Environmental Impact Assessment: Gros Islet and Soufriere

Hurricane Lenny Recovery in the Caribbean

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by

SMITH WARNER INTERNATIONAL

COASTAL & ENVIRONMENTAL ENGINEERING

In association with

CEP

and

Goodridge & Associates

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- Ms. Marion Francis-Henry, Sustainable Development and Environment Officer, Ministry of Planning, Development, Environment and Housing
- Mr. Klaus Kretz, Proprietor, Bay Guest House.
- Mr. Kai Wolf, Manager, Soufriere Marine Management Area (SMMA)

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General Overview

As a result of the passage of Hurricane Lenny in November 1999, severe damage occurred on the western shore of the island of St. Lucia. Even though this storm passed well to the north of the island, it generated waves that were high enough to result in severe damage to coastal infrastructure. For this project, the focus of the rehabilitation works is placed at two locations, Gros Islet and Soufriere. Both of these towns were severely damaged during Hurricane Lenny, and in both cases, there are significant communities in close proximity to the affected shorelines. This report documents the Environmental Impact Assessments that were carried out for the works proposed for these shorelines.

This report is divided into three sections:

Part I – Gros Islet;

Part II – Soufriere;

Part III – References.

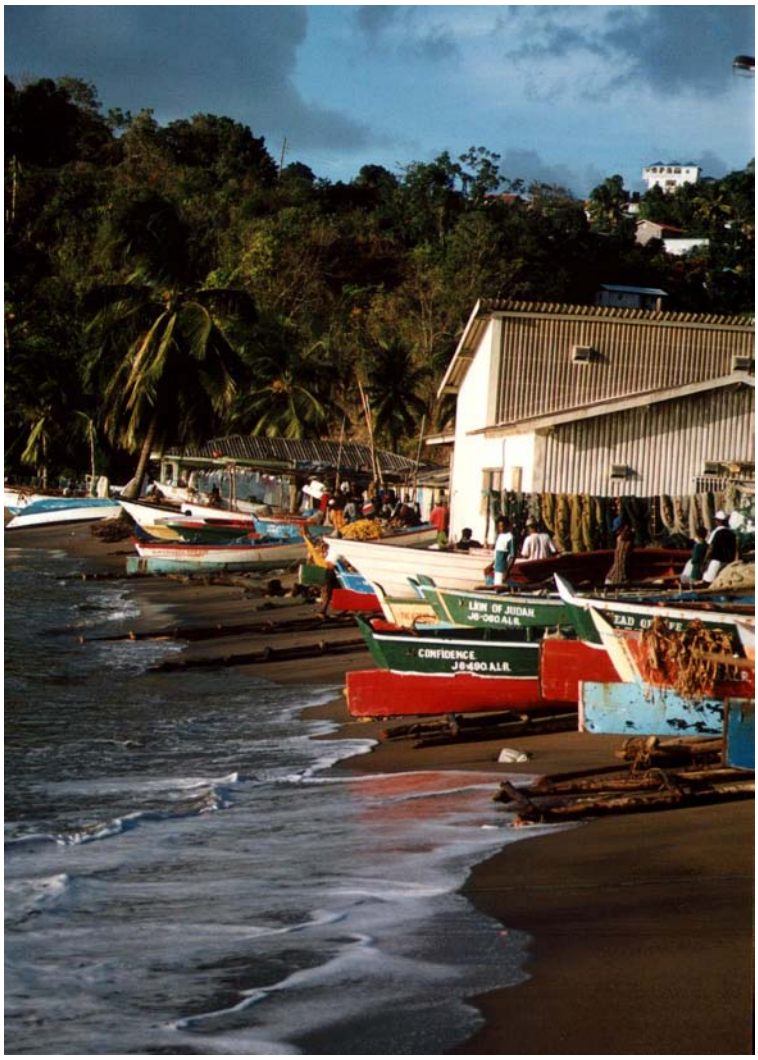
This report is intended to satisfy the requirements of the United States Agency for International Development (USAID). This EIA was conducted in accordance with suggested USAID Environmental Procedures, which are provided as Appendix A of this report.

Study Team

The following are the key professional staff that worked on the various aspects of this study:

- Dr. David A. Y. Smith, Team Leader (Smith Warner International Ltd.);
- Dr. George K. Sammy, EIA Study Director/Environmental Engineer (Ecoengineering Consultants Ltd.);
- Mr. Karl Deen, Engineer (Ecoengineering Consultants Ltd.);
- Mr. Fazal Mohammed, Ecologist ((Ecoengineering Consultants Ltd.);
- Mr. Cromwell R. Goodridge, Engineer (Goodridge and Associates); and
- Mrs. Corinne Smith, Administrator (Smith Warner International Ltd.).

Part I
Environmental Impact Assessment at Gros Islet



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1. Introduction

As a result of the passage of Hurricane Lenny, severe damage occurred on the western shores of St. Lucia. Even though this storm passed well to the north, it generated waves that were still high enough to result in severe damage to coastal infrastructure. This section of the report documents the EIA for the works proposed at the Gros Islet shoreline. Part I of this document consists of five chapters. Chapter 1 is a general overview describing the layout of the document, Chapter 2 gives details of the proposed actions, and Chapters 3 and 4 outline the Project Setting in the Physical and Human Environments respectively. Lastly, Chapter 5 presents information on Significant Environmental Impacts and Appropriate Mitigation Measures.

2. Project Description

2.1 Site Description

The project site is located at Gros Islet on the north-western coastline of St. Lucia (Figures 2-1a and 2-1b). This site is defined as that stretch of shoreline occurring immediately north of and adjacent to the Rodney Bay Marina channel to the south, and the mouth of the Fairview Ravine to the north (see Photo 1).

Figure 2-1a Site Location – Gros Islet

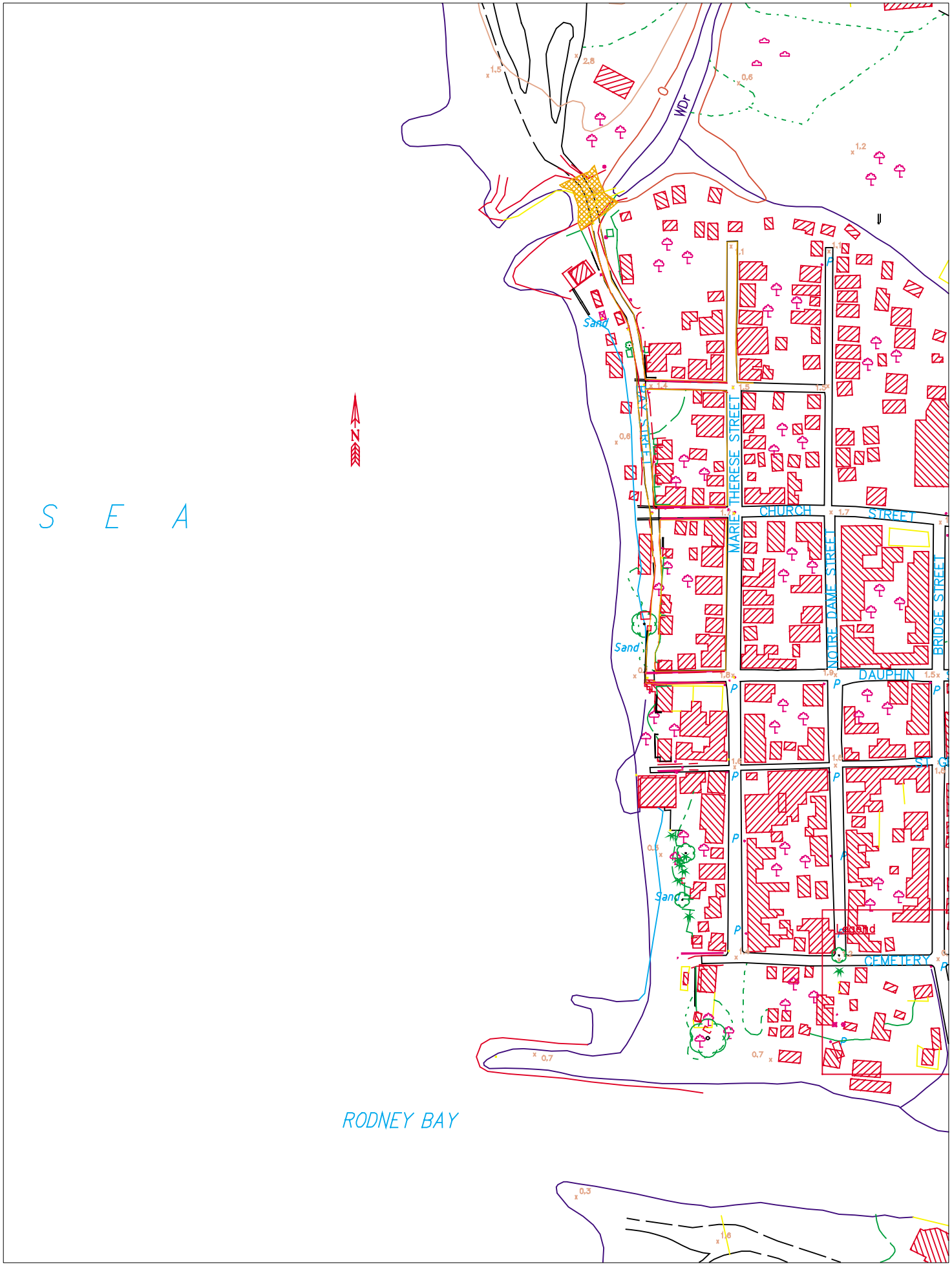


Figure 2-1b Gros Islet

Photo 1 Project Site

The shoreline comprises a narrow sandy beach with three small headlands. Two of these headlands are occupied by guesthouses; Bay Guest House on the northern headland and Alexander's Guest House on the central headland. The southernmost headland supports the entrance to the Rodney Bay Marina. All three headlands are reinforced with rubble protection. In the case of the Bay Guest House headland, the owner has further protected his property by placing reinforced concrete slabs in front of the rubble stones (Photo 2).

Photo 2 Existing shore protection at headland of Bay Guesthouse

Photo 3 Public convenience in poor state of repair

Close to this headland are the remains of a collapsed sea wall, at the back of which is a small, disused public convenience with shower and toilet facilities (Photo 3).

The road that runs just behind the beach from the ravine to the central headland is Bay Street. This road suffered some damage due to Hurricane Lenny. It is unpaved and generally in poor condition. There is a small fishing shed on the beach as well as several small shops that trade in clothes, souvenirs and food items.

The beach is used mostly by the small fishing community situated along Bay Street, as well as by other residents in the Gros Islet area. In the larger community, there are five blocks defined by shore-perpendicular streets that intersect the main shore-parallel street, Bay Street. Gros Islet, which was previously a small fishing community, has seen growth in the commercial and tourism sectors. In addition to the growing number of hotels, guesthouses and small shops, activities in Gros Islet include the Gros Islet Friday Night Street Party. This is a well-known and popular attraction for nationals and guests.

2.2 Project Components

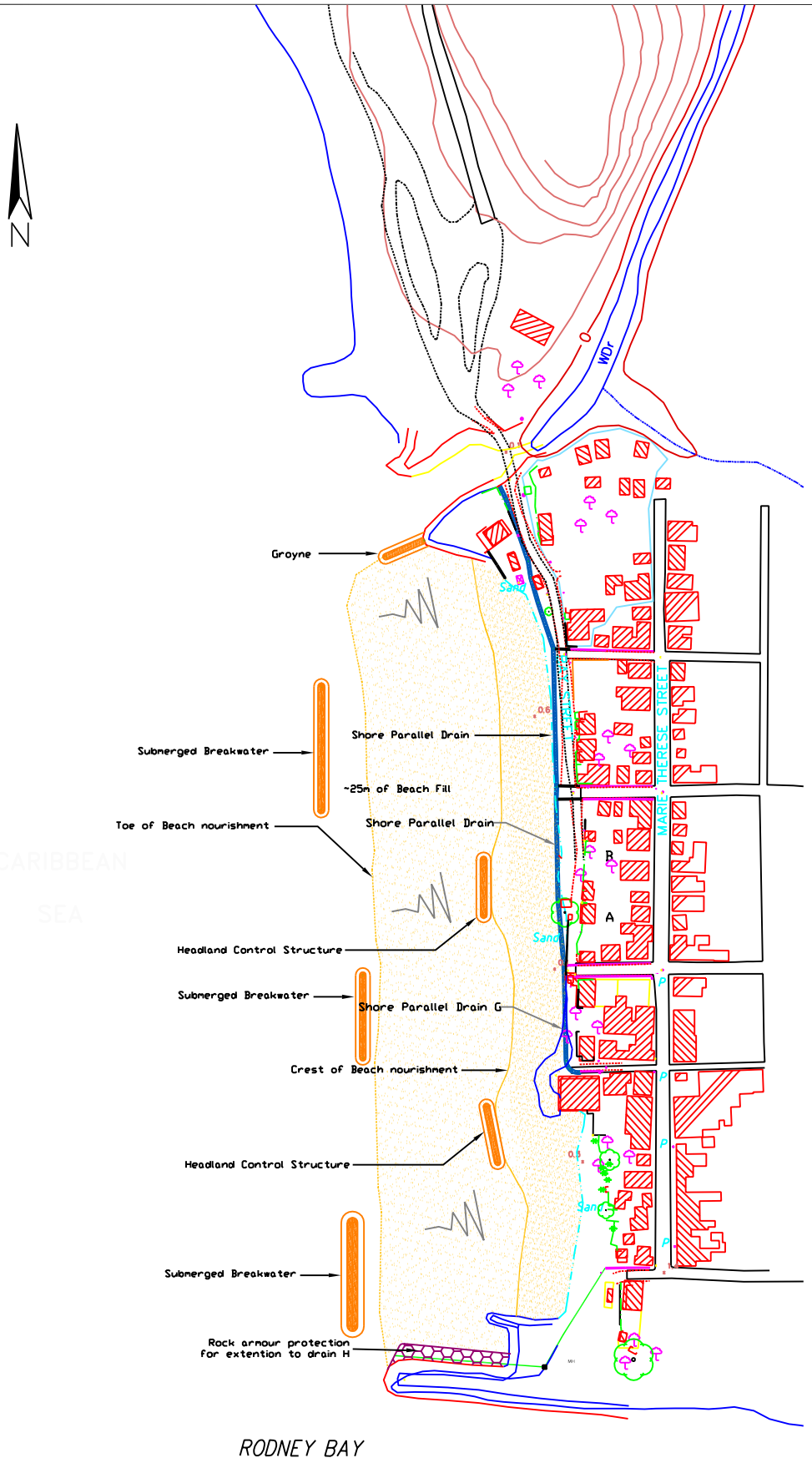
The project scope for the rehabilitation of the Gros Islet Bay, consists of three areas:

i. Shore protection;

ii. Public convenience; and

iii. Drainage

Figure 2-2 represents the works proposed for the Gros Islet area.



PROJECT COMPONENTS

FIGURE 2-2

2.2.1 Shore Protection

A significant volume of beach was eroded as a result of wave action during Hurricane Lenny. Bay Street, which lies adjacent to the shore, was damaged and is now exposed, as were the residential and commercial properties that lie along this road.

The works proposed to strengthen this shoreline consists of the construction of three submerged breakwaters, two headland control structures and a groyne, as well as renourishment of the beach. A rubble groyne will be extended 20 m from the end of the northernmost headland, near the mouth of the Fairview Ravine. The submerged breakwaters were designed to take into consideration the wave and current dynamics of Gros Islet Bay. The first breakwater to the north will be 60 m long with a 4-metre crest width, and positioned approximately 110 m from, and parallel to, the high water mark (HWM). The second and middle breakwater would be somewhat smaller, at 40 m long and with a crest width of 4 m. It is to be positioned closer to shore, at approximately 94 m from the HWM. The last and southernmost breakwater will be positioned approximately 98 m from the HWM of the beach, and 19 m from the headland of the entrance to the Rodney Bay Marina. It will be 50 m long with a crest width of 5 m.

The two headland control structures will each be 30 m long and 3 m wide at the crest, and will be positioned along the edge of the existing beach line, between the three breakwater structures.

A third aspect of the shoreline protection is the planned renourishment of the beach by approximately 60 to 68 m. This is to be achieved by depositing sand from an offshore dredging operation, if a suitable borrow location can be found. Investigations into this possibility are being carried out and will be documented in a separate report.

2.2.2 Drainage

Drainage at the project site is achieved from street-side drains associated with the five streets that run perpendicular to Bay Street. These drains outfall directly onto the beach (Photo 4). The Fairview Ravine drains the larger Gros Islet area and runs along the north of the project site. Water quality tests from this ravine show that it is heavily contaminated with high levels of faecal coliforms. During the team visit on May 9, 2001, a strong, foul stench was observed, emphasizing the level of contamination. The mouth of this ravine is restricted by a driveable dry-weather road that links the Gros Islet Bay to the Pigeon Point causeway (Photo 5). This has caused the increased concentration of contaminants at the mouth of the ravine.

The natural drainage in the project area is to the north and south of Dauphin Street, which lies close to the small central headland and perpendicular to Bay Street. Under this project, it is proposed that a main drain be run from the seaward end of Dauphin Street northward along the seaward edge of Bay Street. This drain would discharge into the Fairview Ravine. All other drains that lie along the shore-perpendicular streets and presently discharge onto the beach would tie into this new drain.

To the south of Dauphin Street, there is one drain that discharges directly onto the beach. This will be extended along the headland at the entrance to the Rodney Bay Marina and discharge into the sea at this point. It is intended that this discharge pipe would be placed within the existing armour stones of the north Rodney Bay channel entrance.

Photo 4 Drain outfall directly onto beach

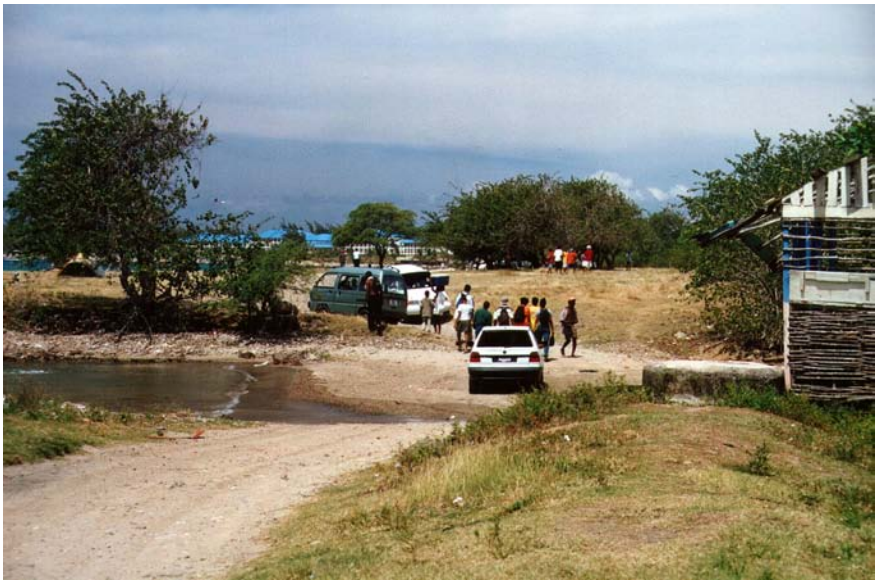


Photo 5 Dry-weather access through Fairview Ravine

2.2.3 Public Convenience

Two public conveniences are proposed for this area. One will be for the use of residents of the area whose homes are without running water or toilet facilities. This will tie into the central sewer system in the area and discourage discharge of raw sewage into the ravine. Another smaller, pay facility will also be built to accommodate visitors to the bay.

3. Environmental Setting: Physical Environment

This description of the physical environment of Gros Islet focuses on those environmental components that are likely to be affected by (or to affect) the proposed project. These components are:

i Wave conditions;

ii Water levels;

iii Sediment transport;

iv Topography;

v Marine water quality;

vi Climate;

vii Terrestrial ecology; and

viii Benthic ecology.

3.1 Wave Conditions

The west coast of St. Lucia is protected from the day-to-day Trade Wind-generated waves that impact the east coast. However, Gros Islet is open to the Caribbean Sea. Hurricane Lenny demonstrated the vulnerability of this normally sheltered shoreline to tropical storm systems, since it resulted in significant damage as it tracked from west to east. Design wave conditions have been developed for the west coast of St. Lucia using the NOAA database of hurricane tracks, which spans a period of over 100 years.

Wave analyses were carried out for the site at Gros Islet. Typically, wave climate falls into two categories, extreme (or design conditions) and day-to-day (or operational). As mentioned above, the extreme wave conditions have been developed from a search of the National Hurricane Center/NOAA database of storms that date back to 1876. Essentially, this database was searched to identify all storms that would have passed within a 400 nautical mile radius of St. Lucia. From this, 89 hurricanes, with intensity Category I or greater, were identified.

For each storm, a parametric wave hindcast procedure was implemented to develop wave height and period characteristics. The distribution of heights and periods are shown in Figure 3-1, as a

function of wave steepness.

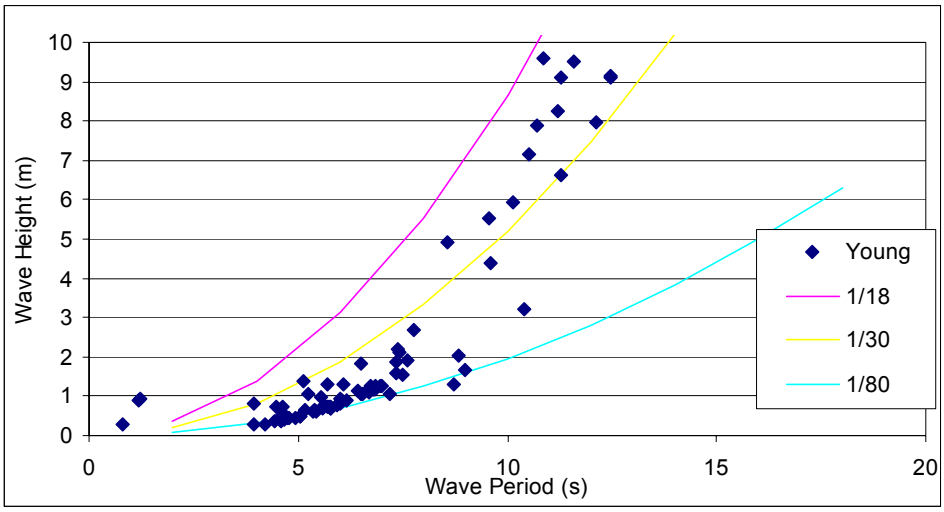


Figure 3-1 Wave Height and Period Characteristics

The diagram shows the combinations of wave height and period that were predicted from the Young (1988) parametric hindcast model. The wave height data was then input to an extremal analysis, using a Weibull distribution. The results are shown in Figure 3-2 for the best-fit graph with 95% confidence limit bands.

Table 3-1 summarizes the results of the detailed statistical analysis of the wave conditions that were computed to occur, utilizing the database of tropical storms that passed within 400 nautical miles of St. Lucia. It must be mentioned that these wave heights represent conditions in deep water, before the effects of wave refraction, shoaling and wave breaking occur.

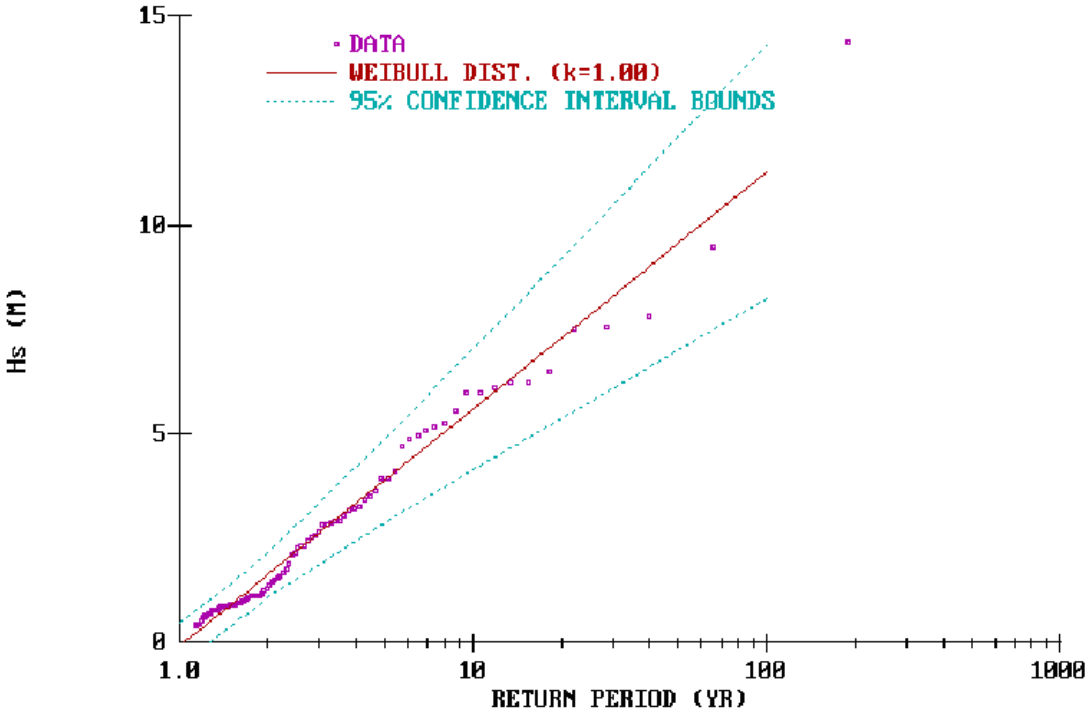


Figure 3-2 Wave Height Data for Gros Islet

Table 3-1 - Results of Analysis of Wave Conditions at Gros Islet

Return Period (Years)	Significant Wave Height[1] (m)	Peak Period[2] (s)
5	3.9	8.2
10	5.6	10.0
25	7.8	12.2
50	9.6	13.8
100	11.3	15.3

1 The significant wave height, H_S, is defined as the average of the highest 1/3 of the waves in a storm.

2 The peak period, T_P, is the wave period that is associated with the wave frequency around which most of the energy of the waves in the storm is clustered.

The structures in Gros Islet have been designed to withstand the 1 in 50 year return period wave. Based on the statistical analysis described above, this translates to deep-water design conditions of:

H_s = 9.6 metres

T_p = 11-14 seconds

In addition to this, day-to-day wave conditions were assessed using two different sources. The first source included five years of 6-hourly computer modeled wave data, (UKMO wave data). The computer model used to generate these wave conditions operates on a global scale, and therefore the island of St. Lucia is not actually represented in the model grid domain. It was therefore necessary to use an additional detailed refraction and shoaling computer wave model to determine the effect of the island of St. Lucia on these deep-water wave conditions. This was found to be an effective wave transformation technique for Gros Islet.

For Gros Islet, the detailed nearshore wave model was set up to give results in a 4-metre water depth. The model showed that regardless of offshore wave direction, the waves approach the shoreline within a limited angular band, from 250° north to 300°.

3.2 Water Levels

Tide data for St. Lucia was obtained from British Admiralty Chart No. 1273. This is listed in the following table and refers to measurements made in Castries:

Table 3-2: Tide Data for Castries, St. Lucia

Tide Level	Water Level (metres above MSL)
MHHW	+0.18
MHLW	+0.03
MLHW	-0.03
MLLW	-0.15
Mean Spring High at Solstice	+0.31
Mean Spring Low at Solstice	-0.24

3.3 Sediment Transport

Morphological computer modeling was done for the Gros Islet shoreline, in order to evaluate the impact of the proposed structures on the adjacent shorelines. The model domain stretched from the north headland of Gros Islet to the entrance channel of the Rodney Bay Marina. The results, shown in Figure 3-3, indicate that the shoreline north of Dauphin Street will accrete, beyond the beach nourishment, by approximately 30 metres. South of Dauphin Street, the shoreline is predicted to remain stable at the seaward extent of the beach nourishment.

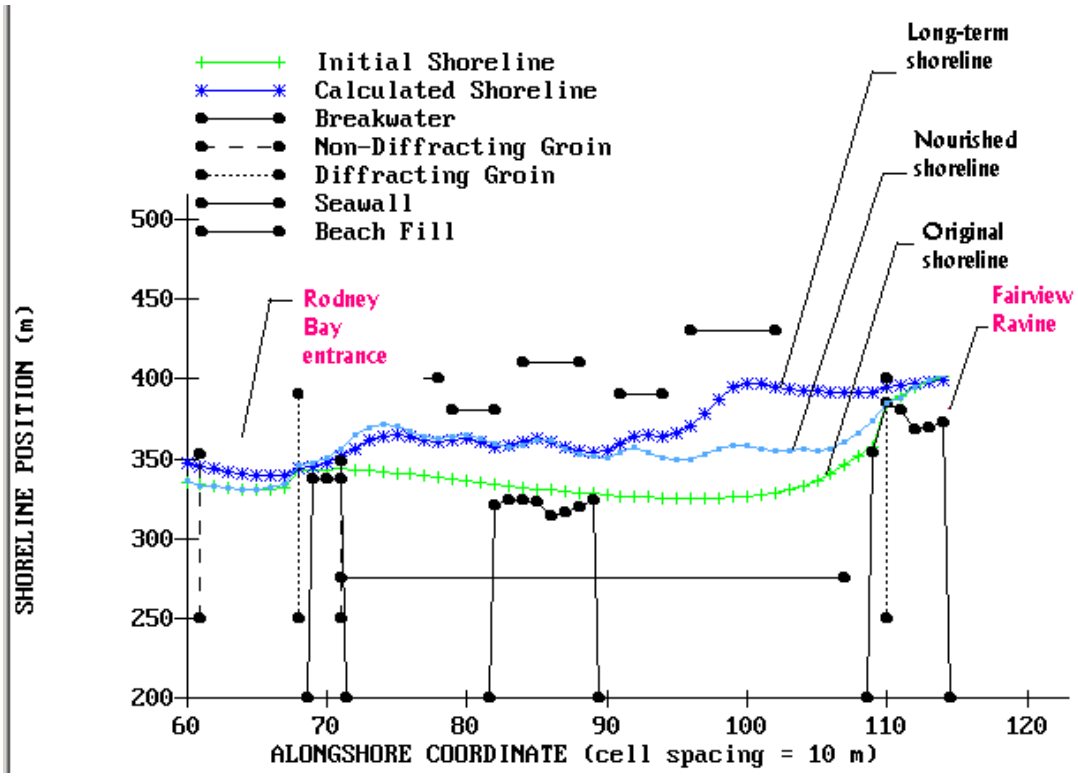


Figure 3-3 Morphological Modeling Results

Effectively, the northern entrance jetty to the Rodney Bay Marina acts as a littoral barrier for this section of the Gros Islet shoreline. To the north of Gros Islet, the impact of the works tapers off, so that the original and computed shorelines merge.

The sediment transport calculations indicate that the net transport will be to the south, at a rate of approximately 12,000 m^3/year. These were done using a bulk predictor that computes transport rates throughout the entire surf zone. Based on our experience with this bulk predictor, this value is considered to be on the high side. The prediction that the net transport will be to the south is consistent with field observations, which demonstrate that the beach to the south end of Gros Islet (i.e. immediately to the north of the Rodney Bay entrance structures) is the widest beach area along this section of shoreline. Other observations, however, lead to the conclusion that this net southerly transport does not result in major bypassing into the Rodney Bay entrance, since there is no program of regular ongoing maintenance dredging at this location.

3.4 Topography

The topography along the project site consists of a sandy beach with two small headlands protected with rubble and in one instance, concrete slabs. In general, the shoreline is relatively

flat, at a typical elevation of 1.0-2.0 m above sea level.

3.5 Marine Water Quality

Nearshore and offshore water quality within Rodney Bay and the marine zone near Gros Islet's waterfront are influenced by several point and non-point sources of pollution as follows:

i. Freshwater discharge from the Fairview Ravine is contaminated with both agriculturally and residentially generated wastes from upland areas that form the principal catchment zone for the ravine. Naturally eroded inland soils are also transported to the marine zone via this watershed. The ravine also conveys solid wastes (dumped in its course) to the marine zone.

ii. Coastal marine waters near the waterfront and within Rodney Bay are influenced by contaminated sewage and grey-water discharges, as well as by storm water runoff from the residences and commercial business establishments in the town.

iii. Yachting activity occurring within and immediately offshore Rodney Bay Marina is also a major point source pollutant contributor to water quality conditions within the bay.

iv. Coastal development in the commercial tourism zone north of Gros Islet town represents another potential source that is likely to effect coastal water quality.

Although detailed water quality data were unobtainable, a review of available literature from the Ministry of Health, Atria (1993) and the St. Lucia Northwest Coastal Conservation Project 1999 suggests the following trends:

i. Nearshore water quality off the waterfront of Gros Islet town is poor and has become progressively worse since monitoring started in 1989; offshore water quality is better than nearshore water quality, as it is further from contaminating point and non-point pollutant sources. However, it is also likely that it has declined since earlier periods.

ii. The Ministry of Health collected marine water quality data for Gros Islet between 1989-1992 (cited in Atria Report 1993). This data shows that concentrations of faecal coliforms exceeded the recommended guidelines for recreational swimming and water contact sports (>200 counts/100ml) on numerous occasions. Some sites were contaminated for the entire year. These high values are as a result of sanitary sewage contamination.

iii. Ministry of Health monitoring data (1989-1992) also indicates a trend of increased faecal coliform levels within the lagoon/marina basin. Guidelines for recreational contact concentrations were considerably exceeded during the late rainy season (late June) and in the late November/December period. This coincides with the Atlantic Race for Cruisers (ARC) activities. The marina is reported to have a berthing capacity of 280 yachts. An additional 150 yachts are reportedly observed to be anchored during ARC season. The marina is not equipped with holding tanks or pump-out services.

iv. Elevated concentrations of total suspended solids (TSS), colour, turbidity, total

phosphorous and ammonia – nitrogen were also recorded, indicating a potentially active plankton population.

v. Sediment samples were collected by Atria from the bottom of the marina basin in 1993. Analyses indicated that sediments were fine-grained, with high organic content. Concentrations of most contaminants were within Canadian Freshwater Objectives and Ocean Disposal Guidelines.

vi. Only copper, one elevated concentration of PCB and one elevated concentration of PAH were recorded. The copper is attributable to antifouling paints stripped from yachts; the localized elevated PCB reading is believed to have been attributable to spillage of transformer or hydraulic oil; and the PAH from spilled waste oil.

vii. Atria (1993) characterized the marina sediments as being uncontaminated to marginally contaminated.

viii. Atria (1993) also reported that there was a sewage treatment facility for land-based waste at the marina, but that there was no provision for treatment of yacht-generated sewage. It was further indicated that the existing treatment plant was moderately successful in meeting current discharge standards but has had significant operational problems in the past due to mechanical failures (Vlugman 1992, cited in Atria Report, 1993).

ix. More recent studies (e.g. the St. Lucia Northwest Coastal Conservation Project, 1999) found that:

- Water quality inside the lagoon at Rodney Bay revealed high levels of faecal coliforms, while levels in the larger bay were low; and
- Areas along the Reduit beach were found to have low concentrations of faecal coliforms, although elevated concentrations were found along the Gros Islet shoreline.

3.6 Climate

It is not expected that these works would affect climate. However, climatic factors will affect the dispersion of emissions and effluents from the construction of these works. It is in this context that this discussion of climate is presented.

3.6.1 Wind

The Windward Island group, of which St. Lucia is a part, is located within the belt of Trade Winds. These winds move westerly along the southern edge of the Atlantic Azores sub-tropical high-pressure zone and approach St. Lucia from directions between east-northeast to east-south-east. Statistical data on wind speed and direction at sea in the environs of St. Lucia are presented in Table 3-3.

Table 3-3: Annual Average Wind Speed and Direction on Seas around St. Lucia

Wind Direction	Wind Speed (m/sec)				Percent Frequency
	0-3.0	3.5-8.0	8.5-14.0	14.5 - 20.5	
N	0.5 %	1.0 %	0.1 %	*	1.6 %
NE	3.1 %	18.7 %	6.2 %	0.2	28.2 %
E	6.1 %	38.1 %	12.4 %	0.3	56.9 %
SE	2.4 %	6.6 %	1.2 %	*	10.2 %
S	0.6 %	0.8 %	0.1 %	0	1.5 %
SW	0.2 %	0.2 %	*	0	0.4 %
W	0.1 %	0.1 %	*	0	0.2 %
NW	0.1 %	0.0	0.0	0	0.1 %
VAR	0.0	-	0.0	0	0.0
CALM	0.7 %	-	-	-	0.7 %
TOTAL %	13.8 %	65.5 %	20.0 %	0.5%	100.0 %

- percentage frequency between 0.0 and 0.09.

Source : St. Lucia Environmental Profile, 1991 Caribbean Conservation Foundation

3.6.2 Temperature

Typical of a small tropical island, the temperature of St. Lucia at sea level is generally high with little seasonal, diurnal or locational variation due to the damping effect of the ocean mass and its near constant temperature between 23-28^{o} C. Diurnal variation is almost entirely within the range of 23^{o}C (73^{o}F) to 31^{o}C (87 ^{o}F). Monthly averages for the Roseau Station, which lies on the west coast, are contained in Table 3-4.

3.6.3 Rainfall

There is a great variability and a high degree of unpredictability to the quantities of rainfall that occur from year to year in St. Lucia. Generally, the period of lowest rainfall occurs in mid-to-late December, when the "Bermuda high pressure cell" extends its influence southward, forcing a pronounced shift of the trade winds from the southeast to out of the north east. These so called "Christmas Winds" as they are known by the seamen, also bring clear, relatively dry conditions to St. Lucia from mid December to early May. For the other months of the year (May through December), rainfall increases with varied intensity according to the degree of windward exposure and height above sea level. Mean monthly rainfall at the Roseau Station is also given in Table 3-4.

3.6.4 Hurricanes and Tropical Storms

St. Lucia lies in the path of tropical storms, including hurricanes, situated as it is between the

subtropical high-pressure belt of the Atlantic Ocean and the equatorial low-pressure belt to the south. It is, however, far enough south that passing tropical cyclones normally do not reach their maximum intensity. Nevertheless, there is a high frequency of micro-disturbances that generate squalls and winds with potentially damaging, short burst high velocities.

On land, the risk of wind and rainstorm damage can be serious, especially during the August-November period. Lesser storms, even though not of hurricane or gale force and of only short duration, are common, and St. Lucia averages about 25 such windstorms per year.

Table 3-4: Weather Station at the Roseau Station, St. Lucia

Month	Rainfall (mm)	Evap. (mm)	Temp. (EC)	Sunshine Hours	Relative Humidity (%)	Wind Run (m/s)
January	152.0	95.0	24.7	7.5	76	0.95
February	97.0	115.0	24.8	8.2	73	1.12
March	84.8	140.8	25.2	8.1	72	1.18
April	95.9	156.2	25.9	8.1	70	1.21
May	113.0	163.9	26.8	8.1	72	1.29
June	175.1	146.2	27.3	7.3	72	1.37
July	245.8	135.8	27.1	7.4	74	1.12
August	251.9	134.5	26.9	7.4	75	0.96
September	251.5	129.1	26.8	7.1	76	0.72
October	266.5	125.4	26.6	7.2	78	0.73
November	237.2	96.5	26.1	7.4	78	0.71
December	176.4	100.4	25.3	7.2	76	0.89
Total	2147.0	1538.8	---	---	---	---
Mean	178.9	128.2	26.1	7.6	74	1.02
Period	1966/85	1978/85	1968/85	1968/85	1978/85	1978/85

Source : St. Lucia Environmental Profile, 1991 Caribbean Conservation Foundation

3.7 Terrestrial Ecology

The northern and central sections of beach in the project area are largely devoid of vegetation. Immediately north of the ravine (outside of the project study area) there is an area of scrub and grassland habitat. Along the edges of the ravine there are a few small white and black mangroves (*Laguncularia* and *Avicenna*). A guesthouse is located on the southern ravine channel embankment, the premises of which are landscaped with the use of lawn grass and ornamental

plants including bougainvillaea.

At the junction of Bay Street and Dauphin Street there is an immortelle tree (*Erythrina* sp), where seine fishers use the beach as an operational base. There is a localized salt grass patch at the back of the southernmost beach (adjacent to the marina crossing). Several mature almond (*Terminalia catappa*), and coconut trees (*Cocos nucifera*) also occur at the back of the beach here. Seaward of Bay Street, there is a general lack of shading vegetation along the northern and central waterfront back beach zones. However, in the yards of some residents on the landward side of Bay Street there is vegetation that includes bananas (Musa sp), Mango (*Mangifera indica*) and breadfruit (*Artocarpus incisa*).

In general, at Gros Islet there are no significant terrestrial habitats occurring along the defined waterfront zone, as the area has long since been exposed to development and the original coastal vegetation has been removed. As a result, there are no major faunal communities or designated ecologically sensitive terrestrial habitats within the study area.

3.8 Benthic Ecology

The nearshore habitat is mainly a bare sand bottom with no significant reef formations. However, some reef formations occur in deeper waters offshore. The status of these ecosystems is not clearly known, as there have not been many monitoring survey efforts. Some efforts at artificial reef creation by the sinking of old or abandoned vessels have been made.

While corals are absent from the area, there are beds of Turtle Grass (*Thelassia testudinum)* intersperse with clumps of Watercress Algae (*Halimeda opuntia),* which form an important part of the marine ecosystem. The abundance and vigorous growth habit of the alga is indicative of a nearby nutrient loading source. This alga can easily be seen as dark patches offshore, as well as when they are washed ashore by wave action, as the beds are scattered within the bay. These beds have been roughly estimated to be as large as 50 metres by 10 metres. The yachting industry also impacts the benthic community since there is unregulated anchoring of yachts within the bay.

4. Environmental Setting: Human Environment

As with the description of the Natural Environment, this chapter addresses the components of the Human Environment that are likely to be affected by this project. These are as follows:

i. Socio-Economic Conditions;

ii. Fishing;

iii. Tourism;

iv. Heritage;

v. Road Traffic;

vi. Waste Disposal, and

vii. Noise.

4.1 Socio-economic Conditions

Interviews were conducted in the Gros Islet community with the households on Bay Street and Marie Therese Street. In total, the Community Development Officer and a representative of the Village Council interviewed 45 households (104 individuals). This survey addressed age and gender distribution, home condition, property ownership, water and sewage facilities, and employment status. The results of these surveys are summarized below.

4.1.1 Age and Gender Distribution

Of the 45 households interviewed, 47% were male and 53% female. 25% of the sample were between the ages of 0 and 18 years, 37.5% were in the age group 19 to 40 years and 10.6% were 66 years and over.

4.1.2 Home Condition

The houses in the study area have been constructed of timber, concrete walls or a combination of both (Photo 6). From the sample, it was recorded that 64.4% of the homes were constructed of timber, 20% of concrete wall and 13.3% of a combination. Of these, less than half (46.7%) are reported to be in good condition, 28.9% are in fair condition and 20% are in poor condition.

Photo 6 Typical housing at north end of Gros Islet

4.1.3 Property Ownership

The survey reported that 73.3% of the respondents indicated that they own their homes. One resident admitted that he was squatting, and the remainder of the residents rent their homes. With regards to land ownership, 57.8% of the respondents own their land, while 15.5% occupy Crown Lands and the remaining 22.2% rent the land. 70.5% of the sample households are made up of 1 to 3 persons, while 25% are composed of 4 to 6 people. 4.5% of the sample did not indicate the numbers of persons living in their households.

4.1.4 Water and Sewage Facilities

44.4% of the respondents have no running water on their premises and 33.3% have no toilet facilities. Inquiries into their methods of sewage disposal revealed that only 6.7% of the residents had a treatment plant, 31.1% utilise septic tanks, while 42.2% dispose of their sewage by other means including the public facility and directly into the sea.

4.1.5 Employment

The survey recorded that 21.2% of the sample were fully employed and 13.6% were unemployed. The type of work among the males of the community included: construction work, apprentice work, fishing, masonry, travel agency, supervisory and maintenance. The females are employed mainly as cleaners, proprietors, clerks, secretaries, fishers, maids and hotel workers.

4.2 Fishing

Information relating to fishing in Gros Islet is summarized in this section. The latest Fisheries Department statistics on fisher numbers (November 2000) indicate that there are a total of 180 fishers for the entire district of Gros Islet, 77of whom are part-time. The district of Gros Islet consists of three principal landing sites, of which the town is one.

Previously, Gros Islet was considered a principal fishing village and was characterized by a seine fishery that employed many. This fishery was largely denuded, through habitat destruction and the blockage of the passage of migratory pelagics (between Pigeon Island and the mainland) with causeway construction. The loss of biomass productivity due to habitat loss induced a decline in the numbers of fishers, with those unwilling or unable to adapt being forced to drop out of the fisheries industry altogether.

Recruitment of new fishers to the industry is slow, but the importance of conch, lobster and other species to the local tourist industry ensures that these fisheries are well supported. Gros Islet remains a major conch and lobster landing area on the island. Conch is harvested by scuba diving in areas outside of Rodney Bay and also in areas on the northeast of the island at depths normally exceeding 30 meters. Fishers tend to rotate their harvesting of areas, thus easing the pressure when it is felt that any one area is heavily or possibly over-fished. Forays into the south of the island are quite common, as substantial fish populations exist there and fishing pressure is normally low.

Prior to the construction of the causeway, fishing took place from small sail-powered canoes or small boats called chaloupes, which were powered by oars. Today the traditional canoe has been replaced by glass reinforced plastic (GRP) or fibreglass pirogues. Close examination indicates that there are 54 active fishers within Gros Islet town, operating with 14 fibreglass pirogues and 5 wooden canoes.

Most pot fishing is now conducted in areas outside of Rodney Bay, with 4 small operators fishing within the bay, and with 6 larger operators setting their pots much further offshore and in deeper water.

Migratory pelagics such as tuna, dolphin fish and flying fish, which are caught by trolling, represent the main contributors to the landings. Snappers, which are normally caught by bottom long lines, are also a highly prized catch and are targeted during the pot fishing season that lasts essentially from April to October. The other category comprises all other species of reef fish that are caught by fillet nets, pots, bottom gillnets and beach seines.

The majority of fish coming ashore in Gros Islet is landed at the new Japanese constructed fish market and landing facility, located along the town side (northern section of the entrance to the Rodney Bay Marina). Some fish is still being landed along the back of the beach adjacent to Bay Street. When catches are large, the excess is taken by open-back pickup truck to be sold in the streets of the town and in surrounding communities.

Photo 7 Canoes hauled onto beach at Gros Islet

At least 14 of the boats in the town moor alongside the fisheries facility, with four canoes hauled onto the beach and one located inside the marina itself (Photo 7). Fishers are apparently quite happy with the location of the facility and the greater convenience it affords the landing and marketing of fish.

The fish landing facility in Gros Islet is owned and managed by the Gros Islet Fishers Co-operative, which has approximately 68 active members. Of these, however, only 25 are actively fishing, meaning that a significant number of fishers are not members of the co-operative. The cooperative itself is not being run as it should (personal communication with past President), and in the recent past has run into a series of difficulties, some of a financial nature. The co-operative essentially generates revenue from the sale of fuel (there is a diesel and a gas pump on

the compound servicing fishing boats, visiting yachts and vehicles), and from the rental of storage lockers.

In addition to this facility, and prior to the passage of Hurricane Lenny, a combination of a small meat and fish market facility was also located on the seaward side of Bay Street, in the vicinity of the junction of Bay Street and Dauphin Street. This facility was totally destroyed during Hurricane Lenny. A small number of seine fishers continue to use this locale periodically to land and sell their catch, as well as to haul up their boats.

There are no known conflicts between fishers and yachtsmen, either in the marina, or in areas outside. Similarly, there is no significant evidence that any conflicts exist between fishers and day boat charter vessels that ply the area daily.

4.3 Tourism

A total of 13 hotel/guesthouse properties are located within greater Gros Islet. Only the following are located with the boundaries of the project site, namely:

- Daphil's Mini Hotel,
- Paradise Beach Hotel,
- Alexander's Guest House,
- Bay Guest House, and
- My Helen Inn.

In addition to hotel and guesthouse accommodation, tourism activities in Gros Islet include the Gros Islet Friday Night Street Party. This is a well-known and popular attraction for nationals and guests but, according to observers, the event may be losing some of its appeal.

Organized bicycle and horseback riding tours are conducted by private agencies. Tours are made to Gros Islet, which is promoted to hotel guests as a fishing village. Tourists and other visitors also take unguided visits to Gros Islet.

The number of people eating out at restaurants in Gros Islet is negligible compared to the volume of restaurant business in Rodney Bay. The Friday Night Street party provides the major source of business for restaurants as well as residents in Gros Islet.

Anchoring in the Gros Islet section of Reduit Bay is done by a small number of yachts, except during special yachting events such as the completion of the Atlantic Rally for Cruisers (ARC) race. Yachtsmen consider anchoring at Gros Islet to be risky for reasons explained later in this section. The Rodney Bay section of Reduit Bay, with similar conditions for anchoring as Gros Islet, is considerably more popular.

The impact of yachting on Gros Islet is negligible, considering the overall development that has occurred in the sector over the last two decades. Gros Islet is strategically located on Reduit Bay, between Rodney Bay and Pigeon Point. It has important credentials for attracting a greater volume of yachting business in its section of the bay, namely:

- Adequate depth,
- Good protection, and
- Historic and traditional charm and interest.

Factors working against the development of yachting activities that would be of greater benefit to Gros Islet, include:

- Inadequate shoreline infrastructure for docking dinghies,
- Limited activities for yachtsmen and women on shore,
- Theft and security concerns,
- Unattractiveness of the waterfront,
- Concerns about harassment, and
- Concerns about the sale and use of drugs.

In addition to yachting activities, several hotels, guest houses and vacation villas in Rodney Bay and Cap Estate provide a ready volume of guests for whom Gros Islet could become a central and convenient place to visit, dine and shop in greater numbers.

4.4 Heritage

Evidence of the fishing tradition exists in Gros Islet. The traditional canoe is still hauled on the beach along Bay Street, but the way of life is changing. Special efforts will be required to preserve elements of the fishing culture as development progresses.

Creole style architecture is giving way to newer and less classic forms. There are no buildings in the project site of heritage importance, but the architectural form of an old building on the corner of St. George Street and Marie Therese Street is of interest. The history of this and other old buildings could be documented even if preservation is not desirable or possible.

A concrete building on the corner of Chapel Street and Marie Therese Street represents one of few attempts to revive the Creole look. Revival of Creole architecture in scale, form and decorative motif could be one of the many considerations given in the revitalization and redevelopment of the waterfront.

4.5 Land Use

The town of Gros Islet also includes Rodney Bay and environs. Nevertheless, the term Gros Islet is still used to refer to what was once Gros Islet village and is so used in this report. This section presents a summary of the present land use in Gros Islet.

Although all the streets have been paved and streetlights have replaced Coleman gas lamps, which were hung on the sides of buildings to provide lighting at night, Gros Islet remains a village in character.

Gros Islet was laid out on a grid typical of small towns in the region. Changes in land use have not significantly altered the grid. The construction of the entrance channel to Rodney Bay Marina terminated the road that once linked Rodney Bay/Reduit to Gros Islet. The channel caused the physical separation between these two areas. Dynamic development has occurred in Rodney Bay, based on a master plan. Gros Islet has also changed, but growth has been insignificant compared to that occurring in Rodney Bay.

4.5.1 Changes in Land Use

Changes in land use followed changes in the town's economy. Gros Islet was once a predominantly fishing community in which most buildings were residential. With the development of Rodney Bay as a hotel resort and yachting centre, Gros Islet has become a tourist attraction, though not a tourist town.

Fishing is giving way to services as the dominant economic activity and a transition in land use is occurring as a result, namely:

- Changes in use of existing buildings from residential to commercial or to residential/commercial combined;
- Construction of new buildings for commercial use;

Two very obvious symptoms of the transition are:

- Construction of small buildings or shacks at the waterfront for residential or commercial uses, as persons try to take opportunity of the new Gros Islet economy;
- A number of vacant lots, indicative of emigration of property owning families.

4.5.2 Land Use by Blocks and Zones

Within the project site, there are five blocks defined by shore perpendicular streets that intersect the main shore adjacent street (Bay Street) and the first main landward shore-paralleling street, Marie Therese Street. These streets are characterized by a combination of residential and commercial buildings. They are as follows:

- Chapel (Cemetery) Street,
- Marie Therese Street (west and east side),
- Dauphin Street,
- Church Street, and
- Parish Street.

Two areas within the project site are identified as beach or beach/shoreline zones, Bay Street beach zone and North Marina Channel shoreline zone, which were both damaged by Hurricane Lenny.

4.5.3 Building Density

Distances between buildings and building setback from the road are typical features of density influencing patterns in urban areas. In the case of Gros Islet, density was moderated by the prevalence of one-story buildings. Practices observed that affect existing building density include:

- Maximum building height 3 stories
- Standard Plot coverage >75%
- Street setback 4-8 ft
- Sidewalk width 4-6 ft
- Distance between buildings <5ft

These practices were typical but not absolute and they were not checked against minimum land development standards used by the Development Control Authority

4.5.4 Land Use Policy

The most recent attempt to shape land use policy by way of planning intervention is the Gros Islet Waterfront Commercial Redevelopment Plan, prepared by the Architectural Section of the Ministry of Planning. The Plan benefited from consultations with the Gros Islet Town Council, the St. Lucia Heritage Tourism Programme and other stakeholders.

4.6 Road Traffic

Gros Islet is characterized by a grid work pattern of roads that run parallel and perpendicular to the existing shoreline. Dauphin Street provides the main access to and from Gros Islet with respect to the coastal highway. Bi-directional traffic flow is permitted along all of the main streets within the grid. Road surfaces are generally composed of asphalt and are in good condition with a few, localized potholes. There is no physical separation for pedestrian and vehicular traffic streams. Marie Therese Street is generally served by sidewalks, but sidewalk inadequacies (due in large part to open roadside drainage structures) affect pedestrian movement along streets that run perpendicular to the shorefront.

Carriageways are reasonably wide and can accommodate traffic flow under normal conditions, even with a single lane of curbside parking. Curbside parking is a standard practice. There are no specifically designated vehicular parking areas along the waterfront.

Average daily traffic flow along the waterfront (Bay Street), as with other streets in the Gros Islet grid, appears to be low with no delays, even at expected peak flow hours (before and after typical working hours). Traffic flow is generally self-regulated at intersections, as there are no traffic lights or roundabouts.

Bay Street runs parallel to the back of the beach along the waterfront. This road surface and its margins are now poorly defined due to the erosion damage sustained with the passage of

Hurricane Lenny.

During special events (e.g. the Gros Islet Friday Night Street Party), some traffic and parking congestion is experienced. Apart from the highway, there is no clearly defined pedestrian or traffic linkage along the waterfront that connects this shore-zone to the Rodney Bay Marina and Pigeon Point tourism centres. There is access southwards to the Gros Islet waterfront, from the Pigeon Point tourism centre across the ravine in the dry season, or when water levels within the ravine are sufficiently low.

4.7 Sewage Collection and Treatment

Sewer mains exist within the Gros Islet community. These mains form part of a secondary treatment system, with a plant located inland. Sewage is pumped from Gros Islet inland and uphill, crossing the main coastal highway, to the treatment facility. The treatment facility is reported to be experiencing a problem of low influent flow.

The Water and Sewerage Company (WASCO) reports that one hundred forty three (143) connections to the sewerage system are in place for Gros Islet. An additional four hundred (400) homes and businesses remain to be connected.

The low percentage of domestic connection was verified in March 2001, from a sub-sample social survey of Gros Islet residents. In this survey, approximately 43% of residents indicated that they disposed of their sewage by other means, including the use of existing public facilities and directly into the sea.

The low percentage of connections to the sewage system contributes to the low public health and ecosystem health qualities of adjacent nearshore waters. Under such circumstances, the potential for infections and consequent health risks from faecally contaminated waters remains high.

4.8 Noise

Apart from the sound of the waves breaking on the beach, other sources of elevated sound levels include vehicular traffic, and sounds of residents. Noise levels were measured for 15 minutes at two locations at the Gros Islet Bay. An average level of 61.5 dBA was recorded on the beach, at the end of Church Street. Another source of noise at this location was music emanating from a loud speaker from a nearby shop. Noise levels recorded near the entrance to the Rodney Bay Marina averaged 52.9 dBA. The main noise source in this area could be attributed to waves as it was away from residences and roads.

5. Impacts and Mitigation Measures

In this chapter, the potential environmental impacts of this proposed development are presented. These impacts are classified by project phase (construction and operation) and are discussed in the following sections.

5.1 Construction Phase

During the construction phase, potential impacts on the environment relate to:

i. Sea water quality,
ii. Benthic ecology,
iii. Terrestrial ecology,
iv. Noise,
v. Air quality,
vi. Employment,
vii. Fishing,
viii. Land use,
ix. Traffic,
x. Waste disposal,
xi. Public safety, and
xii. Recreation.

These are all discussed in this section.

5.1.1 Sea Water Quality

Three potential sources of contamination have been identified during the construction of these works:

i. Silt from erosion of cleared areas,
ii. Silt from rock being placed in the works, and
iii. Fuel and lubricants from construction equipment.

These impacts are expected to be relatively limited in extent, given the size of the proposed works. They will also be transient, lasting only as long as construction is in progress.

Several mitigation measures are available to minimize these potential impacts:

i. Minimize the land areas that are cleared at any one time for the construction work, and re-grass or pave (as may be appropriate) as early as practical. Scheduling the work for the drier period, mid December to early May, (to the extent practical) will also reduce the potential for erosion.
ii. Specify and select rock material with a minimum of fine material (rock powder) and adhering clay.
iii. Fuel and service construction equipment away from the seashore and river banks, and provide specially confined areas for these activities (to catch and contain spills).

5.1.2 Benthic Ecology

The area of seafloor to be disrupted during construction of the breakwater and headland control structures is relatively small. The impact of this disruption on benthic communities is therefore not considered to be significant.

5.1.3 Terrestrial Ecology

There are no significant terrestrial habitats occurring along the defined waterfront zone at Gros Islet since the area has long since been exposed to development and the original coastal vegetation has been removed. As a result, there are no major faunal communities or designated ecologically sensitive terrestrial habitats within the study area. The impact of this project on terrestrial ecology is therefore considered to be insignificant.

5.1.4 Noise

Noise impacts during construction will arise largely from the passage of trucks and the use of heavy construction equipment. These impacts will be temporary, lasting only for the duration of construction activity. In areas where construction works are to be done in relatively close proximity to houses, construction activity should be scheduled to avoid night hours.

5.1.5 Air Quality

The anticipated air quality impacts during construction relate to dust (particularly during earthworks) and exhaust fumes from construction equipment. These impacts are expected to be relatively small in extent, and to be transient in nature (only during the active construction period). The mitigation measures to control dust and equipment emissions during construction include:

- Spray dirt surfaces in the construction area with water or other dust palliative daily during the dry season.
- Pave or grass denuded surfaces (as appropriate) as soon as practical after construction.
- Specify and select rock material with a minimum of fine material (rock powder) and adhering clay.
- Ensure that the contractor properly maintains and services all construction equipment.

5.1.6 Employment

Employment is a short-term benefit of these works, as they are mostly labour-intensive. The contractors should be encouraged to use as much local labour as practical.

5.1.7 Fishing

The breakwaters will serve to protect not only the beach during strong storm events, but fishing boats will also be sheltered.

None of these works is of such a nature as to impede fishing activity offshore during construction. Landing of boats may be temporarily hampered during the construction of the breakwaters. In order to avoid conflict, it is recommended that all members of the community be advised of the nature and scheduling of the work.

5.1.8 Land Use

It may be necessary to negotiate easements for construction access and working areas during construction. This will be the responsibility of the contractor, who will make necessary arrangements for compensation of landowners (if required).

5.1.9 Traffic

Impacts on traffic will be moderate and temporary as far as the extent of the works. Traffic impacts relate more to the type of traffic (heavy trucks as opposed to light vehicles) and to a lesser extent the number of vehicles. Mitigation measures include:

i. Schedule deliveries of construction material to avoid peak traffic periods on heavily trafficked roads.

ii. Avoid long convoys of trucks making deliveries.

5.1.10 Waste Disposal

The construction works will generate solid waste and sewage. Solid waste will consist largely of construction debris and packaging material, all of which are suitable for disposal in a landfill. No hazardous wastes are anticipated during the construction of these works. Adequate provision must be made for toilet facilities on site for workers (Port-a-Johns, etc.).

5.1.11 Public Safety

Public safety concerns arise within the site of any construction works. These concerns are temporary, lasting only as long as the construction activity. On this project, the sites of the works are relatively small. Notwithstanding the small size of the construction sites, they should be adequately demarcated, fenced (where appropriate) and guarded to prevent entry by unauthorised persons.

5.1.12 Recreation

Any recreation activity at the beach will be temporarily impeded during construction. However, recreation activity at this beach is very small. This is a temporary adverse impact, and the long-term effect of the project will be to enhance recreational opportunities in these areas.

5.2 Operational Phase

During the construction phase, impacts on the environment are expected to related to:

i. Drainage,
ii. Land use,
iii. Waste disposal,
iv. Aesthetics,

These are all discussed in this section.

5.2.1 Drainage

Drainage will be improved as a result of this project. Erosion on the beach due to discharge of street side drains will be eliminated with the installation of the new drain to the Fairview Ravine.

5.2.2 Land Use

The operation of these works will protect the integrity of the land and therefore be a major benefit to the properties currently under threat from the eroding coastline.

5.2.3 Waste Disposal

Waste is expected to increase in the project area as recreational use increases in these areas. Even though this increase will be relatively small, systems must be put in place to accommodate it. For example, the St. Lucian government should increase its schedule of garbage collection at this beach as the need arises.

5.2.4 Aesthetics

The aesthetics of the beach will be adversely impacted due to the installation of the headland control structures, which will emerge from the edge of the beach at two locations.

Part II
Environmental Impact Assessment
at Soufriere

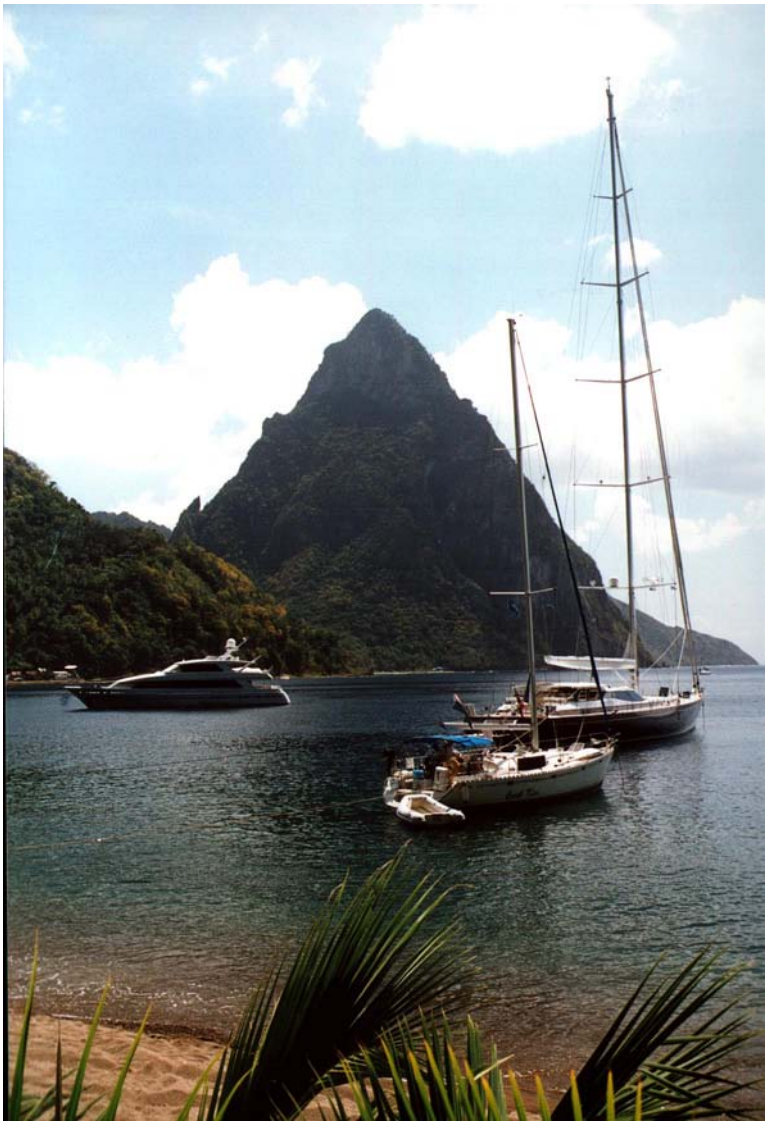


Table of Contents

1. Introduction

As a result of the passage of Hurricane Lenny, severe damage occurred on the western shores of St. Lucia. Even though this storm passed well to the north, it generated waves that were still high enough to result in severe damage to coastal infrastructure. This section of the report documents the EIA for the works proposed at the Soufriere shoreline. This part of the document consists of five chapters. Chapter 1 is a general overview describing the layout of the document, Chapter 2 gives details of the proposed actions, and Chapters 3 and 4 outline the Project Setting in the Physical and Human Environments respectively. Lastly, Chapter 5 presents information on Significant Environmental Impacts and Appropriate Mitigation Measures.

2. Project Description

2.1 Site Description

The project area is located at Soufriere on the western coast of St. Lucia (Figures 2-1a and 2-1b). The project site is defined as that stretch of shoreline occurring from Rachette Point at the northwest end of Soufriere Bay to the section of the bay that represents the end of the Baron's Drive housing settlement.

The bay is relatively large with a variety of uses. At the northern end of the site is Rachette Point. This forms one of the four Marine Reserve Areas created within the Soufriere Marine Management Area (SMMA), the other three being Anse Chastanet, Petit Piton and Gros Piton. The primary purpose of these areas is to allow fish stocks to regenerate in order to ensure healthy fish populations in the future. The coastline at this point and continuing east for a distance of approximately 705 m, is mainly cliff. At the centre of this cliff area, is Bat Cave, another popular diving site.

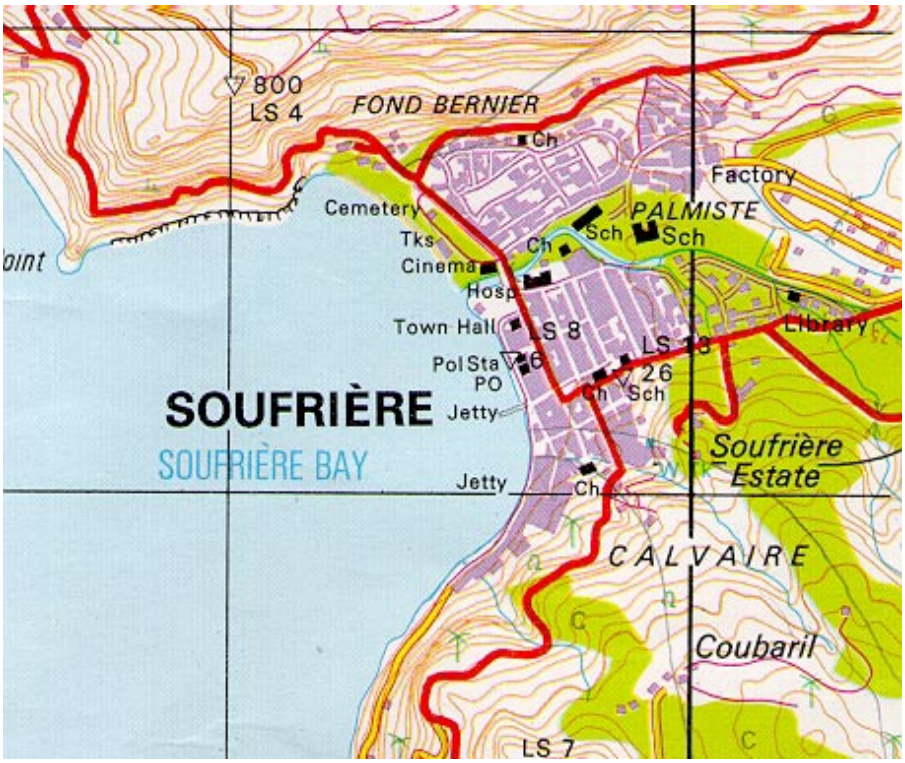


Figure 2-1a Site location

Southeast of the cliff area is Hummingbird Beach (Photo 1), which stretches for a distance of approximately 490 m until it reaches the town's waterfront area. This beach is mainly used for recreational and fishing activities and its waters designated a Fishing Priority Area by the SMMA. Although the beach itself has been designated as a recreational area by the SMMA, the main users are from the immediate surrounding community.

There are two drainage outfalls along Hummingbird Beach; (1) a small storm water drain which exits through a 600 mm culvert onto the beach and (2) the Soufriere River (Photo 2).

Figure 2-1b Soufriere and Environs

South of Hummingbird Beach is the town's developed waterfront area. This area stretches for approximately 290 m ending at a fish market and storage building. Along the waterfront area are two yachting jetties that are used by both individual yacht owners and tour operators. A short concrete wall with pebble stone laid at the base protects the shoreline in this area. There is a very small sandy area in front of this protection. A portion of the waterfront just behind this wall has been recently landscaped. A fuel station also lies very close to the waterfront, just behind this wall (Photo 3).

Photo 1 Hummingbird Beach

Photo 2 Mouth of the Soufriere River

Photo 3 Fuel station near the Soufriere waterfront

Further southeast of the fish market/storage building to the end of the Baron's Drive housing settlement, a narrow cobble beach continues for a distance of approximately 390 m. A large fishing community has developed in this area. The beach is mainly used by this community for fishing, bathing, washing and other domestic purposes. Several drains outfall directly onto the beach (Photo 4).

Photo 4 Drain empties onto beach

The Baron's Drive roadway separates the beach from the residents. This road was destroyed during the passage of Hurricane Lenny and is in poor condition, however it is still being used. Fishermen bring their boats straight up onto the beach in this area (Photo 5).

Photo 5 Fishermen haul boats up onto beach along Baron's Drive

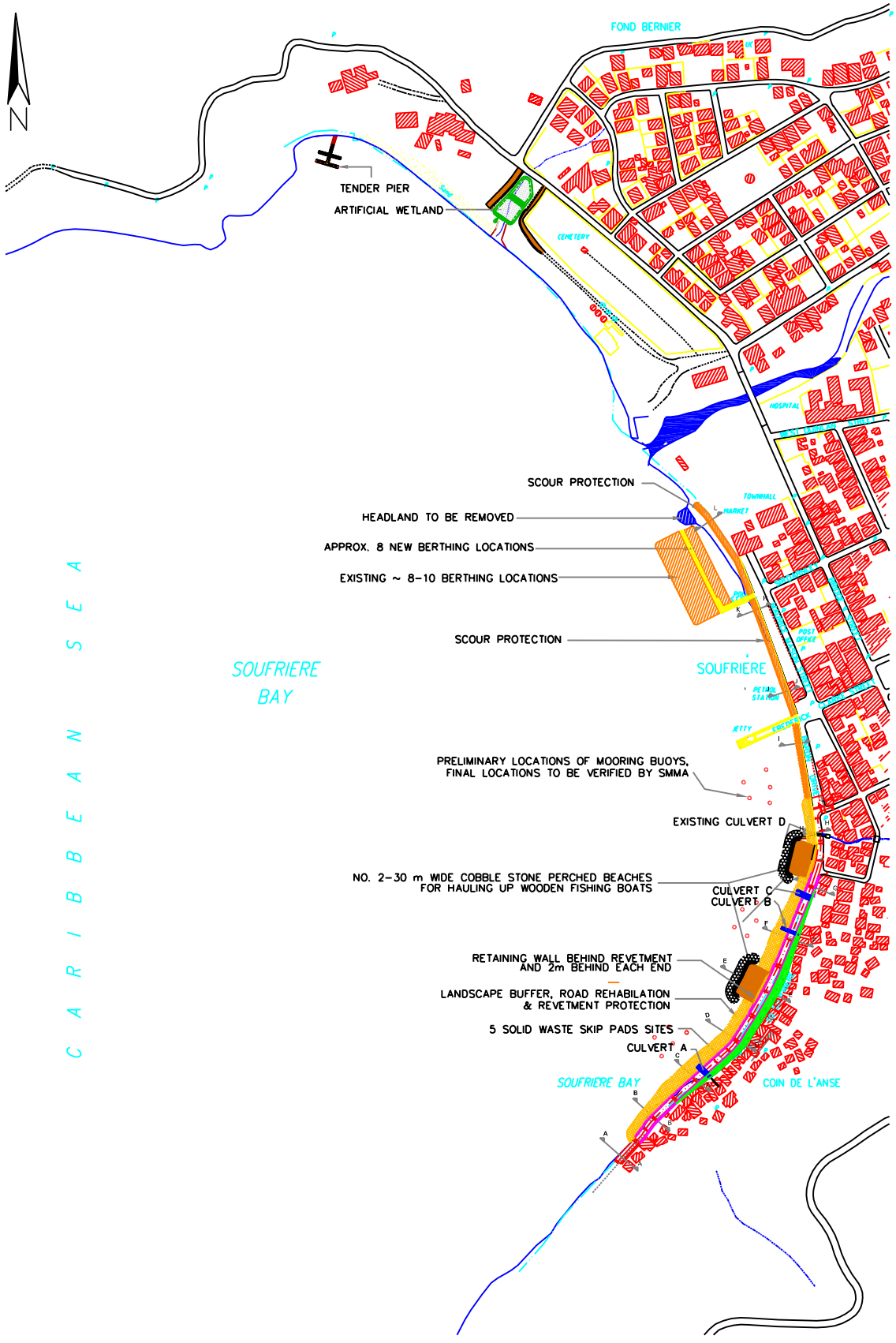
2.2 Project Overview

The project scope for the rehabilitation of the Soufriere Bay, consists of five areas:

- Marine traffic and congestion,
- Water quality,
- Shore protection,
- Access, and
- Aesthetics.

2.2.1 Marine Traffic and Congestion

There are 10 moorings proposed approximately 30 m from the shoreline southeast of Rachette Point. These will be spaced approximately 25 m apart. A series of moorings is also to be placed along the 5 m and 10 m bathymetric contour lines at various locations south of the jetty at the end of Frederick Clarke Street. The next structure to be constructed along the shore is a small tender pier with 20 berthing spaces, which will serve only small dinghies and other small craft.



PROJECT COMPONENTS

FIGURE 2-2

At the middle of the bay is a dock that presently has 8-10 berthing locations. It is proposed that 8 new berthing locations be created on the other side of this dock by removing a small headland that blocks the entrance to this location.

The final marine control structures will be built at two locations along Baron's Drive to service the needs of the Baron's Drive fishermen. These control structures are comprised of two 30 m wide cobblestone perched beaches for hauling up wooden fishing boats. Figure 2-2 provides details of the components described above.

2.2.2 Water Quality

At a location approximately 260 m northwest of the Soufriere River along Hummingbird Beach, there is a drain which discharges directly onto the beach. To improve the quality of the wastewater that eventually reaches the ocean, an artificial wetland is proposed that is 45 m long by 20 m wide. This wetland will be created between Beach Road and Cemetery Road. The wetland will comprise of two cells consisting of two layers: (1) an earthen layer 0.2m deep and (2) a gravel layer approximately 0.85 m deep. The two cells are to be partitioned by a gravel/rock core. Around the upper cell of the wetland, a strip of bamboo will be planted at 5m centres. The wetland will be planted with sedge at 1 m centres in both directions. The lower cell of the wetland will flow into another gravel/rock core at the base of which will lie a 200 mm HDPE pipe (closed at both ends) with 25 mm diameter holes drilled at 300mm centres on the base of the gravel fill. Wastewater from this pipe will flow via a 200 mm diameter pipe into a 1.2 m x 1.2 m manhole equipped with an adjustable straight weir. The water will then flow into a soakaway pit containing boulders lined with geotextile.

2.2.3 Shore Protection

Shore protection is proposed to be effected by two types of structures. First, from just southeast of the Soufriere River to the disused Fish Market building, a toe scour structure is proposed. The second structure is an armour stone revetment, which is planned in front of the Baron's Drive community from the Fish Market building, southeast to the end of the Baron's Drive area.

2.2.4 Access

Baron's Drive was partially destroyed during the passage of Hurricane Lenny. Works at this location will include spot repair, horizontal and vertical realignment and re-surfacing of the road. This work will involve selective excavation, infilling and compaction of localized sites of road surface damage. The existing road surface will then be raised, minor horizontal and vertical realignment will be carried out and the road will be re-surfaced to a double surface dressing.

2.2.5 Aesthetics

As described previously, there are some areas of the Bay where drains outfall directly onto the beach. In one instance, it is proposed to create an artificial wetland at the outfall of a municipal drain. The drainage outfalls from the Baron's Drive residents will be filtered through the proposed armour stone revetment. The construction of a new road and the planting of some palm trees will also improve the overall aesthetics of the Bay.

3. Environmental Setting: Natural Environment

This description of the natural environment along the coast of Soufriere Bay focuses on those environmental components that are likely to be affected by (or to affect) the proposed project. These components are:

- Marine Processes
- Topography
- Bathymetry
- Sea water quality
- River water quality
- Climate
- Terrestrial ecology, and
- Marine ecology and management

3.1 Marine Processes

3.1.1 Wave Conditions

The west coast of St. Lucia is protected from the day-to-day trade wind generated waves that impact the east coast. Soufriere, however, is open to the Caribbean Sea. Hurricane Lenny demonstrated the vulnerability of this normally sheltered shoreline to tropical storm systems, since it resulted in significant damage to the shoreline, as it tracked from west to east. Design wave conditions have been developed for the west coast of St. Lucia using the NOAA database of hurricane tracks, which spans a period of over 100 years.

Wave analyses were carried out for the site at Soufriere. Typically, wave climate falls into two categories, extreme (or design conditions) and day-to-day (or operational). As mentioned above, the extreme wave conditions have been developed from a search of the National Hurricane Center/NOAA database of storms that date back to 1876. Essentially, this database was searched to identify all storms that would have passed within a 400 nautical mile radius of St. Lucia. From this, 89 hurricanes, with intensity Category I or greater, were identified.

For each storm, a parametric wave hindcast procedure was implemented to develop wave height and period characteristics. The distribution of height and period is shown in Figure 3-1, as a

function of wave steepness. This diagram shows the wave height and period combination that were obtained from the hindcast procedure. The wave height data were then input to an extremal analysis, using a Weibull distribution. The results are shown in Figure 3-2 for the best-fit graph, with 95% confidence limits bands.

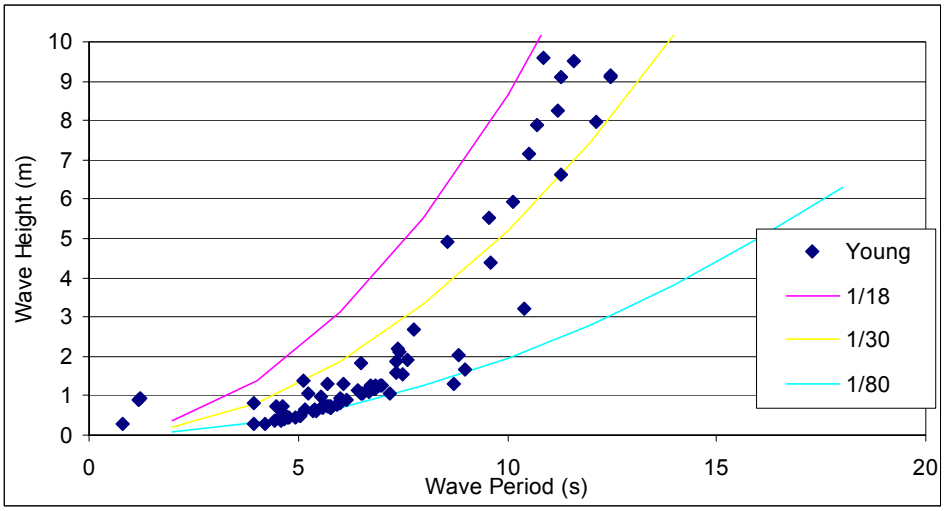


Figure 3-1 Wave height and period characteristics

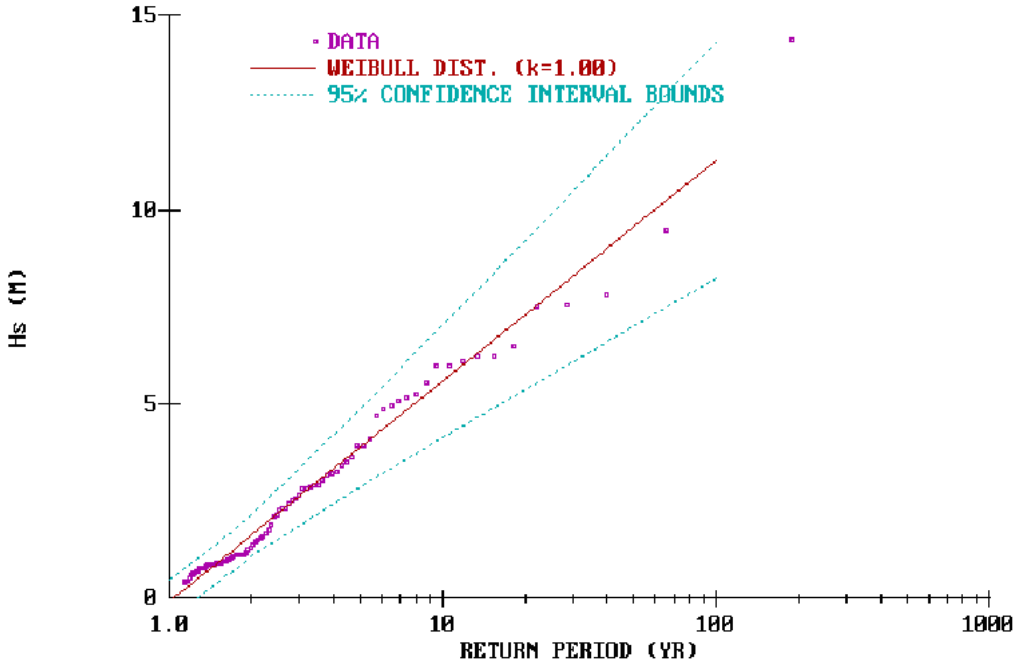


Figure 3-2 Wave height distribution

Table 3-1 summarizes the results of the detailed statistical analysis of the wave conditions that were computed to occur, utilizing the database of tropical storms that passed within 400 nautical miles of St. Lucia. It must be mentioned that these wave heights represent conditions in deep water, before the effects of wave refraction, shoaling and wave breaking occur.

Table 3-1: Wave Conditions for Tropical Storms Occurring Near St. Lucia

Return Period (Years)	Significant Wave Height[1] (m)	Peak Period[2] (s)
5	3.9	8.2
10	5.6	10.0
25	7.8	12.2
50	9.6	13.8
100	11.3	15.3

The structures in Soufriere have been designed to withstand the 1 in 50 year return period wave. Based on the statistical analysis described above, this translates to deep-water design conditions of:

H_s = 9.6 metres

T_p = 11-14 seconds

In addition to this, day-to-day wave conditions were assessed using two different sources. The first source included 5-years of 6-hourly computer modeled wave data, (UKMO wave data). The computer model used to generate these wave conditions operates on a global scale, and therefore the island of St. Lucia is not actually represented in the model grid domain. For the Gros Islet site, it was therefore necessary to use an additional detailed refraction and shoaling computer wave model to determine the effect of the island of St. Lucia on these deep-water wave conditions. This technique was deemed to not to be appropriate for Soufriere, due to its sheltered location on the west coast.

The second source of wave data, which was used to generate the wave climate for Soufriere, was from ERS-1 and ERS-2 satellites. This database consists of global wave height measurements made between the years 1985 to 2000. Specific zones can be specified from the database, and the area immediately west of St. Lucia was specified so as to be able to properly define the

1 The significant wave height, H_S, is defined as the average of the highest 1/3 of the waves in a storm.

2 The peak period, T_P, is the wave period that is associated with the wave frequency around which most of the energy of the waves in the storm is clustered.

Soufriere wave climate.

The bathymetry in Soufriere bay is characterized by very deep water depths, so that operational waves approach the shoreline relatively unrefracted.

3.1.2 Water Levels

Tide data for St. Lucia was obtained from British Admiralty Chart No. 1273 and is listed in Table 3-2. This data refers to measurements made in Castries.

Table 3-2: Tides in St. Lucia

Tide Level	Water Level (metres above MSL)
MHHW	+0.18
MHLW	+0.03
MLHW	-0.03
MLLW	-0.15
Mean Spring High at Solstice	+0.31
Mean Spring Low at Solstice	-0.24

3.2 Topography

At the northern end of the bay beginning at Rachette Point and continues on to the start of Hummingbird Beach, the coastline is characterized by cliff. A small sandy beach continues from this point up to the mouth of the Soufriere River, where pebbles and large rocks have been deposited. The beach continues until the first jetty, where a solid wall has been built, and then over to the second jetty. A very narrow beach fronts this section of shoreline. Baron's Drive continues from this point southeast, and is protected by a small rubble wall in front of which is a pebble beach. This ends at the fishing centre, which extends into the beach and has a small wooden jetty. A small sandy beach continues from this point in front of the fishing village. At the southeastern edge of the bay, beyond this point, cliffs are prominent.

Mountains ring the town of Soufriere, so that its flat land development potential is limited (Photo 6). This is particularly marked in the area landward of Baron's Drive, where the ground elevation rises sharply from sea level.

Photo 6 Looking south towards the town of Soufriere

3.3 Bathymetry

Soufriere Bay is a naturally deep bay. The sea floor drops steeply to a depth in excess of 100m at a distance of approximately 120 m from the shore. The area north of the Soufriere River, Hummingbird Beach is slightly shallower than the area south of the river. The 5m bathymetric contour is about 40m offshore at Hummingbird Beach, and is as close as 20 m along Baron's Drive.

3.4 Sea Water Quality

The quality of nearshore and offshore water is adversely affected by several sources of pollution,

both point and non-point.

Water quality and benthic habitats in the Soufriere nearshore are severely impacted by sedimentation. Heavy rains and storms can cause flooding, and the resulting heavy load of sedimentation has an adverse effect on water quality and reef health. This situation was exacerbated by the straightening of the Soufriere River in 1994, which caused the removal of the natural river bends, which had acted as sediment traps. Subsequent flooding events have been associated with more intense problems of sedimentation in Soufriere Bay.

The quality of the coastal waters is also influenced by the discharge of untreated sewage and grey water from residences and commercial establishments in the waterfront area, as well as discharge from the Soufriere River, which is severely contaminated with faecal coliform and *enterococci*. It is likely that the river is also contaminated by pesticides and fertilizers contained in runoff from the agricultural lands upstream. In addition, a number of spills from the fuel tanks at the Copra plant into the River, just 500 m upstream of Soufriere Bay, have been reported. These incidents would have had a harmful effect on the quality of water in the adjacent nearshore areas.

The current practice of disposing of wastewater from yachts directly into the sea further degrades the quality of the coastal waters.

3.5 River Water Quality

The most recent monitoring of surface waters (March 2001) was undertaken for waters occurring within the ravine immediately north of the Soufriere River (between the northern cemetery wall and the Hummingbird Hotel; and adjacent to the existing shore-perpendicular dirt track). Samples were taken from four locations and tested for BOD, COD, *enterococci*, faecal coliform, pH, total coliform and total suspended solids. Samples were taken at evenly spaced locations, starting between where the ravine passes under the main road (west side of culvert) (station 4) and progressing westwards towards the sea (station 1). Samples were analysed at the Caribbean Environmental Health Institute Laboratory in Castries. The results of these analyses are shown in Table 3-3 following.

Table 3-3: Results of Surface Water Quality Analysis for Soufriere

Parameter	Station 1	Station 2	Station 3	Station 4
BOD_5 (mg/l)	51.11	17.78	17.78	84.44
COD (mg/l)	500	880	1060	130
pH	7.30	7.16	7.09	7.28
Total Suspended Solids (mg/l)	48.4	36.1	48.7	38.2
Enterococci (CFU/100ml)	42800	63000	N/A	N/A
Faecal Coliform (CFU/100ml)	>200000	>50000	11200000	9300000
Total Coliform	-	-	>20000000	>20000000

The total coliform, faecal coliform and *enterococci* counts of all the samples were exceedingly high. These high levels of contamination, which are probably due to the prevalence of inappropriate sewage disposal methods in the region, render the water unfit for consumption or for recreational use. The presence of such contamination poses a serious health risk for residents of the area.

In addition to sewage contamination, it is to be expected that terrestrial water quality would be affected by greywater discharge and stormwater runoff from the town of Soufriere. The release of harmful waste from the Copra factory into the River has been reported; such incidents would also act to compromise the quality of the surface water in Soufriere. Agricultural chemicals contained in discharge from the lands upstream of Soufriere further contaminate the terrestrial water in Soufriere itself. Dumping of solid waste into the river and on the riverbanks also poses a threat to the terrestrial water quality, not only through the presence of rubbish in the watercourse, but also through the leachate produced by the disposal of putrescible wastes.

Natural phenomenon affecting the quality of terrestrial water in Soufriere River include hurricanes, storms and heavy rainfall events, all of which lead to heavy siltation in the river and smaller shore-discharging ravines.

The quality of the terrestrial water in Soufriere significantly affects the quality of nearshore coastal waters in the area, either through direct surface or subterranean discharge.

3.6 Climate

It is not expected that these works would affect climate. However, climatic factors will affect the dispersion of emissions and effluents from the construction of these works. It is in this context that this discussion of climate is presented.

3.6.1 Wind

The Windward Island group, of which St. Lucia is a part, is located within the belt of "Trade Winds". These winds move westerly along the southern edge of the Atlantic Azores sub-tropical high-pressure zone and approach St. Lucia from directions between east-northeast to east -southeast. Statistical data on wind speed and direction at sea in the environs of St. Lucia are presented in Table 3-4.

Table 3-4 : Annual Average Wind Speed and Direction on the Seas Around St. Lucia

Wind Direction	Wind Speed (m/sec)				Percent Frequency
	0-3.0	3.5-8.0	8.5-14.0	14.5 - 20.5	
N	0.5 %	1.0 %	0.1 %	*	1.6 %
NE	3.1 %	18.7 %	6.2 %	0.2	28.2 %
E	6.1 %	38.1 %	12.4 %	0.3	56.9 %
SE	2.4 %	6.6 %	1.2 %	*	10.2 %
S	0.6 %	0.8 %	0.1 %	0	1.5 %
SW	0.2 %	0.2 %	*	0	0.4 %
W	0.1 %	0.1 %	*	0	0.2 %
NW	0.1 %	0.0	0.0	0	0.1 %
VAR	0.0	-	0.0	0	0.0
CALM	0.7 %	-	-	-	0.7 %
TOTAL %	13.8 %	65.5 %	20.0 %	0.5%	100.0 %

Source : *St. Lucia Environmental Profile*, 1991 Caribbean Conservation Foundation
* - percentage frequency between 0.0 and 0.09.

3.6.2 Temperature

Typical of a small tropical island, the temperature of St. Lucia at sea level is generally high with little seasonal, diurnal or locational variation due to the damping effect of the ocean mass and its near constant temperature between 23-28^{o}C. Diurnal variation is almost entirely within the range of 23^{o}C (73^{o}F) to 31^{o}C (87^{o}F). Monthly averages for the Roseau Station, which lies on the west coast, are contained in Table 3-5.

3.6.3 Rainfall

There is a great variability and a high degree of unpredictability to the quantities of rainfall that

occur from year to year in St. Lucia. For St. Lucia, the period of lowest rainfall generally occurs in mid-to-late December, when the Bermuda high pressure cell extends its influence southward, forcing a pronounced shift of the trade winds from the southeast to out of the north east. These so called "Christmas Winds", as they are known by the seamen, also bring clear, relatively dry conditions to St. Lucia from mid December to early May. For the other months of the year (May through December), rainfall increases with varied intensity according to the degree of windward exposure and height above sea level. Mean monthly rainfall at the Roseau Station is given in Table 3-5.

Table 3-5: Weather Information at the Roseau Station, St. Lucia

Month	Rainfall (mm)	Evap. (mm)	Temp. (°C)	Sunshine Hours	Relative Humidity (%)	Wind Run (m/s)
JAN	152.0	95.0	24.7	7.5	76	0.95
FEB	97.0	115.0	24.8	8.2	73	1.12
MAR	84.8	140.8	25.2	8.1	72	1.18
APR	95.9	156.2	25.9	8.1	70	1.21
MAY	113.0	163.9	26.8	8.1	72	1.29
JUN	175.1	146.2	27.3	7.3	72	1.37
JUL	245.8	135.8	27.1	7.4	74	1.12
AUG	251.9	134.5	26.9	7.4	75	0.96
SEP	251.5	129.1	26.8	7.1	76	0.72
OCT	266.5	125.4	26.6	7.2	78	0.73
NOV	237.2	96.5	26.1	7.4	78	0.71
DEC	176.4	100.4	25.3	7.2	76	0.89
Total	2147.0	1538.8	---	---	---	---
Mean	178.9	128.2	26.1	7.6	74	1.02
Period	1966/85	1978/85	1968/85	1968/85	1978/85	1978/85

Source : *St. Lucia Environmental Profile*, 1991 Caribbean Conservation Foundation

3.6.4 Hurricanes and Tropical Storms

St. Lucia lies in the path of tropical storms, including hurricanes, situated as it is between the subtropical high-pressure belt of the Atlantic Ocean and the equatorial low-pressure belt to the south. It is, however, far enough south that passing tropical cyclones normally do not reach

their maximum intensity. Nevertheless, there is a high frequency of micro-disturbances that generate squalls and winds with potentially damaging, short-burst high velocities.

On land, the risk of wind and rainstorm damage can be serious, especially during the August-November period. Lesser storms, even though not of hurricane or gale force and of only short duration, are common, and St. Lucia averages about 25 such windstorms per year.

3.7 Terrestrial Ecology

In the area of Rachette Point there are steep slopes (Hummingbird Wall) suffering denudation and bluff failure. A prominent feature along these slopes is a large crevice known locally as the "Bat Cave" (it is a roosting area for numerous bats). Beyond this point into the northern beach zone, back beach lands of the adjacent hotel and restaurant are landscaped with mainly coconut trees (*Cocos nucifera*). Between the northern watercourse and the Soufriere River mouth there is also a predominance of coconut trees. Apart from the coconut trees, there are also a few Sea Grape trees (*Coccoloba uvifera*) on the beachfront. On the southeastern bank of the Soufriere River there is a very dry playing field, which appears to be almost grassless during the dry season.

The central waterfront zone has undergone significant changes and is devoid of vegetation with the exception of the landscaped area, between the two main existing jetties, which consists of small lawns and ornamental plants including cultivated Sea Grape. Along Baron's Drive, the waterfront is also bare of vegetation. However the slopes to the rear of the housing development are covered by vegetation including *Cecropia* sp., and Juniper (*Genipa americana*).

No sensitive terrestrial habitats nor protected areas have been identified in the study area. Most of the natural vegetation has been removed. However, during recent landscaping efforts near the central waterfront, indigenous plants were utilized (Sea Grape), helping to restore some of the natural vegetation. In general, the terrestrial habitat of Soufriere Bay has undergone significant changes including a history of sand mining.

3.8 Marine Ecology and Management

In addition to field reconnaissance, information sources included the Soufriere Marine Management Area. The sea floor of the bay descends rapidly to a depth in excess of 30 metres, making it an excellent natural harbour. Within the shallower areas of the bay there are no significant coral formations. However, near and along the Hummingbird Wall there are excellent coral formations. The fauna here includes a wide variety of sponges, gorgonian and scleractinian corals. Toward the northwestern end of the bay, there are underwater vents. These formations at Rachette Point and Hummingbird Wall make it a premiere diving destination. Marine fauna, which has attracted local and international interest, has included whale sharks, manta rays and ocean sunfish.

The marine fauna of Soufriere has suffered the effects of smothering in the recent past, due to sediment transported into the bay via the Soufriere River. In 1997, after a period of high

sediment levels within the bay, an intensive 4 week clean-up was undertaken, without which the coral and associated fauna would have sustained even greater damage. At present, it is recovering but it has been reported that heavy rains resulting in high sediment levels within the bay still adversely affect the marine fauna. At the time of field reconnaissance it was the peak of the dry season, so river flows were minimal. As such these effects could not be assessed.

The Soufriere Marine Management Area (SMMA) extends form Anse Jambon to Anse L'Ivrogne and includes Soufriere Bay. The SMMA has various zones (Figure 3-3) that are designated for the following purposes:

- *Marine Reserve* – The primary purpose of these areas is to allow fish stocks to regenerate in order to ensure healthy fish populations in the future. These areas of high ecological value have been set aside for the protection of all marine flora and fauna, scientific research, and the enjoyment of divers and snorkelers. Access to the reserves is subject to the acquisition and conditions of a permit, which can be obtained through the local licensed dive operators, authorised dive leaders or the SMMA office in Soufriere.
- *Fishing Priority Areas* – In these areas, commercial fishing has precedence over all other activities. Access by other users is allowed only to the extent that it does not interfere with fishing activities.
- *Recreational Areas* - Identified as important sites for public recreation, i.e. beaches where local access must be maintained.
- *Multiple Use Areas* - Diving, snorkelling, and other legitimate uses are allowed, as long as the general rules of the SMMA and other national regulations are observed.
- *Yacht Mooring Areas* - Apart from the northern part of Hummingbird Beach, where anchoring is allowed only as long as commercial fishing activities are not disturbed, and a small area north of Anse Chastanet, anchoring is prohibited in the SMMA. Moorings have been provided for visiting yachts.

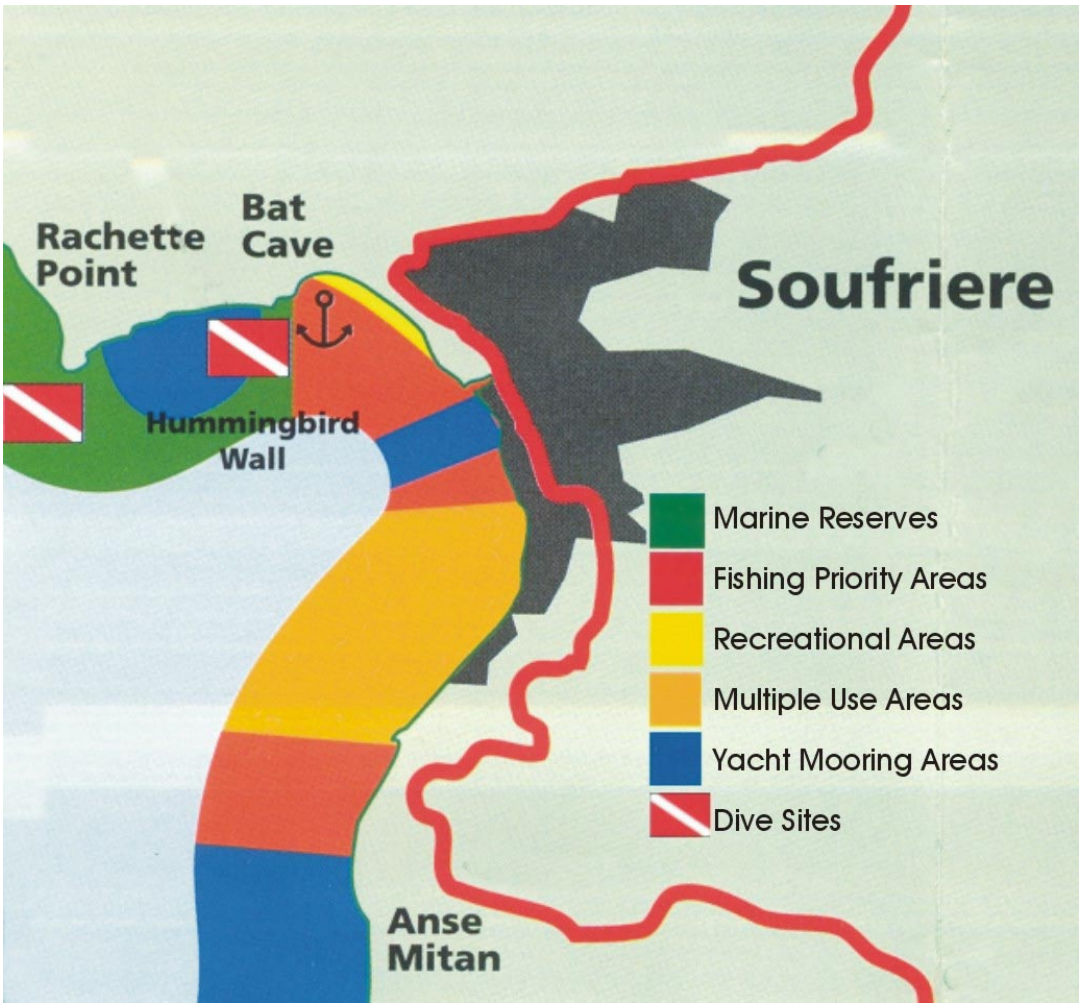


Figure 3-3 Soufriere Marine Management Area

4. Environmental Setting: Human Environment

As with the description of the Natural Environment, this chapter addresses the components of the Human Environment that are likely to be affected by this project. These are as follows:

- Socio-economic conditions;
- Fishing;
- Tourism;
- Heritage;

- Land use;
- Road Traffic;
- Waste Disposal;
- Noise; and
- Utilities.

4.1 Socio-economic Conditions

The Baron's Drive area, located directly on the edge of Soufriere Bay, houses the main residential community along the Soufriere waterfront, and it is therefore within this area that the socio-economic assessment is focussed. Use is made of existing data collected from a UNICEF funded community survey that was conducted in 1997. Following Hurricane Lenny, 17 families were relocated to new homes on the hill just above the existing community. There are promises that the other persons whose homes were damaged will be relocated to an area called Cressland, which is approximately 7 minutes drive or 30 minutes walk from the existing Baron's Drive location. This has not found favour with the residents, especially the fishermen, who wish to remain in close proximity to their boats in the bay.

At March 2001, there were still a number of damaged homes standing in the community, with the remains of corrugated iron roofs and large pieces of concrete dangling and therefore presenting a threat to the residents, especially the children who play in the area. The Community Development Officer indicated that after the initial work to clear the roads of the debris from the hurricane no other work had been accomplished, and when efforts were made to remove some of these dangerous structures, the residents protested. Many of the residents have already begun to erect replacement structures from plywood.

Many of the residents are fisher-folk and more than 50% of the households are female headed. On a typical day, primary and secondary school age children are seen lingering about the community and swimming in the bay. There is a high level of unemployment, and teenage pregnancy and drug use are additional challenges facing this community.

Poor housing conditions, limited access to community amenities and low incomes were signs of poverty all present in Baron's Drive in 1997 at the time of the survey. 92% of the residents did not own the land where their homes were located and at least 50% have been resident in the area for more than 5 years. Prior to the hurricane the housing stock comprised 52% wood, 24% plastered concrete blocks, 12% un-plastered concrete blocks and the balance are wood and concrete. Moreover, 60% comprised 2 rooms or less, where a room is defined as any area in the house excluding the kitchen and bathroom. There is therefore a problem of overcrowding in the homes.

At the time of the survey, 92% of the households used electricity, 4% candles and 4% kerosene for lighting. With respect to cooking, 48% utilized gas, 48% charcoal and 1% wood. 52% dumped their garbage, 28% burn, and 20% utilize garbage trucks. Very few, only 4% have water

piped into their home. The majority, 84% use the public standpipe.

As a result of the insufficient supply of water, as much as 96% reported having no in-house toilet facility, and residents defecate and urinate in the bay or the bushes surrounding the community, leading to public health concerns. It must be noted that the public bath facility, which has been in a severe state of disrepair for some time, was destroyed by the hurricane.

The employment scenario is also depressed. Less than 40% of the residents interviewed were employed, and half of these persons were self-employed. Incomes were reported as being less than EC$200 per week and when asked, 40% of the respondents felt that their economic situation would worsen and 52% believed that it would remain the same.

4.2 Fishing

This section gives a summary of the fishing activities in Soufriere. Fishing has always been a major source of livelihood for the approximately 150 fishers in the town of Soufriere. The main gears used are nets, lines and pots. The total number of boats in Soufriere is 97. 24 pirogues and 28 wooden canoes are normally located south of the Soufriere River, the majority in the Baron's Drive area, with 8 pirogues and 37 canoes located north of the river. Most of the seine fishing is conducted from boats located north of the river. A value of landings at over EC$1 million was earned for the year 2000.

As in the case with St. Lucia in general, fishing activity in the area revolves around the landings of migratory oceanic pelagics during the high season of December to mid-June, and coastal pelagics, reef and bank species during the low season.

Generally, some gear is kept in huts found along the northern portion of the beach on both sides of the Soufriere river mouth; seine nets are stored on bamboo poles along the waterfront on both sides of the river, and near the Coin d'Lance (Baron's Drive) area. Fishers living in Baron's Drive keep most of their equipment at home.

A small cold storage and ice making facility was built, in the mid 1980s, with the assistance of USAID, but due to high operating costs, it was eventually converted into a general storage area and offices for the manager and secretary of the fishermen's cooperative. Storage was also provided for fishing gear and supplies for sale to cooperative members. Other fisheries infrastructure at that time included a fuel station, at that time located near the large main jetty in town.

With the passage of Hurricane Lenny in November 1999, the land on which the fish market stood was washed away by the storm surge, and the structure collapsed (Photo 7). The fuel station and the jetty alongside the fish market were also destroyed, as were the arts and craft market and the larger northern jetty. Six fishing boats were sunk and many more were damaged.

Photo 7 Collapsed fish market

There are plans for the construction, by the Japanese Government, of a new fisheries facility on the northern bank of the Soufriere river mouth, south of the Soufriere Copra Manufacturers oil storage tanks. This facility will provide gear storage (lockers), workshop, market, ice making and other ancillary facilities. However, the facility will not be able to provide secure anchorage for vessels during storm events.

4.3 Tourism

The tourism industry in Soufriere has seen significant growth over the last two decades, with the establishment of two large resorts, four smaller hotels, and a number of guesthouses and restaurants, many of which focus on marine activities such as yachting and SCUBA diving, which have become significant tourist attractions. In addition, an increasing number of day charter boats and water taxis bring visitors in from the northern part of the island.

The CIS & Associates Final Report on the Soufriere Tourism Development Plan Project stated that:

"***St. Lucia as a whole and Soufriere in particular are valued for its nature heritage attributes and these have to be central to a viable tourism development plan.***"

In Soufriere, Government policy and private initiative combine to create conditions that allow

the region to capitalize on its natural and historic patrimony. As a result, the area has emerged as a significant heritage destination, with some of the major attractions being:

- The Pitons;
- Sulphur Springs;
- Rain Forest;
- Botanic Gardens;
- Waterfalls; and
- French Creole Buildings.

It has been estimated that between 56% and 75% of all arrivals to St. Lucia visit the Soufriere region, with most of these spending only a few hours in the area. The CIS & Associates Study of 2000 indicated that of these visitors to the region, 69% visited the beaches in Soufriere, and 66% visited Soufriere Town itself.

Basically, tourism in Soufriere has three major visitor components:

i. Excursionists/Day Visitors;
ii. Hotel and Guesthouse Stayover Guests;
iii. Yacht Charterers and Crew (day or overnight visitors); and

These are discussed in the following sections.

4.3.1 Excursionists/Day Visitors

Day visitors travel to Soufriere by land and sea. Numbers for overland visitors were not obtained; day visitors by sea (not including yacht visitors on regular charter) average between 85,000 and 90,000 persons per year. These are mostly visitors from hotels arriving and leaving by one of several passenger boats. Cruise ship passengers arrive in Soufriere overland from Castries and are picked up by the ships in Soufriere. Between January and February 2001, cruise ship visits to Soufriere averaged one per week, with 150 to 200 passengers per trip taking the overland tour.

4.3.2 Hotel and Guesthouse Stayover Guests

Accommodation for stay-over guests range in size from the Jalousie Hilton Resort and Spa (112 rooms) to the Tree House (4 rooms). Approximately 20 properties within the Soufriere region provide approximately 300 rooms. Three properties (Jalousie Hilton, Anse Chastanet and Ledera) provide 185 of these rooms. There is significant variation in service and room rates; rates range from less than EC$50 per night to over EC$700 per night. Most properties are small. Two of these properties, Hummingbird Beach Resort and the Still Beach Resort, are located within the waterfront zone.

4.3.3 Yacht Charters and Crew (day or overnight visitors)

Table 4-1 shows a significant increase of 25.1% in yacht visits to the Soufriere Marine Management Area between 1996 and 1997.

Table 4-1: SMMA Yacht Visits

	Year						
Month	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
January	---	364	492	484	520	514	328
February	---	294	473	410	392	478	---
March	---	333	485	417	493	398	---
April	---	247	310	348	330	290	---
May	---	219	266	281	288	230	---
June	---	151	255	211	194	189	---
July	124	217	228	225	232	162	---
August	128	185	154	191	164	124	---
September	35	47	46	40	18	24	---
October	130	130	167	135	102	161	---
November	191	236	254	295	205	152	---
December	202	485	508	409	415	408	---
Total	**10**	**2908**	**3638**	**3446**	**3353**	**3130**	**328**

Source : SMMA Statistics.

A steady annual decline has occurred since 1997, resulting in a drop of 14% between the 1997 and 2000 yacht arrivals. The decline in yacht visits has been blamed primarily on two factors. These are:

i. Perception by yachters that they are being overcharged, having to pay a *Permit to Moor* fee to Customs in Rodney Bay, Castries or Marigot as well as a *Coral Reef Conservation* fee in the Soufriere Marine Management Area.

ii. Harassment by boat boys.

In addition, there are no overnight berthing facilities for yachts in Soufriere, and the existing number of moorings in the Marine Management Area (from Anse Jambon in the north to Anse L'Ivrogne in the south), as indicated in Table 4-2, is inadequate. This is a major constraint to growth in yacht traffic, as yachts are not permitted to anchor in the Soufriere Marine Management Area, except for Humming Bird Beach. For these reasons the impact of yachting

tourism on the town of Soufriere, through patronage of restaurants, bars or shops by yacht visitors, is insignificant, and can be expected to remain so if the circumstances are unchanged.

Table 4-2: Mooring Areas in the Soufriere Marine Management Area

Location	Number of Moorings
South of Anse Mamin	4
Hummingbird	4
Soufriere Waterfront	4
Anse Mitan	22
Jalousie	12
Total	**46**

4.4 Heritage

Key heritage resources were listed in the previous section on Tourism. A listing of heritage buildings for the waterfront and for Soufriere town was not obtained. The majority of heritage buildings appear to be located in the southern part of the town. With the exception of the Old Court House, the majority of heritage buildings occur outside the project study area.

4.5 Land Use

Historically, land use in the Soufriere Valley has been shaped by an agricultural economy. Like agriculture, fishing has and continues to be of economic and social importance to the community. Fishermen use the waterfront for mooring and hauling boats, but no significant infrastructure has been built at the waterfront to facilitate the sector. Tourism is changing the economy and the way space is used at the shorefront and nearshore areas. Allocation of space among competing uses has presented major challenges to government and local authorities and should be given major focus in any plans for the development of the waterfront area.

Soufriere town's waterfront extends from the Still Beach Club in the north to the end of the residential development on Baron's Drive, in the south.

Building height in the commercial land use zone is primarily two-storey. Buildings in the residential zone are mainly one storey, with a few two-storey structures. Building density in the commercial zone is typical of urban centres in the region (Photo 8), while the very high housing density at Baron's Drive is typical of regional urban slums.

Photo 8 Commercial section of Soufriere

4.5.1 Residential

The area from High Street south to the end of development on Baron's Drive, and Bridge Street (east side) from the Soufriere River north to the road leading to Castries is primarily residential.

Development along Baron's Drive is comprised of mainly one-storey, low-income residential homes. Despite damage to several buildings by Hurricane Lenny, the area is expected to remain a high-density residential zone for low-income families. Housing is sub-standard and living conditions are inadequate.

The residential strip on Bridge Street is comprised mainly of one-storey buildings. Building and household population density is considerably less than on Baron's Drive. Gradual change to mixed use is occurring, evidenced by the presence of a bar, a building supply facility and a woodwork shop. Three vacant lots provide additional scope for changes in land use, which is expected to continue without any changes in planning policy. Large street trees are a major feature of this area of Bridge Street.

4.5.2 Commercial

Buildings on Maurice Mason Street and Sir Darnley Alexander Street, within the commercial zone of the project site, are mainly of two and three stories. They form part of the core business district of the town. The town's two jetties are located on the waterfront of the project's commercial zone. The Main Jetty is on axis with Frederick Clarke Street, while the section of the L-shaped jetty that is perpendicular to the shoreline is on axis with Sir Darnley Alexander Street.

This part of the waterfront serves as the gateway to Soufriere's tourist attractions, with the jetties serving as landing facilities. Despite this, commercial activity between Frederick Clarke and Sir Darnley Alexander Streets generally lacks vibrancy. A number of empty buildings and a vacant parcel of land point to a trend in declining business, but also provide opportunities for capitalizing on the growth in visitor traffic and waterfront tourism.

4.5.3 Open Space/Sports and Recreation

The sports field next to the Town Hall is a relatively large open area that is mainly used for football. It is a rather unusual use for an urban waterfront. The shorefront of the sports field area is used as a haul-out and storage area for boats.

The open space bordering the cemetery, extending from north of the Soufriere River to the Hummingbird Restaurant and Hotel, is an under-utilized waterfront recreational asset. The north part of the area is used for beach-related activity, but the southern area is less used for recreation. Small shacks used by fishermen for storage exist, and fishing boats and water taxis are hauled and stored on the beach. Tanks for the storage of oil by the Copra Manufacturers Ltd. represent one of only two significant industrial uses in the project site, the other being the service station next to the Main Jetty.

The presence of the oil storage tanks is one of the reasons that the potential for recreation in the area has not fully been realized. Coconut trees are a feature of this landscape. The construction of a fisheries terminal, funded by the Government of Japan, is proposed for the southern end of this area. The construction of this terminal in the open space close to the cemetery will have significant impact on land use, as well as vehicle and pedestrian circulation. Its operation could also substantially increase fishing boat traffic at this area of the shorefront.

A waterfront park, with paving material, plants, park furniture and street lights, was recently erected along Maurice Mason Street between the two jetties at the waterfront. This attractive park is relatively effective in its visual appeal, but perhaps slightly lacking in capacity for public use. Nevertheless, it represents a significant improvement to that area of the waterfront.

4.6 Road Traffic

The road circulation network in Soufriere is built on one main regional road, the West Coast Road, and a district distribution road, the Fond St. Jacques Road. Traffic is dispersed into the town by means of these two roads. The Soufriere Development Plan of 1995 identified vehicular traffic problems, such as lack of continuity of the West Coast Road through the town (this road has since been completed), inadequacy of the town centre roads, lack of vehicular access to some areas, pedestrian/vehicular conflict over right of ways, indefinite and unplanned traffic systems, lack of street furniture such as signs, and the deteriorating conditions of roads.

The movement of pedestrians in the shorefront zone is impeded by poor street layout, substandard road or land use in the area south of Sir Darnley Alexander Street, and by the absence of defined pedestrian pathways north of this point. To move from south to north of the Soufriere River, pedestrians must walk along Bridge Street, where safety is a concern due to a poorly developed sidewalk infrastructure in relation to vehicular traffic. Furthermore, as a result of the passage of Hurricane Lenny in November 1999, the gravel road leading away from Baron's Drive and up the cliff has been rendered extremely hazardous, due to erosion and undercutting.

4.7 Waste Disposal

4.7.1 Sewage Collection and Treatment

A single public sanitation facility with septic tank treatment system services the Soufriere community. This convenience has been damaged due to the effects of Hurricane Lenny and is presently in a severe state of disrepair. The existing facility is incapable of adequately servicing the demand of both the residents and Friday night festival visitors to the area.

There is no functional centralised municipal sewerage system in Soufriere; only isolated sewage disposal systems exist. Currently, the primary means of sewage disposal in Soufriere are single or communal septic tanks (54.6%, 1991 Census data), pit latrines (12.8%) and public sanitary facilities or other means (32.6%). Public sanitary facilities formerly in the Baron's Drive area were damaged beyond use during the passage of Hurricane Lenny in November 1999.

It has been observed that sewage is sometimes disposed of directly into the sea or into the Soufriere River. In the Baron's Drive area, it has been noted that wastewater from bathrooms and kitchens is sometimes disposed of directly into open drains. Hotels in the northern zone utilise septic tanks for wastewater treatment prior to disposal. Yachts docked offshore of Soufriere dispose of their wastewater directly into the marine environment.

The wastewater disposal methods currently prevalent in Soufriere pose a serious threat to the quality of terrestrial and marine waters, and to public health in the town. The potential for infections and consequent health risks from faecally contaminated waters is high.

4.7.2 Solid Waste Management

Garbage bins and skips are located at various points in the town, and the majority of the garbage collected is transported to a waste disposal site in Vieux Fort. However, the existing facilities are not adequate to accommodate the volumes of waste being generated. Only 4-5 skips were observed along the waterfront at Baron's Drive (Photo 9). No skips were observed along the northern section of the Bay.

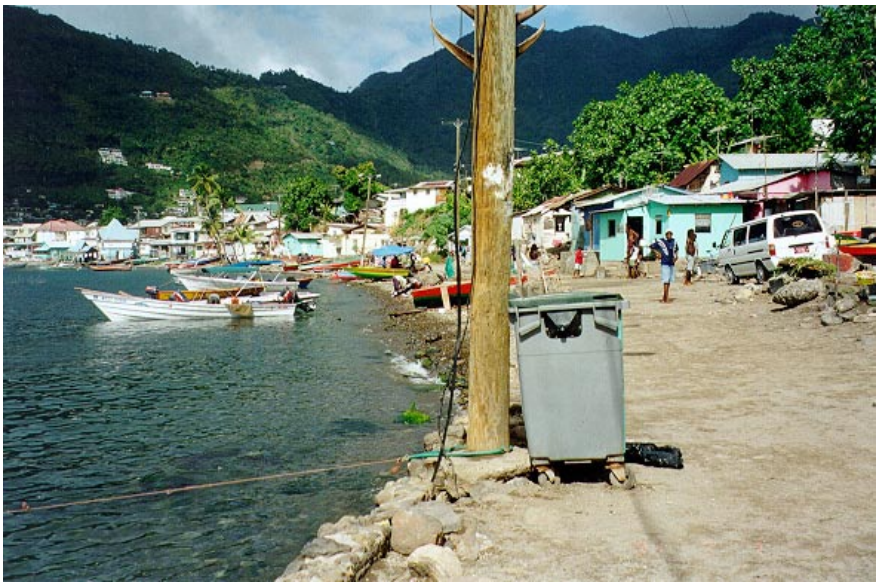


Photo 9 Skip along Baron's Drive

Garbage is still frequently dumped into watercourses, along the street, on the beach, and directly into the sea, and littering is a common practice. Surveys conducted in the Baron's Drive district in 1997 revealed that 52% of the residents there dumped their garbage, 28% burn, and 20% utilize the garbage truck.

Waste generated by tourists is a significant contributor to the total amount of solid waste generated in Soufriere. It has been estimated that for the period 1998-2005, the average amount of waste generated by visitors to the region will amount to 1,720kg/day.

4.8 Noise

The Soufriere Bay area is a very active waterfront. The area north of the Soufriere River is not as active as the rest of the bay. However, there are no heavy works proposed for this area. There are a number of stores, as well as a fuel station and restaurant along the waterfront area. Other activities that contribute to high sound levels are the waves against the shore, traffic and other human activity from yachting tours and fishing.

4.9 Utilities

4.9.1 Electricity

Electricity is supplied by St. Lucia Electricity Service Ltd. (Lucelec). A survey carried out in 1997 indicated that in the Baron's Drive area, 92% of the households used electricity, 4% candles and 4% kerosene for lighting.

4.9.2 Water Supply

Soufriere's water supply consists of a spring system at Diamond Estate and a combined spring and surface water system at Ruby Estate. The infrastructural facilities at both of these sources are old and in need of an upgrade. This is particularly true of the Diamond Estate system, which was commissioned in 1902. The overall distribution system in the town is also in need of upgrading.

Most areas in the town receive 24-hour service. However, during the dry season, supplies are reduced, and are sometimes inadequate to meet the demand. During the wet season and periods of heavy rainfall, supplies may be affected by turbidity, especially at Ruby Estate. In addition, it is reported that the overall water quality is affected by high manganese content.

5. Impacts and Mitigation Measures

The potential environmental impacts of this proposed development are classified by project phase (construction and operation) and are discussed in the following sections.

5.1 Construction Phase

During the construction phase, potential impacts on the environment relate to:

i. Sea water quality;
ii. Coastal stability;
iii. Benthic ecology;
iv. Terrestrial ecology;
v. Noise;
vi. Air quality;
vii. Employment;
viii. Fishing;
ix. Land use;
x. Traffic;
xi. Waste disposal;
xii. Public safety; and
xiii. Recreation.

These are all discussed in this section.

5.1.1 Sea Water Quality

Four potential sources of contamination have been identified during the construction of these works:

i. Silt from erosion of cleared areas;

ii. Material stockpiling;

iii. Silt from rocks being placed in the works; and

iv. Fuel and lubricants from construction equipment.

The potential for some short-term degradation of nearshore water quality exists if there is heavy rainfall and leaching of runoff from designated stockpile zones. These impacts are expected to be relatively limited in extent, given the size of the proposed works. They will also be transient, lasting only as long as construction is in progress. It is important to recognize that ambient water quality is generally low here during the rainy season due to the consistent sediment-laden discharge from the Soufriere River. Any runoff impact from the stockpile will be a minor addition to an already poor water quality.

Several mitigation measures are available to minimize these potential impacts:

i. Minimize the land areas that are cleared at any one time for the construction work, and re-grass or pave (as may be appropriate) as early as practical. Scheduling the work for the dry season (to the extent practical) will also reduce the potential for erosion;

ii. Specify and select rock material with a minimum of fine material (rock powder) and adhering clay;

iii. The construction schedule should be optimized to minimize the residence time of material stockpiled on site;

iv. Surfaces of stockpiled rock can be periodically wetted to reduce suspension of fines by wind; and

v. Fuel and service construction equipment away from the seashore and river banks, and provide special bunded areas for these activities (to catch and contain spills).

5.1.2 Coastal Stability

Negligible impacts on nearshore circulation, longshore drift and wave processes are expected during the construction phase of this project, as no shore perpendicular impermeable structures are planned.

5.1.3 Benthic Ecology

The works proposed for Soufriere Bay are confined to the shoreline. Significant viable benthic

marine communities do not exist within the immediate nearshore zone of the project site. The impact of this work on the benthic communities is therefore not considered to be significant. If there are any negative impacts to offshore benthic communities, they will be minimal and short-term. Such impacts would be due to storm water runoff from the material stockpile. The likelihood of this type of impact, however, is low, especially given the distance from shore at which offshore habitat begins to occur.

5.1.4 Terrestrial Ecology

There are no significant terrestrial habitats occurring along the defined waterfront zone at Soufriere. As a result, there are no major faunal communities or designated ecologically sensitive terrestrial habitats within the study area. The impact of this project on terrestrial ecology is therefore considered to be insignificant.

5.1.5 Noise

Noise impacts during construction will arise largely from the passage of trucks and the use of heavy construction equipment. Although the waterfront is an already active area, noise impacts will be with regard to the type of noise as opposed to the levels of noise. These are unavoidable impacts and will be temporary, lasting only for the duration of construction activity. In areas where construction works are to be done in relatively close proximity to houses, construction activity should be scheduled to avoid night hours.

5.1.6 Air Quality

The anticipated air quality impacts during construction relate to dust (particularly during earthworks) and exhaust fumes from construction equipment. These impacts are expected to be relatively small in extent, and to be transient in nature (only during the active construction period). The mitigation measures to control dust and equipment emissions during construction are:

i. Spray dirt surfaces in the construction area with water or other dust palliative daily during the dry season;

ii. Paving or grassing denuded surfaces (as appropriate) as soon as practical after construction;

iii. Specify and select rock material with a minimum of fine material (rock powder) and adhering clay; and

iv. Ensuring that the contractor properly maintains and services all construction equipment.

5.1.7 Employment

Employment is a short-term benefit of these works, as they are mostly labour-intensive. The

contractors should be encouraged to use as much local labour as practical.

5.1.8 Fishing

Fishing will be temporarily impacted during the construction of the shore protection along Baron's Drive. Fishermen, who usually use the beach area along this road to anchor their boats, will have to relocate for the duration of the works, as it will be unsafe for them. Alternatively, the work may be scheduled in phases so that sections of the beach are left open for use, as the work progresses. It is recommended that all members of the community be advised of the nature and scheduling of the work in order to avoid conflict. This impact will be of short duration and will be eliminated with the construction of the two beach access zones.

5.1.9 Land Use

It may be necessary to negotiate easements with the residents of the area for construction access and working areas during construction. This will be the responsibility of the contractor, who will make necessary arrangements for compensation of landowners (if required).

5.1.10 Traffic

Impacts on traffic will be moderate and temporary as far as the extent of the works along the roads leading to the project site. Traffic impacts along these roads relate more to the type of traffic (heavy trucks as opposed to light vehicles) and to a lesser extent the number of vehicles. Traffic along Baron's Drive, however, will be halted with the repair of this road. Mitigation measures include:

i. Schedule deliveries of construction material to avoid peak traffic periods on heavily-trafficked roads;

ii. Avoid long convoys of trucks making deliveries; and

iii. Alert commuters as to the closure of Baron's Drive, well in advance of the start of construction.

5.1.11 Waste Disposal

The construction works will generate solid waste and sewage. Solid waste will consist largely of construction debris and packaging material, all of which are suitable for disposal in a landfill. No hazardous wastes are anticipated during the construction of these works. Adequate provision must be made for toilet facilities on site for workers (Port-a-Johns, etc.).

5.1.12 Public Safety

Public safety concerns arise within the site of any construction works. However, these concerns are considered significant along Soufriere Bay due to the high amount of activity from tourists, fishermen and other residents. These concerns are temporary, lasting only as long as the

construction activity. The construction sites must be adequately demarcated, fenced (where appropriate) and guarded to prevent entry by unauthorised persons.

5.1.13 Recreation

Any recreation activity at the beach will be temporarily impeded during construction. However, recreation activity at the beaches along Soufriere Bay is very small. This is a temporary adverse impact, and the long-term effect of the project will be to enhance recreational opportunities in these areas by improving the water quality of the nearshore areas.

5.2 Operational Phase

During the operation and maintenance phases, impacts on the environment are expected to relate to:

i. Sediment transport;

ii. Shoreline stability;

iii. Water quality;

iv. Vehicular access and safety;

v. Recreation;

vi. Fishing;

vii. Noise and air quality; and

viii. Aesthetics.

These are all discussed in the following sub-section.

5.2.1 Sediment Transport

For Soufriere, the peculiar characteristics of the bathymetry lead to the conclusion that most of the sediment transport that occurs, takes place within 10-20 metres of the shoreline. Further, observations of the outfall points of the Soufriere River and the urban drainage channel immediately north of the cemetery indicate that the prevailing direction of sediment transport is to the north. Due to their limited seaward footprints, the planned structures are not expected to result in a negative impact on the recreational beach to the north of Soufriere Bay.

5.2.2 Shoreline Stability

The revetment proposed for different areas along the Soufriere Bay will serve to absorb and further enhance the dissipation of incident wave energy approaching the shore. This will offer the waterfront, as well as Baron's Drive, significant protection from wave attack and scour in the future, particularly during higher wave energy events.

5.2.3 Water Quality

The quality of the water leaving the municipal drain and from the residents of Baron's Drive will be improved with the implementation of the wetland and revetment structures. The presence of any of the structures proposed is not expected to negatively impact nearshore or offshore marine water quality. Similarly, all nearshore and offshore habitats will remain unimpacted.

5.2.4 Vehicular Access and Safety

Vehicular access and safety are expected to improve with repair and improvements to the road surface at Baron's Drive. The potential conflict between pedestrians and vehicles is expected to be significantly reduced with the provision of sidewalks on either side of the road. The proposed revetment along this road will enhance the pedestrian and vehicular safety and access along the road edge as a result of the increased level of protection it offers from wave attack and scour.

5.2.5 Recreation

Recreational swimming will not be adversely impacted by the presence of the proposed structures and improvements, as this bay is currently not being utilized for this activity.

5.2.6 Fishing

Fishing is not expected to be impacted by the works proposed along this bay. The fishing area north of the Soufriere River remains unchanged. However, the fishing community along Baron's Drive will now have a rock armour revetment between it and the beach where they anchor their boats. The construction of two beach access zones will help to protect the boats.

5.2.7 Noise and Air Quality

Moderate, long-term noise and dust emission impacts consistent with daily major road use is expected with the improvements to Baron's Drive. There are no impacts anticipated along the rest of the bay.

5.2.8 Aesthetics

Visual aesthetics are expected to improve, in the long-term, as a result of road repair and landscaping at Baron's Drive, as well as the creation of the artificial wetland to the north of the Soufriere River.

Part III
References

Part III References

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