that may be prevailing on the project site. ▪ Establishing footpaths to allow easy and safe movement around the facilities when conditions are slushy. ▪ The drainage systems should be monitored periodically, such as on a weekly basis, to ensure that they are in good condition and free of any obstructions or debris. ▪ Subscribing to the Weather Bulletin prepared by the Hydrometeorological Department of the Ministry of Agriculture to stay abreast of national precipitation trends and forecasts.
Construction and Operations	Flood risk to solar farm associated with heavy rainfall	Minor	Likely	Medium	
Construction	Flood risk to transmission line	Negligible	Unlikely	Low	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
	due to sea level rise and heavy rainfall				
Construction and Operations	Increased temperatures result in heat related illnesses among project workforce	Minor	Almost Certain	Medium	<ul style="list-style-type: none"> Building awareness of the work force of the signs and symptoms of heat stresses measures to bring relief. Developing an occupational safety and health protocol for the work force to follow during periods of high temperatures including access to emergency health care should it be required such as in the event of a heat stroke. Establishing cool areas for rest for workers who work in hot conditions such as in hot generating equipment and machinery during both project construction and operations. Limit outdoor work on hot days.
Operations	Increased temperatures result in line losses	Negligible	Unlikely	Low	None
Operations	Increased temperatures result in increased energy demand for cooling	Minor	Likely	Medium Likelihood of Beneficial Impact	None
Construction	Greenhouse gas emissions from fuel combustion during the construction phase	Negligible	Certain	Low	<ul style="list-style-type: none"> Periodically schedule maintenance of all engines to maximize fuel efficiency. Monitoring and recording, on a continuous basis, the volume of fuel used by all combustion sources.
Operations	Climate change mitigation from offsets of diesel combustion for power generation and fuel transportation	Moderate	Certain	High Likelihood of Beneficial Impact	None required
Ambient Noise Levels					
Construction	Occupational ambient noise levels	Moderate	Likely	Medium	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
	during the construction period				<ul style="list-style-type: none"> Workers should be equipped with the necessary PPE including hearing protection for employees exposed to high noise levels: ear muffs and earplugs for employees who operate heavy-duty machines/equipment. Noisy activities should not occur in close proximity to proximate receptors during the night, Sundays and on Holidays. It is not recommended to conduct any works after 18:00hrs and prior to 06:00hrs. Transmission pole planting should be timed to avoid any activities in proximity to sensitive receptors (schools and places of worship) during their hours of operation. Noise levels should be controlled at the source through installation of muffles on exhaust system. Noisy equipment such as generator should be sited away from receptors. Contractors should ensure that machinery and equipment are working efficiently. Periodic monitoring of noise levels should be conducted during the construction phase of solar PV farm.
Construction	Environmental receptors exposed to high noise levels for solar farm construction	Negligible	Likely	Low	
Construction	Sensitive receptors exposed to high levels of noise for transmission pole planting	Negligible	Unlikely	Low	

Ambient Air Quality

Construction	Occupational exposure to elevated dust levels and emissions from fuel combustion during construction of solar farm	Moderate	Almost Certain	High	<ul style="list-style-type: none"> Workers should be equipped with the necessary PPE to combat dust nuisance. Personnel working within dusty environments should be required to use dust masks and respirators if needed. During dry periods, it may be necessary to soak some areas of the construction zones and routes where vehicles and equipment traverse. Dry materials used for construction such as sand should not be stockpiled in close proximity to receptors such as site offices, workers break/lunch areas, and neighbouring properties. All vehicles transporting loose materials should be covered to minimize dust emissions. All mechanical equipment should be adequately maintained to reduce gaseous emissions.
Construction	Occupational exposure to emissions of particulate matter and emissions from fuel combustion for the substation	Minor	Unlikely	Low	
Construction	Environmental exposure to elevated dust levels during construction of the solar farm	Minor	Unlikely	Low	

Biological Resources

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Vegetation					
Design	Limited vegetation clearing to conduct site surveys and waste disposal onsite	Negligible	Certain	Low	<ul style="list-style-type: none">Vegetation clearing should be staged to minimise soil erosion and unwanted loss of vegetation cover, and that remnant vegetation should be preserved as much as is practicable.Clearing should be conducted in a manner that maintains the aesthetics of the natural landscape and should be limited only to areas required for construction.Re-vegetation utilising native vegetation should be done where practical, particularly in areas susceptible to erosion.
Construction	Vegetation clearing intensifies habitat fragmentation at the project site	Negligible	Likely	Low	
Construction	Loss of vegetation cover and habitat shelter for resident fauna	Negligible	Likely	Low	
Construction	Increased sedimentation of water bodies as a result of deforestation contributes to eutrophication	Negligible	Unlikely	Low	
Terrestrial and Aquatic Fauna					
					<ul style="list-style-type: none">Conduct a biodiversity study, particularly for avifauna, in footprint of the project site.Cover vegetation should be maintained in areas not earmarked for construction activities to enable wildlife present in the area to relocate to adjacent areas. Prior to land clearing, the project site should be thoroughly inspected for the presence of small animals, including herpetofauna, small mammals and nesting birds.Animals with reduced movement capabilities should be allowed to escape if encountered and captured and released using an appropriate capture and handling method specific to the animal to be relocated.Live capture should adhere to the following guidelines:<ul style="list-style-type: none">Live captured animals should be released into the adjacent areas of the project site which will not be utilized during project construction.
Construction	Habitat loss and displacement of terrestrial fauna	Negligible	Likely	Low	
Construction	Increased sedimentation of water bodies contributes to altered aquatic habitats	Negligible	Rare	Low	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Construction	Contamination or pollution of surface waters from hydrocarbon spills	Moderate	Likely	Medium	<ul style="list-style-type: none"> ○ Live caught animals must be released only at the sites with similar habitat characteristics to where they were captured. ○ Animals should be released as soon as possible after capture to minimize behavioral and physiological stresses resulting from the conditions of captivity, or immigration to replacement individuals. ○ Live captured animals must be placed in appropriate holding cages, which can include live traps if those traps are provided with adequate ventilation, food, and a source of moisture, and if they encompass sufficient space with appropriate padding and bedding to ensure the comfort of the captive animal. ○ Live traps also should be positioned to permit drainage of urine produced by the captured animals. ○ For injured animals care must always be taken to ensure that any additional stressors which the casualty is exposed is minimized, that no further injury is sustained and that the animal is secure from escape. At the same time precautions must also be taken to ensure that both handlers and the public are protected from any potential injury. An injured animal should be transported to a rehabilitation site, for example, the Guyana Zoological Park, or a veterinary practice. ○ While being transported, captured animals should be provided with adequate food and sources of moisture (e.g., moist fruits, if water is not a practical option), and placed in an appropriate environment for thermoregulation. ○ Animals in transport should never be subjected to thermal environments that exceed their limits of tolerance. ○ Cages for transporting mammals should be kept out of the sun, wind, and precipitation and at a comfortable temperature. Captives should be checked frequently. ○ Consideration should be given to releasing animals at times coincident with their normal daily and seasonal activity patterns. ○ Persons dealing with wild-caught animals in the field should work under the assumption that the animals they are handling pose some risk to their health and safety. The risk can be substantially reduced by common sense and good personal hygiene (e.g., washing hands often with soap and water). ○ Handlers should endeavor to minimize the chances of being bitten or scratched (e.g., wear leather or fabric gloves) and should use latex gloves to avoid unnecessary exposure to blood or other body fluids and feces, which may contain parasites and pathogens that affect humans. ○ Handlers who work with carnivores or bats should be careful to avoid being bitten and should be immunized against rabies and should maintain up-to-date tetanus vaccinations.
Construction and Operation	Presence of workers promulgate the presence of domestic and synanthropic species	Negligible	Unlikely	Low	
Operation	Project infrastructure attract individuals and provide opportunities for foraging, roosting or nesting	Negligible	Unlikely	Low Likelihood of Beneficial Impact	

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
					<p>immunizations.</p> <ul style="list-style-type: none"> Land clearing should be conducted, to the extent practical, outside the nesting period of animals identified onsite. Waste storage and disposal should be undertaken according to best practices (see Section 7.1.3). Measures to manage risks of erosion and sedimentation outlined in Sections 7.1.1.1 and 7.1.2.2 of this ESMP should be fully implemented. Vegetation cover should be maintained on site to the extent practical so as to maintain existing habitats. Water quality of receiving water bodies within project impacted areas should be monitored to ensure ecologically acceptable turbidity, nutrient and sediment levels are maintained during construction.
Socio-Economic Resources					
Land Use					
Construction and Operation	Cessation of occasional use of the project site for livestock grazing	Negligible	Rare	Low	<ul style="list-style-type: none"> Fence the boundaries of the property. Erect appropriate signage so as to prevent any potential occupation or use of the site. Unauthorized locals should be restricted from entering the premises. All staff should be informed and educated to avoid direct confrontation with any visitors to beach of residents of Canefield and to report all issues relating to such matters to the manager. Design spacing of the transmission structures to avoid direct interactions between residential, commercial or other land users located along the transmission line route. <p>The following measures should be put in place for conflict management:</p> <ul style="list-style-type: none"> Potential affected parties should be informed of the details of the project and be engaged in discussions on possible measures to reduce the negative impacts prior to commencement of construction. The relevant authorities should be notified of any emerging problems and the contractor should work with the local authorities to address any issues. Developing a Code of Conduct for Workers A Grievance Redress Mechanism is implemented for both the construction and operational phases of the project.

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Employment, Community Development					
Construction and Operation	Project encourages investment due to stable source of power with positive impacts on employment and new businesses development	Moderate	Almost Certain	High Likelihood of Beneficial Impact	None required
Construction and Operation	Transportation of construction materials contributes to a deterioration of roads in Canefield.	Minor	Almost Certain	Medium	<ul style="list-style-type: none">The solar farm incentivises Government to construct an asphalted road leading to the project site.
Employment and Local Content					
Construction and Operation	Employment of local populations including vulnerable groups such as women and youth	Minor	Almost Certain	Medium Likelihood of Beneficial Impact	<ul style="list-style-type: none">The contractor should prioritise employment opportunities for persons residing in Leguana, particularly in the neighbouring village of Canefield.The possibilities of employing women should also be explored and considered during all phases of the project, so as to ensure that there are opportunities for both genders.The contractor should support local content through local procurement. This may include purchasing of agricultural products, poultry, other meats and fish from the surrounding communities. The use of transportation providers and rentals of required equipment and machinery, if in good working condition and available locally, should be considered.Wages offered to local staff should be in keeping with Guyana’s labour laws or higher standards which should be competitive in all categories of workers.Local workers should work for standard working hours (an eight-hour work day) and be fairly remunerated.The Government should be encouraged to construct an asphalted road leading to the solar farm site.
Construction and Operation	EPC contractor providing training to employees	Moderate	Almost Certain	High Likelihood of Beneficial Impact	
Construction and Operation	Local procurement of goods, services and other materials	Moderate	Almost Certain	High Likelihood of Beneficial Impact	
Aesthetics and Visual Impacts					

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Construction and Operation	Site clearing, stockpiling and PV arrays change aesthetics and cause distractions	Moderate	Likely	Medium	<ul style="list-style-type: none">Examine options for positioning of solar PV arrays so as to maximize power generation capacity while minimizing visual distractions for visitors to the beach (foreshore) and residents of Canefield.Limit vegetation clearing only to areas where it is necessary.Remove all construction waste from the site within 30 days of generation.Ensure that the contractor properly demobilized from the site at the end of the construction period. This should include removal of all of the contractor's buildings, materials, waste, equipment. Landscaping and restoration of disturbed areas should also be done, including the contractor's stockpile and staging areas.
Traffic					
Construction	Increased traffic associated with road transportation of construction materials and other items	Not assessed	Not assessed	Not assessed	<ul style="list-style-type: none">Journey Risk Management Plans should be developed and implemented prior to transporting of large equipment or materials during the construction phase.Construction materials which would have to be transported by river should consider the following options:<ul style="list-style-type: none">Transportation by ferry, should be arranged over multiple trips with smaller loads to prevent undue pressure to the ferry service and prevent locals from utilizing the services.Alternatively, a private form of transportation could be utilized (for example, a barge).All drivers and operators must be licensed in accordance with the Laws of Guyana and have the requisite experience and training.First Aid Kits with the requisite drugs and equipment to cater to emergencies or occurrences should be available in all vehicles.Drivers should be instructed to observe and respect all traffic and warning signs along various roadways and to maintain all required speed limits.Appropriate safety signage should be posted leading up to the entrance of the construction site.All light and heavy-duty equipment and vehicles should be properly maintained and in good working condition so as to comply with the national road fitness/safety requirements and manufacturer's safety recommendation.Passengers should not be permitted on mobile equipment unless they are being trained to operate the machine or are required to ride on it as an unavoidable part of their duties provided it is safe to do so.
Construction	River transportation of construction materials by ferry	Moderate	Likely	Medium	
Archaeological Resources					

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Construction	Archaeological resources are lost or damaged during project construction	Minor	Rare	Low	<ul style="list-style-type: none"> All activities in the immediate vicinity of the remains should cease immediately. The find location should be recorded, and all remains left in place. The contractor should inform the GEA who should then inform and the National Trust of Guyana of the find. The National Trust of Guyana should coordinate with the relevant personnel to determine the significance of the findings and assess appropriate mitigative options. If the significance of the remains is judged to be sufficient enough to warrant further action which cannot be avoided, the GEA, in collaboration with the National Trust of Guyana, should determine the appropriate course of such action. Relocation of the artefacts for preservation and security reasons may be determined as appropriate action. In the case of human remains, the appropriate authority should be contacted. In addition, a coroner and/or physical anthropologist may be involved if the remains are classified as an artefact. Options for removal and burial should be considered if the location must be disturbed. The National Trust of Guyana should inform the GEA of when work may recommence in the specific area.
Health and Safety					
Construction and Operation	Project activities, particularly during the construction phase, increase	Major	Likely	High	<ul style="list-style-type: none"> The contractor should have an Occupational Health and Safety Policy which should be used to guide all mobilization, construction and demobilization works. This policy should be well known to all staff and posted where it can be easily accessible. The contractor should have a permanent Health and Safety Officer on site, or at least designate a senior member of staff with that responsibility. Given the challenges in accessing emergency health care services in Leguan, this individual should have training and experience in First Aid and CPR. The Health and Safety Officer should conduct daily routine checks to all active construction sites and equipment so as to ensure that all safety measures are fully in place. Checks should be guided by a simple to use checklist form. Operational areas are also to be monitored to ensure compliance with all health and safety requirements and that good health and safety practices are maintained throughout every aspect of construction. A Job Safety Analysis (JSA) should be conducted for jobs that are determined to be of high risk to safety and health. A vehicle should be permanently available on site to be used for all emergency cases. The vehicle should be regularly serviced and be kept in a good working condition at all time. The contractor should establish or have in place arrangements with the Leguan Cottage Hospital for any emergency cases and medical evacuations.

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
	risks to workers health and safety				<ul style="list-style-type: none"> ▪ A Health and Safety Committee should be established and meet on a monthly basis to review health and safety performance and discuss measures for improvements. This Committee should include at least one member from the GEA. ▪ All staff should undergo an induction exercise on occupational health and safety and regular training programmes on safe practices and proper handling of equipment and machinery. ▪ Workers operating certain equipment and conducting risky tasks should be provided with specialized training and proper skills set to allow for efficient and safe utilization of vehicles and machinery. ▪ All employees should be properly oriented to safety and health practices consistent with construction activities. ▪ All workers should be provided with the necessary protective gear and attire (gloves, respirators, hard hats, high visibility vests, protective glasses, long boots and safety boots) as required. Employees required to work in the rain should be provided with wet weather gear. ▪ All employees should be required to wear safety equipment and protective clothing provided in designated areas. Employees not wearing prescribed safety clothing and associated equipment in an area where the use of such is mandatory should be required to leave such designated area and should be subject to disciplinary action. ▪ Smoking should not be permitted anywhere in or near the fuel storage areas or in any other designated non-smoking area. ▪ First Aid Kits with the requisite drugs and equipment to cater to emergencies or occurrences should be available. ▪ Workers should be trained to use emergency response equipment such as fire extinguishers and first aid equipment. ▪ Prescribed COVID-19 measures outlined in the Government's COVID-19 emergency measures should be implemented, including requirements for vaccination. In addition, Guidelines prepared specially for construction sites such as those by PAHO should be utilized for guidance. ▪ Appropriate safety signage should be posted throughout the construction site and along roadways, particularly during the construction of the transmission line. ▪ Potable water should be provided for all employees, thus reducing the possibility of waterborne diseases. ▪ All vehicles and equipment should comply with the traffic rules while traversing the main road. ▪ An ERP should be prepared as part of the CESMP and made available to all relevant personnel and the necessary training and resources required should be provided. ▪ Swimming in the Essequibo River or nearby water bodies should be prohibited for all project staff.

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
Construction and Operation	Project activities, particularly during the construction phase, increase risks to public health and safety	Major	Likely	High	<ul style="list-style-type: none"> The project site should be secured to prevent access to unauthorized personnel, especially those who are visiting out of curiosity and children. Members of the community should be engaged prior to the commencement of works and made aware of the risks presented by the works and the precautionary measures with which they should abide when visiting the beach during project construction. Vehicles passing through communities should not exceed the stipulated speed limit and drivers should exercise extreme caution. All vehicles should be in a full functional state prior to its use on the roadways, and within the outside of the project area. Advance warning signs should be posted along the roadway during the installation of the transmission line. Equipment and materials kept along the roadway should be clearly demarcated, including at nights. There should be no encumbrance of the roadway. All drivers and operators should be employed based on their experience working in similar terrain and should be provided with further training, particularly in road safety practices. Drivers should be instructed to stop and park along open roads during periods of high rain and poor visibility, especially when transporting heavy materials. Trucks should at no time carry more materials than their rated carrying capacity.
Construction and Operation	Project activities strain extant emergency response services in Leguan	Minor	Likely	Medium	<ul style="list-style-type: none"> Prepare and implement an Emergency Response Plan
Decommissioning					
Decommissioning	Project is not decommissioned following stated 20-year project lifetime	Moderate	Almost Certain	High Likelihood of a Beneficial Impact	None required
Cumulative Impacts					
Energy Generation and Renewable Sources of Energy					
Operation	Contribution to national targets to	Moderate	Almost Certain	High Likelihood	None required

Project Phase	Nature of Potential Impact	Impact Rating			Mitigation and Management Measures
		Significance	Likelihood	Rating	
	generate 100 percent of electricity from renewable sources			of a Beneficial Impact	
Employment					
Construction and Operation	The project contributes to employment in Leguan including for Canefield	Minor	Certain	Medium Likelihood of a Beneficial Impact	None required

8.0 IMPLEMENTATION FRAMEWORK

8.1 Introduction

This chapter provides the framework for the implementation of the ESMP outlined in Chapter 7. The Implementation Framework also aims to ensure that the project complies with the relevant policies, legislation and guidelines detailed in Chapter 3.

8.2 Roles and Responsibilities

The Leguan Solar PV Farm Project is being implemented through an EPC approach for the Installation, Commissioning and Turn-key Delivery of a solar PV power plant, including battery energy storage system. As part of the EPC approach, the project will be publicly tendered and a contractor will be procured for the activities comprising the EPC. The GEA is envisaged to provide technical oversight and supervision of the design-build aspect of the project. GPL will be the operator for the project. To ensure the environmental and social management measures are implemented GEA and the contractor will have major roles to play.

The roles and responsibilities are outlined below.

GEA

The project is being executed by the GEA on behalf of the Ministry of Public Works. The GEA's role is to provide technical oversight and provide supervision to the contractor. An integral element of this role is to ensure that the environmental and social requirements are fulfilled.

During the construction/installation phase, the GEA will have oversight of the contractor's activities so as to ensure that all recommended environmental and social measures are implemented. The GEA will also lead monitoring and reporting based on the requirements of the EPA, those outlined in the ESMP and those of the IDB. To effectively execute this mandate, the GEA should assign dedicated personnel to fulfill the role of Environmental and Social Officer whose responsibilities of ensuring compliance with the environmental, social, health and safety requirements. Specific responsibility of the Environmental and Social Officer should include but not be limited to the following:

- Obtain approval from the EPA for the project.
- Review of the contractor's CESMP to ensure it is compliant with the requirements of the EPA, requirements of IDB's safeguards and the provisions of this ESAR.
- Approve the contractor's CESMP.
- Conduct routine inspection of construction activities for compliance with the CESMP.
- Conduct environmental and social monitoring of key parameters.
- Prepare Monthly Inspection Reports on environmental compliance by the contractor and which should include recommendations for corrective actions for any non-compliances observed.
- Engage with the contractor on a continuous basis to ensure any recommended corrective actions are implemented.
- Participate in stakeholder engagements and outreach to key stakeholders.
- Ensure the views of stakeholders are reported and any grievances received from stakeholders are addressed in a timely manner.
- Participate in project progress meetings to discuss and report on environmental compliance.

EPC Contractor

The contractor will be responsible for ensuring environmental compliance during the construction phase of the project. It is recommended that the contractor be required to prepare a CESMP and

employ full-time environmental and social personnel to assist with the implementation of environmental management measures. Such personnel should be suitably qualified and experienced for such a portfolio and to be responsible for the following:

- Prepare the contractor's CESMP. The CESMP should be guided by the EPA's Construction Permit to be obtained for the project and the provisions of this ESAR including the ESMP.
- Oversee implementation of the CESMP at the construction site.
- Conduct orientation for all staff and sub-contractors on the health, safety, environmental and social requirements.
- Monitor all construction activities onsite and prepare and submit monthly environmental and social compliance reports to the GEA.
- Work closely with the contractor's workforce to ensure full compliance with the CESMP.
- Ensure the implementation of mitigation measures to ensure compliance with the requirements.
- Identify any non-compliance and ensure corrective actions are taken as appropriate.
- Liaise routinely with the GEA's Environmental and Social Officer.
- Assist in arranging and participate in meetings and engagements with stakeholders.
- Take the lead from the contractor's end to address grievances from stakeholders and maintain liaison.
- Attend project progress meetings to report on environmental compliance.
- Following the completion of construction, ensure all of the construction worksites are adequately decommissioned.
- Design a training programme for GPL's technicians to ensure that operation and maintenance of the power plant follows all health and safety requirements.

GPL

The project will be handed over to GPL for operations. As such, GPL will be responsible for ensuring the provisions of the EPA Permit to be issued for the project are implemented and that monitoring and reporting during project execution are consistent with Permit conditions. To fulfill this requirement, GPL will need to assign suitably qualified personnel with the requisite qualification and experience.

Responsibilities for environmental management for the EPC and operational phases of the project will held by three entities at different stages, GEA, the Contractor and GPL. These are summarised in Table 8-1 below.

Table 8-1: Summary of Environmental related Responsibilities

Pre-Construction Phase	
GEA	Conduct the relevant site specific studies agreed to with the IDB
	Prepare construction bidding documents to include environmental and social requirements
	Assign an Environmental and Social Officer
	Require the contractor to prepare a CESMP
	Review the CESMP and make recommendations for revision, if necessary
	Approve the CESMP
Contractor	Employ environmental and social personnel
	Prepare the CESMP
	Conduct site induction and training of employees and any sub-contractor personnel
GEA & GPL	Secure Environmental Authorisation for the construction phase of the project.

Construction Phase	
GEA	General oversight of the contractor's environmental performance
	Monitor project activities to ensure health, safety, environmental and social compliance.
	Identify non-compliances and recommend corrective actions.
	Participate in stakeholder engagements and take the lead in conflict management and grievance redress
	Ensure all monitoring and reporting obligations are satisfied
	Convene monthly meetings and discuss status of contractor's compliance with environmental requirements
	Prepare Annual Environmental Report for submission to EPA.
Contractor	Implement the CESMP; environmental, social, health and safety mitigation and management measures; and corrective actions
	Participate in the progress meetings
	Prepare monthly environmental and social compliance reports
	Monitor for non-compliances and effectiveness of mitigation measures
	Engaging with stakeholder and addressing any grievances which might arise
	Conducting regular refresher training for workers on health, safety, environmental and social requirements
Operation Phase	
GPL	Assign environmental and social personnel to the project
	Conduct compliance monitoring and reporting in accordance with the EPA Permit.
Contractor	Provide technical support during the first year of operation. This support should include requirements for health and safety in operations
	Design programme for training and knowledge transfer to HECI/MPL including requirements for health and safety

8.3 Construction ESMP (CESMP)

The Contractor will be required to prepare a CESMP to mitigate issues pertinent to the construction phase of the project and relevant to their assigned tasks. This CESMP is to be submitted to the GEA for approval following the approval of the design and prior to the commencement of works. Once approved, the CESMP is expected to be implemented during the construction period.

Preparation of the CESMP should be guided by this ESAR, the requirements outlined in the EPA's Construction Permit, IDB safeguards, relevant national standards and guidelines including those of the GNBS, GEA and the Ministry of Public Works. The following should be addressed/included in the CESMP:

- HSSE Policy – The contractor's Health Safety, Social and Environmental Policy should be included in the Plan. The policy should also address alcohol and drug use, hunting and the prevention of harm to wildlife, and interactions with local communities and stakeholders.
- Management Structure – The CESMP should describe the Contractor's management structure for the project, clearly highlighting the responsibilities for health, safety, and the environment.
- Contractors' Work Programme – An overview of the Contractor's proposed Work Programme, including information on the duration of works, number of workers to be onsite, type and quantity of heavy equipment to be onsite, construction activities to be undertaken, forms of transportation to be utilised, etc. This information will be essential in the review process of the CESMP.

- Waste Management – Measures to manage the various waste types to be generated should be included, including solid waste, liquid waste/wastewater, hazardous waste and construction waste. This should include measures for collection and disposal.
- Erosion and Sedimentation Control – The CESMP should describe measures to be implemented by the Contractor to prevent erosion onsite, and sedimentation of the nearby surface water flows.
- Hazardous Materials Management – The Plan should outline how hazardous materials will be managed onsite, including fuel and lubricants.
- Dust Control - The CESMP should outline measures to prevent dust nuisance from occurring.
- Noise Prevention – The Plan should put forward measures to reduce noise levels and prevent noise nuisances.
- Workers Health and Safety – A Health and Safety Plan for workers should form a component of the CESMP.
- Community Safety – Measures should be implemented to ensure that the safety of members of the public is not compromised, especially relating to the use of the roadway, and managing interactions with project site neighbours. These measures should be documented in the CESMP.
- Contingency and ERP – A Contingency and ERP needs to be included in the CESMP to address emergencies relevant to the project. The possible emergencies are:
 - a. Accidents/Medical Emergencies
 - b. Fires
 - c. Fuel/Chemical Spills
 - d. Flooding

The Contingency and ERP should also address training of employees, assembly point in case of emergency, emergency contacts, communications, responsible personnel, response procedures and incident reporting.

- Chance Find Procedure – This should be included to cater for if during project activities archaeological pieces are found. The procedures to be followed should be outlined.
- Training Plan - Training to be conducted should be described in the CESMP.
- Site Closure, Decommissioning and Restoration - At the conclusion of works the site will need to be cleaned up, all waste removed and all temporary structures belonging to the contractor dismantled and removed. The measures to be employed by the contractor during this process should be described in the CESMP.
- Grievances – A Grievance Mechanism is included in this ESAR (Section 7.3.2.3). Since the Contractor will be responsible for addressing grievances, including implementation of corrective actions, the measures to be employed by the contractor in dealing with grievance should be outlined in the CESMP.
- Monitoring and Reporting – The CESMP should outline how monitoring will be done including frequency, areas to be monitored, etc. A checklist to be utilized should be included.

8.4 Environmental Monitoring

Monitoring of project activities should be conducted to ensure that the recommended mitigation measures and management practices identified in the ESMP are implemented and effective. This is required mainly for the construction phase of the project.

The GEA and the contractor, through their environmental and social personnel, should conduct periodic monitoring during the construction phase of the project. This will require frequent visits to the project site, compliance monitoring, and preparation of monthly environmental compliance reports. Table 8-2 below identifies the various parameters to be monitored as well as the frequency and location of monitoring activities. Additional parameters may be added to those identified in the Table based on the Contractor's CESMP or any other determined as necessary during project implementation.

Table 8-2: Environmental Monitoring during Construction

Parameters	Frequency	Locations
Air Quality <ul style="list-style-type: none">Evidence of dust accumulation and suspended particles through visible observationEase of visibilityPM_{2.5} and PM₁₀	Continuous Quarterly	Construction site
Meteorology <ul style="list-style-type: none">TemperatureHumidityRainfallWind speed, directionSolar radiation	Continuous	Construction site
Water Quality <ul style="list-style-type: none">pHTurbidityTotal Suspended SolidsOil and GreaseDissolved OxygenChemical Oxygen DemandColiforms	Quarterly	Receiving drain for area drainage
Noise <ul style="list-style-type: none">Decibel	Quarterly	Construction site boundaries
Waste Management <ul style="list-style-type: none">Compliance with CESMP and waste management practicesLittering and waste accumulation	Weekly	Waste receptacles, disposal sites and active construction sites.
Health and Safety <ul style="list-style-type: none">Use of protective gear by workersAdequate and appropriate signage installed	Daily	Construction site (all project components)

Parameters	Frequency	Locations
<ul style="list-style-type: none"> Location of Emergency Procedures Availability of emergency response equipment Tool box talks, Induction Training, etc. Health conditions of staff. Stocked First Aid Kit Demarcation and securing of construction site COVID-19 Preventative Measures 		
Community Wellbeing/Concerns <ul style="list-style-type: none"> Local employment and employment of women Trained workforce Road safety measures for transmission line installation Grievance redress Any emerging issue 	Monthly	Leguan NDC
Coastal Monitoring <ul style="list-style-type: none"> Erosion of the adjacent beach 	Weekly	Beach adjacent to the project site

Environmental monitoring should continue by GPL during the operational phase of the project and be guided by the Monitoring Plan presented in Table 8-3.

Table 8-3: Monitoring Plan for Project Operations

Parameters	Frequency	Locations
Meteorology <ul style="list-style-type: none"> Temperature Humidity Rainfall Wind speed, direction Solar radiation 	Continuous	Solar farm site
Water Quality <ul style="list-style-type: none"> pH Turbidity Total Suspended Solids Oil and Grease Dissolved Oxygen Chemical Oxygen Demand Coliforms 	Bi-Annually	Discharge points from the drainage systems of the solar farm into the receiving environment.
Waste Management <ul style="list-style-type: none"> Compliance with waste management practices. Littering and waste accumulation. Monitoring septic system for signs of its being filled to capacity. 	Weekly	Waste receptacles, septic system disposal sites and temporary storage areas for damaged or defunct plant components

Parameters	Frequency	Locations
Drainage System <ul style="list-style-type: none"> Condition of drainage infrastructure. Cleanliness of drains. 	Weekly	Internal site drainage
Health and Safety <ul style="list-style-type: none"> Use of protective gear by workers Adequate and appropriate signage installed Location of Emergency Procedures Availability of emergency response equipment Tool box talks, Induction Training, etc. Health conditions of staff. Stocked First Aid Kit COVID-19 Preventative Measures Safety Drills Fire extinguishers serviced and available at strategic locations 	Daily	Solar farm
Community Wellbeing/Concerns <ul style="list-style-type: none"> Employment Trained workforce Grievance redress Any emerging issue 	Monthly	Leguan NDC

8.5 Reporting

8.5.1 Reporting During the Construction Phase

Regular meetings between the project management team (GEA and the contractor) should be convened to discuss progress and to address challenges. These meetings should be supplemented by formal compliance monitoring reports prepared by both the contractor and the GEA.

The GEA is expected to convene such progress meetings at least monthly at which the contractor's environmental and social personnel will attend as well as the GEA's Environmental and Social Officer. The agenda of each meeting should include environmental, health, safety and social compliance and where a report should be presented on the contractor's environmental and social performance. This report should then allow for discussion on areas for improvements, review the progress of implementation of corrective actions and to plan ahead to prevent non-compliances from occurring. Representatives from GPL should be invited to attend these meetings so as to stay abreast of any emerging issues which may become areas of concern during the operational phase. These meetings should be convened on a statutory basis throughout the duration of the project and should be documented.

The contractor's environmental personnel should prepare a Monthly Environmental Compliance Report which should indicate areas of non-compliances, reasons for the non-compliances and corrective actions which have been taken or are planned to be implemented. The report should also indicate environmental incidents occurring during the month, complaints or grievances received and follow-up actions. This report should be submitted to the GEA prior to the convening of the monthly meetings and should include but not limited to the following:

- Environmental incidents or non-compliances observed and corrective actions taken with regards to contract requirements, including waste management, contamination, noise and dust control, traffic management, etc.
- Health and safety incidents, accidents, injuries and all fatalities that require treatment and actions taken to improve conditions. Information on number of workers, work hours, PPE provided and usage, and worker violations and follow-up actions taken (if any).
- CESMP implementation progress, including implementation of the management and mitigation measures outlined in the plan, effectiveness of the measures being implemented, any emerging environmental, social, health and safety issue and adjustments required (if any).
- Grievances by workers and the community, including grievances received, how resolved, those unresolved and plan for resolving these.

Prior to construction, the contractor should prepare and submit a reporting format to the GEA for approval.

In addition to the monthly report, the contractor should also provide immediate notification to the GEA of incidents in the following categories:

- Confirmed or likely violation of any Construction Permit conditions or any relevant legislation.
- Any fatality or serious (lost time) injury.
- Significant adverse effects on the environment.
- Damage to private or public properties.

Full details of such incidents should be provided within the timeframe agreed with the GEA.

8.5.2 Reporting and Record Keeping during the Operational Phase

Overall monitoring should be carried out by GPL's dedicated HSSE personnel. All areas of concerns should be visited daily, or more frequently, if necessary. Operational related activities such as use of safety gears and compliance with health and safety procedures should be monitored on an ongoing basis.

Annual Environmental Reporting should be carried out and report submitted to the EPA. The Annual Environmental Reports should include environmental performance, objectives and targets, and future planned improvements. The results of monitoring activities conducted throughout the year should also be presented. Additional reporting requirements should be done in compliance with the Operation Permit to be issued by the EPA.

Records of monitoring should be kept by GPL on-site and made available to the EPA or other regulatory authorities upon request. Monitoring results which exceed national standards should be reported to EPA.

The company should be willing to facilitate site monitoring activities to be conducted by regulatory bodies such as the EPA and the Ministry of Labour.

8.6 Orientation and Training

During the construction phase of the project, it is essential that the contractor conduct orientation and training of workers prior and during construction activities. Training should include both theory and practical exercises and should cover a range of topics on health, safety and the environment including an overview of the CESMP and the roles and responsibilities of contractor personnel. Orientation and training should be done as part of site induction and should include, but not be limited to the following:

- Environmental requirements and environmental management and health and safety measures as outlined in the CESMP.
- Workers' role and responsibilities in environmental management and health and safety.
- First aid, occupational safety and health measures and the use of PPE.
- Emergency response measures.
- Methods for waste and hazardous materials management and disposal.
- Social responsibilities of all personnel working under the project and rules of engagement with stakeholders, in particular local communities.

Any new employee should undergo an orientation programme to ensure they fully understand the job requirements and employment conditions and is motivated to improve his/her skills.

On a day-to-day basis, there should be Tool Kit Orientation by the contractor's site manager or Health and Safety personnel to emphasise key issues on health, safety and the environment.

The EPC contractor should support GPL in the orientation and training of personnel to operate the solar PV power plant. GPL will also require training in installing and maintaining the 13.8kV transmission lines. These procedures should be documented to allow GPL to continue with these activities following the end of the EPC contractor's tenure.

8.7 Mitigation and Monitoring Budget

An indicative annual budget is presented in Table 8-4 and Table 8-5 respectively, outlining estimated costs for mitigation and monitoring activities during the construction phase of the project. The cost of mitigation activities are to be borne by the contractor and incorporated as part of the CESMP.

Table 8-4: Indicative Annual Budget for Mitigation during Construction

Environmental Component/ Impacts	Action	Equipment/ Personnel/ Activities	Annual Cost US\$
Human Resources	Hiring of contractor's environmental and social personnel		18,000
Waste Management	Collection and disposal of garbage and construction waste	Bins and garbage receptacles Disposal of waste	1,000
	Managing of liquid waste	Provision of Portable Toilets /Toilets with Septic Tanks	2,000
Health and Safety	First Aid Kits	Procure kits	1,000
	Protective gear for workers e.g. safety vests, helmets, gloves, dust masks, safety boots and ear piece.	Procure gears	5,000
	Warning signs at work sites.	Prepare and erect signs	500
Emergency Response	Fire Extinguishers and Spill Kits.	Procure equipment	1,000
Training	Training of personnel e.g. in Environmental		3,000

Environmental Component/ Impacts	Action	Equipment/ Personnel/ Activities	Annual Cost US\$
	Responsibilities, First Aid, Health and Safety, Emergency Response, etc.	Conduct training prior to start up and thereafter every 6 months	
Incidentals and Emergencies	Response needed in event of accidents and emergencies.	Materials and personnel (depends on type/scale of incident or emergency)	10,000
Waste Management	Specialized disposal of hazardous wastes generated during project construction	Storage and transport of waste to treatment/disposal facility	10,000
TOTAL			51,500

The table below presents the indicative cost to the GEA for monitoring of construction activities to ensure environmental, social, health and safety compliance. Some of these costs such as for personnel may already be included in GEA's operational budget.

Table 8-5: Indicative Annual Budget for Monitoring during Construction

Environmental Component/ Impacts	Action	Equipment/ Personnel/ Activities	Annual Cost US\$
Human Resources	Hiring of GEA environmental and social personnel		18,000
Meteorology	Collection of information on temperature, humidity, rainfall, wind speed, direction	Automatic Weather Station	6,000
Air Quality	Conducting air quality testing for PM _{2.5} , PM ₁₀	Air Quality Meters/Contractor	5,000
Water Quality	Water quality tests such as pH, Turbidity, Oils/Grease, Dissolved Oxygen, Chemical Oxygen Demand, etc.	Samples collected tested <i>in-situ</i> and outsourced to Lab for analysis	3,000
Noise	Monitoring	Noise level testing	1,000
Miscellaneous	Report preparation etc.	Materials, printing etc.	1,000
Stakeholder Engagements	Engagements with relevant stakeholders		5,000
TOTAL			39,000

The costs identified for monitoring are indicative since at this stage the final design for the project is not yet available. It is therefore expected that these budgets will be revised based on final project design.

CONCLUSION

The Leguan Solar Farm Project is being implemented to provide a 0.6-megawatt peak (MWp) solar PV power plant inclusive of a battery energy storage system on the Island of Leguan, Region 3. The battery storage system (energy storage and battery inverter) will support the primary function of 'grid forming' and meet the demand of the Leguan mini-grid during the periods for which solar energy is available. The electricity generated by the project will be integrated into the existing Transmission and Distribution Grid managed by GPL (Leguan). The approach to project development will be through an Engineering, Procurement, Construction contract that will see the Installation, Commissioning and Turn-key Delivery of the solar PV power plant. In the medium- to long-term, GPL plans to interconnect with the grids of Wakenaam and Hogg Island and the project (including with its potential expansion) will support this goal.

This ESAR assessed the potential impacts of project activities across the various phases for the solar farm, and the transmission line. The impact assessment utilized the baseline conditions of the project areas considered against the planned project activities. This was done by establishing the potential interactions between the activities and the characteristics of the existing physical, biological and socio-economic environment. Risk ratings were assigned using a Risk Assessment Matrix. Subsequently, the mitigation and management measures which can be incorporated into the project design and execution were considered and this contributed to an assessment of the residual risks associated with potential impacts. However, additional site specific studies recommended by the IDB should be considered to inform project design and construction. The specific studies to be conducted will need to be agreed upon by the GEA and the IDB.

Overall, a comprehensive Environmental Management Plan (EMP) was prepared outlining the measures which should be implemented during the construction and operational phases of the project to mitigate and manage the risks. As a consequence, the significant majority of residual risks assessed in this ESAR are of Low or Medium Risk. In particular, measures outlined in the EMP supported the significant de-risking of several impacts which were rated High. No Critical Risks were identified to be associated with pre-mitigation impacts of the project.

In addition to the mitigation and management measures which were identified to address potential adverse impacts, measures to maximise the positive impacts of the project were also identified. Moreover, provisions have been made and guidance provided for detailed management measures to be determined and implemented during the construction phase, and as part of the CESMP. Once the recommended measures are implemented during the project execution it is envisaged that any potential adverse impacts will be prevented or reduced, thereby enabling the project to positively benefit the environment and the community.

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Personal Communications

Personal Communication 01 – Interview with the Sea and River Defences Board (Leguan Office)

Personal Communication 02 – Interview with the Leguan Neighbourhood Democratic Council

Personal Communication 03 – Interview with Guyana Power and Light Inc. (Leguan)

Personal Communication 04 – Interview with Mr. Zakir Khan (Owner of Neighbouring Pasture Lands)

Personal Communication 05 – Interview with Mr. Oudit (Neighbouring Resident)

Personal Communication 06 – Interview with Mr. Sudesh Gangaram (Neighbouring Resident)

Personal Communication 07 – Interview with Ms. Roodmattie Smith (Neighbouring Resident)

Personal Communication 08 – Interview with Mr. Dewnand Roopjagdai (Resident of Canefield)

Personal Communication 09 – Interview with Major Projects Department, Engineering Services Division of Guyana Power and Light Inc. (Georgetown)

Personal Communication 10 – Interview with Guyana Tourism Authority

Personal Communication 11 – Interview with the Chief Sea and Rives Defences Officer

Personal Communication 12 – Interview with Neighbouring Land Owners

APPENDICES

Appendix A: Terms of Reference

GUYANA

LO-4676/BL-GY

ENERGY MATRIX DIVERSIFICATION AND INSTITUTIONAL STRENGTHENING OF THE DEPARTMENT OF ENERGY (GY-L1066)

TERMS OF REFERENCE

CONSULTANCY SERVICE: PREPARATION OF AN ENVIRONMENTAL AND SOCIAL ANALYSIS REPORT FOR THE LEGUAN SOLAR PV SITE

BACKGROUND AND JUSTIFICATION

- 1.1 Guyana is 96 percent dependent on imported fossil fuel for its electricity generation needs. The cost and reliability of electricity are recognized by the Government of the Cooperative Republic of Guyana as a major factor for profitability and efficiency in business operations, especially in energy-intensive industries such as manufacturing. Renewable energy solutions for the Hinterland under the Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE) Programme is one of three components which will address the energy diversification policy goals of the Government of Guyana. It will finance the investment of solar technology in three townships and the Island of Leguan, by means of the installation of solar PV-tied mini-grid systems in Bartica (1.5 MW), Lethem (1.0 MW), Mahdia (0.65 MW) and Leguan (0.6 MW) totaling 3.75 MW, and the implementation of a storage capacity to manage intermittence of these sources. Overall, this Component will provide a reliable electricity source to the expanding needs of power supply in these communities, now relying on fossil fuel.
- 1.2 In accordance with the Inter - American Bank's Policy OP-703, this operation is classified as Category "B" and it is anticipated that the project will generate moderate impacts that could be easily moderated by the implementation of the required mitigation measures. The main impacts for Component 1 will be associated with land clearing (pre-construction) and erosion during both construction and operations. To meet the requirements of the IDB's Environmental and Social Safeguard Policies, the Government of Guyana will comply, to the satisfaction of the Bank, with the contractual terms and conditions set forth. These conditions and definitions will be incorporated into the Loan Agreement and as such the Borrower is legally bound to comply with these conditions.
- 1.3 To this end, the Guyana Energy Agency is looking for a suitable candidate to offer consultancy services, in accordance with these Terms of Reference as it relates to the Special Conditions of Execution of Component 1: Renewable Energy Solutions for the Hinterland of the Operation GY-L1066, which require the Executing Agency to complete an Environmental and Social Analysis Report inclusive of an Environmental and Social Management Plan.

OBJECTIVES

The main objectives of this consultancy are as follows:

- 2.1 to identify, predict and evaluate the economic, environmental and social impacts of the development of a Solar PV Farm and all its associated activities in the community of Leguan
- 2.2 to provide information on the environmental consequences for decision making

- 2.3 to promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.
- 2.4 to carry out an Environmental and Social Analysis based on:
 - the inputs of and coordination with the Guyana Energy Agency for the construction and operation of the plant
 - information available in academic literature, and
 - field visits and consultations and campaigns.

REQUIREMENTS

Type of Consultancy: Individual

Duration: Fifty (50) days

Place of work: Georgetown, Guyana, office work (or Consultant's habitual place of work) with multiple field visits to location of relevant infrastructure or activities.

Qualifications:

Candidates must have:

- A Master's Degree or Post Graduate Academic qualifications in Environmental Studies, Environmental Science, Environmental Impact Assessments or Environmental Management.
- At least 10 years of experience in environmental assessment and management involving the preparation of at least five (5) Environment and Social Management Plans

Experience with donor requirements including the Inter-American Development Bank (IADB) and/or other multi-lateral agencies will be an asset.

Core and Technical Competencies: Good analytical and communication skills. Good command of English language is required, knowledge of local dialects might be necessary for consultations. Ability to plan, organize and meet goals in a timely manner. Ability to multitask and response to multiple demands and changing priorities. Pro-activity and motivation. Ability to work under minimal supervision when necessary.

EVALUATION CRITERIA

The Executing Agency (GEA) will shortlist a minimum of three (3) candidates in accordance with the IDB's 3CV procurement method.

- 4.1. All submissions will be evaluated and ranked on their merits in accordance with the evaluation criteria, sub-criteria and point system outlined as follows:
 - 4.1.1. Academic qualifications
 - 4.1.2. Specific training or experience related to assignment
 - 4.1.3. General experience related to assignment
 - 4.1.4. Communication skills
- 4.2. The Contract shall be awarded to the Individual Consultant who offers the lowest evaluated price, provided that the successful candidate has been determined to be eligible and has met the qualification requirements in accordance with the Evaluation Criteria.

SCOPE OF ACTIVITIES

The scope of developing the Environmental and Social Analysis Report should include the following key aspects:

- 5.1 Description of the Construction and Operation
- 5.2 Diagnostic of AoI (Direct and Indirect) and Stakeholders of the Construction and Operation
- 5.3 Institutional and Legal Framework

- 5.4 Main Environmental and Social Impacts
- 5.5 Environmental and Social Management Plan
- 5.6 Consultation Plan and Disclosure

DELIVERABLES

- 6.1 Site visit(s) to the island of Leguan are required.
- 6.2 Intermediate report on the preliminary findings as per the activities described above, information gathered in the consultations and Environmental and Social Management Plan.
- 6.3 A final report on Environmental and Social Analysis with respective Environmental and Social Management Plan, including Public Consultation Plan and Consultation Reports, and if necessary, FPIC procedure, Socio-cultural Analysis, Involuntary Resettlement Plan and/or Livelihood Restoration Plan.
- 6.4 The final report shall be delivered via electronic submission (flash drive) in addition to three (3) hard copies.

PAYMENTS

Payments will be scheduled as follows:

- 7.1. 20% (less 2% withholding tax where applicable) of the Contract Amount upon submission and approval of operational plan;
- 7.2. 30% (less 2% withholding tax where applicable) of the Contract Amount upon submission and acceptance of the Draft version of the Environmental and Social Analysis and Environmental and Social Management Plan;
- 7.3. 40% (less 2% withholding tax where applicable) of the Contract Amount upon submission and acceptance of the Final version in one document, which will incorporate all the comments of the Project Coordinating Unit made to the Draft version of the document;
- 7.4. 10% (less 2% withholding tax where applicable) of the Contract Amount upon final execution of all project's administrative closures, which shall involve the receipt of IDB's no objection to the final submission.

COORDINATION

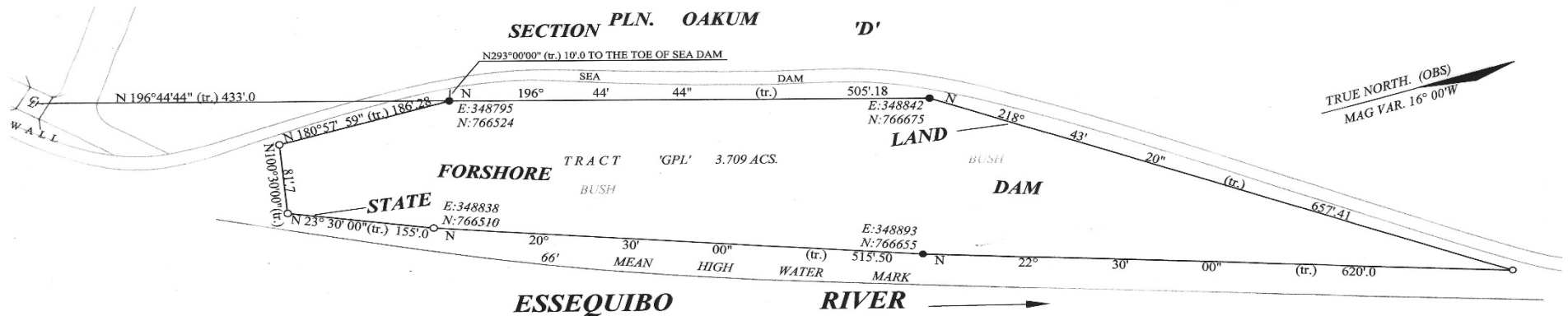
- The consultant will report to the Chief Executive Officer or any other representative of the Guyana Energy Agency, on all matters relating to the execution of this assignment.

Appendix B: Consultant Support

The Consultant Mr. Shyam Nokta utilized the personnel outlined in the table below to support the preparation of the ESAR.

Personnel	Role
Mr. Khalid Alladin	Environmental Management Specialist
Ms. Kandila Ramotar	Community Engagement and Social Specialist
Mr. Enrique George Monize	GIS Specialist
Mr. Colis Allen	Hydrologist
Mr. Michael Philander	Biologist
Mr. Bankole Holder	Biologist
Ms. Latchmi Mukhlall	Environmental Assistant

Appendix C: GLSC Cadastral Survey of Property



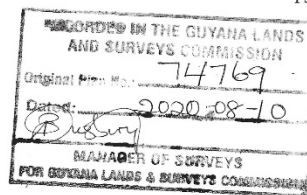
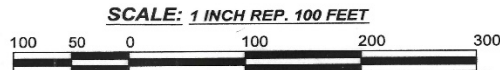
PLAN
SHOWING
TRACT 'GPL'
BEING PORTION OF STATE LAND
PORTION OF THE FORSHORE DAM
PLN. OAKUM
SITUATE ON THE LEGUAN ISLAND, ESSEQUIBO RIVER
IN THE COUNTY OF ESSEQUIBO
GUYANA.

VEYED AND PAAL OFF UNDER THE UNDER THE INSTRUCTION OF THE
COMMISSIONER OF GUYANA LANDS AND SURVEY COMMISSION.

BY.

DATE: 22-07-2020

TRAVIS A. FIELDS
(S.L.S)



MEMORANDUM

1. NO NOTICE OF INTENDED SURVEY WAS SERVED SINCE ALL ADJOINING LANDS ARE STATE LAND.
2. THE SURVEY COMMENCED ON THE 11-06-2020 AND WAS COMPLETED ON THE 14-06-2020.
3. Mr. HILLIMAN REPRESENTING G.P.L ATTENDED THE SURVEY. NO OBJECTION WAS RAISED.
4. REFERENCE WAS MADE TO THE FOLLOWING G.L.&S.C PLAN No. 3615 BY D.C.S MOSES S.L.S DATED 25-05-1931 ON WHICH THE SURVEY WAS BASED AND PLAN No. 22067 BY A. N FAGU S.L.S DATED 20-08-1988.
5. THE AREA SURVEYED WAS APPROVED FOR GUYANA POWER AND LIGHT COMPANY VIDE FILE No. 31223/5 AND THIS IS THE PRE-REQUISITE TO THE ISSUANCE OF A 50 YEARS LEASE.
6. THE SURVEY WAS DONE AS FAR AS PRACTICABLE IN ACCORDANCE WITH THE STATE LAND REGULATION.
7. U.T.M COORDINATES WERE OBTAIN BY THE USE OF A GARMIN 64CSx. GPS WHICH REFER TO PSAD 56.

LEGEND

- DENOTES WOOD PAAL (T.A.F)
- DENOTES WOOD PAAL IN CONC. (T.A.F)
- BRIDGE
- ROAD/ DAM

Appendix D: No Objections/Permissions

No Objection from the Leguan Neighbourhood Democratic Council

Neighbourhood Democratic Council's Office,
Enterprise, Leguan.

Email: leguanndc2020@gmail.com

7th February, 2022.

Dr. Mahender Sharma,
Chief Executive Officer,
295 Quamina Street,
South Cummingsburg,
Georgetown.

Dear Sir,

Please be informed that the Leguan NDC herein give approval and has no objection for the construction of Solar Photovoltaic Plant, associated transmission line network and further revised location at Oakum, Leguan.

All for your information.

Yours co-operatively,

Lachhman Dwarkha
Lachhman Dwarkha
Chairman

LEGUAN NEIGHBOURHOOD
DEMOCRATIC COUNCIL

No Objection from the Regional Democratic Council – Region # 3



*Regional Administration Office
Office of The Regional Chairman*

Vreed-en-Hoop
West Coast Demerara
Tele: 264- 2692
Email: regionalchairmanreg.3@gmail.com

Essequibo Islands/West Demerara
Region No. 3

Date: 14th January, 2022


Dear Sir/Madam,

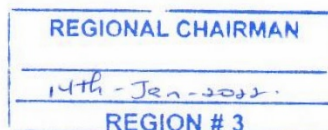
To Whom It May Concern

This letter serves to inform you that my office has reviewed the resubmission letter from the Guyana Energy Agency, 295 Quamina Street, South Cummingsburg, Georgetown, for a shift in location to construct a 0.6 MW Solar Photovoltaic Plant on the island of Leguan, Essequibo River and as such my office has No Objection to the same.

All for your information and guidance.

Regards


.....
Sheik M.I Ayube
Regional Chairman
Region #3.



Permission from Guyana Lands & Surveys Commission

GUYANA LANDS AND SURVEYS COMMISSION

File No. 312235/5

GEORGETOWN, DEMERARA
22nd October, 2019

PERMISSION TO OCCUPY STATE LAND

Issued **under Section 3 (b) of the State Lands Act Chapter 62:01**

Permission is hereby granted to – **GUYANA POWER AND LIGHT COMPANY INC.**, of Lot 40 Main Street, Cummingsburg, Georgetown, under **Section 3 (b) of the State Lands Act Chapter 62:01** to occupy and commence work with effect from: **01-10-2019** on a tract of approximately **8 acres** of State Land, **situate at the Foreshore Reserve at Plantation Okium, Leguan Island. The tract commences at a point with UTM coordinates (E348769, N766399) being N12° 31' 44" (tr), 394 feet from the Plantation Okium Koker, thence N170° 45' 55" (tr) for 600 feet, thence N90° 0' 00" (tr) for 581 feet, thence N193° 46' 55" (tr) for 600 feet, thence N90° 0' 00" (tr) for 581 feet to the point of commencement, as shown on GL&SC Plan No. 14400, applied for on the 04-09-2019 for Commercial Purposes.**

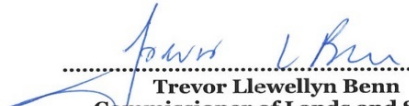
This permission is subject to the same condition and terms, wherever applicable, of a **LEASE**, which when issued shall be deemed to have commenced from the date of this Permission, and the conditions attached to such **LEASE** shall be deemed to have been in force as from the date hereof.

This permission may not be transferred before the tract is surveyed and all accumulated fees and rent of any excess are paid.

The annual rent is **\$240,000.00 per annum for Commercial Purposes** payable in advance and subject to revision at every three (3) years.

The **Permittee** shall within three (3) months from the date of this Permission, take all the necessary steps to define the area described herein by a Cadastral Survey which is a prerequisite to the issuance of the **LEASE** and beneficially occupy at least one-fifth part of the area approved within the first year.

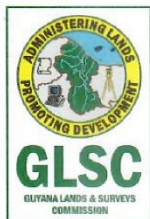
The **Permittee** shall not sublet or give permission to anyone to occupy the land or part thereof.


.....
Trevor Llewellyn Benn
Commissioner of Lands and Surveys

COMMERCIAL PURPOSES

I hereby agree to the Terms and Conditions of this Permission


.....
Guyana Power & Light Company Inc.
(PERMITTEE)



GUYANA LANDS AND SURVEYS COMMISSION

22 Upper Hadfield Street, Durban Backlands,
Georgetown, Guyana.

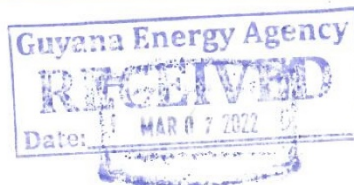
Tel: (592) 226-0524 - 9

website: www.lands.gov.gy

Fax: (592) 226-4052, 226-0520

March 7, 2022

Dr. Mahender Sharma
Chief Executive Officer
Guyana Energy Agency
295 Quamina Street
South Cummingsburg
Georgetown



Dear Dr. Sharma,

Re: Request for “No Objection” to change in location on Leguan (GDF)

Reference is made to your correspondence dated December 9, 2021 requesting a no objection for a shift west of the current location to facilitate the construction of the 0.6 MW Solar Photovoltaic Plant on the island of Leguan, Essequibo River due to concerns about flooding.

The Guyana Lands and Surveys Commission hereby grants a “No Objection” to your request to utilize the area identified.

Yours respectfully,

Jewel Cheong
Land Administration Manager
for Commissioner/ Chief Executive Officer

Secure Your Land, Pay Your Rent

Sea Defence Board Initial 'No Objection'

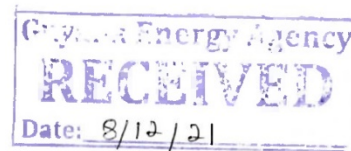


SEA DEFENCE BOARD

MINISTRY OF PUBLIC WORKS

Fort Street, Kingston, Georgetown, Guyana

Email: sdb@publicinfrastructure.gov.gy | Tel. +592-225-9868 | +592-227-8294



Our Ref: SDB R3-010-21 07-12-2021

December 7, 2021

Dr. Mahender Sharma
Chief Executive Officer
Guyana Energy Agency
295 Quamina Street
South Cummingsburg
Georgetown



Dear Dr. Sharma,

Application for the Installation of Solar Photovoltaic Electricity Plant at the Okum Foreshore, Leguan Island, Essequibo River

Reference is made to your application seeking the no-objection of the Sea Defence Board to the installation and operation of a solar photovoltaic electricity plant at Tract 'GPL' located at the Okum foreshore, Leguan Island, Essequibo River. The Board has noted that the Guyana Energy Agency (GEA) is collaborating with the Guyana Power and Light Inc. (GPL) on the implementation of the project, which is envisaged to supplement GPL's power supply capacity on Leguan Island by 0.6 megawatts. Additionally, GPL has obtained a lease from the Guyana Lands and Surveys Commission to utilise the section of the Okum foreshore identified for the project.

Pursuant to our review of your application and supporting documentation, the Sea Defence Board hereby grants its no-objection to the construction and operation of the proposed solar photovoltaic electricity plant. This no-objection is limited to the objectives and particulars outlined in your application and is contingent on the strict compliance of the GEA and GPL to the following conditions:

1. Compliance with the Requirements of Other Regulatory Agencies

Prior to the initiation of construction and installation works at the site, the GEA must acquire final approvals, permits and licenses (as may be applicable) from all relevant regulatory agencies including (i) the Environmental Protection Agency (ii) Regional Democratic Council, Region No.3 and (iii) the Guyana Lands and Surveys Commission. In the case of duration restricted permits and licenses, strict adherence to renewal requirements is expected. Copies of all approvals must be promptly submitted to the Sea Defence Board for our review upon acquisition from the respective agencies.

2. Protection of River Defences During the Installation Works

To ensure that the structural and functional integrity of the flood defences adjacent to the project site is not compromised, the installation works must be executed in a manner that avoids disturbances to the existing river defence embankment at Okum. All components of the solar photovoltaic plant should be installed at a minimum offset distance of 20ft from the toe of the earthen embankment to allow ease of access for future flood protection works.

3. Directives Related to River Defence Maintenance and Future Upgrade

The GEA and GPL shall expeditiously and fully comply with all directives issued by the Sea and River Defence Department in relation to the dismantling, partial or full removal of structural elements of the solar photovoltaic plant to facilitate flood protection works. There shall be no compensation from the Ministry of Public Works for any losses or inconveniences resulting from such activities.

4. Disturbance of Natural Flood Protection Systems

Disturbance, clearing or removal of natural flood defences, including foreshore sediment, mangrove trees and other forms of beneficial vegetation from the Okum foreshore shall be limited to the 2.48 acres plan footprint area proposed for the solar photovoltaic plant as outlined in your application. There shall be no disturbance or clearing of natural flood defence elements beyond this limit unless prior approval is granted by the Sea Defence Board and other regulatory agencies.



5. Access to Site for Construction and Monitoring Purposes

Access to the river defences and reserve adjacent to the solar photovoltaic plant must be facilitated at all times. Officers from the Sea and River Defence Department and equipment must be allowed unimpeded access to the river defences and reserve to facilitate construction and monitoring activities as may be undertaken by the Ministry of Public Works.

6. Construction Programme

The Sea and River Defence Department must be informed of the programme for the installation works so that intermittent monitoring by our technical officers can be facilitated.

7. Liability

The Sea Defence Board shall not be liable to compensate the GEA and GPL for the dismantling/destruction of structures so erected to facilitate reconstruction of river defences adjacent to your proposed facility.

The failure of the GEA and GPL to comply with the aforementioned stipulated conditions will result in immediate annulment of this approval.

Yours sincerely,



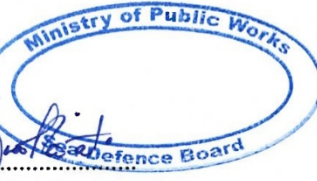
Brigadier Gary A Beaton, MSM
Chairman - Sea Defence Board



Kevin Samad
Chief Sea and River Defence Officer



Jermaine Braithwaite
Secretary – Sea Defence Board



cc: Executive Director, Environmental Protection Agency
CEO, Guyana Power and Light
Commissioner, Guyana Lands and Surveys Commission
Regional Chairman, RDC-Region No. 3

Sea Defence Board 'No Objection' for Shift in Project Site



SEA DEFENCE BOARD

MINISTRY OF PUBLIC WORKS

Fort Street, Kingston, Georgetown, Guyana

Email: sdb@publicinfrastructure.gov.gy | Tel. +592-225-9868 | +592-227-8294

Our Ref: SDB R3-006-22 03-03-2022

March 3, 2022

Dr. Mahender Sharma
Chief Executive Officer
Guyana Energy Agency
295 Quamina Street
South Cummingsburg
Georgetown

Dear Dr. Sharma,



Sea Defence Board No Objection Ref No. SDB R3010-21: Installation of Solar Photovoltaic Electricity Plant at the Okum Foreshore, Leguan Island

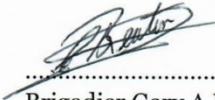
Request for Adjustment to Project Site

Reference is made to the captioned Sea Defence Board approval and your letter dated February 28, 2022 seeking the Board's no objection to the westward shift of the site proposed for the construction of the photovoltaic electricity plant at the Okum foreshore, Leguan Island. The Board has noted that the adjustment to the position of the site has been proposed to reduce the potential flood risk to the facility.



In consideration of your request, the Sea Defence Board hereby grants its no objection to the proposed adjustment in the position of the electricity plant. Please note that the GEA is expected to fully comply with all conditions stipulated in our no objection letter Ref No. SDB R3010-21 07-12-2021 in relation to the implementation and operation to the proposed facility.

Contact should be made with Mr. Seenarine Nandram, District Engineer - District 3 in relation to the scheduling of the installation works to facilitate intermittent monitoring of the activities at the site.

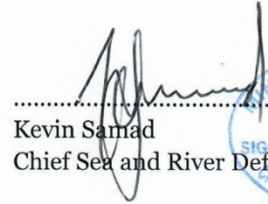
Yours sincerely,



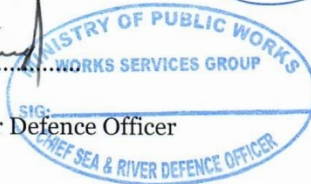
Brigadier Gary A Beaton, MSM
Chairman - Sea Defence Board

Jermaine Braithwaite
Secretary - Sea Defence Board



Kevin Samad
Chief Sea and River Defence Officer



cc: Executive Director, Environmental Protection Agency
Commissioner, Guyana Lands and Surveys Commission
Regional Chairman, RDC-Region No. 3

CENTRAL LABORATORY

Research Centre, Agriculture Department, LBI Compound, E.C.D, Guyana, S.A.

Telephone #: 592- 220-2229 Email: riship@guysuco.com

Fax #: 592-220-4027

211

Appendix F: Minutes of Stakeholders Engagements

Appendix F1: Personal Communication 01 – Interview with the Sea and River Defences Board (Leguan Office)

Date: October 07, 2021

Time: 10:30 to 11:30 hrs

Venue: Sea and River Defences Board (Leguan Office)

Consultant Team:

Mr. Shyam Nokta
Mr. Khalid Alladin
Ms. Kandila Ramotar
Mr. Michael Philander
Mr. Bankole Holder
Mr. Enrique Monize
Dr. G. R. N Rao
Mr. Colis Allen

Representatives of the Guyana Energy Agency:

Mr. Mfon Akpan	Project Coordinator
Mr. Kyle Lewis	Environmental and Social Officer

Representatives of the Sea and River Defences Board (Leguan):

Mr. Neville Udit	Checker (ag)
Ms. Niomi Azad	Accounts Clerk

Introduction

Mr. Khalid Alladin thanked Mr. Udit for participating in the discussions on the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback from the Sea and River Defences Board, particularly on issues pertaining to the conditions at the project site.

Summary of Discussions

The following issues were discussed by the representatives of the Sea and River Defences Board (Leguan) with the GEA and the Consultant team:

- Consultant questions on **sea defence structures**: When were the existing sea defences installed? Are there plans for extension in the near- to medium-term? How are areas prioritised for new sea defences?

Sea and River Defence Board response:

- Shorelines in Leguan are susceptible to a 30-year erosion and accretion cycle. The project site was previously silted up with sand from the sea during the accretion phase of the cycle. However, over the last one to two years, the erosion phase of the cycle commenced. As an example of the extent of erosion which has already occurred, the grove of coconut trees on the project site extended further onto the beach almost reaching low-tide water level.

- As a result, in early 2021, the Sea and River Defence Board installed a boulder face along a 65-meters of the section of the shoreline most susceptible to erosion, north of the project site.
 - Additional sea defences, either rip raps or the extension of the boulder face, will be required to protect the sandy area of the project site from erosion. Plans are in place to extend for approximately 500 meters from the existing boulder face to the koker following the existing line of vegetation. However, this was not included in the budget for activities to be conducted in 2022.
 - The Sea and River Defences Board conducts condition surveys of the sea defences on the island. The approach to selecting sites for new interventions is to prioritise the areas which are at greatest risk which are considered to be in “critical” condition.
- Consultant question on **boulder face and rip rap structures**: What is the difference between boulder faces and rip raps?
- Sea and River Defence Board response:
- Boulder faces are weaker structures than rip raps. They are typically temporary structures with lifetimes of about two to three years and are eventually replaced by rip rap structures. The estimated life of rip raps are 30 years.
 - The cost of rip-rap depends on the type of structure to be installed. The two main types of structures include either (i) a toe, lower slope, upper slope, geotextiles, berm and dams or (ii) toe, single slope, geotextiles and dam.
 - In Leguan, rip rap structures covering up to 600-meters of the shoreline have been constructed at one time so an installation at the project site could be achieved under one project.
- Consultant questions on **high water mark and flooding of the project site**: What is the current high-water mark? Does water ever reach the project site? Is the project site prone to flooding? Are any other areas of Leguan prone to flooding?
- Sea and River Defence Board response:
- The high-water mark is visible along the shoreline following the line of vegetation as well as the accumulation of trash on the beach.
 - Although there are several spring tides each year, the “Diwali Spring” is the highest. During this spring tide, there are splashes into some areas of the project site.
 - The project site itself has never flooded.
- Consultant questions on **erosion**: What is the estimated depth of the sand at the site? Do you believe erosion will accelerate if the existing cover of vegetation is removed from the site?
- Sea and River Defence Board response:
- During the accretion phase, sand siltation levels were high. The existing sand bank at the project site is approximately nine meters deep. Some areas may be higher and this is due to accretion.
 - The existing cover of vegetation is important to maintaining the sand bank. With vegetation, the sand bank is estimated to hold for about the next five years, until hard structures are installed.
 - Erosion will drastically accelerate if vegetation is removed and it is conceivable that the sand bank will wash away.
- Consultant question on **role of Sea and River Defences Board**: Does the Sea and River Defences Board construct hard structures?
- Sea and River Defence Board response:
- No, Contractors execute all capital works. However, the Board has equipment/machinery and manpower to conduct maintenance of the structures.
 - The Board also monitors the condition of all sea defence structures including sluices.

- Consultant question of **flooding in Leguan**: Are any other areas of Leguan prone to flooding?
Sea and River Defence Board response:
 - The Island of Leguan is used for rice cultivation and as such, the land was designed to facilitate the flooding of rice fields.
 - However, flooding as a result of heavy rainfall does not occur when trenches are cleaned and the kokers/sluices are operational. All kokers in Leguan are self-acting kokers.

- Consultant questions on **uses of project site**: Is the project site used by local people for any recreational or religious purpose? Is the site used for grazing or for harvesting firewood?
Sea and River Defence Board response:
 - The beach is a popular spot for recreation and people visit the area daily for recreation purposes. The installation of new sea defence structures will not restrict public access to the area for recreational purposes.
 - The beach area, close to the shoreline, is used for Hindu religious purposes on special occasions.
 - The Sea and River Defence Board prohibits clearing of vegetation from the area to be used as firewood. In addition, grazing is not permitted within lands designated as the project site.

- Consultant questions on **Government reserve lands**: Does the Government have any reserve lands in the vicinity of the project site? What is typically the extent of the Government reserve areas along sea defence structures in Leguan.
Sea and River Defence Board response:
 - The triangular plot of land south of the project site and east of the sea dam is a Government reserve area. Currently, there is some squatting occurring on the reserve.
 - Reserve areas for sea defences are typically 50-feet from the center of the dam. However, in many areas in Leguan reserve areas have been exhausted and the Government obtained permission to erect sea defences on privately owned lands.

- Consultant question on **climate change**: Are potential impacts of sea level rise as a result of climate change considered in the design of sea defence structures?
Sea and River Defence Board response:
 - Yes, potential sea level rise is factored into the design of sea defence structures. Previously, sea defence structures were designed at 17 to 18 GD but was increased to 19 to 20 GD on account of sea level rise.

- Consultant question from the Sea and River Defence Board on **site selection**: What were the reasons for the selection of the project site?
GEA response:
 - Most of the lands in Leguan are publicly owned and this limited available options for selecting the site. The key criteria in selecting the site was its easy availability for lease as public lands and its proximity to the GPL power station and feeders to limit line losses. There are alternative sites on public lands which were ruled out because it would require clearing of mangroves.
 - In addition, a Feasibility Study was conducted for the site including on its solar irradiance and these were feasible.
 - The Environmental and Social Analysis Report will also help to further inform decision making.

Appendix F2: Personal Communication 02 – Interview with the Leguan Neighbourhood Democratic Council

Date: October 07, 2021

Time: 13:20 to 14:20 hrs

Venue: Boardroom of the Regional Democratic Council

Consultant Team:

Mr. Shyam Nokta
Mr. Khalid Alladin
Ms. Kandila Ramotar
Mr. Michael Philander
Mr. Bankole Holder
Mr. Enrique Monize
Dr. G. R. N Rao
Mr. Colis Allen

Representatives of the Guyana Energy Agency:

Mr. Mfon Akpan	Project Coordinator
Mr. Kyle Lewis	Environmental and Social Officer

Representatives of the Neighbour Democratic Council (Leguan):

Mr. Lachman Dwalla	Chairman
Mr. Jainarine Singh	Vice Chairman
Mr. Tulsie R. Singh	Overseer (ag)
Ms. Fazia Ali	Councillor
Ms. M. Rambajan	Councillor
Mr. Sheed Ayuda	
Ms. Bibi Fajine Khan	Teacher
Ms. Rovina Hayman	Accounts Clerk

Introduction

The Chairman and Councillors of the Neighbourhood Democratic Council (NDC) of Leguan opened the meeting and welcomed the representatives of the Guyana Energy Agency (GEA) and the Consultant's team. One of the Councillors shared the expectation of the NDC that the project will come to fruition.

Mr. Mfon Akpan thanked the NDC for continuing its productive engagements with the GEA on the Leguan Solar Farm Project. Mr. Akpan provided an overview of the Energy Matrix Diversification and Institutional Strengthening of the Department of Energy programme and progress which has been achieved in its implementation. He also explained the developments which lead to the addition of Leguan to the project. He then indicated that, following updates during the previous meeting with the NDC, a consultant was hired to conduct an environmental and social assessment of the project. Therefore, the purpose of this meeting is to facilitate engagements between the NDC and the consultant.

Mr. Shyam Nokta thanked the NDC for participating in the discussions on the Leguan Solar Farm Project and introductions to Consultant's team were made. Mr. Nokta then invited Mr. Alladin to discuss the project and the project area with the NDC in detail. Mr. Alladin provided an overview of the purpose of the ESAR and the activities that will be conducted to prepare the ESAR. Mr. Alladin explained that the discussions will aim to receive feedback from the NDC about the project including

any concerns, expectations and recommendations. He also explained that information about the Island of Leguan and the project site will be sought from the NDC.

Summary of Discussions

The following issues were discussed by the representatives of the NDC (Leguan) with the GEA and the Consultant team:

- Consultant question on **potential benefits to public facilities**: What public facilities, including those managed by the NDC, are expected to be electrified by the project?

NDC response:

- Street lights, although some street lights are solar powered, others are connected to the GPL grid.
- Public buildings: RDC office buildings, NDC office building, Sea and River Defence office, the Government Guest House, Schools, the Hospital, Health Centres, Police Stations and the Community Center.

- Consultant question on **historic and current uses of the project site**: Are there any historic uses of the project site? What are the current uses of the project site and the beach?

NDC response:

- There are no historic uses of the project site.
- Currently, the site is used mainly for recreational purposes and a few people visit the site daily. On weekend, approximately 50 to 60 people visit the beach for recreational purposes. On Easter, hundreds of people from around the Island visit the beach to fly kites and picnic.
- A few persons also use the beach for Hindu religious purposes.

- Consultant question on **livelihoods**: Is the project site used by locals to support their lives and livelihoods? Do locals collect firewood or graze animals in the project site? A cluster of coconut trees were observed on the project site – were these planted there? Moreover, seines were set just off the beach and fishing boats were moored just south of the koker. On a larger scale, what are the main livelihoods on the Island as a whole?

NDC response:

- No, the site is not used to support any livelihoods.
- Grazing is not permitted on the project site.
- Nobody collects firewood from the area, and generally, firewood is not widely used for cooking in the present day. Most people use kerosene or gas.
- The coconut trees grew naturally on the beach and some have washed away due to erosion.
- The seines were set along the area by persons living in the nearby residential area and the boats also belong to people who live in that area. The boats are used to access fishing grounds further offshore. However, during crab season, many boats belong to artisanal fisherfolk dock in this area.
- The most dominant livelihoods of the people of Leguan are livestock rearing (mainly cattle) and the cultivation of rice and cash crops.

- Consultant question on **flooding**: Does the project site flood during high tides?

NDC response:

- No, the project site is not flooded during high tides. In the past, the site was flooded but this has not occurred since the accretion of the site.
- However, recently there has been erosion of the site.

- Consultant question on **land uses**: Are any land use conflicts anticipated to occur on the project site or for the transmission line? Are neighbouring lands privately owned?
NDC response:
 - The project site is situated on public lands and were not previously earmarked for any purpose. Therefore, no conflicts are likely to occur.
 - All lands west of the project site, across the sea dam, are privately owned and used as grazing areas.
 - The transmission line is expected to be situated within the reserve lands. However, it should be noted that the junction between the access road and the sea dam is used by vehicles (including tractors) to access the beach and the grazing areas.

- Consultant question on **NDC concerns**: In the notes of previous engagements with the GEA, concerns were raised about the selection of the project site and including potential impacts to the use of the beach for recreation. Do you still have these concerns?
NDC response:
 - The questions which were raised previously were intended to help the NDC to understand the project. The specific enquiries were whether the project will have an effect on the use of the beach and also whether people using the area can affect the panels.
 - The NDC is aware that the Government has acquired private lands to establish an airstrip and also considered whether a similar process could have been followed for this project.

- Consultant question on **project benefits and beneficiaries**: What benefits do you expect from the project? Who are the main beneficiaries of electricity provided by GPL?
NDC response:
 - The main benefit is that electricity costs are expected to go down. If electricity costs do not decline, the benefit of pursuing this project will be difficult to understand.
 - Overall, the existing power system is reliable and there are not many blackouts. Reliability is not an issue. However, there was only one challenge where a section of the line connected to the NDC office burned out every few months but this issue has been fixed.
 - The entire Island of Leguan is connected to the GPL grid including residential and commercial areas. Only rice milling operations are not connected to the grid and instead, are powered by diesel generators. In total, there are six rice mills but only four are currently operational.

- Consultant question on **development initiatives in Leguan**: Are there any existing or planned development initiatives in Leguan that could benefit from the project?
NDC response:
 - GPL intends to establish a sub-station close to the community centre and secondary school and the NDC has provided its No-Objection to this initiative. This could also allow for the installation of lights at the playfield so that night-games, particularly for cricket, could be played.
 - A Plantain Chip Factory was constructed in Leguan. All the equipment for the factory was procured and is functional. However, the factory never became operational because of the cost of electricity. Lower costs of electricity as a result of the project could help to make the plant operational.

- Consultant question on **waste disposal**: How is waste disposed in Leguan? Is there a designated dumpsite?
NDC response:
 - There is no dumpsite. Currently, most households burn their waste.

- Previously, there was a clean-up effort around the Island and the waste was buried.
 - The NDC has identified a potential location for a dumpsite but this has to be approved by the Ministry of Local Government and Regional Development (MLGRD). This project presents an opportunity for the NDC (and the GEA) to pursue approval of the dumpsite location.
- Consultant question on **water supply**: What is the main source of freshwater on the Island?
NDC response:
 - Water is provided to households by Guyana Water Incorporated (GWI) but water quality is poor due to a high iron content which causes rusting.
 - GWI's distribution system is also powered by the GPL grid. In the unlikely event that there is a blackout then there is no running water.
- Consultant question on **cost of fuel**: What is the cost of fuel in Leguan?
NDC response:
 - Fuel is more expensive in Leguan than in Parika. Prices paid by consumers are approximately GYD\$ 100 to 200 higher (per gallon) than in Parika.
- Consultant question on **health care**: What is the capacity of the health care system in Leguan? How has the Island coped with COVID-19?
NDC:
 - The Leguan Cottage Hospital has 16 beds and is capable of dealing with minor illnesses.
 - Serious illnesses are referred to the West Demerara Regional Hospital. The costs of transfer is typically borne by patients. Transportation in emergency situations and during the night is dangerous as speed boats are the only available mode of transportation.
 - There is only one doctor, who is on call 24/7. This is believed to have contributed to circumstances which lead to the death of a child earlier this year.
 - There have been positive cases of COVID-19 but no deaths have been attributed to the virus.
- Consultant question on **recreational facilities**: Are there any recreational facilities on the Island?
NDC response:
 - Yes, there are two playgrounds. However, their use was impacted by the COVID-19 pandemic as public use was restricted.
- Consultant question on **recommendations**: Do you have any recommendations that should be implemented by the project?
NDC response:
 - Yes, sea defence structures should be installed prior to clearing vegetation for the project construction.
- NDC question on **employment**: How many people will be permanently employed?
GEA response:
 - Between 15 to 20 people will be employed by the project. However, the final decision on employment will be made by GPL who will be the operator of the project.
- NDC question on **project implementation**: Based on the work that has been conducted so far, does it seem likely that the project will be implemented?
Consultant and GEA response:
 - The work on preparing the ESAR had only just begun.

Appendix F3: Personal Communication 03 – Interview with Guyana Power and Light Inc. (Leguan)

Date: October 07, 2021

Time: 14:30 to 15:10 hrs

Venue: GPL (Leguan) Power Station

Consultant Team:

Mr. Shyam Nokta

Mr. Khalid Alladin

Ms. Kandila Ramotar

Mr. Michael Philander

Mr. Bankole Holder

Dr. G. R. N Rao

Representatives of the Guyana Energy Agency:

Mr. Mfon Akpan Project Coordinator

Mr. Kyle Lewis Environmental and Social Officer

Representatives of the GPL (Leguan):

Mr. Colin Hodge Operations and Maintenance Foreman

Mr. Shaun Singh Technician

Introduction

Mr. Khalid Alladin thanked the representatives of GPL (Leguan) for participating in the discussions on the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project. Mr. Alladin indicated that the purpose of the discussion was to allow the Consultant's team to gain insights about the operations of GPL (Leguan) as well as to receive feedback and recommendations about the project.

Summary of Discussions

The following issues were discussed by the representatives of the GPL (Leguan) with the GEA and the Consultant team:

- Consultant question on **generation capacity and peak demand:** What is the maximum electricity generation capacity of GPL in Leguan? What is peak demand in Leguan? Does GPL has excess capacity?
GPL (Leguan) response:
 - Currently, GPL has an installed generation capacity of 820 kilowatts (kW). This is provided by two diesel powered generators. A third unit has been procured from MACORP and will be installed by November 2021.
 - Peak demand ranges from 350 to 370 kW. Demand has been increased because of increased installations of air conditioning units in private residences and increased use of power from GWI where work is being done to construct a water treatment facility. Peak loads are expected to continue to increase and may reach 390 to 400 kW by the end of this year.
 - Typically, GPL would have some excess capacity. However, one generator is down and as such, demand is met by only one generator.

- Consultant question on **beneficiaries of GPL's power**: Is the entire Island of Leguan electrified? Who are the beneficiaries of electricity provided by GPL?
 GPL (Leguan) response:
 - The entire island is electrified by GPL and most households are connected to the grid. However, the rice mills are not connected to the grid because millers have concerns about the tariffs and operations are also seasonal.
 - However, GPL's goal is for all operations to be connected to the grid ultimately.
- Consultant question on **tariffs**: What is the cost of electricity per kWh in Leguan?
 GPL (Leguan) response:
 - The Accounts Department will have to advise on the tariff rates.
- Consultant question on **interconnection with solar farm**: Will the existing transmission and distribution system be expanded for the implementation of this project?
 GPL (Leguan) response:
 - Hardware and other factors for interconnection was designed by a GPL engineer based in Georgetown (Amir Dillawar).
 - GPL has also identified a site behind the secondary school for a new sub-station. The transmission lines from the solar farm will be connected to the sub-station before heading to the main power station. However, the current alignment for the transmission line from the solar farm does not include the sub-station.
 - Currently, construction works are ongoing to construct new facilities at the power station to accommodate new feeders needed to facilitate the solar farm.
- Consultant question on **inter-island grid connectivity**: Does GPL intend to pursue plans to interconnect the grids of Leguan and Wakenaam using a sea-cable?
 GPL (Leguan) response:
 - Last year, GPL engineers examined options for potential locations of the sea-cable between Leguan and Wakenaam. These studies were conducted for connections with both Wakenaam and Hogg Island.
 - GPL has also been considering the potential relocation of the power station to a larger facility to facilitate these interconnections.
- Consultant question on **forecasting**: Has any forecasting of demand for electricity in Leguan and surrounding islands been conducted?
 GPL (Leguan) response:
 - The team should engage with Amir Dillawar to determine whether forecasting was done for Leguan.
- Consultant question on **fuel**: How is fuel sourced for use in the generators? Have challenges in transportation ever hindered fuel transportation and contributed to power outages?
 GPL (Leguan) response:
 - Whenever supply is low a notice is sent to GPL's procurement department who places an order with the supplier, Rubis. Rubis transports the fuel to the site using a river tanker about once every 14 days.
 - The power station uses approximately 60 gallons of fuel per megawatt (MW) of power. Currently, there are some issues with the generator and thus, approximately 63 gallons of fuels are required to produce 1MW of power.
 - Transportation of fuel to the power station has never encountered challenges that were so significant that power generation was interrupted.
- Consultant question on **staffing**: How many people are employed at GPL in Legaun? Are they locals? If so, what percentage? What percentage are female?

GPL (Leguan) response:

- There are 10 employees of GPL (Leguan) and all are locals of the Island. Each shift is manned by a senior and junior operator. There are no female operators or technicians and only the security personnel are female.

- Consultant question on **technical capacity**: Does GPL have the technical capacity to manage this solar farm? Do you think any new capacities will have to be built?

GPL (Leguan) response:

- From an electrical perspective, GPL is expected to have the technical capacities to manage the electrical aspects of the solar farm project.
- However, new capacities may have to be built for any special requirements needed to for the hardware which will be installed.

- Consultant question on **waste disposal**: How does GPL (Leguan) dispose of old transformers or defective equipment?

GPL (Leguan) response:

- GPL (Leguan) does not dispose of any electrical wastes. These wastes are transported to the Anna Regina Power Station if repairs are required.
- If disposal is required, the equipment is transferred to GPL's headquarters in Georgetown.

- Consultant question on **challenges**: What are the main challenges encountered by GPL in providing electricity? Will the project help to alleviate these challenges?

GPL (Leguan) response:

- The main challenge is that in the event of a blackout due to an issue in a community, the Transmission and Distribution crews have to be dispatched to the area to fix the malfunctions. These crews are staffed by trained personnel.
- There are no other major challenges encountered by GPL's Leguan operations.

- Consultant question on **project benefits**: Are there any other foreseeable direct or indirect benefits of the project?

GPL (Leguan) response:

- Two primary benefits are expected:
 - First, GPL (Leguan) will have a greater power generating capacity.
 - Secondly, reduced consumption of fossil fuels indicates that GPL will be able to direct funds to other areas of development.

- Consultant question on **grievance management**: Do you have a mechanism for addressing or managing grievances raised by customers or other members of the public?

GPL (Leguan) response:

- Yes. GPL (Leguan) has two cell phone numbers that are open to the public (623-5017 and 608-8543). Members of the public call these numbers to report complaints. The complaint is logged and is passed on to the relevant department of GPL (Leguan), typically the Transmission and Distribution crew, to action to address the challenge.

- Consultant question on **history of GPL (Leguan)**: How long has GPL been operational in Leguan? How long has power been provided 24/7?

GPL (Leguan) response:

- GPL has been operational in Leguan for approximately 24 years.
- For approximately 15 years, power was provided intermittently during certain hours of the day. However, in 2015, GPL commenced 24-hour service to the Island.

Appendix F4: Personal Communication 04 – Interview with Neighbouring Land Owner # 1 (Owner of Neighbouring Pasture Lands)

Date: October 07, 2021

Time: 09:30 to 09:45 hrs

Venue: Sea Dam West of the Project Site

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Mr. Michael Philander

Mr. Bankole Holder

Mr. Colis Allen

Stakeholder:

Owner of Neighbouring Pasture Lands (Located West of the Project Site)

Introduction

Mr. Khalid Alladin thanked Neighbouring Land Owner # 1 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and Neighbouring Land Owner # 1:

- Consultant questions on **land use and ownership**: What are the uses of the lands located west of the project site? Are the lands privately or publicly owned?
Neighbouring Land Owner # 1 response:
 - The lands are used as pastures for cattle grazing.
 - There is also a bar of reef sand running in a north-south orientation in some of these pasture areas. This sand is extracted and sold to interested buyers. Construction materials, including sand, is very expensive in Leguan because it has to be imported from Parika and reef sand is a commonly used alternative by people of the Island.
 - All lands are privately owned. Each individual plot is approximately 3 to 4 acres. Mr. Khan owns a plot of land in this area and there are two other owners namely Mr. Shaffur and Mr. Razack.
- Consultant questions on **uses of the project site**: Is the project site used by local people to support their lives or livelihoods such as for collecting firewood or grazing animals.
Neighbouring Land Owner # 1 response:
 - There are strict rules in place to prevent use of the project site for gathering firewood or for grazing animals.
 - A ranger attached to the Sea Defences Board visits the area almost daily and has issued fines if there are any uses of the area which are not permissible. As such, many people chose not to use the area.
 - The beach area is mostly used for relaxation and recreational purposes.

- Consultant question on **benefits and recommendations**: Do you think the project will have any benefits? Do you have any recommendations which the project should apply?
Neighbouring Land Owner # 1 response:
 - The project will benefit the people because it is expected that the cost of electricity will be cheaper.
 - The Government should ensure that local people are employed by the project.

Appendix F5: Personal Communication 05 – Interview with Canefield Resident #1 (Neighbouring Residents)

Date: October 08, 2021

Time: 09:30 to 09:45 hrs

Venue: At the Project Site

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Mr. Colis Allen

Mr. Michael Philander

Mr. Bankole Holder

Stakeholders:

Canefield Resident # 1

Introduction

Mr. Khalid Alladin thanked Canefield Resident # 1 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and Canefield Resident # 1:

- Consultant questions on **flooding of the project site**: Has the project site ever been flooded?
Stakeholders' response:
 - The project site does not flood due to heavy rainfall.
 - Typically, the high tide does not reach the project site but stays at the high-water mark. However, high-tides and windy conditions result in limited occurrences of sea spray into the project area.
 - Nonetheless, during spring tides in 2018 or 2019, when several communities on the West Demerara were flooded, water also reached the project site.
- Consultant question on **uses of the project site**: Do local people use the project site for any purpose such as collecting firewood, grazing animals or recreation?
Stakeholders' response:
 - The Sea Defences Department has strict rules against cutting the vegetation on the project site or using the project site for animal grazing. A Ranger visits the site frequently and if any prohibited activities are found, then fines are issued or people can be taken to jail.
 - The beach is used for recreational purposes and people visit frequently to 'lime'. However, if people visit the project site during high-tides, they would usually spend their time on the project site.
- Consultant question on **pontoon on the beach**: Do you know who owns the pontoon which is grounded on the beach?
Stakeholders' response:

- The pontoon was brought to the beach a few years ago by a businessman who intended a temporary mooring for repairs. However, it has since been abandoned.
- Consultant questions on **fishing activities**: Who sets the seines along the beach of the project site? Who owns the boats which are docked south of the koker?
Stakeholders' response:
 - There are three fisherfolks who live in Canefield and these persons own the boats and also set the seines.
- Consultant questions on **land ownership**: Who owns the land immediately south-west of the project site? Is it government reserve lands?
Stakeholders' response:
 - The land is owned by Canefield Resident # 1 and was fenced to prevent unauthorised people for using the lands. However, the lands will be made available for use by the Government if it is needed.
 - There are squatters east of the area fenced by Canefield Resident # 1. The Sea Defences Department is aware of these squatting activities but has not attempted to move the squatters because of the hardships they endure.
- Consultant question on **project benefits**: Do you think the project will have any benefits?
Stakeholders' response:
 - The project will have several benefits. Firstly, there are expectations that the access road to the project site which passes through the Canefield village will have to be repaired.
 - In addition, more people will visit the beach and people from other parts of Leguan may be interested in visiting the solar farm.
- Consultant question on **recommendations**: Do you have any recommendations which should be implemented by the project?
Stakeholders' response:
 - Sea defences or revetments will have to be installed along the high-water mark to prevent the area from washing away once vegetation is cleared.
 - Local persons should be employed by the project because many people do not have permanent jobs.

Consultant's Note: The lands located south-west of the project site were confirmed to be government reserves by the Sea and River Defences Board (see Personal Communications 01 and 11). Thus, these lands are not privately owned by Canefield Resident # 1.

Appendix F6: Personal Communication 06 – Interview with Canefield Resident # 2 (Neighbouring Resident)

Date: October 08, 2021

Time: 09:30 to 09:45 hrs

Venue: At the Project Site

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Mr. Michael Philander

Mr. Bankole Holder

Stakeholder:

Canefield Resident # 2

Introduction

Mr. Khalid Alladin thanked Canefield Resident # 2 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and Canefield Resident # 2:

- Consultant question on **squatting**: How long have you been squatting in the area?
Canefield Resident # 2 response:
 - Resident is originally from Bonasika Creek. He moved to Leguan two years ago and began squatting in the area.
 - The area was covered in bushes but an engineer from the Sea Defences Board gave permission (orally) to clear the bushes and temporarily squat because of the hardships his family faces.
- Consultant question on **goat pens**: Do you own the goat pens which are also located on the government reserve?
Canefield Resident # 2 response:
 - No. Those pens are owned by "Janey" who is another resident of Canefield.
 - Resident is not permanently employed but generally works on artisanal fishing vessels.
- Consultant question on **benefits and recommendations**: Do you anticipate any benefits as a result of the project? Do you have any expectations?
Canefield Resident # 2 response:
 - Resident is glad the project will be implemented in Leguan because it is an opportunity for employment.

Appendix F7: Personal Communication 07 – Interview with Canefield Resident # 3 (Neighbouring Resident)

Date: October 08, 2021
Time: 10:00 to 10:15 hrs
Venue: Lot 19 Canefield, Leguan

Consultant Team:
Mr. Khalid Alladin
Ms. Kandila Ramotar

Stakeholder:
Canefield Resident # 3

Introduction

Mr. Khalid Alladin thanked Canefield Resident # 3 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and Canefield Resident # 3:

- Consultant question on **residence**: How long have you lived in this area?
Canefield Resident # 3 response:
 - Canefield Resident # 3 is the wife of Canefield Resident # 2 and lives in the residence constructed on the government reserve with her husband and their son.
 - Canefield Resident # 3 has two brothers who live in the house constructed on lands immediately south of the sea dam that separates the residential area of Canefield from the government reserve.
 - Her brothers have lived in this area for approximately five years. The land on which their house is located belongs to Canefield Residents # 1 and he gave them permission to live there.
 - Canefield Resident # 3 brothers work with artisanal fishermen or are employed as cattle herders to take cows to and from the pastures just west of their home.
- Consultant question on **goat pens**: Do your brothers own the goat pens located on the government reserve?
Canefield Resident # 3 response:
 - No. Those pens are owned by Canefield Resident # 4.
- Consultant question on **benefits and recommendations**: Do you anticipate any benefits as a result of the project? Do you have any expectations?
Canefield Resident # 3 response:
 - Canefield Resident # 3 indicated that she did not give much thought to the project before.

Appendix F8: Personal Communication 08 – Interview with Canefield Resident # 4

Date: October 08, 2021

Time: 10:30 to 10:45 hrs

Venue: Lot 15 Canefield, Leguan

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Stakeholders:

Canefield Residents # 4

Introduction

Mr. Khalid Alladin thanked Canefield Residents # 4 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and the stakeholders:

- Consultant questions on **goat pens**: Do you own the goat pens located close to the koker? Are these lands government reserves?
Canefield Resident # 4 response:
 - Canefield Resident # 4 confirms that he owns the goat pens and that they are located on the government reserve. He indicated that he has been conducting goat rearing activities in that area for approximately 15 years.
 - At the peak of his activity, he had a herd of 55 heads but that has drastically declined and currently, the herd comprises 20 heads. The main reason for the decline is that stray dogs fatally bite goats and their kids. There are prohibitions on the island to shooting stray dogs even to prevent attacks to livestock.
- Consultant question on **grazing**: Do the goat graze in the project site?
Canefield Resident # 4 response:
 - When the goats are open during the day, they visit the project site and may graze there. However, taking animals to graze in that area is prohibited by the Sea Defences Board.
- Consultant question on **livelihoods**: Do you have any other livelihood activities?
Canefield Resident # 4 response:
 - Canefield Resident # 4 has previously de-bushed the entire government reserve area and was also engaged in small-scale crop cultivation. However, Canefield Resident 1 # 1 has laid claim to the land and fenced the area preventing access. This is unfair because Canefield Resident # 1 own large tracts of lands in Canefield dedicated to cultivation on bananas, plantains and other crops.
 - Canefield Resident # 4 was previously engaged in fishing activities and his three sons also worked with him on this activity. However, in 2012, they were charged with piracy

and taken to court. The charges were ultimately dropped but he has not since resumed fishing. However, his three sons are still engaged in fishing activities – they own the fishing boats docked south of the koker and occasionally set seines along the beach. Fishing trips are not frequently productive and his sons sometimes work as cattle herders to take cattle to pasture but this is not a well-paying job, earning only about GYD\$ 2000 per day.

- Canefield Resident # 4 currently works as a security guard.
- Consultant question on **benefits and recommendations**: Do you anticipate any benefits as a result of the project? Do you have any expectations?
Canefield Resident # 4 response:
 - The project is expected to be beneficial to the island as a whole.
 - The access road passing through Canefield will be repaired to allow for access to the project site. Canefield Resident # 4 indicated that he has lived in Canefield for his entire life (59 years) and that section of the road has never been properly repaired.
 - Canefield Resident # 4 expects to be employed by the project.

Appendix F9: Personal Communication 09 – Interview with Major Projects Department, Engineering Services Division of Guyana Power and Light Inc. (Georgetown)

Date: October 18, 2021

Time: 13:30 to 14:58 hrs

Venue: Virtual via Zoom

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Representatives of GPL's Major Projects Department:

Mr. Ryan Ross

Divisional Director

Mr. Orville Chrichlow

Project Officer

Introduction

Mr. Khalid Alladin thanked the representatives of GPL's Major Projects Department for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and the stakeholders:

- Consultant questions on **transmission and distribution:** Will the existing system for transmission and distribution have to be expanded for the project? Has the route of the transmission line been finalized? Has the location of the sub-station been finalized? Where any alternative locations for the sub-station evaluated?

Response of GPL's Major Projects Department:

- The route of the transmission line and the location of the sub-station have both been finalized. The location of the transmission line and the sub-station would have been influenced by considerations of system planning and involves the give and take between the locations of existing infrastructure (like feeders) and the associated costs.
- However, definitive responses will require engagement of GPL's specialists in the relevant Department. Mr. Crichlow requested that a list of questions be shared via e-mail following the meeting to allow appropriate responses to be sought and shared with the consultant via e-mail.
- GPL will not comment on the selection of the site for the installation of the solar farm and will not indicate whether this site is considered as an acceptable location. This site was selected by the Guyana Energy Agency (GEA) for several factors foremost of which was its availability as Government lands. GEA should be engaged for this justification.

Consultant response:

- A list of questions will be shared following the meeting. Grateful if the final transmission line route and the location of the sub-station could be shared with the consultant as well.
- The Consultant has engaged with GEA on the site selected for the installation of the solar farm. Moreover, there is an understanding that GPL's role pertains specially to the transmission line and the distribution system, inclusive of the substation.

- Consultant questions on **inter-island connectivity**: Does GPL intend to pursue plans to connect the grids of Leguan and Wakenaam? When is this expected to commence?
Response of GPL's Major Projects Department:
 - Yes. The connection of the grids in Essequibo is part of GPL's Strategic Plan to build reliability of its system. Wakenaam will have an independent power generation system and a solar farm is also planned for development on Wakenaam.
 - Interconnection between Leguan and Wakenaam is expected to occur in the medium-to long-term (approximately the next five to ten years) but definitive timelines are too uncertain.

- Consultant questions on **cost of energy and tariff**: What is the cost of energy in Leguan? What tariffs do consumers pay? What factors influence the setting of tariffs?
Response of GPL's Major Projects Department:
 - Tariffs tend to be similar with variations based on the type of community. Smaller communities, like Leguan, have smaller economies of scale and thus lower loads. The costs of transporting fuel to these locations must also be taken into account. Typically, the tariff is expected to be more than GYD\$ 50 per kWh.

- Consultant questions on **demand**: What is the existing level of demand for electricity in Leguan? Does GPL have excess capacity? Has demand increased over the last 5 to 10 years?
Response of GPL's Major Projects Department:
 - It is unlikely that demand in Leguan has increased significantly over the last 5 to 10 years because of the on-going phenomena of migration from the Island by people, particularly young people, seeking employment elsewhere in Guyana.
 - However, there may be a small number of people returning to Leguan for employment in the rice industry. Although rice milling operations are not currently connected to the grid, GPL's aim is to show that power supply is reliable so that more operations transition to the grid.
 - The current generation capacity is suitable for demand and typically, GPL's designs systems to cater for excess capacity. In addition, a new generator unit will soon be installed in Leguan.

- Consultant question on **forecasting**: Has any forecasting of demand for electricity in Leguan and surrounding islands been conducted?
Response of GPL's Major Projects Department:
 - GPL has a Forecasting Unit. Mr. Chrichlow will follow-up on whether any work was done for Leguan.

- Consultant question on **capacity**: What are the main capacity constraints of the GPL in Leguan? Does GPL have the technical capacity to manage this solar farm?
Response of GPL's Major Projects Department:
 - GPL's core competency is thermo-electrical power generation. As a result, training in the operations of the solar farm should be built into the project to ensure that the necessary capacities are built to manage the solar farm.

- Consultant question on **challenges**: What are the main challenges encountered by GPL in providing electricity? Will the project help to alleviate these challenges?
Response of GPL's Major Projects Department:
 - GPL (Leguan) does not encounter significant challenges in power generation because the grid is small and all equipment is relatively new.
 - As long as a training component of this project is properly executed, then no challenges are expected to be associated with the operations of the solar farm.

- Consultant question on **benefits and recommendations**: Do you anticipate any benefits associated with the project? Do you have any recommendations that should be implemented by the project?

Response of GPL's Major Projects Department:

- One of the main benefits of the project will be the reduced costs of fuel for power generation that will allow GPL to better provide service and contribute to national goals for development.
- The project will also help to ensure that GPL's consumer base becomes more forward-minded.
- The benefits of the project will need to be clearly communicated to the consumer based in Leguan.

Next Step:

The Consultant will share the list of questions which were raised during the meeting to allow for follow-up and additional information to be provided. The questions will be sent to Mr. Ross (rross@gplinc.com) and Mr. Chrichlow (ocrichlow@gplinc.com)

Appendix F10: Personal Communication 10 – Interview with Guyana Tourism Authority

Date: October 18, 2021

Time: 14:00 to 14:30 hrs

Venue: Virtual via Zoom

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Representatives of the Guyana Tourism Authority:

Mr. Kamrul Baksh

Deputy Director

Introduction

Mr. Khalid Alladin thanked the Guyana Tourism Authority (GTA) for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Mr. Alladin indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the activities that will be conducted to prepare the ESAR. Mr. Alladin indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and GTA:

- Question from the GTA on the **project site**: Were any alternative project sites considered?
Consultant's response:
 - According to the Guyana Energy Agency (GEA), most of the lands on Leguan are privately owned and therefore, there were not available to be used as the project site. The existing state-owned lands are not suitable for use as the project site because they have mangroves which would have to be cleared for the project. Moreover, there are also lands which have been designated for the construction of an airstrip.
- Question from the GTA on **perspectives of locals**: The solar farm may impact the recreational use of the project site and in theory, this presents several disadvantages of the project. What are the sentiments of the residents about the project?
Consultant's response:
 - The consultant conducted engagements with local stakeholders, including the Neighbourhood Democratic Council, during the site visit which was conducted on October 07 to 08. Generally, stakeholders are looking forward to the project because of anticipated benefits associated with cheaper electricity and opportunities for employment. In addition, locals living in the residential area close to the project site anticipate that there will be repairs to the access road as a result of the project.
 - However, during GEA-led public engagements conducted earlier this year, some concerns were raised about the potential impacts on the recreational use of the beach.

Comment from the GTA:

 - The expectations of locals of secondary benefits of the project are expected. In particular, the expectation of employment is anticipated because of the challenging economic circumstances in Leguan.
 - Once residents provide positive feedback, the project should proceed.

- Question from the GTA on **employment**: How many people will be permanently employed by the project:
Consultant's response:
 - GPL will be the operator of the project and will determine how many personnel are needed. However, there are expected to be about 12 to 15 permanent employees.

- Consultant question on **tourism in Leguan**: Does the GTA have any tourism packages for Leguan? Are any tourism packages being developed?
GTA response:
 - The GTA plans to develop a tourism circuit for Region 3, particularly the islands of the Essequibo River. The plan is intended to leverage the idea of "island hopping" where tourists will visit Leguan and, on the same day, move on to other islands like Fort Island and Long Island.
 - In Leguan, the tourism product will be based on natural and socio-cultural offerings such as the St. Peter's Anglican Church, beaches (including possibly the project site) and the Hindu religious monument.
 - No implementation of these plans are anticipated to occur in the medium-term and when it comes to fruition, planning will occur around the solar farm.

- GTA question on **land uses**: Are there any other uses of the project site? Is it a crab marching area?
Consultant response:
 - According to local stakeholders, a few boats dock at the koker south of the project site during crabbing season.
 - The project site is mainly used for recreational purposes and there is minor grazing by goats. However, there are no livelihood activities in the area.

- GTA question on **perspectives of the Sea Defences Board**: Was the Sea Defences Board consulted about the project? What were their perspectives?
Consultant response:
 - The Sea Defences Board Office in Leguan was consulted and there are plans to consult with the Chief Sea and River Defence Officer.
 - The perspective of the Leguan office is that authorities would have to be convinced to invest in sea defences for the project site to ensure that it is protected from erosion.

- Consultant questions on **tourism potential of the solar farm**: Do you believe there is tourism potential for the solar farm? Will the GTA consider building it into a tour package for Leguan?
GTA response:
 - No. There is virtually no tourism potential for a solar farm because solar technology is too widespread to be considered a pull-factor. A large-scale solar farm may have some pull-factor but this project is believed to be too small for this to apply.
 - If a patron is interested in visiting the farm, arrangements could be made. However, it is not likely to be a fundamental component of Leguan's tourism product.

Appendix F11: Personal Communication 11 – Interview with the Chief Sea and River Defence Officer

Date: October 20, 2021

Time: 11:00 to 11:25 hrs

Venue: Office of the Chief Sea and River Defence Officer

Consultant Team:

Ms. Kandila Ramotar

Mr. Bankole Holder

Representatives of the Sea and River Defences Board:

Mr. Kevin Samad

Chief Sea and River Defence Officer

Introduction

Ms. Kandila Ramotar thanked the Chief Sea and River Defence Officer for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Ms. Ramotar indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the project as well as the activities that will be conducted to prepare the ESAR. Ms. Ramotar indicated that the purpose of the discussion was to provide a background on the proposed project and receive feedback particularly on issues pertaining to land uses.

Summary of Discussions

The following issues were discussed by the Consultant's team and Chief Sea and River Defence Officer:

- Question from Chief Sea and River Defence Officer on the **project site**: Were any alternative project sites considered?

Consultant's response:

- According to the Guyana Energy Agency (GEA), most of the lands on Leguan are privately owned and therefore, these were not available to be used as the project site. The existing state-owned lands are not suitable for use as the project site because they have mangroves which would have to be cleared for the project. Moreover, there are also lands which have been designated for the construction of an airstrip. The proximity of the site to GPL's infrastructure and feeders was also an important consideration.

Comment from the Chief Sea and River Defence Office:

- This justification is not well-founded. Although lands were privately owned, the Government acquired an area which was designated for use as an airstrip. This area is close to the Leguan Stelling and to the GPL Power Station. A similar approach could have been followed for this project to acquire an alternative site.
- The shoreline of the project area is a dynamic environment which fluctuates based on the erosion and accretion cycle. The area has been stable for some time but the location significantly increases risks of erosion which is concerning for such a significant investment.

- Question from Chief Sea and River Defence Officer on the **cadastral survey and permission to occupy**: Has the Guyana Lands and Surveys Commission (GLSC) completed the cadastral survey for the site? Has the lease been issued?

Consultant's response:

- Yes, the cadastral survey was completed and the GLSC has issued permission to occupy the site.

Comment from the Chief Sea and River Defence Office:

- This is unfortunate because the Sea and River Defences Board should have been consulted by the GLSC during that process.

- Consultant question on **sea defences**: Sea defences structure was installed just adjacent to the northern extent of the project site. Are there any plans to continue this heading south along the project site within the next 1 to 5 years?

Chief Sea and River Defence Officer response:

- The boulder face was installed as emergency works to prevent erosion which was accelerating in that area. The plans were to continue installing new sea defences heading north of the project site as the vegetation cover offered shoreline protection for the project area. The boulder faces are temporary structures.
- The project will require the installation of new sea defence structures to safeguard the Government's investment. This will require the installation of approximately 550 meters of sea defences costing approximately GYD\$ 300 million (at current prices) – which could have been invested to construct sea defences in other critical areas. Even on an advanced schedule, these sea defences cannot be installed in Oakum earlier than 2024.

- Consultant question on **criteria to select areas for interventions**: What criteria are used to determine which locations will be prioritized for installation of sea defences.

Chief Sea and River Defence Officer response:

- New sea defences are typically constructed in areas which are in the greatest need based on erosion, the condition of any existing sea defences and where there are natural sea defence methods including mangroves.

- Consultant question on **government reserve**: Is the triangular plot of land located south south-west of the project site government reserve lands?

Chief Sea and River Defence Officer response:

- Yes, this area was designated as a government reserve.
- It is notable that the old shoreline was immediately adjacent to the sea dam (located west of the project site). As such, the entire project area, as well as the government reserve land, formed as a result of accretion.
- Regardless if the project is to be implemented, the Board would have install new sea defences along the high-water mark/vegetation line so as to reclaim the lands.

- Consultant question on **vegetation clearing**: Are there any policies that restrict clearing of vegetation on the project site? If yes, what procedures have to be followed by the GEA to obtain permission to clear vegetation for installation of the project?

Chief Sea and River Defence Officer response:

- Given the location of the project site, the GEA will have to complete an *Application Form for No-Objection* from the Sea Defence Board.
- Following the submission of the Application, an engineer will be dispatched to conduct a site visit. The engineer will be accompanied by the Checker (ag) from Leguan.
- A buffer of vegetation or land will have to be maintained between the high-water mark and the project site. However, the extent of this reserve area will be determined only after the site visit has been conducted.

- Consultant question on **erosion**: If the sea defence is not installed, do you believe the site will be eroded if vegetation is cleared for project installation?

Chief Sea and River Defence Officer response:

- Yes. Erosion will certainly occur if vegetation is cleared before sea defences are installed.
- Consultant question on **recreational use of beach**: Are there any policies to restrict access to areas where new sea defences have been installed?
Chief Sea and River Defence Officer response:
 - No. The recreational use of the beach will not be restricted following the construction of sea defences. On the contrary, the Board encourages the use of sea defence structures for relaxation and recreation for local people.

Appendix F12: Personal Communication 12 – Interview with Neighbouring Land Owners # 2

Date: October 29, 2021

Time: 10:00 to 10:25 hrs

Venue: Virtual (via Zoom)

Consultant Team:

Mr. Khalid Alladin

Ms. Kandila Ramotar

Stakeholders:

Neighbouring Land Owners # 2

Introduction

Ms. Kandila Ramotar thanked Neighbouring Land Owners # 2 for taking the time to discuss the Leguan Solar Farm Project, and introductions were made. Ms. Ramotar indicated that a consultant was hired to prepare an Environmental and Social Assessment Report (ESAR) for the project and provided an overview of the project as well as the activities that will be conducted to prepare the ESAR. Ms. Ramotar indicated that Mr. Kumar Baksh, Deputy Director of the Guyana Tourism Authority (GTA), suggested that the consultant should engage with Mr. Chin on his plans for developing a resort on Leguan. She also indicated that the purpose of the meeting was to provide a background on the proposed project and receive feedback on issues of interest.

Summary of Discussions

The following issues were discussed by the Consultant's team and the stakeholders:

- Stakeholder comment on **land use**: Neighbouring Land Owners # 2 own 21 acres of land in Oakum (in three 7-acre plots). These lands are located west of the sea dam bordering the project site. Ultimately, the plan for use of these lands has two phases. First, the focus would be on establishing an open-air restaurant. Subsequently, one to two years after the restaurant is operational, a 'green' resort using local sustainable materials and produce will be pursued. The beach is intended to be a major attraction of these initiatives and the developments will rely on having access to the beach. The primary concern is that the project will be located on the beach and will negatively influence these plans.
Consultant's response:
 - The project will not be situated on the beach. The project will be situated west of the high-water mark where there is currently, growth of shrubs and other vegetation.
- Stakeholder comment on **trade-off of land uses**: Neighbouring Land Owners # 2 indicated that Mr. Baksh (GTA) suggested that there could be a 'trade-off' of land uses with the GEA. As such, Neighbouring Land Owners # 2 is offering inland sections of their lands for the project and in exchange, the project will not cause obstruction of the beach. An alternative project site would probably also be beneficial for the GEA because of the significant erosion which is occurring at the project site.
Consultant's response:
 - This proposal will be conveyed to the GEA.
- Stakeholder comment on **site selection**: The beach adjacent to the project site is one of the most important recreational areas in Leguan. This is because it is the largest stretch of beach on the Island, where social and recreational activities are few. This area is especially important

during special occasions like Easter when the beach and, to a lesser extent, the project area are the main recreational areas in Leguana.

Consultant's response:

- These concerns are well noted.

- Consultant question on **stakeholder engagement**: Have you engaged any local authorities, such as the Neighbourhood Democratic Council (NDC), about your plans?

Stakeholders' response:

- No, there were no engagement with local authorities. Last year, during a visit to the area, survey palls were observed in the project site. Subsequently, an engineer attached to the Sea and River Defences Board indicated that the Government of Guyana was pursuing an installation of a solar farm.
- Neighbouring Land Owners # 2 was unsure of what the project would entail and how his plans for tourism development may be impacted by the solar farm. Moreover, Neighbouring Land Owners # 2 did not know to whom queries about the project should be addressed until a recent meeting with Mr. Baksh (GTA).
- Given these uncertainties, Neighbouring Land Owners # 2 did not immediately work to advance the tourism initiatives.

- Consultant question on **Trail Masters Adventure**: Can you tell us about your operations?

Stakeholders' response:

- Trail Masters Adventure is in the process of becoming licenced as a local tour operator. Several different tourism initiatives are in the works. These include:
 - Development of an open-air restaurant and green resort in Leguan.
 - A hiking tour to Kaieteur Falls from Mahdia.
 - A tour from Rockstone to Bartica.
- Consideration is also being given to a proposal from Mr. Baksh (GTA) to establish an "Island Hopping" tour between the three islands in the mouth of the Essequibo River – Leguan, Wakenaam and Hogg Island.

- Consultant request on **maps**: Do you have a map of your lands? Are you willing to share this map with us?

Stakeholder's response:

- Yes, we are willing to share the map. It is most readily available in hard-copy.

Next Step:

The consultant will arrange for the collection of a hard-copy of the map showing Neighbouring Land Owners # 2 lands.

Appendix G: Minutes of Public Meeting conducted by the GEA

Public Consultation Report

Project Name:	Renewable Energy Solutions for the Hinterland	Public Consultation #: 1 Reporting period: September 2021
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Programme Details:

Name:	Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)
Operation Number:	4676/BL-GY
Executing Agencies	Component 1: Guyana Energy Agency (GEA) Component 2: Guyana Power and Light Inc. (GPL) Component 3: Guyana Energy Agency (GEA)
IDB Loan US\$	US\$ 21,160,000

Contact Details for Implementing Agency:

<i>Name</i>	<i>Position</i>	<i>Tel</i>	<i>E-mail</i>
Dr. Mahender Sharma	Chief Executive Officer	226-0394	gea@gea.gov.gy

Minutes of Public Consultation Meetings

MEETING: Key Stakeholder consultation at Leguan

DATE: Friday, September 24, 2021

CHAIRPERSON: Mr. Mfon Akpan

IN ATTENDANCE: Mr. Kyle Lewis, Social and Environmental Officer
Key Stakeholders in Leguan

A. REGISTRATION

Registration commenced at the Leguan Secondary School at 10:30 hrs and continued throughout the duration of the meeting.

B. ATTENDANCE

In Leguan, the meeting witnessed 16 persons in attendance with 6 females and 10 males. (Annex II).

C. CALL TO ORDER

The meeting was called to order by Mr. Akpan at 10:45 hrs in Leguan.

D. AGENDA ITEMS

- i. Introduction of the Project Team Mr. Akpan introduced the project team.
- ii. Presentation of the status of the project The discussion was led by Mr. Akpan.

Mr. Akpan provided a summary of the project, highlighting that by 2023 there would be at least three commissioned solar PV farms at Bartica (1.5MW), Lethem (1.0MW) and Mahdia (0.65MW), totaling 3.15 MW. Mr. Akpan gave insight as to why and how Leguan was selected for the installation of the 0.60 MW solar farm, based on the savings from the budget of \$8.6 million USD allocated for the initial installation of the three solar PV farms, plus other savings from other budget lines. He noted that the contract for Bartica and Lethem would have been already awarded to Farfan and Mendes and SOVENTIX on November 11, 2020, whereas Mahdia as well as Leguan would be tendered later. Mr. Akpan noted some of the challenges facing the project implementation citing COVID-19 pandemic, which would have resulted in delays in the shipping and delivery of major components for the installation of Bartica and Lethem.

Further, Mr. Akpan briefly explained some of the pre-requirements requested by the IDB to commence the project related works using the Revegetation Plan as an example. He noted the stakeholder consultation meetings as a requirement within the project which presents a forum for the residents to express concerns and queries and to have them addressed. He explained some of the benefits of the project including job opportunities for the local communities, reduction in the use of fossil fuel for electricity generation, and reduction in the cost of electricity generation among others. He pointed to the contact information of the PCU for questions, comments and suggestions.

The meeting was adjourned at 12:00 noon, and snacks and juice were provided to all participants.

Annex I: Questions and Answers

1. Which site was selected for the installation of the solar farm?

Mr. Akpan noted that the site was selected through careful consultation with the Regional Democratic Council, GPL and parties from the Guyana Energy Agency. He noted that all parties agreed to the use of a plot of land located at Oakum Beach front. He also noted why that site was selected for the solar farm giving reasons such as, the distance away from households, noting on this point that solar farms tend to emit a glare from the panels that may affect households close by. Seeing that it will be located away from the public and fenced there would be no issues going forward.

2. Can't another location be chosen for the farm?

Because the proposed site is frequented by the population on the island, the residents were skeptical as to the location of the farm. Mr. Akpan noted again that the site was selected through consultation and reiterated that it was placed at an optimal location away from residents so as to prevent any issues with its day-to-day operation. Mr. Lewis noted the negative effects that a solar farm has and why it is important that the farm be placed outside of the residential area in the community of Leguan. In addition, Mr. Akpan noted that a social and environmental analysis was to be conducted at the site and that the GEA would be guided by the findings of social and environmental analysis.

3. Why not use the vacant rice field proposed for the airstrip in Leguan?

Mr. Akpan noted that it makes no sense using a plot of land designated by the government for other reasons since this might cause some confusion. He also noted that in the event the airstrip is not built those lands can be redistributed for the purpose of farming since it is fertile land. He also noted that the area is surrounding by houses that may be affected by the farm. The team of councilors and persons from the sea defense department agreed with Mr. Akpan.

4. Will the farm have any effects on the community if placed at Oakum?

Mr. Lewis noted that an ESAR will be completed by a Consultant as part of the project and it will outline all the environmental and social effects, both negative and positive, the farm will have on the community if placed by Oakum. He noted that it will give an idea of the type of flora and fauna in the area and whether or not they will be affected by the project. He also noted that once the document is complete the residence can have a copy which will be lodged with the NDC.

5. Will a rip rap structure be constructed at the site?

Mr. Lewis noted that during the design of the project all things inclusive of hydrology will be taken into consideration and if the need arises for a revetment structure, it will be installed as a part of the project.

6. How will electricity reach the residents of Leguan?

Mr. Lewis noted that there will be a transmission line network installed from the solar farm to an off-taker at the GPL and electricity will be distributed to the residents of Leguan.

7. Will we have a reduction in the cost of electricity?

Mr. Akpan noted that the GEA does not have the responsibility of setting rates on electricity and he would not be able to comment fully on the reduction. He however noted that there is supposed to be a reduction with the introduction of a new source of energy in the community and that GPL would be in a better position to address the question after the installation of the solar farm.

8. Will there be a substation built to receive the electricity coming from the solar farm?

Mr. Akpan noted that the question would be fully addressed by the engineers on the project at our next consultation.

Annex II: Register of Attendance

No	Name	Address or Name of Organization	Gender
1	K. Rampersaud	Leguan	M
2	Clement Teekaram	6 La Bagatelle	M
3	Sheik	Enterprise Leguan	M
4	Thenicia Peters	GPL	F
5	Orin Hodge	GPL	M
6	Sarita Dhanessar	Leguan	F
7	Lacthman Dwarkha	Leguan NDC	M
8	Mustapha Zaman	Ministry of Agriculture NDIA	M
9	Nalita S. Hardat	Chairwoman Leguan NDC	F
10	Viren Chintaman	HOD, Leguan Secondary School	M
11	Jainarine Singh	Vice Chairman Leguan NDC	M
12	Hemraj Sharma	Guyana Rice Development Board	M
13	Maheswarie Nandram	Blenheim, Leguan	F
14	Anita Sooklall	La Bagatelle, Leguan	F
15	Bibi Fajina Khan	Waterloo, Leguan	F
16	K. P Sharma	Councilor Leguan NDC	M

Audience at the Consultation Meeting at Leguan Secondary School

