

2017



CLIMATE VULNERABILITY REDUCTION PROGRAM (BL-L1028)



ENVIRONMENTAL AND SOCIAL ANALYSIS INTERIM REPORT


Prepared For:

**Interamerican Development Bank and
the Government of Belize**



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Acronyms

CCMR	Caye Caulker Marine Reserve
CSI	Central Statistical Institute
CVRP	Climate Vulnerability Reduction Program
CZMAI	Coastal Zone Management Authority and Institute
DOE	Department of the Environment
ECP	Environmental Compliance Plan
EIA	Environmental Impact Assessment
ESCI	Emerging and Sustainable Cities Initiative
ESMP	Environmental and Social Management Plan
ESA	Environmental and Social Assessment/Analysis
ESMP	Environmental and Social Management Plan
FD	Forest Department
GDP	Gross Domestic Product
GoB	Government of Belize
GPL	General Poverty Line
IADB	Interamerican Development Bank
IUCN	International Union for Conservation of Nature
Km	Kilometer
MFB	Minimum Food Basket
MTDS	Medium Term Development Startegy
NEAC	National Environmental Appraisal Committee
NEMO	National Emergency Management Organization
NGO	Non-government Organization
NICH	National Institute for Culture and History
NPAS	National Protected Areas Secretariat
NSTMP	National Sustainable Tourism Master Plan
PA	Protected Area
S.I.	Statutory Instrument
TOR	Terms of Reference

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SECTION A

PROJECT DESCRIPTION AND REGULATORY FRAMEWORK

1 The Project Description and Plan

1.1 Introduction

The Interamerican Development Bank (IADB) and the Government of Belize (GoB) has embarked on a program (BL-L1028) to reduce climate related vulnerabilities in the productive sectors and to improve flood control in Belize City. This Environmental and Social Assessment (ESA) looks at the potential beneficial and adverse effects of the scheme and proposes mitigation measures for impacts that cannot be avoided

This report consists of eight (8) chapters including this chapter which gives a description of the propose project including its components and activities; **Chapter 2** describes the methodological approach while **Chapter 3** addresses the legal and policy framework governing the execution of the propose climate reduction program. **Chapter 4** sets out and characterizes relevant environmental and social baseline conditions for the three priority climate vulnerability reduction sites. **Chapter 5** describes the relevant social factors within the projects zone of influence. **Chapter 6** describes the potential benefits as well as the environmental and social impacts likely to take place under the activities associated with the climate vulnerability reduction program. **Chapter 7** presents the Environmental and Social Management Plan (ESMP) which lays out a series of mitigation measures by which the project proponents can reduce or eliminate potential impacts arising from project activities. **Chapter 8** addresses the monitoring requirements to gauge the efficacy of the mitigation.

This ESA is prepared following the IADB's screening procedures which classify projects in four graduated categories namely A, B, C, and Uncategorized —according to the scale of the project, location, sensitivity and potential impact. This screening is a requirement for all bank financed projects and enables early identification and avoidance of impacts and provides for mitigation for impacts that cannot be reasonably avoided. It also creates opportunities for input from relevant stakeholders in a timely manner when their inputs are liable to do the most good.

According to the IADB's Environment and Safeguards Compliance Policy (OP-703), this investment program is classified as a Category "B" due to the nature of the proposed climate vulnerability reduction interventions. This classification was given during the project screening phase because it is anticipated that the program is likely to cause mostly local and short term negative environmental and associated social impacts for which effective mitigation measures are available.

1.2 Project Objectives and Description

Because of its location coastal Belize including Belize City and the offshore islands are very vulnerable to the effects of Climate Change including from storms, flooding events and sea level rise. The country has been severely affected by recent climate phenomena including hurricanes and floods resulting in widespread damage to infrastructure and hardship for residents. As a recent example, Hurricane Earl in 2016 severely damaged coastal infrastructure, agriculture and housing resulting in millions of dollars in damages including to the tourism and agricultural industry from which the country is still recovering.

Because of the severity of the threat Belize City was selected to be part of the IDB's Emerging and Sustainable Cities Initiative (ESCI). In 2016 a number of baseline studies were carried out including a Vulnerability and Natural Disasters Study. That report highlighted that the city, due to its flat relief and low elevation is easily flooded – a problem exacerbated by the city's fast growth in recent years (from 140Ha in 1925 to 1,462 in 2015) and the impacts of climate change.

The ESCI's baseline studies recommended improvements to the local management of natural hazards and disasters systems and on building strategic grey-interventions to reduce risks from fluvial, pluvial and coastal flooding. Based on this assessment, the IDB and the GoB agreed on a strategy to reduce climate-related vulnerabilities in the productive sector and to improve flood control in Belize City. The work will be carried out under 2 main components.

1.2.1 Description of Components and Activities

Each Component consists of a number of activities and subactivities to meet the objectives of the program and is being implemented with financial and technical support from the IADB. The original project document foresaw 2 components as follows:

- Component 1 - Improve governance for climate risk reduction. The following actions are identified under this component:
 1. Make risk information accessible to decision makers, technicians, the private sector and the general population;
 2. Increase capacities for climate change adaptation planning with a focus on water management;
 3. Support the design of climate proof housing and tourism building codes, including nature-based solutions;
 4. Support the design of a climate risk financing strategy, especially for tourism and agriculture sectors; and
 5. Increased damage assessment capacities, particularly in the agriculture and environment sectors.
- Component 2 – Climate risk reduction in sectors affected by Hurricane Earl. The following activities are identified under climate risk reduction:

1. Belize City – The Belize City interventions are focused on improving the hydraulic operation and efficiency of the canals as well as the flow dynamics between the canals, the Haulover Creek and the feeder drains. The major activities associated with this site are as follows:
 - Rehabilitate, clean and build infrastructure along the Collet and East Canals for more efficient drainage of the project area. This includes:
 - Isolating the canals from the sea and Haulover Creek by the installation of sluice gates (locks) at 4 locations,
 - Installation of a pumping station where the canal meets the sea to remove water from the canals during periods of heavy rainfall.
 - Dredging of the canals to improve drainage and increase capacity to hold water,
 - Improvements to the drains emptying into the canals from adjacent streets,
 - Lining of a section of the canal between Kut Avenue and the sea which presently has earth embankment and susceptible to erosion.
2. Caye Caulker – The intervention is centered on Coastal Protection Works in the Palapa Gardens area with the aim of improving coastal stabilization and recovering the loss of significant areas of sandy beaches. The interventions are proposed as follows:
 - Construction of a groyne structure,
 - Construction of a beach berm,
 - Vegetation of the new berm and groyne to reduce climate vulnerability.
3. Goffs Caye - Coastal Protection Works including construction of small-scale soft structures to mitigate beach erosion.
4. Climate Proofing Horticultural Improvements – This activity centers on rebuilding and improving 61 farmers' covers structures damaged or destroyed by Hurricane Dean in the Belize and Cayo districts.

This Environmental and Social Assessment addresses portions of the work that will be undertaken under component 2 of the program at the sites shown in **Figure 1. 1)**

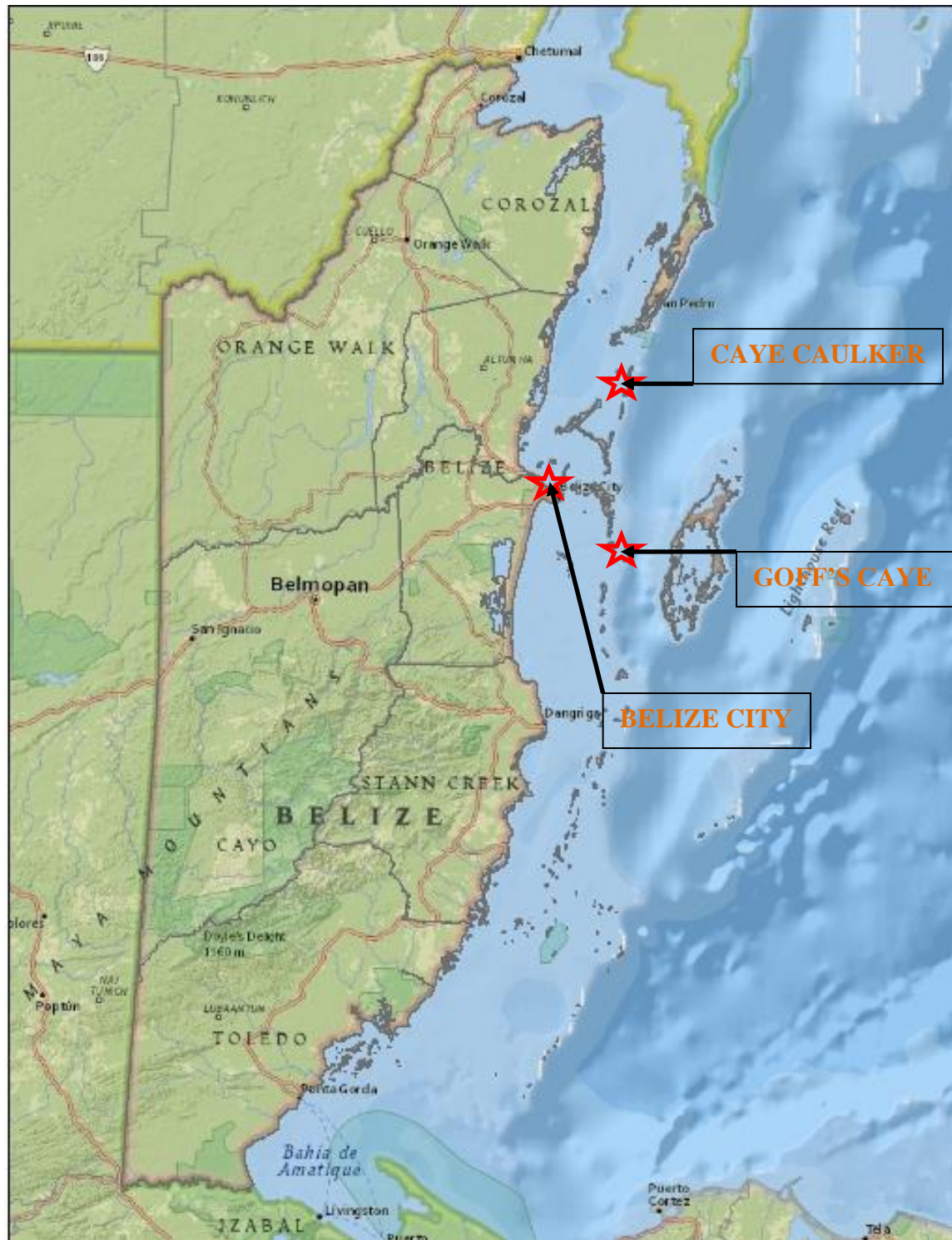


Figure 1.1: Location of climate vulnerability reduction sites.

2 The Methodological Approach

IDB policy requires an Environmental and Social Assessment (ESA), for all Category A and B loan programs. The project at hand, fall under the IDB's category B designation, that is, they are "likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available".

The production of this ESA is taking place in tandem with engineering studies aimed at devising solutions to climate related threats at the identified climate vulnerability reduction sites in Belize City, Caye Caulker and Goff's Caye. The nature of the engineering interventions has informed the methodological approach for this study as well as the priorities of the IADB Safeguard policies.

The methodological approach for the ESA has included the following elements:

- a. Visits to relevant intervention sites in the company of IADB staff and project engineering consultants,
- b. Identification of relevant lender safeguards likely to be triggered by the climate vulnerability reduction measures,
- c. Collection and review of existing information to inform the thematic area of influence and to provide grounding with which to engage stakeholders and conduct the impact assessment. This includes strategic documents provided by the IADB project team, GoB official statistical data, and initial and interim reports produced by project engineering consultants.
- d. Identification of relevant stakeholders including decision makers in the 3 locations identified for the study (Belize City Council, Caye Caulker village council; CZMAI; DOE; NEMO among others), and key stakeholders for the program.
- e. Meetings and constant contact via telephone and internet to obtain technical inputs, coordination and exchange of information with the other thematic consultants.

Work on the production of the ESA started with a literature review of relevant documents including recent Government of Belize statistical data, sustainability reports, climate daptation and mitigation reports, urban development plans and strategies including the Belize City Urban Regeneration Project, The Belize City Emerging and Sustainable Cities Initiative (ESCI), the Belize City Flood Mitigation Project plus relevant national legislations, policies and plans (see **List of References**).

2.1 Stakeholder Engagement Plan

2.1.1 Methodological Approach for Social Analysis

There are many different frameworks for conducting social impact assessments. The one being applied in this study is that of the International Association of Impact Assessments which includes a number of tasks divided into 4 phases.

Phase 1 – Understand the Issues

Understand proposed project – includes a thorough understanding of each project with all their dimensions and ancillary activities. This requires a focused study of the project plans, visits to the various project sites, and consultation and clarification of unknowns with the engineers and the various consultants.

Clarify roles and responsibilities – implies an understanding of the relationship of these projects to other studies, plans, visions, etc. within the local, national, and even global context. In addition an understanding must be developed of the national laws, international guidelines and/or standards that need to be observed and the the ramifications for non-compliance.

Social area of influence – Social influence or impacts, often times transcend the geographic boundaries of the community in which the intervention is being applied. The SIA takes into account major linkages and networks that connect people including the value chain that connects people.

Community profiling – a rich qualitative description of the affected communities will set the context for a proper analysis of impacts as well as assessment of mitigation and benefit strategies. The community profile includes the following aspects:

- A thorough stakeholder analysis
- A discussion of the socio-political setting
- Assessment of different needs, interests, values and aspirations of various subgroups of affected communities, including a gender analysis
- Assessment of impact history, which comprises the experiences of past projects and other historical events
- A discussion of trends happening in the community
- A discussion of assets, strengths and weaknesses

Public participation – It is important to recognize that social impacts begin the moment a project is announced, as people begin speculating and sometimes acting, in anticipation. The SIA team is therefore committed to engaging affected communities at a very early stage, in order to discuss and explain the project, and to identify and respond to issues and concerns regarding possible social impacts. Specific objectives of the consultations include the following:

- Inform community members and other interested parties about the project and its likely impacts, both positive and negative.
- Determine the acceptability of likely impacts and proposed benefits.
- Share how the community can be involved in the SIA.
- Solicit aspirations, concerns and local knowledge.

- Establish an ongoing relationship, for two-way communication, with the affected communities.
- Minimize any potential for misinformation circulating.
- Inform community members of their procedural rights within the framework of the project.
- Provide access to grievance and feedback mechanisms.

The above objectives will be accomplished through one-on-one interviews with primary and key stakeholders. The aim here is to gather local opinion about the impacts and also to identify how each impact will affect the different social groups within a social justice framework. A combination of one-on-one and focus groups will be carried out with business, public and non-governmental organization (NGO) representatives. Finally, telephone interviews will be used with secondary stakeholders of significance to the project. All responses will be analyzed for key themes of impact.

Issues arising from consultation with public sector agencies and private sector organizations were integrated into the discussion of mitigation measures found in **Chapter 6** and **7**.

At least 2 weeks was allowed after this for the stakeholder to consult and prepare a response during which time the Consultant availed himself to answer/clarify any questions arising from the document. At the end of the period contact was again made with the stakeholder to elicit views and responses meeting was held with each group of community leaders.

Phase 2 – Predict, Analyze and Assess the likely Impact Pathways

Determining the social impacts to communities is the ultimate goal of the SIA. Through analysis of the community profile, the SIA team will determine the social changes and impacts (direct and indirect) that will likely result from the project. The SIA seeks to reveal those sacrifices that may be required but also benefits that will materialize.

In this phase, the project's contribution to cumulative impacts and the community's response to these impacts will also be elaborated. The community's response has implications for indirect impacts and can also determine risks to the project. Consideration will also be given to developing an impact significance assessment to determine priorities for action, however, it must be noted that even minor impacts that might seem inconsequential and therefore not deserving of action, can cause major community upset if left unresolved. Thus, the significance assessment will be used more for highlighting no go or extreme situations, if any.

Phase 3 – Develop and Implement Strategies

Mitigation and remediation strategy – The SIA team intends to solicit recommendations for mitigation from stakeholders using the *Mitigation hierarchy* (International Association of Impact Assessments, 2005) as a guiding framework. The active participation of community members in mitigation strategies allow for the following benefits:

- It is more inclusive, eliminating the top-down resolution approach to risks (see **Figure 2.1**).
- It encourages buy-in to the project as participants have a vested interest.
- It affirms human rights principles whereby those impacted by an action should 1) hold participatory roles to determine the direction of the development, plan or policy and, 2) should be supported to benefit from the event (International Association for Impact Assessment, 2015).

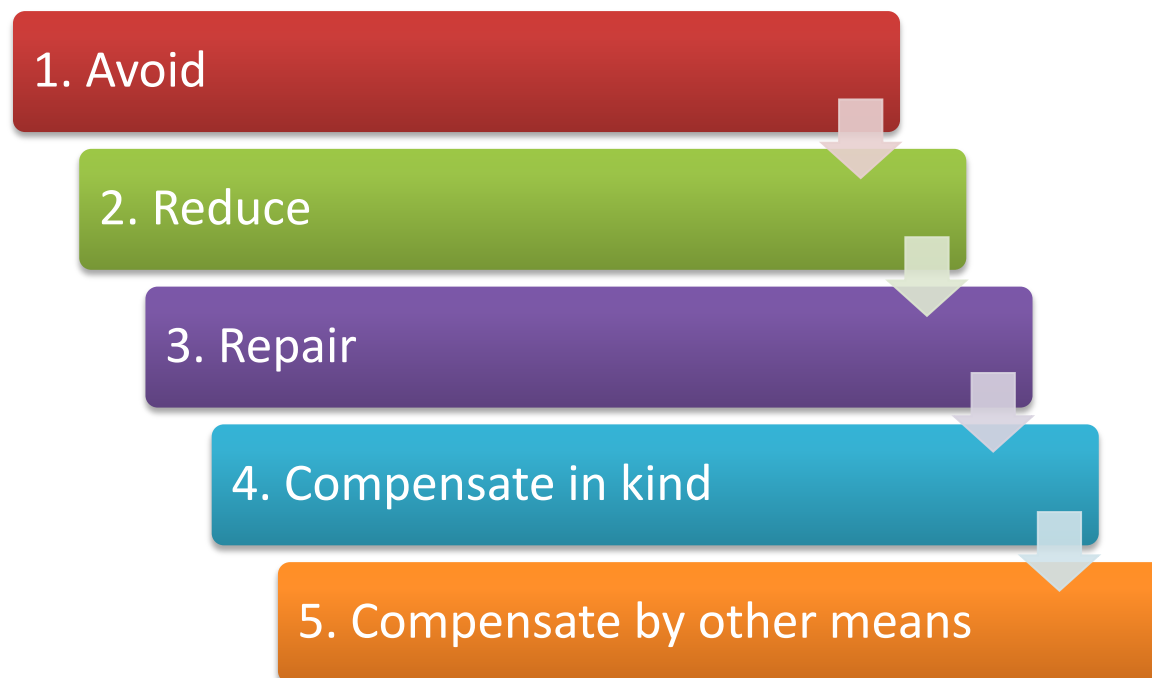


Figure 2.1: Mitigation hierarchy

Source: International Association for Impact Assessments (2005)

Benefit enhancement efforts – The SIA also has a responsibility to elaborate ways of “enhancing benefits and project-related opportunities” (International Association for Impact Assessment, 2005, p. 16). Ideally, the benefits (e.g. increased sales) and opportunities associated with project construction (e.g. jobs) should accrue to the communities receiving the intervention and those affected by the impacts first. The SIA team thus intends to provide sourcing and other relevant information from within these communities in the final ESIA report.

General stakeholder communication records maintenance – Communication records will be maintained by the lead SIA consultant. This will include all key outgoing as well as incoming communication such as comments, general questions, complaints, etc. A summary of actions to be taken, if applicable, will also be recorded.

Monitoring, reporting and feedback mechanisms – Through established communication channels (telephone, email and face-to-face meetings) the SIA lead consultant will monitor and provide

feedback as appropriate. Feedback will come out of the coordinated effort of the SIA and EIA consultants, the various engineers, and developers of the projects.

Phase 4 – Design and Implement Monitoring Programs

Baseline data will be used to develop indicators for monitoring change over time. Within the context of Belize, where resources for monitoring and follow-up are almost never available, it is recommended that a participatory monitoring plan be developed where community members can be empowered to do some of the follow-up work themselves, and where they will have an understanding of the governance structures applicable to the project through which they can advocate for themselves.

2.1.2 Grievance Response Mechanism

Grievances and complaints will be dealt with in the following manner:

- All grievances received will be recorded in a register.
- If grievance can be corrected with an immediate action, complainant will be immediately informed, action will be taken, date recorded and case closed.
- If grievance requires long term action, complainant will be informed of proposed action or why no action is required (within 30 days), action will be implemented (if applicable), follow-up will be carried through, complainant will once again be informed, date recorded and case will be closed.

*Grievance mechanism*¹ – A complaint or grievance can be submitted via a grievance form or verbally. A grievance form may be submitted in any of the following ways:

- To the office of Nextera Environmental and Engineering Consultants (address on form).
- To the office of the SIA lead consultant (address on form).
- To the secretary of the Caye Caulker Village Council

Verbal complaints may be made to the SIA lead consultant, via email, telephone or face-to-face. The consultant's contact information will be provided to stakeholders.

2.2 Methodological Approach for Environmental Analysis

As part of the environmental assessment process visits were made to each priority site identified for climate vulnerability reduction investment and their area of influence. On these visits relevant physiographic and environmental data were collected. Because of the benign nature of the investments and the small footprint of the sites an in depth environmental analysis was not undertaken as this was not a specific requirement of the ToR or an objective of the study. In addition none of the climate investments are taking place within restricted areas although Goff's

¹ Source: WSP Group (2013)

Caye is being managed for both recreational/tourism and conservation management purposes. The development in caye caulker will take place near to two protected areas namely the Caye Caulker Marine Reserve and the Caye Caulker Forest Reserve. Where development is supposed to occur near to or adjacent to protected areas environmental management plans, biodiversity assessments (including maps) were obtained to assist the analysis. Relevant information was also collected from institutional and private sources including PA managers, NGOs, local authorities and community members.

Additional information were obtained from relevant Government agencies and quasi government agencies including CZMAI and the Fisheries Department. In order to gather the required information field visits were conducted to the proposed project site consisting of a team of fauna and flora specialist and a biodiversity management specialist. Site visits were made by all disciplines in order to gain an appreciation of the area. These visits included:

- A walkover survey of the areas within each location identified for climate vulnerability reduction investments,
- Reconnaissance drive and walk through of the surrounding areas, in order to gain an appreciation of the potential impact that the investments would have on adjacent landscape, communities and cultural features,
- Google mapping to get a feel for the area and an appreciation of the layout of the various features such marine areas, rivers and vegetation coverage which would be potential receptor for project impacts,
- Interviews and meetings with local people,

3 Policy, Legal and Administrative Framework

3.1 Introduction

This section reviews relevant planning legislations and regulations to inform project proponents and affiliated agencies and contractors about applicable policy and legislative elements. This should help project proponents ensure that relevant requirements are built into project design and implementation at the onset.

Current national environmental policies are based on an integrated approach to environmental management and the need to work towards the goals of sustainable development. The commitment to sustainable development is firmly established in the newly created Ministry of Forestry, Fisheries and Sustainable Development and is a clear requirement of the NSTMP as well as national development plans including Horizon 2030.

3.2 Environmental Laws, Regulations and Policies

3.2.1 The Environmental and Social Vetting of Development Projects in Belize

The climate investments will require adherence to national sustainable development laws, policies and regulations. The dominant structure vetting potential projects in the country is the Environmental Impact Assessment Process.

The EIA process in Belize is comprehensive and contains elements that are typically used in the region. It normally includes the following stages:

- Screening,
- Scoping,
- Baseline studies,
- Public consultation,
- Review process, and
- Preparation of an environmental compliance plan.

The process consists of an initial conceptual stage of project design, a screening phase (to determine if an EIA is needed), a scoping phase to determine the extent of the EIA, a preparation stage, a vetting stage and follow-up activities (to ensure that any requirements identified by the EIA are satisfied).

Studies to support the process include establishment of an environmental baseline, description of the proposed project, identification of and prediction of potential impacts, identification of

mitigation measures, evaluation of project alternatives, and selection of the preferred alternative, and preparation of an Environmental and Social Management Plan (EMP).

The EIA process also calls for various levels of public consultation. This includes meetings with key stakeholders in order to elicit their views and inputs with an emphasis on local communities. At the final stage of approval, the DoE requires the project owner (“developer”) to sign an Environmental Compliance Plan (ECP), a legal document to which the developer needs to adhere.

3.2.2 Consistency with National Development Planning

Belize has adopted the goal of achieving sustainable development through careful and planned use of its natural resources and as a result has no shortage of planning documents encapsulating the goal of sustainable development. These planning documents meant to guide the country towards sustainable development have culminated in the formulation of the Horizon 2030 National Development Strategy.

The Horizon 2030 National Development Strategy is a long term strategic planning document which is intended to guide national development into the foreseeable future and in any event at least up to 2030. It embodies an overarching, long-term vision from which shorter-term development plans will arise. Horizon 2030 establishes strategic guidelines, development objectives, impact indicators and long-term interactions between the public and private sectors.

Horizon 2030 includes a monitoring, evaluation and follow-up process in order to evaluate the results obtained at the different execution stages of government programs and projects carried out in the country. Likewise, it provides for an executing body to ensure adequate implementation and continuity of the initiatives that are defined, in order to guarantee sound performance and optimum achievement of goals and objectives.

Horizon 2030 heavily emphasizes environmental sustainability along with social and economic development as the 3 pillars and key tenets to be pursued in national development. It provides a new and much needed and invigorated sustainable development context for the country by offering a clear strategic vision of developmental priorities and the principles under which they should take place.

A National Development Plan in the form of a Medium Term Economic Strategy was prepared for the period 2010 – 2013 under the caption “Building Resilience against Social Economic and Physical Vulnerabilities”. The plan targets entrepreneurial development and support for improvement of the export sector’s productivity and competitiveness, environmental protection, disaster reduction, human development and public safety. The plan also promotes the development of an efficient, coherent and consistent fiscal and monetary policy, institutional strengthening, improvement in governance and the technological streamlining of government procedures and processes.

Other important documents which heavily emphasize sustainability are the 2009-2013 National Poverty Elimination Strategy and Action Plans (NPESAP) 2009 - 2013; and the National Medium-Term Development Strategy (MTDS) (2010-2013). The recently produced Belize National Sustainable Development Report is essentially a stocktaking exercise on the progress of national sustainable development (IDC, 2011). In addition a National Sustainable Development Master Plan for Tourism 2030 was released in June, 2011 by the Ministry of Tourism, Civil Aviation and Culture (MoTCCA). The report was produced to aid the technical planners in the MoTCCA in implementing the National Sustainable Tourism Master Plan for Belize 2030.

The trajectory towards sustainable development is further underpinned by a raft of plans, strategies and policies which have been prepared for particular sectors or cut across the needs of several sectors or the entire country. These plans support the development of a framework towards national sustainable development by providing coherency, a sense of direction and a long term vision for development.

Sector specific plans, strategies and policies such as those listed below provide operational direction and the framework for national sustainable development action. The ones most relevant to sustainable development are:

- Agriculture Development Management and Operational Strategy (ADMOS),
- Belize Rural Area Development Strategy (BRADS),
- Belize National Policy on Responsible Tourism,
- National Sustainable Tourism Master Plan (NSTMP) for Belize 2030,
- Belize Integrated Coastal Zone Management Plan 2013,
- National Land Use Policy and Planning Framework (NLUPP),
- National Aquaculture Zoning Plan for Belize,
- National Integrated Planning Framework for Land Resource Development in Belize,
- Belize National Hazard Mitigation Plan,
- Belize Climate Change Adaptation Policy,
- National Environmental Action Plan (NEAP),
- National Environmental Policy and Strategy,
- BAS Environmental Agenda for Belize 2008 – 2013,
- Belize National Action Plan for the Protection of Biodiversity,
- National Guidelines for Subdivision and Consolidation of Land in Belize,
- National Plan of Action for the Control of Land-Based Sources of Marine Pollution in Belize,
- Ministry of Energy, Science & Technology and Public Utilities Strategic Plan 2012-2017:
- Sustainable Chemical Management Action Plan,
- National Protected Areas Policy and Systems Plan (NPAPSP),
- National Health Plan and Policy,
- National Plan of Action for Children and Adolescents,
- National Plan Toward Eradicating Child Malnutrition in Belize,

- Food and Security National Policy,
- Land Suitability Mapping System for Belize,
- National Integrated Water Resources management Policy for Belize,
- Water Sector Adaptation Strategy and Action Plan for Belize,
- Water Resources Management Act 2006

Under Rio+20, Belize like other SIDS countries is obligated to explore a pathway to a green economy and to encourage the adaptation and installation of renewable energy technologies to replace conventional energy generators.

3.2.3 Legal and Regulatory Framework

This section outlines the legislations that pertain either directly or indirectly to the regulation of the petroleum industry as it pertains to the use and management of Belize's natural resources, and also serves to guide sound environmental planning and development prior to and during project implementation. **Table 3.1** sets out the relevant legal environment on which the climate investment program is expected to operate.

Table 3.1: Relevant legal instruments

#	Legal Instrument	Brief Description	Natural Area or Issue Covered	Implementing Agency
1	The Environmental Protection Act SI 22/1992 and 328/2003 and 2009	<p>This enabling legislation provides the Government and the DOE with comprehensive environmental protection authority it needs in order to address modern environmental pollution problems. The Act grants the Department of the Environment broad regulatory and enforcement authority for the prevention and control of environmental pollution, conservation and management of natural resources, and Environmental Impact Assessment.</p> <p>The revised edition 2000 Part III 7 (1) (d) specifies the standards in excess of which pollutants discharged into the environment shall not be discharged or emitted;</p> <ul style="list-style-type: none"> a) Formulating environmental codes of practices specifying procedures, practices or limits for environmental control b) environmental quality guidelines specifying recommendations in quantitative or qualitative terms to support and maintain particular uses of the environment and the control of noise. 	Control and regulate the use of natural resources.	Department of the Environment
2	Environmental Impact Assessment Regulations SI 107/1995	The Environmental Impact Assessment Part V - 20 (4) states that every project, program or activity shall be assessed with a view to the need to protect and improve human health and living conditions and the need to preserve the reproductive capacity of ecosystems as well as the diversity of species; under 20 (5) when making an environmental impact assessment, a proposed developer shall consult with public and other interested bodies or organizations and under 20 (7) a decision by the DOE to approve an environmental impact assessment may be subjected to conditions which are reasonably required for environmental purposes.	Describe in detail the processes involved in the preparation and evaluation of environmental impact assessments.	Department of the Environment
3	Environmental Impact Assessment Regulations (amendment) SI 24/2007	These regulations refine and reclassify many of the regulations in the 1995 document including the types of projects that might be subjected to EIA.	Revises the schedule of developments that require EIA	Department of the Environment

4	Pollution Regulations SI 56/1996	The Pollution Regulations of 1996 addresses issues of air, water and soil pollution, including noise pollution. Part III – 6 (1) deals generally with the emission of contaminants into the air where no person shall cause, allow or permit contaminants to be emitted or discharged either directly or indirectly into the air from any source. Part X 31 (c & d) deals with pollution of land generally that could be harmful, or potentially harmful to animals, birds, wildlife, plants or vegetation.	Environmental pollution	Department of the Environment
5	Effluent Limitation Regulations SI 94/1995	The Regulations are intended to control and monitor discharges of effluent into any inland waters or the marine environment of Belize	Controls release of effluents into the environment	Department of the Environment
6	Environmental Protection Effluent (Limitation) (Amendment) Regulations of 2009	Specifically, the concept of Class I and Class II waters were included as designation of areas in Belize with a particular water quality. Class I waters refers to areas that are fragile biological or ecologically sensitive. Class II waters are waters other than Class I waters that due to oceanographic, hydrologic, climatic or other factors are less sensitive to the impacts of domestic effluent.	These Regulations control and monitor discharges of effluent into any water body of Belize.	Department of the Environment
7	Belize Public Health Act Revised Edition SI 40/2000	Under Part VIII of Offensive Trades 128 (1) b the Minister can make regulations relating to nuisances for the prevention, control or reduction of pollution or contamination of air, soil or water caused by any activity or condition resulting in the emission of a pollutant or contaminant into the environment. The Act also specifies restrictions and regulations for nuisances from factories or other industrial developments, and incidental provisions relating to offensive businesses.	Control of dangerous substances damaging to human health	Ministry of Health
8	National Lands Act (No. 6 of 1992) and SI 191 of 2000	In section 28 where the sea, or any sound bay or creek is described as forming part of the boundary of any national land to be granted or disposed of, then the high water mark shall be considered to be the property boundary. Under the Act, the seabed defined as the land extending seawards from the high water mark of ordinary tides is National Land owned by the Government of Belize under the authority of the National Lands Act.	The Act is designed to establish a framework for the management of national lands	Lands and Survey Department,
9	Land Development Authority Act. Chapter 181 (revised 2000)	Establishes a body corporate with perpetual succession and a common seal and shall have capacity to purchase, take, hold and dispose of land and other property of whatever kind, to enter into contracts, to sue and be sued in the said name and to do all things necessary for the purpose of this Act.	To acquire, develop and improve land (including drainage and irrigation)	Belize Land Development Authority

10	Mines and Minerals Act Chap. 226 of 2000	These Regulations cover a range of topics such as application, duties, terms and conditions and failure to comply with the conditions of a mining license. Under the Act “land” includes land beneath water. The Act also addresses dredging and sand mining, which is essential in avoiding destruction to coastal habitats such as seagrass beds and the coral reef.	Provide a general framework for the implementation of the Mines and Minerals Act	Lands and Survey Department,
11	Forests (Mangrove Protection) Regulations, SI No. 52 of 1989	The Forests (Protection of Mangrove) Regulations, 1989, prohibit any "alteration" (which includes cutting and defoliating, but does not include "selective trimming") of mangroves on any land except with a permit (reg. 4). Alterations which involve dredging or filling can be authorized only in "exceptional circumstances."	Control the exploitation of mangroves	Forest department
12	Crown Land Rules SI 60 of 1939	Under Crown Land Rules (Statutory Rules and Orders 66 of 1939), a 66 ft wide strip of land along all water frontages, measured from high water mark, is designated as public easement, but lands titles prior to 1930 included the land to the high water mark and in some cases, below the high water mark.	Established public easements along waterways	Lands and Survey Department,
13	Housing and Town Planning Act SI 182/2000	Part II of the Act, gives general powers of the Central Authority. Under the Completion of Schemes and Consequential Powers and Duties of the Central Authority 31 (2) the Central Authority may, in connection with any scheme, authorize the laying out and construction of roads and services upon the land acquired by it, and all roads and services as laid out and constructed, if situated within the jurisdiction of a local authority, shall thenceforth be public roads and services maintained by the local authority.	Provides for the provision of services to land including road access	Housing Department
14	Hotels and Tourist Accommodation Act 285/2000	Under Part II (2) an application for registration in respect of any premises used for the business of a hotel or tourist accommodation should be carried out. Part III (14) defines the minimum standards to be observed by hotel and tourist accommodation. Part III of the Act defines registration and Regulations of Hotels and Tourist Accommodations. Under the Act the Belize Tourism Board has the responsibility of registering all hotel and tourist accommodation in Belize. Subject to the provisions of the Act, Part IV (22 91)) states that “there shall be levied and paid a tax at the rate of seven per centum of all the accommodation charges in regards to lodging.” Part V General, sets out Offences and penalties and regulations prescribing standards for hotels and tourist accommodation.	The Hotels Act and the Housing and Town Planning Act complement each other, since they both address tourism and residential developments in coastal areas.	Ministry of Tourism and Culture
15	Belize Tourist Board Act	The Belize Tourist Board Act indirectly encompasses most of the other Acts, since it contains provisions for the development of tourism policies, which would need to consider the effects and roles of all sectors in the development of tourism.	Establishes the procedures for the management of the tourism industry.	MTCCA

16	National Institute of Culture and history Act SI No 331 of 2000 Revised 2003	<p>National Institute of Culture and History (NICH) Act SI No. 331 of 2000 Under section (37.) of the NICH Act, All ancient monuments and antiquities upon any land or in any river, stream or watercourse, or under the territorial waters of Belize, shall absolutely vest in the State.</p> <p>Section 38.-(1) state that: Subject to this Act, no person shall possess or have in his custody any ancient monument or antiquity except under a licence in writing granted by the Director in the prescribed form. (2) Any person who contravenes subsection (1) commits an offence and is liable on summary conviction to a fine not exceeding ten thousand dollars or to imprisonment for a term not exceeding five years, or to both such fine and term of imprisonment, and in addition, any such ancient monument or antiquity shall be forfeited to the State.</p> <p>Under section 39.-(1) it state: Any person who at any time has or takes or comes into possession, custody or control of any ancient monument or antiquity shall within fifteen days of his first having or taking or coming into such possession, custody or control of the ancient monument or antiquity, register his possession, custody or control with IRMAC</p> <p>Institute of Culture and History (Amendment) Act SI No. 20 of 2003 This act empowers the Institute of Archaeology to carry out research, interpretation and the protection of the Archaeological Heritage of Belize. The ownership of all ancient monuments and antiquities shall rest in the Institute of Archaeology, Government of Belize.</p>	Replaces the institute of archaeology Act	NICH
17	Institute of Culture and History (Amendment) Act (No. 20 of 2003)	This act empowers the Institute of Archaeology to carry out research, interpretation and the protection of the Archaeological Heritage of Belize. The ownership of all ancient monuments and antiquities shall rest in the Institute of Archaeology, Government of Belize.	Empowers the institute of archaeology to manage cultural sites	NICH
18	Coastal Zone Management Act. Chapter 329 (1998, revised 2000)	Established as an autonomous institution governed by the provisions of this Act. The Authority may exercise any of the functions entrusted to it by or in accordance with the provisions of this Act or any regulations made there under and may exercise any other duties incidental or ancillary to, or consequential upon, the performance of its functions.	Advise the Minister in relation to the development and utilization coastal zone resources.	Coastal Zone Management Authority
19	Belize Port Authority Act SI 233 of 2000/2003	The Authority may: (a) operate the ports as appears to it best calculated to serve the public interest; (b) regulate and control navigation within the limits of ports and their approaches; (c) maintain, improve and regulate the use of such ports and services and facilities; (d) provide for such ports and the approaches thereto such pilotage services, beacons, buoys and other navigational services and aids as it considers necessary or desirable; (e) to exercise the duties and functions relating to shipping and navigation exercisable under the provisions of any other law.	Established the conditions under which a port may be constructed and operated.	Belize Port Authority
20	Fisheries Act. Chapter 210 (2000, revised edition)	This act regulates the licensing of fishing boats and fishermen and the conduct of researchers. The act also regulates the sale of fish products and the protection marine turtles. It also empowers the Minister to make regulations for all matters connected with the control and regulation of marine reserves and extraction of marine products.	Regulate commercial and personal fishing and protect marine areas of Belize	Fishery officer appointed by the minister

21	Forests Act Chapter 213 (revised edition 2000)	The Minister may by Order declare an area to be a forest reserve and may from time to time alter, vary or revoke such Order. The Minister may make regulations, either of general application or confined to particular forest reserves or other areas of national land, or of private land to which it has been decided to apply any of the provisions of this Act for the protection of trees and forest produce being in or upon such reserve or other area.	The Minister may apply this Act or regulations to any area or tract of private land	Chief Forest Officer
22	High Seas Fishing Act Chapter 210:01 (revised edition 2003)	The Fisheries Administrator shall be responsible for maintaining a record of all fishing vessels in respect of which high seas fishing licenses have been issued under this Act, and such record shall include all information provided by the applicant	Regulates fishing vessels on the high seas by requiring them to have license	Registrar of Ships and/or IMMARBE
23	Maritime Areas Act Chapter 11(revised edition 2000)	The territorial sea of Belize comprises those areas of the sea having, as their inner limits, the baseline of the territorial sea and, as their outer limits, a line measured seaward from that baseline, every point of which is 12 nautical miles from the nearest point of that baseline.	Establishment of the maritime areas and internal waters of Belize	Minister responsible for foreign affairs
24	National Lands Act Chapter 191(revised edition 2003)	National lands means all lands and sea bed, other than reserved forest within the meaning of the Forests Act, including cayes and parts thereof not already located or granted, and includes any land which has been, or may hereafter become, escheated to or otherwise acquired by the Government of Belize	Rules and regulations in relation to land properties	“The Minister responsible for lands.”
25	National Parks System Act Chapter 215 (1981 revised edition 2000)	To provide for the preservation and protection of highly important natural and cultural features, for the regulation of the scientific, educational and recreational use of the same and for all other matters connected therewith or incidental thereto	Covers all national parks, nature reserves, wildlife sanctuaries and natural monuments	The Chief Forest Officer
26	Protected Areas Conservation Trust Act Chapter 218 (1995, revised edition 2003)	To establish a trust for the protection, conservation and enhancement of the natural and cultural resources of Belize; to establish a Trust Fund for the Trust; to establish a board of Directors to control and manage the affairs of the trust; and to provide for matters connected therewith or incidental thereto	Act applies to the whole country.	Board of directors composed of eleven members,
27	Wildlife Protection Act Chapter 220 (1981 revised edition 2000)	Provides the conservation, restoration and development of wildlife, for the regulation of its use and for all other matters connected therewith. It is established within this act all regulations and restrictions related to hunting and the penalties for violating the Act. The Act protects many species from hunting, killing and harassment Part II (a). Many coastal and marine species are protected under this Act and includes two species of crocodiles, the manatee, all birds with the exception of six species, whales, dolphins, and the Caribbean monk seal.	The Act seeks to control hunting, research and trade of wildlife.	Minister responsible for wildlife protection
28	Registered Land Act (2000, revised 2003)	Establishes regulations for land registration and a Land Registry,	This act “shall apply to any area declared by the Minister... to be a compulsory	Commissioner of Lands and Surveys

			registration area.”	
29	Macal River Hydroelectric Act (2000, revised 2003)	Delegate authority for the design, financing, construction and operation of the Chalillo Project to the Belize Electric Company Limited and Belize Electricity Limited.	Regulates the Chalillo water storage facility and the Hydroelectric Plant	BECOL and BEL
30	Private Forest Conservation Act (revised 2000)	Regulates tree clearing or “felling” on private lands.	Regulates privately held forests.	Forestry Department
31	Water Industry Act (revised 2000, 2003)	Addresses the regulation and provision of water and sewerage services, water abstraction and use, licenses, water pollution control, permits for discharge, and offenses and penalties.	National water services.	The PUC and Belize Water Services Limited (BWSL)
32	Water and Sewerage Act, CAP 222, revised edition 2000.	Any area of the country can be declared an area of water supply by the Minister; in these areas the providing of water is regulated by this Act. Any industry in an area of water supply that wishes to extract water from surface water or groundwater has to apply for a license with the Water and Sewerage Authority to be able to do so.	Empowers to government declare an area a reserve for water supply	Minister responsible for public utilities
33	Belize Water Industry Act No. 1 of 2001	The Act deals with controlling disposal of wastes generated from sewer treatment. The Act makes new provisions with respect to the supply and control of water and sewerage services in Belize. The Water Industry Act also establishes the responsibility of private entities to provide facilities for the final disposal of sewerage taking into consideration 36 of the Environmental Protection Act 1 of 2001.	The Water Industry Act repeals the Water and Sewerage Act, Chapter 185 of 1971 Laws of Belize.	Minister responsible for public utilities
34	Disaster Preparedness and Response Act, Chapter 145 (Revised Edition) 2000	The act calls for the preparation of The National Disaster Preparedness Response Plan and include among others: (a) Procedures related to disaster preparedness and response in terms of human resources deployment; (b) Procedures for coordinating the national disaster response plan and its implementation, (c) Procedures for informing persons under paragraph (a) and the public in Belize and elsewhere of the existence of a threatened disaster alert; (d) Procedures for preparing and maintaining inventories of services, systems and supplies for the mitigation of, preparedness for, response to and recovery from emergencies and disasters.	Lays out procedures for disaster preparedness	Minister responsible for NEMO

35	Mines and Minerals Act (revised 2000 and 2003)	Regulates the extraction of all non-renewable resources in Belize. Of interest to water resources management are its control of dredging and quarrying activities.	Addresses mining and mineral use.	Administered by Geology & Petroleum Department
36	Pesticide Control Act (revised 2003)	Regulates and controls the sale and use of pesticides. It establishes a Pesticides Control Board to set standards for the monitoring pesticides, which falls under the responsibility of the Ministry of Agriculture.	Pesticide use in nation-wide agriculture.	Pesticides Control Board,
37	Dangerous Goods Act (revised 2000)	Regulates the use, transport, storage, and monitoring of dangerous goods, such as liquefied petroleum gas, gunpowder, and explosives.	Regulates dangerous goods within Belize.	Ministry of Home Affairs
38	The Land Utilization Act (Chapter 188 of revised edition 2000)7.	The Land Utilization Act, under which the Land Utilization Authority of the Ministry of Natural Resources, Local Government and the Environment (MNRE) is established, provides for measures to govern the use and development of land, and introduces measures for the conservation of land and watersheds.	This Act governs the subdivision of private lands and the construction of jetties on coastal areas.	Lands and Survey Department, Ministry of Natural Resources
39	Land Utilization Act (revised 2000 and 2003)	Controls the subdivision of any public or private land in Belize. It establishes the Lands Utilization Authority which makes recommendations on subdivision applications. It also establishes Special Development Areas which limit the types of development permissible within these zones.	Land registration, subdivision, and utilization.	Lands Utilization Authority
40	Solid Waste Management Authority Act (revised 2000 and 2003)	Under the Act, the Authority shall devise ways and means for the efficient collection and disposal of solid waste employing modern methods and techniques and exploring the possibility of recycling waste materials. Governs the collection and disposal of solid waste in Belize.	Regulates disposal of solid waste.	Solid Waste Management Authority

3.2.4 International Conventions and Agreements

In order to fulfil its sustainable development agenda, Belize has signed several important regional and international conventions and agreements and is a member to many regional organizations involved in the management and protection of biological resources. Those that impact on biodiversity, cultural and natural heritage and sustainable development are listed below.

- (a) World Heritage Convention (ratified in 1990).
- (b) Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) (ratified 1976).
- (c) Convention on Biological Diversity (CBD) (ratified in December, 1993).
- (d) Central American Biodiversity Convention.
- (e) Central American Alliance for Sustainable Development (ALIDES) in 1994
- (f) Convention on the Conservation of Migratory Species of Wild Animals, Bonn (The Migratory Species Convention).
- (g) Convention Concerning the Protection of the World Cultural and Natural Heritage (The World Heritage Convention) (ratified Nov. 6, 1990).
- (h) Convention for the Conservation of Biodiversity and the Protection of Priority Areas in Central America 1992.
- (i) Organization for the Fishing and Aquaculture Sector of the Central American Isthmus (OSPESCA) whose main objective is to manage and promote the development of fisheries and aquaculture in Central America.
- (j) Agreement on Cooperation between Belize and Mexico for the Protection and the Improvement of the Environment and the Conservation of Natural Resources in the Border Zone (signed 20 September, 1991).
- (k) United Nations Law of the Sea Convention (LOSC) (ratified 13 August, 1983).
- (l) Protocol on Specially Protected Wildlife (SPAW Protocol).
- (m) Convention on the Transboundary Movements of Hazardous Wastes (1997).
- (n) Convention for the Protection of the Ozone Layer, and Protocol on Substances that Deplete the Ozone Layer.
- (o) International Convention on Civil Liability for Oil pollution Damag
- (p) Land-Based Sources of Pollution Protocol (LBSP).
- (q) United Nations Framework Convention on Climate Change (ratified September, 1994).
- (r) United Nations Convention to Combat Desertification (UNCCD).
- (s) The Convention on Wetlands of International Importance Especially as Waterfowl Habitats (RAMSAR) (Signed 1998).

- (t) Convention for the Prevention of Pollution from Ships (MARPOL 73/78) (ratified 12 May, 1995).
- (u) Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (signed 1995).
- (v) Western Central Atlantic Fisheries Commission (WECAFC) (1985).
- (w) Latin American Organization for Fisheries Development (OLDEPESCA) (1997).
- (x) Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (The Cartagena Convention).

Belize may soon become party or signatory to the following conventions and agreements:

- International Commission for the Conservation of Atlantic Tunas (ICCAT),
- Inter-American Convention for the Conservation and Protection of Marine Turtles (in progress).
- International Dolphin Conservation Program (IDCP).
- Aquatic Living Resources Bill - will repeal the existing Fisheries Act and is aimed at improving the long term conservation, management and sustainable use of fisheries in Belize.
- Maritime Pollution Bill - for the protection of the marine environment from marine pollution and other forms of negative impacts from shipping and other potentially harmful activities conducted at sea

The country's compliance with its commitments under the above mentioned conventions has been minimal due to the lack of appropriate enforcement mechanisms.

3.2.5 Compliance with IADB Safeguard Requirements

The IDB has classified its proposed investment program under the Climate Vulnerability Reduction Program as a Category B project in accordance with the requirements for categorization of the IDB Environment and Safeguards Compliance Policy (OP-703), as an operation likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available. The Program is in compliance with the applicable directives of OP-703 including:

- Directive B.2 - compliance with in-country regulations;
- Directive B.5 and Directive B.6 - covering Environmental Assessment requirements and requirements for the consultation of affected parties respectively.
- Directive B.9 - The Program will not contribute to the significant conversion or degradation of critical natural habitat or damage critical cultural sites.

Table 3.2 summarizes compliance with relevant IDB Safeguards

Table 3.2: IADB Safeguard Policy Directives and Compliance

Policy/ Directive	Applicable Aspect	Compliance
B.1	Bank Policies	Currently the project complies with all directives of the Environment and Safeguards Compliance Policy (OP-703) as well as with other pertinent policies (OP-102; OP-761; OP-765; OP-704) .
B.2	Country Law and Regulations	The operation includes an <u>Environmental and Social Management Plan (ESMP)</u> that insures full compliance with country laws and regulations, which will be incorporated into the Program Operations Manual - POM
B.3	Screening and Classification	This Project was classified as B
B.4	Other risks	<u>Weak institutions</u> : Institutional strengthening measures are incorporated in the program, with component 1 dedicated to strengthen national institutions to manage disaster risk, particularly MoWT, and local stakeholders. Inclusion of dedicated specialists responsible for management of environmental and socio-cultural aspects of the program and a strong management/supervision and monitoring strategy ensures compliance with bank policies and national legislation. <u>Climate risk</u> : the project is specifically designed to increase capacity of human social and ecological systems to adapt to a changing climate (see OP-704).
B.5	Environmental Assessment Requirements	To meet the requirements of that classification, an Environmental and Social Assessment/Analysis was conducted.
B.6	Consultations	On-site consultations with stakeholders relevant to this operation have been conducted at the 3 priority investment sites; these meetings included with public sector agencies relevant to the Climate Vulnerability reduction program, Local authorities, local communities including woman and youths and business groups.
B.7	Supervision and Compliance	The ESMP will establish internal supervision of compliance. Additionally all environmental; and social mitigation measures and specifications under the ESMP will be duly incorporated into all tender documents and contracts for investment designs and construction, as well as for the Supervisory Firm. The Executing agency will count of an Environmental and social specialist responsible for ensuring all local regulations/requirements and the IDB policies are complied with. The IDB will periodically supervise the Project.
B.9	Natural Habitats and Cultural Sites	Works in sensitive areas will be carefully localized and will keep a small footprint. The ESMP includes specific requirements to ensure suitable siting and minimalist design treatment with use of local materials to blend with the local environment and that are compatible with existing management plans. Site specific ESM implementation plans will be developed for each physical investment for the construction in any sensitive areas that will detail de requirements under the ESMP as well as the requirements under the Environmental Compliance Plan (ECP) that will be required by the DOE as part of the permit.
B.11	Pollution Prevention and Abatement	With the implementation of the measures determined in ESMP, including waste management plan, it is expected that the project will comply with B.11 during the lifetime of the Project.

B.17	Procurement	The program will include safeguard provisions for procurement of goods and services and bidding documents for works as appropriate, as stipulated in the POM.
OP-761	Gender and Equality	Program includes actions specifically designed to elicit the views and opinions of women, youth, and minority groups and inclusiveness through promotion of opportunities for employment and local empowerment.
OP-765	Indigenous Peoples	N/A This project does not affect indigenous people
OP-710	Resettlement	N/A This Project will not involve resettlement, however it may involve compensation for damage to or loss of property.
OP-704	Natural Disasters	Incorporated into the program's strategy, design and implementation; component 2 aimed at strengthening resiliency and reducing vulnerabilities to natural disasters, climate change, and environmental management, including internalizing climate resilience best practices for coastal protection and effective public works.
OP-102	Disclosure	The Environmental and Social Strategy for this Project will be made public prior to IDB Board review. The final ESA and ESMP will be made public on the Bank's website and relevant Government of Belize website.

SECTION B

ENVIRONMENTAL AND SOCIAL **ASSESSMENT**

4 Baseline Environmental Indicators

4.1 Introduction

The project includes 3 coastal and offshore locations considered vulnerable to climate impacts and for which the project proposes climate reduction intervention measures. The manifestation of these impacts ranges from coastline degradation to urban flooding. Notwithstanding the small and relatively benign footprint of the interventions, understanding of the underlying environmental processes is key to developing a project that is sustainable and produces long term social benefits for all while protecting the environmental capital.

During this study, field reconnaissance visits were conducted at the 3 project sites and within the region around the proposed project locations. The following narrative elaborates on the observations made during the field surveys and is intended to give an understanding of the baseline environmental indicators which could be influenced by project activities.

4.1.1 Belize City

Belize City is the nation's largest urban center straddling the coastline in the mid latitudes of the country. The city lies on a low marshy delta at the mouth of the Belize River. The Haulover Creek branches from the main Belize River near the Haulover Bridge and deviates eastward dissecting the city into a northern and southern half. The Creek serves as the main drainage collection system and water transportation hub through the city.

The project area stretches across a number of land systems including coastal, estuarine and alluvial lowlands. The project area is heavily populated within the urban core with the city gradually expanding up the Haulover Creek and along the main highways to the north and south. Only small areas within the project region come under any statutory protection or private conservation initiatives.

Away from the urban center and along its periphery are a number of rich ecosystems which support a rich diversity of life forms. Within this area are found some of the country's richest mangrove stands and an offshore area which is home to a number of threatened species.

4.1.1.1 Vegetation Ecosystems

Vegetation types throughout the area are influenced by soil fertility, drainage and the saline influences of the Caribbean Sea. This is especially evident in the estuarine areas along the Belize River and Haulover Creek where salt loving mangrove species can be found along the

river delta and upstream. The names for the forest ecosystems used in this report are adapted from the nomenclature used in the Central American Ecosystems Mapping project (see **Figure 4.1**).

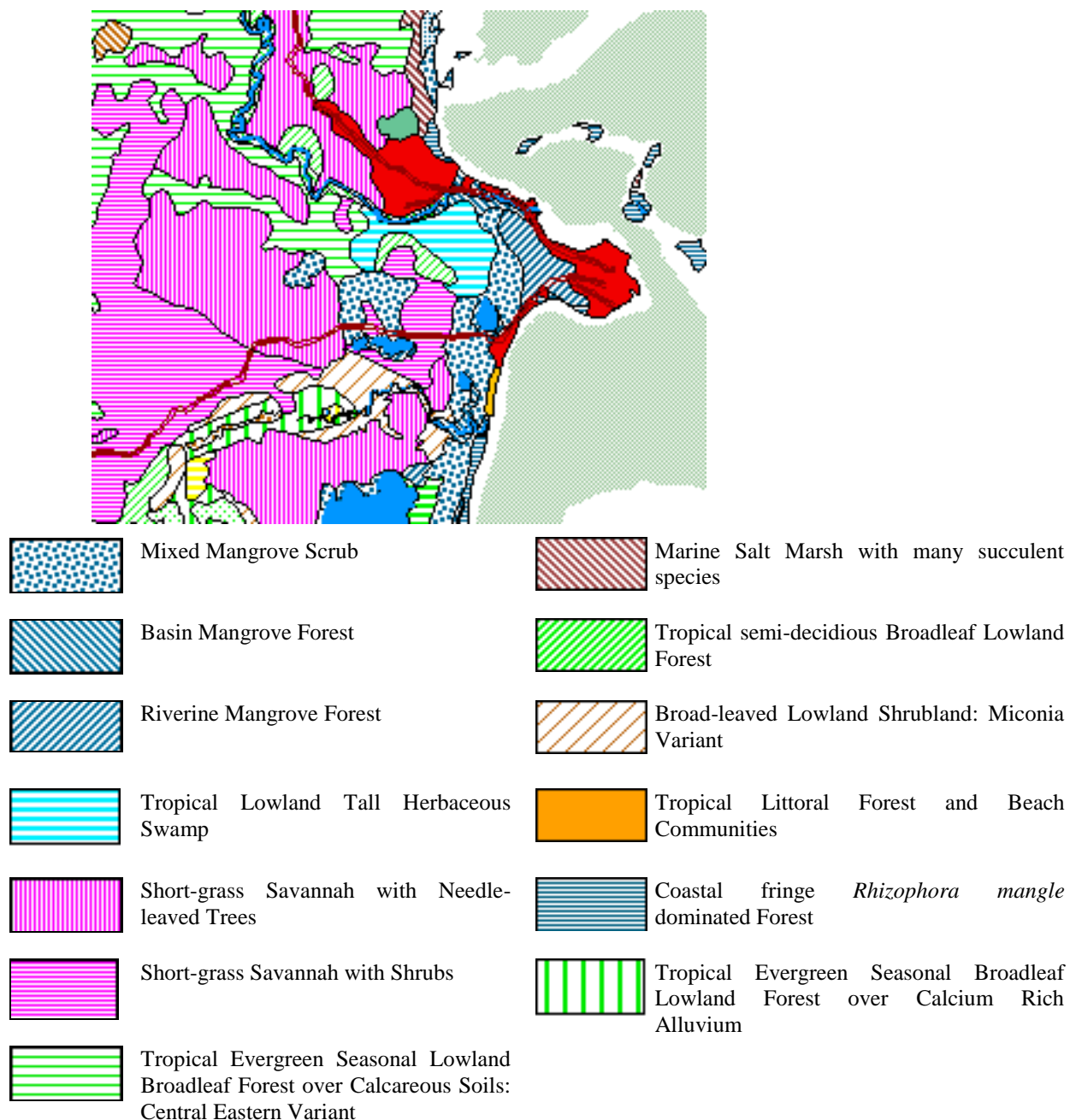


Figure 4.1: Map of main vegetation types within the project region.

The mouth of the Belize River is a lowland delta best described as lowland swamps forest of the Caribbean Plain and dominated by mangroves. Growing within or in association with

mangroves in this waterlogged area are broadleaf species of shorter stature, reeds, grass, ferns and aquatic plants. The main ecosystems within the Belize City area and those over the larger region are shown in **Figure 4.1** and described in **Tables 4.1** and **Table 4.2**.

The Mangrove Communities – These are found mainly in the estuarine area of the Belize River and Haulover Creek and along the coast to the north and south of Belize City in areas not yet disturbed by human settlements. A floristic survey of Belize’s mangroves conducted in 1992 identified over sixty vascular plant species as occurring within mangrove ecosystems or on their margins, (Schofe, Major Events) re : A Natural History of Belize (Samuel; Bridgewater – 2012). Much of the once prolific mangrove communities between the Belize River and Haulover Creek have been cleared for housing development as Belize City expands northward and westward into the area.

Only isolated fragments of this forest remain towards the Belize River and Haulover Creek. Typical species encountered are Red Mangrove (*Rhizophora mangle*), White Mangrove (*Laguncularia racemosa*), and Black Mangrove (*Avicennia germinans*). Often associated with these mangroves are Poke n’ Dough Boy (*Bactris major*), Bullet Tree (*Bucida buceras*) and Mayflower (*Tabebuia rosea*) although the latter is mostly found in the disturbed areas where they can be locally abundant. In all areas mangroves occupy waterlogged soils, but where these are rich in nutrients as they are in this area they achieve rapid growth and form sizeable stems such as along the Haulover Creek and the mouth of the Belize River (See **Plate 4A insert 3**).

- a) **Riverine Mangrove Forest** – This vegetation type grows on the rich alluvial soils deposited by the sluggish waters near the mouth of the Belize River and the upper reaches of Haulover Creek. It thrives in waterlogged condition with canopy height ranging from 10m. to 30 m. Along the Haulover Creek is one of the best and tallest old growth mangrove stand in the country much appreciated by the tourism industry as an attraction for visitors. The mangrove colony in this area benefits from the rich alluvial soil deposited by the river and the relatively saline conditions. Root structure, height and stem diameter are outstanding (See **Plate 4A insert 1 and 2**). The area to the northeast of the bridge up to the mouth of the river also has some outstanding mangrove stands with most prominent species being Red Mangrove (*Rhizophora mangle*) along the coastline and the river and transitioning into White Mangrove (*Laguncularia racemosa*) further inland (See **Plate 4A insert 4**).
- b) **Mixed Mangrove Scrubs** – These are found further north along the coast and upriver from the Haulover Bridge. This vegetation type tends to form a transitional zone between the mangrove areas that are permanently inundated and other non-mangrove type forest having different growth requirements than mangroves. Typical mangrove species are (*Rhizophora mangle*), White Mangrove (*Laguncularia racemosa*), and Black Mangrove (*Avicennia germinans*) of which neither species is characteristically dominant. Also



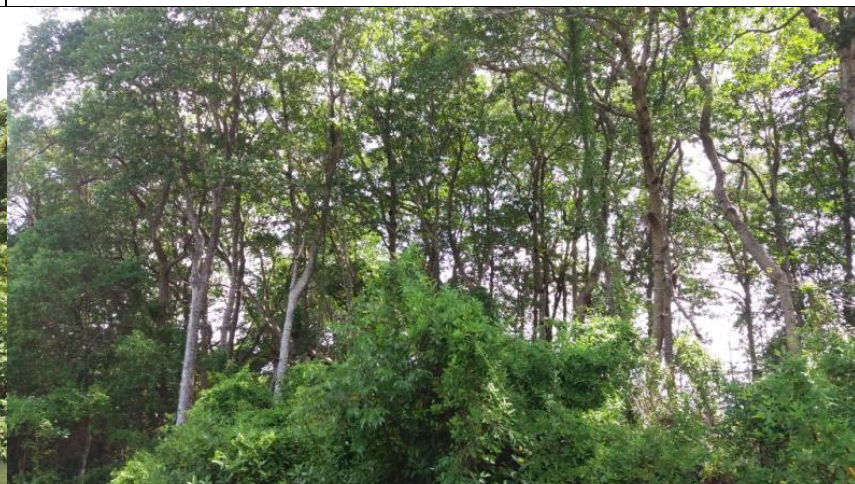
Insert 1: View of Red Mangrove stand along Haulover Creek.



Insert 2: View of impressive mangrove prop roots along Haulover Creek.



Insert 3: Well developed mangrove stands near the mouth of the Belize River.



Insert 4: Prominent stands of White Mangrove near the mouth of the Belize River.

Plate 4A: Vegetation ecosystems within project area.

present are non-mangrove species such as Palmetto (*Acoelorrhaphe wrightii*), *Acrostichum aereum*, *Eragrostis prolifera*, *Myrica cerifera* and *Rhabdadenia biflora*.

- c) Basin Mangrove Forest – This vegetation type thrives under seasonally waterlogged or permanently waterlogged conditions and are found in tidally inundated areas north Belize city along the coast and in brackish lagoons and inlets. Dominant species is Red Mangrove (*Rhizophora mangle*), however White Mangrove (*Laguncularia racemosa*), and Black Mangrove (*Avicennia germinans*) may also be present and indeed dominate the seasonally waterlogged areas, which tend to be higher with better drainage. *Rhizophora mangle* dominates the areas subjected to periodic tidal flushing or where permanent water logging causes a reduction in available oxygen supply.

Tropical Lowland Tall Herbaceous Swamp – This vegetation type is also locally known as “Sibal Forest”. It occurs in inland areas where the land is seasonally inundated swamp and often occupies the transitional zone into higher pine ridge areas. This vegetation type is found near the Philip Goldson International Airport in areas having poor drainage and in the region between the southern boundary of Belize City and the Sibun River on soils not brackish enough to support mangroves. During the heart of the dry season these areas can become droughty and prone to fires. Characteristic species are Bullet Tree (*Bucida buceras*), Calabash (*Crescentia cujete*) and Palmetto (*Acoelorrhaphe wrightii*).

Table 4.1: Main vegetation types found within the project region.

No	Vegetation type	Predominant location	Area coverage (ha).	Distinguishing features
1	<u>Coastal fringe Rhizophora mangle –dominated forest #50</u>	This vegetation type is located predominantly east of the project site along a narrow fringe on the coast and on the small islands at the mouth of the Belize River		Occurs in tidally inundated water along beaches in the project area. Tree heights range considerably but typically falls between 2 – 14m. Red mangrove is the dominant species and in most areas near the project site is the only specie.
2	<u>Riverine Mangrove Forest #51</u>	Occurs to the west of Haulover Creek and constitutes one of the most impressive mangrove stands in the country falling under this ecosystem.		Occurs near the mouth of riverine systems in waterlogged conditions primarily at sea level elevations or below 50m. in nutrient rich alluvial soils. Canopy height typically 10 – 30m.
3	<u>Basin Mangrove Forest #52</u>	Occurs primarily near the Belize River mouth and east of Northern and Southern lagoon.		Occurs at sea level in waterlogged areas along the coast in land locked coastal depression.
4	<u>Tropical Lowland Tall Herbaceous Swamp (#71)</u>	Located in a sizeable area south of Ladyville and west of Belize City.		This vegetation type typically occurs at lower elevations <200m. The soil type is variable since it is distinguished by poor drainage and water inundation throughout the rainy season.
6	<u>Permanently Waterlogged Freshwater Mangrove Scrubs # 48</u>	Occurs over large area to the south of Belize City.		This mangrove community occurs at low altitudes (50m. below sea level) in inland freshwater systems.
7	<u>Mixed Mangrove Scrub #49</u>	Found in several locations along the coast within the project area.		Normally found at sea level in low waterlogged brackish habitats.
8	<u>Tropical Littoral Forest and Beach Communities #69</u>	Within the project area this important ecosystem occupies a narrow strip immediately to the south of Belize City		This forest type never covered large areas and is now under severe threat from coastal development much of it much of it from expansion of the tourism industry. Littoral forest vary in composition but occupy the narrow strip along the coast and typically grow on well drained sandy areas. Typically they are bordered on the beach side by low herbaceous beach vegetation with species such as <i>Argusia gnaphalodes</i> , <i>Canavalea rosea</i> , <i>Euphorbia trichotoma</i> and <i>Surania maritima</i> . On the inland side this ecosystem is typically bordered by Mixed mangrove scrub ecosystem dominated by <i>Rhizophora mangle</i> and <i>Myrica cerifera</i> .

Table 4.2: Dominant vegetation types and species found within project area.

Vegetation Type	Plants associated with Vegetation Type
<u>Riverine Mangrove Forest</u>	Typical species include <i>Rhizophora mangle</i> sometimes in association with <i>Laguncularia racemosa</i> in better drained areas.
<u>Basin Mangrove Forest</u>	Dominated by Red Mangrove <i>Rhizophora-Mangle</i> , however, Black Mangrove (<i>Avicennia germinans</i>) and White Mangrove (<i>Laguncularia racemosa</i>) may also be present. Ferns known to grow in open areas in association with these stands.
<u>Coastal fringe Rhizophora mangle – dominated forest</u>	Typical species associated with this ecosystem include: Usually dominated by Red Mangrove (<i>Rhizophora mangle</i>) but may also be in association with Black (<i>Avicennia germinans</i>) and White Mangrove (<i>Laguncularia racemosa</i>)
<u>Permanently Waterlogged Freshwater Mangrove Scrubs</u>	This mangrove community is dominated by <i>Rhizophora mangle</i> with associations with sedges and tall reeds.
<u>Mixed Mangrove Scrub</u>	Common species include <i>Avicennia germinans</i> , <i>Laguncularia racemosa</i> , <i>Rhizophora mangle</i> often in association with <i>Acoelorrhaphe wrightii</i> , <i>Acrostichum aureum</i> , <i>Conocarpus erectus</i> , <i>Eragrostis prolifera</i> , <i>Myrica cerifera</i> and <i>Rhabdadenia biflora</i> .
<u>Tropical Lowland Tall Herbaceous Swamp</u>	Characterized by a graminoid ecosystem often with <i>Phragmites australis</i> and/ or <i>Cladium jamaicense</i> , <i>Ludwigia</i> spp. And a variety of other herbaceous species. Where trees are encountered the dominant species are often <i>Bucida buceras</i> , <i>Crescentia cujete</i> and <i>Acoelorrhaphe wrightii</i> . Fires are liable to penetrate into the grassy areas during the dry season. Rainfall is not a dominant feature since the inundation is mostly due to lower elevation compounded by poor drainage.
<u>Tropical Littoral Forest and Beach Communities</u>	This vegetation type will usually have representation from the following species: <i>Brassavola nodosa</i> , <i>Bursera simaruba</i> , <i>Cassytha filiformis</i> , <i>Chrysobalanus icaco</i> , <i>Coccoloba uvifera</i> , <i>Cordia sebestina</i> , <i>Hymenocallis latifolia</i> , <i>Metopium brownei</i> , <i>Myrmecophylla tibicinis</i> , <i>Passiflorasuberosa</i> , <i>Pouteria campechiana</i> , <i>Sophora tomentosa</i> and <i>Thrinax radiata</i> with <i>Cocus nucifera</i> also conspicuously present.

4.1.1.2 Important Terrestrial Habitats and Species of Conservation Importance

The National Protected Areas System Plan (NPASP) and the National Biodiversity Strategy and Action Plan calls for the protection of ecosystems that are at risk, or that are not well represented within the National Protected Areas network. Most of the ecosystems found within the project area have good representation within the region and in other areas of the country, much of it under statutory protection.

Among the important ecosystems within the project region is the Riverine Mangrove Forest which grows along the Haulover Creek where it forms the best and tallest stands in the country however a sizeable portion falls within the Burdon Canal Nature Reserve. Another prominent and important mangrove stand lies immediately NW of Belize City with excellent stands of Red, White and Black Mangroves most of which is at risk for clearance for housing development. This species is adapted uniquely for life in super saturated soils, salt tolerant with convergent adaptation to salt-water balance and control of water loss. It is an ecosystem that supports habitat to the reef because it traps sediments and provides adequate spawning sites for several marine fish species.

Littoral forest ecosystems are also critically important for shoreline protection and as a habitat for migratory birds many of which are critically endangered, however almost none of this ecosystem falls within the immediate project area.

No red listed arboreal species are found within the immediate project area.

4.1.1.3 Wildlife and Fisheries

The project area lies near important wildlife habitats in the estuarine areas of the Belize River and in the offshore waters between Belize City and Swallow Caye Wildlife Sanctuary. In addition the project area lies near or at the convergence of the marine, riverine, savannah, mangrove, broadleaf and marsh habitats which supports species diversity.

There is a higher concentration of Manatee sightings offshore Belize City than anywhere else in the country. The forested estuarine areas retains excellent bird habitats and good feeding opportunities for wading birds. The mouth of the Belize River is one of the most important roostery for wading birds in the country many of which are of international conservation concern.

The faunal composition of the mangrove ecosystem is impressive and offers one of the most compelling justification for their protection. In 1992, Schofe conducted a study of species associated with mangroves and documented a minimum of 74 species of fish, 40 species of mammals (either as residents or transients), 178 bird species, 30 species of reptiles and 11 species of amphibians occurring or likely to occur in mangroves (Bridgewater – 2012).

i. Large vertebrates

Crocodiles, especially the Morelets Crocodile (*Crocodylus moreletii*) are reported to be common throughout the Belize River but the estuarine area seems to be a particularly active node of activity. Serious encounters between crocodile and people have been reported from the Belize City especially along the Haulover Creek and the numerous urban canals that connect to it. American Crocodiles (*Crocodylus acutus*) are also reported from the estuarine area but as usual there is little reliable data to substantiate this.

In Belize, the mammal associated with mangroves is the Manatee or Sea Cow (*Trichechus manatus*) and can be affected by the removal of plant component species such as “sea grass”, a food resource. Another species that follows is the “bottle-nosed Dolphin (*Tursiops truncatus*) which can occur on fringing mangroves but occasionally swim downstream the Belize River and into Haulover Creek to feed.

Local fishermen report Manatee sighting in the Haulover Creek in the vicinity of the Belize City Flour Mill. It is believed the animals migrate up the Belize River and enter the Haulover Creek and travel down that water body to exploit feeding opportunities until noise and the activities of people including high pollution levels act as deterrents.

ii. Bird Species

In their 2000 checklist of the “Birds of Belize”, Miller and Miller reported 384 bird species in the Belize City area making it one of the highest readings for the entire country but this may have more to do with the intensive coverage of this area which can be partly attributable to its easy access.

Birdlife is abundant between the area bounded by the Belize River area the Phillip Goldson Highway and the George Price Highway and adjacent coastal areas. The Belize City area especially in the West Landivar, Port Loyola and the many ponds along the highway adjacent to Belize City are important for wading birds. Several wading and resident sea birds in the family Phalacrocoracidae, Pelicanidae Anhingidae and Fregatidae were documented in the area. Species of that category observed in this general area are Snowy Egrets, Limpkin, Wood Stork, Roseate Spoonbills, Little Blue Heron, Great Blue Heron, Yellow-Crowned Night Heron and White Ibis. The extensive system of wetlands affords good habitat for these birds.

The most common species of birds occurring in the mangroves of Belize are: Brown Booby (*Sula leucogaster*), Brown Pelican (*Pelecanus occidentalis*), Olivaceous Cormorant (*Phalacrocorax brasilia*), Magnificent Frigate bird (*Fregata magnificens*), Tiger Heron (*Tigrisoma mexicanum*), White Ibis (*Eudocimus albus*), Amazon Kingfisher (*Chloroceryle amazona*) and the American Pygmy Kingfisher (*Chloroceryle aenea*).

Disturbance of the vegetation in the vicinity of the development area will affect nesting sites for resident species. Consideration must also be given to the North American migrants that winter in this habitat (including passerines, shorebirds, water fowls and wading bird species). One resident specie of warbler is restricted to mangroves, Mangrove Warbler (*Dendroica petechia* – erithachorides group). Two important bird species that are mostly restricted to mangrove habitats are: Mangrove warbler (*Dendroica petechia* – erithachorides group) and Mangrove cuckoo (*Coccyzus minor*).

Despite its largely urban setting the Belize City/Ladyville area remains a stronghold for many avian species, given the availability of sufficient cover and roosting habitats and the abundance of foraging area especially aquatic habitats. Although many species that favor undisturbed habitats will doubtless relocate with the expansion of Belize City others will move in which are better adapted at surviving in the disturbed habitat as is the case with the Barn Owl which is abundant in Belize City where it contributes considerably in rodent control.

iii. Reptiles

Though two species of crocodiles have been documented in mangrove habitat, both American (*Crocodylus acutus*) and Morelet,s (*Crocodylus moreletti*), the former is most commonly noted in such habitat. The other reptile species includes a number of species of snakes including the boa Constrictor which feed on the rodents that are associated with urban areas. These snakes also prey on smaller reptiles such as lizards, anoles and birds. Crocodiles are common to abundant in haulover creek and in some neighborhoods have become a nuisance preying on pets and occasionally attacking people.

iv. Crustaceans (crabs, lobsters and shrimps)

This broad taxonomic group is particularly associated with mangroves, since it is used as important breeding grounds. Crab species associated with such habitat are: the Blue Land Crab (*Cardisoma guanhumi*), the Fiddler Crab (*Uca* spp), the Large Land Crab (*Ucides cordatus*), the tree crab (*Aratus pisonii*), the Mud Crab (*Eurytium limosum*) and the Root Crab (*Goniopsis cruentata*). A study done by Fleagle and Kay, “Platyrrhines” concludes that some of these species, including the Root Crab and Land Crab are important herbivores feeding on mangrove vegetative parts. Others such as the Mud Crab, are predators and scavengers.

The dense network of mangrove roots provides shelter for these organisms and the heavy deposit of organic matter contributes to local food chains within the ecosystem. Additionally, the prop roots of mangroves provide a crucial solid substrate for the early developmental stages of the brown shrimp (*Penaeus astecus*), and the spiny lobster (*Panulirus guttatus*).

4.1.1.4 Aquatic and Riparian Fauna

i. Marine and Estuarine

Aquatic Vertebrates – The aquatic fauna in the Belize River, the upper sections of Haulover Creek and offshore areas of Belize City are quite diverse since it includes both marine, anadromous and fresh water species. During the dry season the salt-water wedge can extend all the way up to Lords Bank but in very severe droughts it may extend even further than this and reach up to the vicinity of Burrel Boom.

The diversity of aquatic animals is huge and includes such well known marine species as Tarpon (*Megalops atlanticus*), Crevalli Jack (*Caranx hippos*), Red and Black Snappers (*Lutjanus griseus*), Dolphins, Jew Fish (*Epinephelus itajara*) and Gray Angel Fish (*Pomacanthus arcuatus*). It has been well documented that mangroves play an important role in providing nursery sites for other marine organisms. The ecology of fish species such as snapper, grouper, barracuda, jewfish, bone fish and snook are good examples that are closely linked to mangroves. Simpson documents this in a study titled, “Mammals and Land Bridges”.

The numerous drains within Belize City are stocked with juvenile fish some of which are marine species but Tilapia is more common in the drains in the Ladyville area. Bottlenose Dolphins frequent the estuarine areas of the Belize River and offshore where they find favorable feeding opportunities (See **Plate 4B**).



Plate 4B: Bottlenose Dolphin in Belize River near the mouth of Haulover Creek.

4.1.1.5 Vulnerable or at Risk Wildlife and Habitats

Several species of national and/or international conservation concern are found within the project area. These species depend on the habitats found within the estuarine areas of the Belize River delta and the numerous seasonally inundated ponds, swamps and marshy habitats. These wetland “micro habitats” are important feeding grounds for both resident and migratory wading birds (family Phalacrocoracidae – cormorants, Anhingidae – anhinga, Ardeidae – herons and egrets, Ciconidae – storks and Anatidae – waterfowls, Jacanidae – jacanas) that forage on mostly macro aquatic organisms.

It is also a temporary staging site for a few migrant and transient species of shore birds in the family Scolopacidae (sandpipers, phalaropes, snipes, yellowlegs, etc.) that migrate further south. These wetland micro habitats are prone to flooding during the rainy season and numerous fish species get washed from main streams into these ponds which offer critical sanctuary during their juvenile life stage. Ospreys use these as important feeding sites as they dry up.

Migratory bird species that also frequent mangrove and coastal swamp habitats are of the family Parulidae – American Redstart, Black and White warbler, Yellow-throated warbler, Black-throated green warbler, etc. Both resident and migrant species of Blue-gray gnatcatchers are present in the pine savanna ecosystem. Species of raptors of special conservation importance which are associated with these habitats are the Plumbeous Kite, Collared Forest-falcon, Aplomado Falcon and Bat Falcon. Other important species that are declining within their range but still currently enjoying good habitats and healthy numbers within the project area are the Yellow-breasted Chat, Common Yellowthroat Ovenbird, Grace's Warbler, Grey Catbird, Wood Thrush, White-eyed Vireo, Manikins, Trogons, Hermit, Black-throated Bobwhite, Plain Chachalaca, Black-bellied Whistling-Duck, Jabiru, Bare-throated Tiger Heron and Black-crowned Night Heron.

Perhaps the most charismatic and best known of the endangered species is the Antillian Manatee. The lower Belize River and immediate off shore waters are its prime habitat in the country. Because of the location so close to the cruise ship terminal these sites are heavily visited by tourist resulting in heavy mortality due to incidences with tour boats.

The urban settings of the Belize City sites earmarked for climate vulnerability reduction interventions are habitat and species poor. Course fish such as catfish which can tolerate low oxygen levels and nutrient enriched waters live in the canals however they are of low conservation significance.

4.1.2 Caye Caulker

Caye Caulker is a small island offshore northern Belize with an area of approximately 399ha (986 acres) and maximum length and width of approximately 4.7 miles and 0.8 miles respectively. The current resident population is estimated at over 1,700 (Census 2010) but this

increases considerably during tourist season from October to April. Most of this population is concentrated on the south central portion of the island.

The northern area of the island is occupied by a forest reserve with area 40.5 ha (100 acres) (see **Figure 4.2**). The wide southern end currently lies in an increasingly disturbed state as a result of the approval of private residential subdivisions. A small natural channel (split) separates the island into 2 more or less equal halves. The Caye Caulker coastal planning region created by the CZMAI encompasses the entire island, and the surrounding waters.

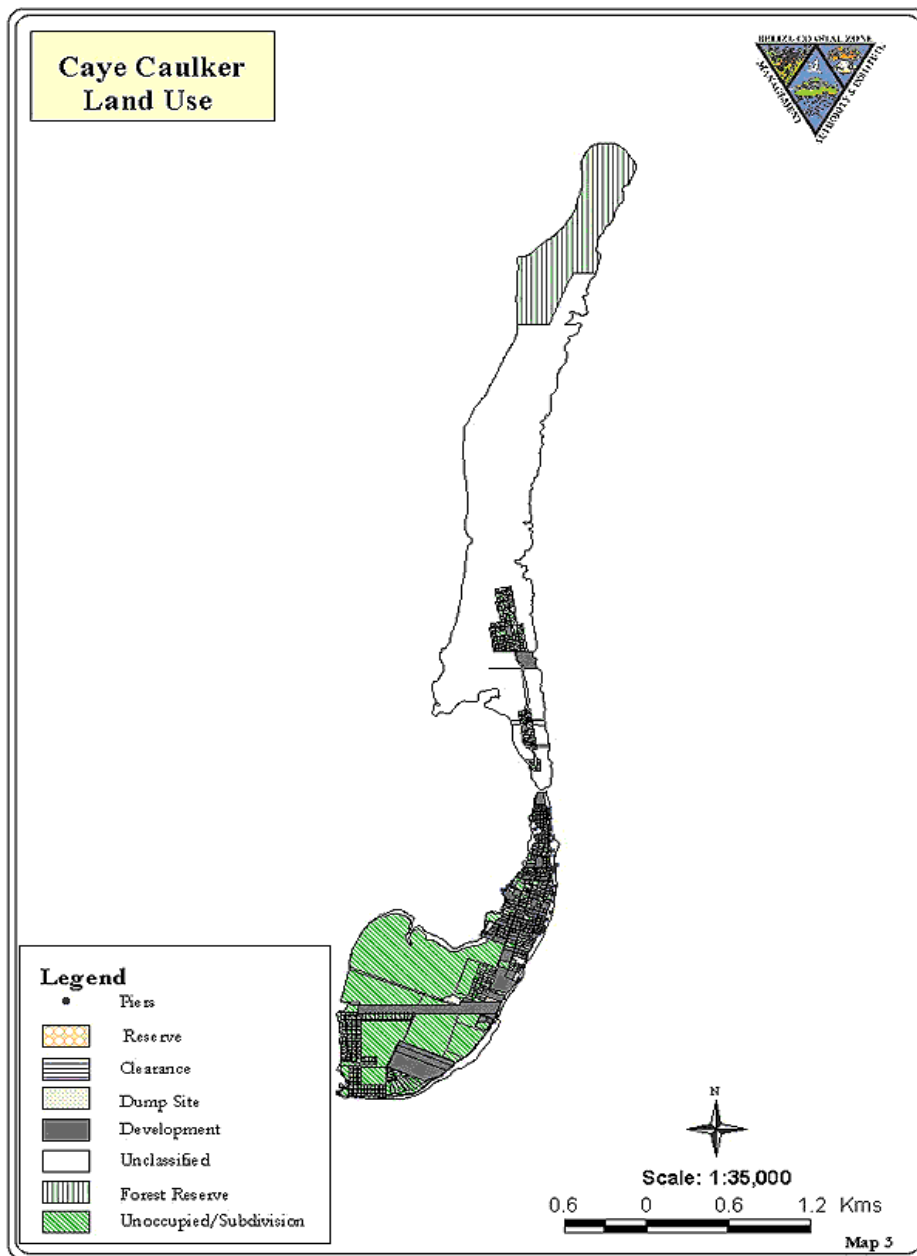


Figure 4.2: Caye Caulker predominant land use.

4.1.2.1 Marine and Terrestrial Ecosystems

i) Terrestrial Ecosystems

Uninhabited areas of Caye Caulker are generally occupied by littoral forest and associated mangrove colonies including red, white and black mangroves. Other common tree species include coconuts, buttonwood, gumbo limbo, poisonwood, madre de cacao, ficus, and ziricote. Mangroves grow into shallow water fringing the coast and act as nursery for many juvenile species of fish as well as shoreline protection and land reclamation.

In addition to this, most properties on the island are planted out to a variety of flowering and fruiting trees which provide valuable habitat and cover for wildlife.

The Caye Caulker Marine Reserve (CCMR) is located south of Hol Chan Marine Reserve and has an area of 3,913ha of which the preservation zone occupies 584ha, while the conservation zone occupies 821ha and the general use zone occupies 2,509ha (see **Figure 4.3**). Since its declaration, the marine reserve has played a pivotal role as a tourism resource attracting visitors to Caye Caulker and in protecting the fishing and diving resource that so many local stakeholders depend upon. The main marine habitats are sandy beaches, lagoon marshlands, shallow lagoon, sea grass beds, the fore reef and the back reef.

ii) Marine Ecosystems

- a) **Lagoonal Ecosystem** - The lagoonal ecosystems within the CCMR range in complexity from bare sand, through mixed algae succession to mixed seagrass beds (*Halodule wrightii*, *Syringodium filiforme*), and Turtlegrass (*Thalassia testudinum*). The seagrass vary in the intensity of their coverage ranging from sparse (30% coverage) to dense (70% coverage). Seagrass is an important habitat for a number of commercially important species including the Spiny Lobster which bring in considerable revenue to the local fishing industry.

In addition, sea grass in the lagoonal area is a critical habitat for juveniles of a wide variety of fish species including members of the grunt (Pomadasyidae), Snapper (Lutjanidae), and Parrotfish (Scaridae) family which are fished commercially in reef habitat. Other important species are Yellowtail (*Ocyuris chrysuris*), Lane Snapper (*Lutjanus synagris*), and Mutton Snappers (*L. analis*).

- b) **Coral Reef Ecosystems** - The reef within the CCMR is extensive, with the Barrier forming an 11.1- km-long wall slightly over a mile offshore the island with three major breaks—North and South Caye Caulker and Caye Chapel Channels. The channels have significant patch reefs with lesser patch reefs found scattered throughout the lagoon area.

The reef within the CCMR and throughout the Belize Barrier Reef System has been damaged over the last decade and a half by coral bleaching and a series of hurricanes and storm events (CZMA/I, 2000). Although some species of corals appear to be more

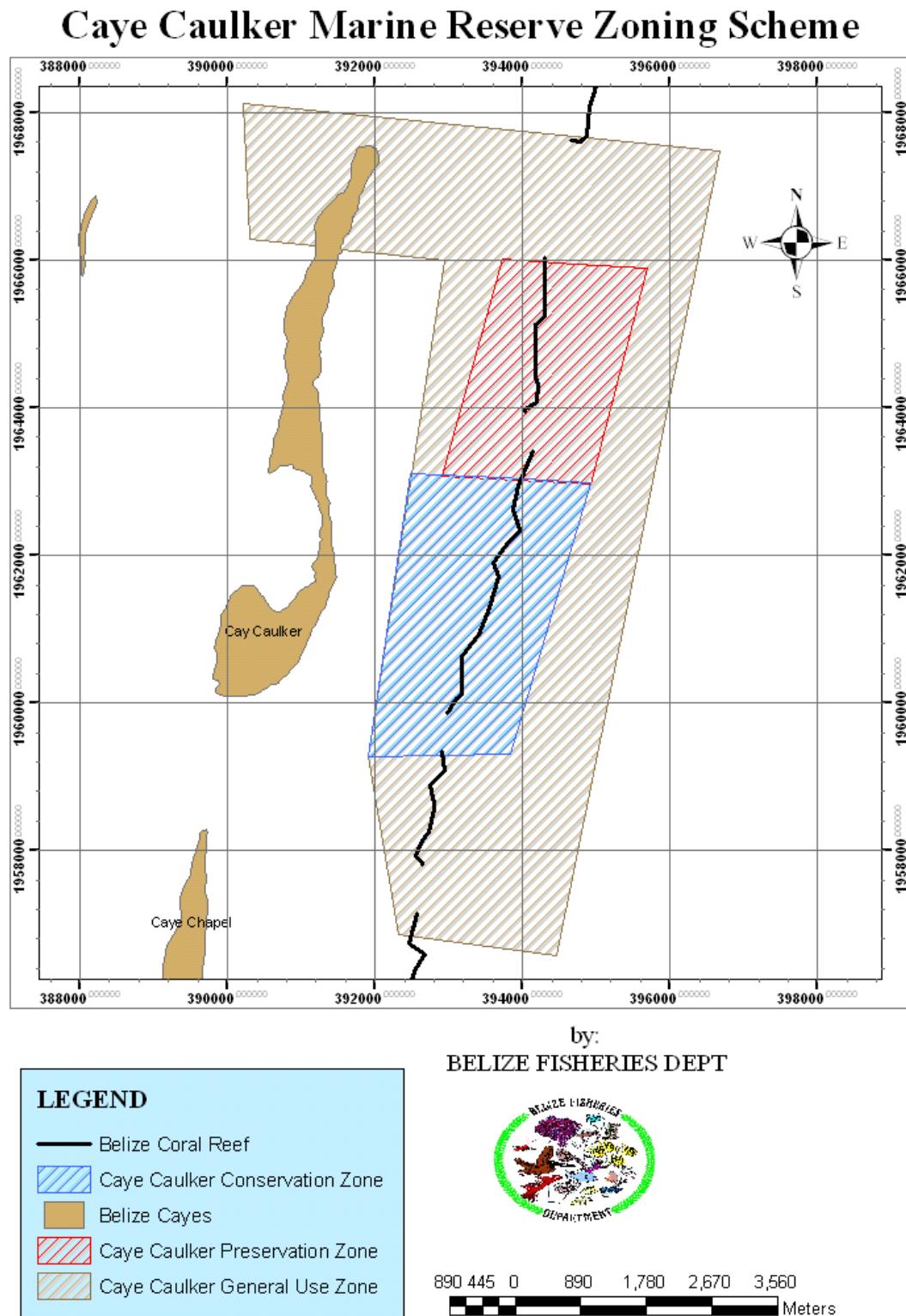


Figure 4.3: Caye Caulker Marine Reserve management zones.

affected than others, the reef has recovered over time and is in a succession phase. The general consensus within the scientific community is that coral bleaching appears to be a recurrent event triggered by changes in water temperature which itself is being brought about by incipient climate change.

A study by the University of Wisconsin on Caye Caulker's patch reefs revealed 31 species of Scleractinian corals with an average species richness of 12.2 species per site in Caye Caulker's patch reefs (Burkett et al, 2002). On average, density of coral was 584 colonies/25 m², with coral cover averaging 14.64%. Dominant species by coverage were *Montastraea annularis*, *Porites asteroides*, and *Montastraea faveolata* (88.4%), while *M. annularis*, *P. asteroides*, *Porites porites*, *Agaricia agaricites*, and *Acropora cervicornis* were dominant by density (90.1%).

The University of Wisconsin study found that, of all coral species, *M. annularis* was by far the most important species, with 97.6% of density and coverage (Mcrae, E., 2004). A Rapid ecological assessment carried out in 2003 found ninety-four (94) species of fish in 32 families in patch and barrier reef habitats with the most abundant species being Striped Parrotfish in patch reefs, Sergeant Majors in the backreef area and on the outer crest, and Creole Wrasse in the fore reef.

4.1.2.2 Threats

Threats were identified from observations made during the field visits, interviews with PA manager and villagers and a review of management reports and related documents. Main threats to the ecosystem of the area include:

1. Onshore developments especially in the south which result in rapid deforestation and the infilling of coastal lowlands.
2. Runoff of pollution and sediments from existing developments and from the colonization of new areas. These could potentially be organic effluents in particular from fertilizer runoff, sewerage, solid waste and waste from businesses. Additional pollution could potentially come from dredging to fill low lying areas resulting in sedimentation. Coral reefs have been shown to be sensitive to even very low concentrations of nutrients and sediments.
3. Poor oversight of community planning including lack of adherence to Cayes Development Policy and Caye Caulker Planning Guidelines.
4. High visitation rates to some marine sites potentially exceeding the threshold of acceptable change coupled with inadequate enforcement capacity.
5. Deforestation and building on the immediate beachfront area.
6. Uncontrolled placement of seawalls, piers and overwater structures.
7. Loss of beach area to currents and storms.

8. Damage from boats to corals resulting from groundings or from improperly placed anchors.
9. Lack of proper delineation for the various management zones as the demarcation buoys available are not sufficient.
10. Potential for damages to marine ecosystems as large barges which bring in fuel and construction supply pass through narrow channels exposing shallow marine habitats to potential fuel spills.
11. Anthropogenic threats include trampling by uncontrolled visitation, boat groundings; breakage by commercial divers going after fish, lobsters or salvage operations.
12. At times there are not enough buoys for all the charter boats hence some are known to cast anchor damaging the sea bed.
13. Lack of meaningful targeted community and/or stakeholder education programs.
14. Lack of meaningful participation of townspeople in management of resources of the area.

4.1.2.3 Vulnerable or at Risk Wildlife and Habitats

Several marine reptiles and mammals are known from the area including Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*) and Green Sea Turtle (*Chelonia mydas*), Bottlenose Dolphin (*Tursiops truncatus*) and West-Indian Manatee (*Trichechus manatus*).

Before the establishment of the CCMR some species such as Goliath Grouper (*Epinephalus itijarra*), Nassau Grouper (*E. striatus*) and a variety of snapper (*Lutjanidae*) and Grunts (*Haemulidae*) were in decline, however the staff now claim that populations have rebounded with good representation through all size classes.

The reserve provides sanctuary to several critically endangered species including Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*), and Loggerhead Turtles (*Caretta caretta*) and Manatees (*Trichechus manatus*).

Palapa Beach where the intervention is planned consist of sandy beach of very low floristic and faunal diversity (see **Plate 4C; Insert 1**), however the waters adjacent to and offshore from the site contain rich and thriving sea grass beds that are home to many juvenile species of fish (see **Plate 4C; Insert 2**).

4.1.3 Goff's Caye

(i) Physical-ecological

Goff's Caye is a small island (1.2 acres) located about 23 km SE of Belize City and north of the English Caye channel (see **Figure 4.4**). Because of its accessibility to Belize City and the excellent recreational opportunities on the island and the surrounding waters the site has become popular with the Belizean public and with tour guides who take visitors to the site.



Insert 1: View of Palapa Beach from south to north.



Insert 2: Rich sea grass beds offshore Palapa Beach area.

Plate 4C: Views of the Palapa Beach area, Caye Caulker.



Figure 4.4: View of Goff's Caye within the larger regional marine region including the barrier reef and nearby atolls.

Most importantly, the site lies near to the reef with clear shallow waters to the east and southwest of 0.6 to 1.5m.

Goff's Caye and adjacent sites are considered a special management area and a potential candidate site for future recruitment into Belize's National Protected Areas System. The Caye falls within the larger Goff's Caye management area which has a total area of approximately 1,461 acres and includes other islands including Rendezvous Caye. Goff's Caye is registered as an archaeological site because in the Colonial era it served as a settlement area, a fishing camp, a trade center and a cemetery.

Since 2005, the responsibility for day to day management of the site falls under the responsibility of the Coastal Zone Management Authority and Institute (CZMAI). The CZMAI manages the site under an agreement with the Government of Belize (GoB). The agreement specifies a list of conditions that the CZMAI must meet for the management of the site chief among them is the requirement to produce a comprehensive management plan.

It is estimated that the site currently receives about 24,000 visitors per annum of which most are from cruise ships (CZMAI, 2017). At the present time management does not want to increase the visitation numbers but they would like to improve the visitor experience through the upgrading of the facilities. This would hopefully translate into increased revenue for site management. A prime concern for management is to protect the fragile marine and terrestrial ecosystems.

(ii) Terrestrial and marine Ecosystems

Terrestrial Ecosystems – Most of the land cover of Goff's Caye is bare open land consisting of coral derived sand (see **Figure 4.5**). Scattered coconut (*Cocos nucifera*) trees are the dominant tall vegetation, however to the southeast of the island are a small clump of mangroves with associated beach community vegetation (see **Plate 4C, Top Right and Plate 4D, Bottom Right**). The plants of the beach community consist of *Blutaparon vermiculare* (see **Plate 4D, Top Right**), Beach Morning Glory (*Ipomoea pes-caprae*) which dominate the beach community (see **Plate 4D, Bottom Left**), occasional Turtle Weed (*Batis maritima*) and Sea Lavender (*Tournefortia gnaphalodes*) which on the eastern side of the island dominates a small area (see **Plate 4E**), Beachcreeper (*Canavalia rosea*) and the more abundant *Distichlis spicata* (see **Plate 4.F**). Sea Grapes (*Coccoloba uvifera*) also grow on the island however the heavy volume of use over such a small area means that vegetation that would have once covered the island has been lost with new regeneration restricted to areas outside normal walking areas.

Marine Ecosystems - To the east, northeast and south of Goff's Caye along the shoreline are extensive areas of coral rubble (see **Plate 4C, Bottom Left**). To the west, northwest and southwest of the island are areas of bare sand substrate which are the main swimming areas (see **Plate 4C, Bottom Right**). Beyond this are extensive areas of sea grass beds (see **Figure 4.5**). The luxurious sea grass beds that surround the island provide home and forage for many animals including juvenile reef fish.

The reef system around Goff's Caye is considered one of the healthiest in the country despite the heavy use of the resources by snorkelers and swimmers

The ecosystems around Goff's Caye are very important to the fisheries sector. They have been and continue to be productive grounds for lobster, conch and finfish. In addition, the area northwest of the Caye is known to be a foraging area for sea turtles. Fisherfolks from Belize City and the northern part of the country regularly fish the area.



Figure 4.5: Aerial view of Goff's Caye and adjacent waters.

Top right, View of Goff's Caye approaching from the west.

Bottom left, View of sandbar to the west of the island.

Bottom right, Coral rubble along the east beachfront and offshore.



NB: All pictures photographed July 2017.

Plate 4.D: Views of physical aspects of Goff's Caye.

Top right, Cluster of *Blutaparon vermiculare* growing within beach community.

Bottom left, Beach Morning Glory (*Ipomoea pes-caprae*), and associated beach community along eastern shore area.

Bottom right, Mangroves growing along eastern shore area.



NB: All pictures photographed July 2017.

Plate 4.E: Views of the vegetation communities on Goff's Caye.



Plate 4.F: Sea Lavender (*Tournefortia gnaphalodes*) growing in clumps along east beach area.



Plate 4.G: Scattered clumps of *Distichlis spicata* growing adjacent to beach vegetation community.

(iii) Threats

Goffs Caye is used primarily for tourism and recreational purposes and hence many of the threats to the ecosystems stems from this use. The main threats to the site and the larger Goff's Caye management area are summarized below:

1. **Tourism** – Goff's Caye receives a large number of visitors from cruise ships who travel to the easily accessible island in boats in the company of trained guides to swim and snorkel. The management of CZMAI believes that 300 visitors per day is the desired number however this is often exceeded with up to 500 persons a day visiting in high season on peak cruise ship days. This level of use brings up the question of carrying capacity and the ability of the terrestrial and marine ecosystem to sustain this level of use. Although the CZMAI believes the marine habitats are generally in good condition there is not an active sustained monitoring program to empirically validate this claim.
2. **Fishing** – Goff's Caye does not yet have a permanent management presence. Currently the CZMAI send staff to the site on cruise ship days to maintain the facilities and overlook the activities of the guest on the island. Fishermen still use the island and the offshore waters to fish even though the site lies within a management area. Currently no data is available on the sustainability of the catch or of the species taken or potential damage to habitats.
3. **Erosion** – The coastline of Goff's Caye is being gradually transformed by wave erosion. Although this process is natural and the island has been able to rebound from these events the lack of vegetation due to removal by humans make the islands more susceptible to long term detrimental changes.
4. **Climate Change** – As a low lying remote island Goff's Caye could be severely impacted by rising sea levels associated with a changing climate. This may affect rates of erosion along the coastline while inundating portions of the island reducing its size. Coral bleaching associated with increased temperature and warming waters may cause increase coral bleaching which could reduce the value of the site as a tourism destination.
5. **Storms and Hurricanes** – Storms and hurricanes could seriously alter the coastline of Goff's Caye as they have done in the past. Projections for hurricanes in the Caribbean forecast stronger storms with more intense rainfall. Such storms can damage coral formations, remove vegetation and cause mass erosion of the coastline forever changing the morphology and ecosystem dynamics of the island.

5 The Social Factors

5.1 Social and Economic Baseline Profile

Baseline conditions are important as the starting point to monitoring the effects of any intervention over time. They represent a snapshot of the conditions of a community prior to the project implementation. The following is an outline of the pre-project conditions of the Belize City (Southside) and Caye Caulker communities. Goff's Caye currently has no permanent inhabitants.

5.2 Demographic Profile

Belize City (Southside) – Belize City is the oldest city in the country, with the south side dating back to the first settlement in the 1600s. Unfortunately, although the south side enjoys a rich history, it is also one of the most impoverished areas of the country and has often been the focus of poverty alleviation efforts.

In 2010, there were 39,555 residents living in the south side, which represented 69% of the total population (57,169) of the city (Statistical Institute of Belize, 2013). Fifty-eight percent of the residents were Creole, 18% were Mestizo, 12.5% were of mixed heritage, and 5.5% were Garifuna. There were slightly more females than males living in the area, with a ratio of 0.95:1. The average household size was 3.6, which is slightly higher than the district's average, but considerably below that of the country at 4.1.

The population density of Belize City at the time was 22 people per hectare, with the south side being more congested than the more affluent north side. Housing arrangements in the south side consist primarily of private dwellings (80%), part of private dwellings (8%), apartments (6%), and a combination of other arrangements. City wide, a little below half (40%) of the houses are built of wood with zinc roofs. The bulk of these wooden houses are located in the south side of the city.

Caye Caulker – The island of Caye Caulker is the second most populous island in Belize with 1,763 inhabitants. There is almost a 1:1 sex ratio on the island with 875 males to 888 females (**Table 5.1**). Household size is one of the smallest in the country at 3.2 (**Table 5.1**).

Caye Caulker is a predominantly Mestizo village with a small but growing body of Creole mainlanders and American ex-patriates who have been drawn there by the prospect of the tourism dollar and the laid-back “island culture” (**Table 5.2**).

Language – Languages spoken in Belize include English (63%), Spanish (56.6%), Creole (44.6%), Maya (10.5%), Garifuna (2.9%), German (3.2%) and Chinese (0.9%).

Religion – Belize is religiously diverse akin to the diversity in ethnicity (see **Table 5.3**). Major religious groups practicing in Belize include Roman Catholic (40.1%), Protestant (28.3%), Eastern religions (0.5%), Muslim (0.2%), None (15.5%) and Other (15.4%).

Table 5.1: Population by Sex Composition, Number of Households and Average Household Size

Area	Population	Males	Females	Sex Ratio	Number of Households	Average Household Size
Country Total	322,453	161,227	161,226	100	79,492	4.1
Belize District	95,291	46,872	48,419	96.8	27,282	3.5
Belize City	57,169	27,655	29,514	93.7	16,162	3.5
Caye Caulker	1,763	875	888	98.5	555	3.2

Source: Statistical Institute of Belize (2010)

Table 5.2: Ethnic Distribution of Project Communities

Ethnicity	Asian	Caucasian/ White	Creole	East Indian	Garifuna	Maya	Mestizo/ Hispanic	Other	Not Reported	Total
Belize District	1,328	1,248	45,467	2,163	3,735	1,338	27,600	12,217	197	95,292
Belize City	1,009	363	30,197	1,340	2,560	542	12,886	8,181	93	57,169
Caye Caulker	25	76	270	12	51	98	1,156	64	11	1,763

Source: Statistical Institute of Belize (2010)

Table 5.3: Religious Distribution of Project Communities

Religion	Anglican	Baptist	Jehovah Witness	Methodist	Nazarene	Pentecostal	Roman Catholic	Seventh Day Adventist	Other	None	Not Reported	Total
Belize City	7,887	2,122	768	4,985	1,297	2,700	23,214	2,642	4,280	6,771	505	57,169
Caye Caulker	35	7	60	6	16	110	858	44	142	472	13	1,763

Source: Statistical Institute of Belize (2010)

Poverty – At the last country poverty assessment carried out in 2009, it was found that 41.3% of Belize’s population or 31% of households were living below the poverty line. Of this, 15.8% of the population or 10.4% of households were considered indigent and 25.5% of the population or 20.6% of households were considered poor/not indigent (Government of Belize and the Caribbean Development Bank, 2010). Poverty, in this instance, is defined “as not having the per capita income to afford a market basket of basic food,” whereas indigence means “falling short of being able to afford even food” (Close, 2017, p. 276). The market basket is determined by calculating the minimum cost of a balanced diet, within a particular community, for an adult male consuming 2,400 calories/day. **Table 5.4** shows the daily and annual MFB cost for an adult male, for each district of Belize, in 2009.

Table 5.4: District Minimum Food Basket Costs for an Adult Male.

District	Daily Cost	Annual Cost
Corozal	\$5.35	\$1,953.00
Orange Walk	\$5.32	\$1,942.00
Belize	\$5.36	\$1,958.00
Cayo	\$4.91	\$1,791.00
Stann Creek	\$5.99	\$2,186.00
Toledo	\$6.12	\$2,234.00
Country	\$5.50	\$2,005.00

Source: Government of Belize and the Caribbean Development Bank (2010)

An additional 13.8% of the population or 12.9% of households, while not poor, were considered vulnerable to poverty. When individual or household expenditure is less than or equal to 25% above the General Poverty Line of the community, then this individual or household is thought to be vulnerable to poverty. The General Poverty Line is derived from determining the average food share (of total expenses) of the poorest 40% of the community and then accounting for the difference (MFB x reciprocal of food share) in expenses.

The GPL also tells a story of the cost of living within particular areas of Belize. As **Table 5.5** shows, Belize City and surroundings (including Caye Caulker) is the third most expensive area in the country to live. The GPL is slightly above the national average. Food share of expenses in Belize City and surroundings area is 50%, indicating that residents spend half of their monies on food items. Finally, Belize's not poor population constitutes 44.9%. These individuals have an expenditure that is more than 25% above the General Poverty Line.

Table 5.5: District General Poverty Line.

District	MFB Annual	Food Share	Annual General Poverty Line
Corozal	\$1,952.00	64%	\$3,041.00
Orange Walk	\$1,941.00	59%	\$3,308.00
Belize City & surrounding	\$1,920.00	50%	\$3,810.00
San Pedro Town	\$2,354.00	45%	\$5,279.00
Belmopan & surrounding	\$2,088.00	56%	\$3,730.00
San Ignacio/Santa Elena & surrounding	\$1,621.00	54%	\$3,537.00
Stann Creek	\$2,186.00	56%	\$3,906.00
Toledo	\$2,233.00	81%	\$2,753.00
Country	\$2,005.00	58%	\$3,429.00

Source: Government of Belize and the Caribbean Development Bank (2010)

While the poverty situation in Belize might look dismal, it must be remembered that the actual “not poor” figure is 69%, which takes into account those who are vulnerable but not poor (**Table 5.6**). The Country Poverty Assessment Report also did indicate that there were several external impacts that created this picture of poverty in Belize, including but not limited to, a sluggish economy due to a global recession, setbacks in several of the agricultural industries, a hurricane in 2007, and major floods in 2008. The south side of Belize City and Caye Caulker are particularly vulnerable to hurricanes and flooding.

Table 5.6: Extent of Poverty.

Category	Indigent	Poor/Not Indigent	Total Poor	Vulnerable	Not Poor	Total Not Poor	Grand Total
Households	8,539	16,852	25,390	10,583	45,927	56,510	81,900
	10.4%	20.6%	31%	12.9%	56.1%	69%	100%
Population	52,185	84,455	136,640	45,614	148,460	194,074	330,715
	15.8%	25.5%	41.3%	13.8%	44.9%	58.7%	100%

Source: Government of Belize and the Caribbean Development Bank (2010)

5.3 Employment

Labour Force – Eighty thousand, five hundred and eighty five individuals make up the working age population of the Belize District (**Table 5.7**). Of this figure, 69% or 55,626 comprise the labour force. The remaining 41% do not comprise the labour force because they are not available or not able to work. This includes students, housewives, disabled and retired persons. Thirty thousand, five hundred and forty individuals in the labour force are males while 25,086 are females. The group of 25-34 year olds, have the highest representation in the labour force of the Belize District. This is followed by the 35-44 year olds and the 14-24 year olds, respectively. The bulk (41%) of the labour force in this district has only a primary level education; 31% has a secondary level education; 21% has a tertiary level education; and the remaining have no education or were not sure (**Table 5.8**).

Table 5.7: Belize District Labour Force Distribution by Age Group

Age Group	Working Age Population	Labour Force	Unemployed
14 – 24	24,555	10,846	3,415
25 – 34	19,472	17,325	1,848
35 – 44	15,133	13,312	1,308
45 – 54	10,650	9,045	448
55+	10,775	5,095	86
Total	80,585	55,626	7,105

Source: Statistical Institute of Belize (2010)

Table 5.8: Belize District Labour Force Distribution by Highest Level of Education

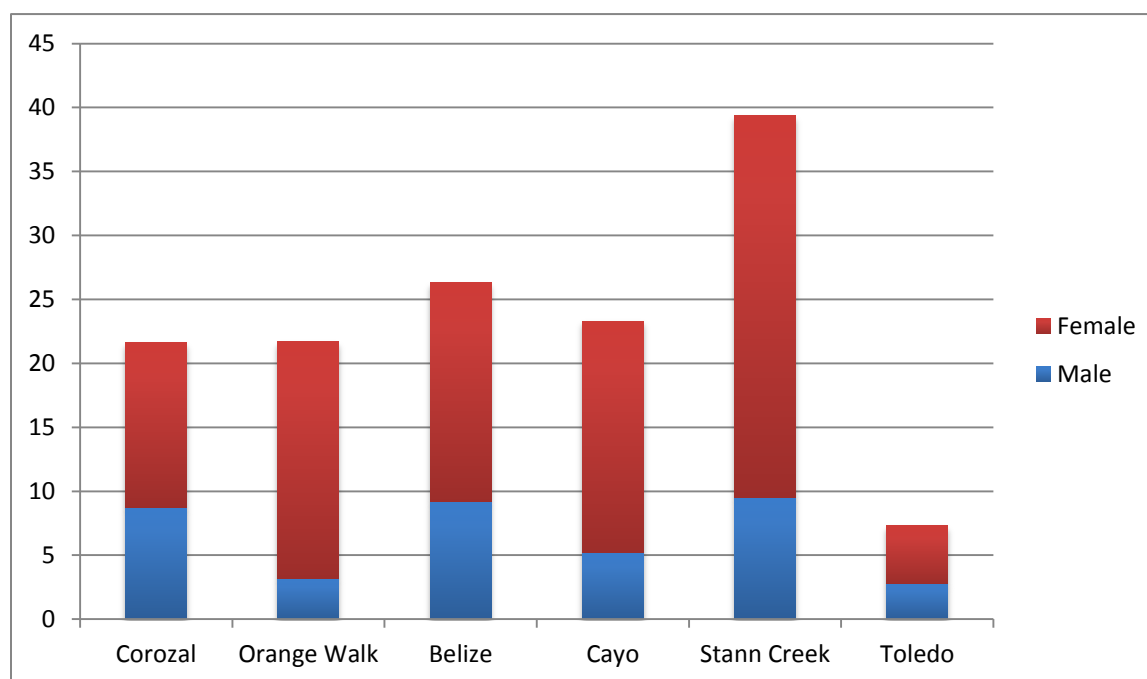
Education Level	Working Age Population	Labour Force	Unemployed
None	6,124	3,780	316
Primary	38,271	22,863	4,278
Secondary	21,609	17,121	1,706
Tertiary	13,659	11,523	804
Other	257	-	-
Don't know/ Not sure	666	338	-
Total	80,585	55,626	7,105

Source: Statistical Institute of Belize (2010)

The unemployment rate in the Belize District is 12.8%, which equates to 7,105 individuals. This is slightly higher than the national average of 11.1%. Unemployment among Belize District women is almost twice as high as that of men (**Figure 5.1**). Unemployment among men in the Belize District is the second highest in the country at 9.2%, only trailing the male unemployment rate in the Stann Creek District by 0.3%. While the bulk of the unemployed have only a primary school level education, followed by secondary school level education, the majority of unemployed prefer future employment in the service industry as opposed to primary and secondary industries.

This tendency of primary certificate holders to the service industry is not indicative of global trends. Noteworthy, is that 76.3% of the unemployed in the Belize District are Creole and an almost equal percentage (79%) of unemployed individuals prefer jobs in the service industries. This is perhaps attributable to historical colonial trends where the Creole population was guided into the civil service and other service oriented jobs and away from production jobs (Shoman, 1994). In addition, service oriented jobs have historically been indicative of an elevated social status in Belize (Shoman, 1994).

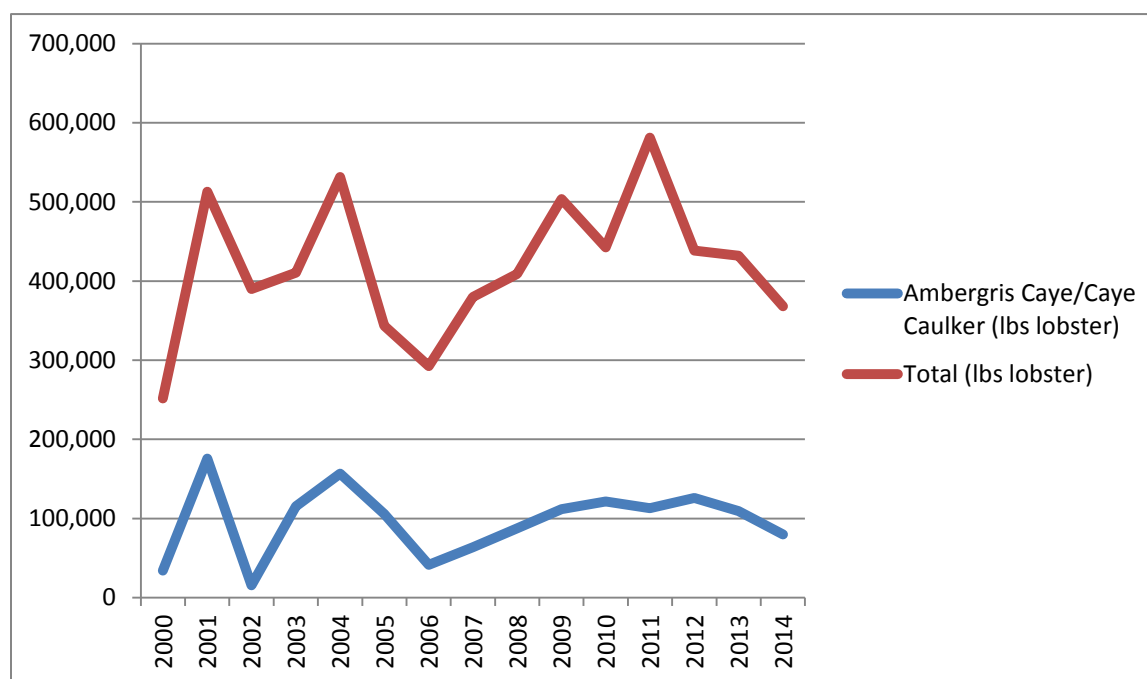
Finally, there are 5,594 individuals in the Belize District who are underemployed. Approximately 82.8% of these individuals indicated that they were underemployed not of their own making but because the only jobs available required less than 35 hours of their labour time or their work hours had been cut. Again, the bulk of the underemployed had only a primary school education, while 57% were Creole and 27% Mestizo.

Figure 5.1: District Unemployment Rate by Sex.

Source: Statistical Institute of Belize (2010)

Employment Sector – the bulk of economic activity on the island of Caye Caulker is concentrated in the fishing and tourism industries, while support industries such as retail, construction and transportation make up the remaining economic activities.

Residents of the Caye Caulker have a long tradition of fishing several species including Spiny lobster, finfish and Queen conch. While most fishermen are involved in multiple fishing activities, 94% are primarily lobster fishermen, 22% engage in catching finfish and 8% are conch fishers (Coastal Zone Management Authority and Institute, 2016). These fishing activities have contributed significantly to Belize's fishing industry, both for local consumption and export to markets in USA, Canada, Asia, Mexico, Guatemala and CARICOM (Beltraide, 2015). Fishing accounted for 3% of Belize's Gross Domestic Product in 2015, while the highest contribution to GDP was in 2005, when fishing accounted for 6.8% (Statistical Institute of Belize, 2017). According to the Belize Fisheries Department (2017), Ambergris Caye, Caye Caulker and surrounds alone have registered a catch of over 1,456,790 pounds of lobster tails, equating to 23% of the country's catch, during the period 2000-2014 (**Figure 5.2**).

Figure 5.2: Lobster Catch Ambergris Caye/Caye Caulker and Country, 2000-2014

Source: Belize Fisheries Department (2017)

Tourism on the other hand, is a very recent activity on the islands beginning in the 1980s with the advent of increased transportation to and from the mainland. The industry however, has overtaken fishing in terms of income earner for residents – contributing 4% of GDP in 2014 and 3.7% of GDP in 2015. This increase in tourism is due to the decline in fish catch as a result of climate change and over fishing, among other things. The growth of the tourist industry is expected to continue. Over the past year alone, there has been an increase in tourist arrivals at the airport of 16.5% above the previous year, 2015 (Belize Tourism Board, 2016). The number of overnight tourist has also increased from 341,161 people in 2015 to 385,583 people in 2016 (Belize Tourism Board, 2016). This translates to a 19.6% increase in visits to Caye Caulker (Belize Tourism Board, 2016).

Economic activity in the Belize City/District area also includes tourism. Belize City is a major cruise port with well over 300,000 visitors per year. This is in addition to the 60,000 over-night visitors. Tourist destinations in the area include historic old Belize, several Maya sites, a water park, cave tubing and the Belize Zoo. The Belize Tourism Board has been exploring the potential for the growth of tourism in the historic south side area (Sustainable Tourism Master Plan, 2030). Additionally, Belize City is the largest commercial center in the country with offshore outsourcing, fisheries, agribusiness & agro-processing (coconut & cashew), logistics (road & highways, sea ports, airports), construction and administrative industries.

5.4 Community Infrastructure

Communication – all project communities in the study have telephone and internet service provided by both Belize Telemedia Ltd. and the Smart phone company. In the case of Goff's Caye, they will have access through mobile internet and cellular phone.

Electricity – is provided to the Belize City and Caye Caulker communities by Belize Electricity Limited (BEL). Belize City receives electricity from the main grid running in overhead powerlines. Caye Caulker is not powered through the main grid but rather is supplied electricity via four generators located on the island. These generators belong to the electricity company as well. Goff's Caye is powered by a private generator, which is the property of the Coastal Zone Management Authority and Institute.

Water – the Belize Water Services Limited (BWS), supplies potable water to Belize City and Caye Caulker. In Caye Caulker, BWS owns and manages its own desalination plant (Haydon Brown, personal communication). The majority of households in each community use the public water supply while a few have their own source of water. In Goff's Caye sea water is used for the flush toilets while visitors bring their own drinking water from the mainland.

Transportation – Belize City is accessible by automobile, plane and boat. The island of Caye Caulker is serviced by several water taxis, including San Pedro Belize Express and Ocean Ferry. Tropic Air and Maya Island Air also provide airplane service to Caye Caulker. Goff's Caye is accessible by private tour boat only.

Health Facilities – there are several poly-clinics and private clinics serving the south side of Belize City, in addition to several specialist clinics. Caye Caulker however, has only a health center with one doctor. Emergency cases for both communities are referred directly to the Karl Heusner Memorial Hospital in north Belize City.

Schools – the south side Belize City has a substantial number of kindergarten and primary schools, five high schools and one tertiary level educational institution. In addition, there are approximately three adult learning institutions. Caye Caulker also has several kindergartens and primary schools. However, it only has one high school and no tertiary level educational institutions. Many students from Caye Caulker thus travel daily or board in Belize City to attend high school, junior college or the University of Belize.

SECTION C

ENVIRONMENTAL & SOCIAL **IMPACT ASSESSMENT**

6 Environmental and Social Effects

This chapter presents the potential negative as well as beneficial aspects of the proposed investment scheme and its associated hard and soft infrastructural and climate vulnerability reduction measures. The investigation of potential environmental and social benefits and impacts conforms to IADB investment requirements which require that projects must be vetted through the implementation of appropriate safeguard measures to ensure that the investment program is sustainable and beneficial to the population into the foreseeable future.

As can be seen from **Table 6.1** the climate vulnerability reduction measures being contemplated are small scale and localized and in the case of Caye Caulker and Goff's Caye are relying on soft ecosystem based interventions of a relatively environmentally and socially benign nature. Belize City which is low lying and has a severe flooding and drainage problem exacerbated by heavy rainfall from tropical storms requires hard interventions to address historical settlement patterns, poor infrastructure and bad maintenance. Notwithstanding this, direct and indirect short and long term negative impacts are expected to be small.

The proposed projects are yet to be screened and vetted by relevant Government of Belize Authorities including the Department of the Environment (DoE). Projects within the coastal region of the country are closely scrutinized by both public and private sector agencies for potential environmental harm. It is possible that some or all of the proposed projects will require an environmental screening and scoping by relevant national authorities for potential environmental and social impacts (see **Section 7.5**). At such times there may be a requirement for further environmental and social assessments as provided for under the Environmental Protection Act, Chapter 328 of the Substantive Laws of Belize Revised Edition 2000-2003 and its Subsidiary Legislation, the Environmental Impact Assessment (EIA) Regulations, 1995 as was Amended 2007.

6.1 The Proposed Infrastructural and Shoreline Protection Investments

Climate mitigation interventions are planned for Belize City, Caye Caulker and Goff's Caye with the intervention commensurate with the scale of the problem. For example, the severe problems of flooding experienced in Belize City warrants a hard infrastructure approach, whereas Caye Caulker and Goff's Caye which are popular tourism destinations are proposed for soft ecosystems based approach as follows.

6.1.1 Belize City

Belize City because of its low elevation and exposed coastal location suffers from recurrent flooding resulting in damage to infrastructure, loss of productivity, suffering and inconvenience to residents and the creation of unhealthy and less than wholesome living and work environment. This condition worsens during heavy rainfall events such as those associated with hurricanes and tropical storms. The condition is expected to worsen with the onset of insipient climate change with the city having only modest financial resources to address the problem.

This project seeks to design and construct effective infrastructure that will alleviate the effects of flooding for some of the city's most vulnerable residents and businesses who are found predominantly on the southside. The planners intend to focus efforts on improving the conditions and hydraulic functioning the Collet and East Canal which are considered the two major canals and drainage arteries in that area of the city. They have as their ultimate goal to rehabilitate, clean and build infrastructure along these canals that will allow for more effective and efficient drainage of the project area. **Figure 6.1** shows the propose location for the interventions in the southside of Belize City.

The concept propose by the planners include a system to separate and isolate the flow of the canals from the sea and from the Haulover creek which runs through the heart of the city and is its main drainage system. The plan calls for the use of gates (locks) which would only be closed when the need arises to prevent backflow of water from the river into the cities canals. The canals would be isolated when the locks are mechanically closed. With the canals isolated from the two predominant hydrological systems namely the river and the sea it will then be possible to systematically pump water out from these waterbodies into the sea effectively lowering the water level in the canals. With the water in the canals lowered, stormwater should be able to enter the canals faster due to gravitational forces in effect draining the city at a faster rate and thus reducing the incidence of flooding in the area resulting from localised and extreme rainstorm events. It was originally proposed to place revetment walls along the intersection of the Haulover Creek and the canals; however this plan has been placed on hold pending further investigations.

The main components of the investment are summarized below:

- (i) **Pumps** - The project expects to use an array of Archimedes type pumps at a single location at the south end of Collet canal. It is considered that these pumps are suitable for the propose location and use based on the following factors:
 - a. Less potential for clogging due to screw type design,
 - b. Lower operating and maintenance cost,
 - c. Sufficient lift to raise water out of the canal at design specification of up to 3 m although it is believed that a lower height would suffice.
 - d. Less detrimental to aquatic life

The pumps would be run on electrical energy provided either from the mains or backup generator if the former is not available. The required power is expected to be 157 kW [210 Hp].

The distinct advantages of screw pumps are its effectiveness when pumping debris-laden water. The main components are a screw, trough and a driver (motor) that spins the screw. The main applications are in drainage water pumping stations and water treatment plants. It is also known for reduced damage to aquatic life when in operation compared to a conventional centrifugal pump.

- (ii) **Hydraulic gates (locks)** – These are planned to be placed in 4 locations (see **Figure 6.1** at strategic locations in the canal system where they interface with the Haulover Creek and the sea. The lock is essentially a device which cuts off water flow as a curtain is moved down or across the fluid flow to control the flow of water. The type of gates that are being considered are slide (sluice) gates with motorised operation and manual over-ride, however the planners also recommend consideration of butterfly gates or fixed wheel gates. The main advantages of sluice gates are simple operation and minimal maintenance requirements².
- (iii) **Dredging of the Canals** – Over time, the canals have accumulated significant quantities of debris which includes runoff solids from land, illegal garbage disposal and general debris. At intervals it is necessary to clear this silt and debris from the canals to improve drainage and overall operational efficiency. Project engineers suggest that this build-up in certain sections of the canal system can account for more than 80% of the total canal depth and may well be the limiting factor impairing hydraulic capacity resulting in flooding of the surrounding area. The project engineer calculates that up to 9,300 cubic meters or 1,200 truckloads of settled material must be dredged from the canals of the area.
- (iv) **Lining of Collet Canal** – It is proposed to line the lower portion of Collet Canal from the Canal Intersection at Kut Avenue to Yarborough Bridge to improve erosion control, water containment and overall aesthetics of the area.

In its present configuration this section of the canal has unlined earthen banks susceptible to erosion. The new lining of this section of the Collet Canal would be done using prestressed concrete piles, a reinforced concrete plate (slab), and a reinforced concrete capping beam. This is expected to provide additional stability and confinement to the canal for a distance of approximately 1,000 feet.
- (v) **Side Street Drain Rehabilitation** – Like the canals the drains leading to them can become clogged up over time with sediments and debris. It is believed that the lack of functioning drains is a major contributor to the recurrent flooding events. There is therefore a need to rehabilitate these drains and if necessary construct new drains along critical streets that run perpendicular to the canal system. The recommendation

² Erbisti, Paulo, Design of Hydraulic Gates, 2nd Ed., CRC Press, 2014, pg. 30.

is for most of the side drains leading to the target canals be rehabilitated or upgraded which would constitute about 6,100 m. of drains for rehabilitation.



Figure 6.1: Location of the planned CVR infrastructure for Belize City.

6.1.2 Caye Caulker

The intervention in Caye Caulker is limited to a small area along the beachfront called Palapa Gardens. The objectives are to reduce the rates of erosion on the areas already filled from previous beach enrichment activities and reduce the vulnerability of the infrastructure behind the Palapa Gardens while beautifying the area as a boost to the tourism trade.

It is understood that the Palapa Gardens area has seen about 3 beach nourishment activities in the last 5 years in response to the damage caused by tropical storms however constant erosion is threatening to remove this fill and transport it north through the “Split”.

This project proposes to create a groyne type structure using rocks to block the wave energy and topping of the structure with mangrove plants to create a “mangrove groyne”. The plan is to place this structure on the northern side of Palapa Gardens to “hold” the beach sand from wave erosion and to also include some beach nourishment into the area adjacent to the groyne. In addition, the project proposes a vegetated beach berm be provided for the upland part of the beach. Finally, trees and other vegetation would be planted that would provide both aesthetic appeal, erosion control and shade which is severely lacking at the site (see **Figure 6.2**). The intervention is intended to reduce the longshore transport erosion, protect the infrastructure behind the beach and provide vegetation for shade.

Issues flagged for consideration as possible Design/Construction constraints include the following:

- ❑ Design of a groyne feature that incorporates mangroves. Although innovative and ecosystems based it is a new and mostly untried concept with potential for adverse public reception due to visibility issues,
- ❑ Delivery of rock materials to the site for the groyne. These would need to be barged from the mainland and trucked to the site,
- ❑ Need for upland or dredge and fill material to comprise the beach berm,
- ❑ Requirement to keep the walkway/road accessible during construction.



Figure 6.2: Layout of the proposed intervention at Palapa Gardens.

6.1.3 Goff's Caye

The interventions at Goffs Caye are considered to be on a more modest scale with the main activity to remove the Palapa to higher ground where it will be safer from impacts of wave

activity and erosion. Also being advocated is the installation of 3 mooring sites, the removal of the Palapa foundation and the opening of additional beach area for tourism activity.

Palapa - The present site for the Palapa is a dynamic area prone to shifting of the coastline due to natural oceanic forces. The southeast of the island has been shown over time to be more stable and hence a better place for the Palapa (see **Figure 6.3**). It is believed that the foundations of the Palapa are contributing to erosion in the same way that scouring affects concrete sea walls.

The plan is to rebuild the Palapa to be more resilient to hurricane damage. This would require the use of piling instead of slab foundation replete with structures to provide renewable energy which is currently provided by a portable generator.



Figure 6.3: Figure illustrating the relocation of the Palapa structure.

Mooring Sites - Three new mooring sites are being proposed for the anchoring of vessels to address possible damage to the reef and seagrass beds from vessels anchoring indiscriminately in the area (see **Figure 6.4**)

The locations for potential mooring fields were proposed in the coastal engineering studies being namely a mooring site adjacent to the existing jetty, and the others adjacent to the popular dive sites to the east of the island. It is proposed that the mooring site should consist of mooring blocks cubes made of concrete with approximate dimensions of 0.5m x 0.5m x 0.5m and associated hardware and mooring buoy. The intention is to place these concrete blocks on sand away from the living reef system.

The following Design/Construction constraints are associated with the interventions:

- ❑ Need to barge in all inputs including planting materials and construction materials due to the remote location of the site.

- ❑ Paucity of geological information that could help to increase natural coastal dynamics at the site,
- ❑ Undetermined carrying capacity for the site which would need to be informed from detailed ecological studies supported by a robust monitoring program,
- ❑ Need for architecture approaches to align with the needs of users,
- ❑ Potential for disruption during construction to tourism groups visiting the site and from storms and inclement weather conditions.



Figure 6.4: Figure illustrating the propose location of the mooring sites.

6.2 Potential Direct and Indirect Environmental and Social Effects

Although a relatively modest investment program with a small footprint and expected laudable and worthwhile public outcomes there is the potential for impacts that will need to be considered and mitigated against. **Table 6.1** shows the expected activities associated with the investments in the 3 locations and those that are expected to result in some environmental and or social impacts.

Table 6.1: Register of proposed physical investments at the 3 priority sites.

Location	Proposed Climate Vulnerability Reduction Measures
Belize City	1. Pump Station at the Collet Canal outlet to the sea;
	2. Gate 1 at the Collet Canal outlet to the sea;
	3. Gate 2 at the confluence of Collet Canal with Haulover Creek;
	4. Gate 3 at the confluence of East Canal with Haulover Creek;
	5. Gate 4 at the confluence of Collet Canal and West Canal;
	6. Dredging of both canals;

	7. Lining of lower portion of Collet canal;
	8. Rehabilitation and connection of side drains that empty into the canal system;
	9. Construction of protection walls at the confluence of Collet Canal and Haulover Creek; ³
	10. Provision of operating manuals and procedures for the proper functioning and maintenance of the proposed infrastructure.
Caye Caulker	1. Mangrove groyne and beach nourishment
	2. Vegetated beach berm in the Palapa Gardens area
Goff's Caye	1. Relocation of existing Palapa and its foundation to higher grounds
	2. Installation of 3 mooring buoys
	3. Amenities upgrade, signage installation and revegetation
	4. Open additional beach area to tourism activity

☐ No impacts anticipated ☒ Potential for impacts

6.2.1 Potential Social Effects of the Climate Vulnerability Reduction Program

This section of the ESMP describes the type, level and significance of the project's potential social and economic impacts (both beneficial and adverse) on the local and cultural area. Adverse impacts and mitigation are addressed in **Tables 6.4 and 6.5**.

A. Direct and Indirect Benefits

Belize City (South side) – A direct benefit of the flood mitigation works, which includes the installation of four floodgates and a pump house, is the significant reduction in flooding along the streets that run perpendicular to the canals. The economic benefit is that retail stores and other business will not need to close their doors during heavy rains and other instances that heretofore caused minor to moderate flooding. In addition, school children will be able to reach classes without having to wade through water. Thus schools can remain open when it rains, which is currently not the case.

The water pumps will directly benefit the community by allowing for the healthy movement of water throughout the canals. Currently, the water in the canals is stagnant, as sediment at the mouth of Collet Canal blocks the outflow of this water into the sea. This lends itself to a foul smelling and unhealthy water situation, which is a prime environment for disease borne vectors. Cleaner water will lead to a healthier and a happier community.

Indirectly, the maintenance of the canals can be upheld since the water can easily be pumped out. This will maintain the integrity of the canals for a longer period. Finally, less flooding will in the long term advance more economic growth and development in the area.

Caye Caulker – One direct benefit of the small scale, nature based coastal protection works in Caye Caulker is the maintenance of beach nourishment in the Palapas Gardens area. The Palapas

³ This has not been confirmed pending further studies.

Gardens area hosts a majority of Caye Caulker's community events. In addition, the Garden has become the go-to public beach as other beach areas have increasingly been converted to private beaches. Locals have indicated that there has already been three beach nourishment works conducted in the area however the sand is slowly eroding. The result is a narrowing of the beach with resulting shallow waters being created directly in front. The groyne will have the effect of mitigating this erosion.

The proposed planting of trees and vegetation will provide aesthetic value to the beach, in addition to provide shade for beach goers. Finally the berm, which will be situated in the upland area of the beach, will provide protection to properties west of the beach during a tidal wave.

Goff's Caye – The relocation of the palapa on Goff's Caye will provide for a larger beach area to accommodate visitors to the island. Indirectly, the larger beach area will improve the ambience of the tourism product. Solar panels, high-grade compost toilets and appropriate ecologically friendly signage will enhance the island's eco-friendly image, making it a destination of choice. This eco-friendly concept will be aided by the installation of mooring fields that will minimize the destruction of the surrounding coral sites, enhancing the status of the island.

6.2.2 Potential Environmental Effects of the Physical Investments

A. Potential Negative Effects

Notwithstanding the expected small footprint of the individual projects, the innovative approaches and the expected small impacts, the location of any project within communities or near to restricted areas must be carefully planned and managed. In addition, location of any projects within high traffic tourism areas that are import revenue earners for stakeholders and which help to support the national economy are understandably closely scrutinized.

These projects require public support which can only be earned through proper disclosure and community consultation buttressed by educational and informational initiatives. This will help to promote public buy in through the realization of benefits that transcends the temporary inconveniences and potential loss of income. Community groups and other stakeholders will stand to win or lose according to their position in the value chain.

The priority investments sites have great differences between them and one size will not fit all. The Belize City site falls within the country's largest urban area and its most socially disadvantaged setting. Caye Caulker is a relatively large island bustling with commercial activities built on the back of the island's booming tourism industry. Goffs Caye on the other hand is small and remote however it offers an outstanding tourism product within pristine habitats and far away from commercialization and other human distractions.

It should be noted in the discussion of impacts below that specifics on the exact nature of the investments are still not entirely clear at some sites. This for xample includes Belize City where further studies are still to take place on the revetments that were being proposed for the Haulover

Creek. In addition the program proposes to expand on the number of drains that are to be addressed by the project with no confirmation as to the numbers involved.

In this sense the identification of impacts is to a certain extent speculative, however they are of the type typically associated with such development projects in Belize. Some interventions are expected to produce no negative impacts while insufficient information is available to form an opinion on others. In the discussion of probable project impacts reference should be made to **Table 6.2** which features the physical investments to be made in each location under Component II of the Climate Vulnerability Reduction Program.

Potential impacts associated with the priority climate investment sites include the following:

- (i) **Terrestrial and Marine Flora** – No flora will be significantly impacted by the development at any of the 3 locations. Indeed the project stands to benefit flora in a marginalized way with planting of mangroves on the propose groyne in Caye Caulker and the planting of trees on the berm structure. The project is also proposing to plant rootstock of native ornamental and shade trees on Goff's Caye as a measure to reduce beach erosion and provide shading which has been identified from previous investigations as a concern for visitors to the site.

If the beach berm is to be built of dredged material taken from offshore Caye Caulker there is a potential for damage to sea grass beds depending on the location of the dredging, however even if the dredging does not directly impact the seagrass beds they may be adversely affected by increased sedimentation.

- (ii) **Fauna** – Given the location of the limited interventions fauna will be minimally affected by the interventions. The investmentss will neither fragment the area nor isolate species from breeding and feeding opportunities. Neither are the sites expected to isolate gene pools or negatively compromise the ability of species to develop and flourish in the area.

The following discussion looks at potential impacts at the 3 locations:

- a. **Belize City** – The use of sluice gates may affect fauna such as catfish which move freely between the canals and Haulover Creek and the ocean. Catfish are conspicuously present in these waterways where they serve as water cleaners feeding on detritus, human waste discarded food etc. Catfish are able to survive in the nutrient rich and oxygen poor water infested with deadly microbes that would kill most commercial fish species.

In addition, certain fish species enter the canals to feed at night. The use of sluice gates and the installation of the pump station may disrupt this daily migration, however the effects are expected to be minimal given that the presumption is that the sluice gates will be open most of the time except during storms and periods of abnormally high rainfall.

The dredging of the canals may result in the mobilization of toxic metallic compounds such as mercury which will migrate out from the canals during the dredging operation potentially entering the Haulover Creek and offshore southern Belize City. These metals may be consumed by fish while feeding and enter the food chain.

On the positive side, the cleaning of the canals and the drains will create better water conditions that might encourage other finer and more desirable fish species to use these waterways. The Haulover Creek for example has many anadromous fish species who could readily migrate into the canals to feed if the water conditions improve.

- b. **Caye Caulker** – If the dredging of sand for the beach berms and beach nourishment occurs offshore Caye Caulker and seagrass is affected this may have a knock on effect on juvenile commercial fish species which live in mangroves and seagrass beds prior to migrating out to the reef at a later life stage.

In addition the barging in of rocks and other building materials for the Groyne may result in impacts to the reef and increased turbidity in near shore areas which could affect sea grass beds and habitats for near shore marine life, however this effect if any is expected to be minimal.

On the positive side the planting of mangroves on the groyne and ornamental and shade trees on the berm will provide feeding and roosting habitat for birds including migrants such as warblers and native seabirds.

- c. **Goff's Caye** – The effects on fauna at this location is primarily positive, however the increase in demolition and subsequent construction activities may result in disturbances resulting in birdlife exercising avoidance behavior. The transport of construction materials and construction equipment may likewise result in damage to the reef and disturbance of marine habitats.

The installation of mooring buoys will help to alleviate pressure on the coral reef and sea grass bed by providing a relatively safe anchorage, however the buoys will create some visual impacts and might cause localized disturbance to the sea floor resulting in localized erosion.

On the positive site the planting of trees at the site may provide additional feeding roosting and breeding habitat for seabirds.

- (iii) **Hydrology** - The hydrological regime is considered a crucial factor in maintaining the natural balance including the movement of nutrients and the regulation of temperature among others. The installation of sluice gates and the installation of a pumping station will disrupt the hydrological cycle between the river and the canals and between the canals and the sea, however the canals are recent manmade features

hence their existence is in itself a disruption to the previous hydrological regime in the name of drainage and flood control.

The installation of the sluices and the pumping station will minimally affect the existing hydrological balance given that their operation will be on the rare occasion of heavy rainfall and flooding of the river. The regime will benefit from the clearing of the canals which will improve water flow and throughput improving water quality and decreasing incidences of flooding.

- (iv) **Quarrying and Barrowing** – It is expected that quarried rock materials for the construction of the groyne will be sourced inland where adequate deposits exist and transported to Caye Caulker by barge. The boulder size materials will break the wave energy on the groyne and because of their size and mass will provide the necessary stability to dissipate the wave energy which is currently depleting the beach sand at Palapa Beach.

Quarried materials should only be sourced from approved quarries working under approval from the Mining Department of the Government of Belize with approved permits. No new quarries will be opened for the purposes of this project.

In addition, dredged materials will be dewatered on land and stored for the use of berm construction on Caye Caulker. The contractor must ensure free and efficient natural and artificial drainage to prevent erosion. Stockpiling of materials (topsoil, fill material, gravel, aggregates, and other construction materials) shall not be allowed during rainy season unless covered by a suitable material.

- (v) **Sedimentation** – This may become an issue during the climate mitigation work on Caye Caulker and Goff's Caye (see **Table 6.1**). If the sediments are not contained, the possible adverse impacts could include the smothering of sea grass beds outside of the project site. In the case of Belize City dredging may mobilize sediments from runoff silt creating sediment plumes within the intertidal zone and near shore marine areas, resulting in contamination of near shore marine waters, and possible contamination of soils outside of the project site. Other than these localized impacts, sedimentation could also cause impact further down the coast which may increase the predictable geographic extent of the impacts.

Sediment plumes increase turbidity and total suspended particles within a water-body. Organisms which require sunlight for photosynthesis such as marine phytoplankton and vegetation could be affected as sunlight is blocked by particles suspended in the water column. Where particles cover photosynthetic pigments in leaves (such as sea grass) photosynthesis is prevented and the producer is unable to synthesize glucose for respiration and growth. If high turbidity levels endure the producers are unable to survive, impacting subsequently on the wildlife who feed upon them.

Plumes can also cause impacts to migratory fishes which pass within the coastal zone area and cause an increase in foraging behavior by birds and mammals within the plume area. The intertidal zone is especially vulnerable to effects of sedimentation.

- (vi) **Water resources** – Belize is considered a water rich country and there is usually sufficient water to go around, however in coastal areas where utility services do not reach, the fresh water lens is often drawn upon for gardening and domestic use. Depletion of the fresh water lens in coastal areas is a real threat and can result in elevated salinity levels while pollution of ground water sources from liquid waste can affect local community wells and springs.

None of the anticipated investments will impact this resource; however the investments in Goff's Caye will result in the creation of a new Palapa which will have some concrete inputs. Since the Caye does not have an indigenous supply of fresh water, water will have to be brought in for the construction effort or the builders will have to rely on rainwater caught in cisterns. At any rate water from the freshwater lens will be too salty for concrete mixing, however it can potentially be used in the welfare facilities created for the workers during the construction phase.

- (vii) **Liquid waste** - Only a few of Belize's coastal communities have proper facilities for the treatment of liquid waste. Pollution of ground and coastal waters is a real concern in such areas where robust package type treatment plants are not installed.

Both Belize City and Caye Caulker have liquid waste management facilities to handle any liquid waste that might be generated from the investments. Only a portion of Belize City is served by a centralized system including a portion of the project area. In the case of Caye Caulker residents use septic systems and drainfields for the disposal of liquid waste. Goff's Caye has a toilet and septic system which is currently used by staff and visitors.

Of the 3 sites only Goff's Caye has a potential liquid waste management issue due to limited capacity and potential conflict of use where visitors may resent sharing toilet facilities with construction workers.

- (viii) **Valued Landscapes** – Although late in coming, Belizeans are increasingly becoming aware of the need to maintain cherished landscape values and to respect local planning laws. This is most evident in the launching of Guidelines for Cayes Development produced by the CZMAI.

There is a potential for conflict with local tourism interest if the developments are considered detrimental to maintaining landscape values. This could be a major concern in Caye Caulker where visitors come to enjoy the unhindered views along the beautiful coastline. The creation of the berm although expected to be only a meter high will detract from those cherished views even though good views of the marine areas should still be possible.

The creation of the groyne planted with mangroves may also detract from visitor experience of the beach area, however in recent consultation with community leaders and the general public on Caye Caulker it was found that residents appreciate the threats to the coastline and the need for a soft ecosystems based approach to addressing the problem.

In the same vein the installation of buoys at the mooring sites offshore Goff's Caye may detract from the otherwise benign natural setting.

- (ix) **Soils** – During the construction phase the use of heavy machinery can compact soils and spillage of fuels and lubricants can contaminate localized areas. The adverse impact would be that no vegetation grows within a specific area due to pollution damage or soil degradation. Impacts to soil are of special concern given the long length of time that the soil takes to reconstitute itself. Soils by nature are mixed very slowly and mixture is what is needed to expel or oxidize contaminants.

In addition, the deposition of dredged waste from the canals may result in soil contamination depending on where they are disposed. Given the scope of the development it is not expected that there will be the need to transport large quantities of fuels or lubricants however in remote areas such Goff's Caye storage of small quantities of fuels in barrels may be necessary. Fuels must be stored in approved containers and contained in a bondwall type structure.

- (x) **Air and noise pollution** – Construction activities including the transport of materials associated with the establishment of the climate defense and flood control facilities may produce noise and dust pollution. During the dredging of the Belize City canals in particular, dredged materials containing potentially toxic compounds and virulent pathogenic organism may spill onto areas used by people. If this material dries out it may be entrained into the air as dust which may be breathed in by residents. In addition the dredged material may create an odour nuisance which may affect business especially near the fish market, the bus station, the farmers market and the taxi stand and for other commercial enterprises in the area.

The rerouting of traffic during the dredging of the canals and the rehabilitation of the drains may result in quiet residential streets becoming more congested with traffic and increased noise nuisance and dust.

- (xi) **Transportation** - The movement of vehicles affiliated with the dredging and construction program will create increased traffic on public roads in Belize City. This can lead to deterioration of road conditions especially where roads are not concreted, creation of dust and noise and raise a host of safety issues for other road users and pedestrians. This will especially be the case in Belize City where large trucks will likely be used to haul away the dredged materials from the canals. The local population will in all likelihood be concerned about all these impacts and will demand some form of mitigation.

During the dry season when dust becomes a problem it will be necessary to water the portion of road used by these vehicles if not paved and restrict speeds especially near schools and within residential areas. Special containers must be used to transport the dredge slurry if not watered to prevent spillage. If speeding becomes an issue, speed calming devices should be installed on the roads.

- (xii) **Buried services** – Within urban areas the potential exist for damage to buried services from the excavation of foundations and the rehabilitation of drains. Consultation with local utility companies will be required.
- (xiii) **Solid waste** – Belize is in its infancy stage in the area of proper solid waste disposal with only the central area of the country and the large northern offshore islands currently having the option of accessing sanitary disposal facilities. Currently most rural areas and offshore, nearshore and coastal areas are currently poorly served in the disposal of their solid waste.

This project will produce significant amounts of solid waste estimated by the project engineer at c.9,300m³ as a result of the dredging of the canals. Normal practice in the past is to use this material for landfill within Belize City, however with recent health concerns in regards to the presence of toxic substances entrained in the silt and mud current practice is to dispose of the materials away from humans. The project dredging contractor for Belize City will have to consult with relevant health authorities and the Department of the Environment in regards to safe disposal options.

Some solid waste will also be produced from the construction of the foundations for the sluice gates and for the pump station. Small amounts of solid waste will also be produced as a by product of the construction activities in Goff's Caye. The construction contractor must bring these waste safely back to the mainland and dispose of properly according to waste category. During the construction process every effort should be made to reduce, reuse and recycle waste.

- (xiv) **Biodiversity** - Physical impacts result in degradation and loss of wildlife habitats and disturbance and erosion of the local ecosystem caused by alteration of drainage, soil disturbance from earthworks, sedimentation caused by disturbance to coastal ecosystems from building of coastal defenses, from compaction of land and overlay of land by infrastructure. The impacts to biodiversity arising from these activities are expected to be minimal given the scale and nature of the activity; however they will extend into the long term.

B . Potential Beneficial Effects

The main purpose of the social impact assessment is to analyze the social factors and potential impacts the proposed developments may have on the immediate area and the region on a whole. The associated effects may indicate both positive and/or negative outcomes.

There are significant direct and indirect social benefits associated with the climate interventions however the most important benefit will be to improved quality of life for Belize City residents will decreased incidences of destructive flooding including the loss of personal possessions, decreased risk of waterborne diseases in the long term and improved mobility after heavy rainfall and storm events. A cleaner canal will improve the quality of life for residents who live along the canal and improve the aesthetic appeal of the city. For Caye Caulker the main benefit will be to the tourism industry through beautification of the Palapa Beach area, increased resilience from storm damage and reduced vulnerability to climate change. For Goff's Caye the proposed intervention will enhance the tourism offering and reduce the erosion of the coastal areas of the island.

The execution of the projects will result in increased employment for the construction of the flood and climate defenses. The poor who make up the majority of residents on the south side will have improved access to employment. It is expected that the construction projects will generate demand for local labor to build and operate the facilities, and to provide building materials, food and other associated services. It is expected that local communities will provide the bulk of unskilled labor of which there is normally a good supply.

Wage levels are expected to be above par with other local opportunities with the possibilities of acquiring additional skills which will make employees associated with this project more competitive when applying for similar opportunities in the future. In addition it is believed that advancement of the Program will increase awareness and support for land use planning creating a positive feedback loop.

C. Indirect Environmental and Social effects of the Physical Investments

It is expected that the improved drainage system and flood mitigation work associated with this project will result in improved living conditions in south side Belize City an area long associated with poverty and substandard living conditions. It is expected that improvements in health conditions and improved human welfare will provide the catalyst for increased private sector investments in job creating enterprises which will help to alleviate poverty and increase economic opportunities.

In Caye Caulker and Goff's Caye it is hoped the investments will bring attention to the threats posed to the coastal region by climate change and galvanize residents and businesses into initiatives to reduce climate vulnerability in the all important coastal and beach areas which are critical to the future survival of the tourism industry. Some of the other potential indirect benefits and cost are summarized in **Tables 6.2, 6.3 and 6.4.**

Table 6.2: Comparison of potential project benefits and cost Belize City.

Benefits	Costs
<ul style="list-style-type: none"> Rehabilitation of critical local infrastructure such as the canals and drains in Belize City and facilities and the creation of new facilities to improve flood control. 	<ul style="list-style-type: none"> Noise and dust from dredging and construction machinery. Potential short term increase in potentially hazardous

<ul style="list-style-type: none"> • Increase beautification of canal areas and improvement of overall health and living conditions. • Increased awareness on the part of the community of the potential harmful effects of climate change by the installation of the highly visible climate defense works resulting in galvanizing community action and support. • New appreciation for the value of planning and wise use of natural resources. • Employment opportunities and increase demand for goods and services along the value chain for south side residents to participate meaningfully as beneficiaries of the investment program. 	<ul style="list-style-type: none"> • dust conditions. • Potential for disruption to local business enterprises facing the canals and drains earmarked for rehabilitation. • Disruption to traffic resulting in rerouting and overcrowding in certain neighborhoods. • Potential disruption to wildlife feeding and migratory routes between the Haulover creek and the sea. • Potential disruption to boat owners. • Inconvenience to households with sewage connection to canals. • Disruption of ecosystems and animal behavior such as feeding patterns and habitats in canals. • Seasonal effects on wildlife population densities and structures. • Change of landscape at sensitive sites—permanent environmental restructuring. • Potential for conflicts over landuse of and the use of traditional resources.
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Table 6.3: Comparison of potential project benefits and cost Caye Caulker.

Benefits	Costs
<ul style="list-style-type: none"> • Conservation of the beachfront area by the use of a berm structure. • Protection of the beach area by the construction of a groyne structure and beach nourishment. • Mobilization of local people along the value chain to participate meaningfully as beneficiaries of the investment program. • Increased awareness on the part of the communities of the potential harmful effects of climate change by the installation of the highly visible climate defense works resulting in galvanizing community action to protect vulnerable beach front areas. • New appreciation for the value of collective community planning and wise use of resources on the part of local communities. 	<ul style="list-style-type: none"> • Potential loss of aesthetic value and local ambience, however this is offset by progressive design practices blending developments into local environment by planting of native tree species and ornamentals. • Potential disruption to tourism trade and short term loss of revenue to local artisan during the construction phase. • Potential for long term loss of aesthetic appeal and functionality of beachfront area for tourism trade • Silting on sea grass beds and inaccessibility of the area to swimmers. • Potential for permanent loss of small area of seagrass bed and associated habitats. • Potential disruption to boat owners who travel through area. • Change of landscape at sensitive sites—permanent environmental restructuring. • Potential for conflicts over landuse of and the use of traditional resources.

Table 6.4: Comparison of potential project benefits and cost Goff's Caye.

Benefits	Costs
<ul style="list-style-type: none"> • Conservation and beautification of beachfront areas on Goff's Caye. • Protection of marine resources including corals by the installation of buoys. 	<ul style="list-style-type: none"> • Potential disruption to tourism trade and short term loss of revenue during the construction and rehabilitation phase. • Temporary inaccessibility of certain beach front areas to swimmers, • Change of landscape at sensitive sites—permanent environmental restructuring. • Temporary unavailability of choice snorkeling and diving sites. • Potential for overcrowding and conflict at selected or preferred mooring sites

6.3 Reversible/Irreversible Effects

Some of the identified impacts will be ameliorated over time and the environment returned to pre-project condition; however other impacts will be more long lasting and irreversible.

- i. Reversible effects
 - a. Temporary displacement of aquatic and terrestrial biota;
 - b. Increase noise and dust levels during construction;
 - c. Air pollution caused by the operation of heavy motorized and wheeled machinery;
 - d. Temporary behavioral changes in wildlife arising from presence of workers, the operation of machinery and installed infrastructure.
- ii. Irreversible effects
 - a. The transformation of the local landscape in Caye Caulker due to the placement of the berm and groyne will create a lasting change in the seafront area and aesthetics, however activities incorporated into the program will ensure that new construction will create a pleasing ambience and complement the local natural settings.

6.4 Characterization of Potential Negative Impacts

Table 6.3 summarizes the definitions used for the characterization of the potential impacts. **Table 6.4** provides the potential environmental impacts and the mitigation measures including the responsibilities for implementing the same. **Table 6.5** summarizes the social impacts and propose mitigation measures.

Table 6.5: Definition of Terms for the Environmental Impact Study Area.

Magnitude - The proportion of the parameter or overall intensity of the potential impact rated as high, medium, low or non-existent.

Duration - Refers to the time it normally takes for the resource to recover to normal levels following the impacts of project activities. Activities are rated on the scale of:

- Short term < 1 year
- Medium term 1-6 years
- Long term > 6 years

Scope - A term used to describe the effects of a given action and the extent of its impact in terms of area coverage. The scope of the impact can be localized within the proposed development area (local) or outside the development area (regional).

Table 6.6: Environmental Impact and Mitigation Measures for Climate Vulnerability Reduction Sites.

S. No.	Environmental Issues	Duration / Extent	Magnitude	Scope	Mitigation Measures	Responsibility
1	Location Impacts					
1.1	Location impacts related to siting of facilities and improvements to associated infrastructure within economically important sites	Permanent	Moderate	Local	Investment projects will benefit from progressive and innovative design which is being included as part of the program and is being informed from the social consultations. All proposed siting of facilities will be discussed with local stakeholders and with local government authorities. To the extent possible impacts to sensitive ecological habitats will be avoided.	GoB
1.2	Planning to ensure long-term sustainability of the climate investments and ensure protection of the natural assets of the sites.	Permanent	Moderate	Local	The Climate Vulnerability Reduction program advocate an ecosystems based approach using soft engineering approaches on Caye Caulker and Goff's Caye due to the ecological sensitivity of the locations and potential to negatively impact the tourism trade. The designs will be worked out and implemented in accordance with best regional and international practice and any applicable site management plans and in conformity to existing policies, regulations and plans of the Coastal Zone Management Authorities of Belize.	GoB
2	Design and pre-construction Impacts					
2.1	Layout of development components to avoid impacts on sensitive sites	Permanent	Moderate	Local	As much as possible buildings and infrastructure should be sited away from sensitive features and valued environmental components (VECs). Siting of structures will be made in conjunction with site managers, relevant GoB authorities and local authorities including Village Council and City Council..	GoB and Engineering Consultants
2.2	Selection of materials and construction technologies, if not carefully chosen, will adversely impact the aesthetic appeal of the destinations	Permanent	Major	Local	The design concept for all climate vulnerability reduction components on Caye caulker and Goff's caye will strictly conform to soft ecosystems based approach using local materials and plant stock to the extent practicable.	GoB and Engineering Consultants
2.3	Design of sluice gates and pump station may disrupt free flow of water between the canals and Haulover Creek and the sea	Permanent	Moderate	Local	The sluice gates are designed to be operable with and electric pump and will be open most of the time except during periods of flooding of the Haulover Creek and the canals. This should allow normal flushing of the waterways and the free movement of aquatic organisms including fish between the water bodies.	GoB and Engineering Consultants

2.4	Defining of construction/work program at the sites and activities detrimental to the management goals to the restricted areas	Temporary	Moderate	Local	None of the proposed work is slated to take place in restricted areas, however the Goff's caye management area is being proposed as a candidate protected area and therefore must be treated as a sensitive site. In addition the proposed caye caulker works lies adjacent to 2 protected sites. Measures must be taken to avoid impact by construction workers on such sites and to ensure that adequate measures are taken to prevent accidental fuel spills and release of effluents into these water bodies.	GoB and project engineering consultants
2.5	The dredging of the canals will produce large amounts of potentially hazardous waste from accumulated silts	Temporary	Major	Local	The dredging company must consult with the Belize Solid Waste Management Authority on proper procedures to dispose of the accumulated waste. Safe disposal of the wastes, extraneous material will be ensured in the pre-identified disposal locations.	Belize City Council Contracted dredging engineers
3	Construction Impacts					
3.1	Improper stockpiling of construction materials.	Temporary	Moderate	Local	Due consideration must be given for material storage at construction sites. Materials must not be stored within sensitive sites or in areas within townships that would disturb the flow of traffic or present a safety danger to the public. Materials stockpiles will be covered to protect from dust and erosion.	Contracted construction engineers
3.2	Transport of materials to the site	Permanent	Moderate	Local	Adequate safety precautions will be ensured during transportation of material to the construction site. Boats transporting the material will be covered to prevent spillage and will use established navigational channels. Trucks will be adequately covered, and will abide by applicable speed limits, be well serviced and in good mechanical condition. Special care must be exercised when transporting materials through restricted areas such as the Caye Caulker Marine Reserve.	Contracted construction engineers
3.3	Generation of Dust	Temporary	Moderate	Local	The construction contractor will take every precaution to reduce the levels of dust at construction sites to the satisfaction of the IADB's environmental engineer. All earthworks and dredging spoils to be protected/covered in a manner to minimize dust generation.	Program managers and contracted construction engineers
3.4	Emission from Construction Vehicles, Equipment and Machinery	Temporary	Minor	Local	The discharge standards promulgated under the Environmental Protection Act will be strictly adhered to and where standards are not specified applicable international standards should apply. Machinery used for construction will conform to the relevant Standard. All vehicles, equipments and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant	Program managers and contracted construction engineers

					requirements.	
3.5	Noise from construction Equipments	Temporary	Moderate	Local	Maintenance of vehicles, equipment and machinery will be regular, to keep noise from these at a minimum. All vehicles and equipment used for construction will be fitted with exhaust silencers.	Program managers and contracted construction engineers
3.6	Disposal of Construction Waste / Debris / Cut Material	Temporary	Minor	Local	Waste will not be used for landfill or disposed within site limits in low lying mangrove areas. There shall be no disposal of construction materials within any sensitive site or within the boundaries of the protected areas. Final disposal of construction waste and debris should not impact natural drainage courses or surface water bodies or swampy and low lying areas and no endangered / rare flora is impacted by such materials.	Program managers and contracted construction engineers
3.7	Safety Measures During Construction	Temporary	Moderate	Local	The construction contractor must ensure that workers use Personal Protective Equipment (PPE) and adequate safety measures are taken when handling dangerous or potentially hazardous materials at the sites. The construction contractor must comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway and safe means of entry and egress. The construction site managers must be able to deliver first aid treatment by on site qualified personnel for all injuries likely to be sustained during the construction program	Construction company
3.8	Risk caused by natural disasters	Temporary	Minor	Local	In the hurricane season which last from June to November during which time damaging storms can be expected. All reasonable precaution must be taken to prevent danger to the workers from floods and wind, etc. All necessary steps will be taken for prompt evacuation.	Construction company
3.9	Disease and injury	Temporary	Minor	Local	The construction company must ensure adequate and prompt medical treatment for its employees. Advance arrangements should be made with nearby medical institutions in case of emergencies including notification on the nature of the work and potential hazards.	Construction company
3.10	Chance finds of archaeological Property / remains	Temporary	Moderate	Local	The construction company will take reasonable precaution to prevent workmen or any other persons from removing and damaging any archaeological features or artifacts and will, immediately upon discovery thereof and before removal acquaint the Archaeological Department of such discovery and carry out the Department's instructions for dealing with the same. In the intervening period all work will be stopped 100 m all directions from the site of discovery. The IADB will seek	Construction company and Archaeology Dept.

					direction from Archaeologist at the Department of Archaeology before instructing the construction company to recommence work on the site.	
3.11	Clearing of workers camps & restoration	Temporary	Major	Local	On completion of the works, all temporary structures will be cleared away, all rubbish removed, excreta or other disposal pits or trenches filled in and effectively sealed off and the site returned to its former condition.	Construction company
4	Operation & Maintenance Impacts					
4.1	Inconsistent operation of the pumps and sluice gates causing harm to wildlife and restricting natural water flushing.	Permanent	Major	Local	The project will produce an operational manual which will provide guidance and training to the operators of the pump station and sluice facilities. Where possible facilities will be automated and powered to reduce chances for human error and non compliance.	Belize City Council
4.2	Impacts due to non-maintenance or poor maintenance of the facilities.	Permanent	Moderate	Local	The designated management agencies with possible support from the communities and the city council, will be responsible to carry out maintenance of the facilities and the oversight of the facilities operation.	Belize City Council, Caye Caulker Village Council and the CZMA&I

Table 6.7: Social Impact and Mitigation Measures for Climate Vulnerability Reduction Program.

S. No.	Social Issues	Duration / Extent	Magnitude	Scope	Mitigation Measures	Responsibility
1. Construction Impacts						
Belize City						
1.1	Disruption of docking access for small boats in the Collet Canal near the Haulover Creek during dredging.	Temporary	Moderate	Local	Since fishermen tend to dock their boats in the north area of the Collet Canal to sell their catch at the Conch Shell Bay Fish market, dredging should occur when the market is closed or operating at a minimum. The duration of the dredging and cleaning work should be minimized. Fishermen should be temporarily directed to nearby docks.	Project managers and contracted construction engineers.
1.2	Disruption of docking access for small boats in the Collet Canal near the outlet with the Caribbean Sea.	Permanent	Moderate	Local	A permanent docking pier should be built in the Caribbean Sea not far from the mouth of the Collet Canal to accommodate fishermen who dock directly on the sediment buildup in the mouth of the Collet Canal and who sell their catch on the southernmost bridge crossing that canal.	GoB, project managers and contracted construction engineers.
1.3	Noise associated with the dredging process.	Temporary	Moderate	Local	Maintenance of vehicles, equipment and machinery should be regular, to keep noise from these at a minimum. All vehicles and equipment used for construction should be fitted with exhaust silencers.	Project managers and contracted construction engineers.
1.4	Disruption of traffic during the dredging process, possibly during the transportation of waste material and during the installation of gates.	Temporary	Minor	Local	Blocking off of roads to host worksite and the transportation of dredged material should be planned in advance to minimize disruption to traffic. The community should also be informed in advance of the commencement of work. In addition, traffic signs should be placed in strategic locations to advise drivers of construction works ahead. Finally, the construction company should have individuals posted on either side of the work site to direct traffic.	Belize City Council, project managers and contracted construction engineers.
1.5	Interruption in the movement of women (privacy issues) when dredging, cleaning and installation of gates are carried out next to residential properties.	Temporary	Moderate	Local	Work in areas close to residential neighborhoods should be carefully planned to minimize disruption. Residents should be informed in advance of the impending works. Duration of the work should be minimized. Care should be taken so as not to damage houses that are located directly on the canal banks. Workers should abide by worker code-of-conduct and confine themselves to the work area.	Project managers, contracted construction engineers, and construction company.

1.6	Transmission of infectious diseases due to the presence of organic waste in the canal.	Temporary	Major	Regional	Canal waste should not be handled with bare hands. Workers cleaning and repairing canal should wear protective clothing to avoid contamination. Medical waste, such as syringes, should be separated from the dredged material and disposed of at a proper disposal facility. Canal waste, temporarily deposited on the canal bank, should not be left to dry there but will be removed beforehand. Residue should immediately be washed back into canal. Canal waste (sediments and water) should be permanently deposited at a MoH designated safe spot.	Construction company and (MoH)
1.7	Degradation of neighborhood aesthetics when canal waste and plugging clay is temporarily deposited on the canal bank.	Temporary	Minor	Local	Dredged material should be loaded directly to haul trucks for transport to permanent disposal site. Where dredge material is temporarily deposited on the canal bank, it should be removed before it dries and the residue should be washed back into the canal. Plugging clay residue should also be washed back into the canal.	Construction company
1.8	Odor during the dredging process and from temporary and permanent disposal sites.	Temporary	Minor	Local	Dredged materials should be covered until removal from the site	Construction company
B. Caye Caulker						
1.9	Beach closed to construct groyne.	Temporary	Minor	Local	Community should be notified in advance and redirected to other beach and swimming areas on the island.	Caye Caulker Village Council and project managers.
1.10	Selection of materials and construction technologies, if not carefully chosen, will adversely impact the aesthetic appeal of the beach.	Temporary	Minor	Local	The focus should be to enhance the appeal of the Palapas Gardens area in accordance with the vision for Caye Caulker as outlined in the Sustainable Tourism Master Plan, 2030.	Architectural consultants, Caye Caulker Village Council, (BTB) local tourism advisors.
1.11	Noise and dust will affect the amenity of the area.	Temporary	Moderate	Local	Maintenance of vehicles, equipment and machinery should be regular, to keep noise from these at a minimum. All vehicles and equipment used for construction should be fitted with exhaust silencers. Construction area should be sprinkled with water periodically to keep dust at a minimum.	Project managers, contracted construction engineers and construction company.

C. Goff's Caye						
1.12	Disruption to tourist visits during construction.	Temporary	Moderate	Local	It is recommended that all construction activities on the island occur during the off-season.	Project managers and contracted construction engineers.
1.13	Selection of materials and construction technologies, if not carefully chosen, will adversely impact the aesthetic appeal of the beach.	Temporary	Minor	Local	The focus should be to enhance the appeal of Goff's Caye in accordance with the country's tourism vision as outlined in the Sustainable Tourism Master Plan, 2030.	Architectural consultants, CZMAI and (BTB).
1.14	Safety Measures During Construction	Temporary	Moderate	Local	The construction contractor must ensure that workers use Personal Protective Equipment (PPE) and adequate safety measures are taken when handling dangerous or potentially hazardous materials at the sites. The construction contractor must comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway and safe means of entry and egress.	Construction company
1.15	Risk caused by natural disasters	Temporary	Minor	Local	The hurricane season last from June to November during which damaging storms can be expected. All reasonable precaution must be taken to prevent danger to the workers and the public from floods, wind, etc. All necessary steps will be taken for prompt evacuation and the construction sites be able to deliver first aid treatment by on site qualified personnel for all injuries likely to be sustained during the construction program.	Construction company
2. Operation & Maintenance Impacts						
A. Belize City						
2.1	The potential for flooding caused by operator or mechanical failure.	Temporary	Major	Local	The city engineer and floodgate operator/s should be fully trained and should coordinate with the NEMO experts/engineers at all times before operating the floodgates and pumps. Maintenance schedule recommended by manufacturer should be adhered to.	Belize City Council, (NEMO).
2.2	Potential for human injury or death if caught in the floodgates or pumps.	Permanent	Major	Local	Unauthorized access to floodgates and pumps should be restricted through the use of fence barriers and caution signs. Warning sirens should alert community when gates will be opened or closed and when pumps will be activated.	Project managers, contracted construction engineers, construction company and Belize City

						Council.
2.3	Aesthetic quality of neighborhoods decreased due to unsightly mechanical floodgates and barrier fences within the canals, in addition to the pump house obstructing the view of the Caribbean Sea.	Permanent	Moderate	Local	Beautification shrubbery and trees should be planted around gates and pump house to dampen the visual harshness of these mechanical structures. In addition, shrubbery and trees will bring much needed green spaces to this area of Belize City.	Belize City Council, project managers and contracted construction engineers.
B. Caye Caulker						
2.4	Proposed berm will displace local artisans and their booths from street side.	Permanent	Major	Local	Local artisans should remain within the Palapas Gardens area, purposefully and attractively positioned slightly west of the berm. This will ensure that the composure and ambiance of the community beach is maintained.	Architectural Consultants
2.5	Berm will obstruct view of local artisan booths.	Permanent	Major	Local	Signs marketing the artisans and their crafts should be strategically placed throughout the island as well as in front of the berm to indicate that behind the berm is an oasis of arts and crafts.	Local artisans, Caye Caulker Village Council, (BTB) and local tourism advisors
C. Goff's Caye						
2.6	Possible degradation of environment from excessive tourist visits.	Permanent	Major	Local	It is recommended that a carrying capacity for the island be developed in accordance with the planned management strategy for the island.	CZMAI
3.6	Theft of property	Permanent	Major	Local	It is recommended that valuable property, such as solar panels and batteries, be stored in a safe room on the island for protection against theft.	CZMAI

SECTION D

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

(MITIGATION AND MONITORING)

7 Environmental and Social Management Plan

This Environmental and Social Management Plan (ESMP) shows how activities, that could have an adverse impact on the environment during the design, construction and operational phases of the project will be mitigated, controlled, and monitored. The ESMP also defines the arrangements that will be put in place to ensure that the mitigation measures are implemented by including recommendations on the roles and responsibilities of the project proponents, environmental management team and contractors.

Mitigation seeks to find better ways of doing things, by the implementation of practical measures to reduce, limit, and eliminate adverse impacts or enhance project benefits and protect public and individual rights. If an impact can be avoided, then the actions leading to avoidance of the potential impact takes place. However, if the impact cannot be avoided, or is too costly, then mitigation measures to eliminate and reduce impacts take place.

This section provides a summary of the key potential residual impacts and recommended mitigation measures for actions where avoidance is not entirely possible. The focus of the ESMP is to ensure that the contractors and subcontractors maintain adequate control over the project in order to:

- Minimise the extent of impacts during construction.
- Ensure appropriate restoration of areas affected by construction.
- Prevent long term environmental degradation.

The contractors must be aware of the environmental obligations stipulated in this ESMP and be conversant in all relevant national environmental legislation including those that apply to the coastal region of the country as presented in **Chapter 3** of this report. During the construction period it is envisioned that the IADB will appoint an Environmental Officer to monitor environmental compliance. It will therefore be the responsibility of the designated Environmental Officer of the IADB as the executing agency and the collaborating local authorities to monitor the implementation of the procedures.

7.1 Objectives of the ESMP

The ESMP has the following goals:

- Identifying those construction activities that may have a detrimental long term impact on the environment;
- Detail the mitigation measures that will need to be taken, and the procedures for their implementation;

- Establishing the reporting system to be undertaken during the construction program.

Although the proposed interventions are small scale with relatively small footprint and pose minor threat to the local and regional environment it is nevertheless imperative that they take place in a sound planning framework that ensures the conservation of resources and the meaningful participation of the host communities. In this way the project will ensure community “buy in” to the proposed interventions which will translate into the communities and organizations assuming ownership and long term responsibility for their successful operation.

The detailed provisions for specific environmental issues are outlined in **Table 6.4 and 6.5** on impacts and mitigation measures with key clauses outlined in the sections below.

7.2 Roles and Responsibilities

The following are general requirements for the regulation of the climate infrastructure investments at the three sites:

- The GoB with the support of the Department of the Environment (DoE) and other relevant national authorities shall be responsible for implementation of environmental and social provisions outlined in the ESMP, in addition to adhering to all environmental provisions in the applicable specifications for the works as part of good engineering practices. This project has a significant social safeguard component and must incorporate the following social measures among others:
 - ❑ Development of strategies for continued public participation and communication,
 - ❑ Development of a traffic management plan for the Belize City works program,
 - ❑ Implementation of the grievance redress mechanism covering compensation or restitution for property loss among others.
- The scope of works in the implementation of the environmental and social provisions established by this study to be implemented by the GoB and its relevant national agencies shall be as follows:
 - ❑ During project implementation abide by all applicable environmental regulations and requirements of the Government of Belize,
 - ❑ Compliance with all measures required for construction activities in sensitive areas, in line with the regulatory requirements and especially those established by the CZMAI as guidance for development falling within the coastal zone of the country,
 - ❑ Incorporate contract-specific HSE roles and responsibilities, in contract and subcontract agreements.
 - ❑ Ensure that job-specific HSE goals are fully and continuously implemented.
 - ❑ Select environmentally responsible contractors and subcontractors.

- ❑ Select environmentally responsible service providers and vendors along the value supply chain.
- ❑ Facilitate open and transparent inspection by any relevant permitting agencies.
- ❑ Hire qualified environmental and safety personnel.
- ❑ Ensure contractors and subcontractors conduct regular environmental toolbox meetings where applicable.
- ❑ Make environmental compliance integral to each operation by promoting worker involvement in the work planning and environmental impact identification process.
- ❑ Verify that site personnel and subcontractor supervisors read the ESMP plan before site activities begin.
- ❑ Confirm that appropriate site-specific environmental permits, procedures, training, and records are reviewed and accepted before construction and operations begin.
- ❑ Verify that project environmental permits are obtained and are available onsite, and that project execution complies with the permits.
- ❑ Compliance with all mitigation measures and monitoring requirements set out in the Environmental and Social Management Plan (ESMP),
- ❑ Monitoring of project environmental performance and periodic submission of monitoring reports.
- ❑ Prepare a construction plan detailing the staging and sequencing of construction activities etc. The plans should include all safety requirements, and the provision of adequate health and safety measures such as water, food, sanitation, personal protective equipment and emergency medical facilities.

7.3 Potential Impacts and Mitigation Measures during Project Stages

This project must seek to mitigate detrimental impacts to the greatest extent possible so that citizens are able to realize the full benefits of the project while being able to avoid the worst consequences. Many of the potential negative effects of the Climate Vulnerability Reduction Program are being anticipated including provisions for long term sustainability of the project from an institutional, environmental and climate perspective.

The assessment of potential environmental and social effects for the 3 sites has been carried out addressing the different stages of project planning and implementation. For these components, management specifications and mitigation measures are recommended for the following stages:

- **Location** – Implementation of measures to address issues associated with site selection, including effects on environment and livelihood of communities,
- **Design** - Issues arising from project design, including the technology used, scale of operations, discharge standards etc

- **Construction** - Issues arising from construction of the facilities and infrastructure including site clearance, earthworks, civil works, etc.
- **Operation & Maintenance** - Issues associated with the operation and maintenance of the climate mitigation infrastructure.

Environmental and Social Specifications

Given the small scope and innovative approaches to be used in the design and generic construction of the facilities there is expected to be only minor impacts, however whenever any developments takes place within populated areas and within or adjacent to restricted areas extra precaution and due diligence is required.

1. Specifications for Location of Facilities

Investment projects to be located within the coastal zone should be considered as falling within sensitive sites given their potential to affect offshore waters, the sea bed and the Belize Barrier Reef a World Heritage Site. Any development within protected areas and along the coastal region must be subjected to close scrutiny and oversight. Permits must be obtained to clear vegetation, and excavate for building materials including materials for the berm and groyne. Within urban settings environmental impacts will be less while social impacts are likely to be more pronounced. These may include competition for land and space, traffic congestion and health and safety issues.

2. Design & Pre Construction Specifications

To avoid potential negative effects, the program should adopt appropriate designs compatible with the natural environment, and carefully select materials to enhance the aesthetic appeal of the natural surroundings. This is especially important for Caye Caulker and Goff's Caye. The results of the interventions should be unobtrusive and be an integral part of the overall ambience so as to avoid impacts on the aesthetics of the site. These principles are to be integrated into the design criteria for the proposed sites and other project components as follows:

- Physical infrastructure components should be developed with minimalist design treatment with use of local materials to blend with the local environment and that are compatible with existing zonation schemes and management plans and,
- Where possible design should stress straight lines and simple geometry for incorporation into landscape and architectural features.

Social safeguards targetting project impacts that may affect the economy and livelihoods of stakeholders in the project area is an important aspect of this project. Impacts may require mitigation measures in the form of compensation or rehabilitation and must be accounted for if alternatives to avoiding these impacts cannot be found. During the preparation of this report, baseline data was collected that found more than 20 homes with sewer and bathhouse

connection to the canals which are being earmarked for intervention in this project. In addition, one pier provided access to the canal and the river near the intersection of Collet Canal and the Haulover Creek. The livelihood restoration plan which will be included in the final version of this report identifies compensation and /or rehabilitation measures to reestablish the livelihoods of the affected population.

3. Construction Specifications

Given the small scale of the developments and the innovative approaches to be adopted for the designs appropriate management interventions should be able to reduce negative effects to a minimum. Appropriate measures must be taken to eliminate or reduce environmental effects normally considered generic to construction activities including noise, dust, increase traffic arising from transport of materials the production of exhaust fumes from electrical generators in more remote locations and the production of solid waste. Due consideration must be given to management of liquid waste in more remote locations such as at Goff's Caye which has only rudimentary facilities which may or may not be shared with the construction company.

Measures must also be taken to address potential social effects at this stage which may include failure to adopt adequate safety measures for workers and failure to respond to community concerns in respect to impacts arising from the placement of structures and support facilities and from the construction activity itself. The ESMP specifies a suite of mitigation measures to be strictly followed by the developers.

4. Operation and Maintenance Impacts

Program management must implement measures to address potential impacts on environmental and social factors associated with the operational stage of the subproject components. Much of the focus should be on the performance of the groyne structure on Caye Caulker and the sluice gates in Belize City. Measures must be taken to ensure adequate maintenance of facilities and to ensure that relevant authorities effect adequate monitoring of the effectiveness of the implemented mitigation measures (see **Chapter 8**). These measures can be strengthened to some extent through participation of the communities in management and operation of the facilities.

7.4 Environmental Management Program

The interventions are planned as environmentally benign and low impact with a commensurate small footprint operating under the principle of limiting environmental change to an acceptable level by promoting climate resiliency and environmental sustainability.

The forgoing section has identified a number of potential impacts that are likely to arise during site preparation, construction and site operation. Where adverse impacts have been

identified, the focus will be to eliminate or mitigate these effects through the adoption of industry best practice and guidelines and following local legislative requirements.

For each impact or operation (where practicable), the following information is presented:

- A comprehensive listing of the mitigation measures,
- The parameters that will be monitored to ensure effective implementation of the action,
- The timing for implementation of the action to ensure that the objectives of mitigation are fully met.

The IADB must be committed to the adoption of these measures and carry out regular inspection to ensure their implementation and effective adoption by its contractors and subcontractors. In addition, it is expected that Belize government agencies will implement their own inspection and monitoring program for the relevant areas that fall within their purview.

An examination of the projected impacts during the climate investment program shows most impacts will be small and in the larger scheme of things insignificant. Two areas were identified with potential for significant impacts over the short term. These are in the areas of solid waste management for the dredge canal waste and dredging for materials to build the berm on caye caulker. The ESMP is therefore focused on addressing the impacts from these sources.

7.4.1 General Guidelines for Protection of Environmental Resources

Having regard to the objectives of the Program and without prejudice to any other provision of the Contractors specifications (to be included in the contract and supervised by the supervisory GoB and the responsible national agencies) and the law of the land and its obligation as applicable, the GoB and its contractors will take all precautions to protect the environment including the following:

- ❑ The GoB and its contractors shall ensure that construction activities do not result in any contamination of land or water by polluting substances.
- ❑ Unless otherwise prescribed in the specifications, the GoB and its contractors shall ensure that no trees or waterside vegetation are removed except those required for execution of the works.
- ❑ Where possible the bulk of the works should take place in the dry season.
- ❑ Spoils should be disposed of in locations that will not promote instability and result in destruction of vegetation.
- ❑ Wood for construction and formwork should be sourced from sustainably managed forest to the extent possible. Such wood is now widely available in Belize.
- ❑ Building materials and other inputs into the construction program should be sourced from reputable suppliers operating under appropriate licenses and permits and

- preferably those that have achieved or are in the process of acquiring international standards certification for environmental protection and quality control,
- ❑ Use ecologically friendly materials wherever practicable throughout the construction period,
 - ❑ Advocate the installation of renewable energy in all new buildings and new construction especially in remote areas such as Goff's Caye as an alternative to the current noisy and polluting generator. This supports the country's commitment to transition towards a green economy as is embodied within its National Energy Strategy. Key to this is the overt goal of national energy sustainability and national energy security.
 - ❑ On completion of work all construction plant, surplus materials, rubbish, scaffoldings, and temporary works of every kind shall be cleared away and remove from the sites and the sites left in a clean and pleasing condition.

7.4.2 General Guidelines for Protection of the Social Capital

While there is an obvious need to protect natural capital there is also a need to educate people and to create employment in order to fight poverty and deprivation. The design of this project incorporates provisions to empower local communities and engage their participation throughout the process. Adjusting to the needs of local communities and ensuring their acceptance will assure project sustainability over the long run. The specifications of the Climate Vulnerability Reduction Program include the requirements for social consultations in alignment with the IADB's social safeguards policy. These include provision for livelihoods restoration and fair compensation for damage or loss to property. Central to the determination of best approaches for the climate intervention investment is the requirement for provisions for social inclusion and active community participation which has been incorporated into each phase of the project cycle.

All efforts should be made to encourage the participation of communities through engagement in the construction process, participation on committees and preferences in assigning rights as service providers. Commensurate with this is the protection of the rights and dignity of workers and their families during the implementation of the investment program as follows:

- ❑ The GoB and its contractors must ensure that workers are provided with a safe and healthy working environment, in the work areas, through application of preventive and protective measures consistent with national legislation and international good practice. The contractors must include provisions to ensure steps are taken to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by:
 - Providing preventive and protective measures including modification, substitution, or elimination of hazardous working conditions.

- Provide opportunities for skills acquisition and personal advancement.
- Providing appropriate equipment to minimize risks and enforcing its use.
- Training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment.
- Documenting and reporting occupational accidents, diseases and injury from contact with wildlife and polluted or contaminated water such as from the Belize City canals.
- Having emergency prevention, preparedness, and response arrangements in place.

7.4.3 Solid Waste Management Plan

The projected types and quantities of waste to be generated from the project are specified in this waste management plan as well as the collection, storage, transportation and ultimate disposal options. Apart from dredge spoils which will accrue from the cleaning of the canals, only minor amounts of solid waste will be produced at the three sites during the construction program and negligible amounts during the operational phase hence the plan does not include the operational stage. The solid waste management plan therefore offers general guidance for solid waste disposal during the site establishment and construction phase. The disposal of potentially hazardous dredge waste taken from the canals should be of most concern to this project and is the main subject of this solid waste management plan. The following sections highlights the discrete steps that site management should take to mount an affective solid waste management program.

Objectives of the Waste Management Program

- ❑ To prevent inappropriate management of waste and associated risk of environmental pollution;
- ❑ To facilitate waste minimization entailing avoidance, reduction, reuse, recycling or treatment before disposal;
- ❑ To streamline waste segregation, storage, and disposal and promote resource recovery from waste;
- ❑ To contain, control and dispose of waste in accordance with required waste management practices (e.g. waste segregation) and in accordance with local legislation and international best practices;
- ❑ To define responsibility for waste management at the various levels of operation within the sites.

The developer will create a system to sort and differentiate waste as the first step in the proper management and disposal of waste since this has knock on implications for downstream treatment options and mitigation. Each class of waste will be assigned to a different treatment category based on waste characteristic and potential for recycling or

treatment. It is anticipated that the project will produce the following waste streams according to source:

- Field Waste (Waste Category I)
- Domestic Waste (Waste Category II)
- Industrial (Construction and transportation) Waste (Waste Category III)

7.4.3.1 Waste Management Site Establishment Stage

During the site establishment phase most waste produced will accrue from the leveling of the land for the placement of infrastructure in Belize City. Almost all of this waste will be recycled back on site for filling of low areas. At none of the 3 sites are there vegetation matter that will need to be removed hence field waste production will be negligible. It is expected during the site clearing operation that driftwood, old boards etc will be found and will need to be disposed of (see **Table 7.1**). This waste will be piled and taken out for disposal. No open air burning of field waste will be allowed within urban areas during any of the phases.

Table 7.1: Solid waste type land clearing and site preparation.

Activity	Type of waste and origin		
	Ordinary	Hazardous	Others
Vegetation removal	Woody materials, rock and earth debris	--	--
Land filling			
Excavation for foundations			
Drainage and contouring			

7.4.3.2 Waste Management Construction Stage

During this stage, solid waste will arise mainly as spoils and leftovers from the building program (see **Table 7.2**).

Table 7.2: Solid waste type construction stage.

Activity	Type of waste and origin		
	Ordinary	Hazardous	Others
Construction of palapa	Paper, cardboard, plastics, food waste, medical waste, wood (treated and untreated), metals, and packaging	Packages with chemical or dangerous substances, fluorescent lamps, remainders of sharp objects (e.g. circular saw blades etc).	Rubbish, earth (soil)

Activity	Type of waste and origin		
	Ordinary	Hazardous	Others
Construction of Sluices and pump house	Wood, plaster, cement, Paper, cardboard, plastics, packaging, electrical wires, PVC piping etc	Waste generated from equipment and machineries such as used fuels, and oils.	--
Installation of support facilities and amenities such as backup generator and pumps			--
Installation of third party services such as electricity			

The following will apply for waste management during the construction phase:

- Where practicable waste wood will be recycled back into the construction effort,
- Waste concrete, cement blocks hardboards and sheetrock will be crushed and recycled,
- Metal waste will be taken out for recycling,
- Every effort should be made to buy building materials with reduced packaging,
- Hazardous waste such as used oils and batteries will be taken out for recycling,
- Solid hazardous waste will be placed in appropriate, clearly labeled containers, in accordance with manufacturer's / supplier's instructions and industry good practice,
- Oily rags will be placed in a metal container provided at each workspace. Oily rags must not be mixed with other combustible materials or stored in direct sunlight,
- Used oil filters will be drained into a waste oil container and placed in a dedicated collection bin and away from direct sunlight,
- Used batteries (both wet and dry) will be stored then transported to an appropriate disposal facility or recycled with reputable firm,
- Open waste burning will only be allowed in designated areas outside of residential areas and only approved waste will be incinerated,
- Waste treatment, storage and disposal will not take place near open surface waters and have proper containment.
- Every effort should be made to minimize waste production and to reuse and recycle to the extent possible.

7.4.3.3 Educational Programs and Monitoring

Tool box talks during the construction stage will be especially useful as it will allow managers and supervisors to appeal directly to the workers in the proper procedures for waste management on a regular basis.

Management of the sites will implement a solid waste monitoring program in which records will be kept of waste sources, volumes and types as well as method of disposal. The process of managing solid waste should be continuously monitored and evaluated with a view of continuously improving the system.

7.4.3.4 Canal Dredge Waste Collection Storage and Disposal

Dredging is an essential part of sustainable waterway management and is necessary to improve drainage and reduce flood risk while maintaining navigable channels and ensuring the ecology and biodiversity of the waterway environment. Without dredging, the Belize City canals would fill up over time and become dry land as is now happening at the southern end of Collet Canal. Properly managed, the canals can become important amenities delivering important social, economic and environmental benefits.

In most countries dredged material arising from canal cleaning activity is subject to waste and environmental legislation hence it is vitally important any applicable Belizean regulations are understood by the operators who will be engaged in the dredging activity on the southside canals of Belize City.

In the future, the City administration of Belize City should take measures to reduce solid waste disposal into the canals to reduce maintenance cost and to improve the drainage efficiency of the waterways.

(i) Dredging procedures

The dredging procedures will depend on the local conditions prevailing in the canal waterways. To decide on the best procedure for dredging the canals technical and environmental factors have to be considered. The dredging contractor should be required to carry out physical and chemical analysis of the silt composition and general water quality of the canals prior to the commencement of dredging.

(ii) Dredge Spoils Definition

Dredge spoils can be classified as either liquid or solid waste. If they are classified as liquid waste they may not be allowed to enter landfills. In the same vein the sediments and other materials may not be classified as waste if they have been dredged specifically to be used in the construction/engineering program with no intention to otherwise discard them.

Materials dredged from the canals will in all likelihood appear as a slurry or sludge and qualify as a liquid waste which would be reason to ban them from landfill. Prior to landfilling these dredged materials, it must be pre-treated or dewatered to make them easier to handle and to qualify as solid waste. The requirement to pre-treat this waste to acceptable criteria may add significantly to the cost of the project.

(iii) Dredging Techniques and Options

Raking - Raking can be used as a means of reducing both the volume of waste created and the level of contamination contained in the dredgings removed. The technique involves the use of an open tined bucket on a conventional backhoe dredger.

The advantage of this technique is that it enables the removal of the larger debris, typically greater than 50mm, whilst leaving the finer organic silts which are mobile. As the contaminants are generally attached to the finer fraction of the silts, the larger debris is relatively uncontaminated. The technique is especially suited to the clearance of bridge holes and urban areas where malicious 'dumping' of waste takes place.

Land Based Back Hoe/Grab Dredgers - This type of dredger comes in many shapes and sizes usually related to the size of the waterway to be dredged and the availability of access. The technique involves tracking the excavator/back hoe alongside the waterway as the dredging takes place. This method is the most widely used to dredge canals in Belize City.

Grab dredging is a traditional method for removing sediments from wide rivers, the method uses a clam shell bucket, suspended from a crane jib. The bucket is lowered into the water and closed, grabbing a bucket of sediment; the full bucket is raised out of the water and the machine slews, depositing the material onto the bank or into a waiting mud containment structure or truck.

This method is ideal where large volumes of soft and loose deposits require dredging. The increase of suspended solids in the waterway as a result of the dredging activity is kept to a minimum provided that the bucket seals properly as it is being removed from the water; achieving a good seal can be an issue in areas with high levels of debris are present. The floating plant used is usually held in place by weighted anchors and operates in a longitudinal fashion.

Floating Back Hoe/Grab Dredgers - This type of dredger comes in many shapes and sizes and consists of a back hoe excavator mounted either temporary or permanently on a pontoon/hull. The hull or pontoon is usually fitted with adjustable 'spud' legs that provide stability for the craft whilst it is dredging.

Due to the size of the plant and supporting vessels this method of dredging is best suited to rivers and canals with good width and room for other vessels to pass safely.

Cutter Suction Dredgers - There are several different types of cutter suction dredgers available but they are seldom used on urban canals because they cannot deal with dredgings that contain debris such as discarded household appliances, traffic signs and street furniture and large pieces of masonry, and produce a very liquid discharge with low concentrations of solids. High volumes of water are taken up with the sediments through the pump, resulting in a low percentage of solids (usually 10%). The technique would better suit large waterbodies such as reservoirs. Unless large areas of suitable land are available where the discharge can be spread and allowed to dry naturally, it will require the construction of large engineered lagoons to contain the discharge until it dries sufficiently for re-use or final disposal. Geo-textile bags can be used to contain the wet

material and this method allows good quantities of material to be removed but it cannot be contained in a small area. Creating lagoons is likely to need both a planning consent and an environmental permit.

The excess water can be returned to the water body, but suspended solids need to be settled out first to ensure no local pollution at the discharge point. The material may take significant time to dry sufficiently to be re-handled and the area reinstated.

(iv) Dredging Spoils Transportation

Since the dredging spoils taken from the canals and river mouth of Belize City are potentially hazardous the Department of the Environment requires that they are disposed of responsibly to avoid contamination.

Side casting is an option used when the disposal area is within the reach of the dredge machine. Since this will not be the case other methods need to be considered viz:

Pumping - Pumping the material is an efficient method of transporting dredged material but it is reliant on there being access to install the pipework between the dredger and the disposal point and the availability of suitable pumps. This will not be the case for the Belize City canal dredging project since the overland routes are impeded by traffic and residential areas.

Transportation by road - Transporting dredgings by road is a feasible option providing distances are not excessive. In the past the DoE has designated the Fabers Lagoon area as a potential dump site for dredged waste from the canals and the mouth of the Haulover Creek. Leakage of slurry from the vehicles would be an obvious hazard and limitation for this method. If the dredgings have a high water content, special Heavy Good Vehicles can be used which have rubber seals fitted to the tailgate to prevent leaking during transit. A key requirement will be the need to avoid contamination of the streets while loading the slurry. It may also be possible to use sealed purpose built containers which can be loaded on the ground and hoisted on to the top of trucks.

Dewatering - Dredged materials can be placed on the bank of the canals to be dewatered before being removed for disposal. The dewatering process would rely on excess water draining back into the waterway and by percolation and evaporation.

It should also be possible to use geotextile bags which are widely used in the marine dredging environment the same technology with modifications would allow them to be used for dewatering dredging spoils from inland waterways, however there may be constraints due to the limited space available.

(v) Spoils Disposal and Treatment Options

The choices available for re-use, recovery and disposal can be greatly affected by the physical and chemical properties of dredgings. Examination of these factors is necessary to achieve the most cost effective and environmentally acceptable solutions. This should

be done prior to the commencement of the dredging operation. Unfortunately Belize does not currently have the treatment facilities to subject the waste to high level treatment which would allow their reuse, hence responsible disposal is the only available option. The following are necessary procedures that would need to be followed prior to disposal:

Removal of debris – Large debris such as car parts and appliances can be removed either through the use of the excavator bucket or a fixed screen with the debris stockpiled for later removal.

If necessary small debris can be removed using a screened vibrator however this should not be necessary given the ultimate goal is safe disposal and not reuse.

Disposal – It is preferable given the potential of the dredge canal waste to be hazardous they be disposed of at the sanitary landfill disposal site at Mile 24 on the George Price Highway. In view of their potentially hazardous nature they should not be disposed of in the mangrove area near Faber's Lagoon.

7.4.4 Dredge Management Plan

The dredge management plan applies to the Caye Caulker project where an estimated area of 50m on the Palapa Beach will be used for the placement of a berm structure which is planned to be 1m high and 3 to 4 m wide. This would suggest the requirement for about 200m³ of beach sand to build the berm not including the beach nourishment activity which is associated with the placement of the groyne. The coastal engineer has not yet identified the source for this amount of sand but in almost all coastal developments in the country it would require dredging in the offshore areas at locations that have a product of suitable quality and in relatively close proximity to the site of intended use.

Risks – The areas in front of the Palapa Beach are richly invested with sea grass beds and are a popular site for swimmers and beach strollers. Dredging in this area could adversely affect the sea grass ecosystem and the many commercial fish species which rely on them during their juvenile stage of life as well as regular marine traffic.

Dredging Options - The project has the option of using either mechanical or hydraulic dredges or a combination of both to remove materials from the sea floor for the construction of the berms (see **Figure 7.1**). The use of any type of dredging equipment should be dictated by local environmental conditions to reduce impacts to the extent possible and should ultimately be determined by relevant national authorities after consultation.

Normally the mechanical dredge will employ a grab dredger head in the deeper areas and a backhoe type dredger in the shallower areas. Although the use of mechanical dredge inland and nearshore locations cannot be entirely ruled out it is recommended to use hydraulic dredging to reduce the amount of silts and sediments suspended into the water column from the disturbance arising from the dredging activity. To further prevent the flow of sediments

from the working area a floating silt curtain should be built around the dredge to reduce migration of sediments from the work area (see **Figure 7.2**).

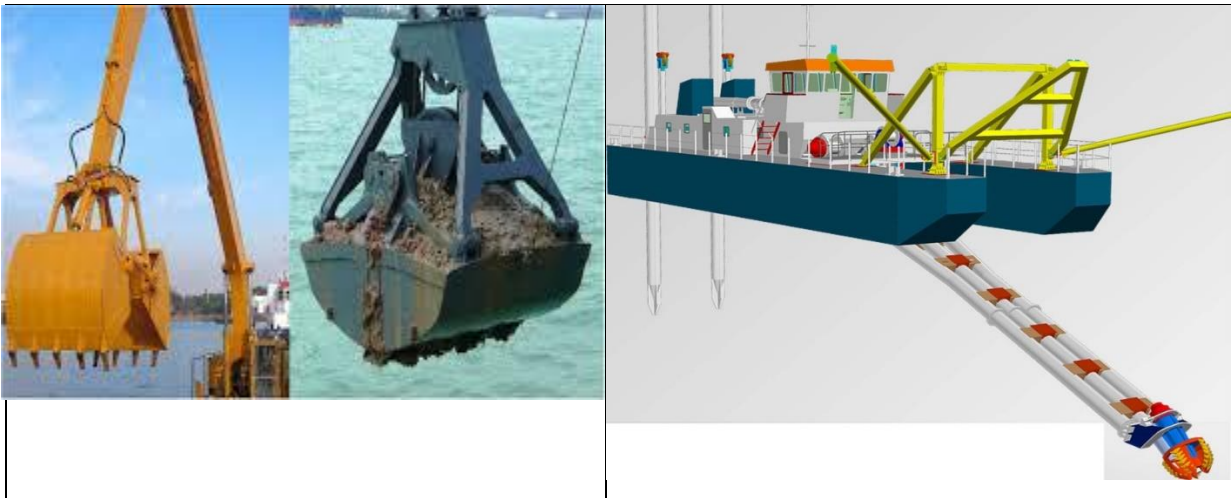


Figure 7.1: Typical views of Grabber and Suction Dredge.

Materials dredged by the cutter-head/suction (see **Plate 7A, Bottom Left**) will be pumped to the dredge spoils dewatering site through a series of 4" and/or 8" High Density Poly Ethylene (HDPE) submerged pipes with flanged and/or fused ends.

7.4.4.1 Proposed Methodology for the Dredging Program

The following methods employ techniques currently being approved by the DoE and other relevant authorities including the Mining Unit for deployment in Belizean offshore waters. It does not constitute official approval for the approach in this particular project which must be obtained separately from these agencies

- Equipment** - An electric submersible centrifugal type pump will be powered by an electrical generator both of which will be mounted onto a pontoon boat (see **Plate 7A, Bottom Right**). The pump and generator will be transported to the sand bank on the pontoon boat and High Density Polyethylene (HDPE) pipes will convey the dredge slurry to the dewatering area. The discharge pipes will then be connected from the suction pump to the regeneration zone for beach enrichment and berm construction.
- (i) **Anti-fine mesh** - Before starting with sand filling activities an anti-fine-dispersion mesh must be installed. The mesh should be fine enough to trap sediments inside while allowing filtered water to escape. The curtain must be held erect and above the surface by booms consisting of styrofoam or other similar suitable flotation devise (see **Figure 7.2**). The sections of the curtain will be seamlessly connected together so as not to allow the inadvertent passage of sediments. The bottom of the curtain will connect to the seafloor by weights so sediments do not escape. The water must have

sufficient residence time for all the sediments to settle out (see **Plate 7A, Top Right**) and in any case must conform to the following formula.

Settling Velocity and Detention Time Using the Continuity Equation,

Q = AV (Clarifier Theory)

– Q = Pump Rate, L³/T

– Vs = Settling velocity, L/T

– A = Surface Area required to remove sediment (by gravity), L²

Therefore: A = Q/Vs

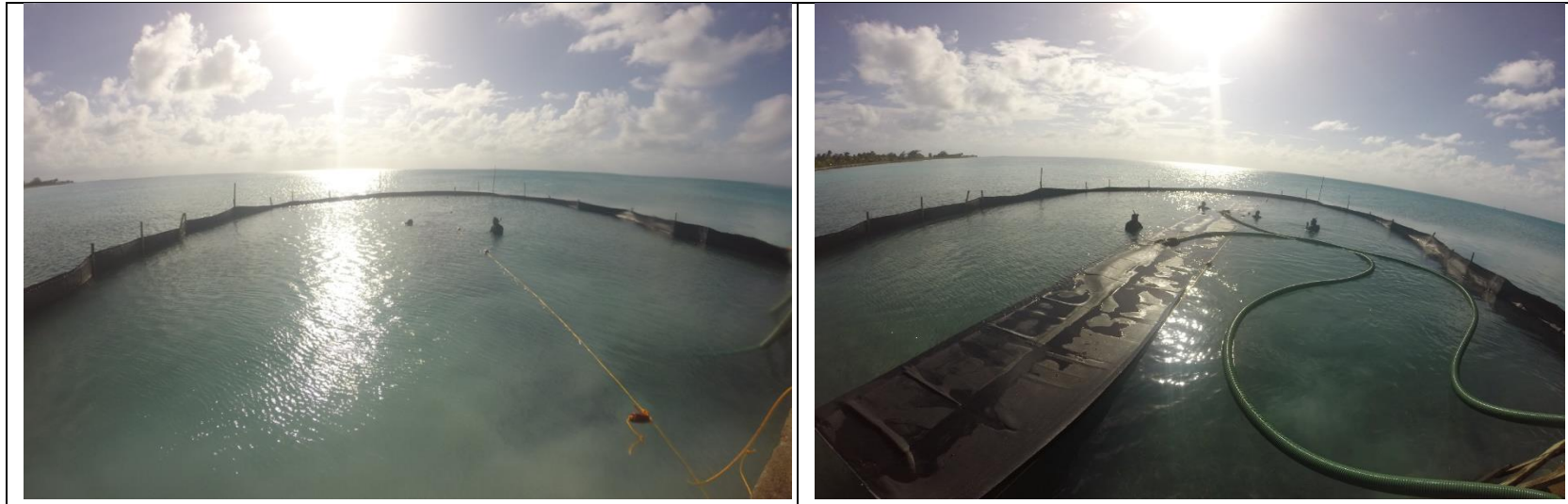


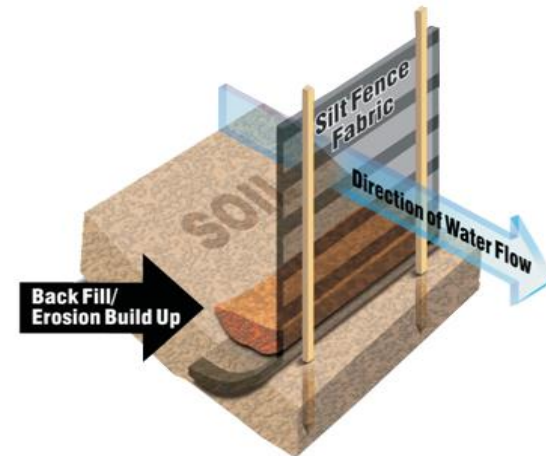
Figure 7.2: Typical view of the boom and membrane containment structure.

- (ii) **Aspiration of sand and beach profiling** - The pump is lowered on the sandbar by means of a system of mechanical pulleys. When the pump is ready to operate, the generator that supplies electrical power to the pump is started. The pump starts the sand aspiration process. When the pump has drilled an average of one meter depth into the sandbar the system stops and the pump is relocated to a new position. The process then continues incrementally until the required volumes of dredged materials are obtained. The conformation of the beach should be made in successive layers, with the first being the base, the second the beach area itself and finally the profile or beach crown (berm).
- (iii) **Stability of beaches** - To secure the stability of the sand filling, a groyne constructed with Geotextile Tubes and surrounded by large rockboulders will be used.

Top right, Schematic view of the membrane structure used to trap dredge silts.

Bottom left, Dredge suction head.

Bottom right, Pontoon with pump and generator.



NB: All pictures photographed June 2017.

Plate 7.A: Views of the propose system that may be used during the dredging operation.

7.4.4.2 Specifications of the Dredge Equipment

Dredging engineers will always try to match their equipment to the difficulty of the task at hand for an effective dredging operation. The materials identified adjacent to Caye Caulker as potential material for beach enrichment and berm construction are loose granular sand of coral origin which is very easy to remove using moderately powered equipment.

Therefore, for the dredging of the loose sand hydrodynamic suction dredging techniques will be used. This includes having a suction dredge with cutter-head mounted on a barge/pontoon with suitably sized pumps to push the watery dredge material to the selected dredged dewatering sites.

Only the top 1 meter of the sandy layer will be removed. No silt and organics or clayey sand nor fat and lean clays will be mined. In the same vein no cemented or calcareous strata will be penetrated which would likely present a challenge for hydrodynamic dredging techniques as the jettying water may not be able to disintegrate the materials into individual particles; rather, these soils tend to “ball” and potentially clog the dredge pipes and dredging heads. To the extent possible dredging should take place in borrow pits already mined from previous dredging activity to avoid disturbing new areas. It is expected that over time most of these sites would be “healing” and refilling with sediments

Table 7.3 summarizes the types of dredging equipment that may be used on Caye Caulker.

Table 7.3: Dredge equipment needed for the dredging operation in Caye Caulker.

EQUIPMENT	SIZE	QUANTITY	Dredging capacity per 8 hours operating	BASIC USE
Electric Centrifugal pump	8"x8"	1	300-500 m3	Dredge/filling operation
	6"x6"	2	100-300 m3	Maintenance/ Geotextile tubes filling operation
	4"x4"	2	<100m3	Maintenance/ geotextile tubes sand filling operation
Electric Generator	120 KVA	1		
	100 KVA	1		
	65 KVA	1		
Pontoon	8m x 2.5m	2		
Hydraulic pipes	6"	300 m		
	4"	300 m		
HDPE pipes	8"	1200 m		
Marine cables	0	300 m		

7.5 Requirements for Environmental Impact Assessment

Developers should take note of their projects potential for environmental and social impacts and ask for a screening opinion at an early stage from the DoE (see **Figure 7.3**).

Developers should note that project with the following criteria may require environmental and social vetting:

- ❑ Projects falling within sensitive areas e.g. protected areas and buffer areas, coastal areas and projects likely to affect the seabed.
- ❑ The nature of the propose development (some projects are more associated with impacts than others,
- ❑ The scale (size of the project)

The most likely outcome is that some of the physical investment will require some form of environmental and social vetting because of location within sensitive areas.

The DoE normally grades projects into 3 categories based on their potential for environmental harm (see **Figure 7.3**):

- ❑ Schedule 1 – Full EIA mandatory
- ❑ Schedule 2 - Full EIA discretionary however some form of environmental vetting is required,
- ❑ Schedule 3 – Project does not require environmental vetting however may need to follow an environmental compliance plan.

Table 7.4 summarizes the main requirements in tabular form.

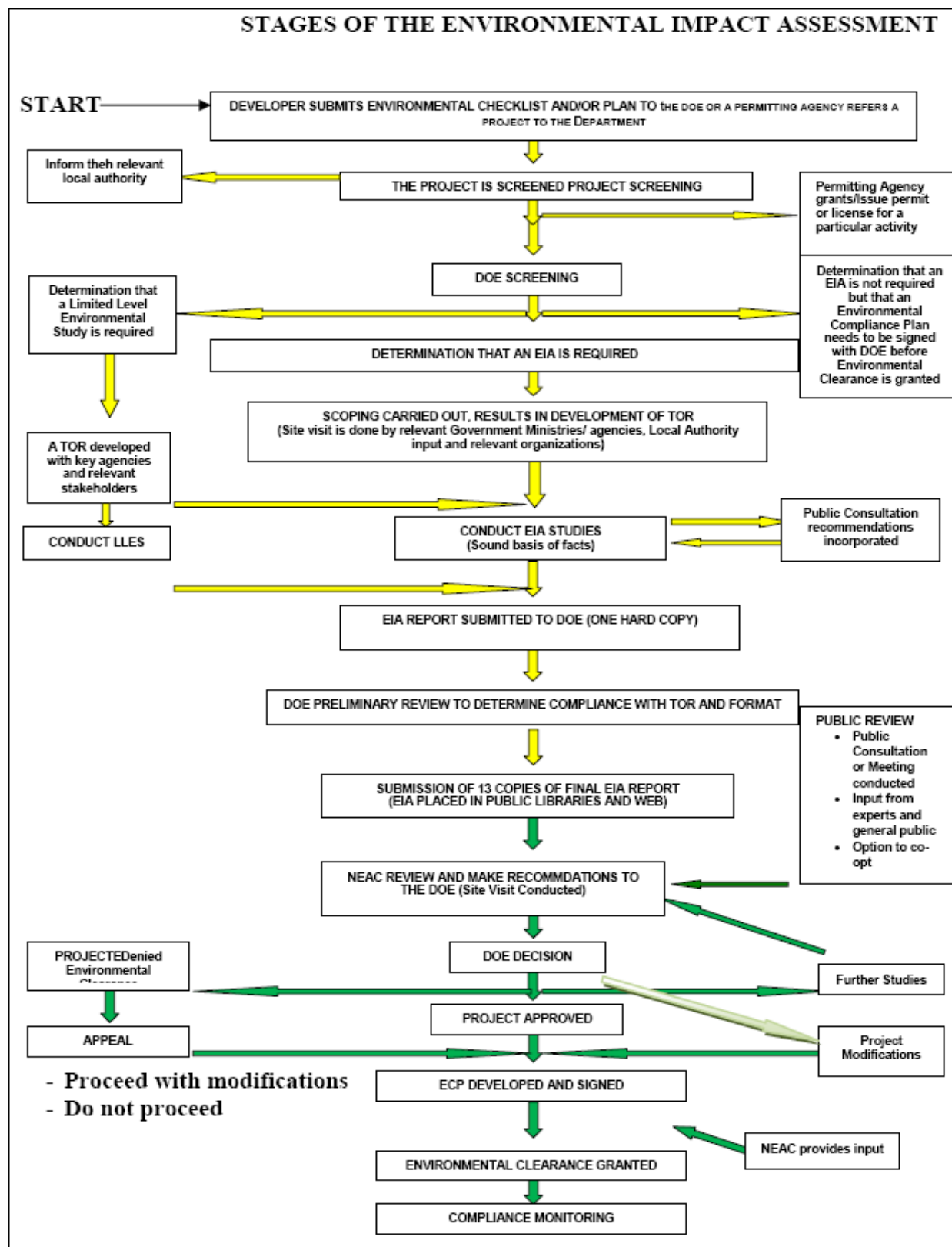


Figure 7.3: Schematic of the stages of the EIA process in Belize.
(Adopted from DoE website)

Table 7.4: Main requirements of the EIA vetting stages.

Stage	Activity
Project Preparation	The developer prepares project proposal
Notification to Competent Authority	The developer informs the DoE as the Competent Authority about the development proposal
Screening	The DoE evaluates the project proposal and makes a decision on whether EIA is required.
Scoping	If EIA required scoping process identify the environmental, technical and social information to be gathered and reported upon in the Environmental Impact Statement.
Environmental Studies	The developer carries out studies to collect and prepare the environmental information stipulated under the ToR.
Submission of Environmental Information	The developer submits the environmental information to the DoE in the form of an Environmental Impact Statement (EIS)
Review of Environmental Information	The Developer submits first draft of the EIS to the DoE who will evaluate it based on whether it adequately addresses the ToR.
Consultation with Statutory Authorities and stakeholders	Environmental information made available to authorities with environmental responsibilities and to other interested organizations and the general public. May also include field visit.
Consideration of the Environmental Information by the Competent Authority	Environmental information and input from consultations considered by the DoE in reaching decision on the development application. DoE is assisted by the National Environmental Appraisal Committee (NEAC).
Announcement of Decision	Decision on EIA made available to the public. Will include description of measures required to mitigate adverse environmental effects if development consent is granted. These measures are detailed in an Environmental Compliance Plan (ECP) which the Developer must sign before he begins the implementation of his project.
Post-Decision Monitoring	There is a requirement to monitor the effects of the project once it is implemented.

8 Livelihoods Restoration Plan and Institutional Assessment

8.1 Introduction

The main objective of the livelihoods assessment is to acquire relevant baseline data on stakeholders living within the relevant project sites and who are likely to be negatively impacted by the project in terms of their livelihoods. As part of the deliverables of this study baseline data is being collected in both Belize City and Caye Caulker where the greatest impacts to livelihoods are expected to take place. Minimal effects are expected on Goff's Caye.

8.2 Approach

The conduct of the livelihoods assessment follows a systematic approach as follows:

- ❑ Identification of relevant stakeholders within project sites,
- ❑ Identification of businesses and individuals likely to be negatively affected by the project such as properties having sewer connection to the Belize City canals or bathhouses or piers that allow ingress and egress into the canal and the river. For Caye Caulker businesses or individuals likely to be affected by the construction and existence of the berm structure and groyne,
- ❑ Preparation of a letter introducing the project and identification of property parcel and head of households residing at property.
- ❑ Inventory of assets that will be lost or affected by the project,
- ❑ Mapping exercise to identify relevant business and residential properties that might qualify for mitigation under the livelihoods restoration scheme,
- ❑ Visit to householders and collection of relevant baseline data using questionnaire sheets as well as photographs for each affected business or household,
- ❑ Assess potential temporary and permanent project impacts on economic activities and livelihoods in the projects area of influence,
- ❑ Establish the cut off date for compensation under the project. The information on economic viability and impoverishment risk will be used in deciding who qualifies and need to be assisted as a result of project impacts.
- ❑ Identify compensation and/or rehabilitation measures to reestablish the livelihoods of owners, employees, renters and others,
- ❑ Assess the potential for social conflict and opposition to the project. Although the Belize City project is for the most part viewed by city residents as necessary and beneficial,

there is potential for opposition to the project in Caye Caulker as it might conflict with land use values,

- ❑ Based on the above approach and considering the relevant factors our team will then prepare a livelihoods restoration plan.

Due to delays in identifying and in agreeing on the climate vulnerability reduction measures at the 3 sites consultations with stakeholders was also delayed as the engineering interventions would have been the basis on which to interrogate and engage the stakeholders. A livelihoods restoration assessment is currently being carried out and a livelihood restoration plan will be included in the final ESA report.

8.3 Institutional Assessment

Institutional capacity is a critical factor for long term viability of the climate vulnerability reduction interventions. Financial and technical support for this project does not continue into the operational phase hence much of the responsibility will rest on local authorities and institutions. This will include the Belize City Council, the Caye Caulker Village Council and the Coastal Zone Management Authority and Institute, however government (public) institutions and private sector agencies including conservation NGO's will have a vested interest in ensuring the long term viability of the interventions.

Component 1 of this IADB assistance program is devoted to improving governance for climate risk reduction of which important actions will climate risk information accessibility to a range of government and private sector actors and to building capacities to undertake damage assessment among others. This investment should help to achieve internal institutional strengthening which is critical to the success of the interventions at the 3 sites.

During this study relevant institutions are being consulted about the structures and capacities that will need to be in place to operate and oversee the investments at the 3 sites. In Belize City in particular, personnel and financing must be earmarked within the municipality's budget to operate the sluice gates, pumps and standby generators among others. In Caye Caulker the local village authority must mobilize community support for and take ownership of the climate investments.

9 Monitoring Program

9.1 Introduction

Environmental Monitoring and Assessment is an environmental management tool that uses data arising from inspections to assess the adverse environmental impacts and pollution risk factors. Based on the risk factor promulgated by this data corrective and remediative actions can be taken on a timely basis. To that end factors that have been identified in the Impact Matrix as potentially having negative impact must be closely monitored to evaluate the scope, duration and level of the impact.

9.2 Monitoring of ESMP Implementation

A properly designed and implemented monitoring programme will ensure the the correct and successful implementation of impact mitigation measures to reduce adverse impacts on environmental conditions and attributes. To be successful this monitoring program requires assumed responsibility and ownership on the part of project proponents which in this case falls directly on the IADB and the project Contractors. Reporting on adherence/compliance as stipulated in the ESMP shall be communicated to developers and contractors as required.

9.3 Monitoring Plan

Environmental monitoring will be done during the construction phase in three levels:

- ❑ Monitoring development of project performance indicators done by the Environmental consultant retained by the project.
- ❑ Monitoring implementation of mitigation measures done by the Environmental Consultant and
- ❑ Overall regulatory monitoring of the environmental issues done by Environmental Consultant possibly in conjunction with relevant permitting and management agencies.

9.4 Indicators and Targets for Environmental Performance

The environmental monitoring plan with indicators and targets for the priority climate investment sites, with measurable outcomes for the various environmental management provisions set forth in the EMP are outlined in **Table 9.1**.

Table 9.1: Indicators and Targets for Environmental Performance during construction

Indicators	Parameters to be Monitored	Targets	Frequency	Responsibility	Remedial action
Dust suppression	Equipments for water sprinkling, Timing of sprinkling, Location of sprinkling	No dust rising from stockpiled materials in populated areas and other sensitive receptors	Preferably Random checks	IADB	Increase in frequency of water sprinkling
Ambient noise	Equivalent Day & Night Time Noise Levels	Conformation to noise limits within acceptable legislated thresholds	At time of site visit but not less than monthly	IADB and DoE	Identify noise source and strictly regulate noise emissions. In case of continued non-compliance invoke penalty clauses. No working beyond 9PM
Machinery noise	Noise dB(A)	<75 dB(A) at 1m free field from M/C	Monthly	IADB and DoE	
Solid waste	Waste segregation, storage and disposal	Compliance with applicable national legislation and best management practices including hierarchy of waste management.	Monthly	IADB, SWMA and DoE	Identify non-compliance and modify plan
Liquid Waste	Source, volumes, treatment efficiency, overflows	Compliance with effluent limitation regulations and international best practice	Monthly	IADB and DoE	Identify non-compliance and modify plan
Sedimentation	Turbidity levels, plumes and percentage substrate cover	As specified by the DoE as acceptable levels for habitat at risk	Monthly or more frequent as situation dictates	IADB, Fisheries Department/CZMAI	Ensure adequacy as per plan and instruct PIC to comply. In case of continued non
Flora and fauna	Area of disturbance to wildlife nesting feeding and breeding sites	Compliance with ESA	Monthly	IADB, Forest Department and Fisheries Department	Ensure compliance and in case of continued non-compliance invoke penalty clauses
Water quality	Dredged canal water and water within dredged area on caye caulker	Measurements of turbidity levels for Caye Caulker and for heavy metals in Belize City canals	weekly or more frequent as situation dictates	IADB and DoE	Ensure compliance with effluent limitation regulations of Belize.
EHS implementation	Safe working practices, training and emergency response capability	Compliance with EHS guidelines or best practices	Preferably Random checks	IADB and Ministry of Labor	Ensure compliance and in case of continued non-compliance invoke penalty clauses

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