

# **DISASTER RISK MANAGEMENT PLAN LEGUAN SOLAR PV FARM 2023 - 2028**



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**CONSULTANCY FOR THE DEVELOPMENT OF DRMP AND  
EMERGENCY RESPOSNE PLAN FOR SOLAR PV FARM AT LEGUAN,  
GUYANA**



**Submitted to:**  
**Inter-American Bank**



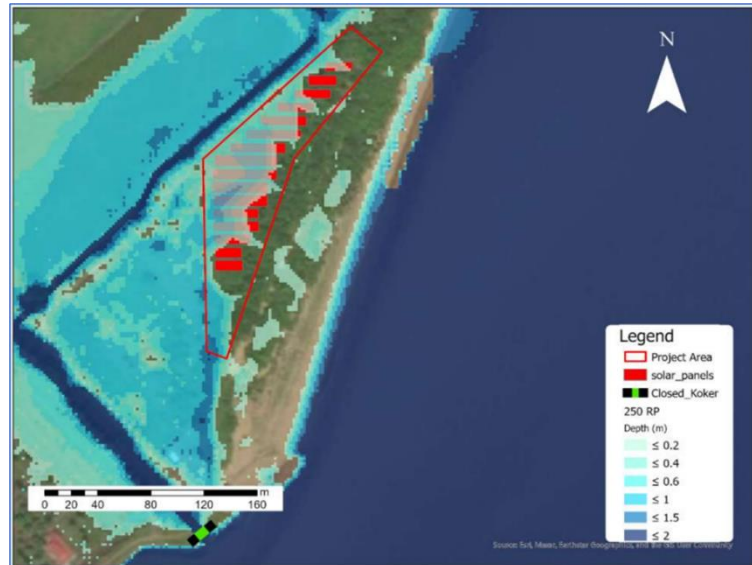
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## EXECUTIVE SUMMARY

A Disaster Risk Management Plan (DRMP) has been developed for the proposed Leguan, Guyana solar farm. The plan followed an Environmental and Social Analysis (ESAR) study and Flood and coastal erosion risk assessment. The DRMP aims to address the risks identified in these assessments and supports output 2.2.1 of the Guyana Comprehensive Disaster Plan (CDRMP), which requires plans inclusive of Early Warning Systems (EWS) and hazard-specific contingency plans for priority sectors. The DRMP outlines the actions and activities for each phase of the disaster risk management framework.

The project site is vulnerable to coastal erosion and flooding resulting from sea level rise, coastal hurricane waves, and high tidal levels. Site-specific flood hazard assessments have revealed that sections of the project site at Leguan are vulnerable to flooding, with the most significant concern being the water level variation due to tidal impacts. The plan recommends considering the possibility of koker failure and the associated flood depth of 1.1m.

Assessments of the shoreline indicate vulnerability to long-term shoreline erosion due to sea level rise and short-term erosion due to passing storms. The site is projected to have 4.7m of shoreline loss in the next 25 years and the predicted short-term erosion ranges from 8m to 20m for the 5- and 250-year return period storms, respectively.



The DRMP identifies measures to tackle the main hazards, baselines, targets, indicators, and the primary responsibility for each measure. An indicative budget is also included to help quantify the financial resources needed to implement the plan over the 5-year horizon. The plan will be continually revised and refined, and the next steps include communicating the plan to relevant stakeholders and integrating feedback where applicable, refining DRM measures to create more concrete programs and implementation plans, and aiding in financial planning using the indicative budget for each mitigation measure.

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## 1. BACKGROUND

With the assistance of the Inter-American Development Bank (IDB) under the Programme entitled **“Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)”**, the Government of Guyana (GoG) is seeking to expand electrification and diversify the grid. The expanded energy mix consists of hydropower, natural gas and solar photovoltaic (PV) systems and wind. Under this programme, the PV system will lead to more than 400MW of newly installed capacity over the next five years.

The objective of the programme is to:

1. 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
2. Investing in the reinforcement of transmission infrastructure to improve reliability and stability of the Demerara-Berbice Interconnected System; and
3. Strengthening the Department of Energy to develop a regulatory framework, and improve institutional capacity and governance of the oil and gas sector

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 <sub>2</sub> Savings	853 tons per year

*Table 1: Project Summary*

*Source: Environmental and Social Analysis Report: Leguan Solar PV Project*

In implementing this programme, a flood risk assessment and an Environmental and Social Analysis (ESAR) were conducted for the project site located in Leguan which pointed to the need for a Disaster Risk Management Plan (DRMP) and a supporting Emergency Response Plan to address climate and disaster risks and other hazards. To this end, a DRMP is developed to address hazards and climate risks identified in these assessments.

## 2. AUTHORITY

### 2.1. GUYANA COMPREHENSIVE DISASTER PLAN (CDRMP)

This DRMP supports output 2.2.1(National, Institutional and Regional Emergency Response Systems Strengthened) of the Guyana CDRMP. This requires sector agencies to review, revive and develop preparedness and response plans inclusive of Early Warning Systems (EWS) and for sector agencies to develop and review hazard specific contingency plans for priority sectors.

### 2.2. NATIONAL MULTI-HAZARD DISASTER PREPAREDNESS AND RESPONSE PLAN – GUYANA (NMHPRP)

Guyana's NMHPRP incorporate all disaster management activities related to response and preparedness. It presents a framework and establishes the coordination mechanism for emergency response for various sectors including public and private sector and civil society.

The plan outlines the institutional framework for disaster management in Guyana, this framework comprises three layers:

1. **National level** – policy level consisting of the Office of the President who also leads policy decisions regarding disaster management. This level is also supported by the Cabinet and specific Cabinet Committee established for DRM.
2. **Technical Level** – This level is led by the Coordinator for the CDC. Guidance is provided by a Disaster Risk Reduction Platform whose membership comprises the Private Sector Commission, multi-lateral partners, humanitarian organizations and key response agencies.
3. **Community/local Level** –

The national preparedness and response structure includes six committees convened around six thematic areas, one of which is Utilities and Infrastructure and Transport. GPL is a member of this committee.

## 3. METHOD

Arising from the hazard assessment and the Environmental and Social Assessment, natural and man-made hazards were identified that required intervention throughout all DRM phases and the project life cycle. The hazards were prioritised based on the risk level posed to the site. These risk levels were indicated in the respective studies.

Appropriate measure to mitigate or control each hazard were identified using several means:

- The recommendations contained in each assessment
- Best practices for disaster risk management as determined by the consultant
- Additional research carried out and
- Stakeholder consultation – At least one consultation was held with GEA on March 1, 2023 in a virtual meeting. The purpose of the meeting was to elicit feedback on the appropriateness of

the measures and additional measures that may need to be incorporated. ***This is to be further elaborated when they are completed***

**This section will be completed for the final submission.**

#### 4. PURPOSE OF THE DRMP

This DRMP is for the proposed solar farm located at Leguan. Its objectives are to:

- a. Outline the actions and activates for each phase of the disaster risk management framework – risk identification and analysis, preparedness, response, mitigation and recovery
- b. Establish policies, strategies and procedures that will guide all levels of persons in disaster management
- c. Contextualize the plan by outlining the risks and hazards likely to occur at the project site
- d. Identifies the roles of various stakeholders throughout all phases of the disaster risk management framework
- e. Establish a framework for monitoring implementation of the plan

#### 5. SCOPE OF THE PLAN

- **Geographic Scope** – This plan relates specifically to the project site for the solar farm located on the island of Leguan
- **Technical Scope** – The plan covers all components of the DRM framework (risk identification and analysis, response, mitigation, preparedness, recovery). It is also applicable to all the stages of the project life cycle (design, construction, operation, maintenance).

## 6. RISK ANALYSIS

The project site is vulnerable to coastal erosion and flooding resulting from sea level rise, coastal hurricane waves and tidal levels associated with intense rainfall.

### 6.1. FLOOD HAZARD ASSESSMENT

#### 6.1.1. Flood Events and Damage History

Guyana has several major rainfall events that have affected the country generally and specifically, Leguan, these events are described below.

Year	Item	Description
1942	Damage	1022mm of rainfall was recorded at the George Town Botanical Gardens in December of that year
	Impact	Damage to agriculture sector, mainly rice industry and non-traditional crops and vegetable farms in Leguan
	Return Period:	2 – 3 year event
	Inundation Depth:	0.1m – 0.6m
	Damage:	USD4,752,000.00
1971	Description	In July 1971 rainfall estimated at 270-453mm was recorded at the Georgetown and Timeheri Stations.
	Impact	Area of greatest impact from flooding were Cane Grove and East Coast. 21,000 locals were affected by the flood; Loss to GDP was 0.1%
	Damage:	USD\$1,338,000
2005	Description	Precipitation data indicated that in January 2005, 1540mm of rainfall was observed in a 6-week period. This is well above the 182mm typically observed in the month of January, as indicated by an analysis of precipitation data on the Essequibo Islands. There was also a spike over a 5-day period, in mid-January which included approximately 650mm of precipitation. The increased precipitation, coupled with the onset of the increased tidal levels caused by spring tide, caused significant inundation. Flood depths of 1.27m or higher were recorded.  An assessment of rainfall gauge data record on the island of Leguan between 14th and 18th indicated that 221mm of precipitation occurred over a 5-day period with a significant peak of 145mm on the 15th of July
	Impact	Intense flooding was experienced within the northern coastal regions of Guyana (75% of Guyana's population) which included West Demerara, the Essequibo Islands, Demerara and the West Mahaica-Berbice Area. 275,000 persons were affected.
	Return Period:	250 year event
	Inundation Depth:	>+-1m
	Damage:	US\$645,332,000

Year	Item	Description
2015	<b>Description of the Event</b>	In July 2015 heavy rainfall was experienced in the coastal regions of Guyana.  Rainfall data on the island of Leguan between 14th and 18th indicated that 221mm of precipitation occurred over a 5-day period with a significant peak of 145mm on the 15th of July.
	<b>Impact</b>	Approximately 100,000 persons were affected. The Regions affected included Barima-Waini, Pomeroon-Supenaam, The Essequibo Islands, Demerara-Mahaica and Mahaica-Berbice
	<b>Return Period</b>	2 – 3 year event
	<b>Inundation Depth</b>	0.1m – 0.6m
	<b>Damage:</b>	USD336,840.09
2019	<b>Description of the Event</b>	In July 2019, heavy rains were experienced within sections of Georgetown and other coastal villages in Regions 2 and 3, as well as in Devonshire Castle, Hampton Court and other nearby divisions.  Rain gauge stations in 2019 within the area recorded rainfall amounts above their long-term averages. Average amounts of rainfall recorded by stations ranged from 140.3 mm in Region 6 (over 11 days) and 336.2 mm in Region 8 (over 21 days). Blocked drains were also blamed.
	<b>Impact</b>	30% of the rice cultivated in Devonshire Castle, Hampton Court and other nearby divisions were lost. Low-lying areas such as South Ruimveldt, Festival City North Ruimveldt, Streets in East Ruimveldt and sections of the West Ruimveldt Front Road also experienced flooding (as seen in Figure 2.1). Roadways were “covered” with floodwaters ranging between 50mm and 100mm
	<b>Return Period:</b>	2 – 3 year event
	<b>Inundation Depth:</b>	0.1m – 0.6m

Table 2: Flood Hazard History (Source: Flood and coastal erosion risks and cost benefit analysis for Leguan solar farm site report (work package 1, 2 and 3))



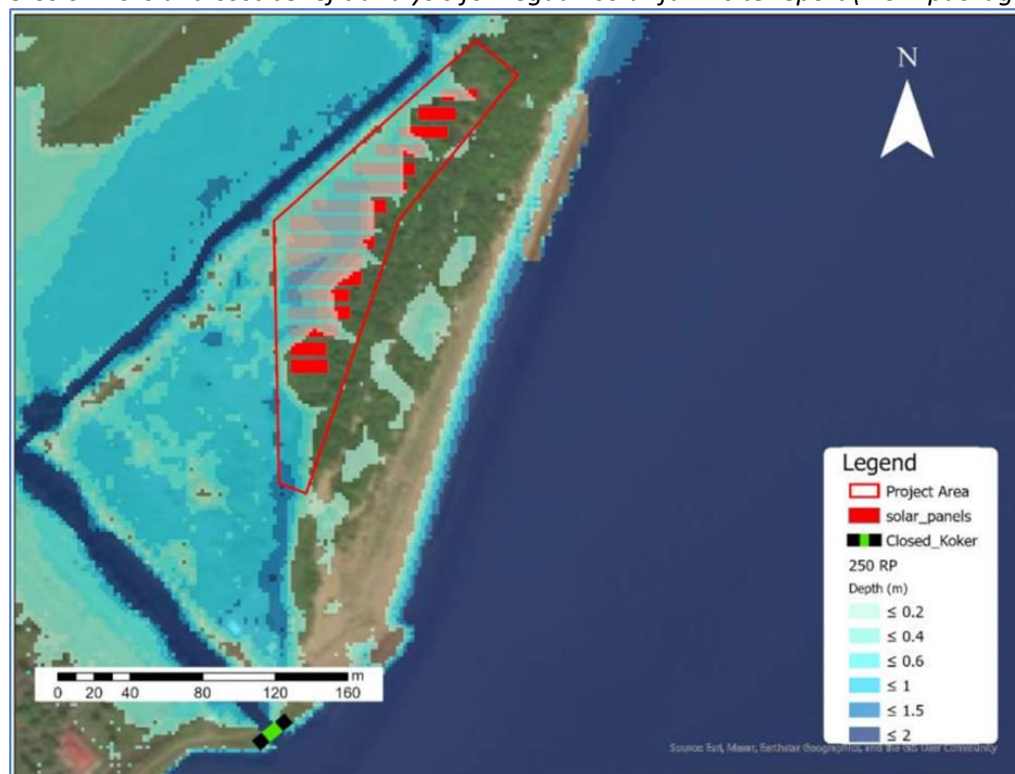
### 6.1.2. Site-Specific Flooding

The flood hazard assessment has revealed that sections of the project site at Leguan are vulnerable to flooding. The findings indicate that the most significant concern to the project area is the water level variation due to tidal impacts. This was confirmed with modelled scenarios wherein the kokers (tidal control gates) were left open. In this scenario maximum depths ranged from 1.09m (5RP) – 1.12m (250RP) of inundation on the lowest point on the site (+0.4m). If the koker system is closed the depths ranged from 0.3m (5RP) to 0.8m(250RP).

From this, the inference can be made that increases in water level were virtually independent of the variations in return period for an open koker scenario. For the purpose of planning, it is recommended that the higher of the two scenarios be selected given the possibility of koker failure.

Return Period	Gates Closed Depth (m)	Gate Opened depths (m)
5 year	0.3	1.1
10 year	0.3	1.1
25 year	0.3	1.1
50 year	0.3	1.1
100 year	0.5	1.1
250 year	0.7	1.1

*Table 3: Inundation depths and their associated return periods in project area (Source: Flood and coastal erosion risks and cost benefit analysis for Leguan solar farm site report (work package 1, 2 and 3))*



*Map 1: Site Specific flood Level for the 250 year Rainfall Event where koker is closed*

*Source: Flood and coastal erosion risks and cost benefit analysis for Leguan solar farm site report (work package 1, 2 and 3)*

## 6.2. EROSION

Long-term erosion trends Investigations allow for identifying erosion hot spots and the long-term threats to the project area from retreating shorelines. Using satellite imagery and comparing them for several time periods, coastal erosion assessments determined that the shoreline at the project site is accreting at an average rate of 2.2m per year. This rate of accretion exceeds the expected annual shoreline loss of 0.28m due to annual SLR. If left unprotected, it is projected to have 4.7m of shoreline loss in the next 25 years.

The site is also vulnerable to short intensive wave action associated with storms which can quickly erode the shoreline. The predicted short-term erosion ranges from 8m to 20m, for the 5 and 100 RP storms respectively. It is important to note that occurrences of storms in the area are rare, and as such, the extent of erosion will only be experienced during a worst-case scenario where a hurricane travels close to the mainland. As such shoreline protection is recommended to secure the project area as reducing the risk of damage due to erosion.

Associated Storm Return Period	Predicted extent of storm induced erosion ( $\Delta X$ (m))
5 year	9
10 year	10
25 year	12
50 year	14
100 year	17
250 year	20

*Table 5: Summary of Erosion for Leguan Source: Flood and Coastal Erosion and cost-benefit analysis for Leguan solar farm report (work package 1, 2 and 3).*

## 7. DISASTER RISK MANAGEMENT PLAN

This Disaster Risk Management Plan is being developed to address the disaster and climate risks identified in the studies. It identifies measures to tackle the main hazards, baselines, targets, indicators and the primary responsibility for each measure. An indicative budget is also included and will help in quantifying the financial resources to implement the plan over the 5-year horizon.

Disaster Risk Management Plan

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
RISK IDENTIFICATION AND ANALYSIS									
Flood Erosion	Periodic review and update of existing erosion and flood assessments	1 recent coastal erosion and flood assessment report	Every 5 years	Frequency of update of risk assessments	Maintenance Operation	High	Long term	GEA	10,000
Erosion SLR	Shoreline monitoring and appropriate storage of data	+/-10m level accuracy	<1m accuracy	Level of improvement in accuracy	Operation	Medium	Long term	GEA	~\$1,000/Annually
Flood	Improved rainfall data collection	1 operational weather stations	2 operational AWS	Number of weather stations/rainfall gauges installed	operational	Low	Short	GEA	~\$2000
PREPAREDNESS									
Flooding	Regular inspections and Maintenance of the surrounding drainage channels and sluice gates	Monthly inspections	Annual inspections extreme flood from affecting the site	Frequency of inspections	operational	High	Long	Public Works Department	~\$50,000/yearly
Flooding	Installation of Weather Station and early warning bulletin alert system	1 (estimated)	1 AWS installed at the site	Number of AWS installed	operational	Low	Short	GEA	~\$2000
Flood/Fire	Test and update emergency response plan	ERP not in place	Annually ( <b>does the regulatory authority have requirement</b> )	Frequency of testing and updating of the plan	Operation Maintenance	High	Long	GEA	

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, Medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
STRUCTURAL MITIGATION MEASURES									
Erosion	Construction of a rock revetment along shoreline by the Solar plant	Shoreline unprotected expected shoreline retreat of up to 20m (After 100RP Storm)	500m of revetment constructed	Length of shoreline protected	Construction	High	Short	Guyana Sea Defence Board	~\$ 1,435,407
Flooding	Construction of plinths and stilts to raise solar panels and critical infrastructure above the predicted flood levels.	Without mitigation submerged depth flood is 0.8m for 100 RP	Elevation of the electrical infrastructure submerged of 0for 100RP flood	Submerged depth of equipment	Construction	High	Short	GEA	~\$ 142,915
Safety and Security Breaches	Erect perimeter fencing around the plant to deter unauthorized entry of personnel and livestock	Area is currently freely accessible	1.1km of 2m high perimeter fencing	Length of 2m perimeter fencing	Construction	Low	Short	GEA	~\$50,000
NON-STRUCTURAL MITIGATION MEASURES									
Heat Stress	Cooling areas established for project teams and staff	Facility is not yet operational	1 cooling stations	Number of cooling stations in place	Design Construction Operation	Medium	Short	GEA	~9500 (Container Office with AC)
	Water coolers installed	Facility is not yet operational	1 water cooler	Number of water coolers installed and functioning	Construction Operation	High	Short	GEA	~\$300
	Outdoor work hours reduced on hotter days	Facility is not yet operational		Reduced working hours on hottest days	Construction Operation	Low	Medium	GEA	~2000\$/Day
	PPE's provided to combat dust nuisance and accidents		100% of employees fully	Number of staff fully equipped with PPE's	Construction	High	Short	GEA	\$300 per person

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, Medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
			equipped with PPE's						
NON-STRUCTURAL MITIGATION MEASURES (Continued)									
River/Boat Accidents	Boats equipped with first aid kits and only certified or licensed boat captains or operators used for transportation	N/A	100% of boats and vessels equipped and licensed	Percentage of boats used for transportation that is equipped and licensed	Construction Operation	High Medium	Short	Maritime Administration Department	-
	Use existing piers/berth for offloading materials and	N/A	0 accidents	Number of river/boat accidents	Construction	Medium	Short	Maritime Administration Department	-
General health and safety risks	Vehicle permanently available on-site for emergency transportation	1 for Leguan hospital	1 vehicle available for site	Number of vehicle reserved for emergency purposes	Construction	Medium	Short	GEA	\$150/Day
	Safety Committee established and functioning	Facility is not yet operational	1	Committee established and functioning	Construction Operation	Medium	Short/Medium	GEA	\$ 150
EMERGENCY RESPONSE									
All Hazards	First aid kit appropriate for number of staff in place and maintained	Facility is not yet operational	1 trained person with appropriately sized first aid kit	Number of staff trained and	Operation	High	Medium	GEA	~150 Per kit
Fire/Flood/Earthquake	Project Staff and employees trained in emergency response – AR, First Aid/CPR, Fire Safety, Water rescue	Facility is not yet operational	1 safety team	Staff responds appropriately during emergencies	Construction Operation	High	Medium	GEA	1000

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, Medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
Fire/ General safety	Safety signs installed	Facility is not yet operational	Fire/Safety Signs installed as indicated by OSHA/IFC and Guyana national Standards	Presence of safety signs	Construction Operation	High	Long	GEA	~200/per sign
EMERGENCY RESPONSE (Continued)									
Flood/Fire/Earthquakes	Emergency Response Plan Developed	Draft being developed	Finalise and approve ERP prior to commencement	Presence of a final approved ERP	Construction Operation	High	Short	IDB	8,000
Flood/Fire/Earthquakes	Arrangement in place with Leguan hospital for emergency treatment and med-evacs			Presence of a signed agreement	Construction	High	High	GEA	-
Accidents /floods	Health and Safety Plan developed	Facility is not yet operational	Finalise and approve Health and Safety Plan prior to commencement	Presence of an approved Health and Safety plan	Construction Operation	High	Short	GEA	-
Fire	Adequate resources available for fire response	0 capacity for electrical fires	Adequate class C extinguishers	Adequacy by type of fire extinguishers	Operation	High	Medium		100/ Extinguisher
		1 water tender for other fires	Install Hydrant		Operation	Low	Long		2500/Hydrant
Accidents	Adequate traffic warden and flagmen in place	Facility is not yet operational	?	Number of accidents	Construction	High	Short		-

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, Medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
Electrical hazards	Implementation of regular inspections and testing of electrical equipment	Not yet in operation	As per manufacturers recommendations	Frequency of regular inspections and testing of electrical equipment	Maintenance	High	Long	GEA	~10,000
Flood/Fire	Implement damage assessment procedures	Facility is not yet operational	After every event	Number of events for which damage assessment procedures are implemented	Construction Implementation	High	Short Medium Long Term	GEA	-
RECOVERY AND REHABILITATION									
Multiple Hazards	Insurance coverage for damage to property and casualties	Facility is not yet operational	100% of assets and employees covered by insurance	% or assets and personnel covered by insurance	Operation Maintenance	High	Medium term	GEA	TBD
	Capacity building of response agencies	Low response capacity	Moderate capacity	Level of response capacity	Construction Operation	High	Long term	GoG	-
	Assess gaps in mitigation and develop plans and strategies to address them	Facility is not yet operational	After every major event	Percentage of events with post-impact reports	Construction Operation	High	Long term	GEA	-
	Establishment of an ex-ante Recovery Plan including a Recovery Committee	Facility is not yet operational	Approved recovery plan	Presence of an approved recovery plan  Committee established and functioning	Operation	High	Medium term	GEA	-
	Establish Long Term Agreements to quickly effect repairs	Facility is not yet operational	LTA’s as necessary		Operation	High	Medium term	GEA	-

Hazard	Description of the Measure	Baseline	Target	Indicator	Stage of Application of the Measure*	Priority (High, medium, low)	Time Horizon (Short, Medium, Long term)	Responsibility (entity or person)	Estimated Cost (USD)
	Employ community labour in the rebuilding phase paying attention to potential roles of women	Facility is not yet operational		Number of community labour employed	Operation	Medium	Long term	GEA	-



## 8. MONITORING PLAN

The monitoring plan establishes the framework for measuring the achievements of the plan. It will assess the extent to which the measures identified in the plan have been achieved.

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
<b>RISK IDENTIFICATION AND ANALYSIS</b>							
Flood Erosion	Periodic review and update of existing erosion and flood assessments	1 recent coastal erosion and flood assessment report	Every 5 years	Frequency of update of risk assessments	Approved updated assessment report	Every two years	GEA
Erosion/SLR	Shoreline monitoring at an acceptable level of accuracy and appropriate storage of data	+/-10m level accuracy of shoreline data	<1m accuracy level of shoreline data	Level of improvement in the accuracy of shoreline data	Coastal erosion database	Annually	GEA
Flood	Improved density of weather stations	1 operational weather stations	2 operational AWS	Number of weather stations installed	Hydromet database	GEA	Hydromet
<b>PREPAREDNESS</b>							
Flooding	Regular inspections and Maintenance of the surrounding drainage channels and sluice gates	Monthly inspections	Annual inspections extreme flood from affecting the site	Frequency of inspections	Inspection log of surrounding flood control infrastructure	Monthly	Local Works Agency
Flooding	Installation of Weather Station and early warning bulletin alert system	1 (estimated)	1 AWS installed at the site	Number of AWS installed	Hazard alert logs, Meteorological data	Annually	GEA
Flood/Fire	Test and update emergency response plan	ERP not in place	Annually	Frequency of testing and updating of the plan	Simulation exercise reports/After Action Reports	Twice yearly	GEA

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
<b>STRUCTURAL MITIGATION MEASURES</b>							
Erosion	Construction of a rock revetment along shoreline by the Solar plant	Shoreline unprotected expected shoreline retreat of up to 20m (After 100RP Storm)	500m of revetment constructed	Length of shoreline protected	Pre and post construction images, project reports, long term shoreline monitoring programme	Post Construction	Sea Defence Board
Flooding	Construction of plinths and stilts to raise solar panels and critical infrastructure above the predicted flood levels.	Without mitigation submerged depth flood is 0.8m for 100RP	Elevation of the electrical infrastructure submerged of 0 for 100RP flood	Submerged depth of equipment	Pre and post construction images, project reports, Damage assessment after flood event to determine effectiveness	Post construction	GEA
Safety and Security Breaches	Erect perimeter fencing around the plant to deter unauthorized entry of personnel and livestock	Area is currently freely accessible	1.1km of 2m high perimeter fencing	Length of 2m perimeter fencing	Pre and post construction images/ Visitor and employee entry logs	Post Construction	GEA
<b>NON-STRUCTURAL MITIGATION MEASURES</b>							
Heat Stress	Cooling areas established for project teams and staff	Facility is not yet operational	1 cooling station	Number of cooling stations in place	Construction logs Maintenance log	Monthly	GEA
	Water coolers installed	Facility is not yet operational	1 water cooler	Number of water coolers installed and functioning	Construction logs Maintenance log	Monthly	GEA
	Outdoor work hours reduced on hotter days	Facility is not yet operational		Reduced outdoor working hours	Employee rosters/ logs	Weekly	GEA

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
				during peak temperatures on hottest days			
	PPE's provided to combat dust nuisance and accidents	Facility is not yet operational	100% of employees fully equipped with PPE's	Number of staff fully equipped with PPE's	PPE distribution logs	Weekly	GEA
River/Boat Accidents	Boats equipped with first aid kits and only certified or licensed boat captains or operators used for transportation	N/A	100% of boats and vessels equipped and licensed	Percentage of boats used for transportation that is equipped and licensed	Vessel safety checklist	Daily	Maritime Administration Department
	Use existing piers/berth for offloading materials and staff where practical	N/A	0 accidents	Number of river/boat accidents	Incident log/accident log	Monthly	GEA/ Maritime Administration Department
General health and safety risks	Vehicle permanently available on-site for emergency transportation	1 for Leguan hospital	1 vehicle available for site	Number of vehicles reserved for emergency purposes	Fleet log	Monthly	GEA
	Safety Committee established and functioning	Facility is not yet operational	1	Committee established and functioning	Minutes of Meeting  Approved Terms of Reference	Monthly	GEA

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
<b>EMERGENCY RESPONSE</b>							
All Hazards	First aid kit appropriate for number of staff in place and maintained	Facility is not yet operational	1 trained person with appropriately sized first aid kit	Number of staff trained	Training registers	Every 6 months	GEA
Fire/Flood/Earthquake	Project Staff and employees trained in emergency response – SAR, First Aid/CPR, Fire Safety, Water rescue	Facility is not yet operational	1 safety team	Number of staff trained	Training registers	Every 6 months	GEA
Fire/General safety	Safety signs installed	Facility is not yet operational		Presence of safety signs	Safety Audit reports/safety inspection reports	Monthly	GEA
Flood/Fire/Earthquakes	Emergency Response Plan Developed	Draft being developed	Finalise and approve ERP prior to commencement	Presence of a final approved ERP	Emergency Committee reports	Annually	GEA
Flood/Fire/Earthquakes	Arrangement in place with Leguan hospital for emergency treatment and medical evacuation	There is currently no arrangement in place	Agreement approved and signed prior to commencement	Presence of a signed agreement	Signed agreement/MOU	Annually	GEA
Accidents/floods	Health and Safety Plan developed	Facility is not yet operational	Finalise and approve Health and Safety Plan prior to commencement	Presence of an approved Health and Safety plan	Safety audits/safety inspection reports	Annually	GEA

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
<b>EMERGENCY RESPONSE (CONTINUED)</b>							
Fire	Adequate resources available for fire response	0 capacity for electrical fires 1 water tender	Adequate class B extinguishers Install Hydrant	Adequacy by type of fire extinguishers	Safety audits/safety inspection reports	Monthly	GEA
Accidents	Adequate traffic warden and flagmen in place	Facility is not yet operational	No accidents of near misses	Number of accidents	Safety audits/safety inspection reports	Monthly	GEA
Electrical hazards	Implementation of regular inspections and testing of electrical equipment	Not yet in operation	As per manufacturers recommendations	Frequency of inspections and testing of electrical equipment	Electrical inspection reports	Quarterly	GEA
Flood/Fire	Implement damage assessment procedures	Facility is not yet operational	1 damage assessment report after every event	Number of events for which damage assessment procedures are implemented	Damage Assessment Reports	After every event	GEA
<b>RECOVERY AND REHABILITATION</b>							
Multiple Hazards	Insurance coverage for damage to property and casualties	Facility is not yet operational	100% of assets and employees covered by insurance	% or assets and personnel covered by insurance	Insurance policies	Annually	GEA
	Capacity building of response agencies	Low response capacity	Moderate capacity	Level of response capacity	Capacity Assessment	Annually	GEA
	Assess gaps in mitigation and develop plans and strategies to address them	Facility is not yet operational	Review after every major event or every 3 years	Percentage of events with post-impact reports	Review Reports Damage Assessment Reports	After every major event (100 RP) or every 3 years	GEA

Hazard	Description of the Measure	Baseline	Target	Indicator	Means of Verification	Frequency (How often will it be measured)	Responsibility
	Establishment of an ex-ante Recovery Plan including a Recovery Committee	Facility is not yet operational	Approved recovery plan	Presence of an approved recovery plan  Committee established and functioning	Emergency Committee Reports	Annually	GEA
	Establish Long Term Agreements to quickly effect repairs	Facility is not yet operational	LTA's as necessary	Presence of LTA's	Signed and approved LTA	Annually OR After every major event	GEA
	Employ community labour in the rebuilding phase paying attention to potential roles of women	Facility is not yet operational	Majority of workforce is locals	Number of community labour employed	Project employment records	During post disaster construction	GEA

## **9. RECOMMENDED NEXT STEPS**

The success of the plan is contingent upon a number of factors. The following recommended next steps can be considered prior to implementing the plan:

### **9.1. COMMUNICATING THE PLAN**

For the strategy to be successful, sector stakeholders need to have a high level of awareness. This activity can be facilitated through the Utilities, Infrastructure, and Transport Committee through GPL's membership. Creativity will need to be employed in communicating the plan in different ways based on the target audience. The message must also be clear and relevant and should facilitate two-way communication and feedback. This includes the communities in Leguan.

### **9.2. REFINEMENT OF DRM MEASURES**

The measures in the plan will need to be further distilled and more concrete programmes and implementation plans developed. However, the plan still serves as a high level plan that can be used to monitor achievement of the measures.

### **9.3. FINANCING THE PLAN**

An indicative budget has been provided for this plan. It can be used as a basis for financing the activities/measures laid out in the plan. Resources should be set aside for the implementation of the measures.