FINAL DRAFT

ENVIRONMENTAL IMPACT ASSESSMENT

OF THE

RIU HOTEL DEVELOPMENT

IN

HANOVER, JAMAICA

Submitted to

RIU HOTEL INTERNATIONAL

Hanover, Jamaica

CL ENVIRONMENTAL

Taking Care of You and Your Environment.

NOVEMBER 2001

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NOVEMBER 2001

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LIST OF ACRONYMS

CBO	Community Based Organisation
DAFOR	Dominant, Abundant, Frequent, Occasional and Rare Rating
dBA	Decibels measured on the A-scale
EIA	Environmental Impact Assessment
EPA	Environmental Protection Area
EPP	Environmental Protection Plan
IGPD	Imperial Gallons Per Day
JHTA	Jamaica Hotel and Tourist Association
LDUC	Land Development Utilisation Commission
LPD	Litres Per Day
NCC	Negril Chamber of Commerce
NCRPS	Negril Coral Reef Preservation Society
NEPA	National Environment and Planning Agency
NEPT	Negril Area Environmental Protection Trust
NGIALPA	Negril Green Island Area Local Planning Authority
NRCA	Natural Resources Conservation Authority
PIF	Project Information Form
TCPA	Town and Country Planning Authority
TPD	Town Planning Department
TPDCo	Tourism Product Development Company

1.0 EXECUTIVE SUMMARY

RIU International hotel chain proposes to develop and operate a four hundred and twenty (420)-room hotel in Bloody Bay Negril adjacent to (1000 m) an existing RIU property (RIU Tropical Bay). The project entails construction of four blocks of 3 story rooms, but no more than 9 meters in height with independent kitchen, dinning and entertainment complexes. The construction phase will employ 600 to 1200 skilled and unskilled labourers and completion is estimated in 12 months. The operational phase will employ approximately 400 staff at 80% occupancy and will employ widely accepted water conservation strategies such as low volume toilets, aerated showerhead and faucets as well as landscape irrigation using grey water. No coastal structures have been proposed for the development and therefore no recommendations are presented herewith. Jamaican environmental requirements are itemised and strongly recommended with special reference to the Negril/Green Island Development Order, the NRCA act, and the green paper on Environmental Protection Areas.

There are no rivers or streams within the study area, and the main road (Normal Manley Boulevard) to the east of the site, is elevated above the nearby Negril Swamp further to the east. As such storm water from road runoff represents the major hydrological feature within the proposed site. The Bloody Bay area hosts a combination of ruinate coastal scrub with a few endemic flora species (*Roystonea princeps* and *Hohenbergia negrilensis*). Avifauna was surprisingly sparse with only six endemic species that were all common residents or very common residents of the area. Terrestrial fauna present were also indicative of a low sensitivity low diversity community typical of coastal scrub classification.

The marine environment is characterized by a shallow decline in topography from land to sea dominated by extensive seagrass meadows, interspersed with patches of sand and a few coral heads. While the marine community appears moderately healthy, the reef systems show signs of stress and much of the area falls within the recently demarcated fish sanctuary to the north of the site. Water quality and algal proliferation indicate some nutrient enrichment however, coral and vertebrate diversity confirm moderate environmental health. Erosion analysis and storm surge predictions indicate 10 to 100 year events would inundate the site and result in significant loss of

shoreline. However, observations and information available refutes these calculations since such levels of inundation and erosion have never been recorded.

Tourism is by far the major employer in the Negril and surrounding community and as such a new development of the magnitude of RIU is viewed with mixed responses where unemployment can be as high as 57%. This is especially important in a social impact area where the age group 15 to 29 is the dominant group and the population education mode is still primary only. Responses from residents within the study area indicate concerns related to beach access, competition especially for small hoteliers and limited benefits to the community due to the all-inclusive nature of the hotel. Others saw the development as an employment boost and a potential for increase in business.

Recent infrastructure developments such as improvements in the Negril sewage system and UDC efforts encourage developments such as RIU as Negril attempts to increase market share in the Jamaican tourism landscape where as third largest visitor accommodation resort it enjoys only 21% of island wide accommodation. RIU aims to target the European market as the resort chain has at other properties that should reduce competition with existing Negril properties where the North American market provides the major clientele. It is estimated that with the addition of the proposed RIU development, even with 100% occupancy and with local resident use neither the ecological carrying capacity nor the tourist social carrying capacity of Bloody Bay would be exceeded.

The Negril community is environmentally proactive and any development encounters scrutiny and participation to protect the environment. This resource and interest should be encouraged and employed within the identification of alternatives and implementation of a monitoring plan. Sensitive issues have been identified which include the proposed fish sanctuary, stands of mangrove and parking to the east of the main road on the edge of the great morass. Alternatives are suggested to address these issues, which range from adjustment of proposed fish sanctuary boundaries with negotiation to no development of parking adjacent to the morass and alternative

sites identified. An environmental management plan and suggested monitoring programme have been devised to allow continued best management practices within construction and operation and even assisting in the value of the final tourism product. Several mitigative strategies have been suggested which can be employed within both the construction and operational phase to improve the environmental ethics of the development with minimal loss in construction time and little change in construction cost. In the RIU development there exists an opportunity for development in an environmentally acceptable framework where partnerships may be fostered with long term mutually beneficial results.

2.0 DESCRIPTION OF THE PROPOSED PROJECT

RIU International is a Spanish-owned international hotel chain with properties throughout the world, including the Caribbean and one in Jamaica. RIU now proposes to develop their second resort in Bloody Bay, Negril in Hanover, Jamaica (See Figure 2.1). The proposed site for this second hotel is approximately 1000 yards away from the present RIU hotel (*RIU Tropical Bay*).

It is proposed that the new hotel will have four hundred and twenty (420) habitable rooms with a floor area of 32,874 square metres (m^2). Four (4) blocks of rooms, each of three (3) storeys high are planned for the main site of the approximately nine (9) hectares (22 acre) (Figure 2.2). A main building, which will house the lobby area, main dining, main kitchen, entertainment area and other service areas is also proposed. It will be no more than nine (9) metres high with a floor area of 8,684 square metres. Table 2.1 details the specifications of the proposed hotel.

Table 2.1: Specifications for proposed RIU hotel

Number of Rooms	420
Site Area	89,012 m^2
Habitable/Rooms floor area	32,874 m^2
Other floor area	8,684 m^2
Number of room blocks	4
Number of Storeys	3

When the consultants visited, the proposed site appeared to be in its natural state; however, the previous owner had cleared an area, which has compacted marl. No pre-construction activities were observed. RIU proposes to construct the hotel in ten (10) months and plans to be operational by 2002. This represents an investment of millions of United States dollars to the Jamaican economy.

Figure 2.1 Map showing location of proposed RIU hotel site.

Figure 2.2 - Overall layout of most of the hotel buildings for RIU-II, showing guest blocks, main building, recreational facilities, etc.

2.1 Construction Phase

The type of construction proposed for the new RIU hotel is traditional concrete block and steel with cast floor and roof slabs.

It is proposed that the aggregate for the project be sourced out of St. Elizabeth. The concrete blocks are to be purchased from local suppliers in Savanna-la-mar, Westmoreland and Green Island, Hanover. The excavated material will be stored on site and covered with tarpaulin to minimise dust pollution.

The work force for the site will be an average of 600 trade men and labourers and at peak time the number will increase to approximately 1200. To the extent practicable, RIU will utilise local skills and labour for construction and operation of the hotel. It is anticipated that construction will be completed in 12 months.

The construction waste will be collected onsite by a waste disposal company and will be transported to the Retirement dump in St. James.

2.2 Operation Phase

RIU expects to have an average of eighty percent (80%) occupancy once it is operational, assuming two guests per room that represents approximately 672 guests. The expected staffing for the operational phase is approximately 400 persons.

2.2.1 Environmental Policy

The hotel does not have a documented Environmental Policy, however, the design of this development has considered a number of strategies to address environmental management of the hotel once it is complete. These include water conservation strategies, including low flow toilets

and showers, a centralised laundry and recycling of grey water from showers and the laundry for use in landscaping and grounds maintenance. (See Section 2.3.1.2). They also propose to recycle materials where practicable, either internally or through the community. The consultants will be outlining an Environmental Management Plan for the development of the hotel, which will include recommendations for continued environmental best practice during regular operation.

2.2.2 Water Supply

2.2.2.1 Customary Hotel Consumption Estimate

An estimate of the likely and expected water consumption of the hotel was undertaken. The two key references for the estimation were (i) the Jamaican Institute of Engineers (JIE) – Guidelines for Design and Construction of Housing Infrastructure (1984)[1] and (ii) Corbitt, R. (1989)[2]. The JIE guidelines suggest an estimation of usage of 200 Imperial Gallons Per Day (IGPD) per room for hotels. Assuming two persons per room, this works out to 100 IGPD per person or 455 Litres Per Day (LPD) per person for total consumption. Corbitt suggests the use of 50 US Gallons Per Day (USGPD) per person for hotels with private bathrooms; 15 USGPD per person for workers. Ten (10) USGPD per person each for restaurants and pools. This adds up to a total of 95 USGPD or 360 LPD, assuming two restaurant visits per visitor and one worker per visitor are assumed for each "visitor day".

The total estimated consumption for the hotel, assuming 420 rooms with 2 persons per room at peak occupancy is 382,200 LPD or 84,000 IGPD. The assumptions utilized for this analysis and breakdown of the potential uses of the water are shown in Table 2.2.

Table 2.2 Estimated rate of water consumption

[1] JIE Recommended "Guidelines for Design and Construction of Housing Infrastructure (1984); Volume 3: 1984: Water Supply Systems

[2] Corbitt, R (1989); Standard Handbook of Environmental Engineering, McGraw Hill, New York

Rate of consumption	455 LPD per person
Room Occupancy Rate	2 persons per room
Total estimated hotel consumption	382,200 LPD = 18,000 IGPD
Housekeeping and habitable areas	224,824 LPD (59%)
Food and beverage preparation	112,412 LPD (29%)
Maintenance and recreational area	44,965 LPD (12%)

2.2.2.2 Water Conservation Strategies and Resulting Consumption Estimate

Several water conservation strategies were noted in RIU's design and design notes (Appendix 1).

These include the following;

1. Use of low-flush water closet (1.6 US gallon per flush) instead of the traditional 4-gallon water closet.
2. Use of a grey-water (face basin and shower) landscape irrigation system
3. Showerheads and faucet heads with aerators have been identified for use in this proposed hotel. They are currently in use at Tropical Bay.

An estimate of the consumption with these conservation measures in place was calculated. It was assumed that the water closet uses about 30% of the total housekeeping and habitable area flow. A 20% reduction in the estimated 20% total usage by faucets and showerheads in habitable areas and 20% reduction in the estimated total food and beverage consumption was also considered. A 10% reduction of the total consumption due to the use of a wastewater landscape irrigation system was also considered.

The revised consumption under the conservation scenario is summarised in Table 2.3. The total consumption of the hotel, given the proposed conservation measures is 276,533 LPD.

Table 2.3 - Revised Water consumption under the proposed conservation strategy

Conservation Measures: Reduction of total	
Water Closets (1.6 vs. 4 gallon)	10.6%
Faucets and showerheads – rooms	1.2%
Faucets and showerheads – staff	5.9%
Wastewater Landscape Irrigation	10.0%
Revised Consumption, with conservation	
Total water conservation saving	27.6%
Total estimated hotel consumption, with conservation	276, 533 LPD = 60,776 IGPD

2.3 Wastewater

2.3.1 Description of Proposed Sewerage, Grey Water Recycling and Grease Trap

Drawings of the proposed sewerage on site indicates that the network consists of 4"and 6" pipes that gravity feed "black water"[3] from the visitors' blocks and main building to a total of six lift stations on site. This black water will go to the Negril Treatment Plant, located at Sheffield. 'Grey water' from visitor's blocks will be handled independently. This water will be collected, strained, settled and discharged into a landscape irrigation system. See Figure 2.3 for a drawing of the proposed system that is already in use by RIU at their first hotel.

[3] "Black water" is untreated effluent from water closets and "grey water" is untreated effluent from sinks and showers.

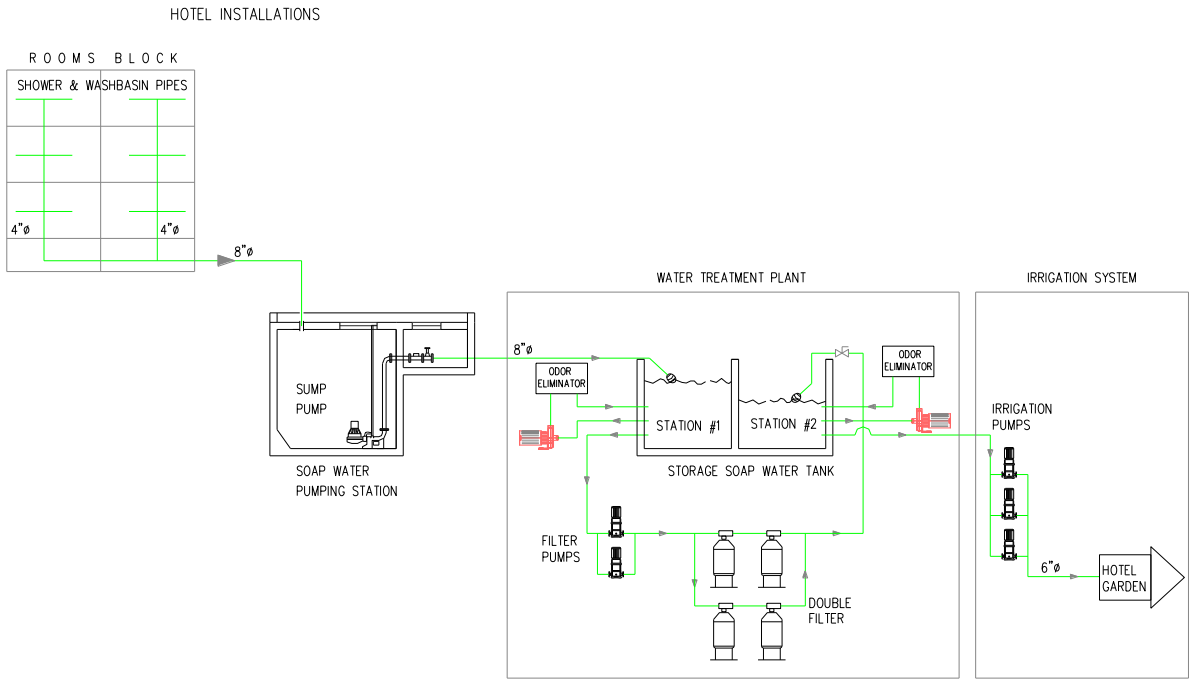


Figure 2.3 - Schematic of "Grey water" recycling scheme

Grease traps are proposed for the primary treatment of the kitchen wastewater discharge (see Figure 2.4 for proposed design). Inspection of the drawings revealed that the grease trap has a volumetric capacity of 20.8 cubic meters (2 m x 6.5 m x 1.8 m). It is estimated that food preparation will result in approximately 68.8 cubic metres per day (assuming 5 US Gallons per meal, by 420 rooms, by 2 guests per room) with a kitchen that operates approximately 16 hours a day. The estimated retention time for the grease trap is 7.26 hours.

NWC (through their consultants Fisher Price Consultants (discussions with Mr. Manherst)) have provided guidelines to be followed for the design of the grease traps. These are as follows:

- A retention time of 2.5 hours should be provided for the average daily flow from the fixtures that leave the kitchen and discharge into the grease trap.
- A retention time factor should be applied to this flow as follows:
  - ⇒ For 8 hours of operation = 1
  - ⇒ For 16 hours of operation = 2
  - ⇒ For 24 hours of operation = 3

According to these guidelines, the grease trap's retention time should be 5 hours or greater. The current design exceeds this guideline.

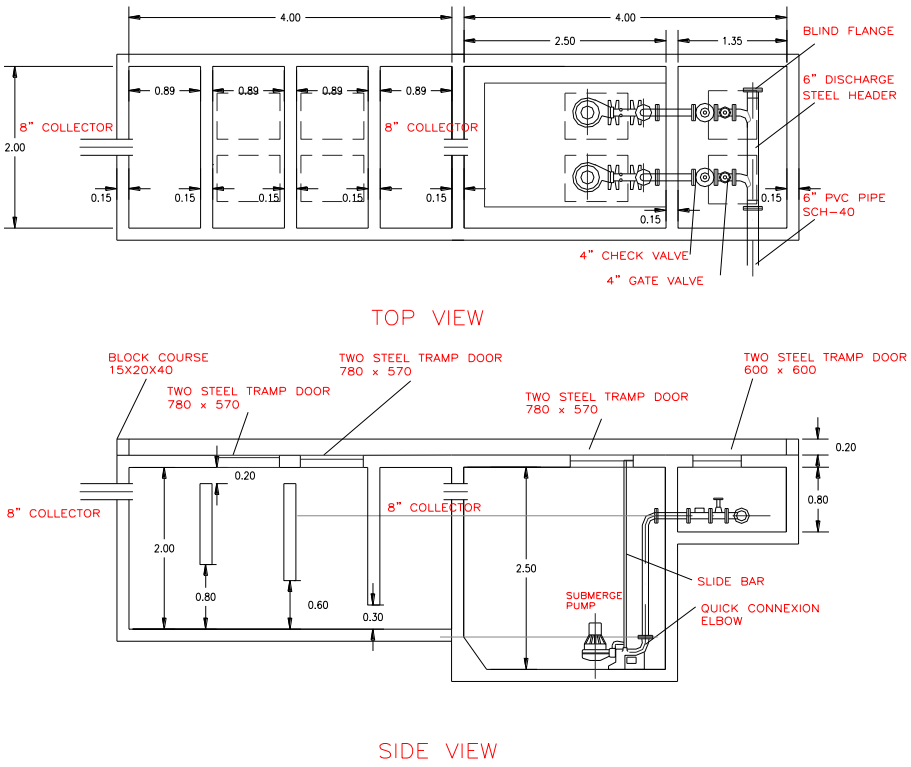


Figure 2.4 - Layout and Section through grease trap

Discussions with the project manager for Tropical Bay (Mr. Sanchis) and the project's consulting architect (Ms. Madden) revealed that the new hotel plans to utilize Tropical Bay's laundry facility. That water is presently recycled to the landscape irrigation.

2.3.2 Wastewater Generation Estimate

Sewage is estimated at approximately 80 to 90% of the total water consumption. However, the proposed hotel's plans utilizes recycled water for landscape irrigation. The estimated water consumption rate will therefore be lower and the estimated wastewater rate can be expected to be closer to 100% of the water consumption estimate.

Assuming an additional 10% loss of water to areas other than the sewers, such as washdown water, the wastewater generation rate can be estimated. It was determined that this flow would range from approximately 343,390 LPD for the customary hotel consumption rate to as low as 248,880 LPD for the situation in which the conservation strategies are fully employed. The results are summarized in Table 2.3

Table 2.4 - Wastewater generation flowrate for the proposed hotel

Generation Rates (LPD)	Customary	With Conservation Measures
Water Consumption	382,200	276,533
Wastewater Generation	343,980	248,880

2.4 Coastal Infrastructure

There is no existing plan for the installation of coastal structures, such as dunes, breakwaters, groynes, beach nourishment, outfalls, or pier structures. The consultants have advised RIU to notify and consult local and national stakeholder, including the National Environment and Planning Agency and the Negril Coral Reef Preservation Society if such plans arise in the future.

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Background

An Environmental Impact Assessment (EIA) is "a structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predictions of how the environment is expected to change if certain alternative actions are implemented and advice on how best to manage environmental changes if one alternative is selected and implemented" (Bisset, 1996).

The basis of EIAs has been summarised as follows[4]:

- Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytic method or technique, but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.
- EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus it should be part of decision-making processes.
- The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.

[4] Wood, C., "Environmental Impact Assessment: A Comparative Review" p. 2. (from Caldwell, 1989, p.9)

3.2 Jamaican Environmental Requirements

EIAs are not only recommended in project design, but also required by Jamaican legislature. The following is a review of Jamaican environmental policy and law that are relevant to the RIU hotel design, construction and operation.

3.2.1 National Environment and Planning Agency (NEPA)

NEPA is the new Government Executive Agency and represents a recent merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilisation Commission (LDUC).

Among the reasons for this merger was the streamlining of the planning application process in Jamaica. The Agency is moving towards one application to NEPA for new developments and new modifications that will review and approve environmental aspects as well as planning, building control and zoning considerations.

Town and Country Planning Authority (TCPA)

The Town and Planning Act, as amended (1987) establishes the Town and Country Planning Authority, which is responsible for land use zoning and planning regulations as described in their local Development Orders.

Negril/Green Island Development Order

The local planning authority in Negril is the Negril Green Island Area Local Planning Authority (NGIALPA). It's functions include (Source: Negril Environmental Protection Plan):

- granting permission to develop land (based on the Development Order, and subject to approval by TCPA), maintaining a public register on land development applications, and enforcing planning controls,
- making Tree Preservation Orders.

The RIU Group has obtained planning permission for this project from the Town Planning Department of the NEPA (Appendix 12). They confirm that the proposed footprint and plot area coverage are within the specified planning policy requirements.

The Development Order for Negril/Green Island requires the following directives:

- a height limit for buildings in the area of three (3) storeys
- maximum protection of the beach
- a plot ratio of between 60% - 75%

Continued proactive communication with the NGIALPA is recommended in order to keep them informed and in dialogue on the activity in their jurisdiction. This will also be the approach of the environmental consulting team in deliberating environmental aspects of the planning and approval process.

Natural Resources Conservation Authority (NRCA) Act

The NRCA Act is Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation and protection of the natural resources of Jamaica.

The Act has established the Natural Resources Conservation Authority (NRCA), which has a number of powers including, inter alia:-

- issuing of permits to persons responsible for undertaking any construction, enterprise or development of a prescribed category in a prescribed area
- issuing licences for the discharge of trade or sewage effluent

- requesting an Environmental Impact Assessment (EIA) from an applicant for a permit or the person responsible for undertaking any construction, enterprise or development
- revocation or suspension of permits.

The Act also gave power of enforcement of the following environmental laws to the NRCA (Source: Negril Environmental Protection Plan):

- The Beach Control Act
  - ⇨ Establishes Crown (Government) ownership and management responsibility for the foreshore, floor of the sea, and overlying water (regulates activities within 25 metres of the shoreline, including control over construction of sheds, and huts on beaches.)
  - ⇨ Prohibits commercial use of these areas without license from the NRCA,
  - ⇨ Directs NRCA control over activities including fishing, waste disposal, dredging, coral removal,
  - ⇨ Requires NRCA permit for any structure on or attachment to the foreshore, including seawalls, piers, jetties, mooring buoys, and artificial reefs,
  - ⇨ Requires NRCA approval of beach development plans (developments up to 1 mile inland), inspection of beaches to ensure adherence to safety and cleanliness standards.

Also,

- The Watersheds Protection Act
- The Wildlife Protection Act

3.2.2 NRCA's EIA Process

Under Section 9 of the NRCA Act, hotels of over 12 rooms such as the RIU complex will require a Permit for construction and may, under Section 10 of the Act, require an EIA. The EIA Process is described below:

- The NRCA permit procedure is initiated by the submission of the Project Information Form (PIF) (RIU's completed PIF Form as submitted is in Appendix 2) to the Authority. The PIF screening form is reviewed to determine whether and EIA is required and to begin determining areas of environmental significance, especially in waste discharge.

- Based on the review of the PIF, the NRCA advised RIU that an EIA would be required for their development. The consultant then liaises with the NRCA to determine the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed by the consultant using NRCA guidelines and are approved by the NRCA. Appendix 3 gives the approved TORs for the RIU Hotel development.
- The EIA is then prepared by a multi-disciplinary team of professionals (see Appendix 4 for the team used in this assessment). The NRCA requires that the EIA include the following:
- A description of the present environment, i.e. physical, biological and social environment. This includes, for example, consideration of economic situations, cultural heritage and ecological preservation.
- A description of the significant impacts the environmental professionals expect the development to have on the environment, compared to the environment that would remain if there were no development. This will include indirect and cumulative impacts.
- An analysis of alternatives that were considered in order to consider means of minimising or eliminating the impacts identified above.
- An Environmental Management Plan, which includes a Monitoring & Hazard Management Plan and an Auditing schedule.
- The NRCA guidance on EIAs states that this process "should involve some level of stakeholder consultation in either focus groups or using structured questionnaires." A draft EIA is submitted to the developer to solicit the proponents' input into the description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply).
- Eight copies of the finalised draft are then submitted to NRCA, two to the client, and the consultant keeps one (11 in all are produced). The NRCA distributes these to various other public sector institutions who sit on the Technical Committee (e.g. WRA, ECD, JNHT etc.) for their comments. Typically this depends on the nature of the project.
- As deemed necessary by the NRCA, Public Meetings are then held, following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged.
- The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report but for incorporation into the development's design.
- The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Minister of Land and the Environment.

Public Participation in EIAs

There are usually two forms of public involvement in the environmental impact assessment (EIA) process. The first is direct involvement of the affected public or community in public consultations during EIA study. These consultations allow the developer to provide information to the public about the project and to determine what issues the public wishes to see addressed. The extent and results of these consultations are included in the documented EIA report.

The second level of involvement is at the discretion of the NRCA and takes place after the EIA report and addendum, if any, have been prepared after the applicant has provided the information needed for adequate review by NRCA and the public.

The RIU hotel development lies in the Negril Environmental Protection Area (EPA). The EPA is managed by the Negril Area Environmental Protection Trust (NEPT), a local community Environmental Non-Governmental Organisation (ENGO). The consultant has contacted the major environmental stakeholders in the development area including NGOs, Community Based Organisations (CBOs) and Academic Experts. Based on the questions and concerns raised in these discussions (addressed later), community interaction and transparency is a critical area of focus for the success of this development and the second level of involvement described above is possible. Please see Appendix 5 for the NRCA reference document entitled "Guidelines for Public Participation" in EIAs.

3.2.3 Parks and Protected Areas Policy

(Reference: NRCA Green Paper on a system of National Parks and Protected Areas)

According to the NRCA, a protected area is "an area of land or water that is managed for the protection and maintenance of its ecological systems, biodiversity and/or specific natural, cultural or aesthetic resources."

A variety of organisations manage Jamaica's several existing types of protected areas. Areas authorised in the Natural Resource Conservation Authority Act of 1991. The national system also encompasses areas established under other legislation and will continue to do so. The NRCA has responsibility under the Wild Life Protection Act, the Watersheds Protection Act and the Beach Control Act for certain protected areas, including game sanctuaries and game reserves. Management authority for other areas is conferred on the responsible agency by its establishing legislation, such as the Fishing Industry Act (1975), the Forest Act (1937), and the Jamaica National Heritage Trust Act (1985).

The RIU development falls within one of the six types of protected areas, an Environmental Protection Area. "Environmental Protection Areas (EPAs) will typically be large areas of mixed and complex ownership and use with interlinked ecological systems. To achieve environmental protection, they require coordinated management of the whole area by a variety of means, including use of Prescribed Area regulations. Unlike the other categories, Environmental Protection Areas are not exclusive and may contain other types of protected areas such as fish sanctuaries, game or nature reserves. Primary uses and management authority will vary by zones that may be set forth in an environmental policy framework or determined later in a management plan. As a basic assessment of protection needs, an environ-mental policy framework for an EPA will often serve as a feasibility study area for or precursor to special protected area designations."

In Jamaica, environmental non-government organisations play a key role in the management of protected areas. NEPT, an umbrella ENGO representing most of the smaller NGOs and CBOs in Negril, lobbied for and helped to develop the management and operations plans for the Negril Marine Park in association with its partner, the Negril Coral Reef Preservation Society (NCRPS).

NEPT will conduct natural resources and socio-economic studies of the Negril Great Morass and the Forests in the Fish River and Negril Hills as well as the neighbouring communities. These

studies will feed into the development of a plan for managing the resources through a variety of strategies likely to include a protected area.

Another component of protected area management is to raise awareness of the need for protecting ecosystems.

3.2.4 Negril Environmental Protection Plan (EPP)

The Negril EPA was declared in November 1997. The aim of this protected area is to promote sustainable development. It is therefore significant that the EPA overlaps with the proposed Development Order area under the Town and Country Planning Act. NEPT worked closely with the two most relevant government agencies – the NRCA and the NGIALPA to develop an EPP to guide environmental activities within the EPA.

Part of EPA management is to coordinate environmental activities between the various groups in the area by sitting on or leading committees. These include the Norman Manley Sea Park Management Committee, Greening Negril Steering Committee, NGIALPA Board, Environmental Legislation Enforcement Committee and the Resort Board. In addition, NEPT reminds other organisations of the role that they should be playing in the management of the EPA.

The EPP lists the following as issues that will be relevant in the proposed development:

- Encroachment on verges
- Use of sea for garbage disposal
- No public access to beaches for fishing and swimming
- Encroachment on foreshore
- Sewage disposal – inadequate facilities for residents and boats

- Inadequate enforcement of environmental laws
- Fisheries depleted
- Large hotels not conforming to zoning regulations
- Inadequate enforcement of litter laws
- Beach development has nearly caused huge crab population to vanish
- Improper drainage infrastructure
- Cutting of "Standing Woods" forests for charcoal kilns

The EPP defines 19 goals for the EPA. Those relevant to the RIU development include:

"Maintain fishing as a viable commercial activity and continued source of local employment." (Goal 1) One of the measures proposed to achieve this is the establishment of a Fish Sanctuary that was proposed for what is now part of the RIU site.

- "Guide growth of the tourism industry in a manner which maintains Negril's unique natural beauty, and is within the capability of the area's ecosystems to support." (Goal 4)
- "Provide proper treatment and disposal of all human wastes and waste water throughout the watershed, keeping nutrients out of the marine environment." (Goal 5)
- "Secure public access and ownership of key beach front and shoreline lands." (Goal 11). The EPA includes the proposed designation of a Negril Marine Park.

3.2.5 Jamaica Hotel and Tourist Association and Tourism Product Company

The Jamaica Hotel and Tourist Association (JHTA) grants licenses for all hotels in Jamaica. Among the licensing criteria are Environmental Guidelines for various aspects of the tourism development, including Watersport and Hotel Operations. Enforcement of licensing requirements is the responsibility of the Tourism Product Development Company (TPDCo).

4.0 DESCRIPTION OF THE ENVIRONMENT

4.1 Physical

4.1.1 Climate

Rainfall

The 30 Year (1951 – 1980) monthly mean rainfall for Negril ranges from a low of 37 mm in January to a high of 186 mm in October. The rainy season is from May to October and the dry season from November to April (Figure 1). The 10 and 25 Year Return Period, maximum 24-Hour rainfall for Negril is 159 mm and 194 mm respectively.

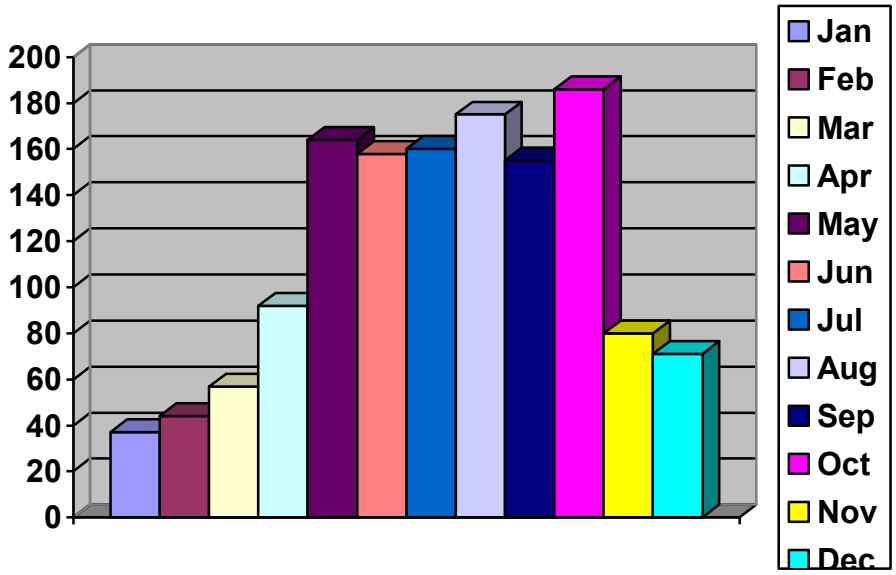


Figure 4.1 - Monthly Rainfall Distribution - Negril Point

The mean monthly temperatures are lowest in January and February (23.6ºC) and highest between August and September (26.6 ºC). The mean monthly relative humidity ranges between 76.8 and 80 percent. Relative humidity is low in the afternoon and high in the evenings. Mean monthly values of daily sunshine hours range between 7.0 and 8.0.

The dominant wind direction is north-east, with a frequency of 37.2 percent, consistent with the north-east trade winds. Winds from the south south-east has a frequency of 22.9 percent (Table 4.1). No data on wind speed was obtained for the project area. Wind speed for the Sangsters International Airport, Montego Bay , ranges from 4.5 m/s in September and October to 6.0 m/s in July.

Table 4.1: Wind Direction and Frequency - Negril Lighthouse

Wind Direction	*Frequency (%)*
North-East	37.2
East	11.7
South-East	22.9
South	5.2
West	1.4
North	16.0

Source: National Meteorological Service, Jamaica

4.1.2 Topography, Soils and Geology

The proposed site is relatively flat with elevation generally less than 3.0 m above mean sea level and gently sloping towards the north. The Norman Manley Boulevard that forms the southern boundary, separates the site from the Negril Morass.

The soils type at the site is typically dark-brown to black, sandy, organic and typically less than 0.3 m thick. Below the soil layer is a sequence of limestone sands mixed with silt and minor clay fraction. The depth of the sand sequence varies from 5.0 m to 11.0 m below ground level. The thickness of the sand sequence decreases from west to east. Isolated layers of peat were observed in some of the exploratory boreholes drilled at the site. Underlying the sand sequence is

a hard compact limestone sequence. The formations occurring below the site are members of the Lower Coastal Group.

Hydrology

The site is located in the Negril Sub-Basin of the Cabaritta Basin. The closest perennial stream is the Orange River, which is north of the site. There are no streams (perennial or seasonal) crossing the site. Surface water hydrology at the site is related primarily to stormwater runoff from the main road to the site, stormwater runoff generated on the site and possible overflow from the wetlands/morass.

Under present conditions, stormwater generated on the main road enters the site via a number of earth drains. Given the high permeability of the sand sequence below the site, no significant surface runoff is generated from the site under present condition. The vegetation cover and burrowing actions of a number of organisms have also significantly improved the infiltration capacity of the soil. With the exception of areas with road, there are no surface water detention ponds on the site as a result of stormwater generated from the main road or on the site.

The main road is higher than the site and the morass on the opposite site of the road. The North and South Negril River and Orange River are in hydraulic continuity with the morass. It is therefore unlikely that there would be overflow from the morass to the site. Reviews of the available literature have not recorded this phenomenon occurring in the past.

The groundwater table at the site was recorded in the exploratory boreholes at approximately 0.5 m below ground level. The groundwater below the site is known to be saline, representing seawater. The groundwater gradient is extremely low and therefore there would be no significant groundwater flow below the site.

4.2 Terrestrial Survey

4.2.1 Terrestrial Flora

4.2.1.1 Introduction

The flora of the proposed sites for the construction of RIU Phase 2 and the parking lot were assessed using transects. At site R1 (allocated for the hotel), four transects were placed from the beach to the road in accordance with the quadrants outlined on the topographic map (Haddad, 2001). The transects were centralized with respect to each lot/quadrant in order to gain a representation of the vegetation present. Each species encountered, was recorded in terms of height, diameter at breast height (DBH), percentage cover and where identification in the field was not possible, a sample was taken.

Based on the hotel design provided, a floral assessment was conducted in a 30m belt (from the sea inwards) in which, trees of DBH >18cm was sprayed/flagged to be used as a guide of the trees to be maintained during vegetation clearance and hence to remain throughout the development.

At site R2 (the proposed parking area), floral assessment was conducted using a belt transect, 60m by 10m. The vegetation encountered were recorded and where necessary, taken as samples. Height, DBH and percentage cover were also recorded.

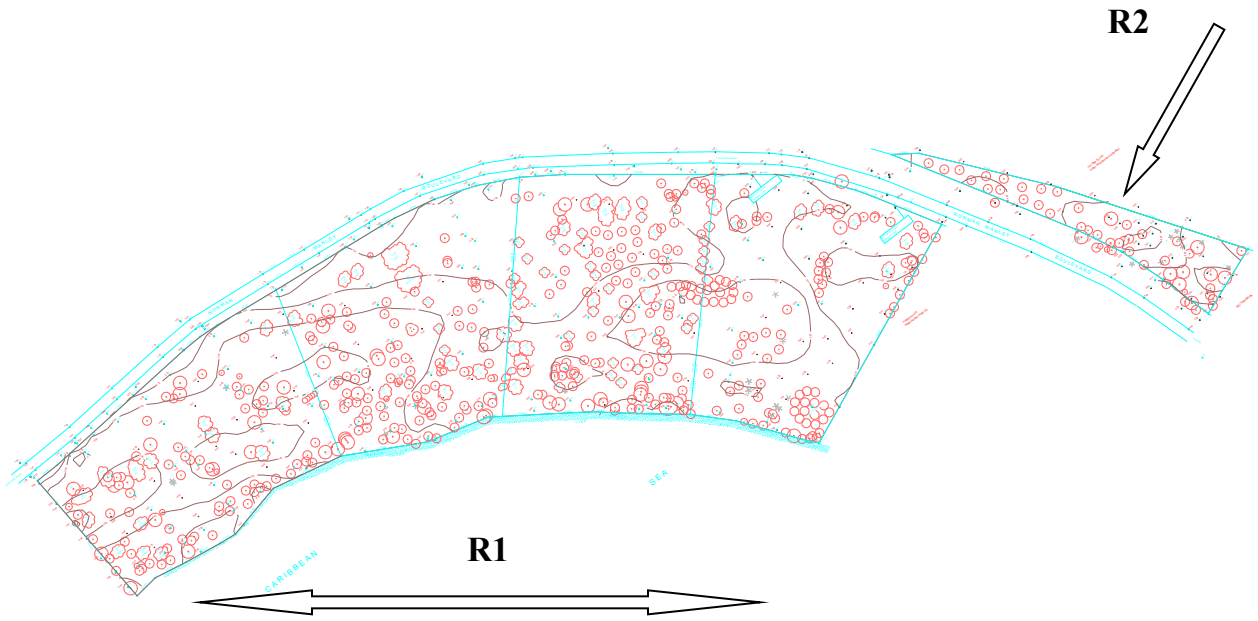


Figure 4.2: Topographic Map showing sites R1 & R2

4.2.1.2 Description of the Floral Environment

Site R1

The proposed site for the construction of the hotel (shown as R1) consisted mainly of trees and few herbs and exhibited a zonation from the beach to the road. The beach, at the beginning of the property was relatively sparse except for the presence of coastal vegetation such as *Cocoloba uvifera* (Sea grape), *Conocarpus erectus* (Button mangrove), *Thespesia populnea* (Seaside mahoe), *Ipomoea pes-caprae* (Beach morning glory), the coastal grass, *Sporobolus*, and large trees of *Calophyllum calaba* (Santa Maria), *Dalbergia ecastaphyllum* and *Terminalia catappa* (West Indian Almond). The striking Spider Lily, *Hymenocallis littoralis* was fairly abundant. The width of the beach decreased towards the edge of the property due to overgrowth of the above-mentioned vegetation and ended in a stand of *Rhizophora mangle* (Red mangrove). Associative species of this stand were *Ipomoea* sp., Seaside Mahoe and Almond.

The change in vegetation was evident approximately 3m - 14m from the shoreline and was dependent on the section of the beach being assessed. The dominance of microphyllous leaved trees, for example, *Bucida buceras* (Black Olive) and *Haematoxylum campechianum* (Logwood), allows this forest to be classified as strand woodland. Species typically found in this type of woodland are *Piscidia piscipula* (Dogwood), *Morinda citrifolia* (Hog Apple) and *Colubrina asiatica* (Hoop With), all of which were observed on-site. These trees were also found in association with coastal plants, such as Sea grape, Button mangrove, Seaside mahoe and *Dalbergia ecastaphyllum*. Occasionally, smaller palms were observed in the under-storey. At the edges of the woodland (by the road) were grassland clearings, with herbs such as *Sida acuta* (Broomweed), *Bidens pilosa* var. *radiata*, *Rhynchospora nervosa* (Stargrass), *Stachytarpheta jamaicensis* (Vervine) and *Wallenia tribolata* (Marigold).

The floral assessment conducted within the 30m belt transect (shore towards inland) of the strand woodland revealed a forest floor with little or no leaf litter, straggling vines {*Ipomoea* sp. and

Mikania micrantha (Guaco)}, climbers {*Philodendron* sp. and *Syngonium auritum* (Five finger)} and an intra-zonation between under-storey and trees. This was evident as the forest changed from dense under-storey to tree dominated (GPS 781 243E, 2031 560N) and then from tree dominated to a dense under-storey (GPS 781 355E, 2031560N). Approximately 85 trees were sprayed/flagged along this transect, including the endemic, *Roystonea princeps* (Swamp Cabbage). The trees exhibited DBH >18cm and should be used as a guide, prior to vegetation clearance. The presence of *Cecropia peltata* (Trumpet Tree) and *Piper amalago* (Jointer) in abundance indicates that the woodland is disturbed and as such, may be described as a disturbed strand woodland. Although the site is considered disturbed, the upper canopies of the trees provide a feeding and nesting area for birds present. The significance of the forest for food is not limited to avifauna but to other animals, which may be present, for example, lizards and frogs (epiphyte).

In total, site R1 exhibited approximately 64 species of plants (Appendix 6), of which, three were endemic and two rare. The endemics observed were *Roystonea princeps* (Swamp Cabbage), *Thrinax* sp. and *Hohenbergia negrilensis*. The rare specimens found on-site were the orchid, *Tropida polystachya* and the tree, *Phyllanthus acuminatus*.

Site R2

Site R2, the proposed site for the parking area is located in the remainder of the mixed-swamp margin forest bordering the Negril Morass. This type of forest was characterised by Coke *et al* (1983), of which three types were identified, namely, *Roystonea*, *Conocarpus* and *Sabal* swamp margin forests.

The swamp forest that coincides with the present location of site R2 is the *Conocarpus erectus* (Button mangrove) swamp forest. This association was found to the east and west of the Morass. There were also located in the centre of the Morass surrounded by hummocks of *Cladium*. Coke *et al* (1983) reported that on the western side of the Morass, *Conocarpus* was found with *Roystonea*, *Terminalia latifolia* (broad-leaf), *Hibiscus tiliaceus* (seaside mahoe), *Thespesia*

populnea, *Bucida buceras* (black olive), *Ficus maxima* (fig), *Artocarpus altilis* (breadfruit) and *Spathodea campanulata* (flame-of-the-forest). Shrubs and scramblers formed impenetrable thickets on the fringes of the *Cladium* formation. Shrubs included *Dalbergia ecastaphyllum* (malanti), *Chrysobalanus icaco* (coco plum), *Pavonia spicata*, *Malpighia* and the giant fern *Acrostichum aureum*. Climbers included *Urechites*, *Rhabdadenia*, *Philodendron*, *Passiflora oblongata* and *Ipomoea tiliacea*. *Tillandsia* represented the epiphytes.

On-site investigation revealed that some of the vegetation denoted for this type forest was not present. However, a few were observed, namely, *Roystonea princeps*, *Ficus* sp., *Philodendron* sp., *Ipomoea* sp. and *Tillandsia* as the dominant epiphyte. Although species listed for this type forest were not encountered in the sample areas, it does not mean they do not exist. The site, however, does reveal signs of disturbance. This is indicated by the presence of *Cecropia peltata* (Trumpet tree) and *Bursera simaruba* (Red Birch).

Generally, the vegetation consisted mainly of an open canopy forest divided into two strata. The first strata consisted of trees, 16m – 30m tall (two *Roystonea* encountered were 13m – 15m tall) and the second (the under-storey), 8m tall. Majority of the trees observed had DBH >20cm. The forest floor exhibited saplings ≤1m in height, and was devoid of leaf litter. The forest is also a climax (mature) community in which the saplings present on the forest floor will replace the existing plants over a period of time. Some of the trees observed, were over 100 years old, for example, a *Haematoxylum campechianum* (Logwood) tree that supported at least 6 clumps of the endemic epiphyte, *Hohenbergia negrilensis*. The importance of this forest is not limited to the growth of new species or supporting orchids and bromeliads, but serves as a nesting area for birds, especially in the upper canopy of the trees and therefore, should remain intact and be preserved.

In total, twenty-four (24) species (Appendix 7) were identified at this site, of which two were the endemics, namely *Roystonea princeps* and *Hohenbergia negrilensis*.

4.2.1.3 Endemic, Rare and Endangered Species

Floral assessment of both sites has revealed the presence of three (3) endemics and two (2) rare species.

Table 4.2: Endemics and rare plants of site R1

Species	***Growth form***	***DAFOR Rating***	***#'s found***	***Notes***
Roystonea princeps	Tree	O	10	***Endemic***. Restricted to western parishes. Found in all four quadrants (as outlined on the topographic map).
Thrinax sp.	Tree	R	3	***Endemic***. Found in the fourth quadrant.
Hohenbergia negrilensis	Epiphyte	R	2	***Endemic***. Restricted to western parishes. Found on two trees in the third quadrant, which were flagged. GPS 781 443E, 2031 554N GPS 781 388E, 2031 615N
Tropida polystachya	Orchid	R	1	***Rare***. Found in central and western parishes in deep leaf litter and shady forest. Found along 30m transect.
Phyllanthus acuminatus	Tree	R	1	***Rare***. Known in Jamaica and limited only from Bloody Bay and Booby Cay.

Table 4.3: Endemics of site R2

Species	***Growth form***	***DAFOR Rating***	***NOTES***
Roystonea princeps	Tree	F	***Endemic***. Restricted to western parishes. Found in all four quadrants (as outlined on the topographic map).
Hohenbergia negrilensis	Epiphyte	F	***Endemic***. Restricted to western parishes. Found on two trees in the third quadrant, which were

4.2.1.4 Keystone species

Keystone species are present within diversified ecosystems located in Jamaica and the removal or decline of such, would trigger changes. Three species observed on both sites would serve as keystone species. These are the tree, *Roystonea princeps* (Swamp Cabbage), the epiphyte, *Hohenbergia negrilensis* and the bromeliads, *Tillandsia* sp. Swamp Cabbage, due to its height and spreading branches would serve as a nesting and food source for avifauna present on-site. Both *Hohenbergia* and *Tillandsia* would provide food, water, nesting and breeding ground for avifauna present as well as for frogs and invertebrates.

4.2.2 Terrestrial Fauna

4.2.2.1 Survey Methodology

Site #1 - The proposed RIU Hotel development site:

A preliminary walk through survey of terrestrial fauna, frequenting and inhabiting the proposed RIU hotel development site, was conducted on September 12, 2001; between the hours of 5:30 am and 10:00 am. The type of terrestrial fauna, and the sections of the project site of highest faunal activity, was determined. Bird counts, and non-quantitative (cursory) surveys of other fauna, were subsequently conducted within the determined areas of highest activity over the four days of ensuing field surveying (from September 13 to September 16, 2001).

With regards to avifauna, two locations were identified as areas of dominant bird activity. These were, respectively:

- in the vicinity of the proposed tennis courts/proposed Hotel Block #1 (in the center of the site, at GPS coordinates:CUTM **Zone 17** 781378E 2031614N (WGS84)); and
- in the vicinity of proposed Hotel Blocks #3 and #4 (in the underbrush/woodland, within the northwestern section of the site, at GPS coordinates:CUTM **Zone 17** 781202E 2031622N (WGS84)).

On September 13, 14 & 15, 2001, three bird counts (i.e. one morning and two evening counts) were conducted at Avifauna Site #1, located at the proposed tennis courts/proposed Hotel Block #1; UTM **Zone 17** 781378E 2031614N (WGS84). The results of these counts are presented in Table 4.4. A fourth (combined) morning count was subsequently carried out on September 16, 2001 beginning at Avifauna Site #1 and concluding at Avifauna Site #2, located at proposed Hotel Blocks #3 and #4; UTM **Zone 17** 781202E 2031622N (WGS84). The results of this fourth count are also presented in Table 4.4.

As indicated in Table 4.4, morning avifauna counts were typically three hours in duration and was conducted between the hours of 5:30 am and 8:30 am; whilst evening counts were one hour

in duration and was conducted between the hours of 5:30 pm and 6:30 pm. A 100 m radius, around Avifauna Sites #1 and #2, was surveyed during each given point count event. This 100 m radius effectively encompassed and included habitats representative of all the major terrestrial habitats found at the site; namely grassed clearings, thick understorey vine/shrub woodland and the closed canopy woodland with negligible understorey vegetation.

With regard to turtles, special attention was paid to the beach during the five day period of terrestrial surveys, specifically for evidence of site use by the five species of sea turtle known to frequent Jamaican coastal waters. In this respect, the entire length of site shoreline was surveyed (at least once a day during the early morning hours of September 12 to September 16, 2001) for signs of turtle activity and turtle tracks.

Site #2 - The proposed RIU parking lot site:

Terrestrial fauna at the proposed RIU parking lot site was surveyed only once during field work for the EIA. A single two hour "walk through"-type avifauna survey was conducted, along the length of the proposed site, to obtain an indication of species diversity and individual abundance through listing and counting the number of species and individuals observed and heard during the walk. The survey was conducted on September 16, 2001, between the hours of 9:30 am and 11:30 am and the results of the census are presented in 4.5. Other fauna was surveyed and qualitatively recorded during the two-hour walk.

4.2.2.2 Avifauna

Birds are good indicators of environmental quality. Species diversity (the relative numbers of different species) is dependent upon the diversity of habitats available for roosting, foraging and feeding in an area. In general, high species diversity and high numbers of individuals (i.e. individual abundance) are indicative of a healthy and diverse ecosystem.

Table 4.4 lists the species observed during the fours (4) days of bird counts at the proposed RIU hotel development site, and Table 4.5 lists the species observed during the two hour walk through survey at the proposed RIU parking lot site. A total of eighteen (18) different bird species, and seventy-four (74) individuals, were observed during the count and the walk through surveys conducted at the two sites.

Overall, it was surprising to find that species diversity was so low (i.e. only 18 different species of observed birds) considering the fact that both the proposed hotel and proposed parking lot sites are both relatively remote and undisturbed. The most plausible explanation for the low species diversity (and individual abundance numbers) is probably the correspondingly low habitat diversity and the overall nature of the floral habitat observed at the sites. With the exception of grassed clearings and those sections of the proposed hotel site that did support heavy understorey vines, both proposed sites were typically woodlands with little or no understorey vegetation/growth with bare, exposed ground cover, devoid of leaf litter. There were, therefore, few available habitats for concealment, foraging and nesting, other than within the tree canopy itself, and therefore both sites were found to be less than ideal for supporting large and diverse bird populations.

Table 4.4 Bird species observed at the proposed RIU hotel site.

			NUMBERS				
FAMILY	***SPECIES NAME***	***COMMON NAME***	***13th Sept. 2001 5:30-8:30 am***	***14th Sept. 2001 5:30-6:30 pm***	***15th Sept. 2001 5:30-6:30 pm***	***16th Sept. 2001 5:30-8:30 am***	***STATUS****
Apodidae	*Streptoprocne zonaris*	White-collared Swift	-	-	3	2	CR
Apodidae	*Tachornis phoenicobia*	Antillean Palm Swift	-	3	2	-	VCR
Columbidae	*Columba leucocephala*	White-crowned Pigeon	1	-	2	-	CR
Columbidae	*Columbina passerina*	Common Ground Dove	-	-	1	1	VCWR
Columbidae	*Zenaida aurita*	Pea Dove	3	-	-	-	CR
Emberizidae	*Coereba flaveola*	Bananaquit	3	1	2	4	CWR
Emberizidae	*Dendroica petechia*	Yellow Warbler	1	1	3	2	CR
Emberizidae	*Mniotilta varia*	Black-and-white Warbler	2	1	1	1	CWV
Emberizidae	*Tiaris bicolour*	Black-faced Grassquit	3	1	-	2	CR
Picidae	*Melanerpes radiolatus***	Jamaican Woodpecker	-	-	1	-	CWR
Trochilidae	*Mellisuga minima***	Vervain Hummingbird	-	-	-	1	VCR
Tyrannidae	*Myiarchus barbirostris***	Sad Flycatcher	1	2	2	1	CR
Tyrannidae	*Tyrannus caudifasciatus*	Loggerhead Kingbird	4	2	1	2	CW
TOTAL			**18**	**11**	**18**	**16**	

* Based on Downer & Sutton, 1990

Table 4.4's STATUS KEY: ** Endemic species

R	=	*Rare*	*VCWR*	=	*Very Common &Widespread Resident*
C	=	*Common*	*CSR*	=	*Common Summer Resident*
CR	=	*Common Resident*	*AR*	=	*Abundant Resident*
VCR	=	*Very Common Resident*	*VCSR*	=	*Very Common Summer Resident*
CW	=	*Common & Widespread*	*WV*	=	*Winter Visitor*
CWR	=	*Common & Widespread Resident*	*CWV*	=	*Common Winter Visitor*

Table 4.5 Bird species observed during the walk through survey at the proposed RIU parking lot site.

FAMILY	***SPECIES NAME***	***COMMON NAME***	***NUMBERS*** ***16th Sept., 2001*** ***9:30-11:30 am***	***STATUS****
Corvidae	*Corvus jamaicensis***	Jamaican Crow	2	C
Emberizidae	*Coereba flaveola*	Bananaquit	2	CWR
Emberizidae	*Loxigilla violacea*	Greater Antillean Bullfinch	3	CR
Picidae	*Melanerpes radiolatus***	Jamaican Woodpecker	1	CWR
Trochilidae	*Anthracothorax mango***	Jamaican Mango	1	CR
Trochilidae	*Trochilus polytmus polytmus***	Red-billed Streamertail	1	CR
Turdidae	*Turdus aurantius***	White-chinned Thrush	1	VCR
TOTAL			**11**	

* *Based on Downer & Sutton, 1990*

STATUS KEY: ** Endemic species

R	=	*Rare*	*CSR*	=	*Common Summer Resident*
C	=	*Common*	*AR*	=	*Abundant Resident*
CR	=	*Common Resident*	*VCR*	=	*Very Common Resident*
UCR	=	*Uncommon Resident*	*WV*	=	*Winter Visitor*
CW	=	*Common & Widespread*	*CWV*	=	*Common Winter Visitor*
CWR	=	*Common & Widespread Resident*	*E*	=	*Endangered*

As a result most of the birds observed during the bird counts conducted at the proposed hotel site were mainly restricted to those areas of the hotel site which were characterised by (a) disturbed/grass clearings (found adjacent to Norman Manley Boulevard) and, to a lesser extent, (b) fairly dense understorey vines and growth. In the remaining sections of the hotel site, where

bare sand and large phanerophytes were typical, bird species and numbers were low and restricted to the canopy of the trees.

At the proposed parking lot site, where ground and understorey vegetation was virtually absent, avifauna activity was restricted to the canopy of tall trees; and the *Acrosticum aureum* wetland/morass adjacent to, and east of, the site. Particularly at the proposed parking lot site, tree cover and the relatively closed forest canopy is extremely important to avifauna activity and should therefore left intact and undisturbed. Individuals were characteristically absent within the understorey, and on the forest floor, and were only observed and heard within the tall tree canopy at this site. Despite the overall low total numbers of species observed during the 4 days of surveying, an overall total of seven (7) different endemic bird species were observed between the two sites.

Details of Avifauna at The Proposed RIU Hotel Site

Thirteen (13) different species were observed during the three hour morning and one hour evening counts conducted between the hours of 5:30-8:30 am and 5:30-6:30 pm (on September 13, 14, 15 and 16, 2001) at the proposed RIU hotel site (see Table 4.4). Sixty-three (63) individuals were observed, however, a number of these individuals (particularly the quits, warblers and tyrant flycatchers) are believed to reside on the site and were therefore probably surveyed more than once during the 4 day survey period. Site resident species and individuals are believed to include *Coereba flaveola* (Bananaquit), *Dendroica petechia* (Yellow Warbler), *Mniotilta varia* (Black-and-white Warbler), *Tiaris bicolor* (Black-faced Grassquit), endemic *Myiarchus barbirostris* (Sad Flycatcher) and *Tyrannus caudifasciatus* (Loggerhead Kingbird).

Of the thirteen (13) species observed during the survey, three (3) are reported as endemic to Jamaica. These were *Melanerpes radiolatus* (the Jamaican Woodpecker), *Mellisuga minima* (Vervain Hummingbird) and *Myiarchus barbirostris* (Sad Flycatcher). These endemic species,

along with the species that are thought to be resident on the site, are discussed and described in greater detail below.

Melanerpes radiolatus (the Jamaican Woodpecker) is an endemic widespread and common resident at all elevations throughout the island. It is found from coastal coconut groves to forested mountain summits, including both dry and wet forests, forest edges, woodlands, shade coffee plantations and gardens. *M. radiolatus* feeds on insects and larvae by characteristically chipping away at rotten wood and tree barks to get at these organisms. *M. radiolatus* breeds most of the year, primarily from December to August, with two to three broods being raised each year. Nests are primarily excavated by the male and are typically a hole in a tall dead tree.

The Vervain Hummingbird (*Mellisuga minima*) is a very common year-round resident, found only in Jamaica and Hispaniola. *Mellisuga minima minima* is an endemic subspecies to Jamaica. *M. minima* is generally found in all open areas which support small flowers inclusive of open woodlands, but tends to be absent in dense forests. It feeds on the nectar of small flowering plants. The single individual, observed at the proposed hotel site, is believed to be a site visitor and probably does not reside or nest on the project site.

Myiarchus barbirostris (Sad Flycatcher) is the only endemic species believed to reside on the project site. This species was observed (as single individuals and in pairs) on more than one occasion frequenting surrounding vegetation and *Coccoloba* stands, found in the vicinity of proposed RIU Hotel Block #1 (at GPS coordinates CUTM **Zone 17** 781416E 2031587N (WGS84)). This tyrant flycatcher typically perches 3 - 9 m above ground and sallies to catch small insects from leaves and surrounding vegetation. Preferred habitats include forests and woodlands, from lowlands to middle elevations. *M. barbirostris* nests are typically constructed of vegetation in a diverse range of cavities, including woodpecker holes and house eaves.

The site-resident quits (*Coereba flaveola* and *Tiaris bicolor*) and the site-resident warblers (*Dendroica petechia* and *Mniotilta varia*) generally all inhabit and nest within surrounding

vegetation of a given site, which may be a range of environments. *D. petechia* tends to prefer to nest within mangroves and coastal scrub. With regard to food, *C. flaveola* (Bananaquit) prefers the nectar of flowering plants and *T. bicolor* prefers small grass seeds. The warblers (*D. petechia* and *M. varia*) tend to feed on insects and spiders.

Details of Avifauna at The Proposed RIU Parking Lot Site

Seven (7) different species were observed during the two-hour walk through survey conducted at the proposed RIU parking lot site (see Table 4.5). A total of eleven (11) individuals were observed.

Of the seven (7) different species observed during the survey, five (5) are reported as endemic to Jamaica. These were *Corvus jamaicensis* (the Jamaican Crow), *Melanerpes radiolatus* (the Jamaican Woodpecker), *Anthracothorax mango* (Jamaican Mango), *Trochilus polytmus polytmus* (the Red-billed Streamertail Hummingbird) and *Turdus aurantius* (White-chinned Thrush); and are discussed and described in greater detail in the remain paragraphs that follow.

Site resident species could not be firmly ascertained, based on the single two-hour walk through count carried out at this site. However, the possibility of site resident species, based upon the type of vegetation at the site and the nesting characteristics of the species observed, is also discussed within the remainder of this subsection.

Corvus jamaicensis (the Jamaican Crow) is a locally common endemic to Jamaica. It is most often encountered in the Cockpit Country, the John Crow Mountains and, to a lesser extent, Moneague and Worthy Park. However, it is also thought to be extending its range into Westmoreland and Manchester (Downer & Sutton, 1990).

C. jamaicensis is omnivorous, commonly feeding on fruit, the eggs of other birds, and lizards. This species also typically forages in bromeliads and under tree bark working its way through tree epiphytes and tree crevices for invertebrates, frogs and water. It is also known to take crabs, larvae and grub.

Given the expanding range of *C. jamaicensis*, coupled with the number of tree bromeliads observed in the relatively secluded and undisturbed proposed parking lot site, it is not all that surprising to find that this species of bird has found a suitable feeding habitat in the area. No actual *C. jamaicensis* nests were observed during the avifauna survey; however, this does not exclude the fact that this endemic may also be nesting on the proposed parking lot site. *C. jamaicensis* nests are typically built high within a tall tree and are usually recognised as a crude platform of sticks and other plant material.

The endemic *Anthracothorax mango* (Jamaican Mango) is widespread and common throughout the island, particularly in coastal and lowland areas. It feeds on insects and the nectar of flowers of trees, cacti and shrubs and is the only Jamaican hummingbird that feeds extensively at cactus flowers. *A. mango* breeds and nests year-round within forest edges, banana plantations, gardens and mangroves.

Trochilus polytmus polytmus (the Red-billed Streamertail Hummingbird) is similar in status and range as *A. mango*, with the exception that it is not found in the extreme eastern sections of Jamaica (including the John Crow Mountains). *T. polytmus polytmus* is found seasonally along the coast, feeds on nectar and small insects and breeds year-round; mainly from October to March.

Although no actual nests of *A. mango* and *T. polytmus polytmus* were observed, it is also highly possible that these hummingbirds not only feed within the tall flowering trees on the site, but also nest there as well.

Endemic *Turdus aurantius* (White-chinned Thrush) is also widespread and common throughout the island. It forages primarily on the ground for a wide range of prey including slugs, lizards, insects, berries, frogs, mice and even small birds. Its primary habitats are forests, woodlands, road edges, cultivated areas and gardens in mountains at mid and high elevations. It is regularly observed in lowlands and appears to be somewhat tolerant of disturbed vegetation, although it is less frequently observed at these elevations. *T. aurantius* tends to be found at lower elevations during its non-breeding season which occurs most of the year. This species breeds from May to July and typically builds its nest in a shrub, tree or at the base of a palm frond.

Given the flight range of *T. aurantius*, its preferred mid to high elevation habitat and the relatively close proximity of the hills east of the project site and the Great Morass, it is unlikely that the White-chinned Jamaican Thrush actually breeds and nests on the proposed parking lot site. The site is most likely used primarily as a hunting and foraging ground for this species.

For similar reasons, although it cannot be ascertain for sure, the Jamaican Woodpecker (*Melanerpes radiolatus*) also probably does not actually nest on the proposed parking lot site preferring the woodlands and forested hills towards the east of the site. Having said this, *M. radiolatus* is more likely to be found nesting in one of the trees of the proposed parking lot site than *T. aurantius* (White-chinned Thrush). If present, it will prefer one of the softer wood palms on the site, or a similar tall dead tree (typically 5-10 m in height), for nesting.

4.2.2.3 Other Terrestrial Fauna

In addition to avifauna, several species of crab were observed and are believed to frequent and inhabit both the proposed hotel and the proposed parking lot sites. These species include:

- *Gecarcinus lateralis* (Black Land Crab),
- *Ucides cordatus* (Mangrove Land Crab), and
- *Cardisoma guanhumi* (Great Land Crab).

All three crab species tend to feed on fruit and leaves, however; only *G. lateralis* (Black Land Crab) and *C. guanhumi* (Great Land Crab) are themselves edible by humans.

G. lateralis and *U. cordatus* crab holes were numerous throughout both sites, averaging one hole per m^2; with as many as three to four holes per m^2 in the northwestern section of the proposed RIU hotel site and over most of the proposed RIU parking lot sites. Dead individuals of *C. guanhumi* (Great Land Crab) were observed along the Norman Manley Boulevard, adjacent to the proposed hotel site (i.e. killed by cars as they attempted to cross the road onto the site). The Fiddler Crab (*Uca sp*.; known for its large (unequal) claw and common at the edge of marshes and mangrove swamps), and the Ghost Crab (*Ocypode sp*.; an active crab on sandy beaches), were not observed during the site visit.

Small garden frogs (Genus *Eleutherodactylus*) were heard throughout various sections of the proposed RIU hotel site (during the late evening bird counts) and are believed to be inhabitants of both the proposed hotel and the proposed parking lot site. Nineteen (19) species of *Eleutherodactylus* are known to occur in Jamaica, 17 of which are endemic, the remaining two being introduced species. These frogs are all small, generally ranging between 25 and 38 mm in length. They are typically dull coloured shades of brown and grey and are mostly nocturnal spending the day in or beneath logs, under rocks or hidden in the leaf litter of forests. The specific species heard during the site visit could not be identified down to species level (based solely on their calls) but are thought to be one of the four species identified by DHV International Limited (1999); namely *E. cundali, E. johnsoni, E. luteolus* and/or *E. pantoni*.

Four species of tree frog are known to live in Jamaica. *Osteopilus brunneus*, an endemic yet widespread species, is one of these species. It is found at all elevations, may be as large as 75 mm in length and is capable of considerable colour change ranging from dark brown to light grey. *O. brunneus* inhabits and breeds within water trapped with wild tree bromeliads (i.e. 'tank' bromeliads like as *Hohenbergia sp*.), often in large numbers. At least two individuals of *Hohenbergia sp.* were observed on both the proposed RIU hotel site and the proposed RIU

parking lot site. *Hohenbergia sp.*, which was particularly abundant at the proposed parking lot site, is most likely supporting at least one species of Jamaican tree frog, along with several other insects and larvae upon which the endemic bird *Turdus aurantius* (White-chinned Thrush) is probably feeding on (see section 4.2.1).

With regards to reptiles, at least two individuals of the endemic green lizard *Anolis garmani* were observed at both the proposed hotel and parking lot sites. This species is characterised by its bright green colour and saw-toothed ridged back.

No turtles, turtle tracks or turtle nests were observed along the shoreline or on the sandy beach of the proposed hotel site. DHV International Limited (1999) reported on the possibility that at least one species of turtle (*Eretmochelys imbricata*) uses the beaches of Bloody Bay and Booby Cay as nesting environments. However, given the small width of the beach, coupled with the dense terrestrial vegetation which grows right up to the waters edge, the possibility that the proposed RIU site is used by nesting turtles is very remote and unlikely. The beaches south of the site, particularly in the vicinity of Grand Lido, are more likely preferred nesting habitats for sea turtles frequenting Bloody Bay than the shoreline of the proposed hotel site. Environmental Solutions Limited (1996) reported that a female Hawksbill (*E. imbricata*) was observed on the Grand Lido Bloody Bay beach in 1995. Approximately, 100 hatchlings were reported to have returned to the sea from a nest on that beach (ESL, 1996).)

Dragonflies and butterflies were few in number; given the absence of significant onsite vegetation capable of supporting large numbers of these animals. However, several termite-like nests of the small black ('duck') ant *Crematogaster sp.* were noted within several trees and the dense vegetation on both sites. This ant species helps attract and support the insect eating avifauna which inhabits and frequents the proposed sites.

Mosquitoes are definite pests at both sites and a single individual of the introduced Indian Mongoose (*Herpestes auropunctatus*) was observed, scurrying across Norman Manley Boulevard.

4.3 Marine Ecology

4.3.1 Marine and Benthic Survey Methodology

Seagrass bed communities, immediately offshore of the proposed RIU hotel site and within the proposed fish sanctuary, were snorkelled, assessed and photographed on September 14 and 15, 2001. The coral reef and seagrass bed extent, in and around the fringing reef ecosystem of Little Bloody Bay, was also assessed and photographed on September 14 and 15, 2001 by a combination of exploratory SCUBA diving, snorkelling, towed-diver transects and boat patrolling.

Existing literature and recent aerial photographs on the extent, coverage and nature of existing coral reefs and seagrass beds within and offshore of Bloody Bay were consulted and reviewed. The accuracy and recentness of these accounts was verified during the boat patrolling exercise for an oceanographic/storm surge modelling bathymetric survey carried out on September 15, 2001.

4.3.2 Introduction and Setting

The morphology of the offshore Negril and Bloody Bay marine environments has been extensively surveyed and described by Hendry (1982). The main features of his findings are summarised in Figure 4.3.

Two coastal shelves characterise the offshore topographic, submarine environment of both Negril and Bloody Bay. The first, an inner shelf, is a relatively flat shallow shelf which coincides with the inshore area of Bloody Bay and the offshore region immediately outside the extent of Bloody Bay itself. This inner shelf terminates at a submarine patch reef/cliff structure, approximately 1.3 km offshore, beyond which is found an outer shelf, inner slope, deep reefs and outer slope as described by Hendry (1982) and shown in Figure 4.4.

Seaward of the outer shelf is an offshore region described as the inner slope by Hendry (1982). This inner slope is approximately 400 m wide and dips approximately 1-8^{o} from a depth of 7 m to a depth of approximately 60 m (cp. Figure 4.4). At 60 m water depth, there is a small sill reef which marks the beginning of the sandy outer slope and which eventually drops off to deepwater depths of several hundreds of meters. Figure 4.4 (Line 5) visually depicts these bathymetric features and changes as a vertical (cross-shore) profile, adapted from Hendry (1982). Figure 4.5, summarises the vegetation and benthic-type distribution within Bloody Bay, as reported by Hendry (1982).

A recent marine biology survey was conducted by DHV International Limited (1999), as part of an Environmental Impact Assessment of the existing RIU Tropical Bay all-inclusive hotel. This survey involved a series of SCUBA dives and towed-diver transects, and extensively covered the marine flora and fauna of Bloody Bay, along with its corresponding offshore spur-and-groove/patch reef ecosystems. However, DHV survey **did not** cover or describe in detail the immediate area offshore of the presently proposed RIU hotel site; nor the fringing reef environment of Little Bloody Bay both of which lie (or partially lie) within the buoyed area of the recently proposed Bloody Bay fish sanctuary.

The proposed fish sanctuary has already been demarcated by the Negril Marine Park with delineating marker buoys but its precise boundaries could not be verified by NEPA. It encompasses Little Bloody Bay, Pelican Cay, most of the northern section of Bloody Bay and: of the nearshore/inshore area of the proposed hotel site. The corresponding location of the DHV International Limited (1999) dives and transects is shown in Appendix 8; along with summary lists of the DHV-observed fish, coral, algal, sponge and invertebrate fauna.

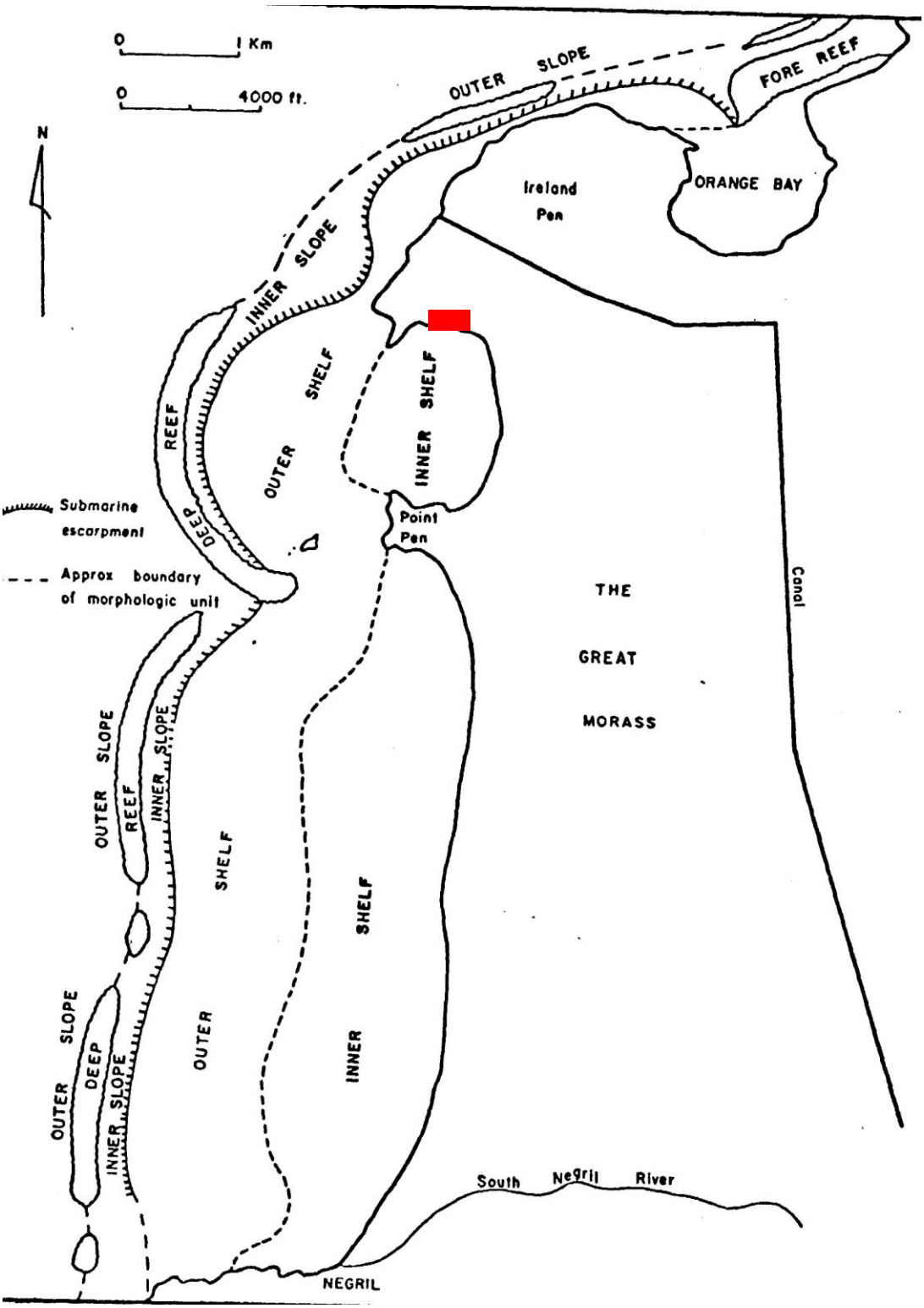


Figure 4.3: Showing approximate location of proposed site and offshore morphology at Bloody Bay

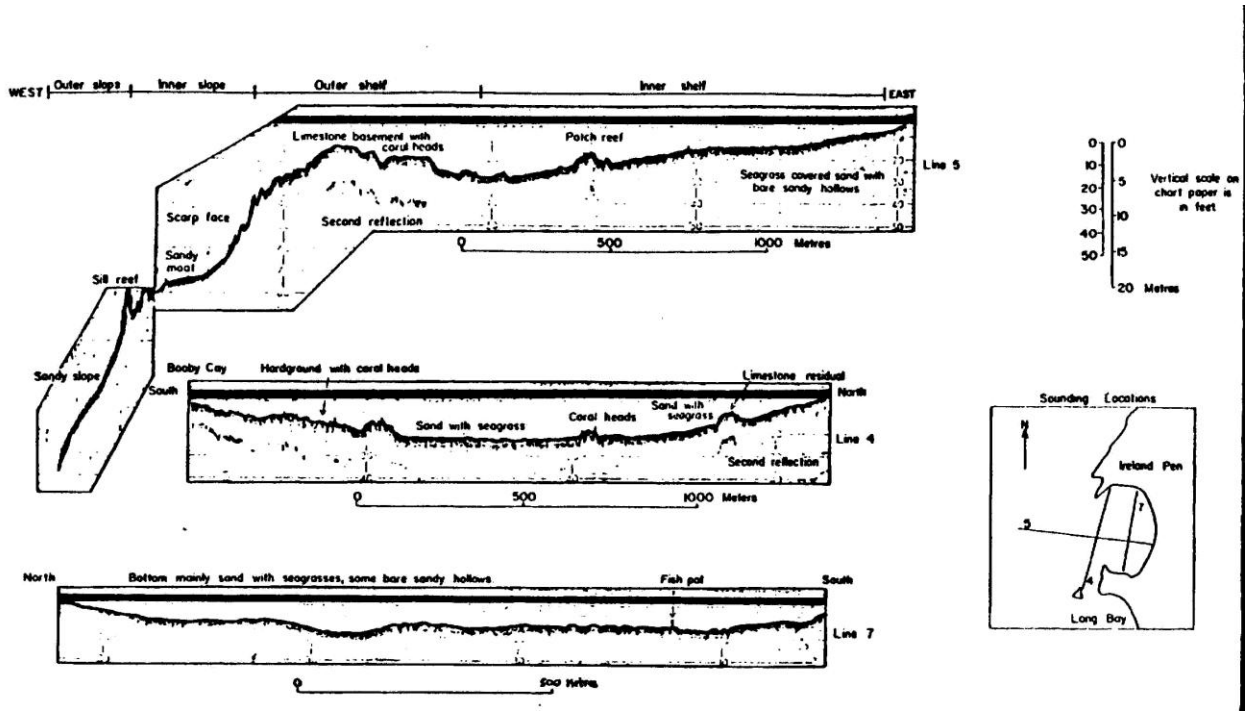


Figure 4.4: Vertical (cross-shore) Profile depicting bathymetric features and changes (adapted from Hendry,1982)

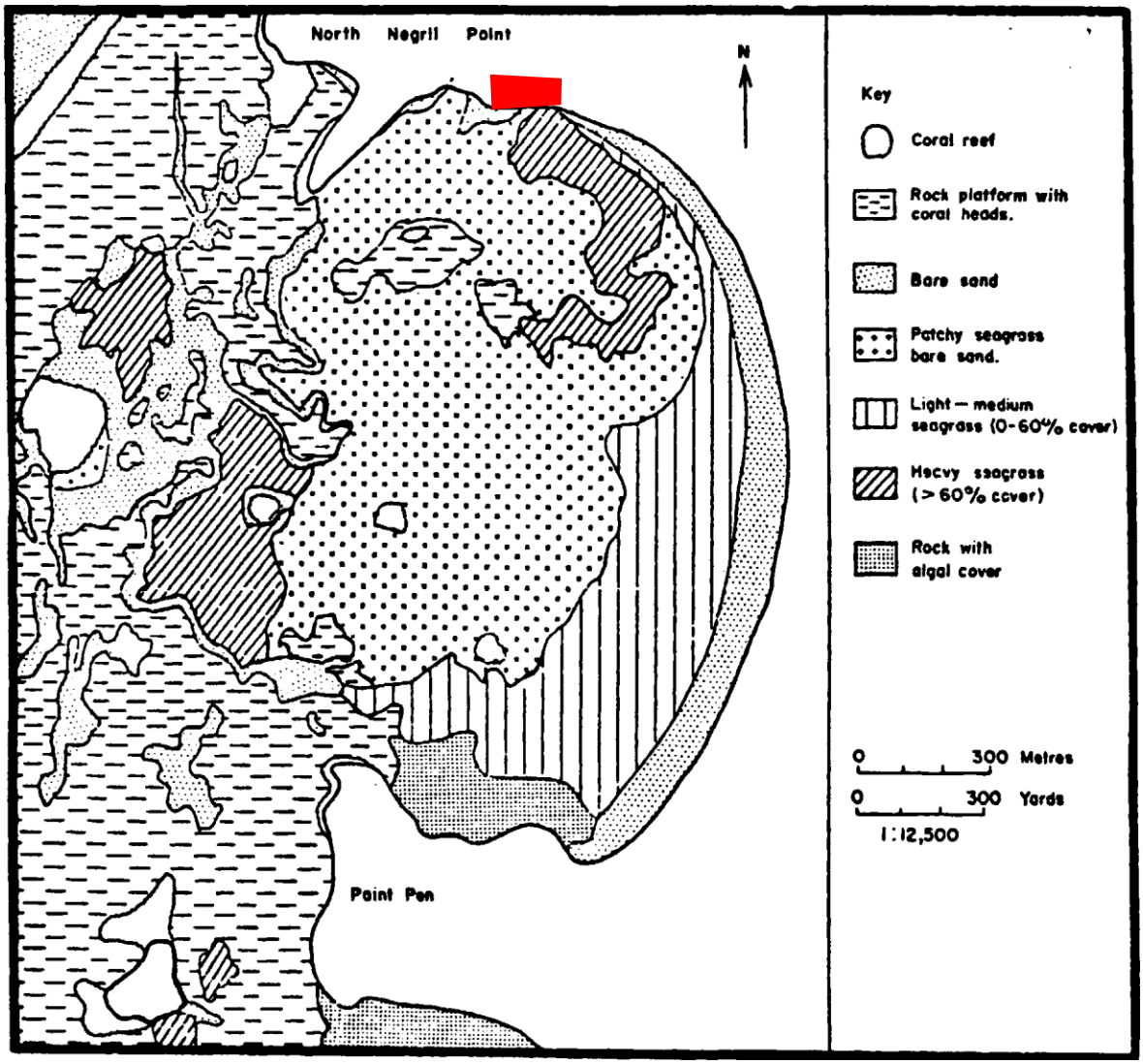


Figure 4.5 : Shows the vegetation, benthic-type distribution within Bloody Bay and proposed site

Overall, DHV International Limited (1999) observed a combined total of 37 different species of fish and 20 different species of stony coral. Their findings indicate that there were no significant changes to the broad physical features, or marine ecology, within Bloody Bay reported and detailed by Hendry (1982) and shown in Figure 4.5.

In summary, DHV International Limited (1999) reported that the coral reefs, offshore of Bloody Bay, were moderately healthy and support an abundant and diverse benthic invertebrate community of stony corals, soft corals, sea fans, sponges, echinoderms and anemones. However, the reef systems themselves were showing signs of stress due to poor/deteriorating offshore marine water quality and heavy use by dive operators.

DHV International Limited (1999) further report that the observed fish populations were also diverse, but low in abundance attributable to pressure from over-fishing.

During the boat patrolling (bathymetry) survey of the current EIA, no significant changes were observed in the overall extent of the benthic communities shown in Figure 4.5 and mapped by Hendry (1982) and DHV International Limited (1999). As reported by DHV International Limited (1999), Bloody Bay was found to be characterised by extensive beds of seagrass, interspersed with patches of sand. The dominant form of seagrass was turtle grass (*Thalassia testudinum*), with manatee grass (*Syringodium filiforme*) being found interspersed throughout. Boat patrolling during the present EIA revealed a mosaic of seagrass communities, intermixed with sand patches. A few coral heads were noted along the rocky coastlines of Rutlands Point and North Negril Point.

Finally, specific to the present EIA, the seagrass beds immediately offshore of the project site, along with the fringing coral reef ecosystem of Little Bloody Bay (both of which lie within the proposed fish sanctuary and were not surveyed in detail by DHV) were surveyed and photographed during consecutive SCUBA dives and snorkelling exercises, conducted on

September 14 and 15, 2001. These two areas are characteristic representatives of the present-day conditions and main ecosystems found within the proposed fish sanctuary. They would also, in turn, be the primary marine and established coral reef ecosystems to be negatively impacted by deteriorating water quality associated with poor wastewater disposal practices at the proposed site and declining ground and marine water quality within the northern sections of Bloody Bay. A detailed account and discussion of the findings of the surveys of these two areas is discussed in the following two subsections. In summary, comparison with the DHV survey, a combined total of 24 different species of fish and 10 different species of stony coral were observed during the present survey (i.e. offshore of the project site and at Little Bloody Bay). Of the 37 different species of fish and 20 different species of stony coral observed by DHV International Limited in 1999, 18 fish and 5 stony coral species were observed during the present survey.

4.3.3 The Seagrass Environment Immediately Offshore of the Proposed Site (and Within the Fish Sanctuary)

The benthos immediately offshore of the proposed RIU hotel site was comprised of coralline sediment which supports a moderately thick *Thalassia testudinum* community of 70% - 80% ground coverage. Average water depths, within this region, are generally less than 2 m.

The *T. testudinum* (turtle grass) beds become fairly extensive, with 100% bottom coverage, approximately 20 m immediately offshore. Associated with the seagrass beds are echinoderms such as *Diadema antillarum* (Plate 4.1), *Tripneustes ventricosus* and *Oreaster reticulatus*, along with holothurians and calcareous algae such as *Halimeda monile* and *Amphiroa sp*. Manatee grass (*Syringodium filiforme*) was observed interspersed throughout the turtle grass bed community and *Halodule wrightii* seagrass beds were observed close to shoreline in the northern and northeastern sections of Bloody Bay.

Plate 4.1: ***Photo of*** **Diadema antillarum**

Algal species observed during the snorkel surveys are listed in Table 4.6 and exhaustive lists of the observed coral, fish and invertebrate species are presented within Appendix 9.

Table 4.6 Marine algal species observed within the seagrass/coral bed community of the fish sanctuary, immediately offshore of the proposed RIU hotel site.

	Classification		
	Green Algae (*Chlorophyta*)	Brown Algae (*Phaeophyta*)	Red Algae (*Rhodophyta*)
Species	*Chaetomorpha linum**	-	*Amphiroa sp.*
	*Dictyosphaeria cavernosa**		
	Codium isthmocladum		
	Avrainvillea nigricans		
	Penicillus pyriformis		
	Halimeda monile		

*Species marked by * are high nutrient indicating species.*
*Species marked by ** are reef building, red encrusting algal species.*

Two high nutrient indicating algal species (i.e. *Chaetomorpha linum* and *Dictyosphaeria cavernosa*) were observed during the survey, suggesting that there are already eutrophic waters within the fish sanctuary and offshore of the proposed RIU hotel site. Water clarity within this section of Bloody Bay, however, was exceptionally good (i.e. horizontal visibility was approximately 30 - 40 m).

Observed fish species were diverse and abundant, however, mainly concentrated around patches of coral heads found east of Pelican Cay and interspersed throughout the seagrass beds (see Appendix 9). Observed coral species were primarily the Starlet Corals (*Siderastrea radians* and *Siderastrea siderea*). The Rock-boring Urchin (*Echinometra lucunter*) was also observed within these coral head communities, breaking down coral rubble.

A single Moon Jelly (*Aurelia aurita*) was photographed in the surface waters above the T. *testudinum* beds (Plate 4.2). This species is mildly toxic to humans and can sting bare sensitive skin causing a slight itchy rash. Similarly mildly toxic species, also observed with the *T. testudinum* beds, include the Upsidedown Jelly (*Cassiopea frondosa*) and the fire worm *Hermodice carunculata*. Blade Fire Coral (*Millepora complanata*) was observed in conjunction with the coral head communities scattered throughout the seagrass bed east of Pelican Cay. This species produces minor rashes/welts upon contact with bare skin.

Plate 4.2: ***A Moon Jelly (*****Aurelia aurita*****)***

A shallow protective fringing reef (with a back reef lagoon) is located west of the proposed RIU hotel site (within the proposed fish sanctuary), at the mouth of Little Bloody Bay. This fringing reef the closest defined coral reef to the project site and would probably be the first established reef ecosystem to be negatively impacted by deteriorating water quality associated with poor wastewater practices at the site and declining ground and marine water quality within the northern sections of Bloody Bay.

The fringing reef is approximately 400 m long with maximum water depths of 8 m, 1 m and 3 m (respectively) on the fore reef, the reef crest and within the back reef lagoon. Overall, substrate composition on the reef and within its back reef lagoon is summarised within Table 4.7, and algal species observed during the SCUBA surveys are listed in Table 4.8.

Table 4.7 Summary of substrate composition, on the Little Bloody Bay fringing reef and within its corresponding back reef lagoon.

Substrate Type*	% Composition	
	Fringing Reef	Back Reef Lagoon
SEAGRASS	0	70
ALGAE	20	5
CORAL (LIVING)	20	0
MACRO FAUNA	3	0
SPONGE	7	0
BASE SUBSTRATE	50	25

SUBSTRATE TYPE CODE:

SEAGRASS	-	'r' species or climax communities
ALGAE	-	turf or macrophytic
CORAL	-	branching, boulder or encrusting
MACRO FAUNA	-	other cnidarians; e.g. gorgonians, anemones or zoanthids
SPONGE	-	fleshy, boring or encrusting
BASE SUBSTRATE	-	bare rock, rubble, sand or mud

Table 4.8 Marine algal species observed on the Little Bloody Bay fringing reef.

	Classification		
	Green Algae (*Chlorophyta*)	Brown Algae (*Phaeophyta*)	Red Algae (*Rhodophyta*)
Species	*Cladophora prolifera* *Caulerpa sertularioides* *Caulerpa serrulata* *Caulerpa cupressoides* *Ventricaria ventricosa* *Cladocephalus luteofuscus* *Penicillus dumetosus* *Halimeda tuna* *Halimeda opuntia*	*Dictyota linearis* *Sargassum hystrix*	*Gracilaria tikvahiae*

*Species marked by * are high nutrient indicating species.*
*Species marked by ** are reef building, red encrusting algal species*.

No high nutrient indicating algal species were observed on the Little Bloody Bay fringing reef or within the back reef lagoon; however, the observed genus *Caulerpa* is considered to be a low to moderate nutrient indicator species, by some authors. Three different species of *Caulerpa* were observed during the surveys.

Exhaustive lists of the coral, fish and invertebrate species, observed on the fore reef and within the back reef lagoon, are presented in Appendix 10. Massive Starlet Coral (*Siderastrea siderea*) and Symmetrical Brain Coral (*Diplora strigosa*) were the dominant stony coral species in the fore reef environment (Plates 4.3 and 4.4); whilst colonies of Blade Fire Coral (*Millepora complanata*), Sea Plumes (*Pseudopterogorgia sp*.) and Slit-pore Sea Rods (*Plexaurella sp*.) were the frequent and dominant soft coral species on the reef (Plates 4.5 and 4.6). Turf and macrophytic algae accounted for 20% of the substrate cover and was dominantly interspersed in and around coral heads and the observed living and dead coral colonies and rubble (Plate 4.7).

Plate 4.3: ***Massive Starlet Coral (*****Siderastrea siderea*****)***

Plate 4.4: ***Symmetrical Brain Coral (*****Diplora strigosa*****)***

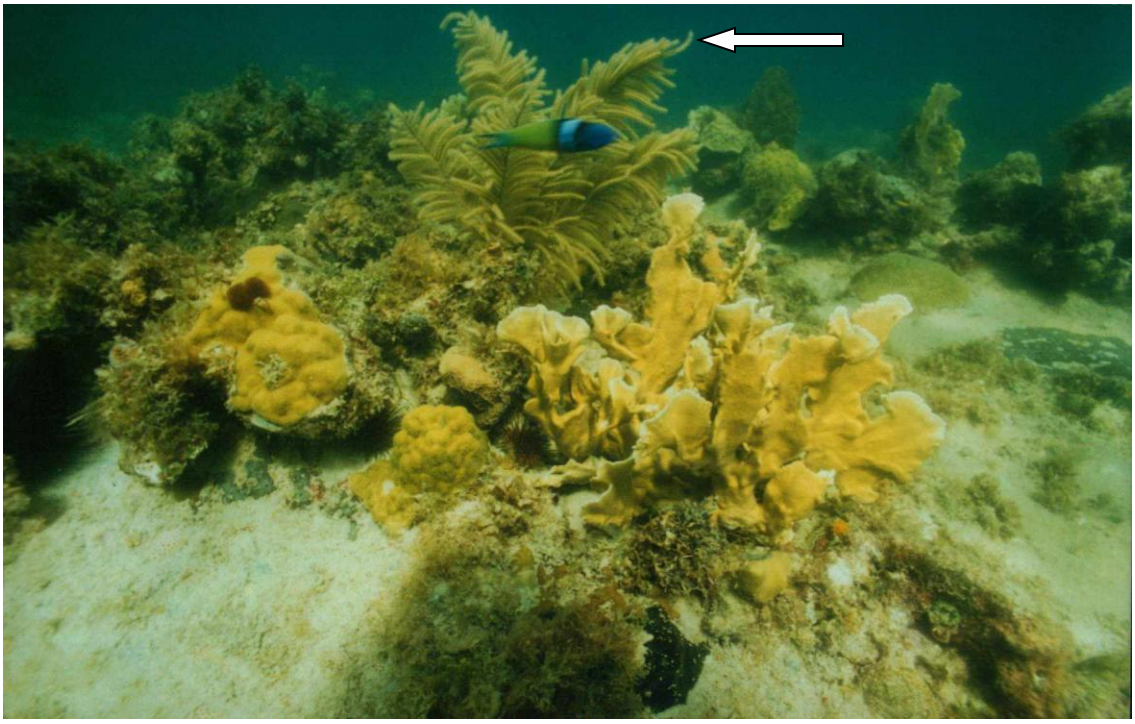


Plate 4.5: ***Photo showing Sea Plumes (*****Pseudopterogorgia sp.*****)***

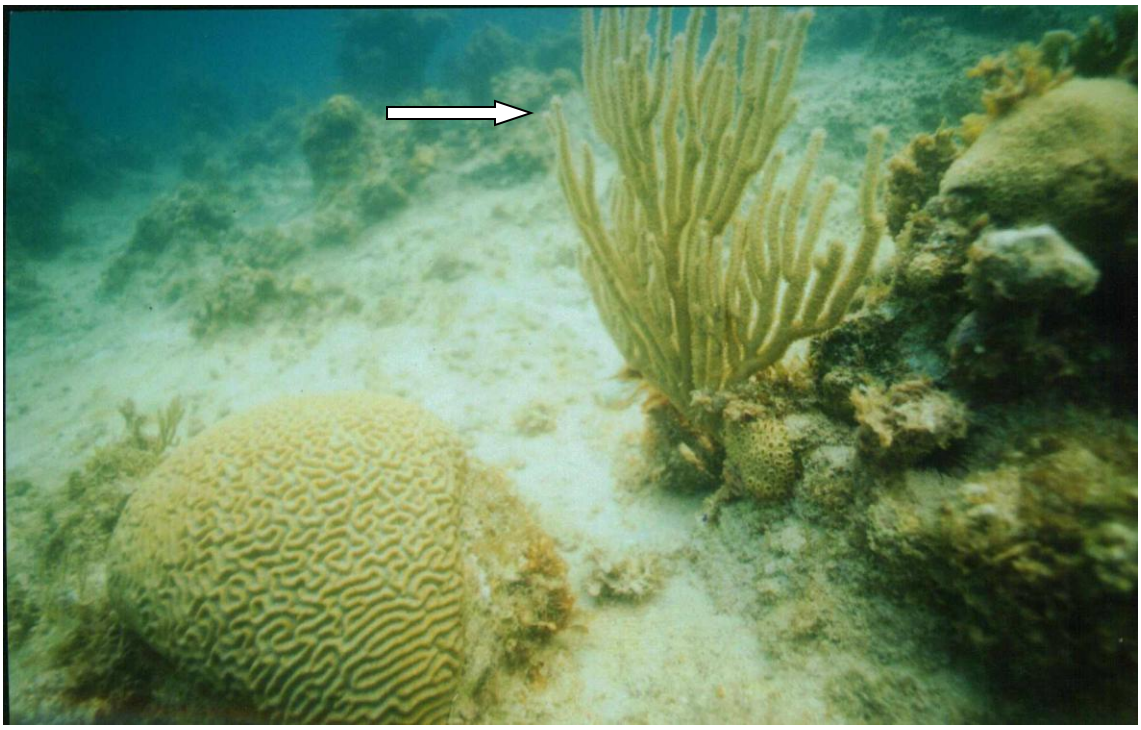


Plate 4.6: ***Photo showing Slit-pore Sea Rods (*****Plexaurella sp.)**

Plate 4.7: ***Photo showing turf macrophytic algae interspersed between coral heads***

Staghorn coral (*Acropora cervicornis*) and living Elkhorn coral (*Acropora palmata*) were conspicuously absent, although dead coral skeletons of Elkhorn coral (*A. palmata*) were observed and photographed on what may be described as the reef crest of the reef (Plate 4.8).

No sea turtles or sea lobsters were observed during the surveys, however, a Yellow Stingray (*Urolophus jamaicensis*) was seen and photographed on both dives (Plate 4.9).

With regards to the back reef lagoon, the latter was approximately 100 m wide (from the shoreline to the reef crest) and protected from high wave energy by a partial reef crest. T. testudinum dominated seagrass cover within this lagoon and accounted for 60 - 70 % of benthic cover. Bare coralline sand, dead coral colonies, coral rubble and algae accounted for the remaining 30 - 40 % of ground coverage.

Plate 4.8: Photo showing dead coral skeletons of Elkhorn coral (*A. palmata*)on reef crest

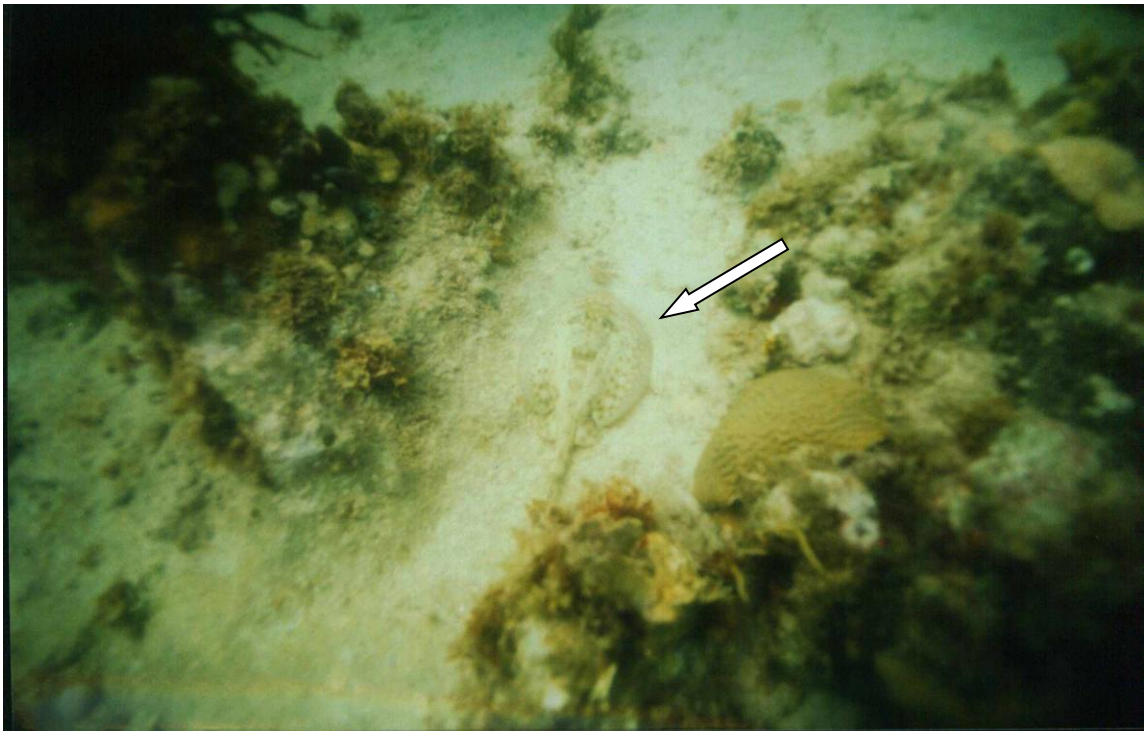


Plate 4.9: A Yellow Stingray (*Urolophus jamaicensis*)

4.4 Bathymetry

Background Data

A search for existing bathymetric data for the Negril revealed that there is only one very course 1:325,000 British Admiralty chart for the area.

A very detailed topographic drawing of the proposed site area was available from the developer. The topographic drawing was contoured to a 0.25 m interval. Trees with preliminary identification were also represented.

A 1:50,000 scanned and geo-referenced topographic map of the region was also available in the Jamaica Grid System

A vertical coloured photograph of the area was also available from NEPA.

In summary, no detailed bathymetric chart existed for the area. However, there was sufficient detailed shoreline and background photograph data to allow for the preparation of a bathymetric chart after fieldwork.

Data Collection and Chart Preparation

A bathymetric survey was conducted on September 8, 2001, between the hours of 10:30 am to 2:00 pm local time. The data collection exercise involved traversing the near shore (between the shoreline and 5m) and collecting simultaneous GPS and depth sounder data using a GARMIN 168 Map Sounder.

The data was reduced from the instrument and error checked for spurious low depth readings. The data was then transformed to the Jamaica Meter Grid system (projection) and Clarke 1884 (Ellipsoid) from UTM coordinates system and WGS84 Ellipsoid. The bathymetric data was then supplemented with topographic data to allow for a reasonable shoreline representation. The data was then put in a grid using a Linear Triangulation algorithm and surface contoured.

A background image consisting of the site layout, topographic map and aerial photograph was prepared. This involved geo-referencing the images using the north-eastern corner of the site as a reference (N=108807.896, E=189433.1538), in an AutoCAD© environment. The photograph was scaled and oriented by measuring the distance between similar objects in both the 1:50,000 topographic map and the photograph. See figures 4.6 and 4.7

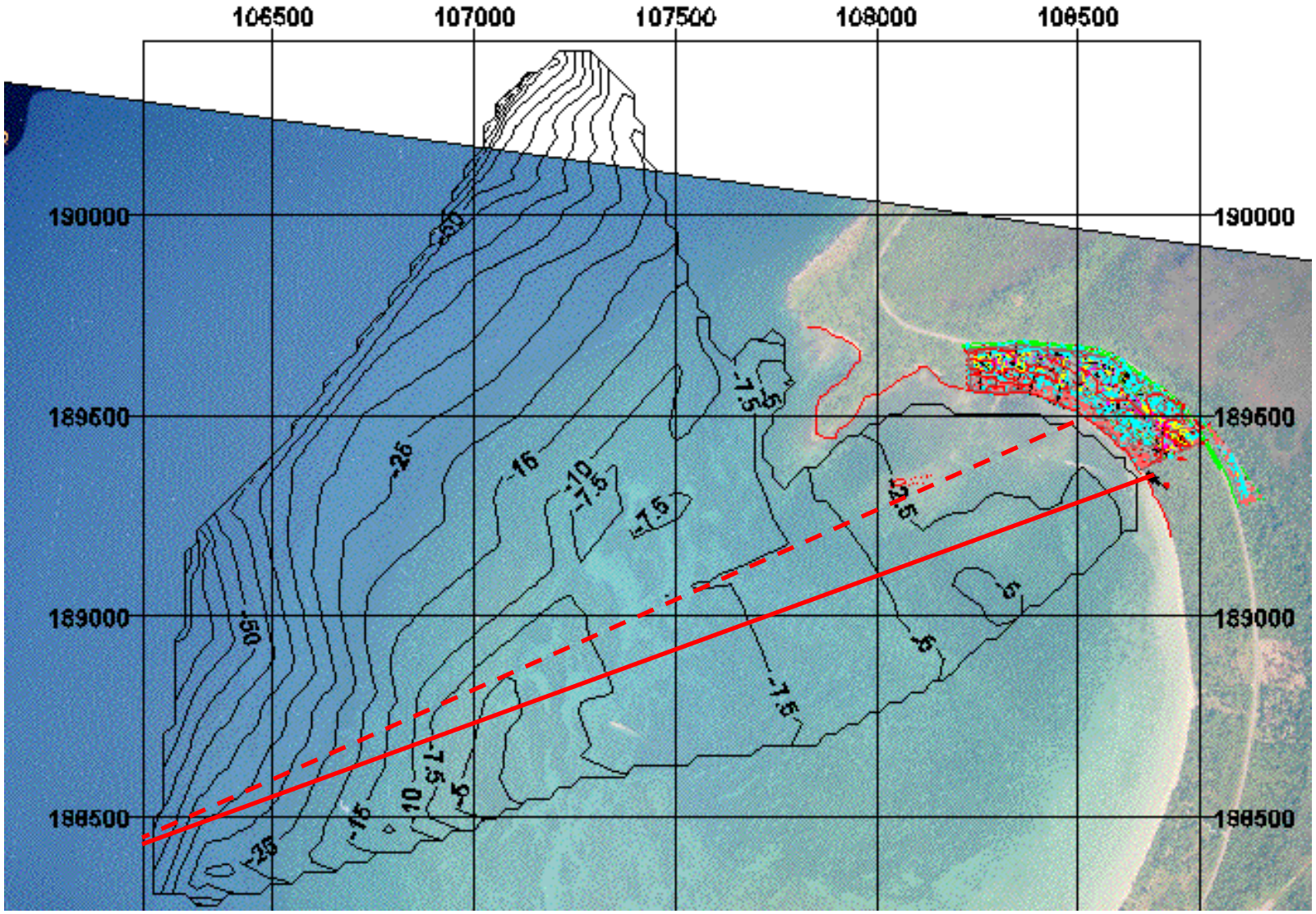


Figure 4.6 - Bathymetric chart of part Bloody Bay, showing RIU -II site and alignment of profiles for middle of site (Red dashed line) and southern end of site (red solid line)

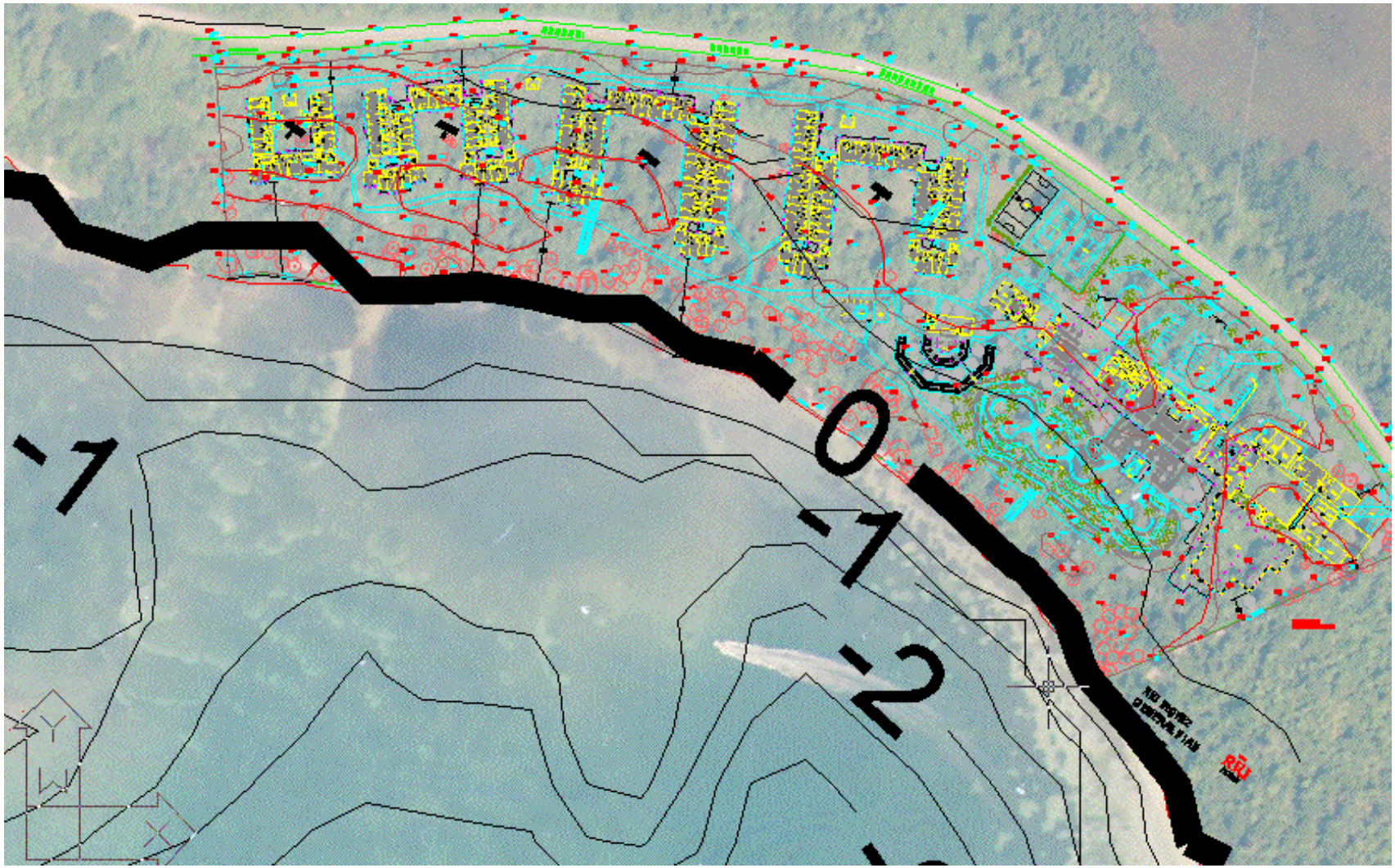


Figure 4.7 - Nearshore bathymetry showing sit layout and contours

4.4.1 Shoreline Sediment

Data Collection

Three sediment samples were collected on the beach face along the proposed site's shoreline. The sediments were dried in an oven and sieved from the 1 mm to the 0.125 mm opening size. The balance was collected in a pan below the rack of sieves.

Grain Size Characterization

Data from the laboratory sieve analysis was analysed to determine the median grain size. The results are summarized in Table 4.9 and shown in Figure 4.8. The results indicate that the sample to the southern end of the site, which is also more exposed to wave action, is some 50% coarser than the sediment samples in the centre of the beach and on the northern end. It must also be noted that the median grain size of 0.42 mm on the eastern end of the beach could reasonably be defined as medium grain sand. Where as the other sediment samples could be referred to as fine grain sand samples.

Table 4.9 - Results of sediment grain size analysis

	BB1 (North)	**BB2 (Centre)**	**BB3 (South)**
Size (mm)	**% Finer**	**% Finer**	**% Finer**
1	98.00	87.98	82.85
0.5	95.26	74.02	64.00
0.355	89.50	68.41	39.30
0.25	69.61	61.58	13.25
0.18	39.02	49.69	3.66
0.125	13.09	16.70	1.30
0	0.01	0.01	0.01
Median	**0.21**	**0.18**	**0.42**

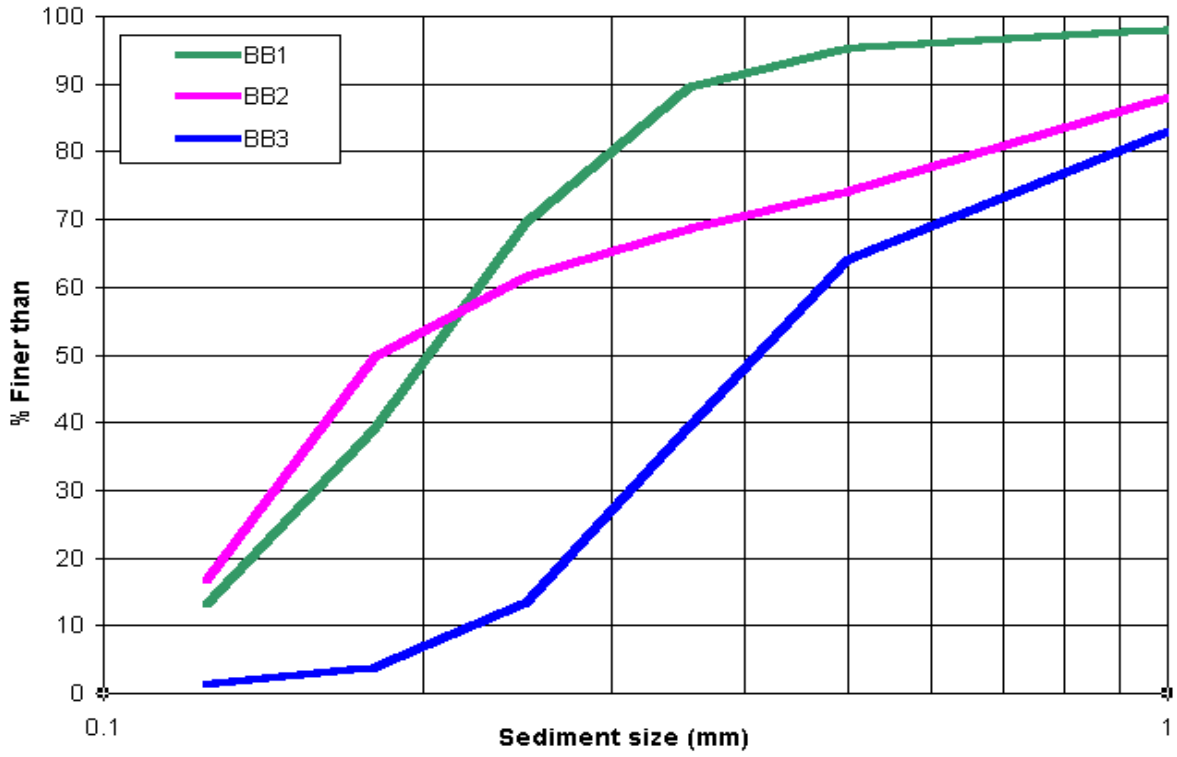


Figure 4.8 - Grain size analysis for proposed hotel shoreline sediment samples

4.4.2 Hurricane Environment

The Caribbean is exposed to yearly occurrences of tropical storms and hurricanes, which often generate waves that have damaging impacts on coastal areas. The coastlines of Jamaica have not been excluded from these occurrences and we must therefore study the probable hurricane conditions at the site. This was done by carrying out a hindcast analysis.

Hurricane Occurrences in relation to Negril

Given the high frequency of hurricane activity and the availability of hurricane data in the Caribbean Sea, we were able to carry out a thorough statistical analysis to determine the hurricane wind and wave conditions at a deep-water location for the site. A database of hurricanes, dating back to 1886, was searched for storms that passed within a 300km radius from the site. Table 4.10 shows the list of storms.

Table 4.10 - Results of search for hurricanes that came within 300km of Negril in the last 100 years

1	ALLEN.'80	**11**	JANET.'55	**21**	NUMBER18.'33	**31**	NUMBER4.'05	**41**	NUMBER8.'06
2	BEULAH.'67	**12**	KATRINA.'81	**22**	NUMBER19.'33	**32**	NUMBER4.'15	**42**	NUMBER9.'09
3	CARMEN.'74	**13**	KING.'50	**23**	NUMBER2.'03	**33**	NUMBER4.'16		
4	CHARLIE.'51	**14**	Lenny.'99	**24**	NUMBER2.'10	**34**	NUMBER4.'35		
5	CLEO.'64	**15**	Mitch.'98	**25**	NUMBER2.'15	**35**	NUMBER4.'44		
6	ELLA.'58	**16**	NUMBER10.'32	**26**	NUMBER2.'33	**36**	NUMBER5.'09		
7	FIFI.'74	**17**	NUMBER11.'44	**27**	NUMBER2.'38	**37**	NUMBER5.'15		
8	FLORA.'63	**18**	NUMBER11.'45	**28**	NUMBER2.'42	**38**	NUMBER5.'39		
9	GILBERT.'88	**19**	NUMBER13.'16	**29**	NUMBER3.'17	**39**	NUMBER6.'12		
10	HILDA.'55	**20**	NUMBER15.'33	**30**	NUMBER3.'38	**40**	NUMBER6.'16		

Wave Hindcasting and Extremal Analysis

The hurricane track records in the database gives the tracked points, maximum wind speed, radius to maximum winds and central pressure of the hurricane at 6 hour intervals. For this analysis, each track was further segmented into 2-hour intervals to get a better representation of a hurricane's effect while in proximity to the project area.

A parametric hurricane model was then used to develop a database of hurricane wind and wave heights at each point along each track. The model used was Cooper (1988), which estimates the wind speed from a parametric representation of a hurricane wind field. The parametric form is given as a function of the hurricane's central pressure, forward speed, maximum sustained wind speed and radius to this maximum wind speed. The model then approximates the wave height from the wind speed.

Following this, an Extremal statistical analysis was carried out on the wave heights. The waves were grouped in descending order and fitted to several Extremal distributions. The best fitting distribution was selected and the return values computed for several periods. Figure 4.9 shows the best-fit plot for the wave heights. This was the Weibull distribution with a shape factor of 1.4. The correlation with the data is 0.972.

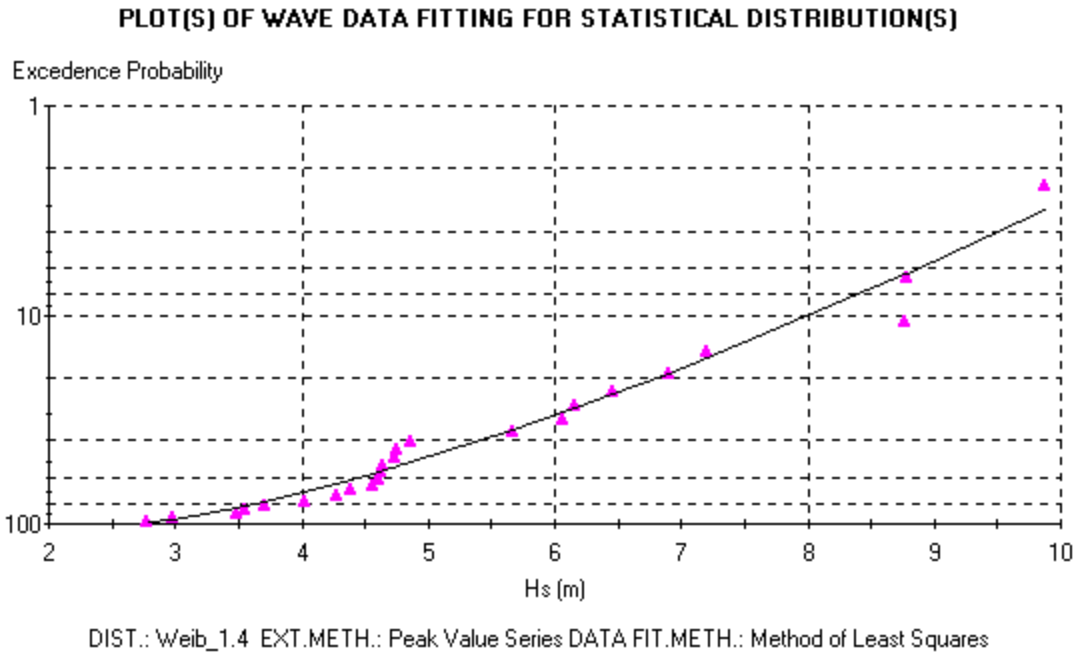


Figure 4.9 - Extremal Analysis for the wave hindcast results for Deep water offshore Negril

Table 4.11 below shows the results for several return periods. The equivalent wave periods were derived by assuming a 1/25 wave steepness for hurricane waves and the equivalent wind speeds were computed by using the model of Cooper (1988).

Table 4.11 - Extremal Analysis results FOR deep-water Wave heights

Return Period, Rp (yr)	Significant Wave Height, Hs (m)	Return Wave Period, Tp (s)	Return Local Wind Speed, V (m/s)
5	6.4	10.1	25.6
10	7.7	11.1	30.8
25	9.2	12.1	36.8
50	10.2	12.8	40.8
100	11.2	13.4	44.0

Phenomena Considered for Storm Surge

Hurricanes often cause inundation in coastal areas. This inundation is referred to as a storm surge which is simply the increase in sea level during a storm. This increase in water level is caused by several components. These include:

1. Inverse barometric pressure rise, which is due to the low-pressure system surrounding a hurricane.
2. Wind setup caused by the high winds associated with hurricanes
3. Wave setup caused from breaking of the hurricane generated waves.

These are the three main components will be analyzed here in order to compute the potential for flooding during a storm. However, sea level change over a long-term period is also due to global sea level rise (GSLR). Short-term (<6 hours) changes also occur due to tides. Researchers have predicted a 0.125 increase in global sea level for the next 100 years for GSLR for the Caribbean. The tidal range is approximately 0.4m. As such, we will add a further (0.125+0.2=) 0.325m to represent the effects of global sea level rise and high tide.

Given these potential increases, we then computed the increase in sea water level by the Inverse Barometric Pressure Rise (IBR). The IBR caused by each hurricane in the database was computed. This was done with the following model:

$IBR = 0.01(Pn - Pc)(1 - e^{\frac{-R\max}{r}})$; where r is the storm distance from the site, Rmax is the radius to maximum winds, Pn (in mbars) is the ambient pressure and Pc (in mbars) is the central pressure. A statistical analysis was then conducted on these values and the return values derived.

One profile to the east end of the site was investigated as far as storm surge was concerned. See figure 4.6.

A one-dimensional non-linear model to compute the total storm surge. This model is called SBEACH (Storm-induced BEAch CHange) and it simulates cross-shore beach, berm, and dune

erosion produced by storm waves and water levels. The input parameters were the wave conditions, sediment sizes and the increase in water level due to IBR. Each hurricane return period event was investigated by running approximately 10 hours of hurricane waves.

Storm Surge Results

Storm surge predictions from SBEACH were extracted and plotted for the 10, 25, 50 and 100-year events. In addition to storm surge, the wave heights at the shoreline were also computed. These results are summarized in Table 4.12 and Figure 4.10. The results indicate that the storm surge for the 10 to 100 Year Return Period Event can be expected to range from 2.59 to 3.56 m above Mean Sea Level. These levels will inundate the site, given the existing topographic information.

Table 4.12 - Storm Surge Analysis Results for RIU-II

Return Period	**Storm Surge (m)**	***GSL+ Tides (m)***	**Total Design Surge (m)**	**Wave Height at shoreline (m)**
10	2.26	0.325	**2.59**	**0.93**
25	2.83	0.325	**3.15**	**1.25**
50	3.23	0.325	**3.55**	**1.50**
100	3.23	0.325	**3.56**	**1.56**

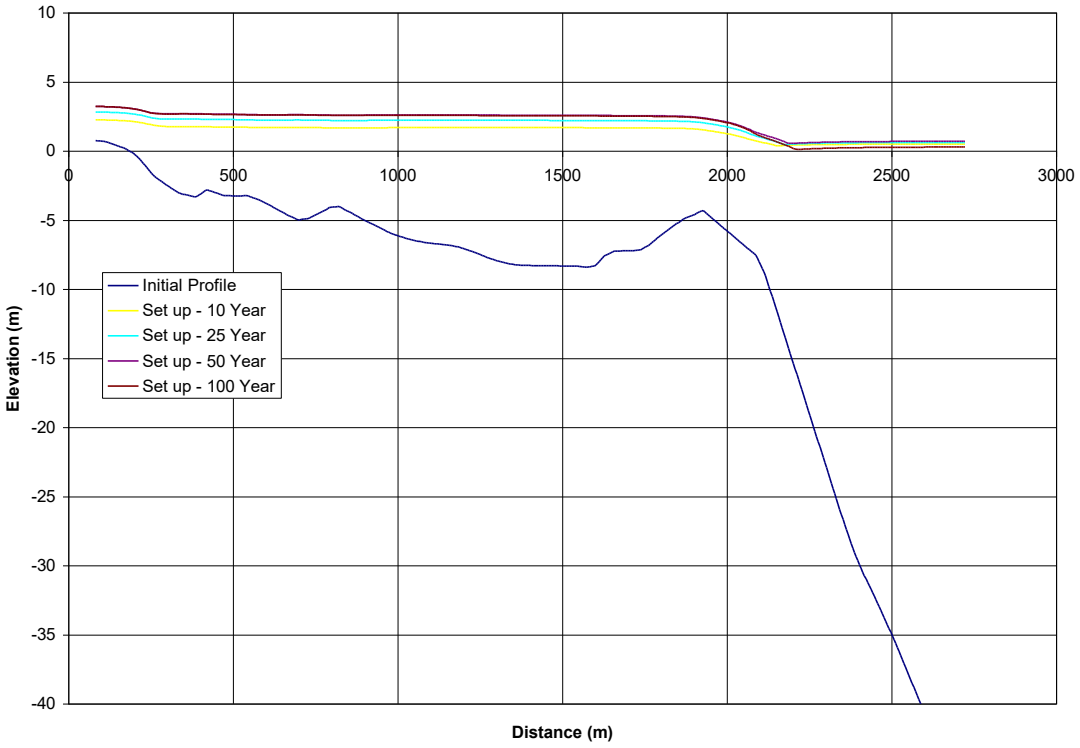


Figure 4.10 - Storm Surge Results for RIU-II

Storm Event Erosion Analysis Methodology

Two profiles were initially investigated as shown in Figure 4.6. Detailed analysis for the middle profile was not conducted. Initial investigations revealed that regardless of the relatively fine sand that was present at this location, the beach was stable due to the presence of the submerged and emergent reef structure. This structure provides a critical sheltering effect for portion of the shoreline between the middle of the site and the western end of the site.

Detailed analysis of the southern portion of the site involved using the sand size determined from the sieve analysis (0.18 to 0.42 mm). The main sediment transport parameters in the SBEACH model: Transport rate coefficient, (ranging from 2.5e-07 to 2.5e-06) K; and Coefficient for slope-dependent term, Eps (ranging from 0.001 to 0.005) are calibration parameters for the sediment transport calculations. Larger K values produce greater sand transport and more prominent bar features, and larger values of Eps produce a more subdued bar. The entire range for these

parameters was investigated. Hence, two scenarios were investigated. These were a low transport regime and high transport regime scenario.

Ideally, the model results should be calibrated with anecdotal and measurements of erosion after significant storm events. Checks with NEPA (Mr. Ainsley Henry) and the Negril Coral Reef Protection Society (Mr. Carl Hansen) revealed that there was very limited anecdotal information in the Bloody Bay area. This is more than likely due to the limited development, until lately (<10 years) in this area and hence limited presence or interest of observers after storm events.

The strategy adopted for the estimation of storm event erosion was to investigate the range that was likely for this stretch of shoreline after storm events. Thus, parameters values that gave the highest likely transport (such as smallest particle size and lowest K and Eps values) as well as parameters that gave the lowest likely transport were investigated.

Erosion Analysis Results

The results for the 10, 25, 50 and 100-year event final profile were extracted from the model. The change in distance between the initial shoreline and final was determined. These results are summarized for the Low and High Transport regime in Table 4.13.

The analysis essentially indicates that the southern shoreline could be prone to 25 m of horizontal erosion of the shoreline after extreme storm events. This preliminary results must however, be tempered by the fact that there was no anecdotal information with which to verify the predictions.

Table 4.13 - Erosion Analysis Results for the Proposed Hotel Site

Return Period	Maximum Horizon Erosion of SWL (m)	Minimum Horizon Erosion of SWL (m)
10	**20**	**~0.0**
25	**25**	**~0.0**
50	**25**	**~0.0**
100	**25**	**~0.0**

4.5 Water Quality

4.5.1 Methodology

Physical and biological data were collected from seven (7) stations within the study area on one occasion. Data for twelve parameters were collected. Of these twelve, seven were done *in situ* using a Hydrolab H_2O datalogger. The parameters that were measured *in situ* were; temperature, salinity, dissolved oxygen, pH, photosynthetically active radiation (PAR), total dissolved solids and nitrates.

Chlorophyll a, biochemical oxygen demand, phosphates, faecal and total coliform were obtained from water samples that were stored on ice and transported to the laboratory at the University of the West Indies.

4.5.2 Results

Coastal water quality is important in island states. Jamaica is no exception. Being dependent on tourism demands that coastal water quality be of a high standard. Water quality monitoring was conducted at seven stations within Bloody Bay. Data for twelve parameters were collected. The results of which are outlined in Tables 4.14 and 4.15

Water quality samples were taken at seven stations within Bloody Bay (see Figure 4.11).

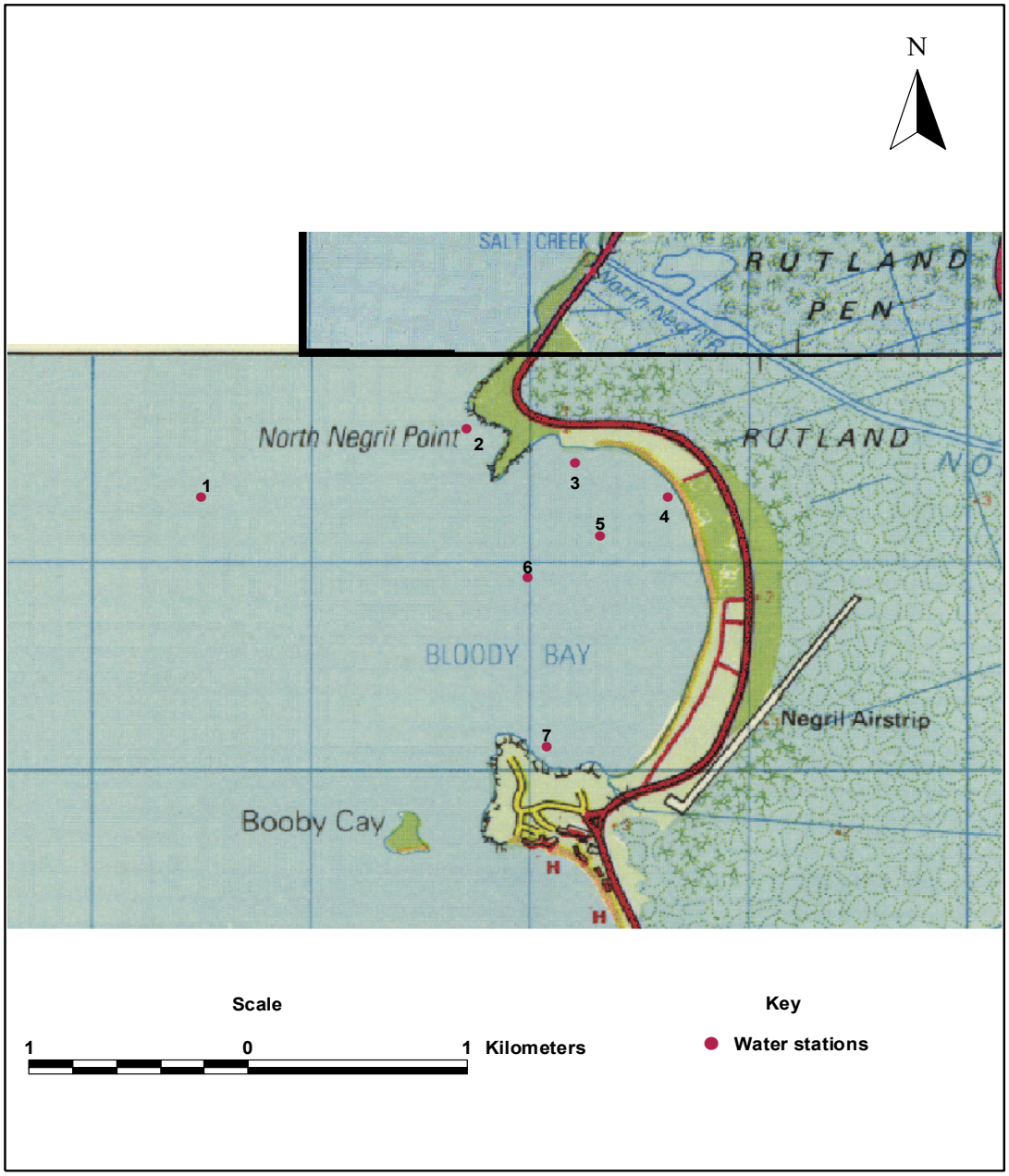


Figure 4.11 Map Showing Water Quality Stations

Table 4.14 Physical and Chemical Parameters

STN #	TEMP (°C)	SAL (‰)	DO (mg/l)	pH	PAR (µE/m^2 /s)	TDS (mg/l)	NO_3 (µmol/l)	PO_4 (µmol/l)
1	30.3	37.5	5.93	7.64	301	36	0.32	0
2	30.47	37.45	5.31	7.25	1813	36.03	49.35	0.06
3	30.96	37.35	5.67	7.54	450	35.92	24.52	0
4	31.5	37.38	7.38	7.63	320	35.91	1.77	0.6
5	31.88	37.13	6.41	7.6	504	35.73	42.23	0.14
6	30.89	37.62	6.77	7.19	2285	36.25	28.87	0.74
7	30.95	37.55	6.17	7.49	335	36.01	38.06	0.3

KEY:

TEMP = Temperature (°C)
SAL = Salinity
DO = Dissolved Oxygen
PAR = Photosynthetically Active Radiation
TDS = Total Dissolved Solids
NO_3 = Nitrates
PO_4 = Phosphates

Table 4.15 Biological parameters

STN #	CHL a (mg/m^3)	BOD_5 (mg/l)	F. COLI (MPN/100 ml)	TOT. COLI (MPN100 ml)
1	0.24	1.66	<2	70
2	0.29	2.29	20	500
3	0.27	3.43	20	220
4	0.51	0	40	170
5	0.46	0.86	20	110
6	0.36	6	80	500
7	0.46	0.86	80	230

KEY:

CHL a = Total Chlorophyll a
BOD = Biochemical Oxygen Demand
F. COLI = Faecal Coliform
TOT. COLI = Total Coliform

The interpretation of the data must be cognizant of the fact that the parameters were collected after a period of rain. Therefore, the results obtained may reflect values that are elevated when compared to what occurs normally.

Temperature, salinity, dissolved oxygen, pH, photosynthetically active radiation (PAR) and total dissolved solids were within the expected range of marine water. However, pH showed some evidence of fresh water influence as normal marine water pH is of the order of eight (8).

Nitrate and phosphate concentrations at the seven stations ranged from (0.23-42.23 $\mu mol\ l^{-1}$) and (0-0.74 $\mu mol\ l^{-1}$) respectively. Lapointe (1997) and Bell (1992) both suggested that critical nutrient levels (nitrates and phosphates) are 1 $\mu mol\ l^{-1}$ and 0.1 $\mu mol\ l^{-1}$ respectively. Raymont (1980) suggested that low nutrients were (0.2 -1.75 $\mu mol\ l^{-1}$ nitrates) and 0.07-0.24 $\mu mol\ l^{-1}$ respectively. Ambient marine water quality standards for nitrates and phosphates are 1.3$\mu mol\ l^{-1}$ and 0.005 $\mu mol\ l^{-1}$ respectively.

As expected, nutrient levels within Bloody Bay were higher than ambient marine water quality standards. Nitrate concentrations were elevated at all stations except station 1. Phosphate concentrations were elevated at stations 4, 6 and 7. Hoegh-Gulbers *et al* (1997) said that coral calcification and growth inhibition occurred when nitrogen concentration is 15$\mu mol\ l^{-1}$ and phosphorus concentration is 0.4 $\mu mol\ l^{-1}$. Only station 6 met that criterion.

Nitrates and phosphates are important to the growth of phytoplankton and together with chlorophyll *a* can be used to determine the state of the water quality within Bloody Bay. Elevated nutrients (nitrates and phosphates) give an indication of eutrophic or potential eutrophic waters. The status of a water body is further confirmed with the use of phytoplankton (chlorophyll *a*), with elevated values indicating nutrient enriched areas (eutrophic).

Phytoplankton are the best aquatic indicators of eutrophication and water quality assessment as they display a rapid response to immediate, short term and long term changes in aquatic systems (Webber, 1990). The value of phytoplankton being used as indicators of water quality is evidenced by the fact that a sharp increase in nutrients produces immediate phytoplankton increases, while rapid disappearance of nutrients only slowly reduces phytoplankton populations (Satsmadjis, 1985).

Total chlorophyll *a* concentration ranged from 0.24-0.51 mg/m^3 at the seven stations within the Bay. The southern section of the Bay had higher concentrations of Chl *a*, with stations 4, 5, 6 and 7 having the highest concentrations. Webber (1990) suggested that the low total chlorophyll *a* concentration ranged from 0.28 –1.03 mg/m^3. This suggests that the total chlorophyll *a* concentration within the Bay was low.

Biochemical oxygen demand (BOD) is indicative of the amount of organic matter present in the environment. Hence, it is indicative of inputs to the environment from sewage and other organic effluent. The BOD at the seven stations ranged from 0 –3.43 mg/l. The northern and western sections of the Bay (stations 1, 2 and 3) having the highest concentrations. Station 3 (3.43 mg/l) exhibited the highest concentration. Ambient marine water quality standard for BOD_5 range from 0.57 –1.16 mg/l. It is proposed that BOD concentrations for coastal waters should range between 0.7 - 1.7 mg/l. The northern and western sections of the bay shows some evidence of be influenced by organic effluent, quite possible from the North Negril River.

Faecal coliform levels were within the standard 100 MPN/100ml, however, elevated levels were observed towards the southern section of the Bay, specifically stations 6 and 7. The presence of faecal coliform can be used as an indicator of sewage contamination. Faecal coliform are found in the bowels of mammals. Total coliform include other bacteria and viruses with faecal coliform. With the exception of stations 1, 4 and 5 all other stations exceeded the 200 MPN/100ml standard.

General nutrient levels within the Bay were elevated, however, not to the limit to be considered eutrophic. Nitrate concentrations were higher than was observed in the previous environmental impact assessment (June 1999) and the Environmental Solutions Study (January 1996). Phosphate concentrations were lower than observed in the previous two studies.

The fact that total Chl *a* concentrations were low further supports the point that the Bay is not eutrophic. It is also important to note that the station with the second lowest nitrate

concentration had the highest Chl *a* concentration suggesting that the phytoplankton was utilizing the nitrogen. This station also had the second highest phosphate concentration.

It can be deduced from the data, that Bloody Bay is not totally pristine (oligotrophic). It is oligotrophic but has the tendency to become mesotrophic (moderately nutrient enriched). This is evidenced by the fact that results of coliform suggest that the southern section of the Bay is being influenced by sewage contamination and the Bay generally had elevated levels of bacteria and viruses. The elevated BOD concentration at the northern and western sections of the Bay suggests that the Bay also influenced being from inputs from the North Negril River. The Bay appears to be phosphate limited, therefore any development occurring there should ensure that in addition to not increasing the nitrate concentration within the Bay, special and concerted efforts must be made to prevent an increase in the phosphate loading to the Bay. If there were to be an increase in the phosphate loading then there would be the potential to increase the algal within the Bay.

The proposed development has the potential to have a negative impact on the water quality within the Bay.

4.6 Noise

4.6.1 Methodology

One off noise readings were taken at points within the proposed development area. The readings were taken in the morning (7-8 am) and in the afternoon (5-6 pm).

Noise level readings were taken by using a Quest 2700 Sound Level Meter. The noise meter was calibrated with a Quest QC - 10 sound calibrator. The meter was turned on and the response was set to slow, the weighting to A and the mode to SPL. The calibrator was turned on for approximately 10 seconds to allow it to stabilise. The decibel range (dB) was set at 60 - 120 and

the calibrator placed over the microphone. The meter was calibrated each time they were turned off.

The reading on the noise meter should be 114 dB. If not, adjustment of the calibration potentiometer was done as necessary. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone.

The meter was pointed in the direction of the noise source (towards the Norman Manley Boulevard) at approximately chest height and 0 - 40 degrees from the body. The dB range was set at the lowest level without the over the limit (OL) signal coming on. If the OL signal came up during a reading then the range level was increased. Records of the high and low dBA readings and the level at which it rests at most were noted.

4.6.2 Results

The average noise level was 53.8 dBA and actual readings ranged from a low of 51 dBA to a high of 56.1 dBA. In the afternoon the average noise levels was 46.3 dBA and actual readings ranged from a low of 46.3 dBA to a high of 58.2 dBA. The higher levels in the afternoon can be attributed to a higher volume of vehicular traffic.

These levels fall within the recommended zone limit (55 dBA - 7 am – 10 pm) for a residential zone proposed by the National Environment and Planning Agency. Noise levels above or equal to 55 dBA may cause a noise nuisance as stated by the World Health Organization (WHO).

The proposed development has the potential to cause a noise nuisance during its construction.

4.7 Air Quality

Actual ambient air quality readings were not conducted, however, due to the nature of the site (vegetated) and the fact that other areas in proximity such as other properties are adequately covered and the main road is properly paved, dust is not considered a problem at the site.

The proposed development has the potential to negatively impact the ambient air quality on the proposed site and areas in proximity.

5.0 SOCIAL BASELINE

The Social Impact Area (SIA) for this study was demarcated as two (2) kilometres from the proposed development area. This is outlined in the map below (Fig 5.1).

5.1 Introduction

5.1.1 Methodology

Informal interviews were conducted with residents within the communities in the study area. Other questionnaires were also administered to beach goers, vendors and shop keepers and to hoteliers (Appendix 11) and informal interviews with boat tour operators and stakeholders. These were supplemented by holding of focus groups. In addition, windscreen surveys were conducted in the communities to verify and update the information on the maps. Historical socio-economic data was obtained from the 1982 and 1991 population census and the Jamaica Journal.

Population was calculated using the formula [$i_2 = i_1 (1 + p)^x$]; where i_1 = initial population, i_2 = final population, p + actual growth rate and x = number of years. Water consumption was calculated based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption. Domestic garbage generation was calculated at 0.75 kg/capita/day and garbage generate by the proposed development at 2.3 kg/capita/day.

Negril is world renown for its seven miles of white sand beach. The area has grown from its initial stages as an area of community tourism in the early1960s and has since become home to some large hotel chains, some of which are all inclusive.

Figure 5.1: Social Impact Area demarcated

The social facilities have not been in the earlier stages been keeping a pace with the phenomenal growth of the area.

5.2 Demography

Regionally the population of Hanover and Westmoreland was 65,400 and126,100 respectively. During the last intercensal period (1982 –1991), Hanover had an annual growth rate of 0.45% and Westmoreland 0.5%. The child dependency ratios for Hanover and Westmoreland in 1991 were 564.3 and 634.4 per 1000 persons of labour force age, old age dependency ratios stood at 61 and 166.1 per 1000 persons of labour force age respectively and societal dependency ratios were 625.3 and 800.5. The sex ratio for Hanover and Westmoreland in 1991 was 100.34 and 103.7 respectively.

Table 5.1 Percentage composition of the parishes of Hanover (H) and Westmoreland (W) over a twenty year period.

AGE GROUP	1970		1982		1991	
	H	W	H	W	H	W
0-4	16.6	15.95	11.85	11.9	12	12.3
5-14	32.2	32.9	27.05	26.05	22.7	22.95
15-29	18.8	18	27.35	27.55	28.75	27.35
30-44	11.7	12.4	12.35	11.95	15.1	15.35
45-64	14.1	14.15	12.65	13.75	12.4	12.8
65 & Over	6.6	6.6	8.75	8.8	9.05	9.25

Both parishes show a young but aging population (Table 5.1). This is further supported by the median age of the population of both parishes (Table 5.2). The median age is the age, which divides a population into numerically equal parts of younger and older persons (STATIN 1991).

Table 5.2 Median age for Hanover and Westmoreland over the last twenty years.

PARISH	1970		1982		1991	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
HANOVER	15.0	16.4	19.1	19.7	22.5	22.5
WESTMORELAND	15.0	16.4	19.7	20.1	22.8	22.9

(Source: 1991 Population Census)

The estimated population at the time of the study for Hanover and Westmoreland at the time the study was conducted were, 68,403 and 132,549 respectively. It is anticipated that the populations for Hanover and Westmoreland will reach 76,529 and 150,151 respectively over the next 25 years if the annual growth rate remains the same.

Table 5.3 Four towns and their population growth over a twenty year span

LOCATION	1970	1982	1991	ANNUAL RATE OF GROWTH 1970-1991 (%)
Lucea	3,579	5,652	5,419	2.00
Savanna-La-Mar	11,604	14,912	16,340	1.64
Negril	1,166	2,475	4,040	6.10
Green Island	1,163	1,370	1,591	1.50

All four towns showed positive growth, however, Negril, showed phenomenal growth over these twenty years. A possible explanation for this the proliferation in hotels, villas and guesthouses which provided a pull for persons seeking employment.

The study area had a population of approximately 472 persons in 1991. At the time the study was conducted, the estimated population was 820 persons, calculated at an annual growth rate of 5.68 % (1982-1991 intercensal period). It is expected that the population will grow to 3,263 persons over the next 25 years if the current population growth rate is maintained.

The child dependency ratio for the study area in 1991 was 592.98 per 1000 persons of labour force age, old age dependency ratio stood at 70.18 per 1000 persons of labour force age respectively and societal dependency ratio were 663.16. The sex ratio for the study area was 100.39.

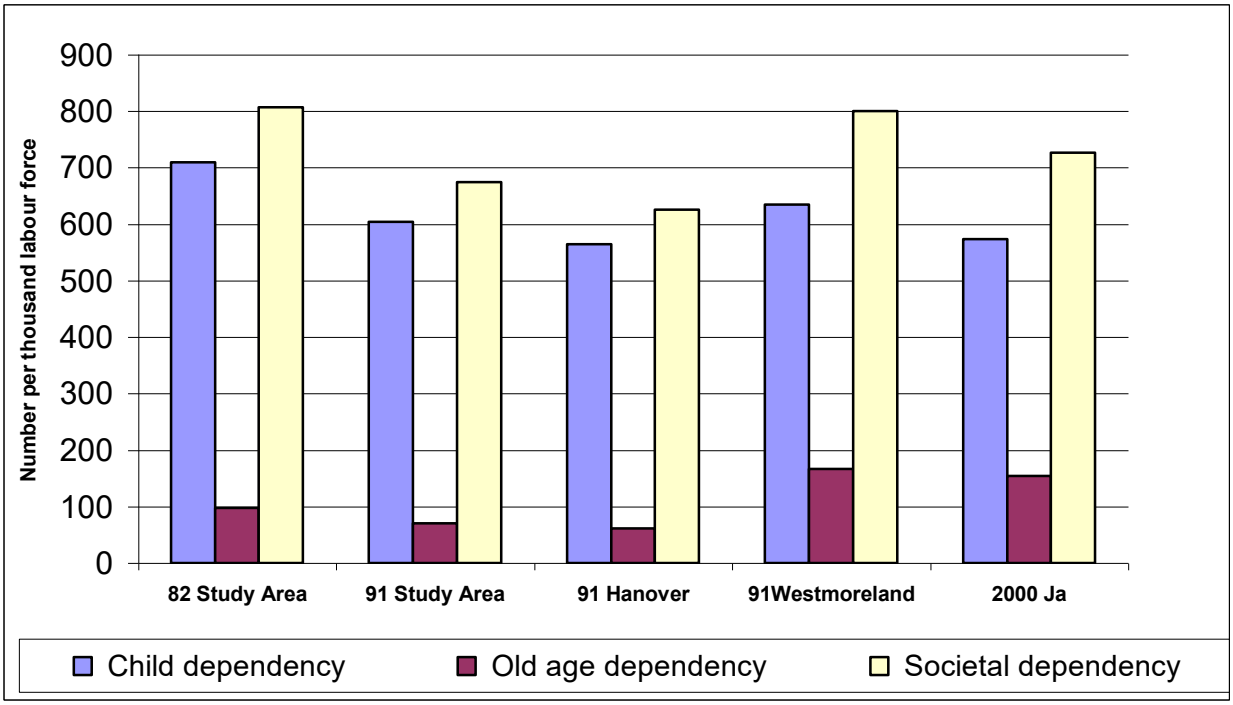


Figure 5.2: Dependency Ratios

A comparison of the dependency ratios revealed that the working population in the parish of Westmoreland in 1991 had a higher demand for child, old age and societal support when compared to Hanover. In the study area, there was a decreasing trend in these dependency ratios from 1982 to 1991. Although there has been a decline in dependency on the working class in the study area, it is still higher than that obtained in the parish of Hanover. However, the ratios are lower than those in Westmoreland are.

Comparing the resident population (1982 and 1991) within Negril and surrounding areas indicates that areas along the coastline have shown an increase in population (see Figure 5.3). This may be because of increase tourism development within the region and hence employment opportunities producing a "pull" to the areas.

The areas that showed most growth were Whitehall and lower West End, Negril, Ireland Pen, Rutland Pen, Orange Bay and Mount Pleasant.

5.2.1 Employment and Income

The economically active population as defined by the International Labour Organisation (ILO) is, all persons of either sex involved in the production of goods and services and includes persons working, those actively seeking work as well as persons not employed or actively seeking work who would take a job if offered one. The economically active population is confined to the ages 14 years and over.

In 1991, approximately 53% of the labour force of Hanover and 54 % of Westmoreland was economically active. There was a general reduction in the percentage of the economically active population over the twenty years (1970 – 1991) in Hanover. There was also a similar reduction in the economically active ratio of male to female with the population. Within Westmoreland, there was a reduction in the economically active population from 1970-1982, however, this increased in 1991. This trend was also observed in the economically active ratio of male to female obtained.

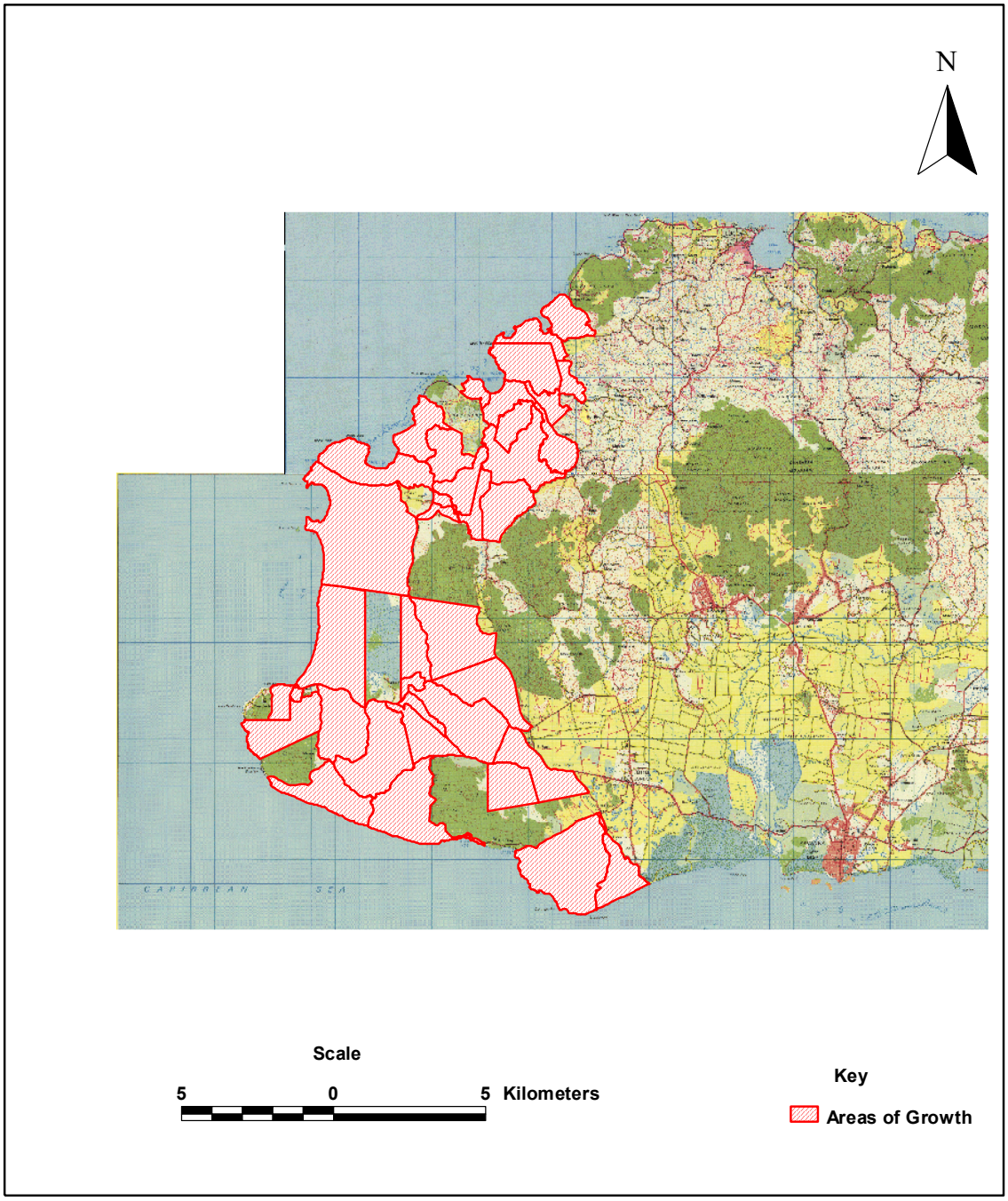


Figure 5.3: Map showing areas of increased population, 1982-1991

The unemployment rate among the labour force in both parishes in 1991 stood at approximately 57 %. It is also important to note that in 1991, although the number of males to females in the labour force population was almost similar and in the case of Hanover, there were more females, males were approximately twice more economically active.

In 1991, 63 % of the labour force in the study area was economically active. The ratio of economically active male to female was lower than that of both the parishes of Hanover and Westmoreland.

Unemployment within the study area in 1991, stood at approximately 50 %. This lower unemployment rate coupled with a higher economically active labour force suggests that persons living in the study area had a better chance of obtaining work when compared with the parishes of Hanover and Westmoreland.

The proposed project is expected to employ approximately 600 trade men and labourers and at peak construction period, this number will increase to approximately 1200 persons.

This proposed project has the potential to create a positive impact on the labour force within the study area and by extension regionally and nationally.

5.2.2 Education

The 1991, educational statistics for Hanover suggested that the 15 years and over population was largely unskilled with approximately 64 % of this population attaining a primary education. The attainment of primary education and above is important as it relates to potential employees to the hotel industry. The two largest categories are found in the primary and secondary educational attainment. There has been a downward trend from 1970 -1991 in persons attaining a primary

education with 68% of the 15 years and over male population and 61 % of the female population in 1991 attaining a primary education. However, there was an increase from 1970-1991 of this population attaining a secondary education, with 30 % and 37 % of the male and female population respectively achieving this milestone.

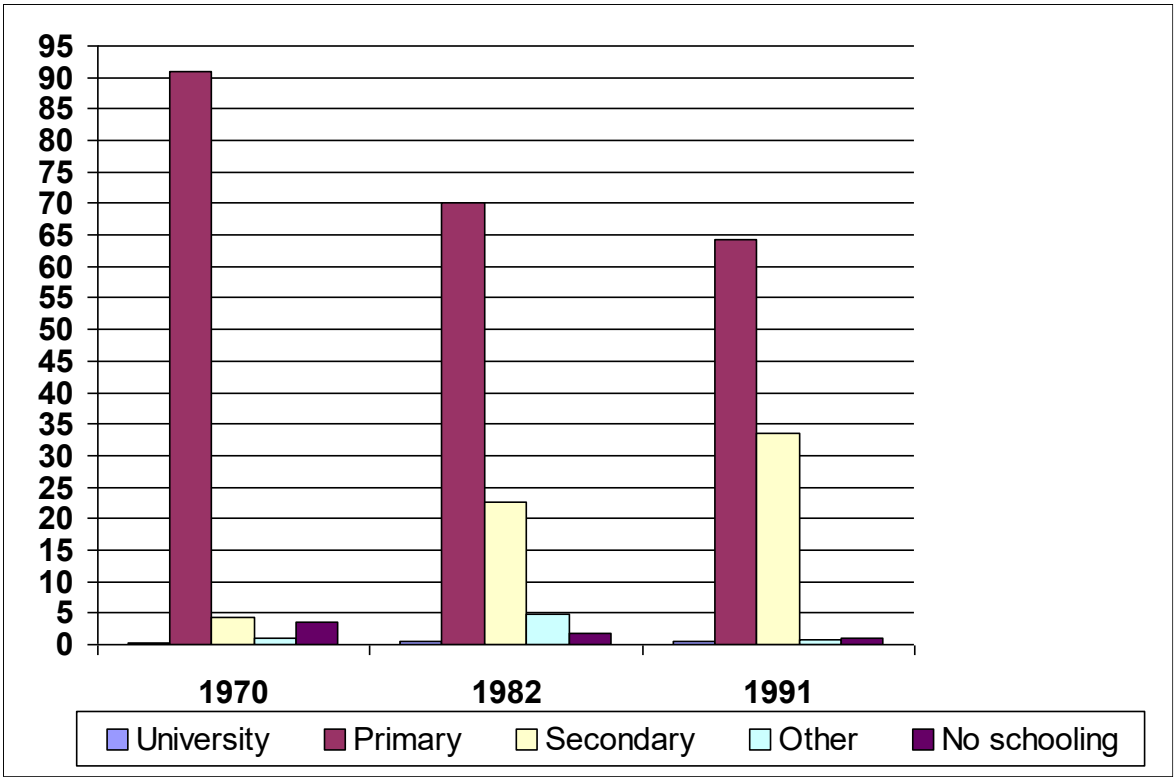


Figure 5.4 Educational attainment over the last twenty years (1970-1991) for the 15 years and over population of Hanover.

Persons within the study area attend seven main schools. These are, Orange Bay Basic School, Church Hill Primary, Green Island Primary, March Town All Age, Negril All Age, Rusea's Comprehensive and Green Island Comprehensive. They travel distances of up to 20 km (12 miles) to attend school.

Table 5.4 Schools, capacity, enrolment and percentage attendance

SCHOOL NAME	Enrolment	Capacities	% Attendance	Comments
Orange Bay Basic	No information	No information	No information	No information
Church Hill Primary	**349**	**210**	**83**	**Co-ed Whole Day**
Green Island Primary	**674**	**545**	**80**	**Co-ed Whole Day**
March Town All Age	No information	No information	No information	No information
Negril All Age	418	520	75	Co-ed Whole Day
Rusea's Comprehensive High	**1,937**	**1,245**	**94**	**Co-ed Whole Day**
Green Island Comprehensive	1,638	810	97	Co-ed Shift

NB. Enrolment based on the 1999- 2000 academic year. The names of schools that are in bold have exceeded their capacities.

Within the study area 43% of the population attained a primary education, 28 % attained a secondary education, 12 % had no formal education, 6% attained a nursery/infant education, 9 % did not state the level of education they attained and 2 % attained university or other educational level. The category of other includes teachers colleges or vocational institutions.

The trend in educational attainment over the 20-year period (1972-1991) suggests that there is a decrease in number of persons in the population of Hanover with only a primary education and those without formal schooling. This trend also occurs within the study area. This coupled with the fact that there is also and increase in this population of persons attaining a secondary education suggests that the population within the parish and the study area should be easier to be trained to perform their job duties and functions.

5.3 Existing Land Use

Existing land use in the study area is tourism, commercial, residential and recreational. Tourism facilities dominate the land use of the study area. There are approximately 10 hotels located within the study area. Commercial the study area has restaurants, craft shops, a gas station and an aerodrome. Residentially there are housing developments located at Orange Bay. There is a

football field located in Orange Bay and the beaches located at Bloody Bay and Long Bay are used for recreational purposes by residents within the study area.

The proposed site is currently being used as dump for both commercial and domestic waste as evidenced by Plate 5.1. In addition, both locals and tourists use the beach abutting the proposed site, for clandestine actions.

Plate 5.1: Photo showing improper waste disposal on proposed project site

The proposed development has the potential to negatively impact the recreational use of the Bloody Bay Beach as it will reduce the extent of the beach that can be used freely by locals. It will however, have a potential positive impact in the reduction of the use of the area as a dump for waste.

5.3.1 Housing

For the purposes of this study the definition of housing unit, dwelling and household are those used in the conduct of the population census conducted by the Statistical Institute of Jamaica. This definition states that a "housing unit is a building or buildings used for living purposes at the time of the census. A dwelling is any building or separate and independent part of a building in which a person or group of persons lived at the time of the census". The essential features of a dwelling unit are both "separateness and independence". Occupiers of a dwelling unit must have free access to the street by their own separate and independent entrance(s) without having to pass through the living quarters of another household. Private dwellings are those in which private households reside. Examples are single houses, flats, apartments and part of commercial buildings and boarding houses catering for less than six boarders.

In 1991, there were approximately 16,054 housing units, 17,151 private dwellings and 17,565 households in Hanover. The average number of dwelling in each housing unit was 1.1 and the average household to each dwelling was 1.0. The parish had an average household size of 3.7 persons/household.

Ninety six percent (96 %) of the housing units in 1991 in Hanover were of the separate detached type, 1 % of the semi –detached type, 1 % each for the categories of apartment buildings / town houses and part of commercial building and 1 % improvised housing, other and not stated.

Approximately 34 % of the housing stock in Hanover was constructed before 1970. Fifty-nine percent (59 %) was constructed between 1970 –1991 and 7 % of the respondents occupying the units were generally not aware of when the unit was constructed.

Nearly three quarters (72 %) of the households in Hanover occupied between 1 and 3 rooms, 26 % between 4 and 6 rooms and 2 % occupied 7 and over rooms. Most of the households in Hanover occupied (28 %) two (2) rooms.

In 1991, there were approximately 142 housing units, 160 private dwellings and 161 households the study area. The average dwelling in each housing unit was 1.1 and the average household to each dwelling was 1.0. The average household size was 2.9 persons/household. While the average dwelling in each housing unit and average household to each dwelling was similar to the parish statistics, the average household size was lower than the parish average.

Separate housing accounted for 96 % of the housing units in the study area in 1991. Three percent (3%) was semi- detached housing and 1 % part of a commercial building. With the exception of the semi-detached category, the other two categories were similar to what obtained in the parish.

In 1991, ninety one percent (91 %) of the households in the study area occupied between 1 and 3 rooms, 8 % between 4 and 6 rooms, 1 % did not state and none occupying seven or over rooms.

Although the average household size was lower than that of the parish, the fact that the majority of households occupied one room suggests that there was some level of overcrowding occurring in the households.

5.3.2 Infrastructure

Electricity

Approximately 50 % and 53 % of the households in 1991 used electricity in the parishes of Hanover and Westmoreland respectively. The use of kerosene was the next major source of lighting in households in these parishes accounting for approximately 48 % and 44 % in Hanover and Westmoreland respectively.

In the study area, approximately 64 % and 34 % of the households used electricity and kerosene respectively. There was a greater percentage of households within the study area using electricity was greater than in the parishes (Hanover and Westmoreland). The percentage of households using kerosene in the study area was lower when compared with the parishes.

It is not anticipated that there will be any problems as it relates to the supply of electricity to the proposed development.

Telephone/Telecommunications

The parishes of Hanover and Westmoreland are served with land lines provided by Cable and Wireless Jamaica Limited. Wireless communication (cellular) is provided by Cable and Wireless and Digicel Jamaica Limited for both parishes.

In addition to telephones, there are numerous Internet service providers (ISPs) in Jamaica. The area is not an exception, with Internet cafes located in the town of Negril. In addition, private homes and hotels have access to the World Wide Web.

It is not anticipated that there will be any problems as it relates to the provision of telephone service to the proposed development.

Water Supply

Water for Negril is sourced from the Logwood Treatment Plant in Hanover. Discussions with NWC personnel (Mr. Patrick Daley, District Manager, Sav-la-Mar, Westmoreland) revealed that the plant has a stated capacity of 6 MGD (Imperial). Only 4 MGD is currently being utilized.

An estimate of the remaining capacity was undertaken. A 20% loss to leakage was considered that resulted in an estimated additional supply capacity of 1.6 MGD or 7.28 MLPD.

Approximately 89 % of the households in the study area in 1991 received water from the National Water Commission and the other 11 % had other means of receiving water supply.

Table 5.5 contains the estimated water consumption in the parishes of Hanover and Westmoreland and the study area in 1991 and 2001. It also estimates the future consumption in the year 2026.

Table 5.5 Estimated Water Consumption (in Litres per Day)

Location	1991	2001	2026
Hanover	14,853,648	15,535,689	17,381,266
Westmoreland	28,639,832	30,104,529	34,102,295
Study Area	107,201	186,238	741,093

Based on these estimates, the expected demand for water supply by the proposed development is not expected to have any potential negative impact on water supply for the area (Appendix 14).

Sewerage

Most of Negril was sewered and connected to a new wastewater treatment plant less than 5 years ago. The sewerage extends through most of the 'West End" in the south to as far as Tropical Bay and Negril Cabins in the north. Negril Cabins is approximately 1000 south of the proposed hotel site. Discussions with NWC personnel (Mr. Junior Francis, Operations Manager, Negril, Westmoreland) revealed that there is a UDC force main in the road between the NWC sewerage and the proposed hotel site. However, this force main has not been equipped with the two required lift stations to date.

Wastewater Treatment

Wastewater from the Negril area is collected and treated at the Negril Treatment Plant at Sheffield. The plant has a capacity that is greater than 3.0 MGPD, in two series of ponds. Less than1.5 MGD is currently reaching the treatment plant. Only one series is currently in operation.

The plant therefore has the capacity to take an additional flow of greater than 1.5 MGD or 6.825 MLPD.

Current Issues

NWC personnel sited two issues as it relates to both the sewerage and the wastewater treatment plant that are of relevance to this project. These are as follows:

1. Poor location and lack of NWC coordination with respect to the design and construction of terminal manholes. This situation can make maintenance and NWC assistance difficult during emergencies.
2. Odorous sewage in the lift stations and grease on the surface of the waste stabilization ponds due to poor grease trap sizing or maintenance.

More NWC/developer interaction in both the design as well as implementation phase was suggested as a potential remedy for design and operational shortcomings.

Past, current and future estimation of sewage generation are outlined in Table 5.6.

Table 5.6 Estimated Sewage Generation (in Litres per Day)

Location	1991	2001	2026
Hanover	11,882,918	12,428,551	13,905,013
Westmoreland	22,911,866	24,083,623	27,281,836
Study Area	85,761	148,991	592,874

In 1991, approximately 92 % of the households within the study area disposed of their sewage by an inappropriate and inadequate manner (See Table 5.7).

Table 5.7 Comparison between the parish and the study area by sewage disposal methods as a percentage of the households.

METHOD OF DISPOSAL	LOCATION	
	HANOVER (%)	STUDY AREA (%)
Pit Latrine	72	47
WC linked to sewer	3	8
WC not linked to sewer	12	17
No established means	1	8
Other	6	17
Not Stated	6	3

NB. WC means water closet.

While a lower percentage of households in the study area compared to those within the parish use pit latrines to dispose of their sewage, there is a higher percentage of households in the study area using water closets not linked to sewer or having no or other established means of disposing of their sewage.

The building of the proposed hotel development is not expected to have a negative impact as the development will be linked to the Negril sewerage system.

Solid Waste Generation

The Western Parks and Markets Department do solid waste collection. This service is provided free for the households within the area. The waste is transported to the Retirement dump located in St. James.

Private contractors do collection of solid waste from the hotels. This service is provided to the hoteliers for a fee, which is dependent on the frequency of collection. This waste is also transported to the Retirement dump. The collection of domestic waste appears to be inefficient as informal dump areas were seen throughout the study area and in particular on the projected project site.

It is estimated that households in the study area generated approximately 356 kg of solid waste in 1991. Based on the growth of the population it has been estimated that at the time of this study approximately 615 kg of solid waste was being generated and it is expected that within the next twenty five years if the population growth rate remains the same to be 2,447 kg (≈ 2.5 tonnes).

The proposed development is anticipated to generate approximately 2,508kg (2.5 tonnes) of waste per day.

Roads and Transportation

The Norman Manley Boulevard is the main road that runs through the study are. It parallels the eastern boundary of the proposed hotel development. The road surface is in an excellent state of repair.

Transportation within the study area is provided by a fleet of taxis and "robot taxis" (unlicensed). Negril has a transportation centre located along the Negril to Savanna-la-mar main road. In addition, transportation to and from hotels within the area is also provided by tour companies and Jamaica Union of Travellers Association (JUTA) buses and cars.

At the present hotel (RIU Tropical Bay), some local taxis and buses have a two-year contract to provide ground transportation to guests. It is anticipate that this arrangement will be replicated when the proposed new hotel is constructed.

Air Transport

The Negril Aerodrome is situated approximately 1.5 km (≈1 mile) southeast of the proposed project site. It provides air transport to other sections of the island. These are Montego Bay where the "hub" of Air Jamaica is, Kingston (Tinson Pen), Port Antonio (Ken Jones) and Ocho Rios (Boscobel). Five air carriers serve the Negril aerodrome. These are, Air Jamaica Express, TimAir, Jamaica Air Link, International Air Link and Burl Air. In addition, Air Jamaica Express, AirPak Express and TARA provide air courier service.

Health Care

In addition to the five doctors that work in Negril, there are three locations where persons within the study area obtain their health care. These are, Negril Health Clinic, Lucea Hospital and Savanna-la-mar Hospital. The Negril Health Clinic is approximately 14 km (≈ 8 miles) from the

study area is the closest facility. Persons travel from as far as Little London and Hopewell to attend to the clinic. It is a type III clinic offering dental, medical, anti and post natal, family planning, gynaecology, psychiatry and food handlers permit. On average, the clinic sees approximate 70 persons per day.

The closest hospital to the proposed site is located at Lucea, which is approximately 30 km (18 miles) from the study area. Savanna-la-mar hospital is approximately 35 km (≈ 22 miles) from the proposed site.

The construction and operation of the proposed hotel development is not expected to negatively impact the health system.

Shopping

The town of Negril is the main commercial centre for the study area. However, persons travel as far as Savanna-la-mar and Lucea for their shopping needs. There are approximately 3 supermarkets in Negril.

5.3.3 Other Services

Financial Services

There are two commercial banks (Bank of Nova Scotia and National Commercial Bank) that serve the study area. They are located in Negril. They are two cambios and a Paymaster also located in Negril. In addition, most hotels provide Bureau de Exchange, where guest can convert their currencies to Jamaican dollars.

Fire Station

There are no fire stations within the study area, however there is one located in the town of Negril, some 9 km (≈ 6 miles) from the proposed development site. Currently, this station has one fire truck and if required backup is received from the headquarters in Savanna-la-mar which has two trucks.

The proposed development has its own designed fire control system (see Figure 5.5), with a series of fire hydrants, fire extinguishers and smoke detectors and alarms. It is not anticipated that there will be any problems as it relates to a fire event.

Police Station

The Negril police station is responsible for policing the Bloody Bay area. Highway patrol is conducted by the Green Island police station. The incidence of major crimes are low, however, *simple larceny* is the main crime committed in the area. The sale of illegal drugs also takes place within the study area.

The police station has a youth group, the Negril Police Youth Club, that is encouraging youths to stay away from drugs.

Crime is not expected to be a major problem within the study area.

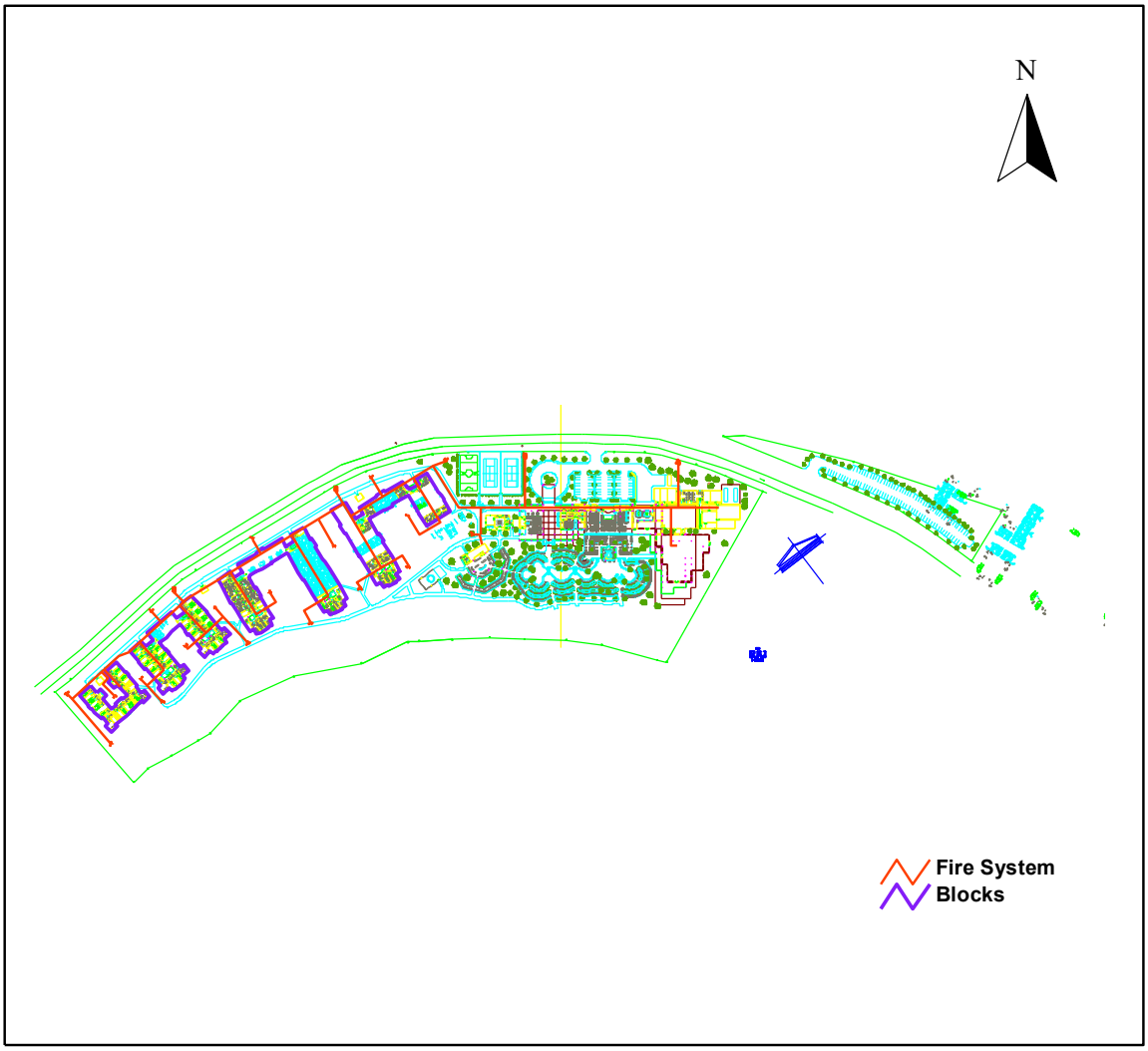


Figure 5.5: Schematics showing fire control systems for the proposed hotel

Post Office

The study area is served by one post office. This is the Negril Post office located along the West End road. It is anticipated that there will not be any potential negative impact on the post office operations due to the proposed construction and operation of RIU hotel in Bloody Bay.

5.3.4 Tourism and Beach Use

Caribbean destinations in 2000 showed good performances. Based on preliminary results from the Caribbean Tourism Organization (CTO), the region recorded an estimated 5 % in stopover arrivals and 10 % increase in cruise passenger arrivals (JTB 2000). The final figures for six Caribbean destinations showed moderate growth. Jamaica was joint third with Barbados (6 %) behind Cuba (11 %) and Puerto Rico (8 %). Aruba was fifth (5 %) and Bahamas sixth with 3 %. The position held by Jamaica is however tenuous as other Caribbean destinations with partial figures showed good growth. These were Dominican Republic (14 %) (Jan.-Sept.) and the US Virgin Island (13 %) (Jan.-Nov.).

Jamaica has increasing become dependent on tourism. Visitor arrivals to Jamaica increased 1999-2000. Stopover arrivals stood at 1,322,690 an increase of 6% and cruise passengers stood at 907,611 an increase of approximately 19 %.

The average length of stay of foreign nationals in 2000 was 10.1 nights. This was a reduction from the 10.3 nights in 1999. This suggests that visitors tend to have numerous short holidays than fewer long ones. Visitors in hotels tended to stay for shorter periods when compared with non-hotel accommodation. The average length of stay in hotels was 6.6 nights, which was a reduction from the 6.9 nights in 1999. There was also a reduction of those who stayed at non-hotel accommodation from an average of 18.3 in 1999 to 18.2 nights.

Average hotel room occupancy rate in 2000 (58.5 %) was almost 2 percentage points above the level achieved in 1999 (57 %). There was a noticeable decline in the occupancy levels of small EP hotels (less than 100 rooms) in most of the resort areas. For the resort areas of Montego Bay hotel room occupancy increased from 59.5 % in 1999 to 62.8 % in 2000, Ocho Rios remained relatively stable (59.5 % in 1999 and 59.3 % in 2000) and in Negril there was a decline from 63.9 % (1999) to 62.1 % (2000). Occupancy rates in all inclusive in the three main resorts increased in 2000 when compared with 1999. In Montego Bay annual room occupancy was 70.2 % in 2000 compared to 66.9 % in 1999, Ocho Rios 65.6 % in 2000 compared with 64.7 % and in Negril 73.5 % in 2000 compared to 67.5 % in 1999. This indicates that there is an increasing trend in visitors who require all inclusive vacations.

Gross visitor expenditure in 2000 was estimated at US$ 1,333 million, an increase of 4.2 % of the US$ 1,279 million earned in 1999.

There was a 2.5 % increase in the number of persons directly employed in the accommodation sub-sector in the year 2000. The number of person increased from 30,325 in 1999 to 31,080 in 2000. Montego Bay, Ocho Rios and Negril accounted for approximately 90 % of the persons directly employed in the accommodation sector. Montego Bay accounted for 10,756 direct jobs (35 %), Ocho Rios – 9,443 (30%) and Negril – 7,652 (25 %).

During the course of 2000, approximately 600 rooms were completed. Of this, 500 were new rooms and the rest from expansion to existing properties. Since the compilation of the 2000 Annual Travel Statistics, RIU's 380-room Tropical Bay in Negril opened its doors.

Negril, from 1997 – 2000, has continued to maintain its place as the third largest visitor accommodation resort town in Jamaica. In 2000 Negril accounted for approximately 21 % of all types of resort accommodation on the island.

Table 5.8 Tourist Accommodations in Negril by Category and Area (1997 – 2000)

	UNITS				ROOMS			
	1997	1998	1999	2000	1997	1998	1999	2000
No. of Hotel Rms								
≤ 50	32	34	37	36	920	963	1,064	1,018
51-100	32	34	37	36	540	622	585	694
101-200	3	3	3	3	464	472	472	472
> 200	4	5	5	5	1,050	1,284	1,284	1,284
Guest Houses	111	100	97	96	1,164	987	898	907
Resort Villas	190	151	244	236	510	626	709	691
Apartments	17	17	17	17	36	36	36	36
TOTAL	**365**	**319**	**411**	**403**	**4,684**	**4,990**	**5,048**	**5,102**

(Adapted from the 2000 Annual Travel Statistics)

There was an increase in the <= 50 and the 51-100 hotel room categories from 1997 – 1999 with a similar trend in the number of rooms available except for 1999 in the 51-100 room category (Table 5.6). Hotels > 200 rooms and apartments generally remained the same over this period. Guesthouses showed a decline in both the number of units and rooms offered. Resort Villas showed an overall increase although there was decline in the number of units in 1998 during this time period. Although there was a decline in the number of units in 1998, the number of rooms available showed a steady increase, suggesting that existing resort villas were expanding.

Comparing 2000 to 1999, there was a decline in the number of units in the categories of hotels with <= 50 and 51-100 rooms and guest houses. Although there was a decline in the number of units in these categories, the number of rooms offered actually increased suggesting an expansion in the existing units. All other categories remained the same.

While there was a fluctuation in the number of units available in Negril (1997-200), there was a steady increase in the number of rooms available (4,684 (1991) - 5102 (2000)) during that time.

A recent addition to the Negril tourism calendar is "Spring Break". It has been estimated that 30,000 students arrived in 2000, a 36 % increase over 1999. Of this total, the majority (64 %) stayed in Negril. The estimated gross expenditure was US $22 million.

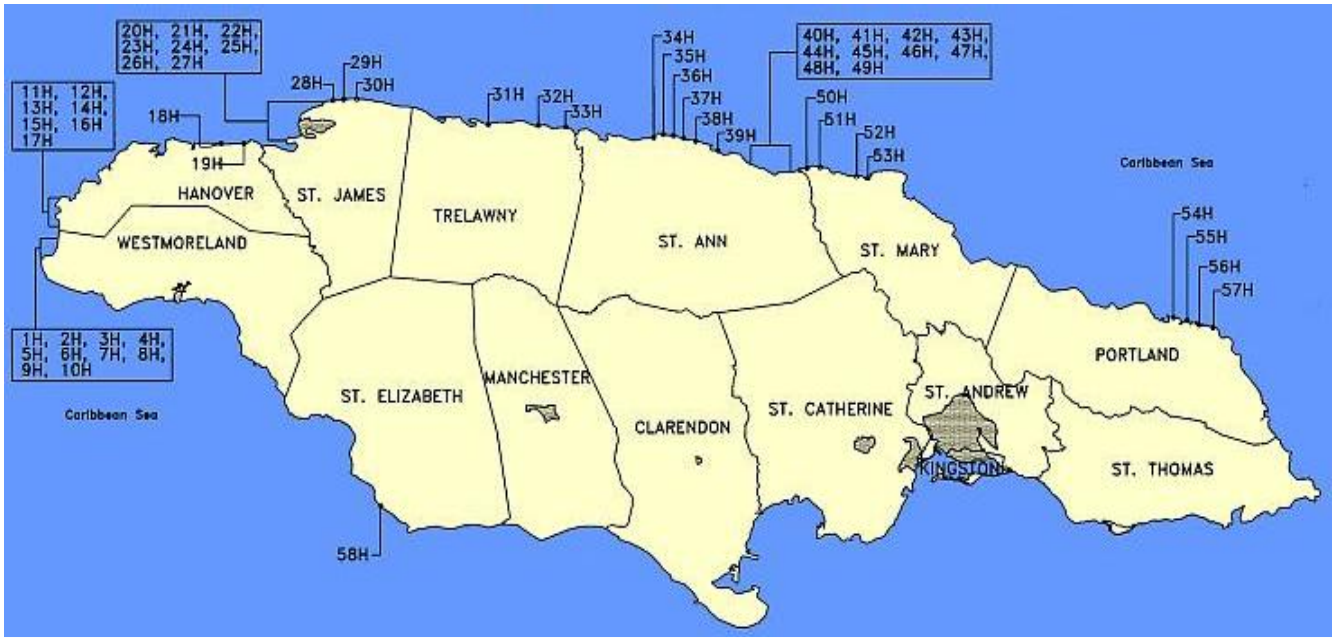
It is planned, that the proposed hotel will target the European market as is currently being done at the present property, RIU, Tropical Bay. Currently there are charter flights from Spain and other European countries. This important on three fronts. First from travel statistics it has been seen that since mid 1980's the European market has been the fastest growing market in the Caribbean and in 2000, Jamaica visitors from the United Kingdom (18.6 nights) and Continental Europe (13.2 nights) on average stayed longer than visitors from the North America (United States - 8.4 nights & Canada – 12.2 nights). This has the potential to positively impact the Jamaican economy. Secondly, the fact that RIU plans to target the European market means that they will not a directly compete with most of the existing properties in Negril. Third, the fallout from the terrorist attacks on the World Trade Centre (WTC) on September 11, 2001, "Anthrax" scares and Operation Enduring Freedom – the war in Afghanistan has had a negative impact on the world economy including Jamaica, which has seen its economy impacted severely as the there has been a drastic reduction of tourists arriving from North America. This has resulting in a fall off in projected revenue and foreign exchange earnings. While this fallout is expected to be in the short to medium term, it is anticipated that the millions of United States dollars investment of the proposed hotel, will inject much needed foreign exchange earnings to the Jamaican economy.

Beach Use

"Going to the beach is a traditional recreational experience for many Jamaicans. With an increasing population, there is now greater demand for the use of beaches. This situation becomes more acute against the background of increased tourism development along the coastal strip demarcated for exclusive use. Thus, fewer beaches are available for the use of the public,

many of which are of poor quality and/or lacking of facilities. In addition, there is on going competition from fishermen who encroach on designated bathing beaches in order to carry out their livelihood."

Eight hotels are using Bloody Bay. These are depicted in the map below. Since the creation of this map, there has been the addition of RIU, Tropical Bay hotel.



(adapted from NEPA, Hotel Bathing Beaches)

11H ……. Mahogany Inn
12H ……. Point Village
13H ……. Swept Away
14H ……. Poinciana
15H ……. Sandals
16H ……. Hedonism
17H ……. Grand Lido

Negril Marine Park

Bloody Bay and by extension the proposed project site fall within the Negril Marine Park (Negril Environmental Protection Plan). A more detailed zonation was obtained from the Negril Coral Reef Preservation Society. It shows five (5) main zonations within the Bay. These are (i) swimming, (ii) non-motorized, (iii) motorized, (iv) replenishment and (v) diving.

Most of the Bay is zoned for motorized crafts, however, a moratorium was placed on motorized water sports within the Bay by the Tourism Product Development Company Ltd. (TPDCO) and supported by NEPA. They essential have stopped issuing licenses to new water sports operators. There are plans afoot to zone the entire Bay for non-motorized craft.

The area zoned as the replenishment zone within Bloody Bay has been proposed as a fish sanctuary. Approximately seventy five percent (75%) of the proposed development falls within this zone. The replenishment zone does not allow swimming, recreational activities, fishing or jet skiing.

There is a potential for conflict between this zonation and the proposed development as there will be need for an area for swimming (beach). The proposed development has the potential to impact negatively on the fish sanctuary.

Carrying Capacity

There are three types of carrying capacities which are an integral part to Sustainable Tourism Development and which forms an integral part of alternative tourism and eco-tourism (Attzs, 1999). These are,

- **Ecological Carrying Capacity** - the level of visitation beyond which unacceptable ecological impacts will occur, either from the tourists or the amenities they require.

- **Tourist Social Carrying Capacity** - the level beyond which visitor satisfaction drops unacceptably from overcrowding.

- **Host Carrying Capacity** - the level beyond which unacceptable change will be detrimental to the host community.

Manning (1996) suggested that sample indicators that may be used to illustrate the carrying capacity for coastal zones include:

- Degradation (% of beach degraded, eroded);
- Use intensity (persons per meter of accessible beach);
- Shore/marina fauna (number of key species sightings);
- Water Quality (faecal coliform and heavy metal counts).

It is normally considered by experts that a beach saturation point varies from 6-8 persons per square metre for the average type of beach, to a maximum of 10 persons per square metre for the best quality beach" (Vassiliou 1995, 51).

However, in the light of the laid back nature of Negril, the consultant suggests that these figures should be revised to 1 person for every $3m^2$.

Table 5.9 Beach Lengths and Areas

LOCATION	LENGTH (m)	AREA (m^2)
Beach from the southern border of Bloody Bay to the southern border of proposed site	1,500	56,990
Beach from the southern border of Bloody Bay to the fish sanctuary marker	1,600	66,620
Beach from the southern border of Bloody Bay to the proposed new fish sanctuary marker 100m north of the present point if negotiated	1,700	73,020

Assuming the present beach extending to the southern border of the proposed site extends 30 metres seaward and 10 metres landwards from the water line then the useable beach area is approximately 57,000 m^2. If the beach is extended to the present fish sanctuary marker then the useable beach area increases to approximately 66,600 m^2. This translates into the beach area in front of the site of approximately 9,600 m^2.

Table 5.10 Hotels using Bloody Bay, number of rooms and estimated number of guests

NAME OF HOTEL	# OF ROOMS	# OF GUESTS (≈ 2/ROOM)
Point Village	256	512
Swept Away	134	268
Beaches Inn	130	260
Sandals	215	430
Hedonism II	280	560
Grand Lido	200	400
Negril Cabins	50	100
RIU Tropical Bay	396	792
Proposed RIU	420	840

NB. Assuming 100% occupancy levels

Without the proposed hotel, and assuming that all the guests go to the beach at the same time then it is estimated that approximately 3,300 guests use the Bloody Bay beach. With the addition of the proposed hotel an additional 840 tourists would use the beach, assuming that they all go to the beach at the same time.

Inclusive of the proposed hotel, an estimated 4,140 guests from the hotels using the Bloody Bay would use the beach. If this figure were tripled to include residents within the study area (and growth within the next 25 years) and expected visitors from outside the study area, then based on the 3 m^2 per person, an estimated 37,300 m^2 beach area would be needed. Based on the estimated areas (Table 5.9), then the beach saturation point would not be exceeded.

Using the sample indicators suggested by Manning, it can be said that the carrying capacity within Bloody Bay has not been exceeded and will not be exceeded with the addition of the proposed hotel. In addition, the relocation of the Bloody Bay Public beach to Long Bay has the potential to reduce the demand on the beach at Bloody Bay

5.3.5 Historical/Cultural Site

There are no known historical or cultural sites located within the study area. Negril Point Lighthouse is a national landmark. It is situated at South Negril Point. The French firm Barber and Bernard built it in 1894. The tower is made of concrete and is approximately 20 metres (66 feet) above ground level and the light is elevated approximately 30 metres (100 feet) above sea level. This light flashes every two seconds and can be seen for up to approximately 16 kilometres (10 miles) away.

5.3.6 Community Consultation and Perception

Persons within the study area ranked unemployment especially among the youths as the major problem within the area. They called for the creation of job opportunities for example factories.

Most persons asked were unaware of RIU's proposed to plan construct another hotel in the Bloody Bay area. There were seven (7) main responses.

1. Those who agreed with the development and saw it as a potential to increase business and employment opportunities within the area.
2. Others agreed that the development had the potential to increase business potential and employment opportunities, however, they were concerned about the potential negative impact it would have on the environment especially within the Bloody Bay area.
3. Those who disagreed said that while they saw the potential for job creation and increased business, the impact would be minimal, because of the hotel being an all inclusive.
4. Others saw the provision of a hospital or the establishment of a factory as better options.
5. Still others expressed the concern that there will be a reduction of usable beach area for locals for enjoyment and recreation if the development is made to go ahead. In addition, the usable portion of the beach may become overcrowded especially during public holidays. This is even more critical, as the public beach, which was relocated to Long Bay by the Urban Development Corporation is seen as small, rocky and steep (Plate 5.2). In addition, there are no public sanitary conveniences located there.
6. Small hoteliers have expressed reservations about the proposed development as they see it as taking away their share of the tourism market and will result in lean times and in the worst case scenario closures of property. In addition, the creation of another large size hotel would help to destroy the resort community effect that Negril is world renown.

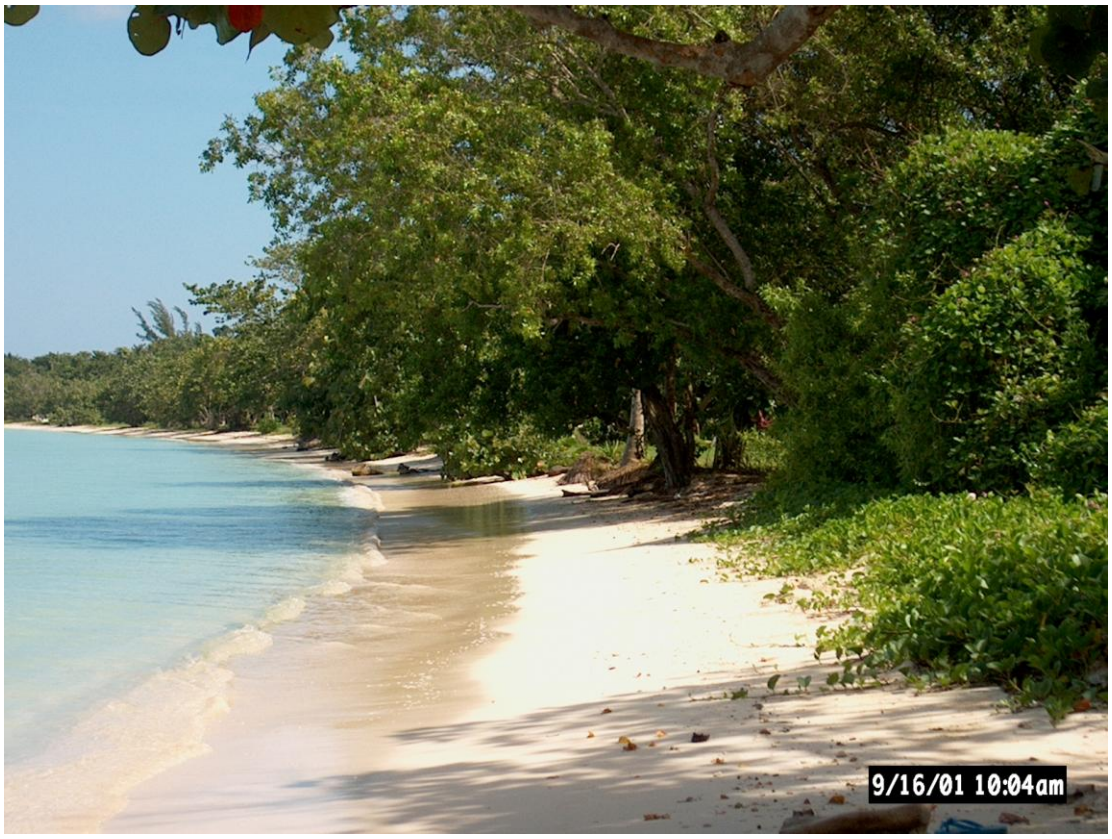


Plate 5.2: Photo showing relocated UDC Public Beach

7. The Negril Chamber of Commerce, Non-Governmental Organizations (NGOs) and friends of the Negril Environmental Protection Area also expressed their reservations about the proposed development with NEPA in a detailed correspondence. Their reservations can be summarised as follows:

    a) The proposed development site will fall in an area where the last stand of *Rhizophora mangle* (Red Mangrove) in Negril is and is also within a proposed fish sanctuary, which is a protected area.

    b) The removal of mangrove and seagrass is illegal.

    c) Whether or not RIU will fully consider their concerns with environmental management.

    d) Whether sewage treatment will be adequately addressed.

6.0 ANALYSIS OF ALTERNATIVES

The discussion and analysis of alternatives in Environmental Impact Assessments should consider other practicable strategies that will promote the elimination of negative environmental impacts identified. This section is a requirement of the National Environment and Planning Agency (NEPA), and is critical in consideration of the ideal development with minimal environmental disturbance.

This draft report has identified the major environmental impacts noted by scientific experts. The RIU project team and the consulting scientists worked together, utilising findings of these impacts to analyse possible options for the final development.

The following alternatives have been identified and have been discussed with RIU as means of reducing environmental effects. They are discussed in further detail below:

- The "No-Action" Alternative
- The proposed Development as described in the EIA
- Original rooms area, with parking lot moved
- Demarcation of fish sanctuary and negotiation of border

6.1 The "No-Action" Alternative

The "no action" alternative is required to ensure the consideration of the original environment without any development. This is necessary for the decision-makers in considering all possibilities.

The development will have a minimal effect on the physical environment. The only major effect identified was drainage and storm surge issues and mitigation measures and solutions have been identified to address these issues.

The no-action alternative **should** minimize the effects on flora and fauna identified, this is not, however, a guarantee. If the land is not secured, damage to the special floral and faunal species and habitats may still occur from independent sources.

The property also fringes on a proposed fish sanctuary. Similar to the discussion above, it is not guaranteed that if the hotel is not built, the beach area will remain in its present state.

There is a possibility of working with the hotel management in a positive way with the development, as a possible useful on-site management solution for the management and monitoring of the sanctuary.

In terms of the social environment, the "no-action" alternative would eliminate the job opportunities and the local economic inflow as estimated in the discussions above.
Negril

6.2 The proposed Development as described in the EIA

The impacts and mitigation measures for this alternative are discussed in detail throughout this report. The positive impacts have been identified in social and economic opportunities for the local vicinity of Negril, as well as a positive impact on the national economy.

This alternative will have minimal impact on the physical environment and has considered the necessary measures to almost eliminate the identified issues of drainage and storm water runoff.

As proposed, however, the consultant has identified some ecological issues with respect to the proposed parking area. The proposed parking lot is in a particularly dense, eco-rich wooded area. The scientists therefore propose that even slightly moving the site of the parking lot may preserve a large eco-habitat.

The beachfront of the present development has also raised some issues with an area that has been earmarked by the environmental interests in Negril for a Fish Sanctuary/nursery. It is proposed that a compromise from both the landowner and the environmental users in the community may best resolve this issue. This will require interactive dialogue and fair debate by both parties to achieve an amicable agreement.

6.3 Original rooms area, with parking lot moved

This alternative considers minimising the ecological impact of the parking lot by relocating it to the present site of the batching plant. This will significantly reduce the disturbance of the ecosystems and habitats as identified and discussed in the impacts for the present proposed development. In addition, based on the high species density in the original proposed site, and the requirements of the environmental agency, this alternative may reduce some of the costs on the Tree Preservation Plan and ecosystem conservation generally.

6.4 Demarcation of fish sanctuary

In addition to relocating the proposed parking lot, it may be prudent in anticipation of the designation of the proposed fish sanctuary in the Negril Environmental Protection Plan to move the fish sanctuary boundary by approximately 75 – 100m north. The border should then be extended westwards so that the area of the sanctuary remains the same. This long-term planning may not only minimize costs at a later date, but will also minimize delays due to process and negotiation and indeed enhance the hotel's community image.

The use of the designated fish sanctuary area is not prohibited, but may have to be limited by the hotel in creative and innovative ways, maybe even in association with the environmental groups.

6.5 Overview of Alternative Analysis

Based on the above, the most environmentally sound alternative is the development of the guest area as proposed, the relocation of the proposed parking area to the present batching plant site and the demarcation of the fish sanctuary areas for lower carrying capacity and possibly special environmental projects.

The findings of the alternative analysis were discussed with RIU hotels and they have agreed to the preservation of the flora and fauna of the originally proposed parking lot site and will therefore relocate the parking lot to the existing batching plant site.

7.0 ENVIRONMENTAL IMPACT IDENTIFICATION & MITIGATION

An environmental impact is defined as any change to an existing condition of the environment. The nature of the impacts may be categorised in terms of:

- Direction - positive or negative
- Duration - long or short term
- Location - direct or indirect
- Magnitude - large or small
- Extent - wide or local
- Significance - large or small

To systematically identify the impacts associated with the proposed hotel development, an impact matrix was constructed which arrayed the main project activities against the relevant environmental factors. This matrix is shown in Tables 7.1 and 7.2.

Table 7.1: Impact Matrix for Site Preparation and Construction

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. **Site Preparation**												
Retain Veg. Corr. (Hotel Site)	x		x		x		x		x		x	
Veg. Remov. – Hotel Site		x	x		x		x			x		x
Veg. Remov. – Parking Lot		x	x		x		x		x		x	
Habitat Remov. – Hotel Site		x		x		x		x		x		x
Habitat Remov. – Parking Lot		x	x			x	x			x	x	
Increased infiltration/runoff		x		x		x		x		x		x
Increased flood potential		x		x	x			x		x		x
Increased soil erosion		x		x		x		x		x		x
Noise		x		x	x			x		x		x
2. **Cut, Fill & Levelling**												
Generated solid waste		x		x	x		x			x		x
Dust		x		x	x		x			x		x
3. Material Transport												
Dusting & spillage		x		x	x			x	x			x
Traffic congestion, road wear		x		x	x			x	x			x
Routing through Negril		x		x	x			x		x		x
4. Improper Material Storage												
Dusting		x		x	x		x			x		x
Suspended solid runoff		x		x	x			x		x		x
5. Construction Works												
Noise		x		x	x			x		x		x
Dust		x		x	x			x	x			x
Beach enhancement/ damage/modification		x	x		x	x	x			x	x	
Mangrove/seagrass removal		x	x		x		x		x		x	
Visual intrusion		x	x		x		x			x		x
Refuelling of vehicles and fuel storage onsite		x		x	x			x		x		x
Repair of vehicles onsite		x		x	x			x		x		x
6. Construction Crew												
Sewage generation		x		x	x			x		x		x
Solid waste generation		x		x	x			x		x		x
Emergency response		x		x	x			x		x		x
Food Hygiene		x		x		x		x		x		x
7. Landscape & Replanting												
Vegetation/habitat reintroduction	x		x		x		x		x		x	
8. Employment												
Job creation	x			x	x		x			x	x	

Table 7.2: Impact Matrix for Operational Phase

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. **Water supply/Consumption**												
Sustainable supply	x		x			x		x	x			x
Water conservation methods	x		x		x		x			x	x	
2. **Wastewater generation/Disposal**												
Sewage		x	x			x	x			x		x
Laundry		x	x			x		x		x		x
3. Transportation/Traffic												
Traffic congestion		x	x			x		x		x		x
4. Beach Use/Carrying Capacity												
Water Pollution		x	x		x			x	x		x	
Erosion		x	x		x			x		x		x
Overcrowding		x	x		x			x		x		x
Access		x	x		x		x			x	x	
Solid waste generation & disposal		x	x		x			x		x		x
Water sports		x	x		x		x			x	x	
5. Emergency Response												
Emergency response		x	x		x			x		x		x
6. Landscaping												
Vegetation/habitat removal		x	x		x			x		x		x
Local veg./habitat intro. (Hotel Site)	x		x		x			x	x		x	
Retain Veg. Corr. (Hotel Site)	x		x		x		x		x		x	
Retain tree canopy/habitat (P. Lot)	x		x		x		x		x		x	
Improved aesthetics	x		x		x		x		x		x	
7. Site Access Road												
Increased surface runoff		x	x		x			x		x		x
8. Security Lights												
Disturbance of nocturnal fauna		x	x			x		x		x		x
Visual intrusion		x	x		x		x			x		x
9. Employment												
Job creation	x		x		x		x			x	x	

7.1 Site Preparation and Construction

Impact: Effect on ecosystems and tree conservation

Vegetation clearance and construction associated with the proposed development, will inevitably mean the removal of some of the existing vegetation at both the hotel and parking lot sites. The issue, therefore, is which species can be removed, how many individuals would be lost and which sections of the sites they would be removed from. The environmental NGOs and NEPA are specifically interested and concerned about the impacts that this vegetation removal would have on the existing environment and the overall woodland habitat of the site, and its corresponding terrestrial fauna.

Several flora and fauna species were identified during the 4 - 5 days of terrestrial surveys conducted at the proposed sites (see Section 4.2). These include avifauna (birds), crabs, amphibians, reptiles and insects, which are not only independent entities and classes but together make up a complex ecosystem. This system is dependent on the interactions, food chains, food webs and relationships that exist between the various floral and faunal classes found on the project site. Therefore, changes made to the diversity or abundance of any given organism, has a potential impact (either positive or negative) on other seemingly non-related organisms residing on and frequenting the project sites. The proposed alterations to the existing environment at the proposed sites should therefore be carefully considered before implementation.

Critical ecosystem and habitat preservation species include onsite vegetation, the amphibians, the reptiles, and the insect populations identified under Section 4.2.4. Avifauna (inclusive of many of the resident and endemic species) rely directly and indirectly on the existence, diversity and the numbers of amphibians, reptiles and insects present at the site. These amphibians, reptiles and insects in turn rely on the diverse floral habitat and species found at the sites. Any large-scale removal and clearance of

vegetation from either the proposed hotel site or the proposed parking lot site is unacceptable. Mitigation methods are discussed below.

Mitigation

The main issue and goal in this development is to retain and maintain adequately-sized, representative sections of the main onsite terrestrial floral and faunal habitats. These habitats are required for the retention of the amphibian, reptile and insect species at the site which themselves support the crab and avifauna populations residing and utilising the site as a living and foraging habitat. In this regard, the implementation of the following mitigation measures are suggested:

(i) **Minimal removal of trees throughout all phases of the project life cycle** (i.e. site preparation and the construction and operational phases of the project). The proposed final landscape plan should seek to incorporate tree species and individuals already present on the site as much as is practicable. This will also enhance the aesthetic quality of the hotel.

(ii) **No conversion of existing onsite habitat in favour of a lower density monoculture** of coconut/other introduced ornamental species; and/or reduction in the species and number of floral individuals at the site, in favour of extensive wide open, cleared, bare or grassed spaces unless absolutely necessary.

(iii) A **Tree Preservation Plan** is recommended before construction work begins. RIU's design architect and suitable representatives from the national regulatory agency, NEPA, must arrange a meeting at the project site to agree on and approve a final layout plan for the hotel that best suits the interests of the developer, yet seeks to retain as many of the onsite trees.

The plan will address the following recommendations:

- The designation, retention and maintenance of a closed-canopy (or partially closed-canopy) vegetation/tree corridor comprising existing site vegetation is ideal. A width of 30m is recommended in the proposed design and supported by the consultant.
- Trees/vegetation that fall within the building footprints of the approved layout plan should be preserved.
- Trees and vegetation stands throughout the remainder of the site that have a Diameter at Breast Height (DBH) of 18 cm.

The selection of these trees should be agreed upon by BOTH the developer and NEPA representatives and should be physically and clearly marked for

protection. Some trees were already marked during the fieldwork for this study (section 4.2.1.2). Selected trees should also be clearly marked and surveyed onto RIU's final layout and "existing vegetation" topographic (CAD) drawings. These drawings must be subsequently passed on to the building contractor, with specific instructions with regards to implementing and adhering to the vegetation preservation plans and drawings.

The consultant recommends marking the selected vegetation, and then removing them (with their root systems intact). They are then kept alive in a temporary designated onsite nursery area and replanted onsite during landscaping and the operational phase of the project.

In addition, legally binding "stop order" caveats must be written into the building contractor's work contract, with regards to any violation of the tree retention and preservation agreements made under (v), above. Evidence of violation or unauthorised deviation from the NEPA-agreed tree preservation and final hotel layout plans, must result in the "stop order" caveats being invoked by onsite monitoring representatives (see iv above), pending a detailed review of onsite site clearance/construction practices and more regular, stricter and stringent policing of these practices.

(iv) During site preparation, site clearance and site construction, tree preservation, retention and removal must be **closely monitored and policed by an independent, qualified entity**. These onsite monitoring representatives should be selected in consultation with (a) local environmental interest groups in Negril, (b) NEPA/NRCA, and/or (c) the EIA consultants.

Impact: Preservation of Endemic Species

As reported in Section 4.2.1.3, the bromeliad *Hohenbergia sp. w*as observed throughout the site. The trees *Roystonea* and *Thrinax* were also obvious. These will also be considered in the Tree Preservation Plan, but also need to be highlighted as the preservation of these plants is not only of local importance, but national significance.

Mitigation

Those trees onsite (*Roystonea* and *Thrinax*), which support the endemics Hohenbergia sp., must not be cut down.

- The trees may be relocated and preserved.
- The *Hohenbergia*, however, must not be removed or their host trees affected. They must be kept, along with these epiphytes, undisturbed and in place. Prior to any issue of a NEPA construction permit, and prior to any commencement of work on the site, the final set of layout plans and building footprints for the hotel must be readjusted and shifted to accommodate this mitigation measure and must reflect and clearly show the location of these trees and the intent to retain and preserve them.
- As only one specimen of the orchid, *Tropida* was encountered on the forest floor, the presence of more than one specimen of this species needs to be determined and if necessary, removed to a sanctuary and re-introduced to the site.
- *Phyllanthus acuminatus* is a small tree and further searches of the site should be made in the development of the Tree Preservation Plan to determine the numbers present and implement a protection plan.
- The tree preservation and endemic species conservation plans could also consider preservation and relocation and of these species on the site for landscaping or tourist attraction.

Impact: Proposed Parking Area in significant ecosystem

The proposed site for the parking area should not be disturbed as it is a climax community, one of the remaining swamp-margin forest in Negril and serves as a habitat for avifauna, frogs and invertebrates present on-site. This site is also the buffer zone to the swamp ecosystem, which is also a protected area. The main issue and goal, at this

site, is not so much the potential loss of tree species and individuals, but the maintenance of the closed tree canopy. In the absence of significant understorey vegetation and undergrowth, the closed tree canopy is the primary nesting and feeding habitat for insects and birds at the proposed parking lot site. Change, modification and loss of this closed canopy will result in a major significant negative impact on bird species at the site. These bird species not only need the canopy for food and nesting, but also rely on it for cover and a sense of safety. Unapproved tree felling and removal at this site is likely to have the greatest impact on the endemic bird species.

Mitigation

An alternative site, for the construction of the proposed RIU parking lot, should be seriously considered and investigated.

In the absence of an alternative site, the existing closed tree canopy habitat must be maintained and should not be opened any more. Only trees necessary to allow sufficient access into the parking lot should be removed. The lot must be constructed and contoured around the existing onsite trees.

Impact: Noise Pollution

Site clearance and construction of the proposed development necessitates the use of heavy equipment to carryout the nature of the job. These equipment include bulldozers, backhoes, etc. They posses the potential to have a direct negative impact on the environment.

Mitigation:

- Use equipment that has low noise emissions as stated by the manufacturers.
- Use equipment that is properly fitted with noise reduction devices such as mufflers.
- Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) so as to reduce the potential of creating a noise nuisance during the night.
- Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

Impact: Air Quality

Site preparation and construction has the potential to have a two folded direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation. The second is from fugitive dust from site roads, cleared areas and raw materials stored on site. Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

Mitigation:

i. Site roads should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.

ii. Minimize cleared areas to those that are needed to be used.

iii. Cover or wet construction materials such as marl to prevent a dust nuisance.

iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

Impact: Employment

During this phase, an average of six hundred (600) trade men and labourers will be utilized and at peak construction an estimated 1200 will be needed. This represents a significant level of employment within he study area. This has the potential to be a significant positive impact.

Mitigation

Not required

Impact: Solid Waste Generation

During this construction phase of the proposed project, solid waste generation may occur mainly from two points:

i. From the construction campsite.

ii. From construction activities such as site clearance and excavation.

Mitigation:

i. Skips and bins should be strategically placed within the campsite and construction site.

ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.

iii. The skips and bins at the construction site should be adequately covered to prevent a dust nuisance.

iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.

v. Disposal of the contents of the skips and bins should be done at an approved disposal site. The Retirement dump in St. James is recommended. Appropriate permission should be sought.

Impact: Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with showers and sanitary conveniences. The disposal of the wastewater generated at the construction campsite has the potential to have a minor negative impact on groundwater. No significant environmental impacts were identified from this activity.

Mitigation:

i. Provide portable sanitary conveniences for the construction workers for control of sewage waste. A ratio of approximately 25 workers per chemical toilet should be used.

ii. Connect to the NWC sewer main.

Impact: Storage of Raw Material and Equipment

Raw materials, for example sand and marl, used in the construction of the proposed development will be stored onsite. There will be a potential for them to become air or waterborne. Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils etc.

Mitigation:

i. Raw materials that generate dust should be covered or wet frequently to prevent them from becoming air or waterborne.

ii. Raw material should be placed on hardstands surrounded by berms.

iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.

iv. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by berms to contain the volume being stored in case of accidental spillage.

Impact: Transportation of Raw Material and Equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along the Norman Manley Boulevard especially at the entrance to the construction site.

Mitigation:

i. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example reduced speed near the construction site access road. This should be done in conjunction with the Ministry of Transport and Works.

ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.

iii. Trucks transporting raw materials should be made to enter the proposed site through one access point and leave through another. The trucks should be parked on the proposed site until the they are off loaded. This will prevent the build up of trucks along the Norman Manley Boulevard.

iv. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.

v. The use of flagmen should be employed to regulate when trucks have access to the construction site or to Norman Manley Boulevard.

Impact: Food Hygiene

The establishment of a construction campsite will cause a proliferation of "cook shops" (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu likes symptoms such as nausea, vomiting, diarrhoea or fever.

Mitigation:

i. Provision of adequate supply of potable water.

ii. The monitoring of the various 'cook shops" by public health authorities, and with the monitoring of the construction management team, to ensure proper hygiene is being followed.

iii. The provision of areas to adequately wash hands and utensils.

Impact: Emergency Response

Construction of the proposed hotel will involve approximately 600-1200 construction workers. The possibility of accidental injury is high. There maybe either minor or major accidents.

Mitigation:

i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to he construction workers.

ii. The RIU construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Tropical Bay to be on call for the construction site.

iii. Make prior arrangements with health care facilities such as the Negril Health Center or the Lucea hospital to accommodate any eventualities.

iv. Arrange with health practitioners to be on call during the construction period.

v. Material Safety Data Sheets (MSDS) should be store onsite.

7.2 Operations

Impact: Earthquake Hazard

From the catalogue of earthquakes impacting Jamaica over the past 300 years, most of the larger earthquakes recorded/reported were offshore. The earthquakes occurring on land tend to be of low magnitude. From a historical seismic perspective, the site is no more prone than any other area on the island.

The major earthquake source zone on land is the Wagwater Belt in the western Blue Mountain area. The proposed site is more than two hundred kilometres (200km) from this source zone and therefore earthquakes in this area are not expected to cause significant damage at the proposed site. Given the distance of the proposed development from this source zone, the impact relating to earthquakes can be considered as moderate to low

The site is underlain by saturated sand with peat lenses. A moderate to high intensity earthquake impacting the site could adversely impact the development. There is also the potential for soil liquefaction or excessive ground acceleration.

Mitigation

i. Proposed structures to be constructed at the site are low-rise and this implies a moderate to low earthquake hazard with respect to life and property.

iii. To minimize earthquake impact it is recommend that the buildings at the site should be designed and constructed to withstand moderate to large earthquakes.

iv. An emergency response plan to address natural and man-made disaster and possible evacuation is required by NEPA and should be developed in close consultation with the Office of Disaster Preparedness and Emergency Management (ODPEM).

Impact: Storm Surge

Storm Surge analysis for the site indicates that water level increases of 2.56 to 3.59 can be expected to occur for storms with Return Periods between 10 to 100 Years. These levels are well above the 1.0 m contour on the existing topographic survey and no floor levels were provided for the proposed buildings.

It is therefore reasonable to conclude that depending on the mitigation strategy adopted that significant landfilling or significant elevation of the proposed buildings will have to be carried out in order to prevent total inundation of the hotel.

Mitigation:

Two mitigations options can be employed for minimizing the likelihood of loss of life and damage to property from storm surge. These are as follows:

i. **No Loss and No Damage Option:** This option requires that all the buildings are elevated above the storm surge associated with the desired return period. The overall objective is to limit the amount of wetting of floor space. This option does however have its disadvantages. These include potentially excessive costs for landfilling and potential aesthetic issues with the landscape.

ii. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) and selective infrastructure such as the 1st floor and higher on the hotel blocks are elevated above a certain critical storm surge level. The overall strategy being to safe guard the operation of the hotel and to provide potential shelter for visitors that may be resident at the hotel on higher levels. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.

iii. Minimize the risk of storm surge implementing an effective disaster and emergency management and evacuation plan for the hotel.

Impact: Beach Erosion

The erosion analysis indicates that the site could experience an erosion loss of up to 25m of shoreline on the western end of the property. Fortuitously, there are no plans for

placing significant infrastructure in this zone. This erosion loss could hinder the operations of the hotel as far as guest satisfaction is concerned given the lack of beach space alternatives on this site.

Mitigation:

Storm event erosion can be mitigated or minimized by;

i. Should beach nourishment be desirable, then similar sized or coarser sand should be used for beach nourishment.

ii. Should the owner decide that the potential erosion losses are unacceptable, as far as operational risks are concerned, then coastal engineering options (such as submerged breakwaters and artificial sand dunes) could be considered. Such options, if carefully thought out, could provide the required protection against erosion while blending with the natural surroundings.

iii. Preservation of sea grass beds that help to anchor the seabed.

iv. Minimizing the risk of storm surge relates primarily to instituting an effective disaster and emergency management and evacuation plan for the hotel.

It should be noted that further detailed design conditions will be required to employ any of the aforementioned options.

Impact: Flooding

Flooding impacts relates to; a) flooding of the site by adjacent properties and b) flooding of adjacent property by the proposed development at the site.

The construction of the proposed hotel at the site will result in increase storm water runoff from the site. This is primarily due to the construction of buildings and paving of

the green areas. Present stormwater from the main road will also be prevented from entering the site. The pre and post development storm water runoff from the site is shown in Table 7.3. With the proposed development at the site, there will be an increase in runoff of approximately 46 to 56 percent. It is assumed that only approximately 50 percent of the site will be made impervious.

Table 7.3 Storm Water Runoff - Development Site

Return Period (yrs)	5	10	25	50
Pre Dev Runoff (ft^3/s)	20.6	28.1	37.9	48.5
Post Dev Runoff (ft^3/s)	42.1	54.6	71.5	86.6

Storm Water Runoff Estimate Calculation:

Storm water runoff to and from the site was estimate using the Rational Method:

$$Q = CIA$$

Q = Peak Runoff (cusecs)

A = Drainage area (acres)

I = Average Rainfall Intensity lasting a critical duration (t) and corresponding to a return period (T) used in the design.

C = Dimensionless runoff coefficient based on the degree of imperviousness and Infiltration capacity of the drainage surface.

Mitigation

Drains and absorption pits will be constructed at the site to accommodate the increased stormwater that should be generated from the site. Consequently the increased stormwater runoff from the site will not impact negatively on coastal waters or adjacent properties. The increased stormwater should not be directed to the coastline.

Stormwater that is presently generated on the main road will be prevented from entering the site. This water will be diverted into a drain paralleling the main road to discharge ultimately into a drain north of the site.

The runoff coefficients for the project site were obtained from published tables of runoff coefficients after a field survey of the physical characteristics of the site. The pre-development runoff coefficients range from 0.25 to 0.35, while the post-development runoff coefficient range from 0.77 to 0.90. The rainfall intensities for the maximum 24-hour rainfall for the rainfall station at Negril were used in the computation.

i. Storm water generated on the site should not be diverted onto the main road, as this will exasperate the flooding problem along this road. The adsorption pits must be designed to accommodate the increased runoff from the site.

ii. There should be no subsurface disposal of effluent at the site. Stormwater disposal system should not be used to dispose hazardous or other toxic substances either directly or indirectly.

Impact: Employment

During this phase, an average of four hundred (400) staff will be needed for the proper operation of the hotel. This represents an increase in the level of employment within he study area. This has the potential to be a significant positive impact.

Persons engaged in this phase will require training, which will result in an increase of persons with training in the hospitality sector.

Mitigation

Not required

Impact: Negril Marine Park Zonation

The Negril Environmental Protection Plan and more specifically the Negril Marine Park has zoned Bloody Bay (section 5.3.4). Of significance is the area that has been zoned as a replenishment area (fish sanctuary). Operation of the proposed hotel has the potential to impact negatively on this zone. In addition, the moratorium placed on motorized water sports within the Bay by the Tourism Product Development Company Ltd. (TPDCO) and supported by NEPA will impact on the hotel operation.

Mitigation

i. Mandate non-motorized crafts in proximity to the proposed fish sanctuary.

ii. Inform and educate guests about the proposed fish sanctuary and what is not allowed there.

Impact: Beach Use and Carrying Capacity

The beach at Bloody Bay is used for recreational and commercial purposes. It is used by residents and the guests of at least of eight (8) hotels. The addition of the proposed development in Bloody Bay will have a potential direct negative impact on beach use and carrying capacity. It will reduce the public beach area used by residents and tourists alike. However, the carrying capacity of the Bay will not be exceeded.

Mitigation:

i. RIU could work in tandem with the Urban Development Corporation to improve the facilities at the relocated public beach at Long Bay.

ii. TPDCO, NEPT or CBOs should conduct periodically surveys to determine if the carrying capacity is being exceeded.

Impact: Solid Waste Generation and Disposal

It is anticipated that approximately 2.5 tonnes (2,508 kg) of waste will be generated/day during the operation of the proposed development. The operation of the development has the potential of significantly increasing the solid waste at the site.

Mitigation:

i. Provision of solid waste storage bins and skips.

ii. Provision of adequately designed bins and skips to prevent access by vermin.

iii. Monitor beach garbage.

iv. Contracting a private contractor to collect solid waste in a timely fashion to prevent a build up.

v. Ensure that the solid waste collected is disposal in an approved dumpsite such as the Retirement dump in St. James.

Impact: Water Supply and Consumption

The analysis of the data supplied indicates that a hotel of the size and composition of the proposed hotel can be expected to consume approximately 382,200 LPD. However, the proposed conservation measures are expected to reduce this amount to approximately 276,533 LPD or approximately 27.6% less than the customary amount. In addition, the available amount of water is 7,280,000 LPD.

The proposed conservation measures are expected to have a significant beneficial impact on the reduction of the customary water consumption of such hotels. In addition, it can be reasonably concluded that the hotel is not expected to place any operational burden on the treatment plant.

Mitigation:

In addition to design and infrastructural measures for the reduction of water consumption, hotels also have to put operational measures in place to manage the use of this resource. Summarized is a list of recommended operational strategies for the reduction of water consumption.

Recommended Operational Checklist for Water Conservation

Areas	Strategies
Housekeeping	• Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet • Give guests the option of changing linen and towels every two or three days • Use only the minimum required amount of detergent in the laundry • Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary period • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation
Restaurant and Beverage	• Do not leave faucets running • Wash food products in buckets, bowls or containers • Use dishwasher with sufficient loads

Areas	Strategies
	• Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Report immediately any leaking and dripping faucet • Install infrared-activated faucets and toilets in restaurant rest rooms • Track the consumption of water by regular monitoring utility bills • Establish an effective employee training program about water conservation
Maintenance and Recreational	• Recover waste pool water for reuse • Make regular inspections of circulating pumps for water leakage • Report immediately any pool or faucet leakage • Purchase and use water-saving pool equipment • Track the consumption of water by regular monitoring utility bills • Establish an effective employee-training program about pool water conservation • Consult pool specialists about effective maintenance of swimming pool

Impact: Wastewater Generation and Disposal

The operation of a hotel generates significant amounts of wastewater from guest and from the operation of laundry and kitchen facilities. Analysis of the data provided indicates that the proposed hotel wastewater can be amply treated in the existing wastewater treatment plant. The estimated flow from the hotel is 248,880 LPD, were as the treatment plant has the capacity to take an additional 6,825,000 LPD. Wastewater treatment is therefore not expected to be an issue.

Grease

There are concerns about excess grease reaching the Negril Wastewater Treatment Plant. The proposed hotel has incorporated a grease trap in their design. The grease trap has a retention time of 7.26 hours, whilst the required (according o NWC) is 5.0 hours. It can therefore be concluded that the design meets and exceeds the NWC guidelines and it is expected to provide sufficient treatment. Grease and its potential adverse effect on the performance of the waste stabilization ponds is therefore not expected to be an issue.

Solid Waste Compactor Effluent

Hotels very often employ a solid waste compactor for minimizing the volumetric requirements of the solid waste that is generated and the required pick up interval. The solid waste that is usually emptied in these compactors consists of all kitchen wastes, except cardboard (which is usually recycled), yard trimmings and office waste. The kitchen waste usually generates a significant effluent stream after the activation of the compaction action. The waste stream is known to have a very strong effluent with BOD in excess of 20,000 to 50,000 mg/l. Because of the relatively small flow, it is usually poorly handled and allowed to flow either into the sewers or into the landscape.

There are no designs for the handling of this compactor effluent. However, the need for proper consideration has been discussed with the project's architect (Ms. Isiaa Madden). The project architect has agreed in principle and has expressed her intention to forward this information to the project's engineers.

<u>Mitigation:</u>

i. Recycle grey water (water from showers and sinks) for irrigation of the hotel grounds.

ii. Ensure that the strainers within the recycling system are adequately maintained.

iii. Ensure that the proposed hotel wastewater system is linked to the Negril Sewage System.

iv. Clean the grease trap periodically to maintain their effectiveness.

Impact: Storm Surge

Storm Surge analysis for the site indicates that water level increases of 2.56 to 3.59 can be expected to occur for storms with Return Periods between 10 to 100 Years. These levels are well above the 1.0 m contour on the existing topographic survey and no floor levels were provided for the proposed buildings.

It is therefore reasonable to conclude that depending on the mitigation strategy adopted that significant landfilling or significant elevation of the proposed buildings will have to be carried out in order to prevent total inundation of the hotel.

Mitigation:

Two mitigations options can be employed for minimizing the likelihood of loss of life and damage to property from storm surge. These are as follows:

i. **No Loss and No Damage Option:** This option requires that all the buildings are elevated above the storm surge associated with the desired return period. The overall objective is to limit the amount of wetting of floor space. This option does however have its disadvantages. These include potentially excessive costs for landfilling and potential aesthetic issues with the landscape.

ii. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) and selective infrastructure such as the 1st floor and higher on the hotel blocks are elevated

above a certain critical storm surge level. The overall strategy being to safe guard the operation of the hotel and to provide potential shelter for visitors that may be resident at the hotel on higher levels. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.

Impact: Beach Erosion

The erosion analysis indicates that the site could experience an erosion loss of up to 25m of shoreline on the western end of the property. Fortuitously, there are no plans for placing significant infrastructure in this zone. This erosion loss could hinder the operations of the hotel as far as guest satisfaction is concerned given the lack of beach space alternatives on this site.

Mitigation:

Storm event erosion can be mitigated or minimized by;

i. Should beach nourishment be desirable, then similar sized or coarser sand should be used for beach nourishment.

ii. Should the owner decide that the potential erosion losses are unacceptable, as far as operational risks are concerned, then coastal engineering options (such as submerged breakwaters and artificial sand dunes) could be considered. Such options, if carefully thought out, could provide the required protection against erosion while blending with the natural surroundings.

iii. Preservation of sea grass beds that help to anchor the seabed.

It should be noted that further detailed design conditions will be required to employ any of the aforementioned options.

Impact: Transportation/Traffic

The operation of a hotel requires that delivery trucks and traffic generated from activities of guest is inevitable. This has the potential of directly disrupting the flow of traffic along the Norman Manley Boulevard.

Mitigation:

i. Design the access road so that one can see clearly in both directions along Norman Manley Boulevard on exiting the development.
ii. Negotiate with the traffic and local authorities for the widening of the main road to include a turning lane.
iii. Add adequate and appropriate signs along the roadway in proximity to the proposed site.
iv. Limit delivery trucks to off-peak periods to minimise traffic hindrance and delay.

Impact: Emergency Response

The operation of the proposed hotel will involve workers and guests, who may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires are real possibilities.

Mitigation:

i. Have first aid kits located in various sections of the hotel.
ii. Make prior arrangements with health care facilities such as the Negril Health Center or the Lucea hospital to accommodate any eventualities.

iii. Arrange with health practitioners to be on call or have an in house physician/nurse.

iv. Design and implement an emergency response plan.

v. Staff should be trained in CPR.

vi. Coordinate with mutual aid organisations/agencies such as with the local fire brigade.

Impact: Water Pollution

There is no surface water source on the site to be polluted by activities at the site. The groundwater below the site is saline and cannot be used in its present state without treatment. There will be no subsurface disposal of effluent at the site and therefore the risk of groundwater contamination is negligible. The disposal of storm water into absorption pits could pose a threat to groundwater. Given that the groundwater below the site is of marginal quality, the risk is moderate to low.

Mitigation

i. There should be no direct disposal of effluent or storm water into the sea from the site and therefore the risk of coastal pollution from effluent disposal is negligible.

8.0 ENVIRONMENTAL MANAGEMENT PLAN

It is recommended that the hotel seek Green Globe certification. Green Globe came into being in 1994 and has been recognised by the tourist industry and governments as the only global environment programme for travel companies and destinations. It proposes ways that make use of our environment without damaging it and ways that allow all local people to benefit from tourism without destroying their culture.

It operates on the following principles;

1. **REDUCE YOUR COSTS** - All companies can reduce their energy water and waste related costs. A company that has recently implemented an energy management system can expect to **reduce energy costs by at least 25%**. Similar cost reductions can be achieved by employing the Green Globe 21 system to water consumption and waste production.
2. **REDUCE YOUR IMPACT ON THE ENVIRONMENT-** Reduced environmental impacts means reduced costs and a better product with broader market appeal. The Green Globe 21 system helps your company conform with environmental legislation and provides a good foundation for building your company's future business.
3. **WIDEN YOUR MARKET APPEAL** - Green tourists make up one of the fastest growing segments of the market. By joining Green Globe 21 your business is promoted on our website and you are able to use the Green Globe 21 logos on your marketing and publicity material to demonstrate your commitment and performance with respect to environmental issues. This can widen your current market appeal,

reduce seasonality and attract more environmentally sensitive customers.

4. **IMPROVE YOUR QUALITY** - The Green Globe 21 System can improve the quality of the customer experience by putting into place a culture that embraces sustainability (economically, environmentally and socio-culturally). All members of staff are brought into the environmental policy and management system. The system also provides mechanisms for letting your customers know about your approach to environmental issues.

Adapted from Green Globe 21 www.greenglobe21.com

9.0 ENVIRONMENTAL MONITORING PROGRAMME

9.1 Monitoring during Site Clearance and Preparation of the Proposed Hotel

- Inspections should be conducted to ensure that the endemic trees of *Roystonea*, *Thrinax* and *Phyllanthus* and those supporting the endemic epiphyte *Hohenbergia* are not removed or sustain any damage.

  This should be done by a qualified person. NEPA and/or NEPT could conduct these inspections.

  It is not anticipated that this exercise will incur additional costs.

- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition, a one off noise survey should be undertaken to determine workers exposure and construction equipment noise emission.

  RIU's project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed.

  It is not anticipated that this exercise will incur additional costs.

- Daily monitoring to ensure that the cleared areas and access roads creating a dust nuisance.

  RIU's project engineer / construction site supervisor should monitor the site clearance. NEPA should conduct spot checks to ensure that this stipulation is followed. In addition, the NGO's within the area can be used to provide additional surveillance.

  It is not anticipated that this exercise will incur additional costs.

- Undertake daily inspections of trucks carrying solid waste generated from site clearance activities to ensure that they are not over laden as this will damage the public thoroughfare and onsite lead to soil compaction.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of soil contamination from spills. Spot checks should be conducted by NEPA.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

9.2 Monitoring During the Construction Phase of the Proposed Hotel

- Weekly checks should be conducted on trees and other vegetation to ensure that they are not damaged and are responding to relocation and reinstatement.

  This should be done by a qualified person. NEPA and/or NEPT could conduct these inspections.

  It is not anticipated that this exercise will incur additional costs.

- Daily inspection of site clearance activities to ensure that they are following the proposed building plan and to ensure that site drainage and wastewater system are being constructed as planned. Check and balance can be provided by NEPA and the Negril Green Island Area Local Planning Authority (NGIALPA).

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake monthly water quality monitoring to ensure that the construction works are not negatively impacting on coastal water quality. The parameters that should be monitored are **salinity**, **dissolved oxygen**, **nitrates**, **phosphates**, **turbidity, faecal and total coliforms**.

The Negril Coral Reef Preservation Society (NCRPS) or any other organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

This is estimated to cost approximately **J$ 46,000** per monitoring exercise.

- Persons selling food to the construction workers should prepare and serve the food in a hygienic manner so as not to cause potential health problems. Each person selling food should provide a valid **Food Handlers Permit** and the pots and utensils used in the preparation of the food should be properly sanitized.

  Person(s) appointed by RIU may perform this exercise. It is recommended that this exercise be conducted at least once per month. In addition assistance maybe sought from the Public Health Inspector for the area.

  No additional cost is anticipated for this exercise.

- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition, a one off noise survey should be undertaken to determine workers exposure and construction equipment noise emission.

  RIU's project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. The noise survey maybe conducted by C.L

Environmental Co. Ltd., Environmental Solutions Ltd. or any other suitable qualified company or individual.

The monitoring of the construction work hours is not expected to incur any costs. The noise survey is estimated to cost approximately **J$46,000**.

- Daily monitoring to ensure that fugitive dust from cleared areas, access roads and raw materials are not being entrained in the wind and creating a dust nuisance.

  RIU's project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that this stipulation is being followed. In addition, the NGO's within the area can be used to provide additional surveillance.

  It is not anticipated that this exercise will incur additional costs.

- Undertake daily inspections of trucks carrying raw material to ensure that they are not over laden as this will damage the public thoroughfare and onsite lead to soil compaction.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that trucks carrying raw materials and heavy equipment are parked at the designated area on the proposed site so as to prevent traffic congestion along Norman Manley Boulevard.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that flagmen are in place and that adequate signs are posted along the roadway. This is to ensure that traffic along the Norman Manley Boulevard have adequate warnings and direction.

  Person(s) employed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. Additionally, solid waste generation and disposal of the campsite should also be monitored.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Weekly assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.

Person(s) appointed by RIU may perform this exercise.

No additional cost is anticipated for this exercise.

- Monitor and approve the suppliers and sources of local materials. Inspection of quarry and sawmill licences should be conducted to ensure that they are legal. Copies of these licences should be kept on file.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of soil contamination from spills. Spot checks should be conducted by NEPA.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment. The Negril Chamber of Commerce could be used as the watchdog to ensure that this is achieved.

Person(s) appointed by RIU may perform this exercise.

No additional cost is anticipated for this exercise.

9.3 Monitoring During the Operational Phase of the Proposed Hotel

- Weekly checks for approximately six (6) months should be conducted on trees that have been replanted for landscaping to ensure that they are responding to relocation and reinstatement.

  This should be done by a qualified person. NEPA and/or NEPT could conduct these inspections.

  It is not anticipated that this exercise will incur additional costs.

- Undertake monthly inspection of drainage, wastewater and recycling systems to ensure that they are in proper working order to negate potential detrimental environmental impacts from malfunctioning infrastructure example grease traps.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake quarterly water quality monitoring exercises for one year to ensure that the hotel operation is not negatively impacting on coastal water quality. The parameters that should be monitored are **salinity**, **dissolved oxygen**, **nitrates**, **phosphates**, **turbidity and faecal and total coliforms**.

  The Negril Coral Reef Preservation Society or any other organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

  This is estimated to cost approximately **J$ 46,000** per monitoring exercise.

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. This is to ensure that the skips and bins do not become overfilled.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake weekly assessment of the beach area to see if there is any damage. If so, there should be a reduction in beach use.

  Person(s) appointed by RIU may perform this exercise.

No additional cost is anticipated for this exercise.

- Undertake an assessment to ensure that beach access by locals is not prevented and the carrying capacity of the beach is not being exceeded.

  NEPA and NEPT may perform this exercise.

  No additional cost is anticipated for this exercise.

- Assess that the water conservation fixtures and methods that were proposed are installed and implemented.

  The Tourism Product Development Company Limited (TPDCO) may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, employees for the operation of the hotel should be sourced from within the study area. This will ensure that the local community will benefit from the investment. The Negril Chamber of Commerce could be used as the watchdog to ensure that this is achieved.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Quarterly checks should be undertaken on the proposed wastewater treatment plant for the compactors effluent to ensure that there is no excessive build up of solids. The system should also be desludged on an "as needed basis".

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise, except that Ja$10,000.00 per annum should be budgeted for desludging.

- Quarterly beach profile monitoring should be undertaken on the beach associated with and just adjacent to the hotel to determine the seasonal and long-term behaviour of the beach's plan form. This profiling should be undertaken at least six locations (100 m intervals) along the beach. Either permanent Bench marks or fixed infrastructure points should be employed to assure that profiles are consistently taken at the same location. The profiles should extend to the 1.5m water depth from fixed point on the back of beach.

  Person(s) appointed by RIU may perform this exercise or NEPA may wish to extend their monitoring programme to this area.

  No additional cost is anticipated for this exercise.

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