Task 3 Report
DRAFT Environmental Assessment

Feasibility Study & Environmental Assessment for Georgetown Coastal Defence

RFP #SVGRDVRP-C-QCBS-16

Submitted to:

Ministry of Finance and Economic Planning
Central Planning Division
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by

SMITH WARNER INTERNATIONAL
COASTAL ENVIRONMENT

5 Octobert 2015

TASK 3 REPORT

Environmental Assessment

DRAFT Environmental Assessment and Water Quality Monitoring Georgetown Coastal Defense

St. Vincent and the Grenadines





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EXECUTIVE SUMMARY

Environmental Solutions limited has worked with Smith Warner International, the coastal engineers to carry out the project: *Regional Disaster Vulnerability Reduction Project - Georgetown Sea Defense – Coastal Zone Investigations and Feasibility Studies*. ESL has been tasked to complete the environmental impact assessment (EIA) for the proposed coastal defense works for the Georgetown project area. This report presents this EIA.

In order to complete the EIA, the Environmental Consultants conducted an ecological assessment, a socioeconomic assessment, a policy and legislative review and a physical assessment which involved a number of water quality analyses.

Ecological results revealed that there is an absence of benthic communities in the nearshore sands due to likely mobile and unstable sand in the immediate nearshore environment. Based on the assessment turtle nesting is of most significance in the area. Water quality results reveal significantly high levels of faecal and total coliforms in all three rivers: Grand Sable, Caratal, and Langley Park, in the project area. This poses a public health risk for uses of the river but exploration of possible causes and recommended to address such an issue is outside the scope of this project but highly recommended.

Unemployment is relatively high for area based on census results and 65% of survey respondents would hope to be employed during the construction phase of the development. Traffic volume is relatively low altogether but s of greatest concern during peak hours in the morning and evening on a daily basis.

Relocation of resident has been forced by significant damage from past hurricane and tropical storm events. The proposed works aims to protect against such damage and loss and will not require relocation to undergo the development.

It is clear from the impact assessment that the negative impacts from the proposed works largely occur during the construction phase of the project cycle. These impacts relate mostly to possible displacement of turtle nesting, air and noise impacting nearby residences and businesses, poor coastal water quality, improper solid waste, improper sewage and hazardous waste disposal, worker health and safety, general site safety, transportation and coastal and physical hazard issues. Mitigation measures have been identified to address all the impacts identified to reduce the likelihood of the potential negative impacts and to reduce the level of impact to more tolerable levels. With these measures in place, the project can be carried out successfully without significant negative impacts to the environment and community.

1 INTRODUCTION

1.1 Purpose

Environmental Solutions limited has worked with Smith Warner International to carry out the project: *Regional Disaster Vulnerability Reduction Project - Georgetown Sea Defense – Coastal Zone Investigations and Feasibility Studies*.

This report represents the environmental impact assessment for the proposed coastal defense works for the Georgetown project area. Chapter 2 presents the methodology, chapter 3, an assessment of the existing environmental environment, chapter 4 presents public opinions on the project, chapter 5, a review of the policy and legislation, chapter 6, the design options and chapter 7, an assessment of the impacts.

2 METHODOLOGY

The environmental consulting team from Environmental Solutions Limited (Barry Wade, Eleanor Jones, Annmarie Barnett) has been working closely with the coastal engineers on the project to ensure the widest possible range of inputs and opinions regarding the Georgetown coastal defense project and its likely environmental impacts. The environmental consultants, was guided by World Banks' (WB) OP/BP 4.01 Manual procedures for environmental assessments (EA) during the EIA process. Based on the WB OP/BP 4.01 guidelines the following have been considered: the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, and physical cultural resources); and global environmental aspects. The Pollution Prevention and Abatement Handbook published by the World Bank in 1998 was also used during the impact assessment and the development of mitigation measures.

A reconnaissance field visit was conducted by the project team during the period June 18 – 26, 2013 for the start-up of the project, to conduct an initial site review and to hold initial stakeholder consultations. The Consultants were able to define a project zone of immediate influence as well as identify the physical, biological, and socio-economic characteristics of the study area during this Inception Phase.

Based on the project screening done during this Inception phase, and in accordance with the WB OP 4.01 guidelines, this project is classified as a Category B. It was recognized that the potential adverse environmental impacts on human populations and the natural coastal environment are less adverse than those of Category A projects. The adverse impacts are likely to be few and reversible. In the case of Georgetown, mitigation measures can largely address any arising negative impact. As such, this EA examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.

Two members of the team (Barry Wade, Annmarie Barnett) conducted the second field trip for field data collection October 1 - 10, 2013. On this visit, the consultants conducted an ecological assessment, a

socioeconomic survey, a traffic survey, collected the second set of water quality samples and conducted a coastal zone management workshop. These activities are detailed below.

On March 11, 2014 a third visit was made to the project area to collect the third set of water quality samples.

Following these field visits, data analysis and document review have been taking place as part of the environmental impact assessment (EIA) process.

2.1 Ecological Assessment

The ecological assessment was conducted in October, 2013 along the coastline of Georgetown from Black Point in the southernmost end to Basin Hole in the north where the Langley Park River empties. The ecological data collected included the identification of nearshore fauna and flora, including the search for mangroves along the shoreline.

The following activities were performed by the Consultants:

- Identification of the flora and fauna that are present
- Determination of the status of the flora and fauna
- Identification of the existing communities

Particular flora and fauna of interest were:

- Turtles and turtle nesting sites
- Avifauna
- The presence or absence of mangroves
- Benthic species including: marine algae, sessile and burrowing invertebrates, etc.
- Fish life

SCUBA dives have been conducted to determine the presence of nearshore marine benthic communities.

The team completed the analysis of the data that were collected in the field and are presented in full, in the Environmental Impact Assessment report.

Watershed management

During the data collection visit in October, 2013 the consultants examined the watershed in which Georgetown is situated. The conditions of the watershed were identified and activities affecting it were assessed. Watershed management mechanisms were also determined including, interviews with relevant SVG authorities and farmers.

2.2 Water Quality Sampling and Analysis

The selection of the sampling sites was done on the reconnaissance trip in June, 2013 based on their location and situation. Four sampling sites (two marine, two freshwater) were situated within the project sphere of influence with two control stations upstream.

Three water quality sampling events took place: the first on June 24, 2013 – average conditions, the second on October 8, 2013 – wet conditions and the third on March 11, 2014 – dry conditions. Sampling was done in accordance with US Environmental Protection Agency standard sampling guidelines for water. Each site was sampled three times over the project period and included wet and dry weather conditions. At each event, three marine samples were taken: Black Point, Georgetown, Rabacca and three fresh water sites: Grand Sable River, Langley Park River and Caratal River. The location and description of the sampling sites are provided in Table 2.1 below.

Table 2.1: Water Quality Sampling Sites

Marine Samples	**Coordinates**	**Location of Station**
Black Point - surf zone	N 13.26543^0 W061.11663^0	At the southern end of the project site at Black Point
Georgetown surf zone	N 13.27836^0 W061.11801^0	In the middle of the project area – at the playfield in Georgetown
Rabacca - surf zone	N 13.29740^0 W061.11610^0	North of the project site, just outside the project area
River Samples	**Coordinates**	**Location of Station**
Grand Sable River	N 13.26656^0 W061.11870^0	Upstream a small dam at Black Point
Caratal River	N 13.28297^0 W061.11659^0	Downstream of main bridge in Georgetown
Langley Park River	N 13.29106^0 W061.11604^0	Upstream of main bridge at Basin Hole

The sampling sites were strategically located to capture the influence of various activities within the project area:

- To assess coastal/land use practices and conditions prior to project construction
- To determine baseline water quality conditions of the surface water systems
- To aid in identifying the best options for recreational and other uses of available surface water systems
- To determine the nature and extent of existing land use impacts

A quality assurance (QA) and quality control (QC) plan described in the sampling procedures in the Final Inception Report was followed. Field observations and *in situ* measurements were made with respect to odour, colour, pH, dissolved oxygen, electrical conductivity, salinity and temperature at each site. The sampling event took one day and the samples were packaged and sent to the ISO 17025 Environmental and Food Accredited Quality and Environmental Health Laboratory at ESL for analysis using DHL courier

services. The Laboratory analyzed the samples taken on June 24, 2013, October 8, 2013 and March 11, 2014 for the following parameters:

- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Total Coliform
- Faecal Coliform
- Enterococci
- Total Nitrogen
- Total Phosphorus
- Turbidity
- Biological Oxygen Demand (BOD)
- Metals – Manganese, Copper

2.3 Socioeconomic Assessment

Socioeconomic data were collected through means of interviews, surveys and the review of documentation. Demographic data such as: population, age and sex distribution, living conditions, housing, waste disposal, educational level within the Georgetown area have been accessed from the Statistical Office. Only population data and the number of households are available from the 2011 census data. The 2001 census data were utilized for other demographic data.

During the period June 19 - 26 2013, the team held a number of meetings with the client and stakeholders. A reconnaissance visit to Georgetown was also conducted which included community meetings on site. This forum was used to introduce the project to the residents as well as to gather anecdotal information about historical happenings within the area.

A socioeconomic survey was conducted October 3 - 4, 2013 to capture data on: livelihood activities, use of the beach, sand mining, threats faced by community and hazard preparedness, property ownership and loss, and public opinions on the project. The two day survey yielded a total of 161 responses. In addition to the survey, targeted interviews with key community personnel were conducted; these included:

- The Manager and staff of the Black Point Recreational Facility,
- The Community Liaison Officer for Georgetown employed by the Ministry of Mobilisation, and
- Residents involved in the tri-tri (*Sicydium plumieri*) fishery

Key community persons were asked about the social facilities within the Georgetown area: schools, recreation, heritage, electricity supply, water supply, telecommunication services and garbage collection. Observations were also made during the site assessment to validate responses. Other human activities and patterns were also observed in the field.

Desktop research and document review was completed and social data for Georgetown was garnered from existing documentation. Some documents consulted included:

- Disaster Vulnerability Reduction Project – Environmental Assessment Report (2010)
- Disaster Vulnerability Reduction Project – Social Impact Assessment (2012)
- Climate Change Risk Profile for St. Vincent and the Grenadines (2012)
- St. Vincent and the Grenadines Coastal Vulnerability Assessment Report (2008)
- Hurricane Risk Reduction Strategies In the Windward Islands: Public and Practitioners Perspectives (2006)

2.4 Policy and Legislative Review

The overall's policy framework, national legislation, and institutional capabilities related to the environment and social aspects in St. Vincent and the Grenadines have been considered based on the WB OP/BP 4.01 guidelines. SVG's obligations pertaining to project activities, under relevant international environmental treaties and agreements are also considered. The policy and legislative review was completed and data were collected on the following areas:

- Environmental management activities, including guidelines for the conduct of EIAs
- Location and management of recreational and environmentally sensitive areas
- Coastal zone management oversight
- Physical planning legislation and regulatory functions
- Sand mining legislation
- International environmental treaties and agreements

3 ASSESSMENT OF THE EXISTING ENVIRONMENT

3.1 Project Area and Sphere of influence

The project area stretches from the Langley Park River in the North to the Black Point headland in the south (See Figure 3.1). The immediate project area is the beach and line of infrastructure along this stretch of coastline, which represents the area immediately impacted by coastal hazards and the area that coastal works will address as outlined in Section 6 of this document.

Figure 3.1: Georgetown Project Area and Sphere of Influence

In addition to this immediate area, the project will include socioeconomically the wider community of Georgetown, given that persons from the community generally utilize the area for recreational purposes largely. It is important to note the ecologically and physically the impacts from the coastal works will not impact the wider Georgetown area. Although this is the case, the state of the watershed can impact the coastline and any structure along the coastline when flood waters can bring rocks and debris down the rivers and to the sea. The poor ecological state of the watershed in the Georgetown hillsides can lead to such negative impacts.

3.2 Geography

The Georgetown site displays fairly typical physical and ecological coastal features especially for a high energy shoreline. The flat coastal plain is relatively narrow, no more than 1 kilometre at its widest and is vegetated by secondary forest growth in a few places, but mostly by planted species such as coconut, almond, and mango. At Black Point there is a recreational park with extensive grass area and at Georgetown, a grassed football field.

The main windward coast roadway separates the beachfront from the more extensive coastal plain on which are planted bananas as well as vegetables and other cash crops. However, such cultivations are increasingly being overtaken by residential, commercial and other buildings.

Rising steeply from the coastal plain are the central highlands which dominate all of the St. Vincent interior. Within the project area, these highlands rise steeply to 100 metres or more and are also covered by natural and secondary vegetation, as well as by cultivated crops. All the highlands in this area drain in a general west/east direction towards the sea.

Two streams/ rivers of note drain the highlands in the project area. At Black Point, there is the Grand Sable River which discharges bout 300 metres north of the Black Point bluff (Figure 3.1). This at one time flowed from the highlands across the Grand Sable sugar cane estate, but this estate is no more. The river is approximately 10-20 metres wide nearest the shoreline, but is known to flood after heavy rains and cover an extensive area, including the Black Point Recreational Park. Small fish (mullet) inhabits this river, but the fauna appears sparse.

Left: Grand Sable River Facing the Atantic Ocean, **Right:** Grand Sable River Facing Inland/Upstream

Figure 3.2: Grand Sable River at Black Point

At Georgetown itself, the Caratal River comprises the main drainage basin for runoff from the highlands (Figure 3.2). Besides draining the watershed, it also receives wastewater from a rum distillery and from the town. Unlike Grand Sable River which, in June was clean and clear, the Caratal River is turbid, more stagnant and has a typical rum distillery waste (dunder) odour. It discharges to the sea after crossing the windward roadway under a 15m expanse bridge.

Left: Caratal River Facing the Atantic Ocean, **Right:** Caratal River Facing Inland/Upstream

Figure 3.3: Caratal River in Georgetown

The Langley Park River which empties just further north at Basin Hole is partly protected by gabion baskets recently emplaced to contain the river during heavy rains and floods (Figure 3.3). Despite its' polluted state, this river also has small fish and a few other aquatic species.

Figure 3.4: Langley Park River at Basin Hole facing the Atlantic Ocean (left); Langley Park River facing inland/upstream (right)

3.3 Existing Ecological Setting

The sea and beach features of the project area are very distinct and somewhat uniform. High energy waves with multiple breaker lines pound the beach at all times. Offshore benthic species are very sparse as is usual in very high energy environments with loose unstable sands.

The beaches themselves are comprised of fine to coarse black volcanic sands, pebbles, cobblestones, larger rocks and huge boulders (Figure 3.4). Sand samples have taken at three sites along the beach for grain size analysis by Smith Warner International and beach slopes at several locations were measured using an inclinometer.

Figure 3.5: Beach Seaward of Georgetown playing field looking north (top); and looking south (bottom)

Erosional scarps are evident on most stretches of the beach, some less than 1 metre but others approximately 3-5 metres high. Shoreline vegetation consists of grasses (*Sporobolus*), creeping succulents (*Sesuvium* and *Batis*), and sea grapes (*Coccoloba uvifera*).

Most beaches are steep and the swash zone is devoid of any sand burrowing animals or hard surface attached plants or animals (Figure 3.5). Overall, the marine fauna and flora of the beach and nearshore are quite sparse.

Figure 3.6: Beach at Playfield in Georgetown

Large stretches of the beaches are strewn with fallen coconut and other trees, some originally from the shoreline itself, but also very many washed down from the watershed by rivers during flood times and deposited on the beaches. These and other debris occasionally harbour small crustacean and other species. The ghost crab (*Ocypode*) and fiddler crab (*Uca*) find some protection from the high energy swash in the lee of such debris.

Results from the dive exercise revealed the absence of any benthic communities in the nearshore sands. This confirms the earlier view that the sand in the immediate nearshore environment is too mobile and unstable to support any burrowing, sedentary, or attached flora and fauna. This information also confirms that the absence of significant marine debris on the beaches is due to the barrenness of the nearshore benthic environment.

Anecdotal evidence indicates that fishing only occurs about 1 kilometre and further offshore, and only for pelagic species such as jack. On the whole, however, there is very little fishing done in the project area and no boats or other equipment were seen during the field visits. Tri-tri (*Sicydium plumieri*) fishing is the major fishing activity which occurs at the mouth of the Grand Sable River at Black Point (Figure 2.6).

Figure 3.7: Tri-tri and fish caught at the mouth of the Grand Sable River by local residents

During the field visit, the beach profiles showed some changes pre and post heavy rainfall that fell on Saturday October 5, 2013. However, the beach at the southernmost end at Black Point showed the least variation with a very gentle slope of 4-7 degrees. This contrasted significantly with the beach in front of the Georgetown playfield which slopes of 15-18 degrees. A noticeable feature on all the beaches was the heavy contamination by watershed and urban debris following the October 5 rains.

The manager of the Black Point Recreational Park confirmed its heavy recreational use over the summer with a fair number of visitors swimming in the sea. However, this activity wained considerably in September once the surf became higher. She also observed that attendance at the park had reduced significantly after user fees had been introduced in May/June of 2013 (Table 3.1). It was confirmed that four species of turtles continue to nest on the Black Point beach although heavier nesting sites occur further south (Figure 3.7). These species are: hawksbill (Eretmochelys imbricata), green turtles (Chelonia mydas) and leatherbacks (Dermochelys coriacea) and much less frequently, loggerheads (Caretta caretta).

Figure 3.8: Black Point Beach

Table 3.1: Beach Users at Black Point, Georgetown

Months in 2013	Total Users
January	1037
February	683
March	1643
April	1030
May	1946
June	984

Months in 2013	Total Users
July	915
August	817
September	233

The St. Vincent Distillers Ltd., which processes molasses into rum, occurs in Georgetown itself, approximately 150 meters from the beach. It discharges its waste into a ductile iron pipe and a concrete drain both of which run directly across the beach into the sea (Figure 3.8). During the field visit, the odour from these conduits was very strong. There is evidence that some distillery waste also reaches the Caratal River as this river also has a dunder odour.

Figure 3.9: Rum Distillery waste stream looking seaward (left); looking inland (right)

Whereas sand mining is approved for the Rabacca valley, landward of the main road, Consultants observed active removal of sand in the fragile beach area between Rabacca in the north and Basin Hole in the south where the activity is prohibited (Figure 3.9). There appears to be no control of this.

Figure 3.10: Sand mining along beach between Basin Hole in the south and Rabacca in the north

3.4 Existing Physical Setting

3.4.1 Coastal Water Quality Analysis

The sea samples for June and October 2013 and March 2014 showed no unusual physical, chemical or microbiological features and were therefore mostly within the acceptable standards. The only exception to this was the faecal coliform levels at Rabacca in October 2013 (See Appendix I Table 1 and 3).

On the other hand, the river samples, while not showing unusual physical or chemical features, were consistently high in bacterial levels. The bacterial parameters measured were total coliform, faecal coliform and enterococci (See Appendix I Tables 4 to 6). The bacterial (faecal) contamination of the river samples is not surprising since they traverse human settlements above the sample points and before discharging to the sea. However, based on the levels, further investigation is recommended due to potential impacts that this can have on recreational uses and tri-tri fishery.

Coliforms and *Escherichia coli*

Water transmissible diseases usually pass through the digestive tract of an affected individual before reaching water bodies where healthy individuals who drink or swim in these rivers, ponds, seas etc. come into contact with the organism and contract an illness. These diseases such as cholera and typhoid fever often prove difficult to culture. In 1892, Shardinger postulated that a group of gastrointestinal

organisms that were relatively simple to culture could be used as an indication of faecal contamination. This group of indicator organisms was given the name “coliform” as they had similar characteristics to *Escherichia coli* (*E. coli*). Of the Total Coliform group, a few were isolated from nature and a sub-group was then formed, the “faecal coliform” group, which were strictly associated with faecal matter (FDA, 2002).

E. coli falls within this subgroup and is considered as the ultimate indicator, due to the ease of detection of the species and the fact that the organism cannot grow or reproduce in nature. If this species is detected it is a good indication of faecal contamination.

In 1914, the US Public Health Service adopted the enumeration of coliforms as a standard of sanitary significance (FDA, 2002). Though *E. coli* helps to keep the gut healthy (normal flora), its presence elsewhere in the body may be of concern causing urinary tract infections, meningitis and bacteremia. Few species of *E. coli* are considered pathogenic (disease causing), but many of these strains are associated with livestock and contaminated water which may be of interest to a factory process line which makes meat products (WHO, 2008).The detection and control for the pathogenic strains of *E.coli* do not differ from those of non-pathogenic strains.

Enterococci

Enterococci are a sub-group of the faecal streptococcus group. They are more resistant to traditional forms of disinfection and due to their ability to grow in water with higher salt concentrations they have proven to be valuable indicator organisms for recreational waters. A ratio of faecal coliforms to faecal streptococci greater than four (FC:FS > 4) may indicate that the source of contamination is human rather than animal while a ratio less than 0.7 points to a likely animal source (Standard Methods, 2012).

These bacteria make up the normal flora of the gut, but can cause disease in the immunocompromised such as bacteremia, wound infections, urinary tract infections and endocarditis. In more recent times, there has developed a growing concern with regards to treatment of these infections due to increasing antibiotic resistance.

The source of the bacteria detected may be from a number of sources (industrial and sewage effluents, animal excrement, storm water run-off etc), and the source of the waste weighs heavily in determining the level of risk involved when these indicator organisms are detected. When the source of contamination is from untreated or improperly treated human waste, the potential public health risk is significantly greater. An investigation into the possible source of contamination is recommended. More recent studies show that the better indicator organisms for recreational waters are *E. coli* and Enterococci as they show better correlation with swimmer-associated gastro enteritis (even more so than faecal coliforms), and Enterococci densities are more relevant for marine samples (Standard methods, 2012).

The elevated total Nitrogen level at Langley Park River suggests chemical contamination which may be associated with the discharge of domestic waste (sewage) into it.

A further assessment is recommended to determine the actual impact (if any) of bacterial contamination on public health through human contact and the fishing and consumption of tri-tri (*Sicydium plumieri*). This must include among other sources:

- Point and non-point sources of domestic waste (surface and soil discharges of sewage waste)
- Animal farms and runoff to surface streams
- Industrial discharges to surface streams
- Agricultural runoff of organic waste and chemicals

3.5 Existing Socioeconomic Setting

Section 3.4.1 to 3.4.7 below presents a summary of the existing socioeconomic setting in Georgetown. Appendix II elaborates further on each of the subsections.

3.5.1 Population and Demographics

The population of Georgetown for the 2011 census was 6,585 persons, a decline of 5.4 percent when compared to the census period of 2001. While not a significant decline, it could be attributed to decline due to deaths and migration as a result of limited employment opportunities in the area. Anecdotal evidence suggests that the closure of the Grand Sable Sugar Factory led to a reduction in employment prospects. The age cohort of those interviewed is reflective of a generally youthful population with 73% of respondents being between the ages of 17 and 39.

3.5.2 Settlement and Housing

Georgetown is the second largest town in SVG located on the northeastern coast of St. Vincent. The 2011 census data revealed a total of 2071 households in the Georgetown project area. The housing is largely of good quality concrete structures with hip, gabled or flat roofing in most cases. Houses are largely characteristic of middle income earners.

3.5.3 Physical and Social Infrastructure

The project area receives piped water from local provider, Central Water and Sewage Authority. The community is powered by electricity from the St. Vincent Electricity Services (VINLEC) and the two main telecommunication providers Digicel and Lime are active in the area.

Georgetown is accessed by the paved Windward Highway and several side roads provide access to residential housing.

Other social facilities present in Georgetown include: a primary and a secondary school, a community college, a community centre which also acts as an emergency shelter in the event of an emergency, a health clinic, the St. Vincent Distillers limited, a number of small commercial businesses including shops, pharmacies, restaurants, among others. It was also noted that a Modern Medical Complex is being constructed in Georgetown.

The Solid Waste Management Unit reports in the Country Poverty Assessment 2007/8 that there is 100 percent coverage in terms of garbage collection for St. Vincent and the Grenadines. This was confirmed by the agency representative at our stakeholder meeting and by residents in June, 2013.

Local residents confirmed that both septic tanks and soakaways are utilised in the community. The CWSA indicates that newer houses have septic tanks while the older houses have soakaways.

3.5.4 Land Ownership and Use

The Georgetown project area has both privately owned and publicly owned lands. The area is largely residential. The seaward side of the Windward highway that runs through Georgetown is of most concern with respect to this project. In this area several dwellings are located, a few commercial facilities, a park, open spaces and beaches. These are among the facilities already at risk from coastal hazards.

Anecdotal information indicates that significant land loss has occurred over the years. Additionally, results from the study conducted by the Coastal Engineers also reveal land losses. The study shows that the shoreline retreated by almost 80m over the 66 years between 1941 and 2007, indicative of an erosion rate close to 1.2m/year. Between 2007 and 2012 the shoreline slightly accreted to the south of Georgetown by approximately 2-5m. This is an accretion rate of approximately 0.5-1m/year.

Anecdotal information also indicates that a few residents living along the coastline of Georgetown were forced to relocate as a result of complete destruction to their dwellings following Hurricane Ivan in 2004. Consultations with the National Emergency Management Organisation (NEMO) indicated that relocation efforts were guided by the project *St. Vincent and the Grenadines - Coastal Vulnerability Assessment* funded by USAID.

It is the intent of the Government of St. Vincent and the Grenadines to construct a Government complex on the seaward side of the Windward Highway running through Georgetown. Consultations with the Central Planning Division indicate that it is the aim of the Government to decentralize the services offered in Kingstown.

Currently, the Government is constructing an international airport at Argyle and a Diagnostic Hospital in Georgetown to serve the Eastern Caribbean. These two facilities are near completion and an increase in activity in the study area is anticipated.

In light of these plans and with the existing nature of the Georgetown coastline, coastal protection is needed to reduce the impacts likely to be experienced from coastal hazards, currents and wave action.

3.5.5 Heritage

Survey respondents revealed that a number of heritage sites are located in Georgetown. Of the sites, the Black Point Tunnel and the Anglican Cathedral are located directly within the project area. The Black Point Tunnel is an established heritage feature of most significance in the project area. The area is set up as a recreational park and is called the Black Point Recreational facility and Heritage Site. Consultations with community members revealed that there is a strong desire for Black Point to be enhanced as a comprehensive recreational facility, including swimming (Figure 3.10).

Georgetown is generally a town of historical significance since it was the first capital of SVG and many buildings in the town, including the Anglican Cathedral, have historical significance.

Figure 3.11: Black Point Recreational Park

3.5.6 Employment and Livelihoods

Residents of Georgetown engage in a number of livelihood activities such as: farming and construction. Persons are also employed in government and private enterprises. 52% of persons interviewed in our survey were unemployed. The survey also showed that only 30% of respondents are employed fulltime while 13% are employed on a temporary basis. 5% were retired or disabled. These figures appear to be a good indicator of the decline in employment opportunities following the demise of the sugar cane and more recently the banana industries. Those who are currently employed (both part time and full time) plied their trade in the following main areas: education and training (18%), farming (16%), shop keeping (12%), business operating (9%), trading (6%), management (5%), administration (5%) construction (3%). Only 4% are employed in fishing, mostly for tri-tri (*Sicydium plumieri*).

The Population and Housing Census (2001) indicates that Georgetown has an unemployment rate of 24.4% which is higher than the national rate of 21.1%. Both the project survey and the census data reveal a significant challenge with unemployment in the Georgetown area.

The project survey revealed that 61% of the respondents were interested in employment from any development arising from this project. Persons were generally interested in working as: construction labourers, skilled construction workers (e.g. welding), and sellers of food items, among others.

3.5.7 Traffic Survey

The traffic survey was conducted along the windward highway at the northern and southern limits of Georgetown on Thursday October 3, 2013. Analysis of the data collected showed that approximately 1200-1500 motor vehicles traversed the Georgetown area over the 12 hour period. On average, there are two peak periods between the hours of 9am and 10am; and 4pm to 6pm. Average vehicle flow in the area is approximately 1-2 vehicles per minute.

Both the northern and southern points showed that cars and minibuses are the most frequent vehicles. On average, just short of 6,000 occupants traverse the study area daily.

The volume of traffic movement along the Windward highway at Georgetown is considered light. Passenger conveyance is the major vehicular use transporting commuters to work places and educational institutions near the outward limits or outside the immediate Georgetown area.

4 PUBLIC OPINIONS ON THE PROJECT

Members of the community were briefed on the project, its origins and purpose, and were then asked the question: "Do you think this project would meet the approval of your community and why?" Figure 4.1 shows that 79% of the total respondents either approve or highly approve of the project. This means that most community members are in favour of any improvements that the project may bring to the area.

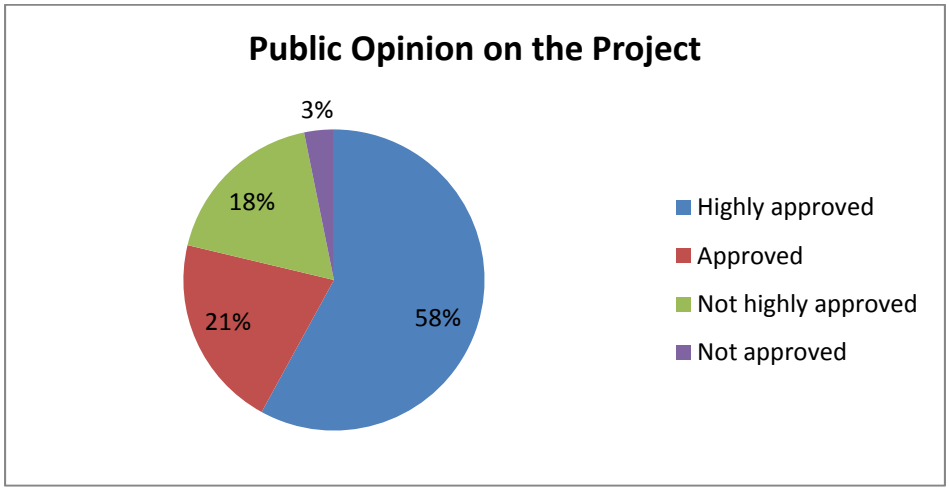

Figure 4.1: Public opinion on the project

Some of the reasons that persons gave for approving the project were:

- to protect their land, houses and life along the coastline
- to make community members feel safer
- to prevent residents from relocating
- to reduce the damage repair costs for the government

- to maintain space to build houses
- to stop and prevent coastal erosion
- to preserve the beach for visitors and residents
- to provide general protection for the Georgetown community
- to reduce the effects of global warming
- to reduce financial spending with rebuilding
- to reduce the vulnerability of the coastal area from damage due to hurricanes
- to bring employment to Georgetown

Persons who did not approve of the project felt that many people live along the coast and the sea cannot be controlled so the development is a waste of time and money. Others felt that the economy of St. Vincent cannot support another major project like this.

Reservations expressed by residents about the project include:

- the fear that changes may create problems elsewhere
- the fear of their land being taken away
- the fear of losing free access to the beach
- the fear that some persons might not understand and as a result may not know what to think
- the fear that persons may question the source of finance
- the belief that too much money will be spent
- the development may not make a difference along the coast
- lack of future maintenance of the structure
- corruption
- cost overrun
- lack of finances to start and complete the project
- the ability of the mitigation measures to be effective would depend on the type that is chosen and utilized for Georgetown
- the use of gabion baskets which get damaged in the long run and the rocks from these may cause damage to buildings along the coastline.

5 POLICY AND LEGISLATIVE REVIEW

The Section reviews both local and international arrangements binding to St. Vincent and the Grenadines.

5.1 Local Obligations

The consultants have reviewed thirteen pieces of legislation relevant to this project. It has been noted that there are no housing or land use Acts or Policies. There is also no legislation related to coastal zone management, as well as, land ownership and acquisition associated with the loss or accretion of land by

sea. Table 5.1 below outlines briefly the critical activities that relate to these policies and legislation. Appendix III outlines further details of the review conducted.

Table 5.1: Review of Relevant Policy and Legislation

Legislation/Regulation	Comments
Town and Country Planning Act (Physical Planning) No 26 of 2008	Based on the review of policies and legislation, this Town and Country Planning Act (2008) is the only legal document making reference to coastal zone management (CZM) which falls under the purview of the Physical Planning Unit. The Physical Planning Unit is therefore a critical stakeholder in any coastal defense works recommended for the Georgetown coastline. The Coastal Zone Management Workshop conducted by the Consultants at the end of the data collection visit in October, 2013 and in which participants from 11 Government Agencies took part expressed the strong opinion that a CZM Unit would be best established in the Physical Planning Department.
The National Emergency and Disaster Management Act, 2006	It is recognized that the coastal area of Georgetown is exposed to erosion impacts from swells, wave action, tropical storms and hurricanes. Any proposed engineering works should be acceptable to NEMO who would be a major stakeholder for any prevention or mitigation measures for disaster risk reduction in SVG.
St. Vincent and the Grenadines National Disaster Plan, 2005	Any mitigation measure to be considered for Georgetown in the form of coastal defence would need to be acceptable to NEMO.
Central Water and Sewerage Act	The Act restricts the pollution of any water by activities. It is important that water quality is monitored during the construction of any coastal works at Georgetown so that undue pollution of coastal waters can be avoided.
Draft Environmental Management Act 2009	This environmental impact assessment conducted for Georgetown coastal defense works will inform any decision that the Department of the Environment in SVG will need to make.
Draft Environmental Management (Pollution) Regulations, 2009	This environmental impact assessment conducted for Georgetown coastal defense works will inform any decisions that the Department of the Environment in SVG will need to make with respect to the prevention and mitigation of pollution of the environment at Georgetown during construction.
Draft Environmental Impact Assessment Regulations, 2009	Once this draft regulation is enacted, all projects will be required to follow the guidelines presented for conducting an EIA in SVG. Although this regulation is still a draft, the Consultants have reviewed these criteria and found them to be standard or similar to EIAs in other jurisdictions.
Environmental Health Services Act, No 34 of 1996	Part III of the Act also states that the Chief Environmental Health Officer may require that an application be submitted for certificate of approval for activities that may cause discharge, contamination or pollution of any part of the environment. Part III of the Act also restricts persons from dumping or otherwise depositing or leaving any refuse in any public or open space. Suitable solid waste management during construction of any defense

Legislation/Regulation	Comments
	structures will be a recommended.
Beach Protection Act, 1987	The Authority may grant permission for the removal of material providing specific conditions that are deemed fit to impose. Any dredging of sand that may be proposed under the project would need to be approved by the respective Government Agency.
Sea Turtle Recovery Action Plan, 1993	This project has taken into consideration likely impacts of proposed engineering works on turtle nesting. Mitigation measures to protect turtles that nest on the beach will be recommended.
Maritime Areas Act, 1983	Transportation of material and activities to be undertaken for any proposed engineering works should take into consideration pollution prevention and mitigation measures to protect coastal waters and marine life.
Fisheries Act 1989	Part IV, Section 17 of the Fisheries Regulations restricts the interference with any turtle nests. The regulation also outlines a 5 month closed season from March 1st to July 31st for turtle harvesting each year. The construction schedule and activities for any coastal defense structures will ensure that turtle breeding and nesting are not significantly affected or permanently displaced.
Waste Management Act, 2000	The Act outlines the conditions/ regulations under which Licenses and Permits may be granted. The Act also classifies and lists a number of hazardous wastes and the entities from which they may originate. Solid waste management will be taken into consideration during the construction phase of the project.

5.2 International Obligations

International law is much different from domestic law. Domestic law describes the rights and obligations of persons and their relationship to each other and the government. International laws set out the powers and obligations of nations not individuals.

Nations will sometimes sign non-binding statements of policy or principle. These may serve as a step towards future treaties. Nevertheless, both binding and non-binding international law may be felt in domestic situations. St. Vincent and the Grenadines have signed on to a number of such international environment related agreements; some relevant ones are outlined below.

1. **United Nations Framework Convention on Climate Change (UNFCCC)**

The main objective of this Convention is to stabilize the level of greenhouse gases in the atmosphere, to avoid triggering rapid climate change. By signing it each party pledge to work for the reduction of greenhouse gas (GHG) emissions, the protection of greenhouse gas sinks and reservoirs, and the mitigation of any effects of climate change. This project does not directly address GHG emissions but addresses climate change impacts. The proposed works have been design with the consideration that the coastline is affected by climate change impacts including seas level rise and increased intensity of tropical cyclone events causing storm surges.

2. Kyoto Protocol

The Kyoto Protocol represents the first binding reduction target under the United Nations Framework Convention on Climate Change (UNFCCC). Under the Protocol, developed countries (Annex I Parties) agreed to reduce their emissions of greenhouse gases (GHGs) by at least 5% below 1990 levels (Art. 3.2). Individually, each Annex I Party agreed to a specific reduction target to achieve the overall goal.

Obligations of Annex I Parties to developing countries are set out in Articles 2.3, 3.14, 10, and 11. Article 2.3, in combination with Article 3.14 requires Annex I countries to strive to minimize adverse effects on other Parties. This includes the issue of adaptation to the adverse effects of climate change such as sea level rise and extreme weather events. Currently, this project already feeling the impacts of climate change aims to mitigate against the coastal damage climate change causes.

3. The Convention on Biological Diversity

The conservation of ecosystems is also promoted through general obligations for the identification and monitoring of important components of biological diversity (Article 7). Parties are required to identify processes and categories of activities which may have significant adverse impacts on the conservation and sustainable use of biological diversity. Environmental impact assessment obligations are set out in Article 14. This report represents the EIA being done for the proposed works to ensure the impacts from the proposed works are minimal and if any, reversible.

4. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their disposal

This convention is the response of the international community to the problems caused by the annual world-wide production of hundreds of millions of tons of waste. These wastes are hazardous to people or the environment because they are toxic, poisonous, explosive, corrosive, flammable, eco-toxic, or infectious.

This global environmental treaty strictly regulates the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner. Recommendations have been made for hazardous waste management during the construction phase of the project.

6 DESIGN OPTIONS

The Coastal Engineers developed a number of engineering design options, which aim to provide the following functions: reduce coastal erosion, protect land and property, promote beach accretion, reduce vulnerability of the people and the infrastructure they depend on, provide socioeconomic opportunities to the community during and after implementation, and add aesthetic and environmental value to the community.

For the purposes of the design, the project area has been split into Sector 1 and Sector 2. Sector 1 extends from Langley Park River to just north of the playing field and is inclusive of the Georgetown headland. Sector 2 runs from just north of the playing field to Black Point, Figure 6.1 Illustrates.

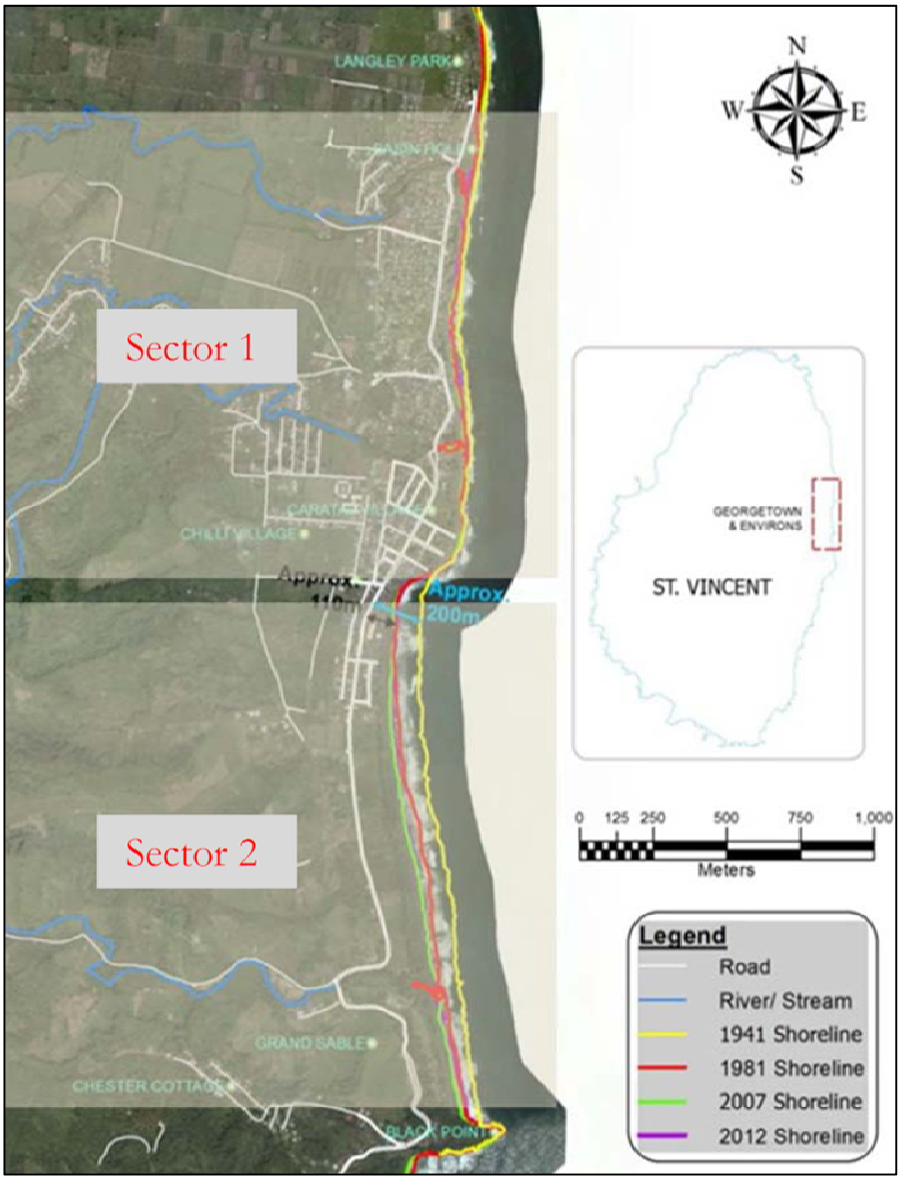

Figure 6.1: Sectors Identified for Development of Options (Source: Task 2 Report)

Sections 6.1 and 6.2 below outline all the options that are being considered for Sector 1 and Sector 2 of Georgetown. The feasibility of each option was qualitatively assessed in terms of the following aspects:

- Effectiveness
- Environmental
- Social
- Technical

- Economic
- Financial
- Spatial

6.1 Sector 1: Summary Option – North of Georgetown

This sector runs from Langley Park River to just north of the playing field and is inclusive of the Georgetown headland where land is to be developed to accommodate a government building. This sector of the shoreline consists of irregular undulating cliffs, as shown in Figure 6.2, which are composed of cobbles and pebbles mostly coming from Rabacca River and the eroding cliffs themselves. Note that the shoreline in this sector does not consist predominantly of sand as the eroding beaches have lost sand, leading to an armouring of the shoreline and an increase in the number of cobbles and boulders. The cliffs in the backshore of this section are also eroding.

Figure 6.2: Irregular and undulating cliffs composed of cobble stones along Sector 1 (Source: Task 2 Report)

Table 6.1: Summary of Options for Sector 1 (North of Georgetown) (Adapted from Task 2 Report)

Option	Pros	Cons	Cost US$ m
1 – Do nothing	No capital outlay required	On-going cliff erosion and loss of infrastructure	0
2 – Armour stone revetment with pebble beach	Reduced vulnerability Requires smaller armour stone Construction ease Pebbles transported landward during hurricanes which reinforce revetment Boulders easily obtainable and cost effective Promote beach growth Maintenance cost reduced	Public resistance to using pebbles as shore protection Sustainability of project depends on availability of sediment from rivers Loss of potential reclaimed land as revetment needs to be constructed further inland for beach accretion	6.4

Option	Pros	Cons	Cost US$ m
	over time		
3 – Armour stone revetment without beach	Established and recognized structure for shore protection Boulders easily obtainable and cost effective	Uses larger armour stone Beach will be lost after storm events Negative visual impact Additional material and /or toe excavation needed to protect the toe of the revetment due to more wave impact and scour Possible toe failure if toe of revetment not built several meters below mead sea level.	9.6
4 – XBloc revetment without beach	Smallest footprint Community employment Does not require maintenance More appropriate to withstand damage from larger waves Requires less material than amour stone revetment as the layer thickness is smaller and structure slope is steeper	Requires specialized expertise to construct Possible toe failure is no nourishment is used and if toe of revetment not built several metres below mean sea level Negative visual impact	17.3

The preferred option for Sector 1 is Option 2 (i.e. rock revetment in combination with a cobble beach) (Figure 6.3 illustrates). This option had the highest score in the feasibility assessment and it is the only option that significantly improves the appearance and potential use of the coastal stretch.

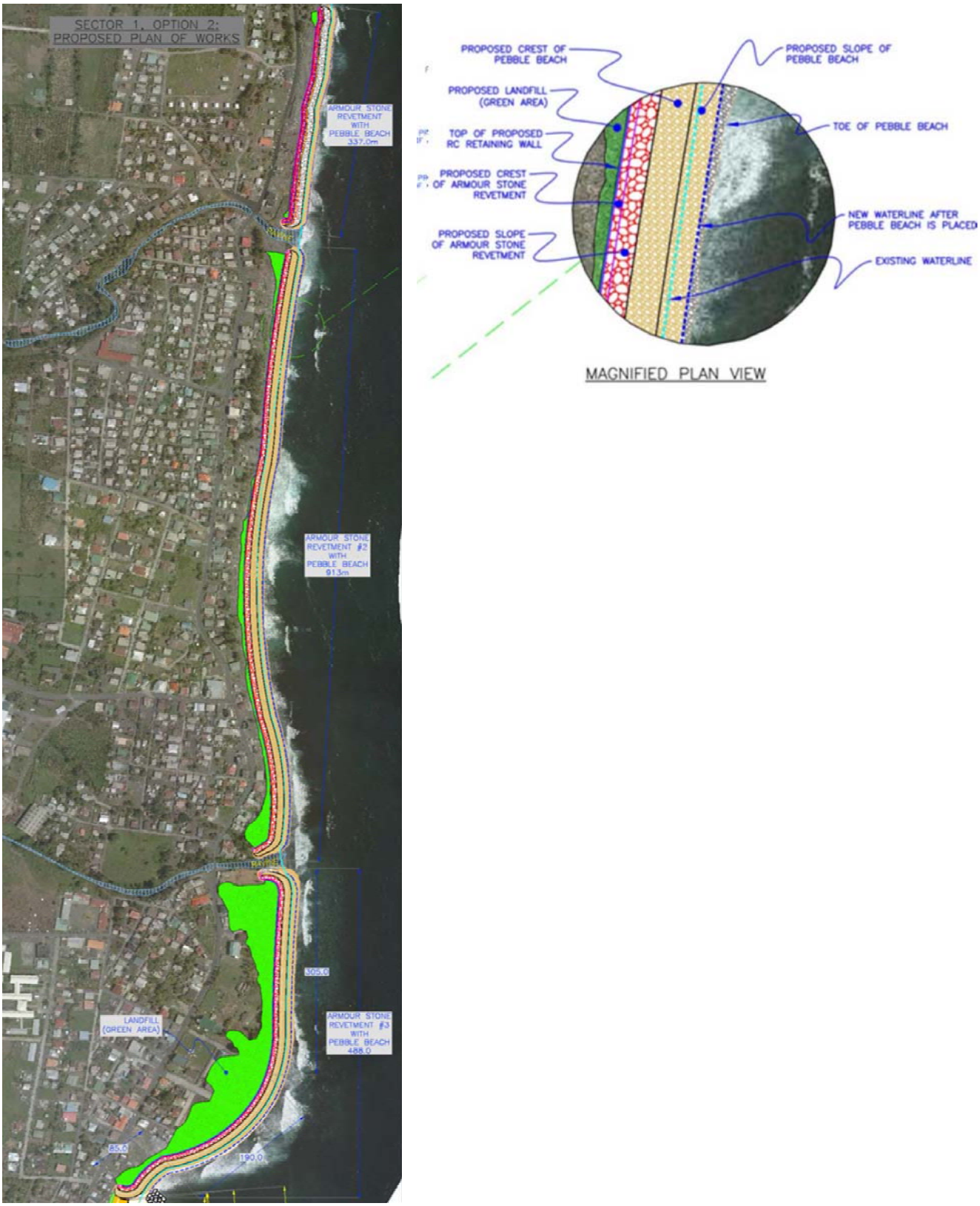

Figure 6.3: Preferred Option for Sector 1 – Protective Armour Stone Revetment/Buffer Zone & Nourishment (Source: Task 2 Report)

6.2 Sector 2: Summary Option – South of Georgetown

Sector 2 runs from just north of the playfield south to Black Point. This sector of the shoreline consists of sand only with some pebbles in the surf zone. There is an abrupt transition from the cobbles/boulders/sand mixture to sand-only at the northern end of the playfield (Figure 6.4).

Figure 6.4: Transition between pebbles to the north and uniform coast with volcanic sand to the south (Source: Task 2 Report)

Table 6.2: Sector 2 – Summary Options - (South of Georgetown) (Adapted from Task 2 Report)

Option	Pros	Cons	Cost US$ m
1 – Do nothing	No capital outlay required	On-going beach erosion and loss of infrastructure	0
2 – XBloc groynes (9) with beach nourishment	Shoreline is stabilized – more appropriate for larger wave resistance XBloc groynes require no maintenance Minimal environmental impact if sand is dredged from offshore Provides recreational space including salt water pool near Georgetown playfield Structures for pool will act as breakwater Shoreline in the lee of works will have reduced vulnerability to waves and lessened beach erosion Sand and gravel readily available from Rabacca Local labour opportunity	XBloc groynes require specialized contractors Requires heavy construction Requires much material Negative environmental impact is sand is mined from rivers Costly if sand is dredged from offshore	23.4

Option	Pros	Cons	Cost US$ m
	Maintenance reduced over time		
3 – Xbloc groynes (4) with beach nourishment	Same as Option 2 Less visual impact Requires less rock material for construction Fewer groynes and more nourishment - more environmentally friendly than option 2	Same as Option 2 Requires more sand than Option 2 Expensive due to nourishment from dredge	17.7
4 – Cofferdam groynes (9) with beach nourishment	Small footprint Can be filled in-situ Used on other Caribbean location Gravel and stones locally available Flexible design Fast installation Cheaper option Provides recreational space including salt water pool near Georgetown playfield	Steel sheet piles will require maintenance Unknown geotechnical conditions may, preclude design Negative visual impact Steel piling has limited service life Installation risk due to boulders and rock Requires a gravel source	9.4
5 – Geotube groynes (9) with beach nourishment	Least-cost solution Provides recreational space including salt water pool near Georgetown playfield Must be filled in situ Used on other Caribbean location Locally available material Flexibility in design Fast installation	Geotubes may be damaged by rolling rocks within the surf zone Negative visual impact Once damaged requires maintenance Not the best in withstanding 1 in 100 and 1 in 105 year events Requires and sand and gravel source	6.2
6 – Beach nourishment	Minimal visual impact	On-going re-nourishment is essential Funding options may preclude this option	10

Figure 6.5 shows and example of the interlocking XBlocs that will be used to create the groynes in options 2 and 3 in Sector 2.

Figure 6.5: 1) Example of Interlocking XBlocs, 2) Example of Double-Wall Sheet Pile Cofferdam, 3) Example of Geotube

The preferred option for Sector 2 is Option 3 (100m long conventional groynes with XBlocs) (Figure 6.6 illustrates). Based on the feasibility assessment, it scored slightly higher than the other options.

Out of the EIA conducted, it was suggested that the preferred design included a bathing area to be constructed in the Black Point area for recreational swimming. This was based on the requests from community residents who complained that the sea at Black Point is rough but it is the only available recreational swimming point in the area. Subsequently, meetings were held with the coastal engineers and the clients who shifted the swimming area from Black Point to near the playfield at Georgetown, as this was seen as a safer location based on current patterns.

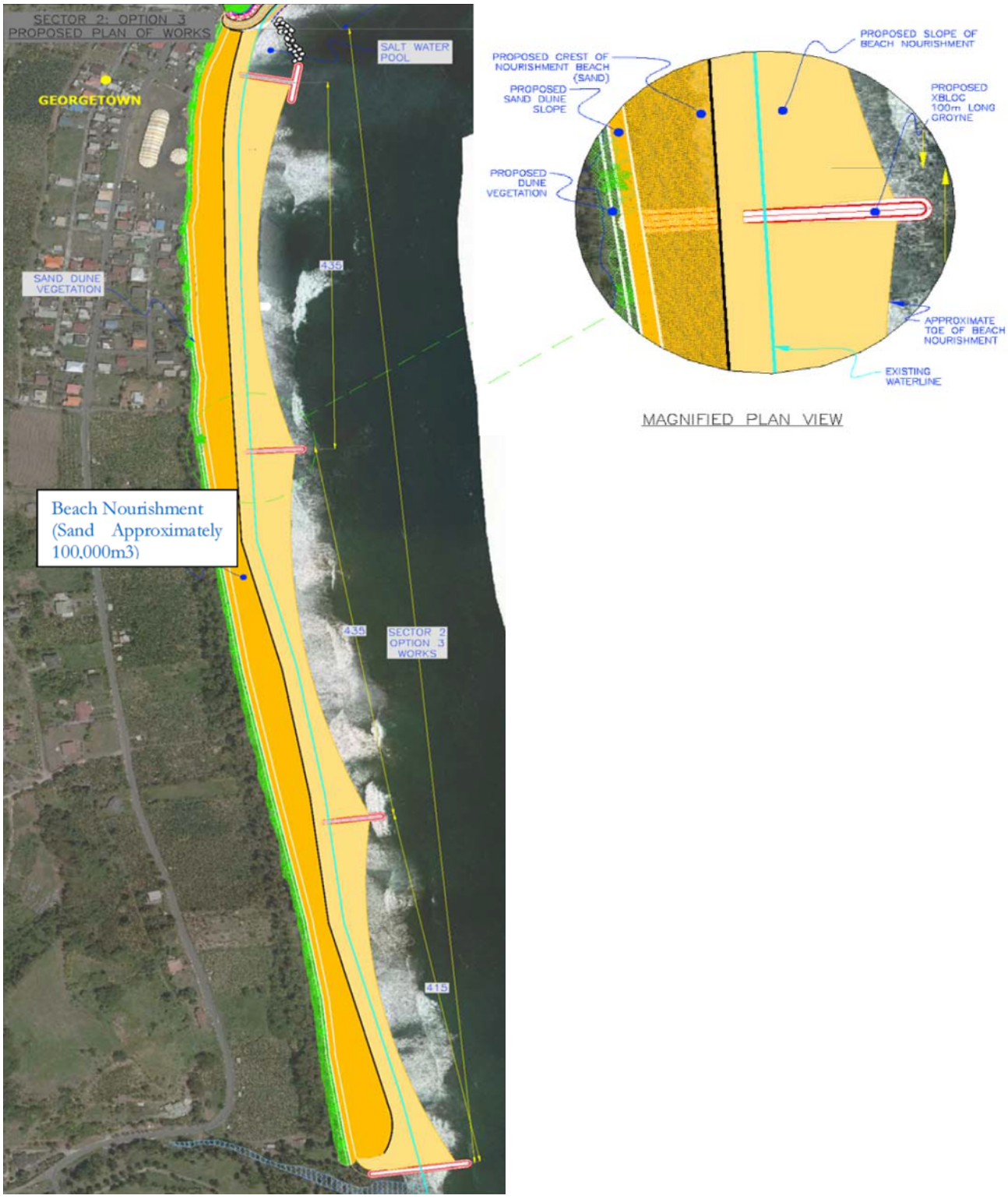

Figure 6.6: Preferred Option for Sector 2 - Option 3 Longer XBloc Groynes, Nourishment and Dune Fencing (Source: Task 2 Report)

7 ASSESSMENT OF IMPACTS

The two preferred options for Georgetown are as follows:

1. Option 2 for Sector 1 which includes: rock revetment in combination with a cobble beach (Figure 6.3 illustrates).
2. Option 3 for Sector 2 which includes: 100m long conventional groynes with XBlocs and beach nourishment (Figure 6.6 illustrates).

The construction and operation phase impacts are outlined below which largely relate to the abovementioned preferred options. The impacts also apply to the other options. Appendix IV elaborates in a table format a detailed assessment of the impacts of all the options presented for Sector 1 and 2.

7.1 Construction Phase Impacts

Outlined below are the ecological and socioeconomic aspects that the various activities will potentially impact.

Ecology

Coastal vegetation will be removed during the construction period. Beach fauna as described in Section 3 above are likely to be negatively affected; however, it is the turtles that are of most significance. Turtle nesting will likely be hindered due to the level of activity along the coastline and some migration of turtles may take place. Peak nesting for turtles occur during March 1 to July 31 along the Georgetown coastline and the contractors and engineers should be cognizant of this when developing the schedule for construction activities.

Tri-tri fishing that usually occurs at the mouth of the Black Point River will have to be discontinued during the period of construction as this will be negatively affected. It is also important that persons are protected from hazardous construction activity.

Mitigation measure:

1. Any turtle found nesting during the construction period should be protected and not killed.
2. Mark turtle nesting spots where needs to be avoided and educating staff.
3. The management of lighting so that they are not shone directly towards the sea to distract turtles because they are guided by moonlight.
4. Appropriate signage need to be put in place and community informed that tri-tri fishing will need to be halted for the duration of construction.

Population and Housing

Both the options presented for Sector 1 and Sector 2 of Georgetown will involve the protection of residential dwellings and persons living along the coastline. No relocation will be required for any of

these residents as the coastal works are not in the direct path of any residences. As such, not compensatory measures are considered. During construction, residents may likely experience some discomfort from dust, noise and traffic nuisances from the trucks related to construction activities. This is a short term impact and these issues will recede at the end of construction.

Dust

Stockpiles of fine materials for construction activities in Georgetown may generate excessive levels of fugitive dust, particularly under dry and windy conditions. Respirable particulates are a public health hazard and may otherwise create considerable nuisances to the public.

During the proposed construction activities residential dwellings along the immediate coastline in Georgetown will likely experience higher than usual fugitive dust levels. This situation will be temporary and with proper mitigation should be effectively mitigated. It is important to minimize and control dust and exhaust emissions to reduce the impacts of construction on air quality.

Mitigation measures:

1. Dampening of exposed surfaces during dry periods should be implemented as part of the site activities during construction, particularly for the revetment which will involve works along the roadside of Georgetown.
2. Covering of stockpiled fine material.
3. Cover materials transported in open trucks.
4. Open burning of solid wastes will not be conducted as these generate polluting emissions which cannot be controlled effectively.
5. The most common pollutant involved in fugitive emissions is dust or particulate matter (PM) (IFC, 2007). It is recommended that PM10 be monitored in µg/m3 using the WHO's ambient air quality guidelines and the World Bank (WB), Environmental Health and Safety Guidelines (EHSG), during the construction period (IFC, 2007). PM can be generated from transport, open storage of solid materials, and from exposed soil surfaces, including unpaved roads.
6. During the construction period the beaches as well as all the construction equipment will be vulnerable to storm surges. As a result, it would be prudent to time the construction activities outside the hurricane season.
7. Standard operating practices for construction should be adhered to: E.g. restricting the time of day that such activities (during work hours). World Bank (EHSG) has a 55 dBa daytime limit and a 45 dBa night-time noise limit for residential areas and a 70 dBA limit for commercial and industrial areas for both day and night time (IFC, 2007). It is recommended that daytime activities for a construction site be less than 70 dBA.

Noise

The noise level is expected to increase during site preparation and construction with the use of heavy machinery and dredging equipment. These impacts are temporary and would not occur outside of equipment operation.

It is important to minim7ize the noise and vibration impact during construction and ensure compliance with any Permits granted.

Mitigation measures:

1. Advise neighbouring properties at least 24 hours in advance of planned noisy activities, for example drilling.
2. Confine construction activities within normal operating hours (i.e. 7:00 Am - 6:00 Pm Monday to Friday and 8:00 am - 6:00 pm on Saturdays) or as stipulated by any Permit granted.
3. Noise should be monitored according to the IFC Environmental Health and Safety Guidelines (2007) published by the World Bank. For residential areas the standard is 55 dBA limit for daytime noise and 45 dBA limit for night time noise. For commercial and industrial areas the standard is 70dBA for both night time and day time. It should be noted that a noise level less that 70dBA is the standard for a construction site. A noise baseline in both Georgetown would need to be conducted prior to construction so that monitoring values can be measured against.
4. Vehicles and equipment used should be serviced to reduce noise levels.

Occupational Health and Safety

The construction activities will provide local labour in the construction of any of the options presented in Section 6. In some cases skilled labour would be critical to operate machinery. This employment will be temporary and will cease after construction is complete. It is not possible to estimate the number of persons likely to be hired or the duration of construction at this time.

Some risk is posed to these workers during construction, these include issues related to the following list and the corresponding mitigation measures to reduce risk.

1. Water quality and availability on site for use
2. Structural safety of project infrastructure
3. Life and fire safety (l&fs)
4. Traffic safety
5. Transport of hazardous materials
6. Emergency preparedness and response

Mitigation measures:

1. Water quality and availability on site for use

a) Sanitary practices in regard to providing potable water and the disposal of human waste should be enforced to safeguard worker health.
b) Potable water supply on site should be available for workers

2. *Structural safety of project infrastructure*
    a) Worker safety should be protected implementing safe site practices.
    b) Wearing of the appropriate protective gear on site should be stipulated and mandatory.
    c) Construction crews should be provided with the appropriate safety gears such as hard hats, gloves, safety shoes, reflector vests where appropriate, etc.
3. *Traffic safety*
    a) Emphasize safety aspects among drivers
    b) Improve driving skills and requiring licensing of drivers
    c) Adopt limits for trip duration and arranging driver rosters to avoid overtiredness
    d) Avoid dangerous routes and times of day to reduce the risk of accidents
    e) Use of speed control devices (governors) on trucks, and remote monitoring of driver actions
4. *Emergency preparedness and response*
    a) In case of emergency, inform public and emergency response agencies, document first aid and emergency medical treatment, take emergency response actions, review and update the emergency response plan to reflect changes and ensure that the employees are informed of such changes.
    b) Emergency assembly point identified on construction site in case of emergency
    c) Identification of equipment storage area in the event of tropical cyclones
    d) Employees should be trained in any relevant emergency procedures such as those relate to storms, fires and other hazards.
    e) Ensure easy access for all emergency numbers including, fire service, ambulance

Sewage treatment

It is important to ensure a clean hygienic construction site.

Mitigation measures:

1. Install adequate numbers of portable toilets, so that solid and liquid human wastes will be contained and transported to an existing approved waste treatment plant.
2. Where appropriate, ensure that only waste contractors approved by the Local Health Authority are engaged in the removal of waste from the site.

Hazardous waste management

Hazardous materials/liquids used on site should be handled appropriately.

Mitigation measure:

1. Inspect (daily) all vehicles and equipment for potential leakage of fuel, oil, hydraulic fluid or coolant. Any machinery found to be leaking will be repaired or replaced.
2. Hazardous materials such as fuels and oils should not be stored near storm water drains.
3. Provide appropriate signage and security for all storage of dangerous goods. All incompatible materials will be segregated.
4. Provide Material Safety Datasheets (MSDS) for dangerous goods used or stored on-site. Personnel will to be made aware of the environmental and safety requirements for these hazardous materials.

Community Health and Safety

During the site visits and community consultations, it was noted that swimming recreationally took place at Black Point. Swimming activities will be impeded during the construction period. Dredging activities that will support groyne construction in Georgetown and Black Point specifically will impact negatively water quality increasing the turbidity making it unsafe for swimming activities. Construction will pose a hazard to those desirous of swimming at the Black Point beach or other area along the Georgetown coastline.

The playing field at Georgetown will also likely be out of use for the duration of construction, landfilling and beach nourishment activities.

Mitigation measures:

1. Placing of appropriate signage in each location to restrict access to the site.
2. Notify community residents of activities that will take place, the likely impacts and the restrictions necessary. Indicate a timeline to residents so that they are aware of the length time for displacement.
3. Caution signs and other critical safety signs to guide community persons as well as vehicular traffic need to be erected to avoid unwanted accidents.

Transportation

The transportation of heavy boulders and sand from quarry site at Rabacca to the project construction sites is likely to result in a number of negative impacts as follows:

- Road congestion and possible damage
- Removal of structures and creation of temporary roadways for access to the shoreline
- The creation of temporary erosional features and other undesirable earth movements
- Excessive dust and noise creation
- Personnel accidents and other human vulnerabilities due to heavy construction traffic
- Improper disposal of waste materials

- Continuation of sand mining in the Rabacca River bed

The mitigation of all of these impacts may pose a considerable challenge and communities affected will have to be advised of the likely negative impacts and the need for certain behavioural adjustments. The period of adjustments to mitigate construction impacts as much as possible cannot now be determined but is likely to last for several months.

Mitigation measure:

1. Trucking material on site during off-peak periods.
2. Appropriate signage during construction such as signs indicating "Danger - Heavy Equipment Traffic Area, No Unauthorized Vehicles Permitted"
3. Ensure that trucks are not overloaded to prevent road damage
4. Ensure that trucks carrying material are properly covered to ensure that material does not litter the road or cause a dust nuisance or damage to pedestrians or housing and business along the truck route. Materials falling off truck may become dangerous hazards to persons and businesses along the Georgetown route it travels.
5. Ensure that road rules are followed, drivers are qualified, and that trucks are not over the load limit to reduce risk of accidents.

Coastal and Physical Hazards

High wave action and storm surge have significantly impacted the Georgetown coastline over the years leading to the loss of dwellings, community amenities, and coastal structures and roadways. The preferred coastal protection designs are based on the 150 year event, other options namely the cofferdam groynes and geotube groynes are not guaranteed to withstand a 100/150 year event. It is anticipated that when these measures are completed the community will no longer suffer these negative impacts.

The Georgetown coastline is exposed to storm wave and surges during the hurricane season. It is important that caution be taken during this period to prevent the loss of equipment stored on site during construction.

Mitigation Measure:

1. The construction activities can be scheduled in such a way that major construction activities take place outside the typical June to November hurricane season.
2. Should any activity take place within this season, the Site manager should caution and be on the alert of any hurricane or storm threats St. Vincent is faced with.
3. Site manager to ensure that equipment are properly stored away from the coastline, residents and roadways should there be a hurricane or storm event to prevent damage to others should the equipment become a hazard.
4. Ensure that the natural drainage remains unimpeded.

Solid Waste Management

Solid waste generated during the construction phase may include a variety of construction waste material, putrescible waste, plastic and glass.

Solid waste should be properly stored on site at all times during construction and disposed of at an approved disposal site.

Mitigation measures:

1. Designate a waste collection area, where a container can be kept for the collection of site waste.
2. Refuse bins should be placed on site to meet the needs of the workforce
3. The waste container will be coated with a waterproofing material to prevent the escape of fluids.
4. The stored waste should be covered to prevent rain water from flooding the waste and overflow the container.
5. Arrange for the collection of solid waste by certified contractors and disposal at an approved site
6. Any hazardous waste should be separated and stored in areas clearly designated and labelled
7. Garbage storage area will always be kept clean.
8. If a bin is damaged, the contents will be transferred to another container in good condition.

Dredging and disposal of spoil

The construction of groynes and breakwater in Sector 2 of Georgetown will require some amount of dredging. It is anticipated that dredged material will be utilized as part of the sand nourishment in Sector 2 of Georgetown. Off shore dredging is proposed as a source of sand for the beach nourishment along Sector 2 of the Georgetown coastline.

Mitigation measures:

1. Identification of appropriate and approved site for disposal of excess dredged material.
2. Testing of material prior to disposal at an approved site to ensure that there are no contaminants.

7.2 Operational Impacts

Ecological

On the landward side of the preferred revetment options, vegetation will be planted as a soft measure to support the constructed features.

The preferred option, which includes beach nourishment, would facilitate turtle nesting along the length during the long term. Beach fauna which was originally sparse will revert to normal conditions after construction is complete. No long term negative impacts are anticipated as a result of the preferred options.

Tri-tri fishing can also be resumed following construction as none of the options hinder the flow of the river to the sea, which is where these are caught. It is important to highlight that water quality issues raised in Chapter 3 for the rivers including Black Point remain a challenge.

Population and Housing

The coastal defence structures will provide a positive improvement for the entire coastal area of Georgetown. Residents located along the coastline would be protected with structures expected to withstand a 150 year event should the preferred options recommended be utilized. This will lower the hazard risk faced by the communities.

Recreation

The protection and enhancement of the football field in Georgetown will be a benefit arising from the coastal works and road protection proposed.

A Salt Water pool will be created near the Georgetown Playfield to enhance the swimming facilities. Black Point was always highlighted as major recreational park in the community, however, based on consultations with the client, Black Point was seen as an unsafe area and they expressed great desire for the Salt Water Pool to be created for swimming north of the playfield. The revetment, groyne and breakwater will be used to facilitate the pool as well as form part of the coastal protection for the area, stabilizing the beach thus enhancing the recreational and other community activities in the area.

Transportation

Although the Georgetown coastline does not come right up to the Windward highway, a number a small community road will be protected from the proposed revetment and landfill, this particularly refers to Sector 1. Coastal erosion would be reduced and areas that have some land protecting the Windward road on the seaward side would be protected and prevent further erosion and potential risk of losing the critical Windward Highway.

Coastal and Physical Hazards

Defense structures erected will have a positive long-term impact on the entire coastal area of Georgetown including: dwellings, commercial structures, recreational areas, and roadways.

Over-time, there may be deterioration of the structures recommended under Sector 1: options 1 and 3 and Sector 2: options 1, 4, 5 and 6, due to intense wave action and storm surges.

Precautionary signs may be put on site post construction, where necessary, for safety reasons.

Sand Reclamation/ Beach Nourishment

It is recognized that sand nourishment proposed in some of the options for Sector 1 and 2 may be at risk from illegal sand mining, which would lead to loss of sand.

7.3 Summary Risk

The greatest risk involved is that related to the construction phase rather than operational phase. Many of the risks are moderate to high and can be altered with the introduction of the mitigation measures outlined for each environmental aspect above. There is expected to be minimal ecological impacts. The only excepted risk is associated with the possible temporary displacement of turtle nesting. The potential impacts and risk posed to neighbouring people, residences, businesses and workers is significant.

Based on the nature of the project, there are no real preventative measures because the type of risk brought about by construction impacts. However, several mitigation measures have been recommended, as indicated above, to reduce the likeliness of the potential negative impacts and to reduce the level impact to more tolerable levels.

8 MONITORING

Environmental monitoring of construction activities relates to environmental legislation and regulations, permits and authorizations, sediment control, deleterious substance control, air, noise and water quality assessments, habitat management, site and habitat restoration, environmental management plans. Effective environmental reporting and diligent professional practice are critical to the monitoring programme that is implemented during any major construction.

Environmental approval is needed in St. Vincent and the Grenadines before major industrial or developmental activity. Following approval, the client is required monitor the construction phase and operation phase to ensure that all proposed mitigation measures are put in place to reduce negative impacts on the environment and nearby residents and businesses.

The aim of this Monitoring Plan is to ensure the following:

- compliance with relevant legislation
- implementation of the mitigation measures provided in the EIA submitted to the Client and regulatory agencies
- conformance with any General or Specific Conditions of permit issues by the Department of Environment (DoE), SVG
- long-term minimization of negative environmental impacts

8.1 Components of the Monitoring Programme

The following sections present the basic requirements of a typical environmental monitoring plan.

8.1.1 Initial Project Team Consultations

Prior to commencement of the project, a meeting should be convened between the client, the DoE and the Consultants monitoring the project to review the monitoring plan in detail and to agree on its purpose, mode of implementation, and the procedures for monitoring and reporting. This meeting should also include a review of the construction schedule and methodologies.

8.1.2 Monitoring Frequency and Reporting

For the duration of the construction works it is likely that the project site will typically be inspected and monitored, once per month for the first three months of the construction phase, followed by quarterly monitoring. This frequency will depend on the requirements of terms and conditions set by the DoE.

Monitoring during operation would be determined by the DoE but based on the nature of the construction works, will not likely be more frequently that on an annual basis. All quantitative data collected during the monitoring events should be analyzed and a report prepared and submitted to the client and to DoE.

8.1.3 Monitoring Standards

Environmental monitoring for the development will be in accordance with the relevant World Bank standards, USEPA standards and approved methods for sampling as outlined in each relevant programme.

- WHO Air Quality Guidelines as references in IFC's (World Bank) 2007 Environmental Health and Safety Guidelines - PM10 (150 g/m Interim target-1; 100 g/m Interim target-2; 75 g/m Interim target-3; 50 g/m guideline)
- WHO Noise Guidelines as references in IFC's (World Bank) 2007 Environmental Health and Safety Guidelines – 70dBA or should not increase 3 dBA above background levels
- USEPA Water Quality Standards for Enterococci
- NRCA ambient marine and fresh water quality standards for Conductivity (mS/cm), Total Dissolved Solids (mg/L) pH, Biochemical Oxygen Demand (mg/L), Total Coliform (MPN/100ml), Faecal Coliform (MPN/100ml)

8.1.4 Equipment Calibration

All equipment should be used for the collection of quantitative data and will be calibrated before and after each set of readings with a calibrator that has been pre-calibrated at production. The calibration certificates should be submitted with each monitoring report.

8.1.5 Construction Phase Monitoring Tasks

The project areas to be monitored will be determined and specified.

8.1.5.1 Materials Sourcing and Transport

Objectives:

1. To ensure project does not induce indirect environmental impacts due to illegal quarry operations.
2. To ensure that transport of earth materials does not cause undue spillage or dusting.

Tasks:

- Through Contractor, examine licenses to verify that earth materials are supplied from approved quarries anticipated to be Rabacca River.
- Confirm that material in trucks as they traverse the property is covered with tarpaulin and that tailgates are closed during transport.

8.1.5.2 Construction Works

Objectives:

1. To maintain sites in tidy manner with adequate sewage and garbage facilities.
2. To ensure that the general construction site works do not exceed air quality standards for respirable particulates (PM10, See Section 8.1.3) or create other environmental problems.

Tasks:

- Inspect construction sites to verify provision and use of garbage receptacles and VIP or chemical toilets for worker use.
- Inspect equipment maintenance yard and ensure that marl base is laid to absorb spilled oil and lubricants.
- Inspect site to ensure that fine construction materials are stored and covered/contained without risk of being washed into drains.
- Inspect site and verify that dust is adequately controlled by wetting.
- Measure noise levels and respirable particulates.

8.1.5.3 Solid Waste Management

Objective:

To ensure that solid waste generated at sites during the construction phases are disposed of in an environmentally acceptable manner.

Tasks:

- Verify use of identified disposal site by contractor.

- Inspect sites to ensure that construction wastes/garbage are not being scattered over the site or deposited in the nearby drains/rivers/sea.
- Inspect site to ensure provision of adequate numbers of garbage receptacles.

8.1.5.4 Water Quality

Indicator parameters for nutrients, organics and bacteria are usually monitored within water bodies at the project site to control the discharge of sediments and pollutants from construction activities.

Objective:

To determine whether quality of surface waters are being adversely affected by construction activities (at sampling stations selected to reflect water quality at project sites)

Tasks:

Measure water quality at specified sites on a monthly basis, prior to and throughout the duration of the construction phases. The parameters to be measured will be as stipulated by approval conditions set by the DoE, SVG.

8.1.5.5 Ambient Air Quality

Various categories of construction activities will generally produce windblown dust as the site is cleared and exposed surfaces are created on the site. High dust levels can lead to complaints from neighbours.

Objective:

To determine whether air quality is being adversely affected by construction activities (at sampling stations selected to reflect air quality at project sites and at receptor sites of nearby residents/businesses)

Task:

Air monitoring equipment that measure particulate matter are generally set up to monitor the 24 hour dust levels at the site so the developer will be cognizant that the site may require greater levels of mitigations such as more frequent wetting of marled surfaces.

8.1.5.6 Noise

Noise monitoring at construction sites is usually done to determine if the construction activities exceed recommended standards beyond the boundaries of the site. In other words environmental monitoring for noise can advise if the activities are nearing nuisance levels and / or whether complaints are valid.

Objective:

To determine whether noise levels are being adversely affected by construction activities (at sampling stations selected to reflect noise levels at the boundaries of the project and at receptor sites of nearby residents/businesses)

Task:

The relevant mitigation measures such as screening and servicing of equipment will normally be implemented by the developer at large construction sites such as the proposed project.

9 CONCLUSION

It is clear from the impact assessment that the negative impacts from the proposed works largely occur during the construction phase of the project cycle. These impacts largely relate to possible displacement of turtle nesting, air and noise impacting nearby residences and businesses, poor coastal water quality, improper solid waste, improper sewage and hazardous waste disposal, worker health and safety, general site safety, transportation and coastal and physical hazard issues. Mitigation measures have been identified to address all the impacts identified. With these measures in place, the project can be carried out successfully without significant negative impacts to the environment and community.

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APPENDIX I - TABULATED WATER QUALITY RESULTS

Table 1: Results of Georgetown's Sea Samples – June 25, 2013

PARAMETERS	TEST METHOD	SAMPLE			NRCA /USEPA AMBIENT MARINE WATER QUALITY STANDARDS
		BP Sea	G Town P	Rabacca S	
Temperature (˚C)	DR	19.1	18.5	19.5	-
Conductivity (mS/cm)	DR	61.6	61.3	61.5	-
Total Dissolved Solids (g/L)	DR	39.1	39.1	39.0	-
Total Suspended Solids (mg/L)	SM-2540D	74.6	8.9	32.6	-
Salinity (ppt)	SM-2520B	40.7	41.0	40.8	-
Dissolved Oxygen (mg/L)	DR	9.45*	9.22*	9.32*	-
Total Coliform (CFU/100ml)	SM-9222B	≥4.2 x 10^2	<10	E 30	**2.0 x 10^0 – 2.56 x 10^2**
Faecal Coliform (CFU/100ml)	SM-9222D	<1.0 x10^2	<10	<10	**<2 x 10^0 – 1.3 x 10^1**
Enterococci (CFU/100ml)	SM-9230C	<10	<10	<10	**35**
Total Phosphorus (mg/L)	SM-4500P-E	<0.01	<0.01	<0.01	-
Turbidity (NTU)	DR	3.54	2.49	6.19	-
Manganese (µg/L)	F-AAS	24	33	28	-
Copper (µg/L)	F-AAS	56	53	51	-

KEY:

DR – Direct Reading
HACH - HACH Water Analysis Handbook 7th edition
SM -Standard Method of the examination of water and wastewater 21st and 22nd editions
FAAS -Flame Atomic Absorption Spectroscopy
* -Readings taken at ESL QEH laboratory
E - Estimate: Plate count below lower limit of 20 CFU; <10 – No CFU observed @ 1:10 dilution; <1.0 x10^2 dilution; ≥ Total bacterial plate count including non- coliforms exceeds 200 (CFU); > -Plate count above upper limit of 80 CFU.

Quality Control – Analytical and Field duplicates, standard reference materials.

Table 2: Results of Georgetown's Sea Samples – October 8, 2013

PARAMETERS	TEST METHOD	SAMPLE			NRCA/USEPA AMBIENT MARINE WATER QUALITY STANDARDS
		BP Sea	G Town P	Rabacca S	
Temperature (˚C)	DR	28.80	28.85	29.35	-
Conductivity (mS/cm)	DR	52.01	51.35	51.26	-
Salinity (ppt)*	-	31.5	31.1	30.7	
Total Dissolved Solids (g/L)	DR	>20	>20	>20	-
Total Suspended Solids (mg/L)	SM-2540D	42.2	87.6	97.4	-
Biochemical Oxygen Demand (mg/L)	H-8043	1.2	1.4	2.3	
Dissolved Oxygen (mg/L)	DR	**	**	**	-
Total Coliform (MPN/100ml)	SM-9222	170	920	540	$2.0 \times 10^0 – 2.56 \times 10^2$
Faecal Coliform (MPN/100ml)	SM-9222	46	79	130	$<2 \times 10^0 – 1.3 \times 10^1$
Enterococci (CFU/250ml)	SM-9230C	≥ 2.7 x 10*	≥2.2x10*	≥9.0*	35
Total Phosphorus (mg/L)	SM-4500P-E	<0.01	0.02	<0.01	-
Turbidity (NTU)	DR	1.73	5.02	5.71	-
Manganese (µg/L)	F-AAS	41	13	56	-
Copper (µg/L)	F-AAS	60	17	71	-

KEY:

DR – Direct Reading

HACH - HACH Water Analysis Handbook 7th and 8th editions

SM -Standard Method of the examination of water and wastewater 21st and 22nd editions

FAAS -Flame Atomic Absorption Spectroscopy

* - the prsence of Enterococci was detected; however the actual value could not be determined due to confluent growth of the organisms

** - value could not be determined in the field due to techinal issues

*-value obtained by calcaluation

Quality Control – Analytical and Field duplicates, standard reference materials.

Table 3: Results of Georgetown's Sea Samples – March 11, 2014

PARAMETERS	TEST METHOD	SAMPLE			NRCA/USEPA AMBIENT MARINE WATER QUALITY STANDARDS
		BP Sea	G Town P	Rabacca S	
Temperature (˚C)	DR	27.33	26.94	27.76	-
pH	DR	8.17	8.19	8.31	8.00 -8.40
Conductivity (mS/cm)	DR	54.66	53.72	54.53	-
Salinity (ppt)	DR	34.43	34.01	34.05	
Total Dissolved Solids (g/L)	DR	34.02	33.64	33.70	-
Total Suspended Solids (mg/L)	SM-2540D	14.4	10.2	66.1	-
Biochemical Oxygen Demand (mg/L)	H-8043	1.4	2.2	1.5	0.0 - 1.15
Dissolved Oxygen (mg/L)	DR	7.13	7.43	7.05	-
Total Coliform (MPN/100ml)	SM-9222	1.8	7.8	<1.8	2.0 – 256
Faecal Coliform (MPN/100ml)	SM-9222	1.8	<1.8	<1.8	<2 – 13
Enterococci (CFU/250ml)	SM-9230C	8	12	<1	*
Total Phosphorus (mg/L)	SM-4500P-E	<0.01	<0.01	<0.01	-
Turbidity (NTU)	DR	1.03	0.72	9.50	-
Manganese (µg/L)	F-AAS	90	77	97	-
Copper (µg/L)	F-AAS	97	73	64	-

KEY:

DR – Direct Reading

HACH - HACH Water Analysis Handbook 7th and 8th editions

SM -Standard Method of the examination of water and wastewater 21st and 22nd editions

FAAS -Flame Atomic Absorption Spectroscopy

*- **The USEPA geometric mean marine water is 35 CFU /100ml**

Quality Control – Analytical and Field duplicates, standard reference materials.

Table 4: Results of Georgetown's River Samples – June 25, 2013

PARAMETERS	TEST METHOD	SAMPLE			NCRA AMBIENT FRESH WATER QUALITY STANDARDS
		BR River	L Park R	Caratal R	
Temperature (˚C)	DR	18.9	19.7	19.4	-
Conductivity (mS/cm)	DR	0.1785	0.2250	0.2320	150.0 – 600.0
Total Dissolved Solids (g/L)	DR	0.0944	0.1180	0.1320	120.0 -300.0
Total Suspended Solids (mg/L)	SM-2540D	7.3	20.3	10.2	-
Salinity (ppt)	SM-2520B	0.1	0.1	0.1	-
Dissolved Oxygen (mg/L)	DR	9.17*	8.86*	4.99*	-
Total Coliform (CFU/100ml)	SM-9222B	≥2.1 x10^3	≥8.9 x 10^4	>8.0 x 10^4	-
Faecal Coliform (CFU/100ml)	SM-9222D	E1.0 x10^3	≥1.0 x 10^3	≥1.5 x 10^4	-
Enterococci (CFU/100ml)	SM-9230C	4.3 x 10^2	E1.9 x 10^3	E30	-
Total Nitrogen (mg/L)	SM-4500N-C	0.3	5.1	0.9	-
Total Phosphorus (mg/L)	SM-4500P-E	<0.01	<0.01	0.02	-
Turbidity (mg/L)	DR	3.24	4.72	5.60	-
Manganese (µg/L)	F-AAS	<10	<10	23	-
Copper (µg/L)	F-AAS	<10	<10	<10	-

KEY:

H - HACH Water analysis handbook 7th edition
DR - Direct Reading
SM - Standard Method for the examination of water and wastewater 21st and 22nd editions
F-AAS - Flame Atomic Absorption Spectroscopy
* -Readings taken at ESL QEH laboratory
E - Estimate: Plate count below lower limit of 20 CFU ; <10 – No CFU observed @ 1:10 dilution;<1.0 x10^2 dilution; ≥ Total bacterial plate count including non- coliforms exceeds 200 (CFU); > -Plate count above upper limit of 80 CFU.

Quality Control – Analytical and Field duplicates, standard reference materials.

Table 5: Results of Georgetown's River Samples – October 8, 2013

PARAMETERS	TEST METHOD	SAMPLE			NRCA AMBIENT FRESH WATER QUALITY STANDARDS
		BR River	L Park R	Caratal R	
Temperature (˚C)	DR	25.70	26.38	25.53	-
Conductivity (mS/cm)	DR	0.138	0.135	0.135	150.0 – 600.0
Total Dissolved Solids (mg/L)	DR	71	69	89	120.0 -300.0
Total Suspended Solids (mg/L)	SM-2540D	48.2	15.6	40.8	-
Biochemical Oxygen Demand (mg/L)	H-8043	2.3	2.0	2.1	
Dissolved Oxygen (mg/L)	DR	**	**	**	-
Total Coliform (MPN/100ml)	SM-9222	>1600	>1600	>1600	-
Faecal Coliform (MPN/100ml)	SM-9222	>1600	>1600	>1600	-
Enterococci (CFU/ 250ml)	SM-9230C	≥3.3 x 10*	≥ 3.0*	≥ 5.0 *	-
Total Nitrogen (mg/L)	SM-4500N-C	<0.3	<0.3	<0.3	-
Total Phosphorus (mg/L)	SM-4500P-E	<0.01	0.02	<0.01	-
Turbidity (mg/L)	DR	14.1	5.53	16.6	-
Manganese (µg/L)	F-AAS	21	54	<10	-
Copper (µg/L)	F-AAS	<10	59	<10	-

KEY:

H - HACH Water analysis handbook 7th and 8th editions
DR - Direct Reading
SM - Standard Method for the examination of water and wastewater 21st and 22nd editions
F-AAS - Flame Atomic Absorption Spectroscopy
* - the prsence of Enterococci was detected; however the actual value could not be determined due to confluent growth of the organisms
** - value could not be determined in the field due to techinal issues

Quality Control – Analytical and Field duplicates, standard reference materials.

Table 6: Results of Georgetown's River Samples – March 11, 2014

PARAMETERS	TEST METHOD	SAMPLE			NRCA AMBIENT FRESH WATER QUALITY STANDARDS
		BP River	L Park R	Caratal R	
Temperature (˚C)	DR	26.50	29.46	27.11	-
pH	DR	8.72	8.15	8.22	7.00 – 8.40
Conductivity (mS/cm)	DR	0.188	0.145	0.224	150.0 – 600.0
Total Dissolved Solids (mg/L)	DR	119	87	140	120.0 -300.0
Total Suspended Solids (mg/L)	SM-2540D	4.5	25.8	11.8	-
Biochemical Oxygen Demand (mg/L)	H-8043	2.3	2.3	3.6	0.8 -1.7
Dissolved Oxygen (mg/L)	DR	8.70	9.60	9.83	-
Total Coliform (MPN/100ml)	SM-9222	>1600	>1600	>1600	-
Faecal Coliform (MPN/100ml)	SM-9222	920	350	>1600	-
Enterococci (CFU/250ml)	SM-9230C	>60	>60	>60	*
Total Nitrogen (mg/L)	SM-4500N-C	<0.3	<0.3	<0.3	-
Total Phosphorus (mg/L)	SM-4500P-E	0.04	<0.01	0.02	-
Turbidity (mg/L)	DR	1.58	4.41	2.08	-
Manganese (µg/L)	F-AAS	<10	<10	<10	-
Copper (µg/L)	F-AAS	<10	<10	<10	-

KEY:

H - HACH Water analysis handbook 7th and 8th editions
DR - Direct Reading
SM - Standard Method for the examination of water and wastewater 21st and 22nd editions
F-AAS - Flame Atomic Absorption Spectroscopy
* **- The USEPA geometric mean ambient water is 33 CFU /100ml**

Quality Control – Analytical and Field duplicates, standard reference materials.

APPENDIX II – ELABORATION ON SOCIOECONOMIC SETTING

Population and Demographics

The population of Georgetown for the 2011 census was 6,585 persons, a decline of 5.4 percent when compared to the census period of 2001. While not a significant decline, it could be attributed to decline due to deaths and migration as a result of limited employment opportunities in the area. Anecdotal evidence suggests that the closure of the Grand Sable Sugar Factory led to a reduction in employment prospects. The age cohort of those interviewed is reflective of a generally youthful population with the 73% of respondents being between the ages of 17 and 39 (Figure 1).

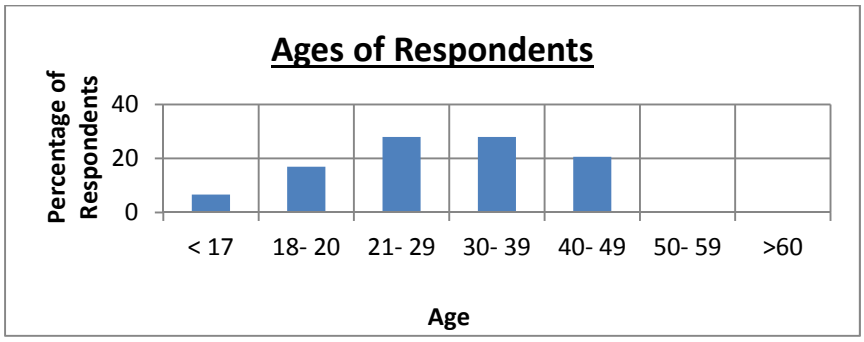

Figure 1: Ages of Respondents (project survey)

The 2011 census data revealed that the population of Georgetown was 51% male and 49% females. In our survey, we attempted to have a gender balance. Figure 2 below shows that the majority of persons who participated in the survey were females accounting for 61 % of the total respondents.

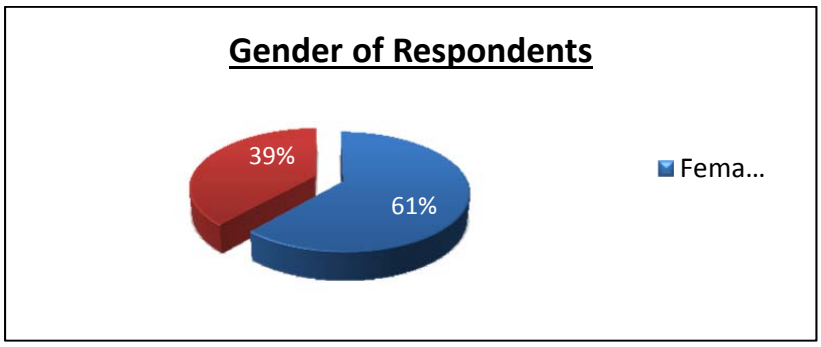

Figure 2: Gender of Respondents (project survey)

Settlement and Housing

Georgetown is the second largest town in SVG located on the northeastern coast of S. Vincent. The town was once considered to be prosperous with most persons employed in sugar cane industry and in arrow root cultivation. The 2011 census data revealed a total of 2071 households in the Georgetown project area. Figure 3 below shows the Census district for Georgetown.

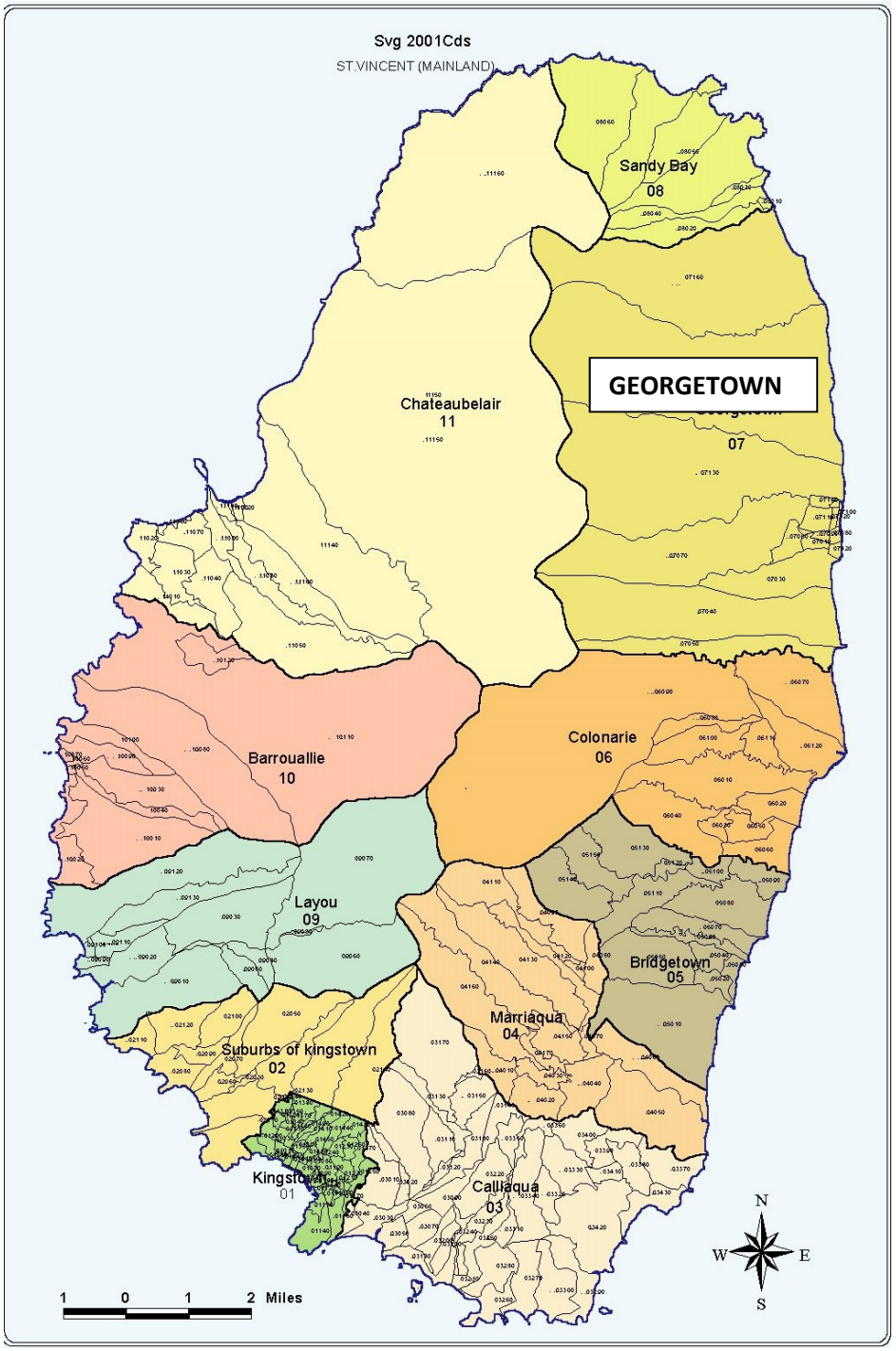

Figure 3: Census Districts in Saint Vincent

The housing is largely of good quality concrete structures with hip, gabled or flat roofing in most cases. Houses are largely characteristic of middle income earners. Figure 4 illustrates.

Figure 4: Example of housing in Georgetown

Physical and Social Infrastructure

The project area receives piped water from local provider, Central Water and Sewage Authority. The community is powered by electricity from the St. Vincent Electricity Services (VINLEC) and the two main telecommunication providers Digicel and Lime are active in the area.

Georgetown is accessed by the paved Windward Highway and several side roads provide access to residential housing.

Other social facilities present in Georgetown include: a primary and a secondary school, a community college, a community centre which also acts as an emergency shelter in the event of an emergency, a health clinic, the St. Vincent Distillers limited, a number of small commercial businesses including shops, pharmacies, restaurants, among others. It was also noted that a Modern Medical Complex is being constructed in Georgetown (Figures 5 and 6).

Figure 5: Health Clinic at Georgetown (top); Modern Medical Complex under construction (bottom)

Figure 6: Some businesses in Georgetown

The Solid Waste Management Unit reports in the Country Poverty Assessment 2007/8 that there is 100 percent coverage in terms of garbage collection for St. Vincent and the Grenadines. This was confirmed by the agency representative at our stakeholder meeting in June, 2013. Discussion with community residents at the recent data collection visit in October highlighted that garbage trucks traverse the area once a week, every week, and they expressed no challenges with the public collection arrangements for the area. The consultants observed on this visit the regular garbage collection not just on the main road but also on the side streets in Georgetown (Figure 7).

Figure 7: Public Garbage Collection observed in Georgetown

Local residents confirmed that both septic tanks and soakaways are utilised in the community. The CWSA indicates that newer houses have septic tanks while the older houses have soakaways.

Land Ownership and Use

The Georgetown project area has both privately owned and publicly owned lands. The area is largely residential. The seaward side of the Windward highway that runs through Georgetown is of most concern with respect to this project. In this area several dwellings are located, a few commercial facilities, a park, open spaces and beaches. These are among the facilities already at risk from coastal hazards.

Anecdotal information suggests that significant land loss has occurred over the years. Additionally, results from the studies conducted by the Coastal Engineers also reveal land losses. The study shows that the shoreline retreated by almost 80m over the 66 years between 1941 and 2007, indicative of an erosion rate close to 1.2m/year. Between 2007 and 2012 the shoreline slightly accreted to the south of Georgetown by approximately 2-5m. This is an accretion rate of approximately 0.5-1m/year.

Anecdotal information suggests that a few residents living along the coastline of Georgetown were forced to relocate as a result of complete destruction to their dwellings following Hurricane Ivan in 2004. Consultations with the National Emergency Management Organisation (NEMO) indicated that relocation efforts were guided by the project *St. Vincent and the Grenadines - Coastal Vulnerability Assessment* funded by USAID.

It is the intent of the Government of St. Vincent and the Grenadines to construct a Government complex on the seaward side of the Windward Highway running through Georgetown. Consultations with the Central Planning Division indicate that it is the aim of the Government to decentralize the services offered in Kingstown.

Currently, the Government is constructing an international airport at Argyle and a Diagnostic Hospital in Georgetown to serve the Eastern Caribbean. These two facilities are near completion and an increase in activity in the study area is anticipated.

In light of these plans and with the existing nature of the Georgetown coastline, coastal protection is needed to reduce the impacts likely to be experienced from coastal hazards, currents and wave action.

Heritage

Most of the survey respondents indicated that a number of heritage sites are located in Georgetown. A number of sites were identified. These are located at:

- Owia
- Sandy Bay
- Salt Pond
- Black Point
- Mt. Young
- Grand Sable Sugar Factory Site
- Steven's Mill
- Dickson Village
- Georgetown
- Rabacca

Of the sites listed, the Black Point Tunnel and the Anglican Cathedral are located directly within the project area. The Black Point Tunnel is an established heritage feature of the most significance in the project area. The area is set up as a recreational park and is called the Black Point Recreational facility and Heritage Site. Consultations with community members revealed that there was a strong desire for Black Point to be enhanced as a comprehensive recreational facility, including swimming (Figure 8).

Anecdotal evidence suggests that Georgetown is generally a town of historical significance since it was the first capital of SVG. Many buildings in the town including the Anglican Cathedral have historical significance.

Figure 8: Black Point Recreational Park

Employment and Livelihoods

The residents of Georgetown engage in a number of livelihood activities such as: farming and construction. Persons are also employed in government and private enterprises. 52% of persons interviewed in our survey were unemployed. The survey also showed that only 30% of respondents are employed fulltime while 13% are employed on a temporary basis. 5% were retired or disabled. These figures appear to be a good indicator of the decline in employment opportunities following the demise if the sugar cane and more recently the banana industries. Those who were employed (both part time and full time) plied their trade in the following main areas: education and training (18%), farming (16%), shop keeping (12%), business operating (9%), trading (6%), management (5%), administration (5%) construction (3%). Only 4% are employed in fishing, mostly for tri-tri (*Sicydium plumieri*).

Traffic Survey

The traffic survey was conducted along the windward highway at the northern and southern limits of Georgetown on Thursday October 3, 2013. Analysis of the data collected in Table 1 showed that a total of 1,202 motor vehicles traversed the study area's Northern Point over the 12 hour period, with peak traffic flow occurring between the hours of 9 and 10 in the mornings, tapering off during the hours of 12pm to 3pm, and resurging from 4pm to 6pm. Cars and minibuses accounted for 19.3 and 58 per cent

respectively of the total vehicular traffic, while large buses (10.5%), trucks and trailers (2.2%) and bikes (0.23%) accounted for minimal vehicular flow.

Average vehicle flow past the counting station was 1.7 vehicles per minute.

Table 1: North Point (Georgetown) summary motor vehicle/occupants count

Cars	Mini Buses	Large Buses	Motor Bike	Light Commercial (*e.g. small trucks vans and pick-ups*)	Large Trucks/ Trailers	Total
VEHICULAR						
462	431	32	14	196	67	1202
PASSENGERS						
774	4032	352	14	437	100	5709

For the Southern Point, a total of 1,504 motor vehicles accounted for recorded flows over the 12 hour period. Peak flow occurred primarily between the hours of 8am to 11 am, then again between the hours of 2pm to 5pm. Cars (47%) and Minibuses (27.13%) accounted for the highest flows of vehicular traffic.

Passenger/ Occupant numbers were highest for cars in the evening, with the reverse obtaining for minibuses for the same period. A total of 5,709 occupants traversed the study area's North Point for the 12 hour period (Table 2) with motorcars and minibuses accounting for 13.6 and 70 per cent respectively.

Table 2: South Point (Georgetown) summary motor vehicle/ occupants Count

Cars	Mini Buses	Large Buses	Motor Bike	Light Commercial (*e.g. small trucks vans and pick-ups*)	Large Trucks/ Trailers	Total
VEHICULAR						
700	408	46	14	269	67	1504
PASSENGERS						
1155	3457	627	14	617	132	5989

For the southern point, occupants/ passengers totaled 5,989. It was a similar scenario for the southern point, with cars and minibuses accounting for the majority of occupants at 19.3 and 58 per cent respectively. The survey revealed that both the northern and southern points recorded the least number of occupants, with motor bikes and large trucks/ trailers.

Average vehicle flow past the counting station was 2.1 vehicles per minute.

The volume of traffic movement at both the northern and southern points along the Windward highway at Georgetown is considered light. Passenger conveyance is the major vehicular use transporting commuters to work places and educational institutions near the outward limits or outside the immediate Georgetown area.

APPENDIX III - POLICY AND LEGISALTIVE DETAILS

Town and Country Planning Act (Physical Planning) No 26 of 2008

The Town and Country Planning Act, 2008, has been established to enable "orderly and progressive development of land and the proper town planning and country areas, to make provision for the control of development". For the purposes of developing the national plan Section 8.2 of the Act speak to prevailing physical and environmental conditions; policies; availability of land for agriculture, forestry reserves, national parks and public open spaces; and provisions for any coastal zone management plan.
The Town and Country Planning Act of 2008 established the Physical Planning and Development Board which comprises the following members:

- Director of Planning
- Manager of National Properties Limited
- Chief Engineer
- Chief Agricultural Officer
- Chief Surveyor
- Chief Environmental Health Officer
- Manager of Central Water and Sewerage Authority
- Saint Vincent Electricity Services Limited
- Commissioner of Police
- Warden of Kingstown Board
- Permanent Secretary

Based on the review of policies and legislation, this Town and Country Planning Act (2008) is the only legal document making reference to coastal zone management (CZM) which falls under the purview of the Physical Planning Unit. The Physical Planning Unit is therefore a critical stakeholder in any coastal defense works recommended for the Georgetown coastline. The Coastal Zone Management Workshop conducted by the Consultants at the end of the data collection visit in October, 2013 and in which participants from 11 Government Agencies took part expressed the strong opinion that a CZM Unit would be best established in the Physical Planning Department.

The National Emergency and Disaster Management Act, 2006

The National Emergency and Disaster Management Act, 2006, established the National Emergency Management Organisation (NEMO) as an agency of the Government. NEMO consists of the National Emergency Council, chaired by the Prime Minister; the National Emergency Executive Committee; and the district disaster management committees.

The Act provides for "prevention, preparedness, response, mitigation and recovery in relation to hazards, disasters and emergencies". These aspects of disaster risk management will be lead out by NEMO. The Act mandates the development of a National Disaster Management Plan. The Act also makes provision for regulating emergency operation centres and shelters, coordination of activities for persons involved in disaster management, and designation of specially vulnerable areas.

It is recognized that the coastal area of Georgetown is exposed to erosion impacts from swells, wave action, tropical storms and hurricanes. Any proposed engineering works should be acceptable to NEMO who would be a major stakeholder for any prevention or mitigation measures for disaster risk reduction in SVG.

St. Vincent and the Grenadines National Disaster Plan, 2005

The National Disaster Plan was designed in 2005 to enhance the capacity of the government to prepare for, respond to, and recover from, disasters. The plan outlines the procedures for the return of the state to normalcy as quickly as possible following a disaster. The main objectives of the National Disaster Response Plan are to: prevent the loss of life and property, in the event of a disaster; establish policies and procedures to guide the effective implementation of response, relief and rehabilitation measures; and provide technical guidance to the National Emergency Management Office (NEMO) personnel in Emergency Operations Management. The Act has within it a national hurricane and tropical storm plan, a volcano emergency plan, a flood plan, and a plan for handling mass casualty situations.

The plan authorizes the evacuation of all areas identified as at risk from the probable impact of a disaster. The Plan also establishes district disaster committees so that civil society is fully involved in the disaster management programme.

Any mitigation measure to be considered for Georgetown in the form of coastal defence would need to be acceptable to NEMO.

Central Water and Sewerage Act

The Central Water and Sewerage Act, 1991, established the Central Water and Sewerage Authority to carry out investigations on the water resources of Saint Vincent and the Grenadines and to advise and make recommendations to the Minister relating to the improvement, preservation, conservation, utilization and apportionment of water resources.

CWSA is in control of meeting the demand for water supply and is responsible for the sewerage facilities in the Island. The Authority is in control of ensuring there are water resources suitable for:

- domestic and stock purposes;
- irrigation, agriculture, industrial and commercial purposes
- hydroelectric and geothermal purposes
- navigation and fishing
- the preservation of flora and fauna and other beneficial purposes
- the prevention and mitigation of the effects of erosion, drainage, pollution and flooding.

The Act restricts the pollution of any water by activities. It is important that water quality is monitored during the construction of any coastal works at Georgetown so that undue pollution of coastal waters can be avoided.

Draft Environmental Management Act 2009

The Environmental Management Act, 2009, established the Department of the Environment in St. Vincent and the Grenadines (SVG). The Department of the Environment is responsible for protecting the country's environment. The Act serves to ensure:

(a) the allocation and coordination of administrative responsibilities for environmental management within SVG;
(b) the prevention and mitigation of pollution of the environment, for the purposes of protecting human health and maintaining the quality of the environment;
(a) the conservation of energy and the development of renewable energy resources; and
(b) the integration of environmental management and monitoring.

This environmental impact assessment conducted for Georgetown coastal defense works will inform any decision that the Department of the Environment in SVG will need to make.

Draft Environmental Management (Pollution) Regulations, 2009

The Environmental Management (Pollution) Regulations, 2009, restricts the emission, deposition, issuance or cause of the following discharges into the environment:

- a contaminant from a domestic, commercial, agricultural, recreational, industrial, or any other source; or
- a contaminant, the presence of which in the environment is prohibited by these Regulations or is likely to affect the life, health, safety, welfare or comfort of human beings or cause damage to or otherwise impair the quality of the environment, unless a prior permit to do so has been granted by the Department upon such terms and conditions as it may determine.

The regulation also restricts the emission or discharge of contaminants either directly or indirectly, into the ambient air from any source.

This environmental impact assessment conducted for Georgetown coastal defense works will inform any decisions that the Department of the Environment in SVG will need to make with respect to the prevention and mitigation of pollution of the environment at Georgetown during construction.

Draft Environmental Impact Assessment Regulations, 2009

The Environmental Impact Assessment Regulations, 2009, outlined the criteria and procedure which determines whether an activity is likely to significantly affect the environment and is therefore subject to an environmental impact assessment (EIA).

All persons, agencies, institutions (whether public or private), unless exempted pursuant to these Regulations, shall, before embarking on a proposed project or activity, apply to the Department for a determination whether such project or activity would require an EIA.

Schedule III of the Act outlines that the following activities may require an EIA based on its size:

- Land reclamation involving an area of more than 1 acre
- Infrastructure projects such as flood relief works, the construction of marinas.

The regulations require EIAs to include the following:

> *(a) "a description of the proposed activities;*
> *(b) a description of the potentially affected environment, including specific information necessary to identify and assess the environmental effect of the proposed activities;*
> *(c) a description of the practical alternatives, as appropriate;*
> *(d) an assessment of the likely or potential environmental impacts of the proposed activities and the alternatives, including the direct and indirect, cumulative, short-term and long-term effects;*
> *(e) an identification and description of measures available to monitoring or mitigate the adverse environmental impacts of proposed activity or activities and assessment of those mitigative measures;*
> *(f) an indication of gaps in knowledge and uncertainty which may be encountered in computing the required information;"*

Once this draft regulation is enacted, all projects will be required to follow the guidelines presented for conducting an EIA in SVG. Although this regulation is still a draft, the Consultants have reviewed these criteria and found them to be standard or similar to EIAs in other jurisdictions.

Environmental Health Services Act, No 34 of 1996

The Environmental Health Services Act, 1996, makes provision for the conservation and maintenance of the environment in the interest of public health. This Act establishes the Environmental Health Division under the leadership of the Chief Environmental Health Officer. The Environmental Health Division is mandated to carry out the following functions:

a) investigate problems and institute preventative and remedial measures in respect of environmental pollution, the management and disposal of solid, liquid and gaseous wastes, food and drinks management, nuisance, rodents, insect pests and general sanitation
b) conduct research, studies and monitoring programmes related to the matters in (a) above
c) gather, collate, analyse, publish and disseminate information relevant to (a) above
d) promote the planning, approval, funding and implementation of measures designed to ensure the wise and safe use of the environment
e) provide ways and means for the training of persons involved in environmental health services
f) undertake ad carry out all related surveys, monitoring and investigations and prepare the necessary reports, plans and programmes
g) maintain and operate the necessary laboratory analytical and inspection facilities
h) provide advice in the field of environmental health and other supportive services to the Ministry and other Government Agencies in Saint Vincent and the Grenadines (SVG)

Part III of the Act also states that the Chief Environmental Health Officer may require that an application be submitted for certificate of approval for activities that may cause discharge, contamination or pollutions of any part of the environment. Part III of the Act also restrict persons from dumping or otherwise depositing or leaving any refuse in any public or open space.

Suitable solid waste management during construction of any defense structures will be a recommended.

Beach Protection Act, 1987

The Beach Protection Act, 1987, has been established to protect beaches in SVG from the illegal removal of sand, coral, stones, shingle and other materials from the shores and sea beds. The Act states that permission is required for the removal of any material from beaches and sea beds.

The Authority may grant permission for the removal of material providing specific conditions that are deemed fit to impose.

Any dredging of sand that may be proposed under the project would need to be approved by the respective Government Agency.

Sea Turtle Recovery Action Plan, 1993

The most common sea turtles in St. Vincent and the Grenadines (SVG) is the hawksbill (Eretmochelys imbricata), with smaller numbers of green turtles (Chelonia mydas) and leatherbacks (Dermochelys coriacea) and much less frequently, loggerheads (Caretta caretta). Based on discussions in the field with locals, only the first three have been cited along the Georgetown coastline.

Habitats for sea turtles are critical and include nesting beaches, marine foraging grounds, and migratory corridors. The Action Plan outlines that there are stresses on sea turtles in SVG particularly where coastal development negatively affect nesting beaches.

Over-utilisation of turtles is another challenge faced in SVG. However, there are no data on sea turtle populations although it is well known that sea turtles have been harvested for generations.

The Action Plan outlines several recommendations for reducing the negative impact on turtles. Some key recommendations include:

- comprehensive surveys be conducted on all the major islands of the country in order to determine which beaches are still used by sea turtles
- EIA's be undertaken by an independent entity approved by the Government
- developers be strongly encouraged to plan for the effective long-term protection of the extremely sensitive and virtually pristine nearshore communities and threatened wildlife such as sea turtles
- Indiscriminate anchoring, pollution, sand mining, coastal lighting should be regulated within critical areas

- the protection of habitats important to sea turtles should occur within a larger coastal zone management framework
- that full advantage be taken of proposed coral reef monitoring programmes
- a comprehensive coastal zone management plan be formulated to regulate development and encourage sustainable use of the coastal zone

The EIA to be prepared under this project will take into consideration likely impacts of proposed engineering works on turtle nesting. Mitigation measures to protect turtles that nest on the beach will be recommended.

Maritime Areas Act, 1983

The Maritime Areas Act, 1983, has been established to ensure the safety of navigation and regulation of maritime traffic; the protection of navigation aids and facilities and other facilities or installations; the protection of cables and pipelines; the conservation of the living resources of the sea; the prevention of infringement of the laws and regulations of SVG governing marine living resources; the prevention of the environment of SVG and the prevention, reduction and control of pollution thereof; marine scientific research and hydrographic surveys; and the prevention of infringement of the customs, fiscal, immigration or sanitary laws and regulations of SVG.

Transportation of material and activities to be undertaken for any proposed engineering works should take into consideration pollution prevention and mitigation measures to protect coastal waters and marine life.

Fisheries Act 1989

The Fisheries Act, 1989, grants the designated Minister the authority to manage and develop fisheries resources for its optimal utilization and benefit in SVG. The Act appoints a Chief Fisheries Officer and other respective officers to lead out in the management and development of a fisheries plan. The Act empowers the Chief Fisheries Officer to issue local fisheries licenses and outlines the regulations on which this is to be done. The Minister is empowered to designate areas as local fisheries management areas and marine reserve areas. Fisheries Division will govern the operations in these areas and the applicable sanctions for breaches committed.

The Fisheries Act empowers the Minister to make Regulations for the development and management of fisheries in the fishery waters. There are subsidiary legislations which forms part of the existing Act:

- Oyster (Close Season) Order
- Fisheries Regulations
- Aboriginal Subsistence Whaling Regulations
- Fisheries (Fish and Fish Products) Regulations
- Fisheries (Prohibition on Exportation) Regulations

All of these govern the fishing of specific groups of aquatic animals through licensing and accompanying regulations, hygiene and packaging standards, and penalties for breaches.

Part IV, Section 17 of the Fisheries Regulations restricts the interference with any turtle nests. The regulation also outlines a 5 month closed season from March 1st to July 31st for turtle harvesting each year. The construction schedule and activities for any coastal defense structures will ensure that turtle breeding and nesting are not significantly affected or permanently displaced.

Waste Management Act, 2000

The Waste Management Act, 2000, provides for the management of solid waste in conformity with best environmental practices and grants the designated Minister the authority to implement regulations for the purposes of the Act. Further, the Act establishes the National Solid Waste Management Authority (NSWMA) which is mandated to monitor, enforce and regulate all matters associated with solid waste management in SVG. The Act outlines an implementation programme which establishes standards, requirements and procedures for the management of all waste. This includes: generation, handling, storage, treatment, transport and disposal of all types of waste.

The Act outlines the conditions/ regulations under which Licenses and Permits may be granted. The Act also classifies and lists a number of hazardous wastes and the entities from which they may originate. Solid waste management will be taken into consideration during the construction phase of the project.

Coastal Zone Management

Government authorities related to coastal zone management were identified and discussions were held with the Central Planning Division (CPD) who endorsed the development of a steering committee for coastal zone management (CZM). CPD also facilitated the holding of a coastal zone management workshop which the Consultants had recommended in the Inception Report, submitted in August, 2013.

The coastal zone management workshop took place on October 10, 2013. The workshop was total of 22 participants, the list of Attendees is presented in Appendix I. The following organisations were represented at the workshop:

- Central Planning Division
- Physical Planning Unit
- Central Water and Sewerage Authority
- National Parks, River and Beaches Authority
- Ministry of Agriculture and Fisheries
- Ministry of National Mobilisation
- Environmental Management Department
- National Emergency Management Office
- Housing Office
- Ministry of Transport and Works
- Land and Surveys Department

A thorough presentation was made by Dr. Barry Wade, Coastal Zone Management Specialist, and project team leader. This workshop was well received by the participants. A vibrant discussion took place with the participants during and after the presentation.

APPENDIX IV – ELABORATION ON IMPACT ASSESSMENT

Assessment of the potential impacts of construction and operation entails consideration of short duration reversible impacts, long term permanent impacts and those with medium term significance. Impacts may be positive, negative or benign. It is important to note that the project may have impacts on the natural as well as built environment, and importantly the project can be affected by environmental processes. An impact matrix is outlined in Table 1 below which examines the potential impacts associated with all the options presented in Section 6 above.

Table 1 also outlines the risk involved with the coastal works proposed. Risk is defined as "a combination of the probability, or frequency of the occurrence of a particular hazard and the magnitude of the adverse effects or harm arising to the quality of human health or the environment" (Royal Society, 1992 In Morris and Therivel, 2001). The level of risk is determined based on the legend below.

Legend

Type of consequence	Description
Very high risk	Environmental aspect/human health irreversibly altered; no recovery. Over 100 km^2 affected in distance
High risk	Environmental aspect/human health altered but not irreversibly; recovery may take as long as 50 years. 50-100 km^2 affected
Moderate risk	Only one component of environmental aspect/human health altered; 10 year recovery period
Low risk	Temporary alteration; effects confined to less than 0.5 km^2; recovery less than 5 years.
Very low risk	Temporary alteration; very localized and minor consequences

Table 1: Summary Impacts for Georgetown

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	Construction Phase						
Excavation and construction of armour stone revetment or XBloc revetment	• Transport and offloading on site as well as any concrete work to be done will likely result in fugitive dust emissions and negatively impact ambient air quality in the immediate and surrounding area. • Potential dust nuisance to residents nearby construction works at Georgetown. • Potential noise and vibration nuisance to residents nearby construction works at Georgetown from trucking and heavy duty machinery. • The Georgetown playfield will be temporarily out of use once construction starts. • The use of the beach will be temporarily discontinued during construction. • Potential for disruption of turtle nesting activities which peak during March 1 to July 31 along the Georgetown	Negative	Short term	Major	Reversible	High Risk	• Dampening of exposed surfaces during dry periods should be implemented as part of the site activities during construction, particularly for the revetment which will involve works along the roadside of Georgetown • Covering of stockpiled fine material. • Advise neighbouring properties at least 24 hours in advance of planned noisy activities. • Limit the hours of noisy activities between 7am and 6pm • PM10 be monitored in µg/m3 using the WHO's ambient air quality guidelines during the construction period. • It may be useful to monitor noise during activity to ensure that decibel is restricted to 70dBA or below of sustained noise which is detrimental to human hearing. • Identification of temporary

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	coastline. • Increased turbidity at Black Point in particular.						alternative tri-tri fishery sites for Georgetown during construction • Develop implementation plan to guide construction activities. • Mark turtle nesting spots where needs to be avoided and educating staff. The management of lighting so that they are not shone directly towards the sea to distract turtles because they are guided by moonlight.
Beach nourishment Construction of geotube groynes for Sector 2, Georgetown	• Sand from offshore is likely to be dredged and used for beach nourishment and used to fill the geotube. • The use of the beach at Georgetown and Black Point would be temporarily out of use during construction and beach nourishment activities. • Noise and vibration is likely to be a disturbance to nearby residents and businesses. • Potential for dislocation of as well as tri-tri fishery operations at Black Point. • Potential for disruption of turtle nesting activities which	Negative	Short term	Major	Reversible	Moderate Risk	• Appropriate signage and site restrictions need to be put in place to prevent community persons from being in danger. • An official notice should be put up with respect to the discontinued use of the beach and playground during construction. • The use of heavy duty equipment should be restricted to during work hours of between 7:00am and 6:00pm. • It may be useful to monitor noise during activity to ensure that decibel is restricted to 70dBA or below of sustained noise which is detrimental to human hearing.

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	peak during March 1 to July 31 along the Georgetown coastline. • Increased turbidity at Black Point in particular.						• Identification of temporary alternative tri-tri fishery sites for Georgetown during construction • Develop implementation plan to guide construction activities. • Mark turtle nesting spots where needs to be avoided and educating staff. The management of lighting so that they are not shone directly towards the sea to distract turtles because they are guided by moonlight.
Construction of cofferdam groynes in Sector 2 Georgetown	• Dredging is likely to occur to construct the two vertical sheet pile walls which will be filled with stone. • Water quality is likely to be negatively affected. • The use of the beach at Georgetown and Black Point would be temporarily out of use during construction. • The use of the playfield at Georgetown will be temporarily out of use once construction starts. • Tri-tri fishing will temporarily be halted when construction is being undergone at the Black	Negative	Short term	Significant	Reversible	High risk	• Conducting the dredging activities when weather conditions are calm to limit disturbance of bottom sediments • Ensure proper management of waste oils, lubricants from equipment/vehicle service areas. • Implement a spills control plan. • Appropriate warning/ caution signage should be put in place during construction. • Water quality to be monitored during construction. • Restricted site access should be

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	Point site. • Potential for disruption of turtle nesting activities which peak during March 1 to July 31 along the Georgetown coastline. • Increased turbidity at Black Point in particular.						in place for the duration of construction. • Identification of a temporary alternative tri-tri fishery sites for Georgetown during construction • Develop implementation plan to guide construction activities. • Mark turtle nesting spots where needs to be avoided and educating staff. The management of lighting so that they are not shone directly towards the sea to distract turtles because they are guided by moonlight.
Transportation by heavy duty trucks of material - boulders and stones for revetment; pebbles for beach establishment; and cement and sand for any concrete works	• Potential for accidents arising from heavy duty vehicles on roads in Georgetown. • Changes in traffic type and volume are expected to negatively affect traffic flow on the Windward Highway in the vicinity of Georgetown when heavy vehicles are entering and leaving the construction site to deliver materials and equipment. • Potential dust nuisance arising from transporting light	Negative	Short term	Significant	Reversible	High risk	• Trucking material on site during off-peak periods. • Appropriate signage during construction. • Ensure that trucks are not overloaded to prevent road damage • Ensure that trucks carrying fine material are properly covered to ensure that material does not litter the road or cause a dust nuisance or damage to pedestrians or housing and

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	material from Rabacca to project site. • Damage to roads and road furnishings, curbs, bridges culverts and poles. • Removal of structures and creation of temporary roadways for access to the shoreline • The creation of temporary erosional features and other undesirable earth movements • Personnel accidents and other human vulnerabilities. • The collection of sand from Rabacca contributes to the existing sand mining and challenges that result.						business along the truck route. • Ensure that road rules are followed, drivers are qualified, and that trucks are not over the load limit to reduce risk of accidents.
Placement and use of equipment	• Potential dust nuisance to residents nearby construction works at Georgetown • Equipment usage onsite will likely result in high noise levels for an extended period Potential noise nuisance to residents nearby construction works at Georgetown	Negative	Short term	Moderate	Reversible	Moderate risk	• Inspect (daily) all vehicles and equipment for potential leakage of fuel, oil, hydraulic fluid or coolant. Any machinery found to be leaking will be repaired or replaced. • Vehicles and equipment used should be serviced to reduce noise levels. • During the construction period the beaches as well as all the

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
							construction equipment will be vulnerable to storm surges. As a result, it would be prudent to time the construction activities outside the hurricane season. • Standard operating practices for construction should be adhered to: E.g restricting the time of day that such activities (during work hours). World Bank has a 55 dBa daytime limit and a 45 dBa night-time noise limit for residential areas and a 70 dBA limit for commercial and industrial areas for both day and night time. • Hazardous materials such as fuels and oils should not be stored near storm water drains. • Provide appropriate signage and security for all storage of dangerous goods. All incompatible materials will be segregated. • Provide Material Safety Datasheets (MSDS) for dangerous goods used or stored on-site. Personnel will to be made aware of the environmental and safety

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
							requirements for these hazardous materials.
Pebble beach in Sector 1	• Establishment of pebble beach in addition to revetment is likely to be a potential hazard.	Negative	Short term	Moderate	Reversible	Moderate risk	• Worker safety is important – proper gears need to be worn by all workers. • Appropriate signage on site to prevent unwanted persons being put at risk.
Solid waste disposal	• Construction waste material, other domestic waste, dredged material that would be generated on site are to be appropriately disposed. • Poor solid waste disposal pose a health risk. • Poor solid waste management can result in blocked drains and flooding during rainy periods.	Negative	Short term	Major	Reversible	High Risk	• Refuse bins should be placed on site to meet the needs of the workforce • Arrange for the collection of solid waste by certified contractors and disposal at an approved site • Any hazardous waste should be separated and stored in areas clearly designated and labelled • Identification of appropriate and approved site for disposal of dredged material. • Open burning of solid wastes will not be conducted as these generate polluting emissions which cannot be controlled effectively. • Garbage storage area will always be kept clean. • If a bin is damaged, the contents

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
							will be transferred to another container in good condition. • The waste container will be coated with a waterproofing material to prevent the escape of fluids. • The stored waste should be covered to prevent rain water from flooding the waste and overflow.
Sewage treatment	• Improper sanitary facilities pose a health risk.	Negative	Short term	Moderate	Reversible	Moderate risk	• Construction camps and work areas must be adequately equipped with portable chemical toilets. • Portable chemical toilets must be provided, maintained and removed by a certified contractor to mitigate inappropriate disposal.
Worker employment	• Generation of employment during construction activities in Georgetown	Positive	Short term	Major	Reversible	No risk	-
Worker safety	• Accidents and adverse effects on workers may occur on construction sites in Georgetown and should be prevented	Negative	Short term	Major	Reversible	Moderate risk	• Worker safety should be protected and safe practices implemented. • Wearing of the appropriate protective gear on site should be stipulated and mandatory.

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
							• Sanitary practices in regard to providing potable water and the disposal of human waste should be enforced to safeguard worker health. • Construction crews should be provided with the appropriate safety gears such as hard hats, gloves, safety shoes, reflector vests where appropriate, etc.
Operation Phase							
Armour stone revetment with pebble beach for Sector 1	• Effective reduction in erosion of Georgetown coastline. • Reduced vulnerability to coastal hazards and wave action. • The protection of road, housing and property behind the coastline. • Additional protection to coastline from the pebble stone beach.	Positive	Long term	Major	Irreversible	No risk	
Armour stone revetment without beach for Sector 1	• Effective reduction in erosion of Georgetown coastline. • Reduced vulnerability to coastal hazards and wave action. • The protection of road and housing and property behind	Positive	Long term	Major	Irreversible	No risk	

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	the coastline.						
	• Beach will be lost after storm events	Negative	Long term	Major	Irreversible	No risk	
XBloc revetment without beach for Sector 1	• Most effective option in reducing erosion of Georgetown coastline but most expensive. • Reduced vulnerability to coastal hazards and wave action. • The protection of road and housing and property behind the coastline.	Positive	Long term	Major	Irreversible	No risk	
Conventional groynes (70m long) with an armour layer of XBloc, combined with beach nourishment for sector 2	• Highly effective method to reduce erosion of Georgetown coastline. • Reduced vulnerability to coastal hazards and wave action. • The protection of housing and property behind the coastline. • Enhancement of beach through nourishment for recreational use. • Requires no maintenance and preserves recreational space. • Improvements to and	Positive	Long term	Major	Irreversible	No risk	

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	protection of playfield at Georgetown from erosion. • Creation of saltwater pool will improve comfort level of residents and enhance recreational swimming.						
Conventional groynes (100m long) with an armour layer of XBloc, combined with beach nourishment for sector 2	• Reduction in erosion of Georgetown coastline. • Reduced vulnerability to coastal hazards and wave action. • The protection of housing and property behind the coastline. • Enhancement of beach through nourishment for recreational use. • Protection of beach at Black Point in particular for recreational use. • Requires no maintenance and preserves recreational space. • Improvements to and protection of playfield at Georgetown from erosion. • Creation of saltwater pool will improve comfort level of residents and enhance	Positive	Long term	Major	Irreversible	No risk	

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	recreational swimming.						
Cofferdam groynes (70m long), with beach nourishment for sector 2	• Reduction in erosion of Georgetown coastline, however, not the most resistant to coastal hazards. • The protection of housing and property behind the coastline. • Enhancement of beach for recreational use. • Improvements to and protection of playfield at Georgetown from erosion. • Creation of saltwater pool will improve comfort level of residents and enhance recreational swimming.	Positive	Medium term	Major	Reversible	No risk	
Geotube groynes (70m long), with beach nourishment for sector 2	• Reduction in erosion of Georgetown coastline. • Most cost effective option • The protection of housing and property behind the coastline. • Improvements to and protection of playfield at Georgetown from erosion. • Enhancement of beach for recreation and creation of	Positive	Medium term	Major	Reversible	No risk	

Activities	Possible Impacts	Possible Impacts				Risk	Mitigation Measures
		Direction	Duration	Magnitude	Type	Type	
	saltwater pool to improve comfort level of residents for swimming.						
	• Maintenance will be required. • Not very resistant to coastal hazards.	Negative	Medium to long term	Major	Reversible	Low risk	Maintenance of structures every 2-3 years to remove and replace broken sections of groyne.
Periodic nourishment for sector 2	• Rehabilitated beach front along the Georgetown to Black Point stretch. • Rehabilitation of playfield at Georgetown.	Positive	Medium term	Major	Reversible	No risk	
	• High maintenance option • Coastline not protected from Coastal hazards and erosion from wave action • Risk of loss from illegal sand mining	Negative	Medium to long term	Major	Reversible	Moderate risk	Maintenance of coastline every 2-3 years to replenish with sand.