ENVIRONMENTAL IMPACT ASSESSMENT

BAHIA PRINCIPE HOTEL

RESORT DEVELOPMENT

PEAR TREE BOTTOM
ST. ANN, JAMAICA

Submitted to

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Frontispiece **Aerial view of Pear Tree Bottom, St. Ann**

EXECUTIVE SUMMARY

The developer, Hoteles Jamaica Piñero (HOJAPI), intends to build a 1,918-room resort development comprised of three hotels on 34 hectares (80 acres) of coastal land, part of an 80 ha (198 ac) of tract of land at Pear Tree Bottom, just west of Runaway Bay, St. Ann. This document presents the Environmental Impact Assessment (EIA) of the proposed resort as requested by the National Environment and Planning Agency in response to the development permit application.

The North Coast Highway traverses the property, dividing it into northern and southern sections. The three hotels are positioned on the northern section where the land is relatively flat and low lying at the coast and gently rising towards the south. The centralised support services facility (including laundry, stand-by generator, water treatment plant, workshops and stores, etc.) and the sewage treatment plant will be located on the southern and more elevated section of the property. Construction of the three hotels will last about 30 months.

The site is underlain by limestone and for the most part covered by degraded dry limestone forest and cleared areas. The soil consists of reddish-brown silty clay mixed with coarse to fine calcareous sand up to 5 meters deep. There are no defined surface drainage features and rainfall percolates readily.

There is a small marsh at the western end of the site; part of a larger wetland situated immediately north and west of the property. This wetland is hydrologically, and ecologically, linked to the sea via streams which arise from springs and blue holes in the south.

The shoreline is partially protected by a fringing coral reef situated about 90m offshore. The 200m depth contour and the abyss beyond, lies less than 500m from the shore. Behind the reef there is a shallow back reef area, which is in large part covered by seagrasses. This is an important nursery area for reef fishes. There is a sandy beach at

Pear Tree Bay and the previous owners constructed three groynes along the eastern shoreline to further create artificial beaches. These beaches were never completed and it is proposed that the project will add the sand fill. The reef crest is covered with debris thrown up by past hurricanes and is in poor ecological condition. However, the fore reef is one of the best inshore SCUBA diving sites in Jamaica and there the corals are in comparatively good health.

The dry limestone forest is home to two endemic and protected species in Jamaica, the Yellow Snake or Jamaican Boa and the Yellow-billed Parrot. On the marine side, Hawksbill and Green turtles have been seen on the reef and it is possible that they may nest on the beach at Pear Tree Bay. All these species are protected under the Wildlife Protection Act 1981 and also under the UN Convention on the International Trade in Endangered Species (CITES). No crocodiles or manatees have been reported in the Pear Tree River, the wetland or in nearby coastal waters.

The significant environmental impacts identified by the EIA are discussed briefly below.

Construction Phase

- ◊ Loss of land use options – resort construction implies an irreversible commitment of land resources
- ◊ Loss of terrestrial habitat and biodiversity - construction of the hotels will mean the loss of much of the existing vegetation and associated habitat.
- ◊ Sand filling of artificial beaches – implies *inter alia* removal of marine nursery habitat and suspension of sediments in water column
- ◊ Deepening of back reef area – will cause suspension of sediments in water column and some loss of seagrass habitat
- ◊ Construction waste disposal – generation of considerable quantities of solid waste requiring proper disposal
- ◊ Roadside vending – unsightly aggregations of stalls, littering and haphazard parking of vehicles induced by presence of construction site.

Except for the first, where loss of options is the trade off for tourism benefits, most of the negative impacts can be mitigated. The positive impacts arising from the construction phase are:

◊ Replanting and landscaping – part restoration of lost habitat, and

◊ Employment – opportunities for income generation and economic activity brought about by hotel construction.

Operations Phase

◊ Sewage generation - treatment and disposal of about 2,000m^3/day of sewage

◊ Solid waste generation – collection and disposal of considerable amounts of waste packaging, plastics, glass, etc.

◊ Electricity generation (co-generation) – noise and vibration issues associated with constant operation of plant as well as fuel spill risks

◊ Misuse of coral reefs – severe damage to corals due to recreational boat anchoring, marine souvenir collecting, and careless diving technique.

◊ Squatting and uncontrolled settlement – induced by presence and economic opportunities provided by resort.

These potential impacts can also be mitigated as indicated in the EIA report. Of course employment at the resort provides opportunities for income generation and economic activity. **Squatting and uncontrolled settlement is the most critical environmental issue and must be seen as a cumulative impact given the other major tourism developments taking place along the coastal corridor between Montego Bay and Ocho Rios.**

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1. INTRODUCTION

1.1 PURPOSE AND BACKGROUND

The Client, Hoteles Jamaica Piñero (HOJAPI), intends to build a 1,918-room resort development (three hotels) on 34 hectares (80 acres) of coastal land, part of 80 ha (198 ac) of tract of land at Pear Tree Bottom, just west of Runaway Bay, St. Ann (Figure 1.1). The development site lies immediately north of the North Coast Highway. The project is to be carried out in three phases, each involving the construction of a hotel. This document presents the Environmental Impact Assessment (EIA) of the proposed resort.

Resort developments exceeding twelve rooms are included in the list of prescribed activities, which under the 1991 Natural Resources Conservation Authority Act (NRCAA) require an application for permission to develop. The National Environment & Planning Agency (NEPA), which administers the NRCAA, has requested the preparation of an EIA of the project as a requirement for review of the application. Environmental Solutions Ltd. (ESL) has been engaged by HOJAPI Ltd. to prepare the EIA and to provide assistance in related activities.

The frontispiece provides an aerial overview of the project site. The North Coast Highway traverses the site, separating a northern coastal portion on which the three hotels will be built from a southern hilly portion, covered largely with dry limestone forest. Originally the main road between Runaway Bay and Discovery Bay ran immediately behind the shoreline until the early 1990's when the road was diverted to run inland as part of an earlier proposed development of the site as a resort. This new road bisected a fresh water marsh located west of the site, requiring the construction of a bridge and culverts to allow passage of the existing Pear Tree River and associated waterways. That development included the construction of stone groynes along the shoreline to create three artificial beaches. The development site was sold to HOJAPI in 2004.

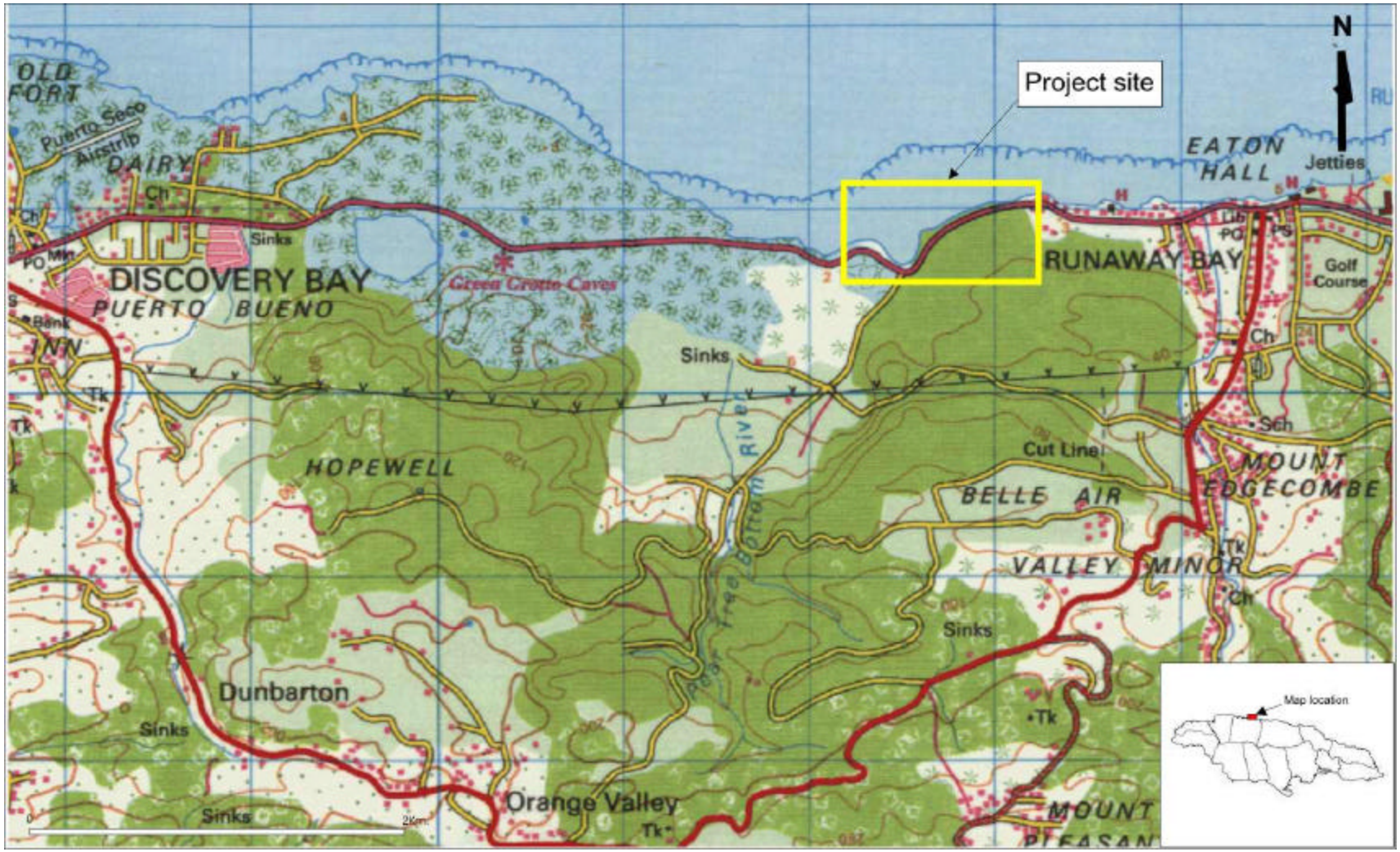

Figure 1.1 Location map

1.2 TERMS OF REFERENCE

The Terms of Reference for the Environmental Impact Assessment of the proposed Bahia Hotel Resort Development are provided below. These were adapted from World Bank guidelines and take account of the contents of the draft TOR provided by NEPA in their letter of 21 October 2004.

1. *Introduction - Identify the development project to be assessed and explain the executing arrangements for the environmental assessment.*

2. *Background Information - Describe briefly the major components of the proposed project, the implementing agents, and include a brief history of the project and its current status.*

3. *Study Area - Specify the boundaries of the study area for the assessment as well as any adjacent or remote areas within the area of influence of the project.*

4. *EIA Team – Identify the individuals responsible for collecting the data and carrying out the impact assessment and their respective skills.*

5. *Scope of Work - The following tasks are to be undertaken:*

   Task 1. Description of the Proposed Project - Provide a full description of the overall project (three hotels built in three phases) and its existing setting using plans, maps and graphic aids at appropriate scales. This is to include: hotel locations; general layout (size, capacity, etc.); areas slated for development, wetland/mangrove/seagrass encroachment; pre-construction and construction activities; construction methodology (buildings, piling, etc.), site management, operation and maintenance activities; project life spans; plans for providing utilities, waste disposal and other necessary services; and employment. Specific attention is to be given to the proposed means of sewage treatment, level of treatment, and mode of effluent disposal.

Task 2. Description of the Environment - Describe the physical, ecological, demographic, socio-cultural and institutional setting of the project. Review and present information that provides an insight into previously existing conditions of the site and the influences of past development initiatives. Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area, including the following:

a) *Physical environment: coastal mainland and wetland features; topography; geology; soils; climate and meteorology; hydrology; drainage and storm water runoff; inshore water currents; shoreline structure; and marine water quality[1]. Any existing sources of pollution and the extent of contamination relevant to the project area are to be identified. The natural hazard vulnerability of the site is also to be considered, particularly with respect to hurricanes and storm surge.*

b) *Biological environment: flora and fauna of the terrestrial, mangrove, sea grass, and coral reef ecosystems on and adjacent to the project site. Specify rare or endangered species, species of commercial importance, and species with potential to become vectors or nuisances.*

c) *Socio-cultural environment: present and projected population size, land use, community structure, issues related to squatting and relocation, current development plans, recreation and public health, public and community perceptions and attitudes on the proposed project, and any historical sites affected by the project. Identify the solid waste management facilities to be used by the project and assess public perception of the proposed development.*

Task 3. Legislative and Regulatory Considerations - Describe the pertinent environmental laws, regulations and standards governing coastal structures, land use control, environmental quality, health and safety, protection of mangroves

[1] Parameters to include: Temperature, Salinity, DO, BOD, Turbidity, TSS, NO_3, PO_4, and faecal coliforms.

and other sensitive areas, and protection of endangered species. Particular reference is to be made to the Town and Country Planning (St. Ann Parish) Provisional Development Order, 2000.

Task 4. Determination of Potential Impacts – Identify the major issues of environmental concern and indicate their relative importance to the design of the project. Distinguish long-term and short-term impacts, construction and post-construction phase impacts, positive and negative impacts, and direct and indirect impacts. Identify the significant impacts and those that are cumulative, unavoidable or irreversible. Identify impacts through use of a matrix arraying the project activities against relevant environmental factors.

Reference should be made to the extent and quality of the available data and any information deficiencies and uncertainties associated with the prediction of impacts should be clearly identified.

Task 5. Mitigation and Management of Negative Impacts - Recommend feasible and cost-effective measures to prevent or to reduce the significant negative impacts to acceptable levels.

Task 6. Development of a Monitoring Plan - Prepare the outline of a plan for monitoring the impacts of the project and the implementation of mitigating measures during construction. This plan is to be detailed after the permit for the project is granted and the construction plans for the project have been finalized at which time the plan is to be submitted to NEPA for approval.

Task 7. Determination of Project Alternatives – Examine alternatives to the project including the no-action option and alternatives involving reductions in the scale and footprint of the development.

Task 8. Assist in Inter-Agency Coordination and Public/NGO Participation - Assist in coordinating the environmental assessment with the government agencies and in obtaining the views of local NGO's and affected groups. Manage

and coordinate the public hearing on the EIA findings as required by the NEPA permit approval process.

6. *<u>Report</u> - The environmental assessment report is to be concise and limited to significant environmental issues. The main text is to focus on findings, conclusions and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental assessment report is to be organized according to the outline below.*
    - o *Executive Summary*
    - o *Policy, Legal and Administrative Framework*
    - o *Description of Proposed Project*
    - o *Description of the Environment*
    - o *Significant Environmental Impacts and Impact Mitigation Measures*
    - o *Environmental Monitoring Plan*
    - o *Project Alternatives*
    - o *Inter-Agency and Public/NGO Involvement*
    - o *List of References*

1.3 STUDY TEAM

The multidisciplinary skills required to conduct the EIA were assembled from expertise at and available to ESL. The core team was made up of the following persons:

- ◊ Peter Reeson, M.Sc. - Principal Consultant; EIA Specialist and Ecologist
- ◊ George Campbell, M.A. – Socioeconomist
- ◊ Aedan Earle, M.Sc. – Geologist and GIS Specialist
- ◊ Margaret Williams, Ph.D. – Terrestrial Ecologist
- ◊ Sharonmae Shirley, M.Phil. - Environmental Chemist
- ◊ Andrea Lanigan, M.Phil. – Marine Biologist

1.4 METHODOLOGY

The previous owners, who had intended to build a low-density resort development, carried out several environmental studies out of the development site. These earlier studies, which particularly looked at the hydrology in relation to water supply and the marine ecology in relation to proposed shoreline modifications provided a base of information for this EIA. The data collection methodologies employed for this study are described below.

1.4.1 Terrestrial ecology

The status of the terrestrial flora and fauna of the study area were determined by a review of literature relevant to the area, by discussions with local persons, and by field investigations undertaken on 15 February 2005. Seven representative sites or stations were visited; five on the proposed resort site north of the main road and two stations south of the main road on lands also owned by the developer.

The terrestrial vegetative communities were identified using the method of Grossman *et al* (1991) and classified into community types. The dominant tree species in the proposed development area were identified.

Birds were recorded by sight and by sound for half-an-hour at each station. Their identification was facilitated by reference to Downer and Sutton (1990) and Bond (1985). The dense woodland behind Station 7 was fairly impenetrable and the more cryptic species likely to occur in that habitat were not seen. Butterflies were captured using butterfly nets and identified from their wing patterns using Brown and Heinemann (1972). Information on endangered reptiles was gathered from the Seven Oaks Sanctuary for Wildlife in St. Ann.

1.4.2 Marine ecology

The description of the inshore marine area adjacent to the site was obtained primarily from earlier EIA reports prepared in relation to various coastal modifications carried out by the then owners (Harvey, 1993, & Harvey et al., 1997). A survey to confirm the

current status of the coral reef and back reef lagoon has been undertaken but the findings were not available in time to meet the deadline for submission of the EIA. This report will be provided later as an addendum to this EIA. However, verbal communication from the marine biologist confirms that the current status of the reef is much the same as described by the earlier reports by Harvey, particularly with respect to the deep reef.

1.4.3 Water quality

Water quality analyses were made of samples taken on 19 January 2005 at selected stations to assess baseline water quality conditions of the surface water systems. The five sampling stations were selected based on their location relative to the discharge points of major water streams, and to their risk of contamination. The station locations are shown at Figure 1.2 and described in Table 1.4.1.

Figure 1.2 Map showing location of water quality sampling stations

Table 1.4.1 Location of water quality sampling stations

STATION #	LOCATION
1	Western end of property.
2	Middle of Pear Tree Bay area.
3	Pear Tree River – under the new North-coast Highway bridge.
4	Little Pear Tree River – under the old road bridge.
5	Middle of West Bay – where both river discharges into the sea.

Samples were collected at a depth of 0.5m from a boat (marine stations) or from the riverbank (river stations). All samples were collected in pre-cleaned 2 litre and 1litre polyethylene sample bottles. Bacterial samples were collected at the water surface in sterilized 100 ml glass bottles.

The samples were analysed for the following parameters:

- pH
- Temperature
- Salinity
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Turbidity
- Nitrate
- Phosphate
- Total and Faecal Coliform

Salinity, temperature, dissolved oxygen and pH were measured *in situ* using an YSI Model 57 Salinity/Conductivity/Temperature (SCT) meter, a YSI Model 33 oxygen meter and an Oakton 10 Series pH meter respectively. Measurements were taken at 0.5m depth.

Environmental Solutions Limited Laboratory performed or supervised the analysis of all parameters. Laboratory analyses used certified methodology, primarily based on

'Standard Methods for Examining Water and Wastewater'. The results of the water quality survey are presented and discussed below at Section 3.9.

1.4.4 Sociology

Rapid rural appraisal techniques were used in nine communities neighbouring Pear Tree Bottom. Of these communities three were fishing beaches, and six were residential. The survey included two unoccupied resort villas on the hotel site. The process involved windscreen observations, in-depth structured interviews as well as non-structured ad hoc discussions with key informants, other individuals and groups. Both Government agencies and private sector enterprises were canvassed. Demographic data was sourced from STATIN and hydrological data from The National Water Authority.

2. ENVIRONMENTAL POLICY, LEGISLATION AND REGULATORY FRAMEWORK

The environmental laws and regulations of Jamaica relevant to the proposed resort development project at Pear Tree Bottom are listed and commented upon below.

2.1 LEGISLATION AND REGULATIONS

2.1.1 Natural Resources Conservation Authority Act (1991)

This is the main environmental legislation that relates to the proposed project. This Act establishes the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development through the protection and management of the country's natural resources and the control of pollution. This is done mainly through an environmental permit and licence system.

The Act enpowers the Authority to:

- issue permits to the person responsible for undertaking any enterprise, construction or development of a prescribed category in a prescribed area [Section 9]. This section, the Prescribed Area Order, designates all of Jamaica as being within the prescribed area;
- issue licences for discharge of trade or sewage effluent or for construction or modification of any works for such discharge [Section 12 (1) (a) and (b)];
- request information or documents as the Authority thinks fit [Section 10 (1) (a)];
- request an environmental impact assessment containing such information as may be prescribed [Section 10 (1) (b)];
- request information on pollution control facilities [Section 17];
- revoke or suspend permits.

The Act also incorporates the earlier Beach Control Act, Wildlife Protection Act and Watersheds Act.

2.1.2 Beach Control Law (1955) and Beach Control Act (1978)

This act has been re-authorized under the NRCA Act and is currently under review. The regulations of 1978 relate to hotels, commercial and public recreational beaches, regulated beach activities, care of beaches and rights of license. The Beach Control Act extends only to the foreshore; and while it provides for the designation of protected areas it does not address the basis for such designation nor does it deal with the management of coastal resources landward or seaward of the foreshore. The Beach Control Law requires that an application be made for the encroachment on or modification of any beach/coastline and for which it requires the posting of public notices.

2.1.3 Wild Life Protection Act (1945)

Prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams. It authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act, inter alia, are six species of sea turtles.

2.1.4 Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

The Island and the Territorial Sea of Jamaica has been declared as a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit.

2.1.5 Natural Resources Conservation (Permits and Licenses) Regulations (1996)

These regulations give effect to the provisions of the Prescribed Areas Order. Hotel/resort complexes of more than 12 rooms, as well as sewage treatment facilities, are included on the prescribed list.

2.1.6 Natural Resources Conservation (Sewage Effluent) Regulations (Draft)

These regulations, when brought into effect, will regulate the discharge of sewage effluent, the operations, monitoring and reporting mechanism of sewage treatment facilities. The effluent discharge standards, including those for irrigation, are exhibited at Table 3.1 below.

Table 3.1 NRCA Draft Sewage Effluent and Irrigation Standards

Parameter	Effluent Limit	Irrigation Limit
pH	6-9	-
Biochemical Oxygen Demand (BOD_5)	20 mg/l	15 mg/l
Chemical Oxygen Demand (COD)	100 mg/l	<100 mg/l
Total Suspended Solids (TSS)	20 mg/l	15 mg/l
Total Nitrogen	10 mg/l	-
Phosphate	4 mg/l	-
Faecal Coliform	200 MPN/100 ml	12 MPN/100ml
Residual Chlorine	1.5 mg/l	0.5 mg/l
Oil & Grease	-	10 mg/l

2.1.7 Water Quality NRCA Act (1990)

The NRCA has primary responsibility for control of pollution in Jamaica's environment, including pollution of water. National standards exist for industrial and sewage effluent discharges to rivers and streams.

2.1.8 Tourist Board (Water Sports) Regulations (1985)

These regulations govern the operation and conduct of water sports.

2.1.9 Town and Country Planning Act (1958)

Established the Town and Country Planning Authority with responsibility for Development Orders to control both rural and urban land development, ensure proper sanitary conveniences, co-ordinate building of roads and other public services. Building approvals for the project will have to be obtained from the Town Planning Authority at NEPA.

2.1.10 Town and Country Planning (St. Ann Parish) Development Order, 2000.

The Order defines the physical planning controls and guidelines for the development of St. Ann. It also confirms the realignment of the boundary on the Pear Tree property between the resort use area and the conservation area as being the old Parish Council road.

2.1.11 Quarries Control Act (1983)

This Act repeals the Quarries Act of 1958 and makes provisions for quarry zones and licenses, quarry tax, enforcement and safety. The proposed project should ensure that any earth materials used for the proposed construction of the resort are obtained only from licenced quarries.

2.1.12 Public Health Act

With respect to the ambit of this law, the Environmental health Unit is required to review the design and plans for sewage treatment.

2.2 POLICIES

2.2.1 National Policy for the Conservation of Seagrasses (1996)

This policy guides the issuing of licenses, or permits for activities such as dredging, disposal of dredged material, beach development and effluent disposal, which directly or indirectly affect seagrass communities. Seagrass meadows occur in the bay and along the shoreline at Pear Tree Bottom.

2.2.2 Mangrove and Coastal Wetlands Protection - Draft Policy and Regulations (1996)

This policy provides a review of the issues affecting wetlands in Jamaica as well as Government's role and responsibility. Five main goals are outlined which include guidelines for wetlands development, cessation of destructive activities, maintenance of natural diversity, maintenance of wetland function and values and integration of wetland

functions in planning and development. There are mangrove trees located at the shoreline at Pear Tree Bottom.

2.2.3 Coral Reef Protection and Preservation – Draft Policy and Regulations (1996)

This document reviews the ecological and socio-economic functions of coral reefs, issues affecting coral reefs and Government's role and responsibility. Five main goals are outlined which include reduction of pollutants, reduction of over-harvesting of reef fish, reduction of physical damage from recreational activities, improving the response capability to oil spills, and control of coastal zone developments. The proposed resort development project must endeavour to ensure that onsite and shoreline construction activities do not threaten or harm the fringing coral reef and back-reef habitats adjacent to the site.

3. DESCRIPTION OF STUDY AREA

3.1 TOPOGRAPHY AND DRAINAGE

The project site is located on a narrow coastal strip at the base of the northern extension of the Dry Harbour Mountain range (Figure 3.1.1). Here the limestone hills to the south, slope northwards from an altitude of 80 m in the vicinity of the plateau at Valley Minor in the south. Southwest of the project site the watershed of the Pear Tree Bottom River forms the dominant landform. At the base of the Pear Tree River valley the land surface flattens unto the an alluvial plain which then passes into the wetland that extends to the coastline lying to the west of the project site. This low-lying wetland extends to the west along the coast as far as Discovery Bay.

The project site north of the main road is relatively flat with a low lying flat area close to sea level in west and rising to a height of 20 meters in the central section of the site on the southern side. From the northeast the land rises gently towards the south. Here the elevation at the coastline is in the order of 1 m.

Surface drainage on the limestone hills just south of the project site is poorly developed with most rainfall percolating downwards through fissures and cracks in the rock. However the Pear Tree Bottom River that begins just south of Orange Valley flows northwards and enters the sea just to the west of the project site (Figure 3.1.2). Measurements of discharge from the Pear Tree Bottom River indicate an average flow rate of 45 m^3sec^{-1}. The Little Pear Tree Bottom River drains the northeastern part of the wetland and discharges into the sea through a culvert under the main road at the western end of the site.

The project site itself is relatively flat and has no distinct drainage features on the slopes. Some ponding is likely to occur in depressions within the flatter parts of the site. Storm runoff from the slopes is intercepted by the east-west running main road and therefore should prevent any significant storm runoff from flowing onto the site.

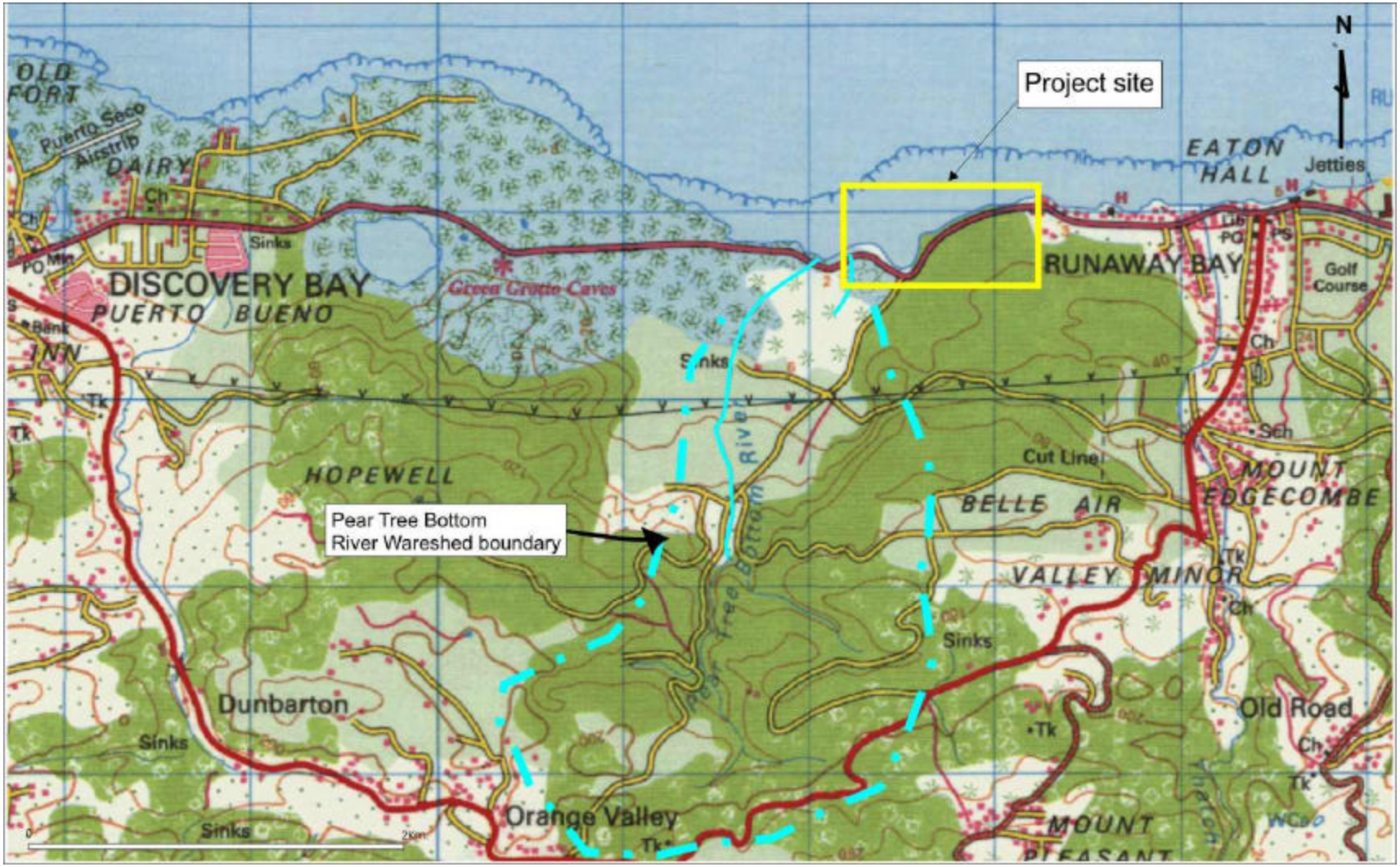

Figure 3.1.1 Topographic setting

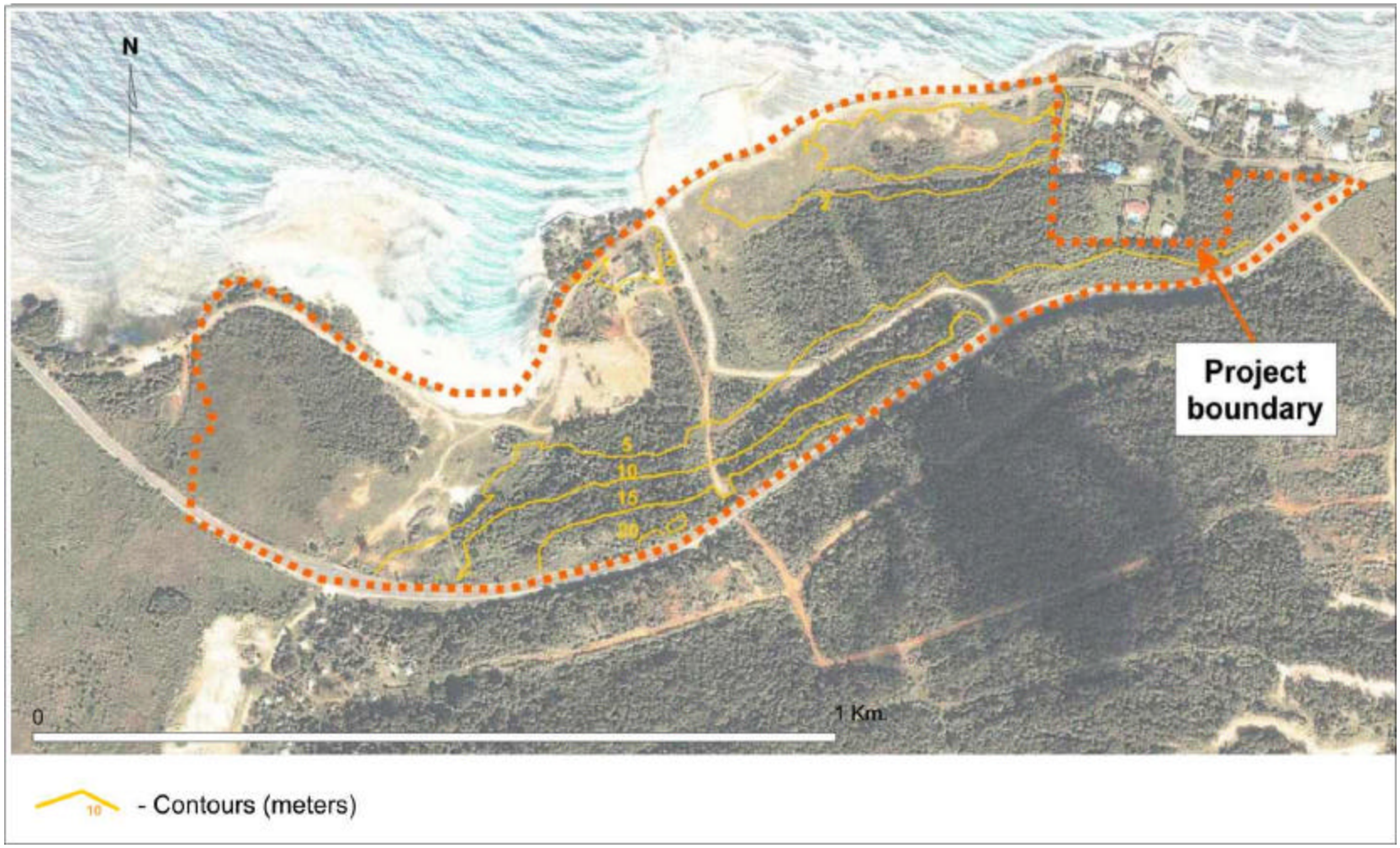

Figure 3.1.2 Site topography

3.2 GEOLOGY

The project site is underlain by limestones belonging to the Coastal Formation, which are found at depths between 35 and 50 feet below ground level. The soil at the surface of the project site consists of a layer of reddish-brown silty clay and coarse to fine calcareous sand that is up to 5 meters deep.

This soil type covers the entire site and overlays four different other soil types, the areal distribution of which is shown in Figure 3.2.1. These consist of dense calcareous sand sand gravels, compact to dense medium to fine sands, soft peaty clays and compact sands.

The Coastal Group of limestones consists of a variety of limestones deposited in shallow coastal environments comprised of reef deposits, limestone muds, and gravels, colluvium and rubbly reworked materials. Further to the south the Coastal Group limestones are overlain by limestones belonging to the Montpelier Formation (Figure 3.2.2).

The Montpelier limestone extends southwards into the hinterland and consists of a sequence of well bedded to massive hard and chalky limestone that contains numerous fossils. The limestone is referred to as bioclastic because the limestone consists mainly of calcium carbonate shell fragments. The lithological characteristics of the limestone is highly variable with significant changes over short distances. In general the limestone is highly permeable with abundant fractures and occasional clay partings.

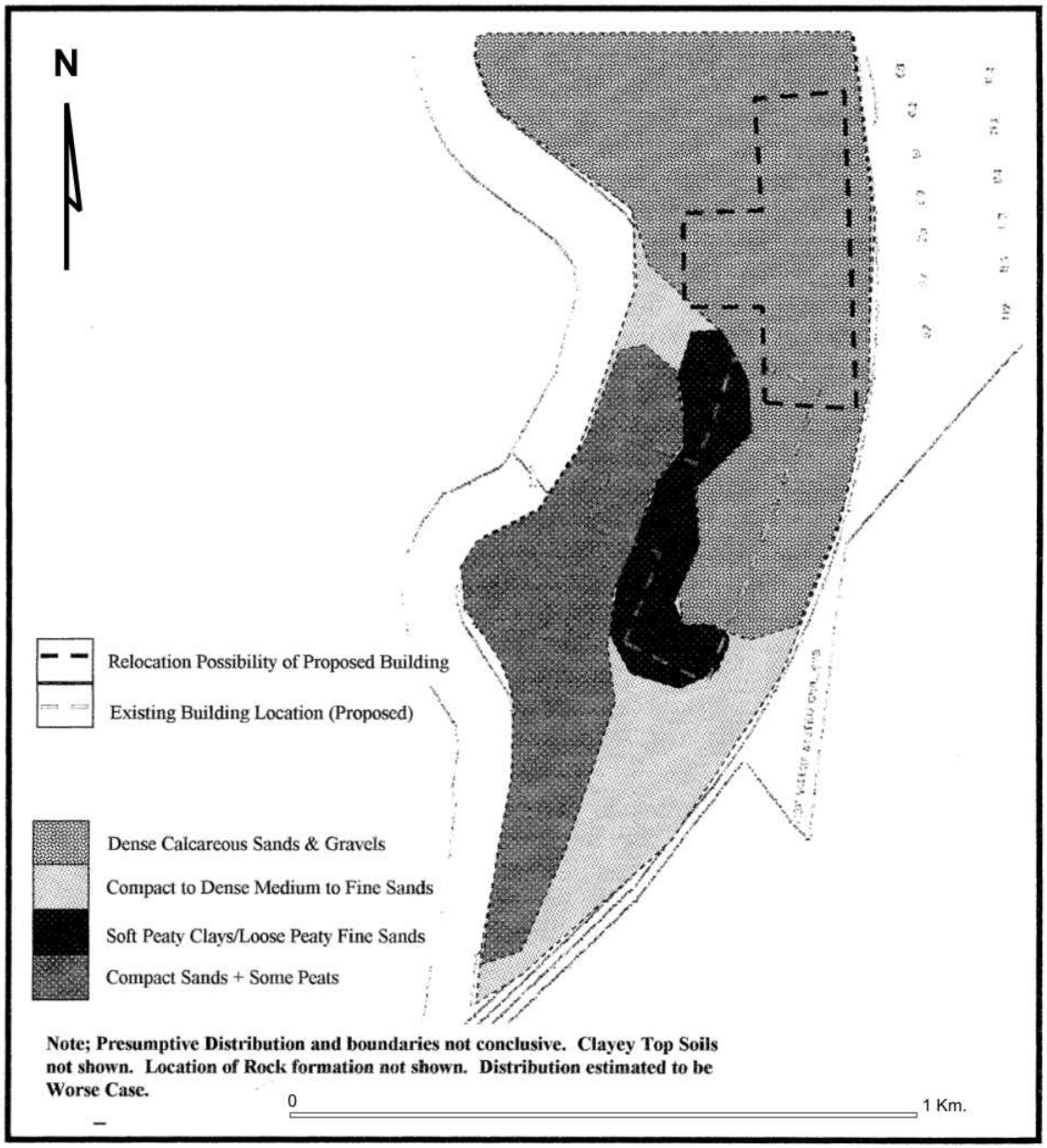

Figure 3.2.1 Soil types (Source: NHL Engineering Ltd.)

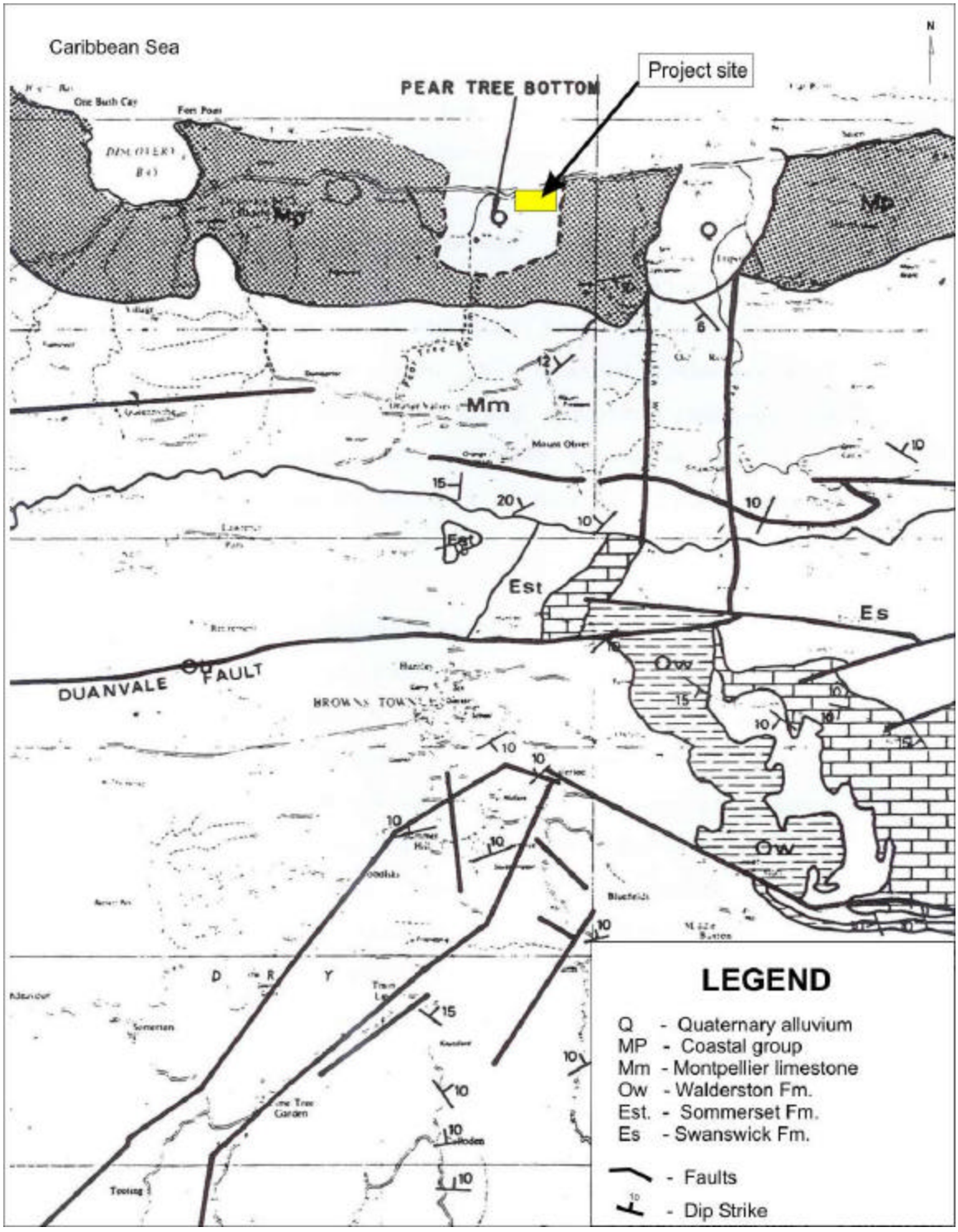

Figure 3.2.2 Regional geology (Source: Beckford, 1991)

3.3 CLIMATE

3.3.1 Rainfall

The climate of the Pear Tree Bottom – Runaway Bay area - is tropical maritime, typical of Jamaica's general climactic conditions. Extreme weather conditions related to cold fronts, northers and tropical systems occur periodically. The long-term mean annual rainfall for St. Ann is about 1450 millimetres. Figure 3.3.1 shows the long-term monthly rainfall distribution for St. Ann indicating that the two months of maximum rainfall are May and December during which about 25 percent of the annual rainfall occurs.

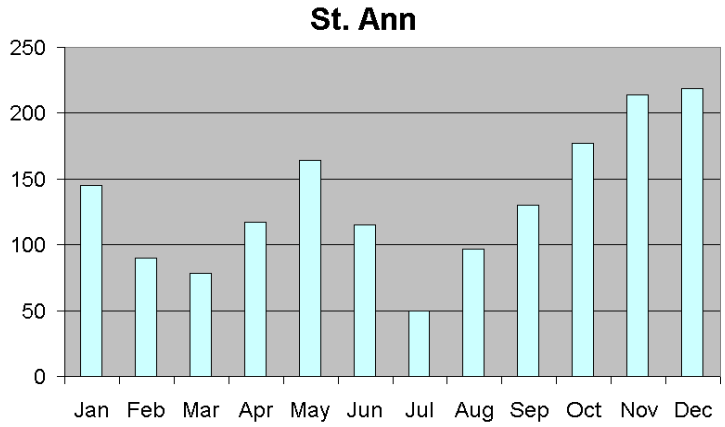

Figure 3.3.1 Long-term mean monthly rainfall for St. Ann 1951-1980. (Source: Jamaica Met. Office)

3.3.2 Wind

Winds approach the project area primarily from the east and northeast. Long-term wind data obtained from the Sangster International Airport located 40 miles east of the site is presented in Table 3.3.2. The data indicates that 75 percent of the time winds are from the easterly and northerly sectors at between 15 and 20 knots.

Table 3.3.2 Percentage of occurrence of annually averaged winds greater than 4 knots.

Direction	%	Direction	%
North	5.6	South	4.9
Northeast	29.3	Southwest	1.2
East	45.9	West	0.9
Southeast	11.4	Northwest	0.8

3.3.3 Humidity

Humidity ranges between 66% and 87% with a significant diurnal variation resulting in high morning humidity dropping off significantly in the afternoon. Temperatures vary from a monthly daily mean of 23^{o}C in January to about 28^{o}C in July. Annual averages of evaporation from free water surfaces is in the order of 183 cm with the highest rates occurring in May and October.

3.4 HYDROLOGY

The project site is located at the northeastern end of the Dry Harbour Mountain Hydrological Basin that extends over the area occupied by the wetland area. The Montpelier Limestones underlying the area forms an aquifer that stores and transmits rainfall infiltrating these limestones within the Pear Tree Bottom River watershed.

The Pear Tree Bottom River drains this aquifer along a fracture zone in the underlying rock. Figure 3.4.1 shows the main hydrological features of the Dry Harbour Mountain hydrological basin. A number of blue holes (Plate 3.4.1) within the wetland area indicate locations where sinkholes accumulate water from the limestone aquifer below. In additions a number of springs occur further to the north where the Montpelier limestones

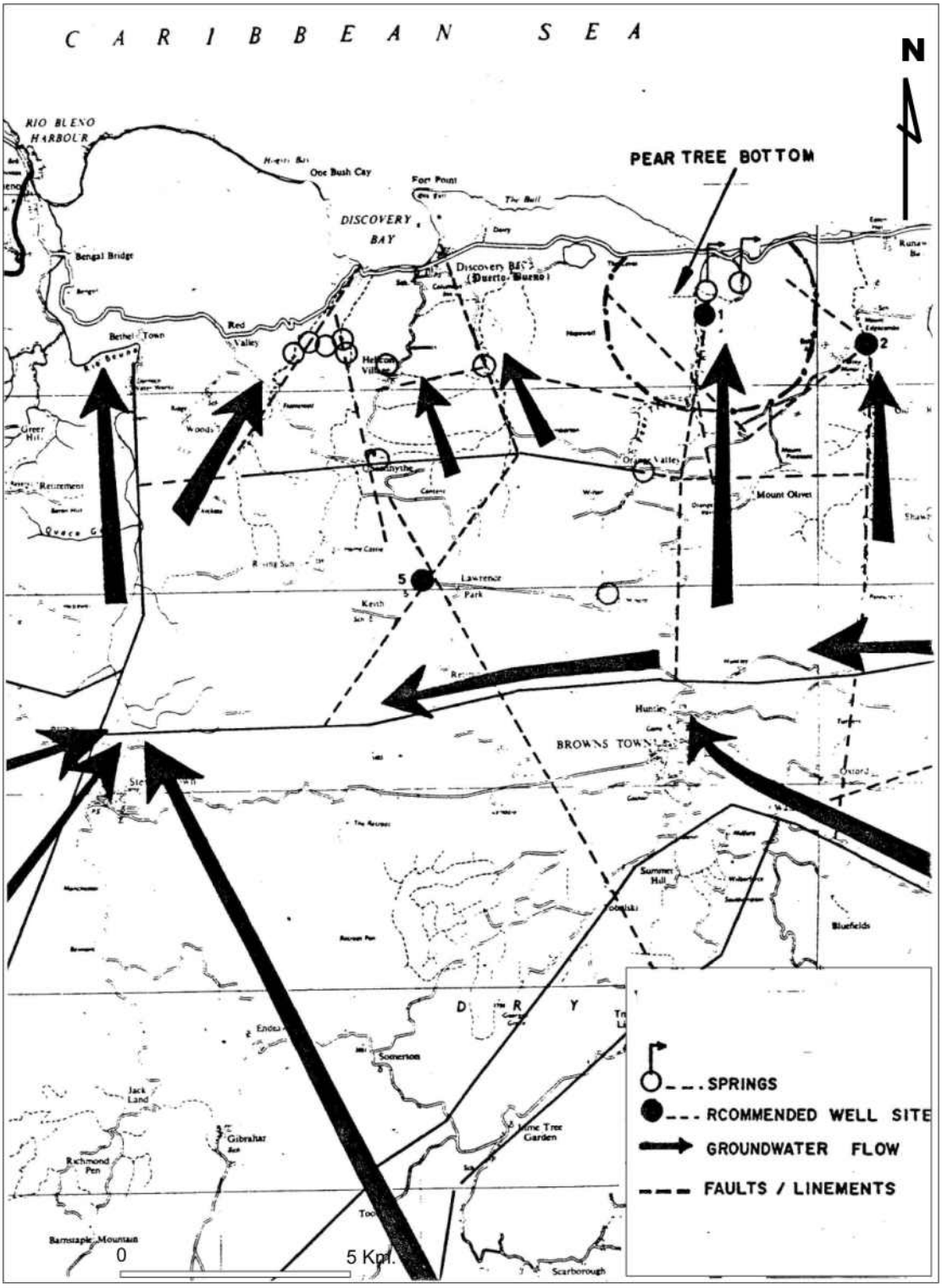

Figure 3.4.1 Regional hydrology (Sources: Beckford, 1991)

come into contact with the overlying Coastal Group limestones. Here fissures in the overlying rocks allow water under artesian pressure to issue onto the surface.

Plate 3.4.1 Blue hole located at eastern side of wetland.

The Dry Harbour Mountain Hydrological Basin is a significant ground water resource. Wells sunk into the limestone aquifer to depths of up to 75 feet have produced yields of 2 million gallons per day. Towards the north the water quality deteriorates becoming progressively saline. An observation well sunk on the site produced brackish water in sufficient quantities to serve as a source of water if treated appropriately.

3.5 OCEANOGRAPHY

The information presented in this section was derived from a part of an unidentified report (1994?) in the possession of the developer which addressed concerns raised by NRCA related to marine physical processes and the proposed construction of groynes along the coastline.

3.5.1 Bathymetry

The bathymetry off the project site is shown by Figure 3.5.1. The eastern half of the shoreline is well protected by a fringing coral reef approximately 365m (1,200 ft) long that lies close inshore behind which there is a shallow back reef lagoon. The reef is about 90m (300ft) offshore. The 200m depth contour lies less than 500m from the shore.

3.5.2 Waves

Wave climates at the project site are consistent with the local wind conditions. Predominant waves are from the northeasterly and easterly directions, occurring about 65% of the time. For just less than 10% of the time, waves approach from the northwesterly and northerly sectors (Table 3.5.1). The average wave height is 0.85m (2.8 ft).

Table 3.5.1 Yearly averaged water waves*.

Direction	% Occurence	Average wave height (ft)
North	7.6	2.6
Northeast	31.4	2.9
East	33.2	2.7
Northwest	2.0	1.8

* Source: 1962 – 1982, Sangster International Airport

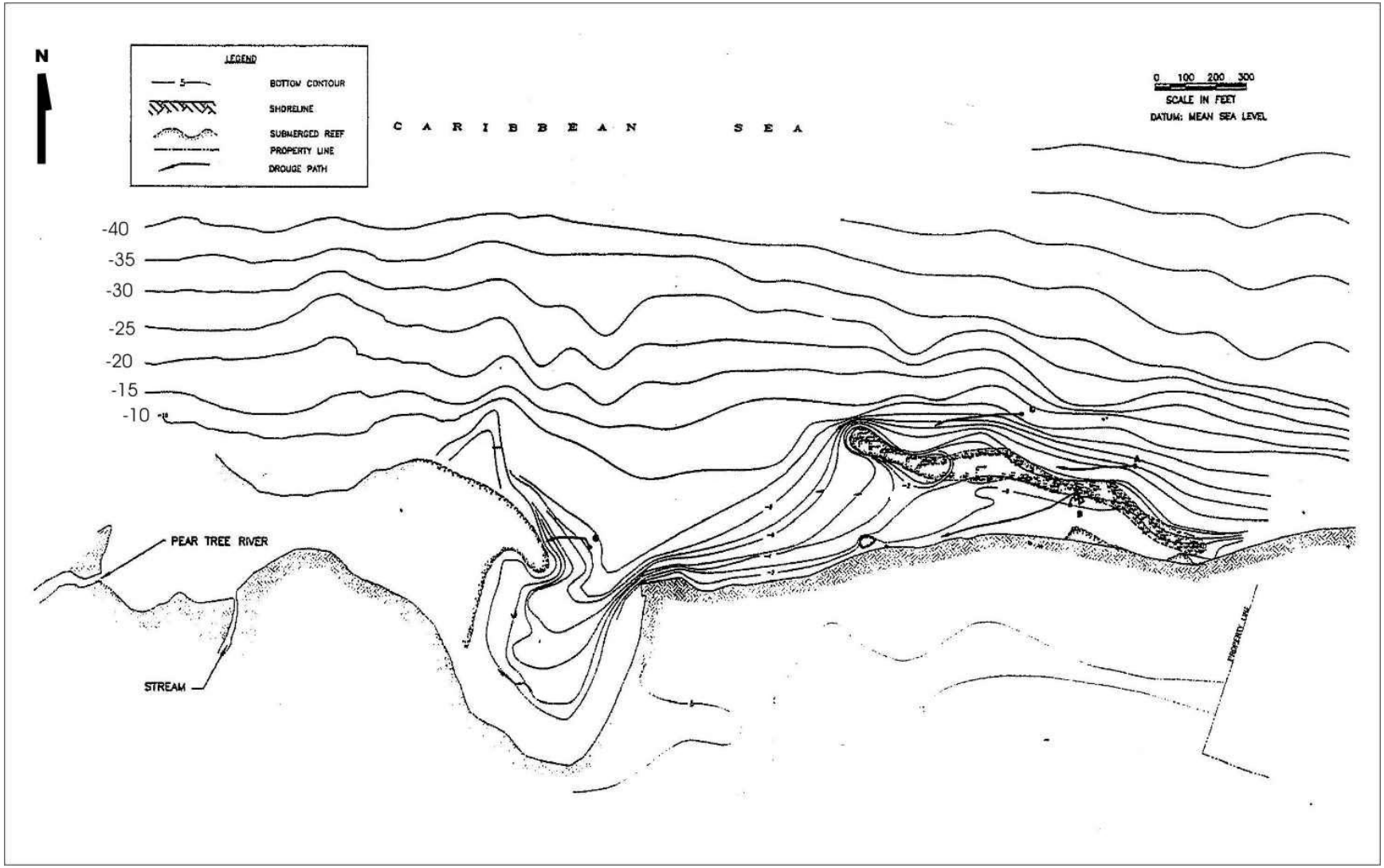

Figure 3.5.1 Bathymetry at Pear Tree Bay

The coastline along the eastern section is subject to waves less than 0.3m (1ft) high. The western half of the project coastline has a steeper beach slope and is subject to greater wave impacts. Wave conditions in Pear Tree Bay are generally calm due to the semi-enclosed nature of the bay and the protection offered by the nearshore reef. Wave energy is also reduced due to shoaling effects.

3.5.3 Tides

Tidal variation at Pear Tree Bay is relatively small and varies between 0.03m (0.4ft) and 0.15 (0.5ft). The tide at the project site is mixed and its period varies from 12 hours (semi-diurnal) to 24 hours (diurnal) depending on the position of the moon.

3.5.4 Water currents

In general, nearshore currents inside and outside of the reef move towards the west. This westerly movement is caused by prevailing northeasterly waves and water piling up landward of the nearshore reef. The greatest flow velocities of 0.15 to 0.21m/sec (0.5 to 0.7 ft/sec) were found seaward of the reef. Flow velocities of 0.06 to 0.12 m/sec (0.2 to 0.4 ft/sec) were measured behind the eastern section of reef. Minimal flow velocities 0.03 to 0.06 m/sec (0.1 to 0.2 ft/sec) were found within Pear Tree Bay. These small velocities allow the growth of seagrass and settlement of fine sediments.

3.6 TERRESTRIAL ECOLOGY

3.6.1 Vegetation

A map of the zonation of the vegetation at the development site is shown at Figure 3.6.1. Based on the classification by Grossman *et al* (1991) the property at Pear Tree Bottom can be described as a secondary modified community, with the following sub-categories:

◊ **Scarcely vegetated areas (Station 1)**

This is an area behind an open coastline that has long been cleared of tall vegetation and which is dominated by grassland and flowering shrubs. There are no woody trees.

◊ **Degraded dry limestone forest (Stations 2, 5 and 7)**

These areas are classified as tropical woodland and are partly dominated by closed canopy dry limestone forest. The section of forest north of the highway is degraded and impacted by human activity (Plates 3.6.1.1.& 3.6.1.2) as indicated by clearings, the open canopy, and the presence of trumpet trees (*Cecropia peltata*). Surveyors transects have been cut through the wooded areas. Station 7 (Plate 3.6.1.3) is separated from the access road by a ravine that is fairly impenetrable.

◊ **Beach (Station 3)**

The beach is characterised by bare white sand and patchy low coastal vegetation (Plate 3.6.1.4).

◊ **Mangrove Scrub (Station 4)**

Behind the beach area is a mixed stand of black mangrove and seaside mahoe (Plate 3.6.1.5) in an area subject to tidal inundation. This mangrove scrub is sparse in areas and fronts the wetland area adjacent to the Little Pear Tree River. Also associated with this community along the beach are trees such as sea grape (*Coccoloba uvifera*) and willow (*Casuarina equesitifolia*).

Plate 3.6.1.1 Dry limestone forest at Station 2.

Plate 3.6.1.2 Dry limestone forest at Station 5.

Plate 3.6.1.3 Dry limestone forest at Station 7.

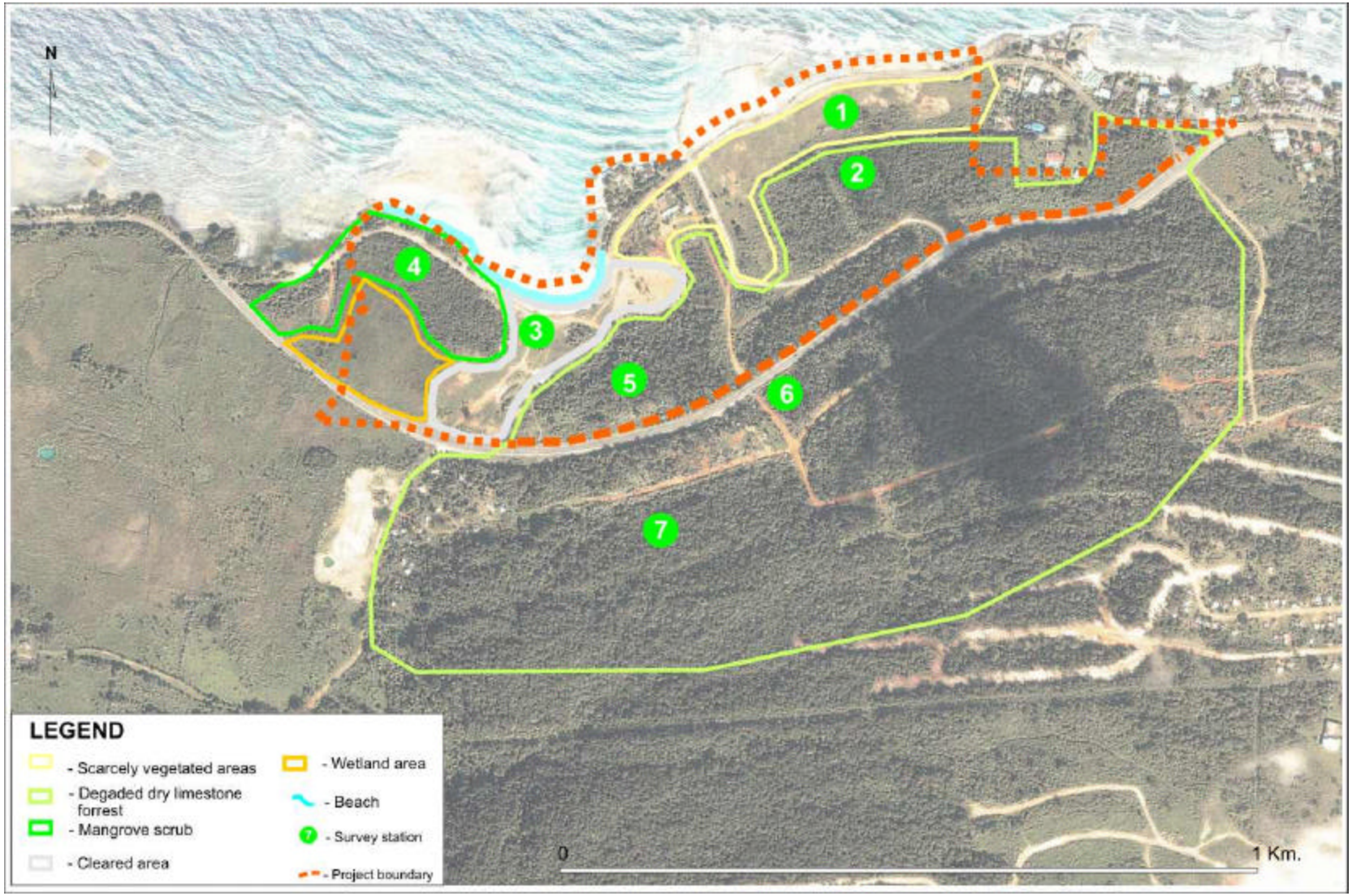

Figure 3.6.1 Site vegetation map and location of sampling stations for terrestrial ecology

Plate 3.6.1.4 Beach at Pear Tree Bay – Station 3.

Plate 3.6.1.5 Mangrove scrub – Station 4.

◊ **Pathside, Bank and Trail (Station 6)**

Several areas on the property have had marl access roads cut through. This station is typical of one such area (Plate 3.6.1.6) as it is clear of vegetation but is bordered by dry limestone woodland.

Plate 3.6.1.6 Marl road and roadside vegetation – Station 6.

A list of the dominant trees on the site is given in Table 3.6.1. Several epiphytes of the family Bromeliacea were noted at Stations 2, 5 and 7.

Table 3.6.1 Trees identified on the Pear Tree Bottom site.

Scientific Name	Common Name	Station No.
Bursera simaruba	Red Birch	2, 5, 7
Piscidia piscipula	Dogwood	2
Haematoxylum campechianum	Logwood	2, 5, 7
Pimenta dioica	Pimento	2
Pelthophorum linnaei	Braziletto	2
Picrasma excelsa	Bitterwood	2, 5, 7
Guasuma ulmifolia	Bastard Cedar	2
Coccoloba uvifera	Sea Grape	2
Terminalia catappa	Almond	3
Casuarina equisetifolia	Whistling Pine, Willow	3
Mangifera indica	Mango	7
Ficus sp.		7
Cecropia peltata	Trumpet tree	

3.6.2 Fauna

Very few birds were observed at Station 1 as the site is quite open, dominated by grasses and flowering shrubs. Several species of birds inhabit the secondary dry limestone woodland at Stations 2 & 5. There the canopy is fairly low (20 – 35 ft.) with spindly trees rooted on loose and bare honeycomb rock. Pigeons, doves, parakeets, hummingbirds, Jamaican woodpeckers, orioles and vireos are common all year round in the scrubby undergrowth of this type of habitat (Downer and Sutton, 1990). Notable was the observation of a flock of four Yellow-billed Parrots flying over the limestone woodland at Station 2. The bird species commonly reported from the area, some of which were observed during the field visit, are listed in Table 3.6.2.

Several species of butterfly were observed feeding on flowering shrubs at Stations 1, 2, 5 and 7. Butterflies are important pollinators and those seen at the site are listed in Table 3.6.3. One specimen observed but which could not be caught appeared to be a Citrus Swallowtail (edge of Station 7). Illustrations of a few of the butterflies seen at Pear Tree Bottom are shown at Figure 3.6.1.

3.6.3 Endangered species

Two endemic and endangered terrestrial species are found around the site. These are the Yellow snake or Jamaican Boa (*Epicrates subflavus*) and the Yellow-billed parrot (*Amazona collaria*). Both are protected by national and international laws.

The boa's habitat is dry limestone forest and it has been reported from the Pear Tree Bottom area, specifically from the proposed project site on the north side of the road. Individuals have previously been injured on the site and rescued by the Seven Oaks Sanctuary for Wildlife in St. Ann. The most recent report was in May 2004, where a badly injured 5 ft long specimen was captured and rehabilitated. The Yellow-billed Parrot is also threatened by habitat destruction.

Table 3.6.2 Birds seen at the Pear Tree Bottom site.

Scientific Name	Common Name	Station No.
Amazona collaria	Yellow-billed Parrot	2
Columbina passerina	Common Ground Dove	1
Bubulcus ibis	Cattle Egret	1,2
Cathartes aura	John Crow	1,7
Vireo altiloquus	John Chewit, Black-whiskered Vireo	2
Columba leucocephala	Bald Pate, White-crowned Pigeon	2,7
Icterus leucopteryx	Jamaican Oriole	7
Tiaris olivacea	Yellow-faced Grassquit	7
Zenaida aurita	Pea Dove, Zenaida Dove	7
Aratinga nana	Olive-throated Parakeet	7
Fregata magnificens	Magnificent frigatebird	3,4
Pelecanus occidentalis	Brown Pelican	3,4
Catoptrophorus semipalmatus	Willet	3,4
Quiscalus niger	Greater Antillean Grackle	3,4

Table 3.6.3 Butterflies seen at the Pear Tree Bottom site.

Scientific name	Common name	Station No.
Precis evarte zonalis		1,7
Danaus plexippus	Monarch	1
Eurema lisa euterpe	Little Shuphur	1,7
Eurema elathea	Little sulphur	1,7
Gesta gesta gesta		1
Ascia monuste eubotea	Southern White	1,2
Anartia jatrophe jamaicensis	White Peacock	1
Dryas iulia delila	Flambeau	1,5,7
Phoebis sp.	Sulphur	1
Heliconius charitonius simulator	Zebra	2,5
Leptotes sp.	Small Blue	2
Kricogonia lyside		7

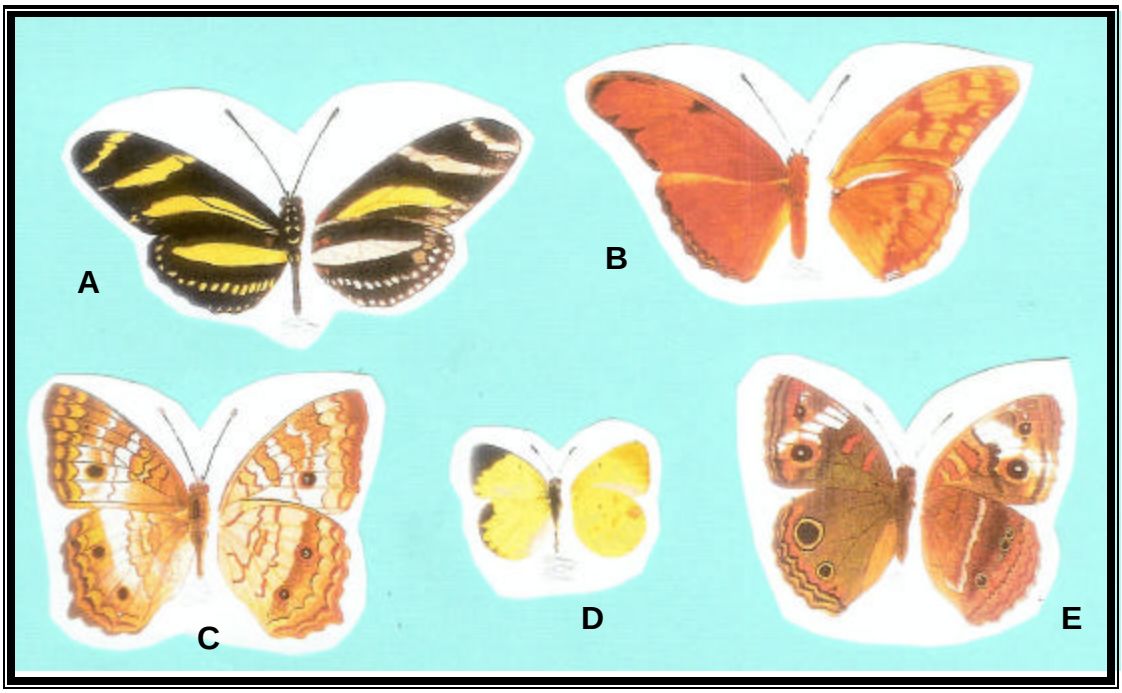

Figure 3.6.1 Some butterflies seen at Pear Tree Bottom.

A – *Heliconius charitonius simulator* **B –** *Dryas iulia delila*

C – ***Anartia jatrophre jamaicensis*** **D –** ***Eurema lisa euterpe***

E – ***Precis evarte zonalis***

3.7 WETLAND ECOLOGY

3.7.1 General

A 65 ha (160 ac) freshwater marsh lies immediately to the south and west of the site (Plate 3.7.1.1). It is a basin type, which has developed around a complex of streams arising from ground water upwelling (blue holes – see Plate 3.4.1) and springs. It is separated from the sea by a sand/beach barrier and the wetland connects to the sea by a few streams of which the Pear Tree River is the most significant (Plate 3.7.1.2).

The new highway traverses the marsh and culverts have been placed under that road to allow existing stream flows. An estimated 25 –30 migd of water flows to the sea. A small portion of the wetland (2.5 ha / 6 ac) lies north of the highway (Plate 3.7.1.3) and adjacent to the western end of the resort.

Plate 3.7.1.1 Aerial view of wetland (outlined in orange) at Pear Tree Bottom.

Plate 3.7.1.2 Pear Tree River below new highway bridge.

Plate 3.7.1.3 Part of wetland on resort site.

As Bacon & Alleng (1991) point out, “the Pear Tree Bottom wetland is a unique feature on the north coast of Jamaica; no other wetland of equivalent size and with the same mix of physical and vegetation characteristics has been described from this coast”. It acts as a sediment trap and a sink for nutrients. An analysis of 1966 aerial photography reveals that the wetland had been drained and modified in the past for agricultural purposes, which corroborates anecdotal evidence. The remnant of coconut plantings are still evident today (Plate 3.7.1.4).

Plate 3.7.1.4 Coconut trees remaining on wetland site.

It is very obvious now that most of those drains have become occluded by aquatic vegetation thus inhibiting surface drainage and causing an expansion of inundated area. This has also facilitated colonization by adventive species.

3.7.2 Flora

Bacon et al (1991) report that some thirty species of plants have been identified from the Pear Tree wetland (Table 3.7.1) These include submerged aquatic plants, rooted emergent hebaceous plants, trees and shrubs associated with the beach barrier, cultivated species, and adventive weed plants. Recent observations confirm that the species composition of plants has not changed over the past decade but that the wetland is now almost completely occluded by bulrushes (*Typha domingensis*) as depicted in Plate 3.7.1.5.

Plate 3.7.1.5 Wetland occluded with bulrushes.

This has restricted water flow, caused spreading of inundated area and diminished the functional value of the wetland in terms of open water habitat (e.g. water fowl).

As noted above, the wetland has been modified by reclamation, channelisation and colonization by adventive species and cannot be regarded as being entirely natural and pristine. Not of major consequence to the EIA but it may be noted in passing that the leaves of the coconut trees in the wetland were yellowed, perhaps as a result of the 'lethal yellowing' disease currently spreading throughout the coconut population in Jamaica.

Table 3.7.1 Plants of Pear Tree Bottom wetland (Source: Bacon et al., 1991)

Scientific classification	Common name
PTERIDOPHYTA (Ferns)	
Polypodiaceae	
Acrostichum aureum	Golden-back fern
Blechnum sp.	
ANGIOSPERMAE (Flowering plants)	
Potamogetonaceae	
Potamogeton nodosus	
Pontederiaceae	
Heteranthera reniformis	
Typhaceae	
Typha domingensis	Bulrush
Palmae (palms)	
Cocos nucifera	Coconut
Cyperaceae (sedges)	
Cladium jamaicense	Saw grass
Cyperus odoratus	
C. giganteus	
C. ligularis	
Eleocharis interstincta	
Fimbristylis ferruginea	
Gramineae / Poaceae (grasses)	
Phragmites australis	Reed
Cenchrus brownii	Burr grass
Coix lacryma-jobi	Job's tears
Polygonaceae	
Coccoloba uvifera	Sea grape
Malvaceae	
Thespesia populnea	Blue mahoe
Hibiscus tiliaceus	Seaside mahoe
Rhizophoraceae	
Rhizophora mangle	Red mangrove
Combretaceae	
Languncularia racemosa	White mangrove
Conocarpus erectus	Button mangrove
Onagraceae	
Ludwigia repens	
Apocynaceae	
Rhabdadenia biflora	Mangrove vine
Convolvulaceae	
Ipomea tiliacea	Wild slip
Hydrophyllaceae	
Nana jamaicensis	

Table 3.7.1 Plants of Pear Tree Bottom wetland (cont'd).

Scientific classification	Common name
Verbenaceae	
Lantana sp.	
Lippia nodiflora	
Compositae	
Spilanthes urens	Pigeon coop
Parthenium hysterophorus	Dog-flea weed
Aster exilis	

3.7.2 Fauna

The wetland supports a diverse fauna. The birds noted by Bacon et al (op. cit.) represented a mix of forest and aquatic species. Cattle egrets (*Bubulcus ibis*) roost in the red mangroves next to the mouth of the Pear Tree River but the value of the site as a habitat for waterfowl is much reduced due the lack of open water. Moorhen (*Gallinula chloropus*) and coots (*Fulica sp.*) were noted by Bacon et al. These were not seen on the present field visit but other species including Little Blue heron (*Florida caerulea*), Tricolored heron (*Hydranassa tricolor*) and Snowy egret (*Egretta thula*) were seen on the eastern edge of the wetland. These three species are represented in Jamaica by residents as well as migrants, indicating the possibility that the wetland is being used as a wintering stop-over.

Bacon et al (op. cit) notes the richness of aquatic fauna due to the linkages between the wetland and the sea. A list of the animal species is given in Table 3.73 It appears that the wetland plays an important role as a nursery for fish and estuarine species and this highlights the need to protect the integrity of the swamp. The potential of the wetland for prawn culture has been identified before (Wiles, M., 1982).

Table 3.7.3 Non-avian animals of Pear Tree Bottom wetland. (Source: Bacon et al., 1991)

Scientific classification	Common name
INVERTEBRATA	
Gastropoda (snails)	
Thiaridae	
Melanoides tuberculatus	
Pelecypoda	
Isognomonidae	
Isognomon bicolor	Flat tree-oyster
Decapoda (shrimps & crabs)	
Penaeidae	
Penaeus sp.	
Atyidae	
Jonga serrai	
Potimirim mexicana	
Xiphocaris elongata	
Palaemonidae	
Macrobrachium acanthurus	
M. carcinus	
M. faustinum	
Portunidae	
Callinectes spp.	
Gecarcinidae	
Cardiosoma guanhumi	
Ocypodidae	
Uca spp.	
Ucides cordata	
PISCES (fish)	
Mugilidae (mullets)	
Agonostomus monticola	Mountain mullet
Mugil curema	White mullet
Carangidae	
Caranx latus	Horse-eye jack
Belonidae	
Strongylura sp.	Needle fish
REPTILIA	
Ophidia (snakes)	

3.8 MARINE ECOLOGY

The ecology of the marine nearshore is predominantly that of the fringing coral reef and the shallow backreef lagoon. This section relies much on the descriptions of these habitats presented in Harvey (1993) but there has been verbal confirmation that the current status of the reef is not much changeed. The disposition and profile of the reef is shown in Figures 3.8.1 and 3.8.2 respectively. Plate 3.8.1 provides a good aerial perspective of a portion the fringing reef in front of the site.

Plate 3.8.1 Oblique aerial view of Pear Tree Bottom.

3.8.1 Fore reef

The insular shelf (100m contour) along most of the north coast of Jamaica is found within 500m of the coastline. At the western end of Pear Tree Bay this contour curves inward to within 200m of the beach. This shelf edge forms the deeper part of the fore reef. Along this line of the fore reef is a line of living coral buttresses, punctuated at intervals by caves and channels. Below this the fore reef falls into the abyss. The fore reef slope is composed of coral patches and calcareous sediments produced by the calcareous alga, *Halimeda copiosa*.

Buttress formation is not continuous along the north coast and in fact is only found at a few locations (e.g. Rio Bueno). Buttresses are spectacular aggregations of living corals

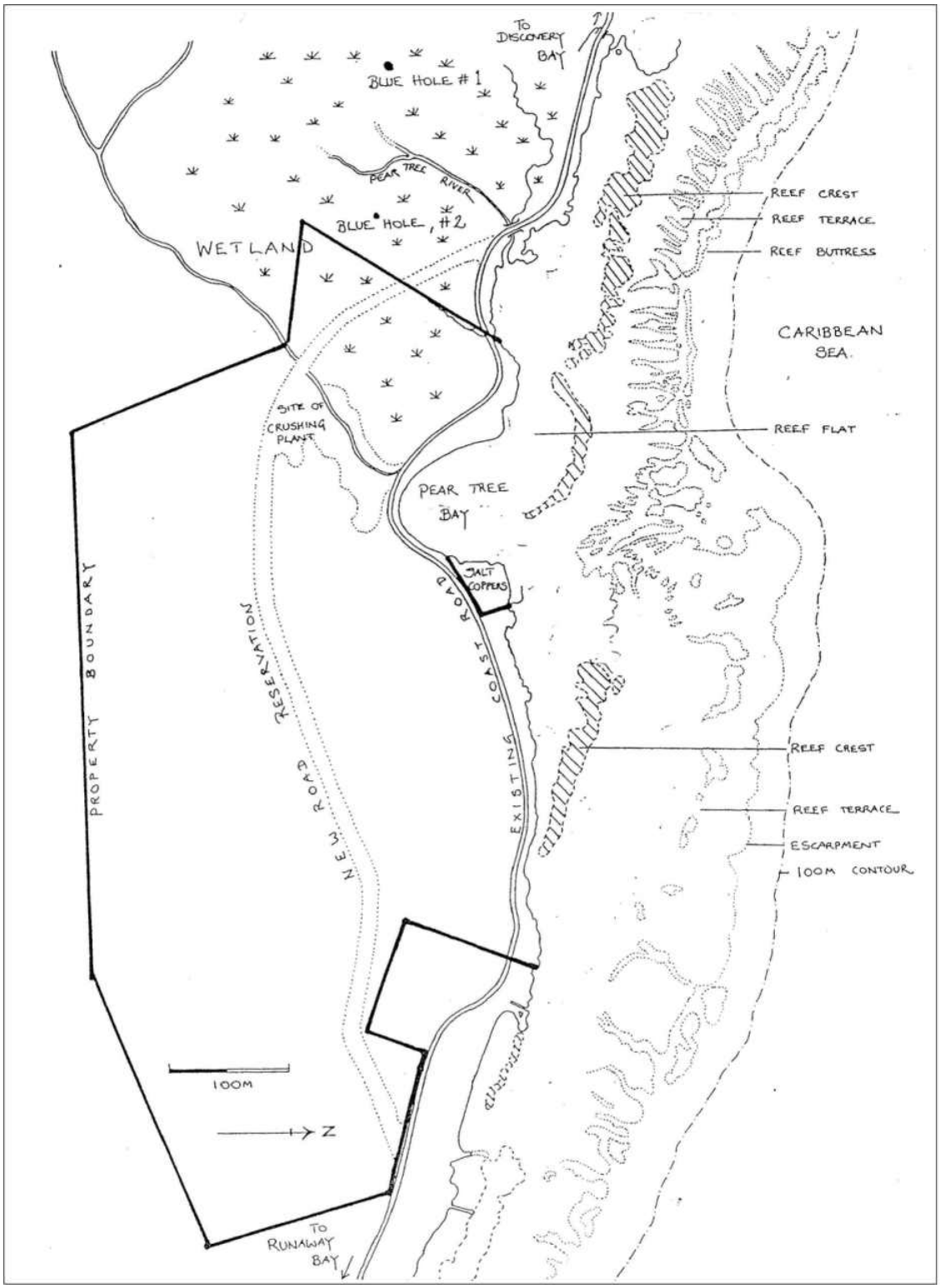

Figure 3.8.1 Disposition of coral reef at Pear Tree Bottom (Source: Harvey,1993)

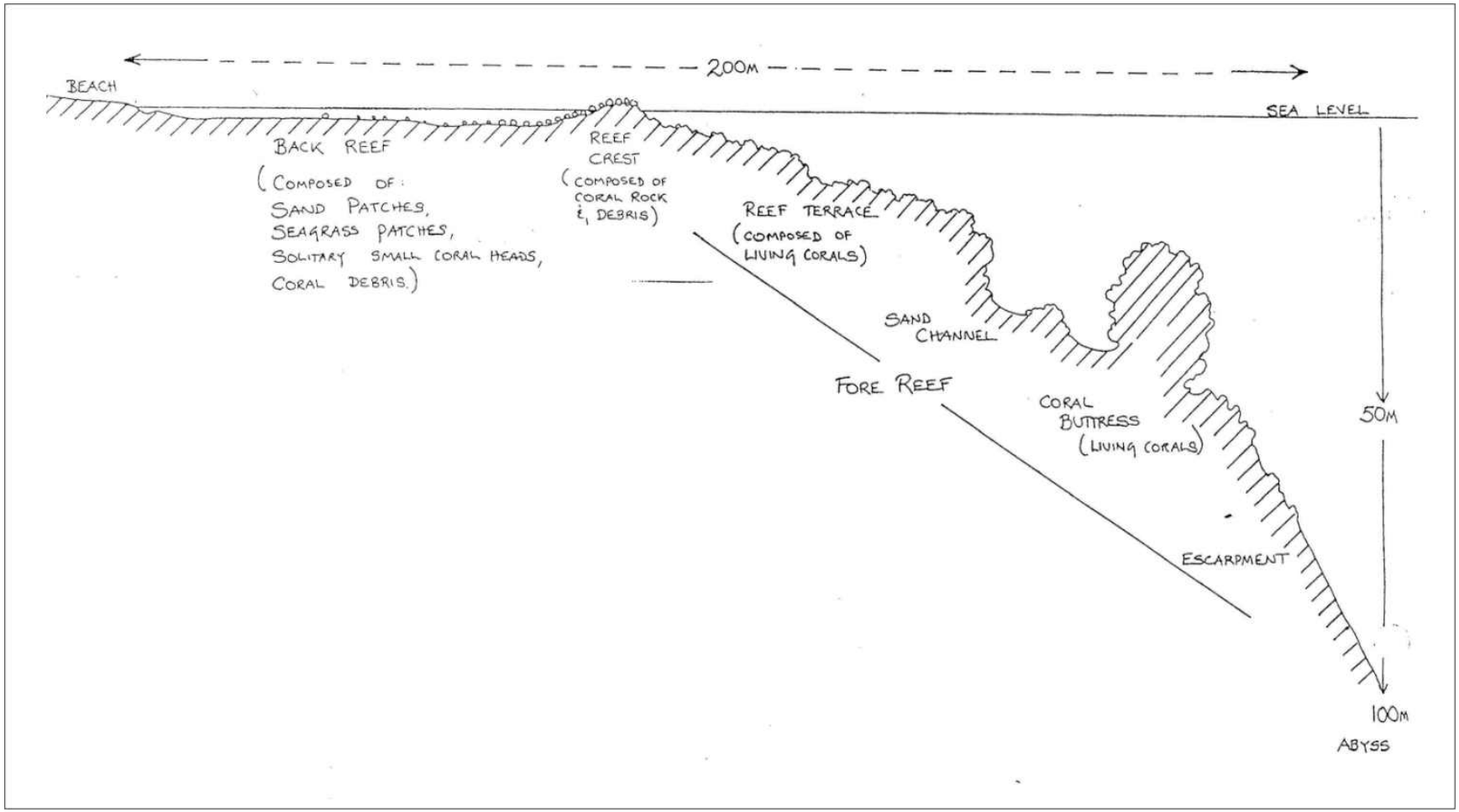

Figure 3.8.2 Profile of reef at Pear Tree Bay (Source: Harvey, 1993)

and provide a haven for a diversity of fish and marine invertebrates. Elevated coral formations found here provide points of aggregation for schooling pelagic species of fish such as bar jacks (*Caranx ruber*) and Bermuda Chub (*Kyphosus sectatrix*).

A feature of particular significance in this area is the presence of underwater caves containing sclerosponges, slow-growing calcified sponges that normally occur a much greater depths. These sponges are out-competed for space by faster growing corals in shallow water and are normally found at depths were the light intensity is too low to allow coral growth. The darkness inside the caves provides shallower habitats for these sponges. Thus the buttress zone at Pear Tree Bay offers a fairly unique habitat and one well worth the effort to protect.The reef terrace zone is narrow at this point along the coast but still provides wide sand channels interspersed with coral ridges. These are composed largely of corals such as *Dendrogyra, Montastrea, Solenastrea, Porites, Siderastrea*, and branching corals. The corals found in this zone are typical of Jamaica's fore reef zones and are common throughout the Caribbean. Gorgonians (Sea Fans, etc.) are well represented in this zone. This zone has been badly affected by the passage of hurricanes, Allen in 1980 and Gilbert in 1988 and there are patches of dead coral, covered with algae, as a result of wave action as well as coral bleaching.

The reef crest was composed largely of branching corals (*Acropora palmate, A. cervicornis*), brain corals (*Diploria spp*.) and sea rod gorgonians. Most of this zone was completely destroyed by hurricane wave action and the dead coral debris has been piled up into an exposed crest. Much of this debris is covered with algae. This is the reef zone exposed to wave action generated by the trade winds.

3.8.2 Back-reef lagoon

The back reef area is generally shallow (< 1.5m) and parts of it may be exposed at extreme spring tides. The sea floor is partly covered by seagrasses, including Turtle grass (*Thalassia testudinum*), Manatee grass (*Syringodium filiforme*) and Shoal grass (*Halodule wrightii*). Calcareous algae are interspersed with the seagrasses and in sand patches, specifically three common species, *Halimeda incrassata, Penicillus capitatus, P. cyanthiformis*. Specimens of *Halimeda tuna,* another calcareous alga, were found

among the red mangrove roots in the western section of the bay. Calcareous algae are important in sand and beach formation as they calcify up to ten times faster than reef building corals. Photosynthesis by corals and calcareous algae adds energy to the community and also creates the optimal physiological conditions for the most efficient production of calcium carbonate. This is of critical importance in the structure and function of the coral reef community.

Three species of sea urchin, *Lytechinus variegatus, Echinometra virides*, and *Tripneustes esculentus*, are common in the seagrass beds. The Black Spiny Sea Urchin, *Diadema antillarum*, is no longer common due to a massive mortality in 1983. There are signs elsewhere that the populations are recovering.

The combination of over-exploitation of herbivorous fishes (Damselfish, Parrotfish, and Surgeonfish) by artisanal traps and spear fishing, the mass mortality of *Diadema*, and increased terrigenous nutrient supplies in the coastal waters of Jamaica have promoted algal growth and the degradation of shallow water reef communities. An even larger threat to the health and survival of coral reefs is the rise in sea surface temperatures due to global warming.

Special note must be made here of the artificially reclaimed and now sheltered areas along the eastern section of the project coastline where groynes were constructed in the mid 1990s. In part these new beaches are filled with gravel and elsewhere the bottom is covered with healthy stands of seagrass.

3.8.3 Beach

The sandy shore of Pear Tree Bay (see Plate 3.6.1.4) is inhabited by the burrowing bivalve mollusk, *Donax sp.*, as well as other burrowing invertebrates. Ghost crabs, *Ocypode quadrata*, are common on the beach. Further inland are scattered land crab (*Cardiosoma guanhumi*) holes in the mangrove scrub. Illegal sand mining has been reported from Pear Tree Bay in the past. Evidence of further sand removal was observed (Plate 3.8.3.1) during a site visit on 2 February 2005.

Plate 3.8.3.1 Sand stealing from beach at Pear Tree Bay.

3.8.4 Rocky shore

The community on the rocky shore at the eastern end of the property is comprised of periwinkles (*Nerita peloronta, N. versicolor* and *Littorina zic-zac*), chitons (especially *Acanthopleura granulata*), and the rock crab (*Grapsus grapsus*). This surface area of this shoreline type has been greatly expanded by the construction of rock groynes.

3.8.5 Fishes

A list of the fishes encountered at Pear Tree Bottom is given in Table 3.8.1. The fore reef supports a large number of adult fishes, all of which are targeted commercially, primarily by artisanal techniques. The shallow back reef areas provide shelter for many juvenile fish as indicated in the above table. This emphasizes the function of the back reef zone as a nursery for many adult species found on the reef. This is also important from the point of view of resort divers and management of the natural attraction to be exploited by the hotel.

3.8.6 Endangered species

Hawksbill (*Eretmochelys imbricata*) and Green (*Chelone mydas*) turtles have been seen on the reef (Harvey, 1993) and it is possible that they may nest on the beach at Pear Tree Bay. These species are protected under the Wildlife Protection Act 1981 and also under CITES. No crocodiles or manatees have been reported in the Pear Tree River, the wetland or from nearby coastal waters.

Table 3.8.1 List of fishes seen in back reef area at Pear Tree Bay (Source: Harvey, 1993)

Scientific name	Common name	Juveniles present
Urolophus jamaicensis	Stingray	✔
Aetobatis narinari	Eagle ray	✔
Harengula jaguana	Herring	✔
H. humeralis	"	✔
Jenkinsia lamprotaenia	"	
Synodus intermedius	Sand diver	
Tylosurus crocodilus	Needlefish	✔
Atherinomorus stipes	Silverside	
Mugil curema	Mullet	✔
Sphyraena barracuda	Barracuda	✔
Caranx ruber	Bar jack	✔
Caranx latus	Horse eye jack	✔
Trachinotus goodie	Jack	✔
T. falcatus	"	✔
Lutjanus apodus	Snapper	✔
L. griseus	Grey snapper	✔
Haemulon chrysargyreum	Grunt	✔
H. flavolineatum	"	✔
Archosargus rhomboidalis	Porgy	
Odontoscion dentex	Croaker	✔
Gerres cinereus	Mojarra	
Eucinostomus argenteus	"	
Bothus lunatus	Flounder	
Pomacanthus paru	Angelfish	✔
Holacanthus ciliaris	"	✔
Eupomacentrus fuscus	Damselfish	
E. leucostictus	"	
E. partitus	"	
Microspathadon chrysurus	"	

Table 3.8.1 List of fishes seen in back reef area at Pear Tree Bay (cont'd).

Scientific name	Common name	Juveniles present
Abudefduf saxatalis	Sargeantmajor	
Halichoeres bivittatus	Wrasse	
H. radiatus	"	✔
H. maculipinna	"	
Sparisoma rubripinne	Parrotfish	✔
S. chrysopterum	"	✔
S. aurofrenatum	"	
Scarus croicensis	"	
S. taeniopterus	"	
Labrisomus nuchipinnis	Blenny	
Acanthurus coeruleus	Surgeonfish	✔
A. chirurgus	"	✔
Balistes vetula	Triggerfish	✔
Monacanthus ciliatus	File fish	
Acanthostracion quadricornis	Trunk fish	
Sphaeroides spengleri	Pufferfish	
S. greeleyi	"	
Diodon holacanthus	Porcupine fish	✔
D. hystrix	"	✔

3.9 WATER QUALITY

The results of the water quality sampling exercise are presented at Table 3.9.1 below.

Table 3.9.1 Water quality data for Pear Tree Bottom.

Parameter	Sampling station					NRCA Draft Ambient Marine Standards
	1	2	3	4	5	
pH (units)	8.2	8.3	7.9	8.3	7.8	8.0-8.44
Temperature (^{o}C)	2.4	25.6	21.6	5.1	22.3	-
Salinity (ppt)	34.5	35.3	0.6	32.6	0.2	-
Dissolved Oxygen (mg/L)	8.3	3.4	0.5	4.9	2.9	4.5-6.8
BOD (mg/L)	2.0	5.0	2.0	5.0	5.0	0.57-1.16
Turbidity (NTU)	0.6	1.6	1.6	2.1	1.6	-
Nitrate (mg/L)	0.01	0.07	6.20	1.40	7.50	0.001-0.081
Phosphate (mg/L)	0.05	0.07	0.01	0.07	0.03	0.001-0.055
Total Coliform (MPN/100ml)	<3.0	<3.0	>2400.0	150.0	93.0	48-256
Faecal Coliform (MPN/100ml)	<3.0	<3.0	23.0	7.0	23.0	<2-13

The following discussion is based on data generated from only one sampling exercise. Therefore no conclusive inferences can be drawn from the limited data although it does provide an indication of the current status of surface water quality in the Pear Tree area. The current data, where possible, are compared with the historical water quality data for the Pear Tree project area. No groundwater samples were taken during this study.

The water quality data generated for the present study as well as the historical data show some interesting features. These are presented and discussed in the following sections.

◊ **pH and Temperature**

The pH for all the marine coastal stations (#1, #2 and #4) was at values expected for nearshore waters and the pH of the river stations (#3 and #5), were typical of fresh waters.

Temperature measurements at the sampling stations are similar to those recorded for other nearby coastal regions on the Jamaican north coast. The fresh water stations expectedly have cooler temperatures.

◊ **Salinity**

Salinity measurements at coastal stations #1 and #2, 34.5 and 35.3 ppt respectively, are typical of Jamaican coastal waters. The salinity regime at the western end of the project shoreline (#4) is affected by the free water flow from the Pear Tree and the Little Pear Tree Rivers. Thus the salinity (32.6 ppt) is somewhat lower. At the mouth of the rivers, the surface waters are brackish reflecting the influence of freshwater inflows from the Pear Tree watershed.

◊ **Dissolved Oxygen (DO)**

Dissolved oxygen concentrations at #1 were good, above saturation levels. The oxygen level at this station is likely being influenced by the algae observed at the site. Oxygen levels at the other two coastal sites were considerably lower with #2, showing surprisingly low levels. The riverine stations, similarly had very low dissolved oxygen levels and appear to be somewhat anoxic.

◊ **Biochemical Oxygen Demand (BOD_5)**

BOD levels in excess of 2.0 mg/l indicate elevated organic loadings and are a cause for concern. The BOD levels at three stations (#2, #3 and #5) were all at 5.0mg/L. The other two stations (#1 and #4) had concentrations of 2.0mg/L. The higher oxygen demand recorded at these stations confirms the reduced dissolved oxygen levels.

◊ **Turbidity**

Turbidity levels are good for the all stations, ranging between 0.6 and 2.1 NTU. Rain fell on the morning of sampling causing runoff from the land. The impact of riverine

suspended solids on the coastal waters appeared insignificant as a result of the influence of the wetlands which effectively filtered the detritus.

◊ **Nitrate**

Nitrate levels are indicators of contamination by sewage wastewater and/or fertilisers from agriculture. Nitrate levels in coastal waters higher than 1 micro-mole (µM) or 0.65 mg/l NO_3 usually indicate nutrient enrichment from one or both sources. Nitrate concentrations exceeded 1.0 µM at #4. This station is influenced by discharges from both the larger Pear Tree River and the Little Pear Tree River. Station #4, located at the mouths of the two rivers had high nitrate loading indicating that the river waters are contributing nitrate to the coastal zone.

◊ **Phosphate**

Of the five stations sampled, phosphate concentrations are only 0.02mg/l above the required limit at #2 and #4 . This is not significant but the levels should be watched for any future increases.

◊ **Total and Faecal Coliform**

The total coliform level at #3, at >2400, far exceeds the NEPA limit. Although total coliforms do not present a serious health hazard, their presence in such great numbers indicate a significant organic loading at this site. Faecal Coliform levels are within acceptable levels.

Total and Faecal Coliforms at #4 and #5 do not exceed the NEPA limit. This parameter should be monitored as there is a growing squatter settlement near to this site. These houses are located on the west, about 200m upstream of the Little Pear Tree River.

Total and Faecal Coliforms levels are not detectable at both #1 and #2. This is good and any increases should be noted.

◊ **Summary**

The water quality data obtained from the present investigation indicates that the present water quality in the project area is under some degree of stress. The estuarine portions

of the rivers have low oxygen levels and significant oxygen demand. This coupled with the elevated nitrate levels could lead to further deterioration if not managed carefully.

The historical data (1972 - cited by Beckford, 1992) for the Pear Tree River demonstrated low levels of turbidity and bacteria. Similarly good turbidity and bacterial levels were recorded by the current study. No comparison could be made with that data in respect of nutrient levels, as the units for measurements were not stated. It appears that the general quality of the water has deteriorated as evidenced by the low dissolved oxygen and thehigh nitrate levels recorded in the current study.

The coastal water quality, though fairly good, is being impacted by riverine discharge. This is most evident at #3. Water quality management programs should be implemented to preserve the water quality of this important recreational site.

The discharge of sewage from the proposed development into the surface waters should not be allowes as the algae growth present on the reef could proliferate with any increase in nutrient levels.
Monitoring of groundwater systems should be conducted to determine their current status.

3.10 SOCIO-ECONOMIC ENVIRONMENT

3.10.1 Introduction

The main purpose of the socio economic analysis is to place the proposed development project within the context of the human environment upon which it will have an important influence. Data collection took place in the nine communities that will more immediately experience the project's positive or negative impacts.

The impacts on the human environment will be grouped under the following convenient headings: land use patterns; population and demography, water; employment and

worker housing. Employment and related income generation are particular areas in which the development is challenged to partner solutions for optimizing project benefits. Worker housing is also an area that requires an urgent interventionist approach because experience indicates that a serious shortage attends major hospitality developments and this acts as a catalyst for overcrowding and sprawl. Heritage issues were not deemed an important issue given the current footprints of the project.

Specific reference to individual communities is limited to where issues considered particularly relevant to the project are found. A Conclusions section summarizes the main negative social impacts associated with the project and recommendations for addressing these are offered.

3.10.2 Communities

The locations surveyed comprised a mix of high, middle and low income communities. Included in the survey were the important commercial and government agencies that operate in or close to them. These communities, roughly aligned from west to east were:

- ◊ Pear Tree Bottom Fishing Beach
- ◊ Pear Tree Bottom (settlement)
- ◊ Pear Tree Bottom (site)
- ◊ Montego Old Road
- ◊ Belle Air Project
- ◊ Belle Air Settlement
- ◊ Swallow Tail Fishing Beach
- ◊ The Hotel Strip
- ◊ Club Ambieance
- ◊ FDR Franklyn D. Resorts
- ◊ Sandals Breezes Runaway Bay
- ◊ Super Clubs Hedonism 111
- ◊ Royal De Cameron
- ◊ Heart Runaway Bay Hotel
- ◊ Salem Fishing Beach

Windscreen observations only were used in Discovery Bay, since the consultants had prior detailed knowledge of this community from an earlier data collection exercise, and in Browns Town, whose role as a beneficiary of or to the project is unlikely to extend beyond some employment potential and the offering of housing accommodation.

The project itself is being developed on a former works site but with few remaining structures. There is only one squatter tenant in place (Plate 3.10.2.1). An understanding in relation to moving off of the property has been reached with that individual. An issue in relation to an existing claim by former residents on the site to ownership of parts of the property is before the courts and is mentioned here for the record.

Plate 3.10.2.1 Lone squatter tenant at resort site.

The large urban centers of Falmouth. Ocho Rios and Montego Bay, which will be influenced by the project, were not surveyed. This was because the impacts were considered both predictable and positive. It is expected that these areas will receive the major share of the land tours offered visitors from Hotel Bahia, and therefore the greater share of this component of tourist spending. They will also receive the greater share of the regional trade and commerce generated by the project.

3.10.3 Land Use

◊ **Settlements**

Land use for settlement is the most important use of land in the area. STATIN's 2001 census data puts the number of houses in the larger population groupings at 3,904 with an average 4.2 persons per unit. The communities closest to Pear Tree Bottom are Pear Tree Bottom Squatter Community (Plates 3.10.2.2 & 3.10.2.3) comprising 150 persons

and Runaway Bay proper inclusive of Belle Air Project, Belle Air Settlement and the hotel strip. These areas range from high to medium land use density.

Plate 3.10.2.2 Members of Pear Tree Bottom squatter settlement

Plate 3.10.2.3 Hillside houses in Pear Tree Bottom squatter settlement

Table 3.10.1 Residential land use indicators.

Area	Number of houses	Percentage of total
Runaway Bay		
Pear Tree Bottom	271	6.94
Cardiff Hall	107	2.75
Salem	389	9.97
Other Runaway Bay	645	16.52
Sub Total Runaway Bay	**1,412**	**36.16**
Browns Town	**1,781**	**45.62**
Discovery Bay	**711**	**18.20**
TOTAL	**3,904**	**100**

Runaway Bay is predominately a residential & tourism community with an intensified strip of small trading businesses in Salem, now effectively a district of Runaway Bay. In addition to low density high value residential homes fringing the golf course on the former Cardiff Hall estate, most of the residences are in communities lying on either side of the inland road to Browns Town. The more recently planned of these, is Belle Air Project (Plate 3.10.2.4), a middle income PRIDE assisted housing estate comprising about 50 units. Immediately to the west of this is Belle Air Settlement (Plate 3.10.2.5), a low-income scheme comprising about 75 units of poor housing stock.

Plate 3.10.2.4 Belle Air Project

Plate 3.10.2.5 Belle Air Settlement

◊ **Tourism**

Land use for tourism forms the most important economic component. There are also several, small tourism-dependent enterprises, mostly offering food or recreational services. The hotel properties in the area offer a combined 3,874 habitable rooms. Table 3.10.2 shows the number of hotel rooms available at the main existing properties along this part of the North Coast, as well as that for the planned hotel developments. It also indicates the relative size of Pear Tree Bottom in relation to these. For comparison the total number of current hotel rooms in St. James and parts of Hanover, Trelawny and St. Ann are included.

Table 3.10.2 reflects that on the basis of current room capacity and additional capacity projected for the three new developments, Pear Tree Bottom would account for approximately 15% of all hotel rooms in the project area and 31% if the three new developments were excluded.

The project will contribute 1,800 rooms. St. James, parts of Hanover and Trelawny currently account for 5,345 rooms and St. Ann' another 3,987. Trelawny, including its new developments, will contribute a further 6,470 rooms.

Table 3.10.2 Total hotel rooms in project area and for select parishes.

	Property	No. of rooms (2003)	% of total rooms (including new developments)	% of total rooms (excluding new developments)
Actual	Club Ambiance	80	0.66	2.07
	FDR Pebbles Resort	96	0.79	2.48
	Super Club Breezes	238	1.96	6.14
	Super Clubs Hedonism III	3,225	26.56	83.25
	Royal De Cameron	179	1.47	4.62
	Heart Runaway Bay	56	0.46	1.45
Sub total		3,874	31.90	-
New developments on completion	Pear Tree Bottom (Bahia)	1,918	14.82	-
	Oyster Bay	1,800	14.82	-
	Harmony Cove	4,670	38.50	-
Sub total		8,488	58.06	
TOTAL		**12,362**	**100**	**100**

There are four large hotel properties in advanced stages of planning or construction in the coastal corridor beginning in Rose Hall and into St. Anns. These are Iberostar, Oyster Bay, Harmony Cove, Bahia Hotel (Pear Tree Bottom) and the Rios Hotel. It is likely that there are other similar developments are in the early planning stages. The project must be seen as an important link in the growing tourism corridor.

Optimizing the potential cumulative positive impacts of these developments on the communities within this corridor will need to be driven by a specific planning mandate. It is necessary that the same degree of focus be placed on social infrastructure support for corridor communities, as has been placed on physical infrastructure support for these developments.

The Pear Tree Bottom project continues the land use conversion of the northern coastline into tourism, from low density relatively undeveloped residential agricultural or commercial use into high value income generating real estate properties. In national economic terms, this is the best value-added land use option available in the context of given opportunities. The project brings with it significant foreign capital inflows, employment and income generation, and is, importantly, an invisible export. While the existing land use will be changed, with appropriate safeguards for the environment this change is expected to be positive in both the short medium and long run. Equally important will be the projects contribution to the new momentum given the physical planning process, since it is the cumulative impacts of this process that will ultimately determine the sustainability of development along the North Coast.

◊ **Fishing**

There are three fishing beaches along this part of the coast. Pear Tree Bottom Fishing Beach and Swallow Tail Fishing Beach are small and unregistered while the third and main beach, Salem Fishing Beach, is recognized by NEPA. Pear Tree Bottom Fishing Beach (Plate 3.10.2.6), just west of the project site, comprises 4 boats and some living quarters for the small number of fishers using the beach (Plate 3.10.2 7). The fishing beach has no sanitary conveniences or legal fresh water source and its presence is probably unfriendly to the mangrove ecology within which it lies. Any benefit to the the project will be indirect and one way to the fishers.

Plate 3.10.2.6 Pear Tree Bottom fishing beach – outside of site's western boundary.

Plate 3.10.2.7 Huts on Pear Tree Bottom fishing beach.

The Swallow Hole fishing beach (Plate 3.10.2.8) berths about 18 boats although only 6 were seen at the time of visit. The beach is somewhat of an anomaly. It is small in size, has very restricted access to the main road, and is hemmed in on three sides by residential commercial development. While it could be redeveloped into a visitor walk-in and beach entertainment attraction, this could be made entirely independent of the existing fishing activity. The current beach is unlikely to impact the project negatively, since it is non-residential, but neither is it likely to benefit the project. However the project may indirectly benefit the beach, through any incremental demand for fresh fish in the Runaway Bay area.

Plate 3.10.2.8 Swallow Hole fishing beach.

Salem Fishing Beach (Plate 3.10.2.9) is the largest in the area. It has 25 registered boats, and about 90 fishermen. It is evolving an interesting synergy with tourism in that it provides both food and entertainment facilities and there are craft vendors. The fishers regard this synergy as very important. It mimics, on a less organized scale, what is taking place at the Jacobs Taylor Public Beach at Silver sands in Duncans. Of the beaches in the area it is the most likely to benefit from the project because of this developing synergy. Fisheries in the area have relatively little to contribute to the project but stand to benefit if the hotel creates an indirect and additional demand for fresh fish.

Plate 3.10.2.9 Salem Fishing Beach.

To the west of the project, the Discovery Bay Fishing Beach berths about 25 boats and supports about 100 fishers. The beach is licensed by the Fisheries Division as a fishing beach. The beach, which has sanitary conveniences and well constructed storage facilities, will likely benefit indirectly from the project if there is a related expansion of the fresh fish market in Discovery Bay.

◊ **Population & Demography**

STATIN's 2001 Census data puts the population of the communities identified at about 16,450 (Table 3.10.3).

Table 3.10.3 Community populations.

Community	Total population (2001)	% M	% F	% 0-39 yrs	% 40+ yrs
Runaway Bay					
Pear Tree Bottom	1,146	51	49		
Cardiff Hall	545	47	53		
Salem	1,946	46	54		
Other	2,203	-	-		
Sub total	**5,840**	48	52	74	26
Browns Town	8,074	48	52	73	27
Discovery Bay	2,518	50	50	67	33
Total	**16,432**				
Average		**48**	**52**	**71**	**29**

From inference, based on the parish population growth rate between 1991-2001 of 1.11% per annum, and observation, these figures perhaps slightly understate the current populations. The field survey suggested that 70% the population in these communities could be classified as belonging to the lower and lower middle-income groups. There are however pockets of middle and upper income residential areas. For example in Cardiff Hall Runaway Bay and also the bauxite induced residential area of Bridgewater in Discovery Bay.

The population is skewed in favour of females (52%) in addition all communities have relatively young populations. On average 7.0 out of every 10 members are less than 40 years of age.

The community surveys also revealed that females head most households. Where lower income populations coexist with young female heads of households, dependency ratios are normally high. The overall parish ratio is 70% indicating that 7 out of every 10 persons are dependents of the remainder. Since this ratio essentially relates the size of the labour force to the population it supports, it can be assumed that this ratio applies to the communities surveyed. The significance of this in relation to the project is that it

justifies female employment as focus of planning training and community development so as to optimize the flow of project benefits into these communities.

Related to this are the particular implications for these communities deriving from the nature of the development. This population and demographic profile juxtaposed with a capital and labour intensive, high hospitality skill needs development, has mixed implications for the communities. Firstly, employment opportunities for skilled community members will be available. The challenge is to create a larger pool of these skills and this must be a joint partnership effort between national training agencies, the project and the communities. Secondly, employment opportunities could be significant if the communities are empowered to become part of the product offered and marketed by the development. This can be achieved with innovative tourism product development targeting individual communities and through establishing product linkages between communities. Thirdly an important challenge will be maintenance of social cohesion and containment of sprawl within vulnerable communities (Belle Air Settlement & Pear Tree Bottom Settlement) given the likely influx of job seekers and other opportunistic elements. Directly related to this is the issue of worker housing within the larger issue of community housing needs and affordability. It is recommended later, that this social planning agenda requires a comprehensive regional planning response for the corridor, rather than a series of local responses following upon each development.

The respondents in the communities surveyed were very positive about the project and considered it a much-needed stimulant to improving the well-being of their communities. They anticipate both employment and income opportunities to accompany the development.

◊ **Water**

St. Ann is served by the Dry Harbour Mountain hydrological basins. The parish has one of the higher levels of ground water reserves (Table 3.10.4). This is supplemented by surface water resources.

Table 3.10.4 Water resources (MCM/Year)*

Martha Brea River Basin	Supply: Average Yield	Supply: Reliable or Safe Yield	Consumption:	Unused: Reliable or Safe Yield
Surface Water	456.8	27.6	1.5	26.1
Ground Water	691.0	691.0	32.8	658.2
Total	737.8	718.6	34.3	684.3

* Figures based on the 1990 Master Plan of the Water Resources Authority

The water supplied to the Runaway Bay area comes from the two wells at Mt. Edgecombe. One is operated by the Urban Development Corporation and sold to NWC. The NWC estimates that the wells have the capacity to supply 2M gallons daily but currently demand is only a small percentage of that volume. The proposed resort project should not have a water supply problem and will have some options. These include buying water from the NWC, reactivating a well on the property, and using a desalination plant. The resort intends to use the well located immediately south of the wetland for which it has a permit to abstract.

Although exact values are not final, the consumption needs for both water and electricity by the project are expected to be well within system capability to deliver.

◊ **Electricity**

Electricity is supplied at the mains running along the highway. The developers are currently contemplating using this service and having stand-by generator capacity in the case of grid power outages. The Jamaica Public Service Co. Ltd. (JPS) will be consulted to confirm availability of supply.

It may be noted that JPS high transmission lines run immediately south of the property.

◊ **Employment**

Employment and income generation will be the main channels through which project benefits will flow to the surrounding communities. Any large-scale project, by its very presence, will introduce positive employment benefits. The issue with the project (and by

extension within the corridor) relates to the scale and optimization of these benefits. It is estimated by the promoters that the project will offer employment to about 800 – 1,000 persons during the construction phase and about 2,200 during resort operations. This will augment direct employment in the tourism sector, currently at 75,000. Training is necessary to optimize community access to this employment opportunity. There are several HEART training centers serving the corridor. The largest is within the project area, the Runaway Bay HEART Hotel and Training Institute (RBHTI), which operates the hotel as part of its training infrastructure. It graduates about 300 students per annum. Other HEART training centers are in St. Ann's Bay, Duncans and Falmouth. HEART.VTC offers training in construction skills and hospitality skills. They graduate about 150 per year. The Kelly Lawson Skill Training Center offers training in other hospitality skills. It graduates about 60 students yearly. Supportive is the Browns Town Community College, which also offers skills training in tourism. It is unlikely that these training centers can address the downstream skill requirements for the parish, much less other rapidly expanding areas within or contiguous to the corridor. However the RBHTI has initiated strategies for addressing increased hotel employment demands within the corridor. These strategies include:

- Seeking to increase the number of training centers and locating them strategically within communities
- Increasing the current system from one to two shifts per day to accommodate a higher student population.
- Introducing new short-term courses that allow for speedy qualification.

The short term target of RBHTI is to increase the number of graduates per annum from 300 to 400 per annum. While the institutional training capacity of HEART island wide, may or may not be capable of meeting projected tourism manpower needs, the more relevant issue for the communities is the availability and accessibility of this training to community members. It is creating this linkage and opportunity for training that requires the participation of HEART, the project and the communities to resolve. Otherwise, the project will be mainly taking skills from other near properties or importing skills from outside of the corridor to the detriment of the giving and receiving communities.

Developers are not required by law or obligation to introduce or even support community development. This responsibility lies with Government. However there are few major

developments of this size where the developers are not committed to improving neigbouring communities and bringing them into the catchment area of benefits. Traditionally the government has relied on this 'trickle down' effect to spread tourism benefits, with exceptions being where TDPCO has fostered new attractions or given assistance to established ones.

The reality is that new tourism developments continue to place surrounding communities on the periphery of the benefit flows. Flankers, Lilliput and the surrounding communities at the Rose Hall end of the corridor are prime examples of this. Neglect, or insufficient emphasis on social planning and lack of political will, has allowed sprawl instead of planned expansion.

It may be timely to revisit the incentives offered under both the *Hotel Incentives Act 1968* and the *Resort Cottages Act 1971,* to examine ways of linking tax incentives to related community value added strengthening investments.

With respect to the Corridor and the project, It is clearly in the interest of the local planning authorities, the developers, and the communities not to repeat the planning neglect referred to earlier. A specific recommendation is therefore that a specific project be mandated and funded within TDPCO, or within the UDC, or created under the umbrella of an appropriate Ministry, to bring concerted tourism product development planning to the Corridor. The main focus of this intervention is to create project/community/linkages through which employment and income benefits can flow. Downstream this mandate could be expanded to include tourism developments on the south coast, or wherever large tourism developments are planned. The current corridor however needs to be the urgent focus of attention. Under existing institutional arrangements, this focus, even if present, is not effective. Sustainable social development in St. Ann's impacted communities, is unlikely to take place in the absence of such a focus.

◊ **Worker Housing**

Unmet housing needs for migrant hotel and non-hotel workers, unemployed speculative elements seeking opportunities and inadequate social infrastructure (both features of main tourism centers) are reasons why potential economic benefits from the project

growth may not translate into corresponding development. Unless this issue is addressed head on, the project will probably result in an intensification of sub-standard housing elements in the surrounding communities. This outcome is not solely a consequence of the housing demand generated by direct project employment, but from job seeking emigrants and hustling occupations attracted by the Project. Both groups however, will gravitate towards unplanned residential accommodation wherever it exists, or will construct it, if it does not. This process is already at work within the North Coast Corridor.

The communities and parish planning authorities are very conscious of this threat. Elsewhere in the corridor, for example at Rock, a community bordering the planned Oyster Bay development at Florida Bay in Falmouth the community has already had several discussions, under the leadership of The Rock Citizens Association and the Parish Councilor for the Division on strategies for resisting these anticipated incursions. One practical approach, already instituted, is to identify the ownership of every property within the community to ensure that legal control is retained. Also the community is being mobilized to act collectively in resisting any attempts at unwanted settlement both within the community borders and adjacent to them.

The challenge posed by the squatting phenomenon, is that it continues to develop alongside and then outpace the low income housing solutions provided by the State. The resulting unplanned sprawl destroys the physical environment and this in turn compromises the sustainability of the original project. Pre-emptive planning, including zoning and enforcement, is required to avoid this.

No requirements exist in law or planning codes for hotel developments to provide worker housing. Nevertheless, proper planning for large projects requires integrated solutions for skills upgrading, housing needs and social services for which these projects are catalysts. It is the responsibility of the Government to provide the planning solutions. It is in the interest of the Project, that these solutions be found.

As has been clearly demonstrated at Cardiff Hall and Bridgewater in Discovery Bay, the private sector will usually respond quickly to the housing needs of higher income groups (Plate 3.10.2.10)

Plate 3.10.2.10 Montego Old Road - upscale community adjoining eastern boundary of project site.

◊ **Heritage**

Ready access from the project to several known heritage sites and points of interest provides the opportunity to support these elements or to properly conserve and rehabilitate them where necessary. The host communities therefore have some potential for developing community-based tourism around heritage themes to a greater degree than has perhaps taken place in the past. These sites include:

- Rio Bueno
  - *Columbus tradition.*
  - Fort Dundas (1778)
  - St. Marks Church (1831)
  - Old Tavern (Wellington Hotel) known to exist in 1816.
  - Old Police Station Building
  - Bengal Bridge
  - Bengal Great House
  - Wattle & daub architecture.
- Bryan Castle & sugar estate

- The Green Grotto or Runaway Bay Caves
- Cardiff Hall Great House (circa 1750)
- Llandovery Estate (1674)
- Laughlands
- Seville Estate
- Orange Valley
- Bel Air Great House (Royal Palm)
- Retreat Pen Great House
- St. Markes Church (1895)

Some of these are well known heritage properties and attractions under the protection of the Jamaica National Heritage Trust). Most of the Great Houses referred to are in private hands but this should not prove too great an obstacle to incorporating some of their remaining estate elements into heritage trails

With respect to Pear Tree Bottom itself, the consultants are unaware of any heritage elements on the site or any at risk by the development. However, there are documented Taino sites on Belle Air and on the Little River. The indicative factors for such sites are coastlines in proximity to rising ground and a river or spring nearby as a source of fresh water. Although the site has been in fairly constant use over many years, including carrying the old coast road alignment, caution dictates that JNHT be requested to visit the site and after inspection, determine if they have an interest in maintaining a watching brief during construction. It should be noted that Seville, Jamaica's first Spanish capital and situated a few miles to the east, remained un-recovered for all practical purposes until 1937 despite it's presence on a relatively active estate.

◊ **Other Issues**

Health and public safety infrastructure seem inadequate to meet the project, community and larger corridor needs. in the event of an emergency. St. Ann's Bay has a Type B regional hospital offering 198 beds, with its nearest support being Type C, hospitals in Port Maria and Falmouth. Fire services also seem inadequate, with 2 functional fire trucks located within the parish (at St. Ann's Bay & Port Maria) and a fire boat.

◊ **The North Coast Highway**

The alignment of the new north coast highway considerably enhances rapid transit along the Corridor and to the project. An opportunity exists for the timely creation of a coastal township development initiative. This would focus the combined resources of tourism, housing, infrastructure, manpower training, and conservation agencies to plan the physical and social re-engineering requirements for developing an integrated, sustainable tourism corridor. Part of this planning initiative would include creating the pathways for project/community benefit flows refereed to earlier. The hotels, which will be major beneficiaries of such a development, should be willing to be part of the process.

In the absence of such focused planning, economic benefits will flow, but attaining true sustainable development will prove much more challenging.

◊ **Conclusions and Recommendations**

As implied earlier, the mainly small size and demographic profiles of the communities investigated suggest that the large tourism development proposed will bring positive impacts. In turn, their proximity as a labour source and their offerings in micro enterprise services to guests will benefit the Project. In some instances, larger attractions such as occur both within and outside of the parish will be the focal points of this exchange. Although the project will generally enhance the human environment the extent of its impact and the degree to which these benefits are optimized will depend on the critical application of focused physical planning to actualize them.

The main recommendations arising from the socio economic assessment can be summarized as follows:

- The project should be creative in allowing opportunities to emerge for community participation in tourism benefits. One strategy could be through its concessionaire arrangements by encouraging the carrying of local products. A second could be by facilitating access to HEART training programs through the early identification and support of potential trainees. Several good examples exist of pre project manpower

training needs assessments being followed by training programs, that support community directed project employment opportunities. The project is encouraged to develop such an out reach program early.

- A coalition of stakeholders to include agencies responsible for planning and implementing social development and housing, and to include the project, should develop a planned and early response to the challenges posed by staff housing, and the avoidance of unplanned settlements arising.

- There needs to be an intensification of effort to upgrade health and safety services within the area.

- On the site Taino elements may exist and JNHT should be consulted to see if they can confirm this or wish to undertake a watching brief during construction.

3.11 NATURAL HAZARD VULNERABILITY

The location of the project area within Jamaica and the Caribbean basin makes it susceptible to a range of natural hazards including the effects of hurricanes and other tropical systems, earthquakes and to a lesser extent slope instability. Jamaica lies in the path of hurricanes and other tropical weather systems that typically develop and move through the Caribbean basin between June and November.

3.11.1 Storm Surge

The location of the project area along the northern coastline of Jamaica makes the coastal zone highly susceptible to the effects of storm surge associated with hurricanes. Low lying areas along the coast are susceptible to inundation and accelerated erosion from increased wave action. Estimates of storm surge along this section of the northern coastline of Jamaica suggest an elevated water height of between 1.5 and 2.5 meters above mean sea level. Intense rainfall associated with these weather systems can cause flooding of low-lying areas in the coastal zone.

3.11.2 Hurricane Winds

High velocity winds generated by hurricanes have the capacity to cause significant damage. No significant acceleration of wind velocity is expected over the low lying hills of the project site although structures located on ridges and spurs are susceptible to higher wind speeds.

3.11.3 Seismicity

The study area experienced a magnitude 6.5 earthquake in 1957 with an epicentre 20 km northwest of Montego Bay. Analysis of historic seismic events and the tectonic setting of Jamaica by Pereira (1987) has produced seismic zonation maps. These maps (see Figure 3.11.1) indicate that the project area is located in a zone that is more susceptible to low magnitude earthquakes. These low magnitude earthquakes do have the potential to cause significant damage especially where buildings are founded on alluvium and poorly consolidated sediment along the coastal zone.

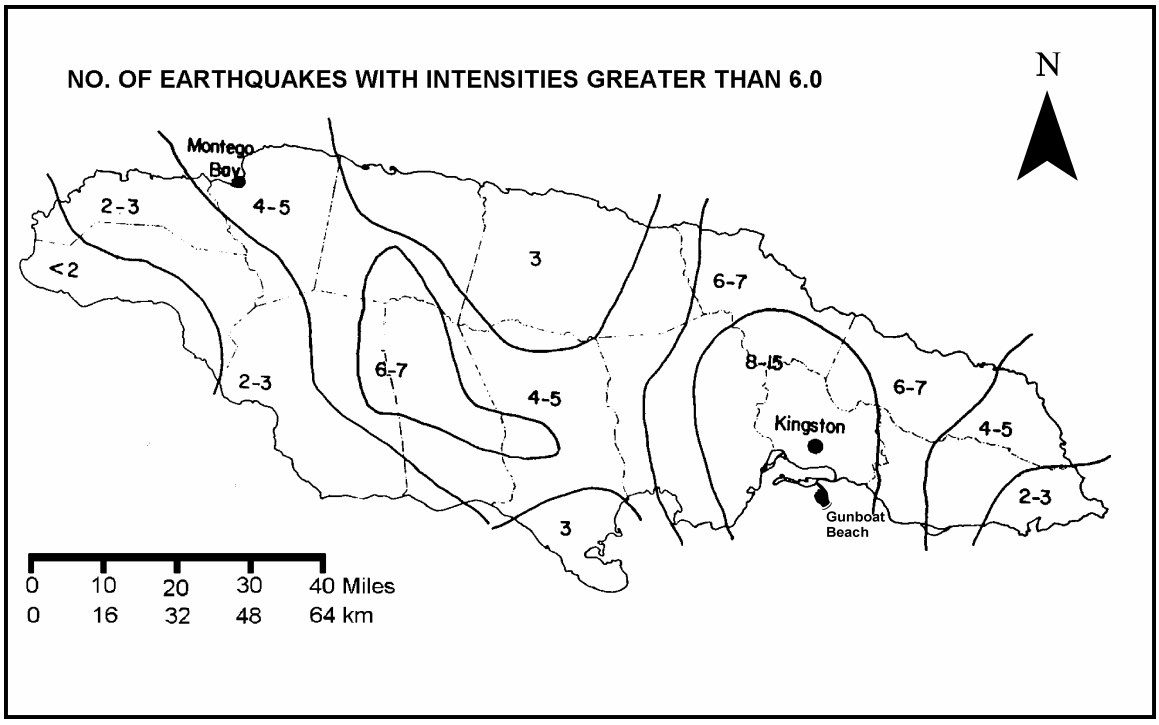

Figure 3.11.1 Seismic zonation map of Jamaica.

3.11.4 Slope Stability

The stability of natural slopes in the project area is good with no evidence of substantial earth movement. High angle to vertical cuts in the underlying limestone for road placement appear to be stable up to heights of up to 15 feet. Where cuts are made into the well-bedded form of the Montpellier Limestone a greater degree of instability can be expected along steep cuts where beds slope downwards into the cut.

4. PROJECT DESCRIPTION

The Hotel Bahia resort development project is a modification of the original concept for the development of the waterfront at Pear Tree Bottom, a project in which NEPA has been involved since the mid 1990s. It intends to create a high-end tourism resort that is environmentally friendly and which will directly contribute to the economic development of the area.

4.1 SITE LAYOUT

HOJAPI intend to build three hotels on the 34 ha (84 ac) site. The layout of the building footprints superimposed on a 2002 satelite image of the site is shown at Figure 4.1. Also indicated are the proposed three phases for the construction works. It can easily be noted that the three hotels will occupy flat and gently sloping land that has either been previously cleared or is covered by disturbed dry limestone forest. The supporting services infrastructure (water treatment plant, laundry, stand-by generator, work shops, etc.) will be centralized and located at a site on the property south of the highway, as will be the sewage treatment plant, the plant nursery, and the temporary construction camp. It is to be noted that the resort footprint does not encroach on the small wetland area to the west of the site, which has been designated as conservation area in the St. Ann Development Order 2000.

It is estimated that approximately 8 ha (19.7ac) or 23.5% of the land area will become covered by impervious surface. The buildings will be a maximum of six stories high in Phases 1 & 2 and seven stories high in Phase 3. The buildings will be will be set back 50m from the high water mark. Ground floor levels will be set at 3m above sea level.

At present there are no definite plans for utilization of the rest of the property south of the highway.

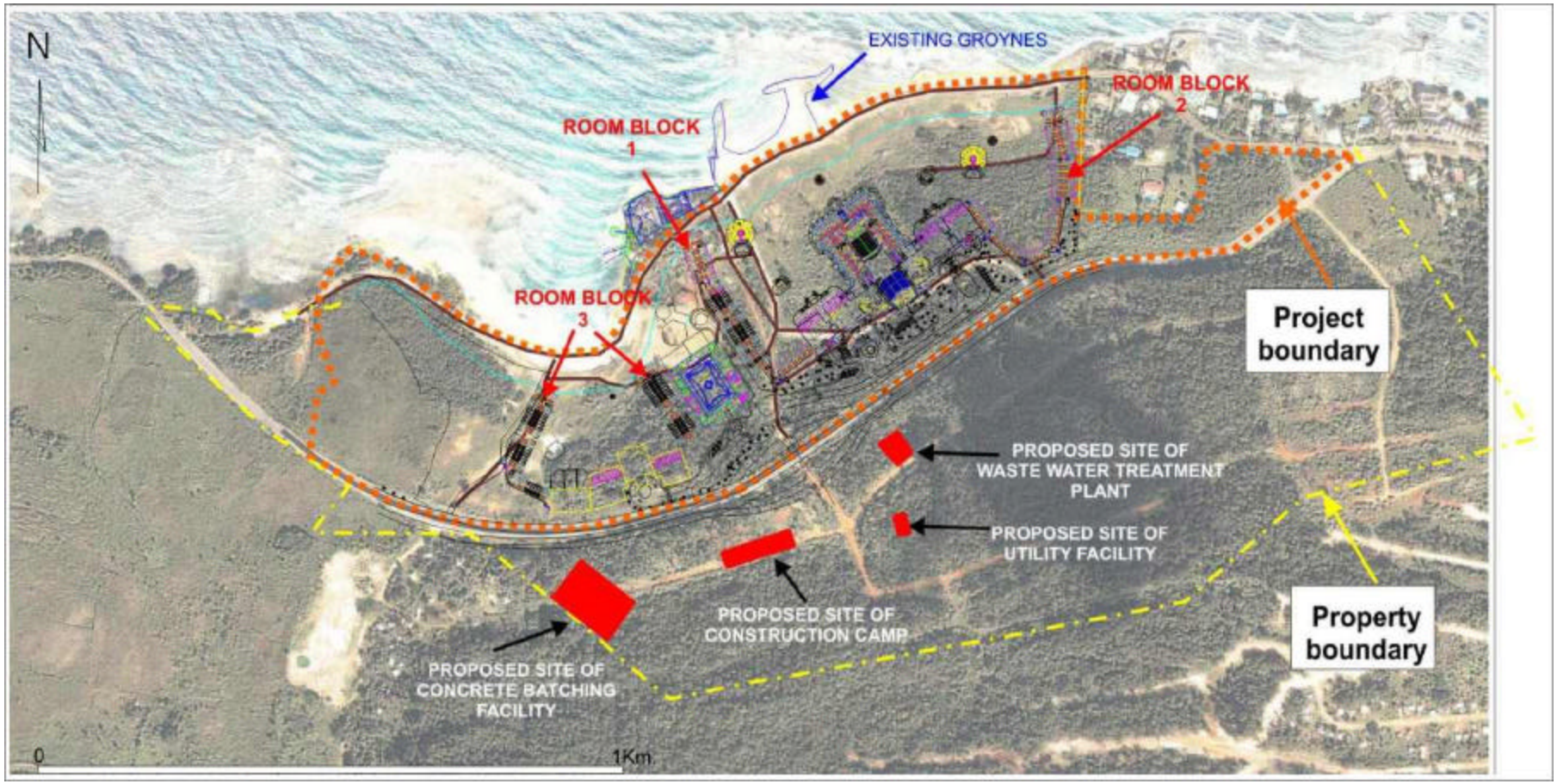

Figure 4.1 Layout of building footprints over 2002 satellite image

4.2 CONSTRUCTION SCHEDULE AND METHODOLOGY

4.2.1 Site preparation activities

Plant rescue and nursery. Initial activities on the site will entail identifying and establishing the plant nursery (see Figure 4.1) to which will be removed selected plants and seedlings taken from the areas to be covered by buildings. This will be done by a landscape contractor in charge of a team engaged in the selection and removal of desirable plant material. This will be done more or less simultaneously with the general clearance of the underbrush on the building areas such that all large trees (diameter > 12 cm) are left and the buildings and adjacent access areas can be pegged out. To the greatest extent possible, building footprints will be laid out and oriented so as to minimize the removal and loss of trees. The area of removal will also take into account the need for clear space around each building for the passage of construction equipment.

Construction camp. Figure 4.1 also shows the proposed location of the construction camp. This site will allow use of the existing underpass to access the site and minimize highway traffic disruptions caused by movement of construction works equipment. The establishment of the camp (access roads, temporary office buildings, concrete batching plant, earth materials stockpiles, equipment and material stores, maintenance yard, etc.) will entail loss of trees and vegetation occurring at that site (approx. 2 ha).

Water supply. The plant nursery, construction camp and site works will require a supply of water. This implies that the provision of water to the construction area from the well north of the wetland will also be an initial construction activity. This will involve vegetation clearance along the route of the water mains and possibly burying of the pipe in a trench. The precise alignment of the route for the water pipes has not yet been determined.

4.2.2 Building construction methodology

It is intended to build the resort in three phases, the two easternmost hotels being built first followed by the westernmost hotel adjacent to the small area of wetland. The first phase will last

approximately fifteen months. For the purposes of this EIA it is assumed that the complete construction works for the three hotels will last thirty months.

A determination of the construction methodology to be employed (e.g. tunnel form, block and steel, etc.) has not yet been made. This is relevant insofar as tunnel forms typically require a greater amount of space beside the building to accommodate the tunnels. On the other hand, that technology allows for a shorter period of construction.

Building construction will take place on largely flat land but where this is gently sloping the developer intends, as far as possible, to place the buildings on 'platforms' or levels created by balanced cut and fill operations. This is depicted in Figure 4.2. This will serve to reduce the amount of earth material to be wasted. Depending on substrate conditions concrete foundation piles will be inserted where necessary.

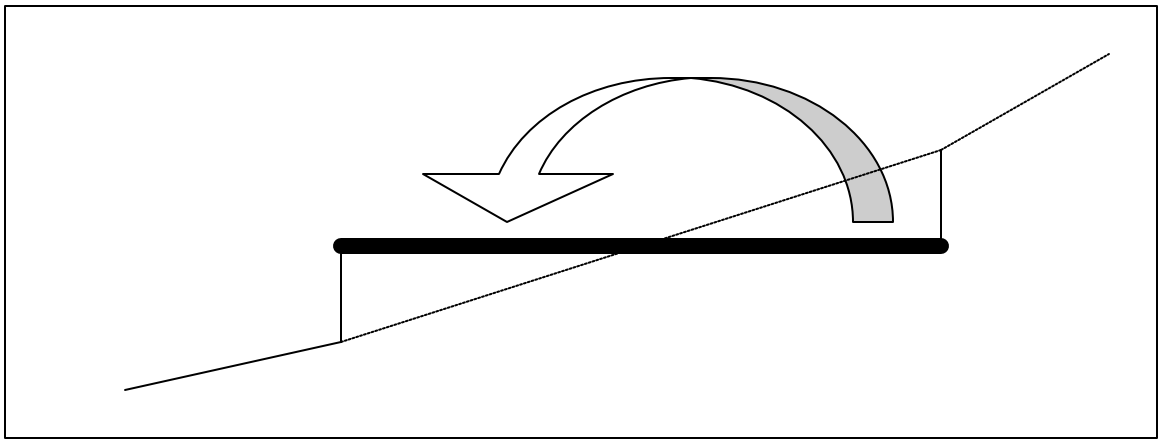

Figure 4.2 Schematic illustrating cut and fill.

4.2.3 Beach construction works

As noted earlier in Section 1.1, the previous owner of the property initiated construction of artificial beaches along the rocky shoreline east of Pear Tree Bay. This entailed the building of five groynes that appear to conform roughly to engineering specifications but which may not have been properly completed. In one case the groyne has partially collapsed.

The present project may or may not undertake groyne repair but certainly it will seek to complete the beach works. This will necessitate identifying a source of suitable sand, transporting the sand to the beach location, and filling the beach area. The works have not been sufficiently detailed or determined to allow precise evaluation of potential environmental impact but the obvious issues relate to loss of sea grass nursery habitat and short-term exposure to suspended sediments.

4.2.4 Bathing area enhancement

Shoals in the back reef lagoon immediately to the west of Pear Tree Bay are covered with seagrass beds, which lie at or just below sea level. These restrict the amount of available bathing/wading area and the developer will be seeking to have this area deepened.

4.2.5 Water supply development

Reference has been made above to the intention to utilize an existing well situated immediately south of the wetland for water supply to the development (see Figure 4.1). The permit # A99 / 013 dated 17 August 2001 issued by the Water Resources Authority for permission to abstract water not exceeding 2,725 m^3/d (599,416 ig/d) has been transferred from the original owners to HOJAPI. The permit is effective for five years and lapses in 2006. Conditions designed to prevent over-pumping and salinisation of the supply are attached to the permit. Should pumping tests prove that this supply is not reliable then the options of opening a new well or installing a reverse osmosis plant will be considered.

The well water will be pumped to the water treatment facility that will be housed in the services support center located south of the highway. In the first instance, the quality of the well water, after some pre-treatment, should be satisfactory for construction purposes.

4.2.6 Site waste management

A considerable amount of organic refuse (vegetation) would be generated during site clearance activities. To the greatest extent possible the soft material (leaves, shoots, etc.) would be separated and composted on site for later reuse during the landscaping phase. Harder and woody material (tree trunks, branches) would be stockpiled and removed from the site by a

waste contractor. The designated waste dump for the parish is at Haddon, approximately 40 km (25 m) away near Moneague.

During construction, chemical toilets will be provided for use on the site.

4.2.7 Wetland/mangrove protection

The developer is aware of the ecological role of wetlands and for that reason the small wetland area located at the western end of the project site will be protected. It is intended that the existing stream and small estuary will be maintained and the marsh will be incorporated as a special feature in the landscape design. The details of this are to be worked out.

4.2.8 Materials transportation

Site clearance and construction of the hotel will require transportation of materials to and from the site and this will generate a significant amount of traffic, especially trucks, on the coastal main road. This will exacerbate traffic congestion in towns along the transport routes and potentially cause a deterioration of air quality due to dust and exhaust fumes. These are issues that can be mitigated to some extent as discussed below in Section 5.1.10.

4.2.9 Employment

It is estimated that approximately between 700 to 1000 persons (skilled and unskilled) will be employed during construction of the resort.

4.3 OPERATIONS

4.3.1 Traffic

Operation of the resort will require the transport of guests to and from the airport, primarily in relation to Sangster International in Montego Bay. This will involve scores of bus movements in addition to the traffic caused by hotel staff, suppliers, and local visitors. The entrance to the resort has been designed (see Figure 4.1) to facilitate the easy exit to and from the North Coast Highway and to prevent traffic congestion at the entrance.

It is noted that the section of the North Coast Highway between Montego Bay and Ocho Rios and which runs directly in front of the development is being upgraded presently.

4.3.2 Water demand

The total estimated demand for water by the resort during full operation is 2,000m ^{3} per day (440,000 ig/d). This will be met from an on-site supply as discussed above at Section 4.2.5.

4.3.3 Electricity demand

The total estimated demand for electricity is 1.8 MW. It is currently proposed to purchase that supply from the Jamaica Public Service Co. Ltd. However, the possibility of co-generation will be considered.

4.3.4 Solid waste management

Solid waste generated at the site will primarily be domestic in nature (paper, plastics, packaging, waste food, etc.). This will be collected on a regular basis by a private waste haulage contractor and dumped at the Haddon Dump in St. Ann.

The hotel operators are willing to institute waste separation and recycling procedures at the resort and the extent to which these can be effectively executed will be examined.

4.3.5 Sewage treatment and effluent disposal

It is estimated that the resort will generate 2,000m^3/d (440,000ig/d) of sewage at full operation. The sewage treatment plant (STP) to service the demands of the resort will be built on land south of the highway and located near to highway underpass (see Figure 4.1). The STP will employ either activated sludge or extended aeration technology. The effluent, which will be treated to water quality standards that meet or exceed NEPA requirements (see Section 2.1.6), will be pumped back to the resort for use as irrigation for the grounds. The NEPA standards are shown in Table 4.3.5.1.

Table 4.3.5.1 Design parameters for treated effluent quality.

Parameter	NEPA Standard	
	Effluent	Irrigation
pH	6-9	-
Biochemical Oxygen Demand (BOD_5)	20 mg/l	15 mg/l
Chemical Oxygen Demand (COD)	100 mg/l	<100 mg/l
Total Suspended Solids (TSS)	20 mg/l	15 mg/l
Total Nitrogen	10 mg/l	-
Phosphate	4 mg/l	-
Faecal Coliform	200 MPN/100 ml	12 MPN/100ml
Residual Chlorine	1.5 mg/l	0.5 mg/l
Oil & Grease	-	10 mg/l

When the ground is saturated with water (e.g. during the rainy season) it is proposed to discharge the treated effluents to ground via deep well injection. Another option could be a distributed discharge around the periphery of the southern end of the wetland, using the natural system for effluent polishing. In this case, the limited capacity of wetlands to absorb phosphorus should be taken into account.

The STP will produce a relatively small amount of sludge ($6m^3$/day) due to the degree of oxidation afforded by the design. The resort will dry and stabilize the sludge for use as a soil conditioner.

4.3.6 Radiation protection

The developers have a concern for the effects of low frequency electromagnetic radiation on humans. Therefore, the architectural design of the buildings incorporates a minimum distance of 7m to 10m between any sleeping area (staff and guests) from an electromagnetic radiation source (e.g. transformers, electrical motors).

4.3.6 Resource conservation technology

It is the intention of the developers to employ resource saving methods and technologies. Some of these are listed below.

◊ **Rooms**

- Air conditioning savings
    - o A/C will switch off automatically once a window is opened.
    - o A/C self-adjusts to the minimum when no presence is detected in the room.
- Use of fluorescent bulbs
- Lights will switch off automatically when there are no people inside the room.
- Water tank in toilet will use water saving device 3/6 liters per flush.
- Faucets will be of low water consumption.
- Guests will be encouraged to reuse towels as part of the ecological laundry policy, thereby saving water and detergents.
- Use of biodegradable soaps in rooms.

◊ **Hotel**

- Reuse of treated sewage effluent for irrigation of the grounds.
- Residual warm water from the A/C system will be reused to warm up the running water.
- Use of environmental friendly (phosphate free) detergents in the laundry.
- All outdoor areas will be provided with electronic switching devices to eensure that lights are turned off during daylight hours.
- Widespread use of low consumption (6/9 watts) fluorescent bulbs.

5. ENVIRONMENTAL IMPACTS AND MITIGATION

An impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts therefore may be positive (beneficial) or negative (adverse). They may also be direct or indirect, long-term or short-term, and extensive or local in effect. Impacts are termed cumulative when they add incrementally to existing impacts. Both positive and adverse environmental impacts could arise during the site preparation, construction and the operations phases of the Hotel Bahia resort development project. These are discussed in this section.

5.1 CONSTRUCTION PHASE IMPACTS

The consideration of the construction phase impacts in the following section includes those impacts related to site preparation and clearance works.

5.1.1 Loss of land use options

The construction of the resort will involve the erection of permanent concrete structures on what is essentially a green field site. This will result in a loss of the options for alternative land use and thus represents an irreversible commitment of land resources. The loss of optional uses for the coastal land in the future is considered to be a negative impact.

Mitigation:
N/A

5.1.2 Loss of terrestrial habitat and biodiversity

The clearing and removal of trees and vegetation during entrance road construction and the development of the resort will result in the loss of a significant part of the existing dry limestone forest and, as a consequence, a reduction of arboreal habitat for epiphytes, lizards, tree frogs, birds and snakes, including endemic species. In particular, the main concern relates to the loss

of habitat for two endangered and endemic species, the Yellow-billed parrot and the Yellow Snake/Jamaican Boa. Noise, vibrations, and intrusive activities related to construction works also will tend to scare away any animals remaining on the site after vegetation clearance. This is the environmental trade off for the expansion of tourism plant.

It is very possible that during site clearance activities snakes will be encountered, including the Yellow Snake. Given the typical local adversity to snakes these specimens may be unnecessarily harmed or killed by workers.

The loss of habitat impacts per unit area will be greater at those construction locations south of the highway (e.g. sites for STP, support services, nursery, and construction camp) where the dry limestone forest has been less impacted than at the area northern portion of the development property. On the larger scale and to provide a wider perspective on the loss of dry limestone forest in this region, note is taken of extensive loss of contiguous habitat at the adjacent Belle Air housing project.

Mitigation:

Impact mitigation here seeks to retain and restore as much of the original and natural forested condition of the site.

- *Site clearance is to be preceded by an intensive search and rescue mission by qualified personnel to identify and collect all endemic plants and ecologically valuable specimens that can be later used for landscaping the resort. These plants are to be placed and maintained in a plant nursery on site until ready for transplanting. These activities should be guided by an appropriate and approved management plan.*
- *Site clearance should be carried out in a manner that retains the large trees while the building footprints are pegged out.*
- *Construction of the internal roads and placement of the building footprints should be carried out after identifying and locating all the mature and ecologically valuable trees (using qualified personnel) and aligning the roads and building footprints as much as possible so as to save these trees. Trees and shrubs contained within the footprints that are amenable to transplanting should be identified and removed to the nursery.*

- *Where possible bird feeding trees should be retained and used in the landscaping of the resort property.*
- *Landscaping should also use native flowering plants to provide habitat and host plants for butterflies.*
- *The landscape plan should seek to utilize low-maintenance native species tolerant of coastal conditions and attractive to birds and should not include imported and potentially invasive species*.
- *The process of identifying and selecting those trees located outside of footprints that are to be protected and retained in situ should also take into account scenic views and the cleared space needed around the building to facilitate construction.*
- *Trees to be protected and left in place should be clearly marked, individually numbered, identified on the site plan and encircled by a sturdy fence prior to the commencement of construction.*
- *The building contractor should be subject to punitive penalties for any breaches of the tree protection plan.*
- *The landscape plan should be prepared prior to commencement of site clearance activities and be subject to careful review and assessment.*
- *All construction workers and persons on site must be given specific instructions not to harm snakes but allow the animals to retreat into the forest. Alternatively they may be captured for safe keeping by the Seven Oaks Sanctuary for Wildlife in St. Ann. All sightings should be reported to the project manager and ultimately to NEPA. It may be prudent to offer a substantial reward for every snake recovered unharmed.*
- *All construction contractors should be exposed to the environmental management plan and sensitized to the environmental issues.*

5.1.3 Groyne repairs

Repair and reconstruction of the stone groynes in the shallow back reef area along the north shore will involve the movement and placement of large rocks and boulders on the existing structure. During this process there may be dislodgement and falling of rocks on to the sea floor

but given its location behind the reef crest it is not likely that this will cause any damage to the corals. In the case of newly quarried boulders, fine sediments adhered to the rock surface will be washed into the sea during placement causing turbidity and sedimentation on sessile organisms.

Turbidity and sedimentation caused by fine particulates would be a short-term impact but not likely to be significant on the northern shoreline given the influence of water currents. These environments are typically exposed to such conditions and the organisms inhabiting these areas are tolerant of short-term turbidity episodes.

Mitigation:

Impact mitigation here seeks to reduce turbidity plumes.

- *Employ skilled and experienced operators to move and place rocks and boulders on the groynes.*
- *Pre-wash new boulders before placing them in the water so as to remove fine sediments, ensuring that washing is done at a location or in a manner that will not cause washout of fines into the sea.*
- *Deploy silt screens downstream of the area to be repaired so as to contain suspended sediments and allow them to settle.*

5.1.4 Artificial beach filling

The artificial beaches created by the previous owners following the construction of the groynes are in need of enhancement and completion. This will require excavation of gravel and coarse sediments presently in place and their replacement with a finer quality of sand. The means of achieving the above has not yet been determined but it will require sourcing sand from some location (with possible indirect negative impacts at source), excavating shallow areas within the groynes covered with luxuriant seagrass beds, and filling these areas with imported sand.

Mitigation:

Impact mitigation here would seek to reduce loss of seagrass habitat and dispersion of sediment plumes at the excavation/sand filling sites.

- *Identify source of beach sand and means of sourcing and transporting the material that does not cause unmitigable environmental impacts.*
- *Design and submit plan for beach filling along with permit application to NEPA.*
- *Deploy silt screens so as to contain suspended sediments and prevent them from dispersing away from excavation/fill site.*
- *Identify site at which to transplant seagrasses removed from beach site.*

5.1.5 Deepening of back reef area

As noted in Section 4.2.4 the developers will be applying for permission to deepen an area of the back reef lagoon immediately to the west of Pear Tree Bay. The method by which it is proposed to carry this out has not yet been determined but this would result in the partial removal of a shoal area (largely created as a result of sedimentation governed by the refraction of waves as well as deposition of coral debris during hurricanes) covered by a raised and senescent bed of seagrass. Sediment and seagrass removal would result in sediment suspension and turbidity, the degree and extent of which would depend on the means employed. It does not appear likely that the shoal area represents an important or viable nursery area in its present condition or that its removal would represent a significant loss of nursery habitat. Indeed, deepening of the area could be done in a manner that would improve the shallow inshore habitat. In this regard it is instructive to note that the previous owners sought and obtained permission from NEPA to dig a channel in front of the beach in this area so as to improve water circulation and the extent of bathing area.

Mitigation:

- *Based on the appropriate study and assessment prepare a plan for deepening the area that would respect the habitat value of the back reef lagoon, improve its habitat function, and avoid the adverse ecological impacts related to sediment suspension and turbidity.*
- *Submit plan along with permit application for consideration by NEPA.*

- *Ensure relocation of representative area of seagrass and invertebrate population prior to sediment excavation.*

5.1.6 Soil erosion

Vegetation clearance, road construction and excavation works related to construction of the hotels and buildings will expose soils in the affected areas leaving them vulnerable to erosion by surface run-off and ultimately threaten adjacent coastal waters with high turbidity and sediment deposition, a negative consequence. The flat topography of the site would tend to reduce erosive surface flows and the threat of turbidity should exist only for the duration of construction works before landscaping and drainage works are put in place that would reduce the susceptibility to soil erosion. Ultimately, it is the corals and inshore marine habitat that would be adversely affected by prolonged levels of high turbidity.

Mitigation:

- *To the greatest extent possible, phase site clearance so as to minimize the area of exposed soil at any given time.*
- *Re-cover exposed soils with grass and other appropriate species as soon as possible.*
- *Temporarily bund exposed soil and redirect flows from heavy runoff areas that threaten to erode or result in substantial surface runoff to adjacent marine waters*
- *Monitor areas of exposed soil during periods of heavy rainfall throughout the construction phase of the project*

5.1.7 Nuisance dusting

It can be anticipated that a certain amount of air borne particulate matter (dust) will be generated by earth moving activities during road and building construction and during off loading of marl. This situation will be worst during the dry season and during the afternoons when the trade winds are most prevalent. Given the relative remoteness of the site, air borne particulates should not pose a hazard to residents in the vicinity or downwind of the construction

site. The occurrence of dusting is periodic and short-term, lasting for the duration of the construction activity.

Mitigation:

- *Access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust.*
- *Stockpiles of fine materials (e.g. marl) should be wetted or covered with tarpaulin during windy conditions.*
- *Workers on the site should be issued with dust masks during dry and windy conditions.*

5.1.8 Noise

The use of heavy equipment during site clearance and road construction works will inevitably generate noise, which may create a nuisance for nearby residents. Albeit annoying, this negative impact will be short-term (limited to the duration of the road construction works) and is not considered to be a significant threat to the health or well being of humans. Distance will help to ameliorate noises. For those persons situated to the immediate east of the project site it should also be noted that they will be upwind of the source of noises.

Mitigation:

- *Construction activities that will generate disturbing sounds should be restricted to normal working hours.*
- *Local residents should be given notice of intended noisy activities so as to reduce the degree of annoyances.*
- *Workers operating equipment that generates noise should be equipped with noise protection gear. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs.*

5.1.9 Earth material sourcing

Earth materials needed for construction (e.g. marl, sand) are normally obtained from quarry and mining operations. Conscious or unwitting purchase of these materials from unlicensed operations indirectly supports, encourages and promotes environmental degradation at the illegal quarry sites and causes medium to long-term negative impacts at source.

Mitigation:

- *Earth materials must be obtained from officially licensed and approved quarries and copies of the relevant licenses made available by the Contractor for inspection at the site.*

5.1.10 Materials transportation

The various materials required for construction and building (e.g. steel, blocks, lumber, marl, asphalt, etc.) will be obtained from sources elsewhere and transported to the site. Transportation of these materials, typically in over-laden and sometimes uncovered trucks, usually results in undue road wear-and-tear.

In the case of fine earth materials, dusting and spillages occur on the roadways between source and site. Dusting degrades local air quality and material spillages worsen driving conditions and increase the risk of road accidents. These occurrences represent indirect, short-term, reversible, negative impacts on public health and safety.

Mitigation:

- *All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting. Trucks used for that purpose should be fitted with tailgates that close properly and with tarpaulins to cover the materials. The cleanup of spilled earth and construction material on the main roads should be the responsibility of the Contractor and should be done in a timely manner (say within 2 hours) so as not to inconvenience or endanger other road users. These requirements should be included as clauses within the contracts made with relevant sub-contractors.*

- *The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.*
- *As far as possible, transport of construction materials should be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.*
- *Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the Bahia Hotel property.*
- *Flagmen should be employed to control traffic and assist construction vehicles as they attempt to enter and exit the project site.*

5.1.11 Materials storage

The improper siting of stockpiles and storage of sand, gravel, cement, etc., at the construction sites could lead to fine materials being washed away, during heavy rainfall events, into the drainage system and ultimately into the adjacent marine environment. This would not only represent a waste of materials but would also contribute to turbidity and sedimentation with consequent negative impacts on inshore marine water quality and possibly the ecology of the shallow marine environments, including corals.

Hazardous and flammable materials (e.g. paints, thinner, solvents, etc.) improperly stored and handled on the site are potential health hazards for construction workers and spilled chemicals would have the potential to contaminate soil and inhibit plant growth in localized areas. It is anticipated that refueling or maintenance of large vehicles will take place on the construction site and therefore there will be a requirement to store fuel and lubricants in a safe manner on the site.

Mitigation:

- *The stockpiling of construction materials should be properly controlled and managed. Fine-grained materials (sand, marl, etc.) should be stockpiled away from surface drainage channels and features.*

- *Low berms should be placed around the piles and/or tarpaulin used to cover open piles of stored materials to prevent them from being washed away during rainfall.*
- *Safe storage areas should be identified and retaining structures put in place prior to the arrival and placement of material.*
- *Hazardous chemicals (e.g. fuels) should be properly stored in appropriate containers and these should be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities.*

5.1.12 Modification of surface drainage

The impervious surface created by the covered building area will be about 23% of the total development land area. Add to this the surface areas of asphalted roads and it becomes apparent that the site will generate considerable volumes of runoff during the periods of prolonged rainfall.

Mitigation:

- *The appropriate design and construction of a storm water drainage system.*

5.1.13 Construction waste disposal

Solid waste generated during site preparation and construction work would include cut vegetation and typical construction waste (e.g. wasted concrete, steel, wooden scaffolding and forms, bags, waste earth materials, etc.). This waste would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Cleared vegetation burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. Vegetation and solid waste, if allowed to accumulate in drainage ways, could cause localised pooling and flooding. Pooling of water, in turn, would create conditions conducive to the breeding of nuisance and health-threatening pests such as mosquitoes. Poor construction waste management constitutes a short-term, possibly long-term, negative impact.

Mitigation:

- *A site waste management plan should be prepared by the contractor prior to commencement of building. This should include the designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site*, and a system for supervision and monitoring. Preparation and implementation of the plan must be made the responsibility of the building contractor with the system being monitored independently.*
- *Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction. To reduce organic waste, softer vegetation may be composted onsite and used for soil amendment during landscaping.*
- *Vegetation and combustible waste must not be burned on the site.*
- *Reusable inorganic waste (e.g. excavated sand) should be stockpiled away from drainage features and used for in filling where necessary.*
- *Unusable construction waste, such as damaged pipes, formwork and other construction material, must be disposed of at an approved dumpsite.*

**At the present time the official dump for Runaway Bay/Pear Tree Bay is at Haddon, St. Ann.*

5.1.14 Sewage and litter management

Inadequate provision of toilets for use by workers can lead to ad hoc defecation in secluded areas on the site, thus creating of unsanitary conditions and sources of fly infestation. Improper disposal of food cartons and other domestic forms of construction camp garbage could lead to littering of the site and pollution of adjacent coastal waters.

Mitigation:

- *Proper solid waste receptacles and storage containers should be provided in sufficient numbers, particularly for the disposal of lunch and drink boxes, so as to prevent littering of the site.*

- *Arrangements should be made for the regular collection of litter and for its disposal only at the Haddon dump.*

5.1.15 Replanting and landscaping

Landscaping and replanting of trees will be carried out to enhance the ecology and appearance of the site. No details of landscaping plans or planting material are available at this stage but the plant species selected for replanting will in large part determine which types of birds, butterflies, and other fauna, if any, inhabit the site (gardens) after construction. In addition to enhancing the aesthetic appeal of the project site, landscaping provides the means for partially restoring the site's natural elements and ecological habitats. It is therefore a significant mitigation activity with a positive impact.

The landscaping plan should seek to avoid the use of non-native and potentially invasive species. It should include low-maintenance local species and the types of trees and shrubs used for feeding by local bird species. The landscape design should seek to encourage bird life, especially for the endemics, maximize shade and windbreak effect, as well as to hide the roofline of the buildings.

Mitigation:

- *See mitigation at Section 5.3.2.*

5.1.16 Employment/Income generation

At this stage it is not possible to accurately determine the number of workers that will be employed on the site during the construction phase but it is estimated that this number would be between 700 and 1,000 persons. These levels of short-term employment opportunities would have a positive impact on the local economy and on regional unemployment.

Mitigation:

N/A

5.1.17 Roadside vending

Large construction projects attract significant numbers of vendors who erect stalls along the road near to the site entrance. Associated with this is the parking of taxis and other vehicles owned by site workers. The overall effect is to create a highly unsightly situation, which includes poor litter and solid waste management practice.

Mitigation:

- *The contractor should identify, demarcate and fence a specific area within which vendors will be allowed to operate. This location should be removed from the side of the main road. The area should be large enough to accommodate worker's vehicles.*
- *The vendors should be instructed to maintain the area in a tidy fashion and litterbins should be provided with arrangements being made to have these emptied on a regular basis and the contents disposed of appropriately.*

5.1.18 Seascape

The six and seven storey buildings will introduce a new visual feature to the existing view of the coast from the highway, particularly when approaching the site from the west. It will not however affect the "window to the sea" present at the western end of the site near to the Pear Tree River bridge.

Mitigation:

- *The site frontage along the highway may be planted with native trees to provide a visual break from the road.*

5.2 OPERATIONAL IMPACTS

5.2.1 Employment

Assuming 1.3 persons per room then the proposed development would potentially offer employment for approximately 2,340 persons. This would represent a positive long-term impact.

Mitigation:

N/A

5.2.2 Water supply

The resort intends to install its own water supply. The increased demand for water is therefore not expected to have a negative impact on the water distribution in the area.

Mitigation:

- *Provide adequate water storage facilities to ensure adequate supplies for the development.*

5.2.3 Depletion of water resources

Occupation of the resort implies a net increase in the number of foreign visitors to Jamaica and therefore it will also mean an increase in the demand on local water resources. Each bungalow should put the following water conservation devices or technologies in place.

Mitigation:

- *Install aerators/water flow restrictors*
- Install low-flush toilets.

5.2.4 Sewage treatment and disposal

Sewage generated by resort will be collected and pumped to the wastewater treatment plant. The construction of a dedicated sewage treatment facility for the development will be of obvious environmental benefit as will be the reuse of the treated effluents for irrigation of the grounds. The potential long-term issue relates to improper maintenance of the sewage collection and treatment system such that inadequately treated effluents become discharged to the open environment. Improper disposal of sludge is also a potential issue.

Mitigation:

- *Retain a fully qualified operator to ensure proper operation and maintenance of the STP.*
- *Ensure preparation and provision of a plant operations and maintenance manual.*
- *Undertake regular monitoring and testing of effluent to ensure compliance with NEPA sewage effluent standards and regulations.*
- *Employ means to stabilise sludge for use as soil conditioner.*

5.2.5 Solid waste disposal

Poor garbage management at the resort would lead to unsanitary conditions including vermin and fly infestation and odours as well as unsightly conditions. Although the means of solid waste collection and disposal have not been determined, it is expected that garbage management and good housekeeping will be practiced on the resort and that problems arising from the improper storage of solid waste will therefore be avoided. It is also anticipated that a private waste contractor will be responsible for collection and disposal of waste from the site. The kitchen will employ a chiller for garbage storage.

Mitigation:

- *Ensure regular collection of garbage by private waste disposal service.*
- *Ensure waste is disposed of at Haddon dump near Moneague, St Ann.*

5.2.6 Use of electricity

At present it is intended that JPSCo Ltd. will supply power for the development site from the existing mains running along the main road. The incremental demand will be within the capacity of the system and this will be confirmed in writing by the utility. The expansion should therefore not cause any supply shortages to the rest of the system. However, this increased demand will commensurately increase the utility's use of fossil fuel to generate that electricity, and thus the project will indirectly incur negative impacts associated with greenhouse emissions.

Mitigation:

Mitigation measures relate to incorporating and improving energy management and conservation practices.

- *Sub-meters and real-time energy monitoring equipment, timers, photoelectric cells, thermostats, etc. should be installed throughout the resort facilities.*
- *Install translucent shades and fluorescent lighting.*
- *Pipe insulation, tank lagging (not asbestos!) and heat recovery systems should be installed wherever it is practical to do so.*
- *See Section 4.3.6 for other energy saving initiatives that will be undertaken by the developer*

5.2.7 Electricity generation

The resort will install stand-by generators and it may decide to forgo JPS power supply in favour of co-generation. This implies the production of noise, vibrations, and storage of diesel fuel and the related disturbances and nuisances as well as the threat of hydrocarbon spills the ground.

Mitigation:

- *The placement of the power generators on the southern side of the property at the service supply center will remove the source of noise and vibration from the vicinity of the hotels.*
- *The fuel storage facilities will comply with suppliers specifications for contained storage.*

5.2.8 Worker housing demand and squatting

Tourism resort development in Jamaica has not been matched by the corresponding development and construction of housing and the social infrastructure to meet the demand of resort facility workers and the immigration to the resort areas induced etc. Therefore, squatting and informal settlements despoil the resort towns and worsen social tensions. This is viewed as an indirect, cumulative, long-term, reversible negative impact. The present project may add to the unplanned settlement problem in the local region

Mitigation:

- *Seek provision of adequate housing opportunities by relevant authorities for hotel workers to reduce incidence of squatting and unplanned development associated with resort development in Jamaica.*

5.2.9 Misuse of coral reef resources

One of the main natural attractions that will be offered by the resort at Pear Tree Bottom is SCUBA diving and snorkeling on one of the best coral reef dive sites in Jamaica. Unless the marine resource is properly managed the increased use of the site for recreational diving could result in degradation of the habitat by damage to corals from boat anchors, souvenir collection, and poor diving practice.

Mitigation:

- *Installation of boat mooring buoys at NEPA approved sites for use of dive boats and banning of anchoring directly over reef.*
- *Ban collection of coral reef souvenirs*
- *Provision of educational and environmental sensitization material on coral reef for guests and for hotel staff.*
- *Institute and support coral reef monitoring programme for Pear Tree Bay.*
- *Seek to have reef area designated as a marine reserve/sanctuary where fishing is banned or where fishing pot minimum mesh sizes are imposed.*

5.2.10 Traffic

It is noted that the section of the North Coast Highway between Montego Bay and Ocho Rios is presently being upgraded and it is unlikely that the additional traffic induced by Bahia Hotel will cause any undue congestion in the near term.

Mitigation:
N/A

5.3 SUMMARY OF IMPACTS

The impacts identified and discussed above are summarized in Tables 5.3.1 and 5.3.2.

Table 5.3.1 Bahia Hotel EIA - Summary of construction phase impacts

ENVIRONMENTAL IMPACT	IMPACT TYPE								MITIGATION		
	Positive		Negative								
	Significant	Not significant	Significant	Not significant	Short Term	Long Term	Irreversible	Cumulative	No Mitigation Required	Mitigation Required	Reference to Mitigation Section
CONSTRUCTION PHASE IMPACTS											
• Loss of land use options			×			×	×	×	×		
• Loss of terrestrial habitat & biodiversity			×			×	×	×		×	5.1.2
• Groyne repairs				×	×					×	5.1.3
• Artificial beach filling			×		×					×	5.1.4
• Deepening of back reef area			×		×					×	5.1.5
• Soil erosion				×	×					×	5.1.6
• Nuisance dusting				×	×					×	5.1.7
• Noise				×	×					×	5.1.8
• Earth material sourcing				×	×					×	5.1.9
• Materials transportation				×	×					×	5.1.10
• Material storage				×	×					×	5.1.11
• Modification of surface drainage				×		×	×			×	5.1.12
• Construction waste disposal			×		×					×	5.1.13
• Sewage and litter management				×	×					×	5.1.14
• Replanting and landscaping	×					×			×		
• Employment/income generation	×				×				×		
• Roadside vending			×		×					×	5.1.17
• Seascape		×				×	×			×	5.1.18

Table 5.3.2 Bahia Hotel EIA - Summary of operations phase impacts

ENVIRONMENTAL IMPACT	IMPACT TYPE								MITIGATION		
	Positive		Negative								
	Significant	Not significant	Significant	Not significant	Short Term	Long Term	Irreversible	Cumulative	No Mitigation Required	Mitigation Required	Reference to Mitigation Section
OPERATIONS IMPACTS											
• Employment/income generation	✕					✕			✕		
• Water supply				✕		✕			✕		
• Depletion of water resources				✕		✕				✕	5.2.3
• Sewage treatment & dis posal			✕			✕				✕	5.2.4
• Solid waste disposal			✕			✕				✕	5.2.5
• Use of electricty				✕		✕				✕	5.2.6
• Electricity generation (stand-by)				✕	✕					✕	5.2.7
• Electricity generation (co-generation)			✕			✕				✕	5.2.7
• Worker housing demand & squatting			✕			✕		✕		✕	5.3.8
• Misuse of coral reef resources			✕			✕		✕		✕	5.2.9

6. PROJECT ALTERNATIVES

6.1 MARINE SANCTUARY

Not so much an alternative to the proposed land use but rather as an adjunct to the resort development is the designation and development of the western end of Pear Tree Bay as a coastal marine protected area that would incorporate the beach and rocky coastline, the Pear Tree River estuary, the mangroves and shallow back reef area, and the fore reef. This area has a designated fishing beach but with the cooperation of the local fishermen and the provision of alternative means of livelihood as reserve keepers and tour guides the few fisherfolk may be induced to adopt a more sustainable mode of living. The back reef area could be much enhanced without long-term damage if the coral rubble were to be cleared.

6.4 NO DEVELOPMENT

The current coastal strip is degraded. Left alone, there will be further deterioration through sand stealing, tree felling, charcoal burning, and squatting with all the attendant physical and environmental impacts.

7. OUTLINE ENVIRONMENTAL IMPACT MONITORING PLAN

Prior to site preparation and construction activities, the main contractor should present an environmental management plan (including, *inter alia*, location of construction camp and toilet facilities, location of material storage areas, solid waste management plan, dust control measures, activity schedule, etc.) for review and approval by NEPA, the environmental monitor and the project manager. The developer should present a landscape plan and the trees/vegetation earmarked for protection should be flagged and hoarded by the contractor. The entity selected to carry out environmental monitoring of the construction works should then prepare an environmental monitoring programme based on the above, the requirements of the EIA, and conditions of the development permit.

The major elements of the environmental impact monitoring programme to be implemented during the construction phase of the project are as follows:

- Site clearance to ensure that trees marked for protection are left untouched and that large areas of soil are not left exposed and uncovered for extended periods of time.
- Site drainage and surface runoff, especially during and shortly after major rainfall events, to ensure there is no flooding, ponding and runoff of surface water across the beach.
- Compliance of construction works with site management and landscape plans.
- Inspection of quarry licences to ensure earth materials are obtained only from licensed operators.
- Ensure transportation of earth materials is done by covered trucks.
- Stockpiles of fine materials are placed away from drainage features and are not washed into the marine environment.
- The contractor must immediately and completely clean up spills of materials in public areas.

- Solid waste disposal practices to ensure appropriate on-site management and final disposal at approved dump.
- The labour camp to ensure installation of VIP toilets and the proper disposal of sewage and labour camp solid waste.
- Monitor marine water quality to ensure that the construction works are not impacting negatively on coastal water quality. The parameters to be monitored should include salinity, dissolved oxygen, BOD, nitrates, phosphates, turbidity, faecal and total coliforms.
- Deployment of silt screens around any works involving groyne repairs and bathing area enhancement.
- Incorporation of native bird and butterfly feeding plants in new landscape.

8. APPENDICES

Appendix I. List of the main bird feeding trees in Jamaica*.

Common name	Scientific name
Red birch	*Bursera simaruba*
Pimento	*Pimenta dioica*
Naseberry	*Manilkara zapota*
Strangler fig	*Ficus*
Coconut	*Cocos nucifera*
Logwood	*Haematoxylum campechianum*
Banana	*Musa sp.*
Bullhoof	*Bauhinia divaricata*
Tamarind	*Tamarindus indica*
Sweetwood	*Nectandra sp.*
Guava	*Psidium guava*
African tulip tree	*Spathodea campanulata*
Cactus	
Bullet	*Bumelia sp.*
Burnwood	*Metopium brownii*
Fiddlewood	*Citharexylum caudatum*
Bitterwood	*Picrasma excelsa*
Prickly Yellow	*Fagara martinicensis*
Orange	*Citrus sp.*
Soursop	*Annona muricata*
Coffee	*Coffea sp.*
Erythrina	*Erythrina sp.*
Black mangrove	*Avicenna germinans*
Button mangrove	*Conocarpus erectus*
Red mangrove	*Rhizophora mangle*
White mangrove	*Laguncularia racemosa*

* Based on Downer and Sutton 1990

These are not the only plants important for bird foraging. Bromeliads and grasses are also important to many bird species. Many of the trees on this list are found on the Pear Tree site.

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