FINAL REPORT

EIA and EIS
FOR RESORT DEVELOPMENT AND SUB-DIVISION
OF LOTS AT FONT HILL, ST. ELIZABETH

BY THE PETROLEUM CORPORATION OF JAMAICA

SEPTEMBER 2004

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Introduction & Project Description:

The Petroleum Corporation of Jamaica proposes to develop small hotels, residential lots and resort cottages at Font Hill, St. Elizabeth on the coastal part of 1054.5 ha of land that it owns and manages. The proposed development, has obtained Outline Approval from the St. Elizabeth Parish Council as indicated in Appendix III. This EIA report seeks to provide data, information and analysis in keeping with the requirements of The National Environment and Planning Agency (NEPA) for Phase 1 developments at the site.

The following features have been proposed for Phase 1 of the development:

- 7 small hotels (30 bedrooms each) of 0.811 -1.50 ha (total 5.7 -10.5 ha). The hotels will be located on the coastline
- 117 cottages (1-4 bedrooms each) of 0.10 ha - 0.2 ha (total 11.7 to 23.4 ha). Most of the lots for cottages will be allocated west and north of the hotels and further inland.
- A public park and jogging trail (3.20 ha). The jogging trail will serve as a buffer zone and recreational area between the development and the main road. The public park/clubhouse/courts west of the development will serve as another recreational area for the development.
- Seaside park and jetty (0.48 ha).
- Sewage treatment facility (9.0 ha.). The sewage treatment will include pumping systems, pipelines, settlement ponds and facultative ponds on the west of the development.
- Pumping station (0.08 ha).
- Commercial shops (single storey) (0.64 ha).
- Park, country club and tennis courts (1.65 ha).

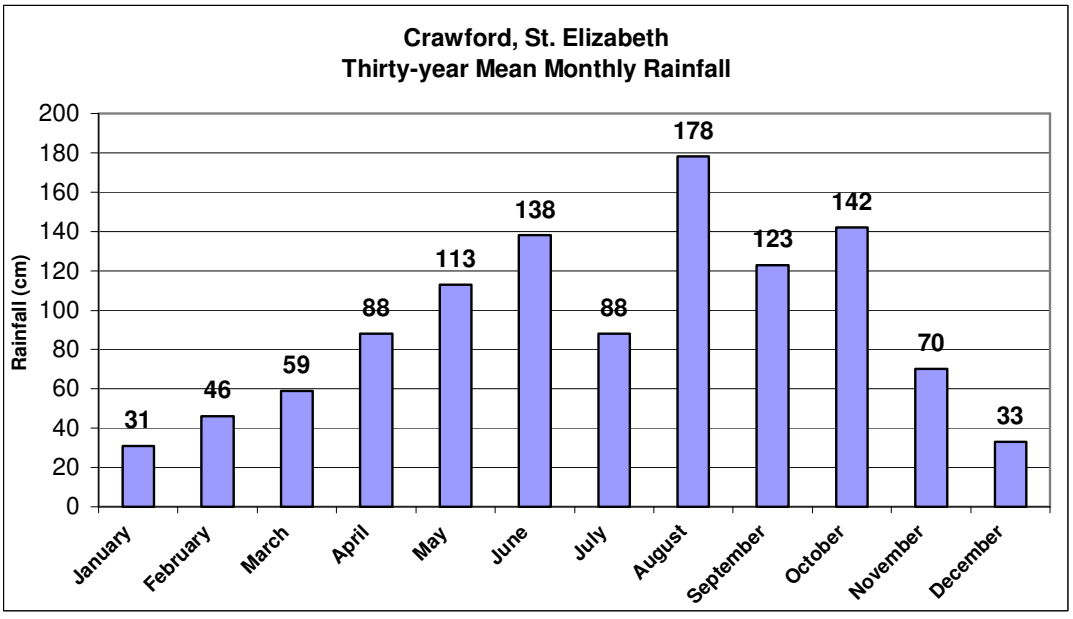
- In essence the sub-division area proposed for development is approximately 37 hectares (91) acres with an additional 9 hectares (22 acres) site for a sewage treatment facility.
- 281.88 ha of land will be retained as an environmentally sensitive and valuable Wildlife Sanctuary of immense biodiversity.

Methodology:

Various methodologies were used in carrying out the EIA. These included the use of standard techniques in desk research, field surveys and assessments.

Existing Environment:

The existing environmental setting of the site and general area were reviewed and analyzed for this report. Issues related to weather, geology, hydrogeology, ecology and socio-economic impacts amongst others were assessed and findings presented. Assessment of weather conditions for the area show maritime tropical weather conditions of relatively low rainfall. This includes a seasonal pattern of intensive rains in May and October, similar to the island's general rainfall characteristics.



The site is gently sloping to the South at an average of 2%, with elevations ranging from

0.0 to 14.0m. The highest elevations are adjacent to the main road to the north. The property is bounded to the north by the Mandeville to Whitehouse main road and to the South and West by the Caribbean Sea and to the east by the Font Hill Wild life Reserve.

Hard limestone rocks, with several outcroppings, are characteristic of the site with relatively thin layers of alluvium consisting of loam, clayey-stone and sand. Fissures and pits on the site to 2.0m deep, show no ground water. It is anticipated that no groundwater will be encountered to the depth of construction activities.

The site is covered by trees and shrubs and contains three small saline ponds. One of the ponds is perennial. The ponds form habitats for turtles and birds.

Logwood is the preponderant species and makes up 70% of the tree cover. There is a large silk cotton tree (see APPENDIX VII - Plate 26) on the western side of the site and a *Lignum vitae* tree which must be preserved. The trees form habitats for climbing cacti. Thatch palm forms an extensive under storey, especially in the western part of the property. There are also bird-feeding trees. There is extensive leaf litter which shows a slow rate of decomposition, possibly owing to the relatively dry coastal conditions. Vegetation shows marked adaptation to xerophytic conditions.

The avifauna shows high diversity (see APPENDIX VI). This is related to the variety of habitats provided by the vegetation, feeding trees, the ponds and the Wildlife sanctuary which provides for breeding, nesting and resting as well as PCJ's effective management strategy for the area. This includes the provision of wardens.

The socio-economic survey involved the use of secondary and primary data sources. Secondary data, Electoral Division (ED) maps as well as population distribution for each district and their demographics were obtained from STATIN and analyzed. Other official statistics, and survey data, historical and archival material from the PCJ library were also used.

The primary or contact survey involved the development, pre-testing (pilot testing on 1% sample), adjustment of the survey instrument as necessary, followed by full scale

administration of the survey instruments on the target populations to produce quantitative data sets amenable to analysis. This was preceded by windshield surveys of the communities. In addition community leaders were interviewed.

The survey instrument was administered by trained staff to 1.0% of the households in the study area or 120 household heads.

The highlights of the survey are as follows:

- employment levels are low
- the project should generate employment
- this part of the island lacks development and the proposed sub-division should cancel out the effects of this
- the development is also needed to enhance real estate value
- the project is a brilliant idea as the area needs development and amenities
- the development will be an asset for the communities
- employment will be provided during the development and the long term
- there was general awareness of the proposed development which was strongly favored because of its employment generation potential, housing potential and the boost it would give to fish sales.
- 39% of the respondents used the site for recreation, fishing, vending, farming, collection of fish pot sticks. 55% of respondents were not involved in the use of the natural resources at the proposed site. However, this category stated their awareness of: logwood trees, wildlife reserve (crocodiles in the mangrove, crabs, turtles (on the coastline), birds (baldpate, white wing, ducks, pea dove), fish (lake fish, black fish), sand mining, the beach and agricultural produce.

In general the respondents also expressed great respect for the work being done by the PCJ in the area.

Each phase of the project was analyzed in detail in order to identify potential environmental impacts and approaches for their mitigation.

The potential impacts identified are illustrated in the impact matrix below. While the methods proposed for their mitigation are illustrated in the proposed impact mitigation matrix.

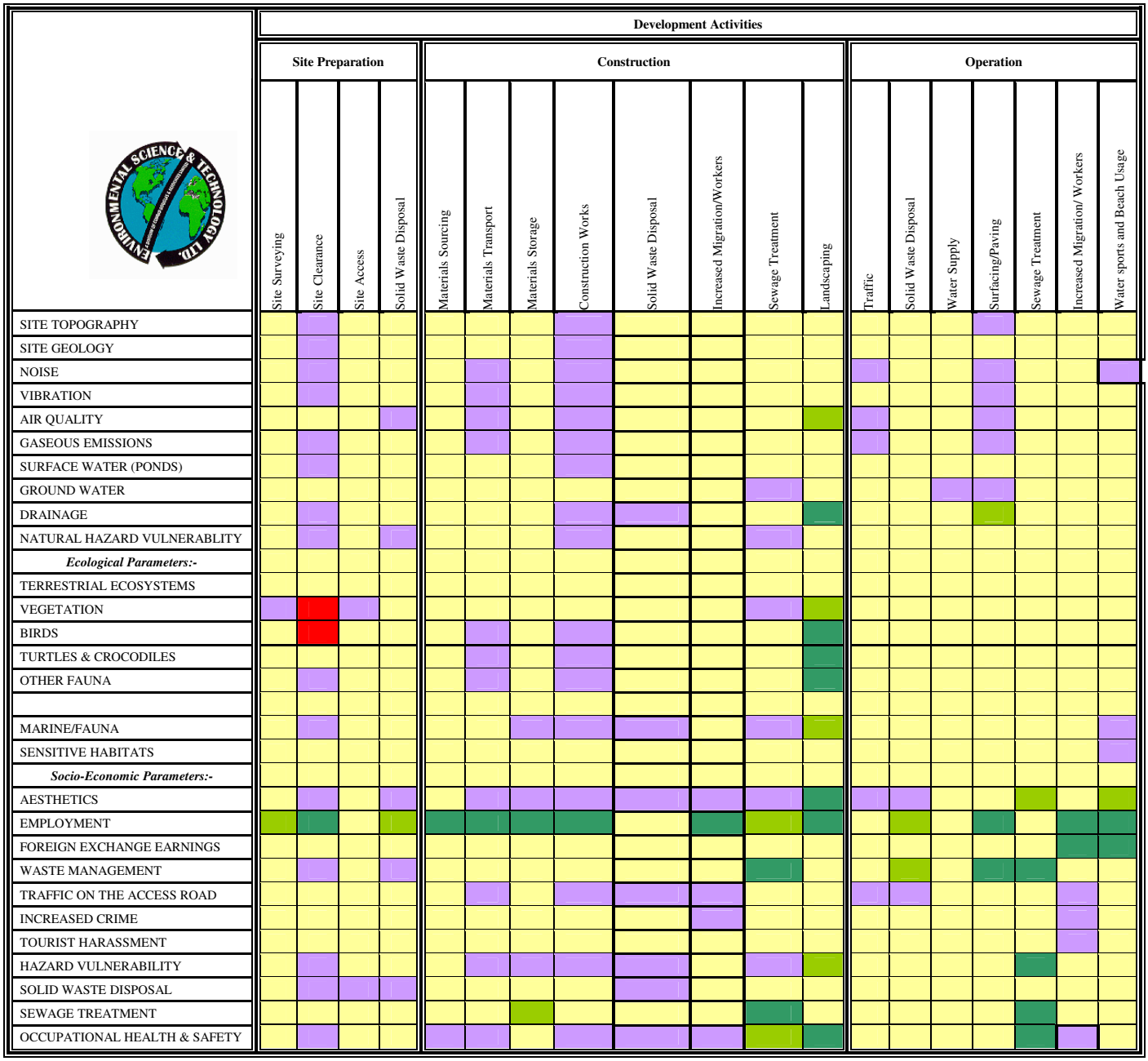
The major potential negative impacts are those involving the clearing of vegetation, loss of habitats and disruption of the avifauna, especially during the construction phase. The loss of vegetation to the footprints of the development, are unavoidable and irreversible. However, it is strongly recommended that the silk cotton tree and *Lignum vitae* be preserved. It is anticipated that the bird population will confine its activities primarily to the wildlife sanctuary during construction.

The effluent from the sewage treatment system will meet NEPA's standards. In addition it is proposed to use it for irrigation and recharging of the ponds during the dry season.

Table 1-1: IMPACT IDENTIFICATION MATRIX

Key

	Major negative
	Minor negative
	No Impact
	Major Positive
	Minor Positive



Conclusion:

The proposed project is an excellent candidate for development and its careful design should integrate well with the natural surroundings while bringing several benefits to the nearby communities. Environmental impacts identified have been found to be avoidable, able to be minimized or mitigable using standard techniques, technologies and proper management.

The project is compliant with national and international policies, legislation, regulations and standards.

Recommendations:

- ✓ We recommend that NEPA issue a permit for implementation of the project.
- ✓ That all phases and aspects of the project are to be monitored to ensure that the recommended strategies for mitigation of negative impacts will be adhered to and beneficial impacts be maximized.
- ✓ That PCJ develops strategies to continue the effective management of the natural resources and attributes of the area after completion of the development.

PROJECT DESCRIPTION

1 PROJECT DESCRIPTION

1.1 INTRODUCTION AND PROJECT DESCRIPTION

1.1.1 Introduction

The Petroleum Corporation of Jamaica (PCJ) currently owns and manages 1,054.5 hectares of property at Font Hill, in the parish of St. Elizabeth. Font Hill is on the southern coast of the parish, 8km west of Black River and 3km from the border between St. Elizabeth and Westmoreland. This is illustrated in Figure 1-1: Regional Map which shows the general location of the property proposed for development. The property is of special significance as it incorporates a stretch of sensitive and ecologically valuable land – The Font Hill Conservation Area and Wildlife Sanctuary, a popular public beach and borders on a vibrant tourism feature – the Scott's Cove seafood vending establishment.

The land south of the main road from Crawford - St. Elizabeth to Whitehouse - Westmoreland, is fairly flat, at an altitude close to or just above sea level, with a gentle slope. The soil has a high proportion of sand and clay and the Urban Development Corporation designates the land capability class for the project area as:

- Land suitable for cultivation - tillage with strong limitation (Class III_e).
- Land suitable for tree crops, pasture and very limited cultivation (Class IV_e).

In both cases the main limiting factor is slope related.

Previous land use maps reviewed during the EIA process indicate that the lands proposed for development at Font Hill have been designated as "resort" in terms of land use planning. Figure 1-2: Proposed Land Use Plan, shows the proposed development land area, "K", in relation to the other designated land uses in the general area.

Current usage of the total PCJ property includes agriculture, growing of fuel wood trees, the Font Hill Beach Park (public beach), the Font Hill Conservation Area/Wild Life Sanctuary and livestock rearing. A portion of the property is being considered for subdivision into beachfront lots and residential cottages. The Font Hill Subdivision Plan includes constructed features consisting of cottages, hotels, a jetty, jogging trail, park, shopping complex, country club and preserved natural features including 3 ponds and rocky shore coastline. There has been no contact between marine turtles or crocodiles and users of the proposed project area, whether accidental or by design. There are no plans in this proposal to facilitate any such interaction for any reason (educational, economic or otherwise). This is the subject of the proposed project, which constitutes Phase One of development activities, as illustrated on Figure 1-3: Phase One – Relative to Property Boundaries. The proposed Phase-One portion of the development has received outline approval from the Town and Country Planning Authority (see APPENDIX III).

Figure 1-1: Regional Map

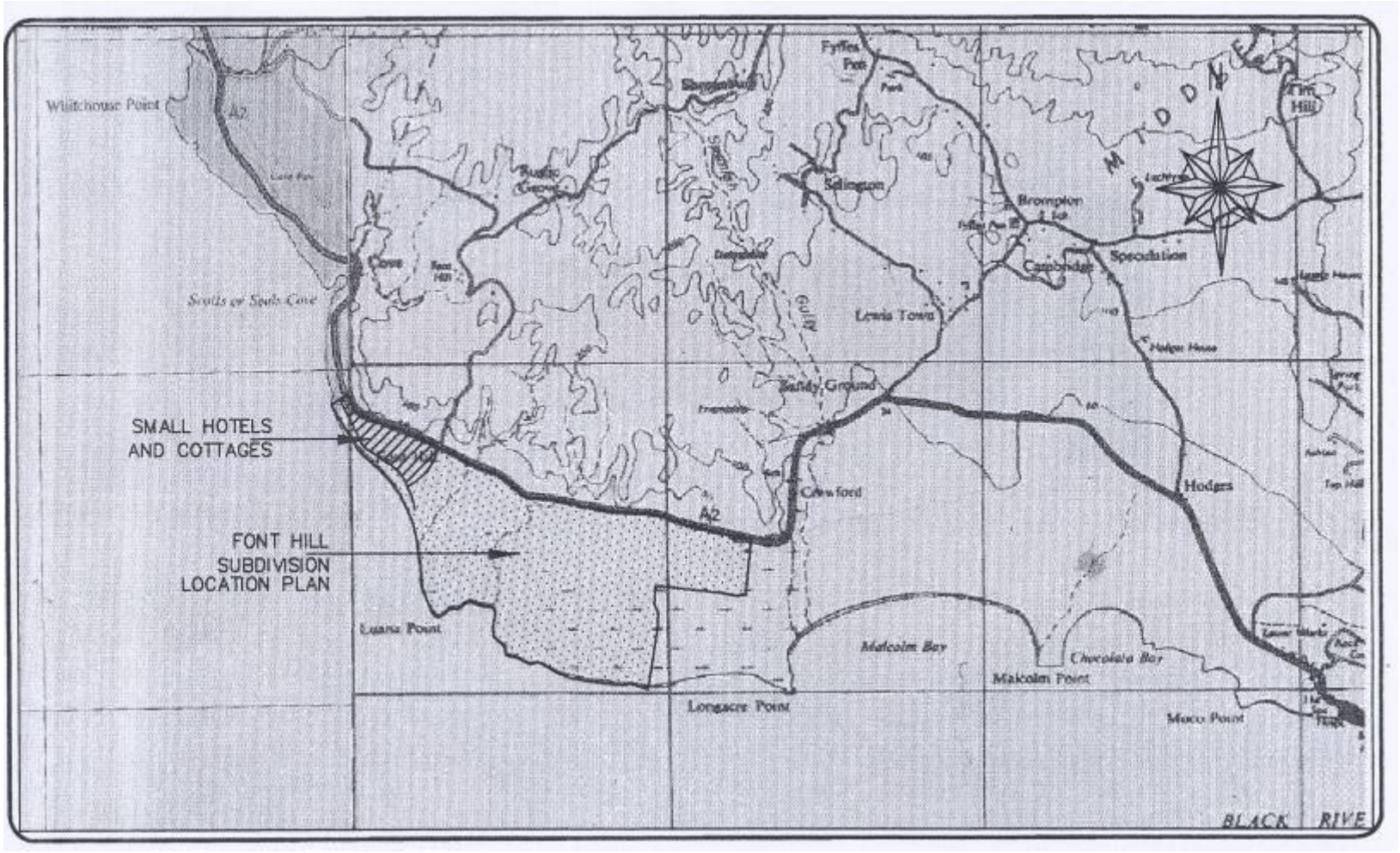


Figure 1-2: Proposed Land Use Plan

1.1.2 Project Description

The Petroleum Corporation of Jamaica (PCJ) Limited has obtained outline approval for Phase 1 of the development plan for the company owned property located at Font Hill in the Parish of St. Elizabeth. This development plan calls for the sub-division of land to accommodate seven (7) small hotels (30 rooms each) and 117 cottages which are to be constructed using the traditional block and steel method, while retaining 281.88 ha of land as an ecologically sensitive and valuable Wildlife Sanctuary. The Wildlife Sanctuary and the existing Beach Park are existing features, but are not part of the proposed Phase I Development. This is an environmentally responsible development plan, which incorporates environmental conservation, all amenities and requisite infrastructure to provide recreation and conveniences to potential residents. This includes an onsite sewage treatment system and potable water storage and treatment to serve the development. Additionally, the area includes a popular public beach and borders on a vibrant tourism feature – the Scott's Cove seafood vending establishment**.** Figure 1-3: Phase One – Relative to Property Boundaries, shows the Phase 1 boundaries, wildlife sanctuary and remaining lands. Figure 1-4: Site Layout, shows the proposed layout of Phase I of the project (hotels – Lots 2-5, 7, 8; seaside park and jetty –Lot 6; park, clubhouse and tennis courts – Lot 16; Pump Station – Lot 15; Existing Beach Park – Lot 10; Sewage Treatment Area – Lot 13; Cottages – Lots 17 – 134).

It is the intention of the PCJ, upon receipt of all necessary approvals (Parish Council, NEPA, MOH, etc.), to commence onsite activities. The PCJ will be responsible for the creation of roadways and infrastructure including installation of utilities and the sewage treatment system. The actual development of lots will be the responsibility of purchasers who will be guided by the approved plans but will be responsible for the timing of implementation and completion of individual units. For this reason, construction schedules have not been defined. However, it is projected that the entire development will be completed within 5 years.

Figure 1-3: Phase One – Relative to Property Boundaries

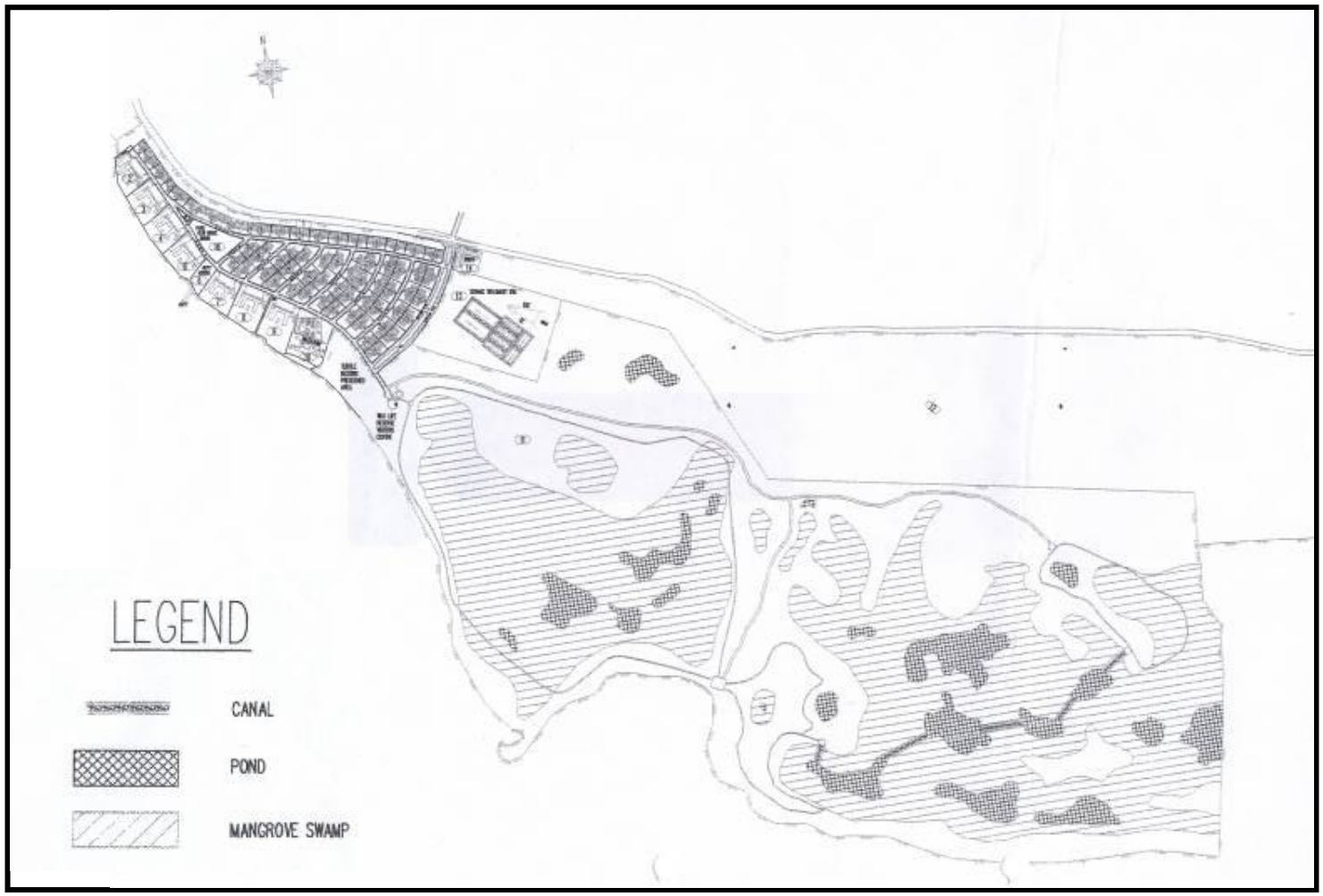
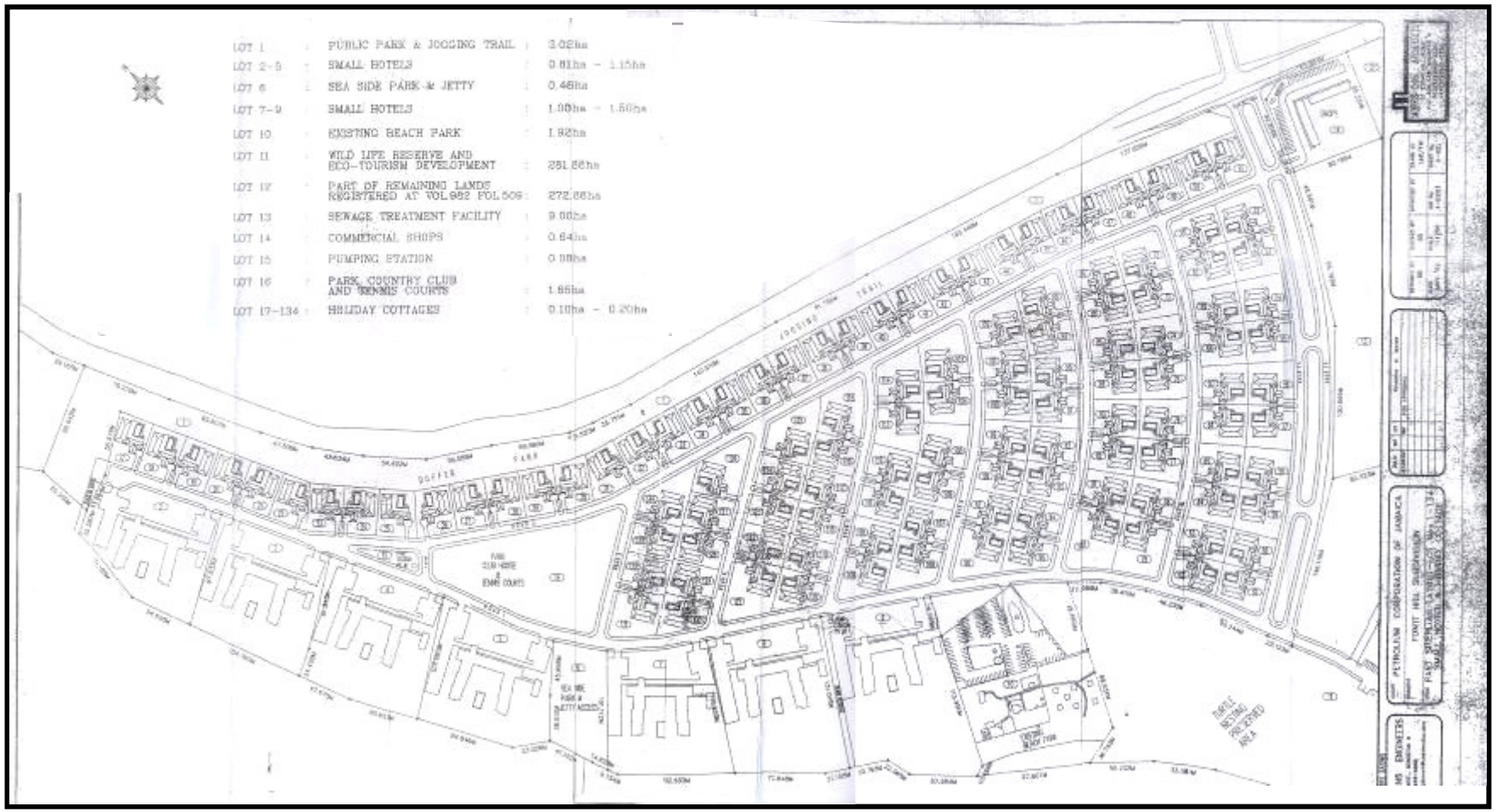


Figure 1-4: Site Layout



The following is a detailed description of the proposed project:

1.2 Project Components

The complete project will include the following:

- **7 Small Hotels** (30 bedrooms each) of 0.81 – 1.50 ha (total 5.7 - 10.5 ha). Hotels will be located on the coastline.

- **117 Cottages** (1 – 4 bedrooms each) of 0.10 ha – 0.20 ha (total 11.7 – 23.4 ha). Most of the lots for cottages will be allocated west and north of the hotels and further inland.

- **Public Park and Jogging Trail** (3.02 ha). The jogging trail will serve as a buffer zone and recreational area between the development and the main road. The public park/clubhouse/courts west of the development will serve as another recreational area for the development. The jogging trail/recreational area will be constructed external to the wetland area and therefore not impinge on the future activities of the wetlands or other areas

- **Seaside Park and Jetty** (0.48 ha).

- **Sewage Treatment Facility** (9.0 ha). The sewage treatment plant will include pumping systems, pipelines, settlement ponds and facultative ponds on the west of the development.

- **Pumping Station** (0.08 ha).
- **Commercial Shops** (singles) (0.64 ha).
- **Park, Country Club and Tennis Courts** (1.65 ha).

The project has received Outline Approval from the St. Elizabeth Parish Council and the Town and Country Planning Authority (see APPENDIX III)

1.3 Project Details

1.3.1 The Site

The proposed project site is located in Southwest St. Elizabeth and is to be developed for cottages and small hotels as described above. The subdivision area is approximately 37 hectares (91 acres) with an additional 9 hectares (22 acres) available for a Sewage Treatment facility. The site is gently sloping to the South at an average of 2%, with elevations ranging from 0.0 to 14.0m. The highest elevations are adjacent to the main road to the north. The boundary to the North is the Mandeville to Whitehouse main road, to the South and West is the Caribbean Sea and to the East the Font Hill Wildlife Reserve. The site is presently covered with trees and shrubs and contains three small ponds. Entry into the site is via the existing roadway to the Font Hill Beach Park.

1.3.2 Soils and Subsurface

Determinations on soils and subsurface conditions were made based on field investigations and literature surveys. Hard limestone rock appears to be the predominant type of material seen in outcrops at the surface. Other than limestone rock, there appears to be thin layers of sand and alluvial soils on the surface which are depicted on Figure 1-5: Upper Layer Soil Texture Map of South West Jamaica. As the formation deepens the soils transition from a gravelly sandy loam to a more silty loam (Figure 1-6: Mid Layer Soil Texture Map of South Jamaica) and becomes a stiff clay at the lower layers (Figure 1-7: Lower Layer Soil Texture Map of South-West Jamaica).

Figure 1-5: Upper Layer Soil Texture Map of South West Jamaica

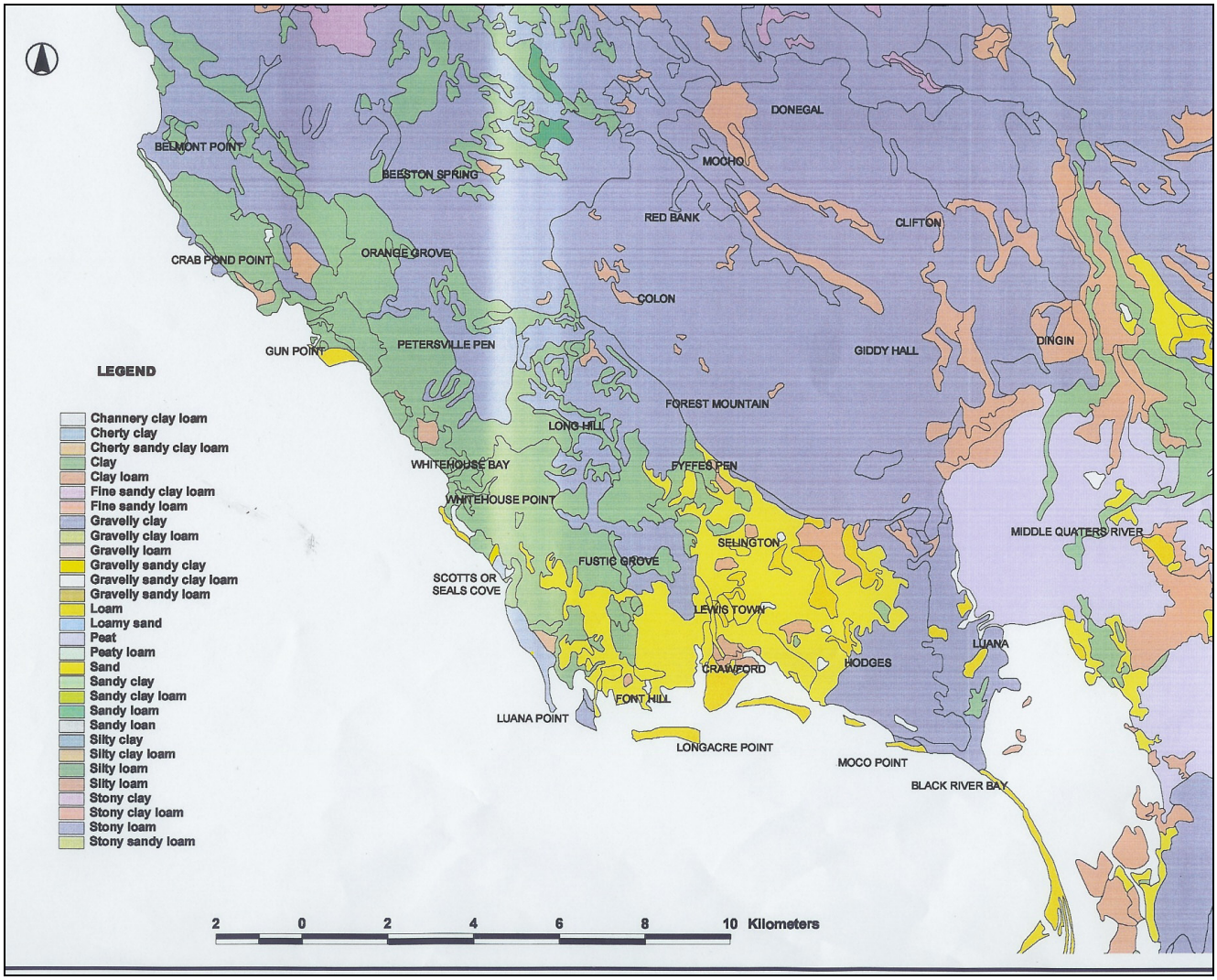


Figure 1-6: Mid Layer Soil Texture Map of South Jamaica

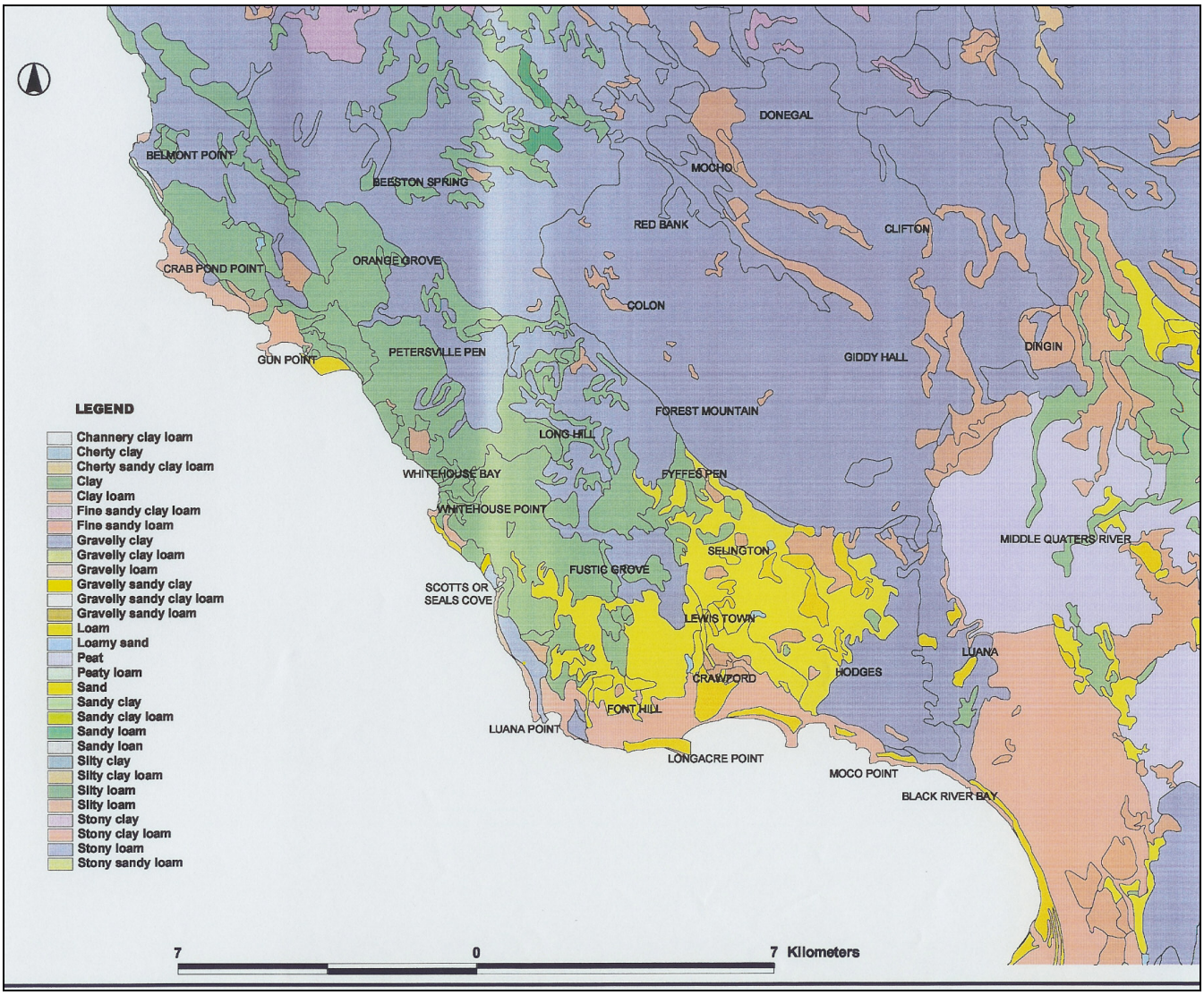
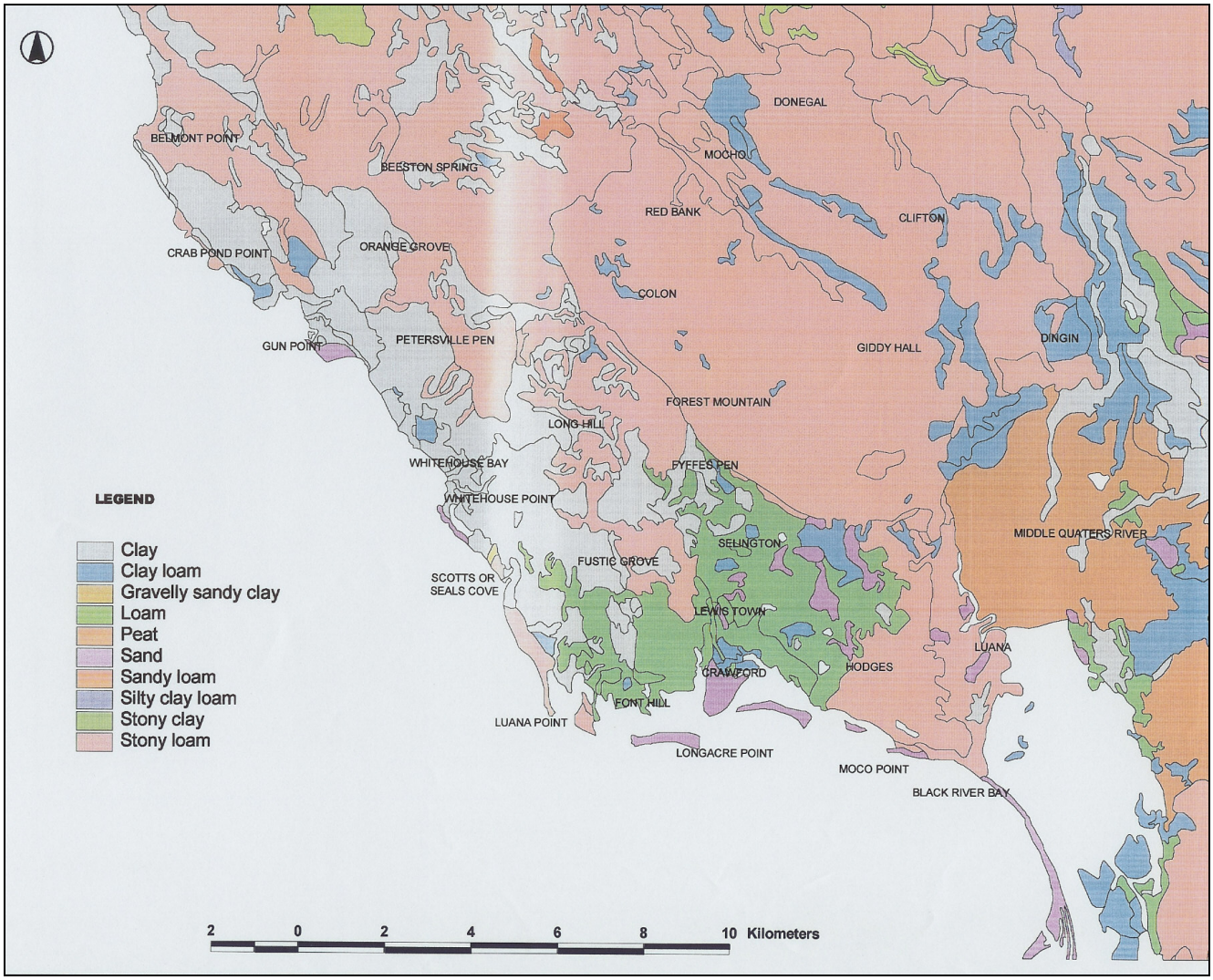


Figure 1-7: Lower Layer Soil Texture Map of South-West Jamaica



Construction activities at the site are not envisioned to be intrusive to great depth and it is not believed that groundwater will be a major concern during construction. Figure 3-1: Hydrostratigraphy Map of South-West Jamaica, indicates an alluvium aquiclude along the south-west coastline of the island which includes the proposed project area. This aquiclude is an indicator that the soils in the area form an effective barrier to groundwater and will result in less likelihood for groundwater to be encountered during construction.

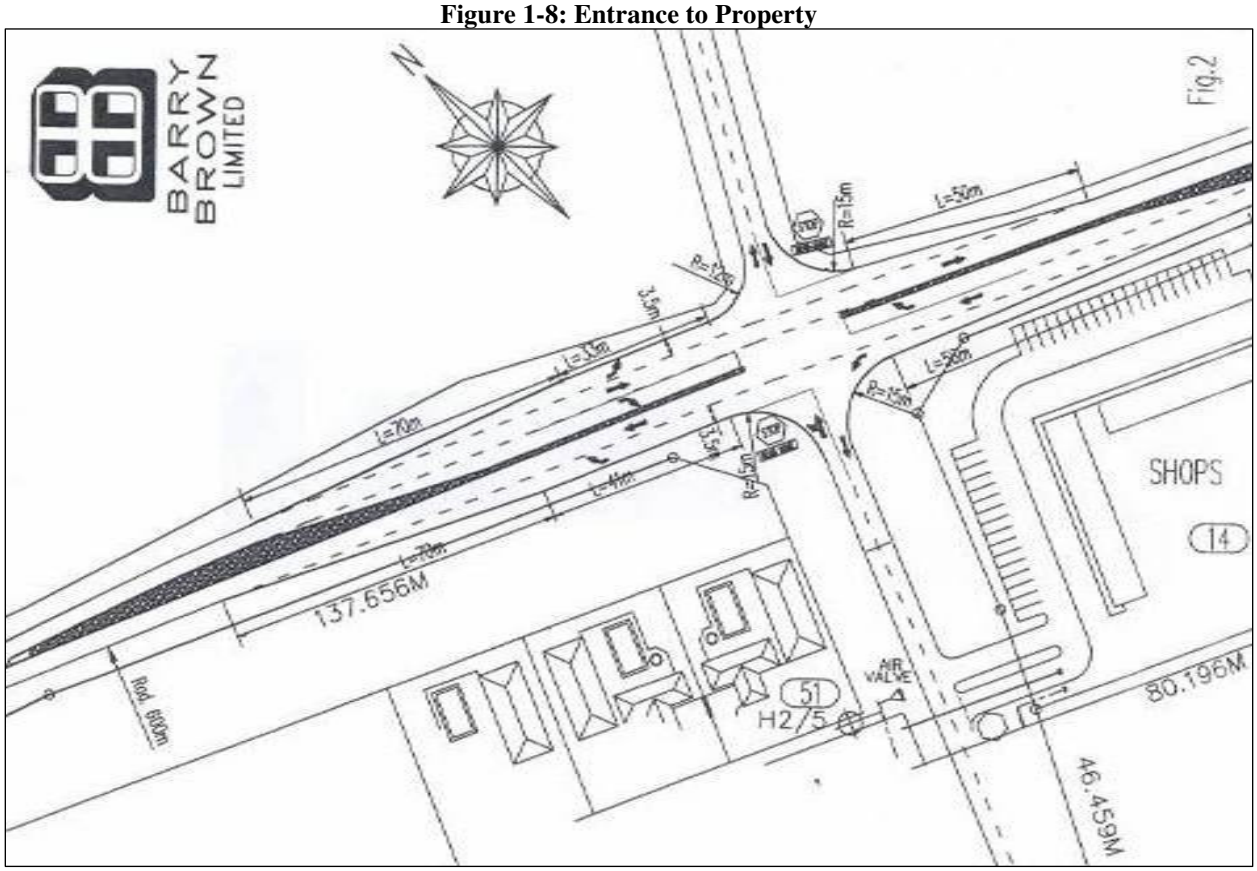
Exposed areas on site, some to 2.0m below ground surface show no ground water. There

are three ponds on the site at an approximate elevation of 0.4m. All three ponds were observed with water at the time of our site visits.

1.3.3 Roadways

Recommendations for the approval for the geometry of the proposed subdivision entrance road to connect with the Mandeville – Whitehouse main road has been given by the National Works Agency (NWA) (See APPENDIX IV**).** The designs have incorporated all of NWA's requirements, including a single entry roadway to the subdivision (Figure 1-8), and addresses the issue of safety regarding ingress and egress.

Figure 1-8: Entrance to Property



The project designs incorporate the three ponds located on the site. To protect the ponds, the roadway designs have been modified to prevent any access for storm water runoff into the ponds.

Road # 1 has been located between the two ponds near to the Beach Park. These ponds will be connected by one 1200mm diameter concrete culvert (Figure 1-9)**.** All roads in the subdivision will have a marl base with asphaltic concrete surfacing. Concrete kerbs will border both sides of the roadway to provide the boundaries for an elevated grassed verge and a kerbed gutter. Roads with slopes in excess of 3.5% will have paved concrete gutters. Subdivision roads will be 6.1m wide with reservations 12.2m wide, with the exception of the main entrance roadway (Road #2). Road #2 will have its reservation widened to 36.0m. Roadways that are not through-roads all end in cul-de-sacs to the N.W.A. specifications. Only pedestrians will be allowed access from any cul-de-sac to an adjacent roadway.

1.3.3.1 Access to Public Beaches

The existing public beach, though not a part of the development under consideration, will still be accessible via the main entrance road, and the southern most road of the site which runs parallel to the main highway. These roads will be handed over to the Parish Council upon completion, and therefore will ensure public access to the beach.

1.3.4 Way Leaves and Parks

Way leaves have been provided at the boundaries of the small hotels to allow easy access of storm water flows to the sea. Way leaves will be 3.0m wide. There is a 23m wide buffer between the main road and the subdivision. This buffer will act as a park and jogging trial and will carry an earth drain for collection of all storm water accessing the site from the highway.

1.3.5 Significant Natural Features

The main natural features with potential for affecting infrastructure works on the site are the assumed rocky nature of the soils, the ponds and the beaches. Excavating roadways and trenches for water and sewer mains will be in rock of varying degrees of hardness. This will most likely be more expensive than excavation in earth. It is anticipated that

excavation cost will be at least two to three times higher than excavating in earth. The three ponds in the subdivision will remain. The Northern Turtle pond (Pond #1) is seasonal in nature. However, all three locations will be kept and the ponds preserved as a feature in the subdivision. The two ponds on Road #1 near the Beach Park (Ponds #1 & #2) will be linked by a 1200mm diameter culvert. As the roadway will be at a much higher elevation than the ponds, a head wall will be built on either side of the roadway to limit the extent of roadway/pond interface. The road reservation in the area of the ponds will be 9.0m wide, this will allow for a 6.1m wide road plus two sidewalks (Figure 1-9). The beachfront within the proposed development, for the most part is rocky outcrops at elevations 0.0 to 3.5m high.

1.3.6 Storm Water Drainage

Storm water from the subdivision will flow along the roadways in asphalt or concrete gutters for collection in paved drains at catch basins along Road #1 (see Figure 1-9).

Culverts under Road #1 will discharge into open rectangular drains in way leaves along the boundaries of the small hotels. Discharge of storm flows to the sea will be in paved drains across the rocky outcrops at the beachfront. Storm water flows from the hotel lots where possible will also discharge into these drains. The open drains will provide easy access for cleaning. However, covers to the drains will be provided in areas where access across the beachfront is required.

The subdivision has been divided into catchment areas of approximately 2.4.hectares to allow for easy handling and disposal of storm flows. The exception being one area between Roads #9 and #2 that is 6.5 hectares in area.

Drains will be designed for a 1: 10 yr. return period. Culverts will be designed to flow about half full and the open paved rectangular drains will have a freeboard of at least 300mm. Structures serving Drainage areas A and B will generally be sized as follows for 1: 10 yr. return period:

Figure 1-9: Drainage System

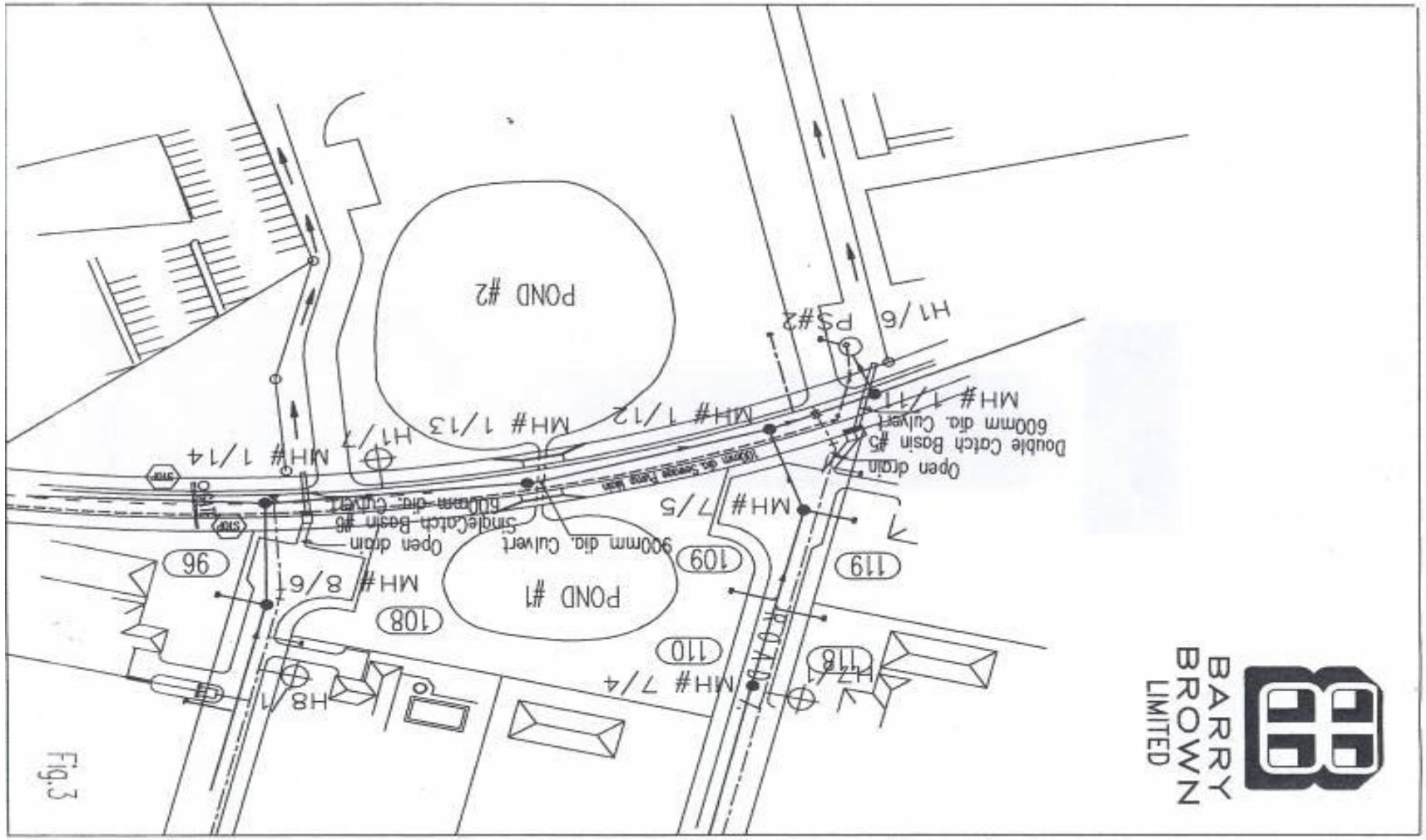
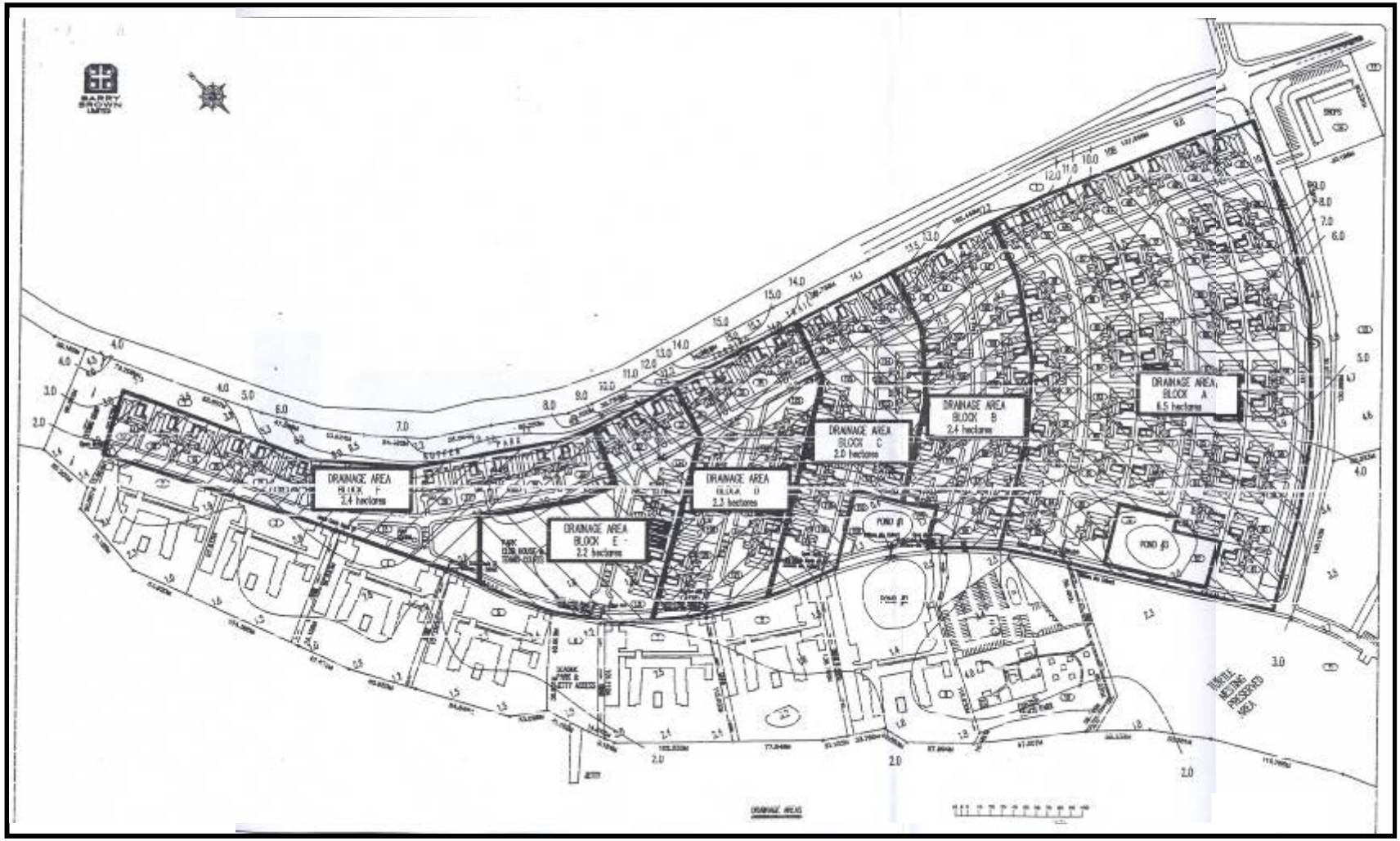


Figure 1-10: Site Drainage System and General Infrastructure Layout



- Area A - 6.5 hectares with estimated flows Q = 1.4m^3/sec.
- Culverts 900mm diameter. RCP, d=50%, n= .012, v=4.2m/sec and s=0.0167. Open block wall drain 900 x 750mm deep, d=64%, v=3.2m/sec and s = 0.01.
- Area B - 2.4 hectares with estimated flows Q = 0.6m^3/sec.
- Culverts 600mm diameter. RCP, d=52%, v= 3.14m/sec and s= 0.0167.
- Open block wall drain 600 x 700mm deep, d=55%, v=2.5m/sec and s= 0.01.
- Areas E through F are designed for Area B flows. Design estimates of flows are based on a 24-hour rainfall at 180mm for a 1: 10yr. return period.

It should be especially noted that the sub-division has been portioned to prevent large volume flows out to sea at any single exit point/discharge area, and should therefore minimize the impact, if any, on the marine life

1.3.7 Sewage Collection

Sewage will be collected in a 100mm diameter PVC lateral from each cottage lot and from 150mm diameter PVC laterals from each hotel lot. 200mm diameter PVC sewer pipes will be used as collectors located along centerline of the roadways. Sewage from all laterals will discharge into the collector sewers. Final discharge will be to the Sewage Treatment Facility to the North East of the subdivision. Due to the adverse slopes on the site relative to the treatment plant and the proximity of ground water to the inverts of sewers on Road #1, pumping of sewage will be necessary. The peak factor for the sewers in this design is 2.5.

Sewage production of 461 m^3/day has been derived as follows. No allowance is made for population growth over 20 years as the subdivision is designed at the maximum population.

Small Hotels	210 rooms	@ 0.60m^3/day	= 126.54 m^3/day
Guest Houses	472 rooms	@ 0.60m^3/day	= 284.41 m^3/day

Shops	6 No	@ 1.5m^3/day	= 9.03 m^3/day
Nature Park	150 persons	@ 0.038m^3/day	= 5.70m^3/day
Beach Park	500 persons	@ 0.038m^3/day	= 19.0m^3/day
Beach Park Restaurant	100 seats	@ 0.113m^3/day	= 11.3m^3/day
Club House	30 seats	@ 0.188m^3/day	= 5.64 m^3/day
Total			= 461 m^3/day

An allowance of 10% will be added to this flow to accommodate infiltration into the collection system. This brings the total average flow to 507 m^3/day. Two lift stations will be located along Road #1 to pump sewage to the treatment plant. Pump stations #1 and #2 will be sited off the road reservations in areas specially provided.

1.3.8 Sewage Treatment Facilities

The type of sewage treatment approved for this site by The Environmental Health Unit (EHU) of the Ministry of Health (MOH) and National Water Commission (NWC) is Waste Stabilization Ponds. This is described below and further details are provided in the appendices. The treatment process will meet or exceed the NRCA sewage effluent standards below:

Table 1-1: NRCA Sewage Effluent Standards

Parameter	Effluent Limit
BODs	20 mg/L
TSS	20 mg/L
Total Phosphorous	4 mg/L
Total Nitrogen	10 mg/L
Faecal Coliform	200 MPN/100 mls
COD	100 mg/L
pH	6-9
Residual Chlorine	1.5 mg/L
Floatables	Not visible

Of the treatment systems acceptable to the NWC, EHU and NEPA the two most favored for this site were considered, and are discussed below.

1.3.8.1 Oxidation Ditch Technology

Oxidation Ditch technology was reviewed along with other sewage treatment options for this project. It was not selected for this project because of the higher capital cost of construction and the availability of adequate lands where less costly technologies could be implemented. Other factors against the selection of the oxidation ditch technology were the need for full time staff on site, and the greatly increased cost of machinery maintenance and ongoing electricity cost. Detailed descriptions of the operations are included in APPENDIX IX.

1.3.8.2 Waste Stabilization Ponds (see Figure 1-9)

The decision was made to use Waste Stabilization Ponds with 1.2m depth of sewage for this project. This decision was guided by the availability of suitable lands for constructing the ponds, very low long-term maintenance cost, the lower initial construction costs and excellent effluent quality. The area of the subdivision reserved for the sewage treatment facility was large enough to easily accommodate the ponds. The area is quite open and the consistent wind pattern across the area from the Southeast and East-Southeast are unhindered.

The sewage surface area-loading rate on the ponds will be limited to create minimal disturbance in the ponds, resulting in an environment where odour will not be a concern. The edge of the ponds will be setback to a minimum of 100m from any domestic dwelling as required by the MOH/EHU and NEPA. The bottom and sides of the ponds will be sealed with approved compacted clay to limit the potential for seepage and leaks. The additional tertiary treatment of the sewage will allow for unrestricted use of the treated effluent. Figure 1-11: Oxidation Pond Details, provides details of the proposed sewage system.

The potential for irrigating the lawns and verges in the subdivision, or to supplement the irrigation water used on the adjacent farms are excellent potentials for reuse of the treated effluent. Treated effluent could also be used to maintain water level in the three existing

Figure 1-11: Oxidation Pond Details

ponds on site. The preferred use of the effluent is to supplement the irrigation demands on the neighbouring Font Hill Farms. The subdivision's domestic water supply will be taken from the wells presently supplying the farm's irrigation water. If the treated effluent is reused, the net demand on the wells due to the subdivision's domestic water needs would be minimal. The treated sewage effluent shall conform to the NRCA irrigation standards as listed in the following table:

Table 1-2: Natural Resources Conservation Authority (NRCA) Effluent Standard for Sewage Used for Irrigation

Parameter	Standard Limit
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chorine	0.5 mg/L
Biochemical Oxygen Demand (BOD_5)	15 mg/L
Chemical Oxygen demand (COD)	<100 mg/L
Faecal Coliform	12MPN/100mls

Additional treatment will take place in Hyacinth Ponds at the end of the treatment process to allow for the removal of nitrates and phosphates to the required levels. Phosphate levels at the end of the treatment process are heavily dependent on inflows at the start of the treatment process. Any excess phosphates above the required NEPA levels will be brought into specification by addition of alum into the last set of ponds. It is anticipated that the addition of alum up to 150mg/L in the last ponds will bring total phosphate levels well below 4mg/L and not significantly affect suspended solids. Approximately 80% or more of pond surface will have plant cover. However, ponds will also be harvested to allow for new growth. As required, (based on plant growth) there will be increased need for manpower and equipment to accomplish programmed harvesting of water hyacinth. All ponds are at shallow depths of l.2m, which will provide sufficient storage for sludge but deep enough to prevent plant growth from the bottom of the pond. The facility is designed with two independent rows of ponds. This will allow shut down of any pond for maintenance and cleaning. We do not anticipate sludge removal from any of the ponds for at least 10 years.

Commercial grease separators will be included in the designs of the hotels to facilitate the effective handling and removal of grease from the system that if not properly managed may result in odour and poor effluent quality.

1.3.8.3 Sludge Management

On entering the facultative ponds, most of the solids in the sewage settle to the bottom of the ponds. Anaerobic digestion of the sludge solids takes place and over a long period of time, it is anticipated that there will be sludge build-up in the ponds.

The ponds are designed to function effectively even when the sludge blanket occupies half the pond depth. This blanket should normally take more than 26-35 years to accumulate. When excessive amounts of suspended solids show up by normal effluent testing then de-sludging of the ponds will be required.

The sludge will be removed from the ponds, dried, and used in making mulch or as fertilizer on the adjoining farm.

1.3.8.3.1 The Design Summary

Parameters. Analysis for two rows of ponds.	**US**	**Metric**
Total avg. flow		461 m^3/day
Average Flow (Q)	0.061 mgal/day	231 m^3/day
Infiltration at 10%	0.006 mgal/day	23.1 m^3/day
Peak Factor	2.5	2.5
Peak Flow (Q_p)	0.17 mgal/day	576 m^3/day
Influent BOD (L_i)		250 mg/L
Lowest average monthly temp. (T)	78.8 deg far.	26 deg cent.

1.3.8.3.1.1 Facultative Ponds

Assume completely mixed reactors with BOD removal following first order kinetics.

To maintain aerobic conditions L_e is in the range 50-70 mg/L

Choose L_e 60 mg/L

Pond depth (D) 1.2 m

Rate constant $k_1(T)$ 0.402 /d $<k_1(20) = 0.3$, $k_1(T) = (1.05)^{T-20}$

from MARA eq 7.11 Min. average area $A = (Q/Dk_1)*(L_i/L_{e-1})$

Minimum average Area (A) 1664 m^2

Modified Average Area (A^*) 2800 m^2

Hydr. Ret. time ($t^* = AD/Q$) 13 days Permissible 400kg/ha d.

Surface BOD loading ($10L_iQ/A$) 226.4 kg/ha d. >< Range 130-270 kg/ha d

Volumetric BOD loading (L_i/t^*) 18.9 g/m^3 d. >< Range 15-30 g/m^3 d.

1.3.8.3.1.2Maturation Ponds

Faecal bacteria removal following first order kinetics

From MARA eq 7.20 $N_e = N_i/[(1 + K_b t_1^*)....(1 + K_b t_n^*)]$

Assumed number FC influent N_i =38,000,000 MPN/100 ml ><3.5 - 4x10^7

Rate constant $K_b = 2.6(1.19)^{(T-20)}$ 7.4 /d

Required Hydr. ret. time (t^*) 6.0 days

Number of ponds 2.0

Number coliform in effluent (N_e) 187.3 FC/100 ml < 1000 MPN/100 ml required

Effluent BOD_5 $L_e = L_i/(1 + k_1 t^*)$ 10.3 mg/l < required 20 mg/l

Average Pond Area $Q t^*/D$ 1268 m^2 each

Pond top dimensions with slope 3:1and 0.6 m freeboard:

2 No. Facultative 71x26 x1.2m deep

4 No. Maturation 36x15x1.2m deep

2 No. Hyacinth 36x15x1.2m deep

1.3.8.3.1.3Nitrogen Removal

First 3 ponds due to volatilization:

$N_e = N_i\ (1/(1 + t(0.000576T - 0.00028)\ \exp^{((1.08 - 0.042T)(pH - 6.6)}$)

Influent Nitrogen N_1 = 30 mg/l N_e = 17.0 mg/L from 3rd pond

Water Hyacinth in additional polishing pond. Final effluent Nitrogen N_{e1} $N_e \exp^{(-kt^*)}$

Removal from 4th pond with 80% or more of pond covered from last pond.

N_{e1} = 4.6 mg/l <10.0 mg/L

1.3.8.3.1.4Phosphorus Removal

Phosphorus removal shown by testing to be limited by nitrogen uptake and be about 30 to 50%

Expected Phosphorus uptake at 30% min. 10.5 mg/l from the last pond >4.0 mg/L

To bring effluent phosphorus to below 4.0 mg/L Alum will be added to the last pond as required up to 150 mg/L.

1.3.8.3.1.5Effluent Reuse

Final number coliform in effluent N required. 19.0FC/100ml<100MPN/100 ml

Chlorination of the effluent will bring the coliform levels to within the 12MPN/100ml required.

The effluent from the Hyacinth ponds will be recycled to the adjacent farm, or used to irrigate lawns and verges in the subdivision

Pond top dimensions with slope 3:1and 0.6 m freeboard:

2 No. Facultative 71x26 x1.2m deep

4 No. Maturation 36x15x1.2m deep

2 No. Hyacinth 36x15x1.2m deep

1.3.8.3.1.6 Desludging Frequency

Sludge accumulation rate is between 0.03-0.04 m^3/hd/yr

Desludge frequency DF = 0.5 (pond volume m^3)/Sludge rate x population)

DF minimum = 26 years

DF maximum = 35 years

1.3.9 Water Supply and Distribution

Water supply to the project site will be from the existing Dalentober wells on the Font Hill property. Water from the wells is pumped to two adjacent existing storage tanks with capacity of 180m^3. The elevations of the tanks are 53.3m. Water from the system was previously used for the Font Hill farm's drip irrigation system. 580m^3/day of water from the storage tank will be chlorinated and fed by gravity to the Font Hill subdivision. Potable water from the tanks will flow by gravity through supply mains directly to the subdivision. The distribution pipe sizes in the subdivision will be 100mm and 150mm diameter. The system will be valved at road intersections (approximately). Fire hydrants will be located as required by the Jamaica Fire Brigade. This supply is entirely in PCJ's domain, is private and does not involve the NWC.

1.3.10 Electricity

Electricity for the development will come from the national grid. It is estimated that at full capacity, electrical demand will be in the range of 185 MWh per month. All indications at this time are that the Jamaica Public Service Company will be able to adequately meet this demand.

Assumptions

Energy use per room	=	347.35 kWh/month
Common areas, cooking areas and any other energy consuming facilities	=	20% estimated total room energy usage

Estimated monthly energy usage for 7 hotels with 30 rooms each

7	x	30	=	210 rooms
210	x	347.35 kWh	=	72 , 943.5 kWh
72,943.5 kWh	x	1.2	=	87, 532.2kWh

Estimated monthly energy usage for 117 cottages of 1-4 bedrooms each

Each cottage is estimated to be equivalent to 2 hotel rooms in size (on average)

117	x	2	=	234
234	x	347.35 kWh	=	81, 279.99 kWh
1.2	x	812, 799 kWh	=	97, 535.88 kWh

Total estimated monthly energy usage for the proposed development

Estimated usage for hotels	87, 532.2 kWh
Estimated usage for cottages	97, 535.88 kWh
Total Estimated usage/ month	185, 068.08 kWh

Reference: Usage for an actual hotel provided by the Jamaica Public Service Company Limited

ANALYSIS OF ALTERNATIVES

2 ANALYSIS OF ALTERNATIVES

2.1 INTRODUCTION

This section proposes alternatives to the proposed development and its design, and analyses the potential environmental impacts of each option. The objective of this section is to determine the most practical, environmentally sound, financially and technically feasible option for this development. Along with the compulsory "No Action" alternative, the following alternatives were considered:

- Other site locations
- Project design alternatives

2.2 No Action

The No Action alternative is a possible alternative to implementing this project. This alternative, if selected, may have significant impacts on plans for the development and improvement of the Font Hill area, for the following reasons:

- The project as designed and proposed will not impact significantly or negatively on endemic, unique or irreplaceable natural resources or the environment.
- If not implemented, the project does not have the opportunity to improve the quality of life or provide well-needed employment or income potential to the community.
- If not implemented, the project does not address the need for accommodations or tourist attractions to service the growing tourism product on the south coast.
- If not implemented, the project does not provide significant positive socio-economic benefits to the community in terms of employment, small and micro-business opportunities and increased property values.

The "No Action" alternative is not the recommended alternative for this project.

2.3 Larger Development

PCJ owns many acres of land in the Font Hill area and it is feasible that they could propose a much larger development, however, if PCJ was to consider a larger project area, the following situations may be realized:

- A larger project area would encroach unfavorably on either the agricultural lands or the conservation area/wildlife reserve which would not be desired.
- A larger project area will also increase the demand for resources such as water, electricity, and sewage treatment.
- A larger project area would increase the potential for negative impacts of the development on the environment keeping in mind that the conservation area/wildlife reserve border on the current project area.
- A larger project area would increase the cost of mitigating potentially negative impacts associated with the development and increase costs.

This is not the preferred alternative for this project.

2.4 Smaller Development

If PCJ was to develop a smaller project than is being proposed, the following drawbacks could be realized:

- A smaller project area may not be able to incorporate all the amenities proposed to make the development attractive to investors and would ultimately not be the optimal financial decision
- A smaller development may not be able to provide the economic, socio-economic and supplemental benefits to the surrounding communities as the one proposed
- A smaller development may not necessarily lower the potential for negative impacts on the environment.

While this represents a feasible alternative, it is not the preferred alternative for this project.

2.5 Alternative Location

Consideration may be given to relocating this proposed development elsewhere, however, this would prove to be an unpopular alternative for the following reasons:

- The PCJ presently owns the land proposed for this development.
- An alternative location would require investment in other lands which may not be available or as suitable for this type of development.
- Large tracts of contiguous land at current prices may negatively affect the viability of the project.

This is not the preferred alternative for this project.

2.6 High-Rise Hotels

To reduce the amounts of land needed for construction or to concentrate the development in a specific area are potentials that could be realized if the development plans were changed to propose high rise hotels at the site.

- The construction of high rise hotels on the property would not necessarily provide the level of amenity or aesthetic integration with the site.
- It would also preclude individual ownership of the lots and cottages and exclude certain segments of the Jamaica market from taking up ownership in the development.
- Additionally, zoning restrictions would dictate the size, height and type of building that may be constructed, which may not fit into PCJ's vision for the development.
- The Jamaican tourism product consists of many high rise hotels, the development

proposed by PCJ offers a different type of experience which is not overly exploited at this time and offers diversification of the tourist experience with an eco-tourism component.

While it is recognized as a feasible alternative, high rise hotels are not the recommended alternative for this project.

2.7 Proposed Design – Preferred Alternative

The proposed design for this development is the most practical, environmentally friendly and reasonable use of the lands in that area, for the following reasons:

- The proposed development will impact a small percentage of the available lands in the area (approximately 40 ha of the over 1,050 ha owned and managed by PCJ in that area).
- The proposed design maintains the existing 282 ha Conservation Area/Wildlife Sanctuary which will be an asset to the development, in its entirety.
- The development is proposed for the area of the property least likely to impact negatively on the environment.
- As designed, the project will offer a positive boost to the economy of the area in all phases of development
- Stands to provide needed recreational conveniences and infrastructure to the area.
- Will provide significant positive socio-economic benefits to the community in terms of employment, small and micro-business opportunities and increased property values.

This alternative is the recommended alternative for this development. The size and layout as proposed make very effective use of the project area, incorporates all necessary amenities and infrastructure to meet regulatory, environmental and aesthetic requirements. Importantly, it makes provision for continued conservation and management of the 282 ha Wildlife Sanctuary and Reserve.

EXISTING ENVIRONMENT

3 EXISTING ENVIRONMENT

3.1 General

The Font Hill property has a diversity of natural ecosystems. These ecosystems vary from marine, inland freshwater ponds, wetlands (mangroves) on the south, dry limestone forests, to open grassy areas to the north. There has been limited interference from humans within these ecosystems and as recently as 1998, cattle and goats grazed within the property boundaries. The northernmost areas of the site are under agricultural production with mango orchards, cashew groves and pimento orchards being most prevalent.

Based on vegetation, these environments could be described as areas with extensive stands of mature mangrove wetlands to the south and stands of secondary forests towards the north made up predominantly of logwood trees and other species such as red birch and wild cherry. Inland (northward), there are also areas of shrubs, scrub forests and open grassy areas, while marginal marine areas have plants that are salt tolerant with xerophytic characteristics.

3.2 Physical Environment

3.2.1 Hydrogeology

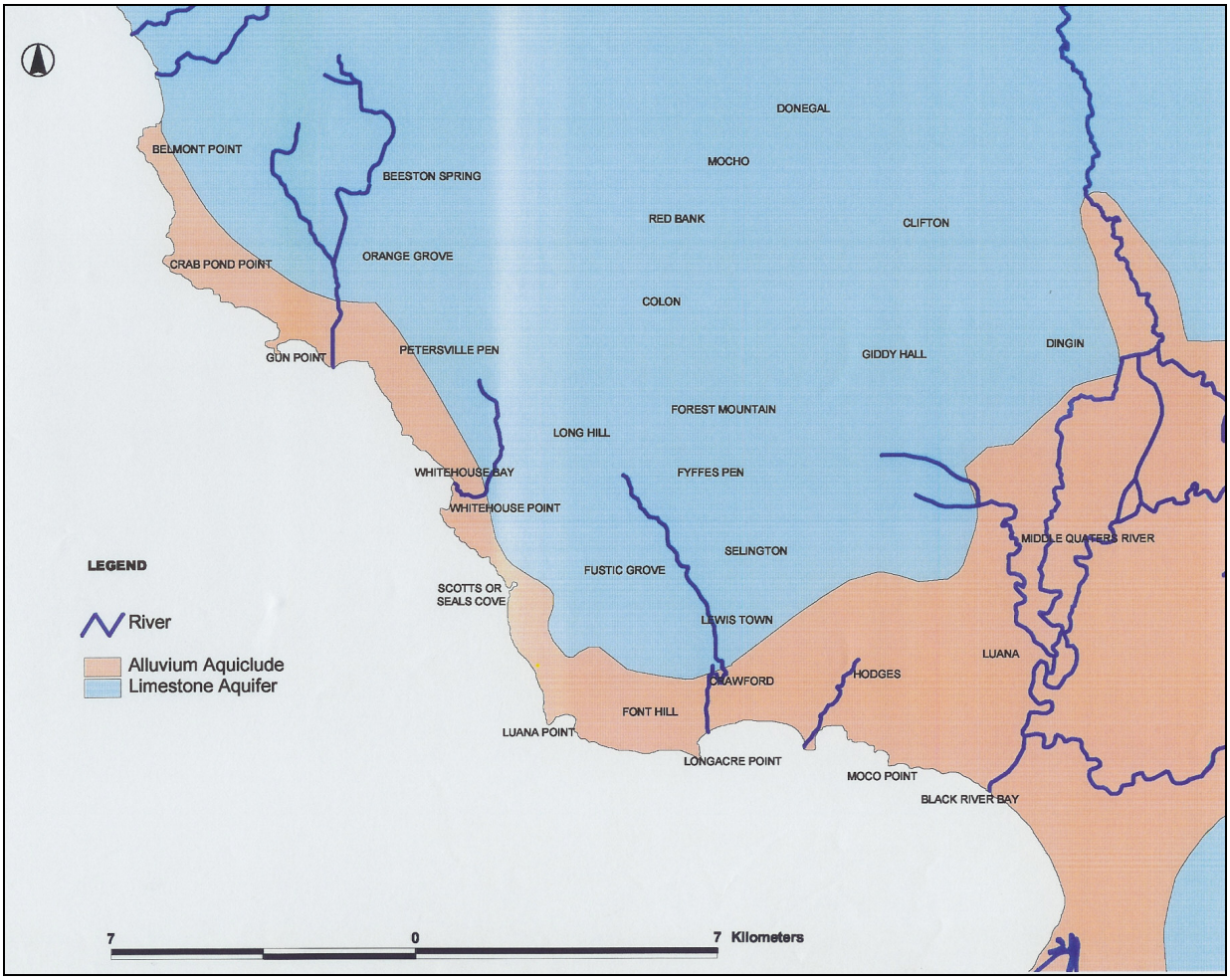
The hydrogeology of the proposed development is consistent with what exists along the coastal strip of the south coast. This is generally underlain by an alluvial aquifer (western & northern section) and an alluvial aquiclude (southern & eastern section - see Figure 3-1). Water resources in the alluvial aquifer are very limited given the small extent of this aquifer. The water table is expected to be less than 5 m below ground in the limestone aquifer.

Various soil types underlay the site ranging from stony loams with very rapid internal drainage capacities to clays with very slow internal drainage capacities.

The coastal ponds in the area are formed by run-off water and the limestone, typical of the

area (see Figure 1-5, Figure 1-6, and Figure 1-7) is largely impervious. The volume of the ponds and their water quality vary as a function of the level of rainfall. There is an alluvial aquiclude in this area which forms a natural barrier to the sea, preventing intrusion of salt water and escape of water from the aquifer north of the property. This aquifer is recharged through infiltration of rain water and not through ground water recharge (Figure 3-1).

Figure 3-1: Hydrostratigraphy Map of South-West Jamaica



3.2.2 Geology[1]

The site sits on the coastal group formation, which consists mainly of variable alluvial type deposits i.e. sands, silts, and clays with the clay often being the dominating feature.

[1] Office of Disaster Preparedness and Emergency Management (ODPEM) Disaster Catalogue; and the ODPEM List of High Risk Areas.

The area is interspersed with subordinate rubble chalky (often soft) marls and shelly limestone deposits with fine-grained matrices and occasional hard reef limestone. (See Figure 1-5, Figure 1-6, and Figure 1-7

The presumed bearing capacity variable, ranges from moderate to low 40-600 KN/m2. Slope stability is primarily dependent on soil strength, particularly cohesion. The alluvial soil in the project area with its high silt and clay content coupled with the relatively mild slopes should result in stable soils in the area. The project area is not prone to flooding and slope failures have not been experienced at the site. The topography of the site slopes gently to the south in the general direction of the sea

3.2.3 Weather

Weather data for the site has been reviewed from secondary data sources. This indicates that the weather regime is generally maritime tropical. The three year rainfall trend for the period 1995 to 1998 was reviewed.

Figure 3-2: Monthly Mean Rainfall for 1995

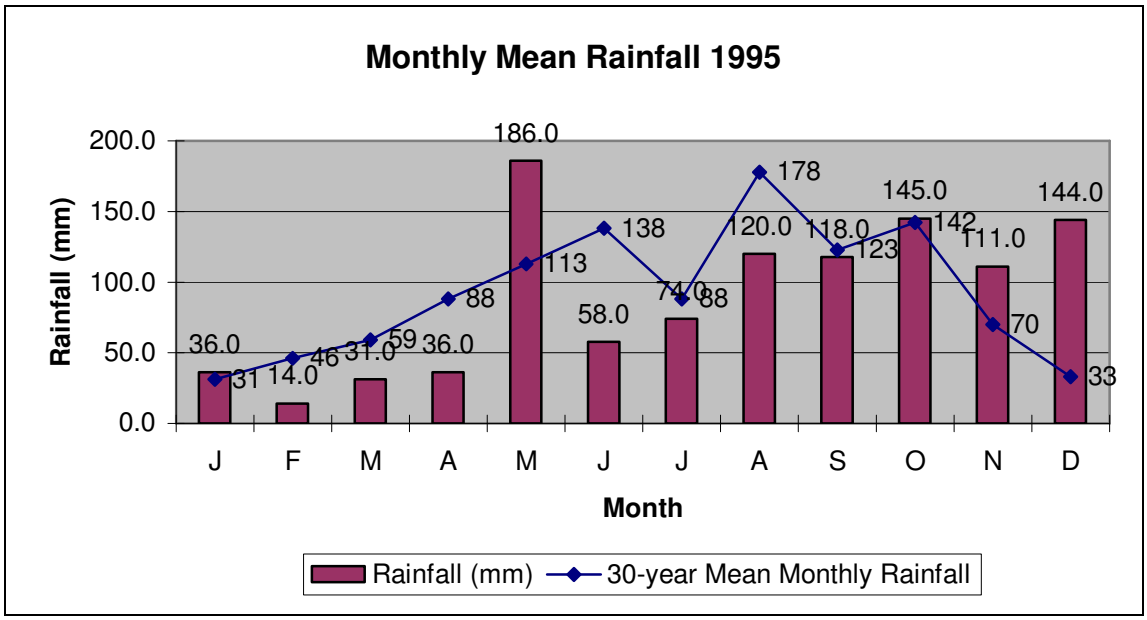


Figure 3-3: Monthly Mean Rainfall for 1996

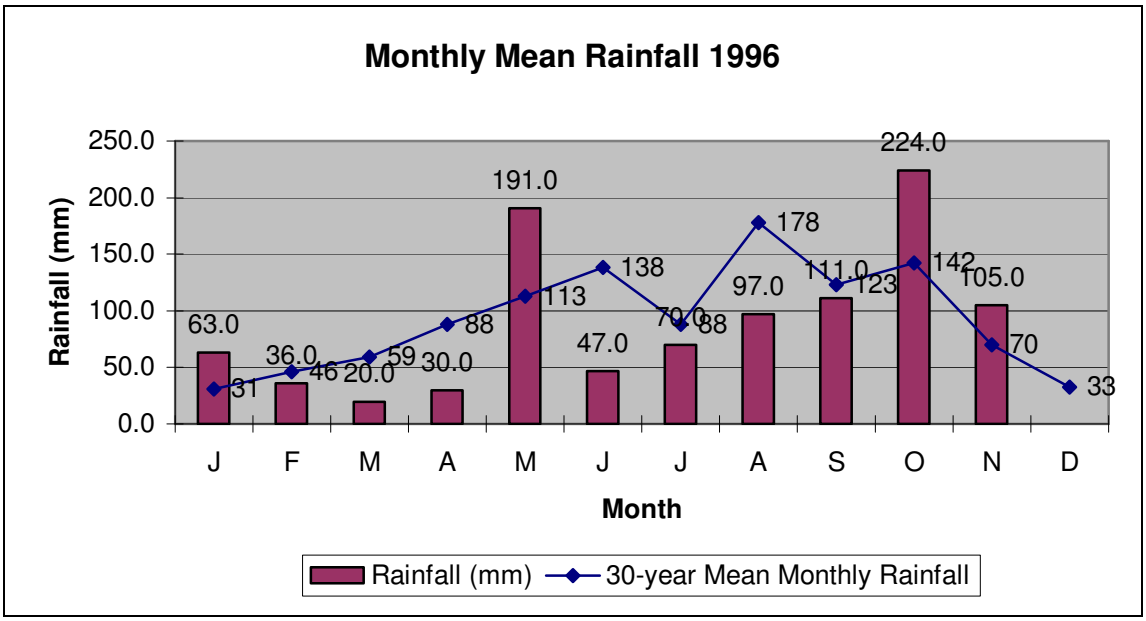


Figure 3-4: Monthly Mean Rainfall for 1997

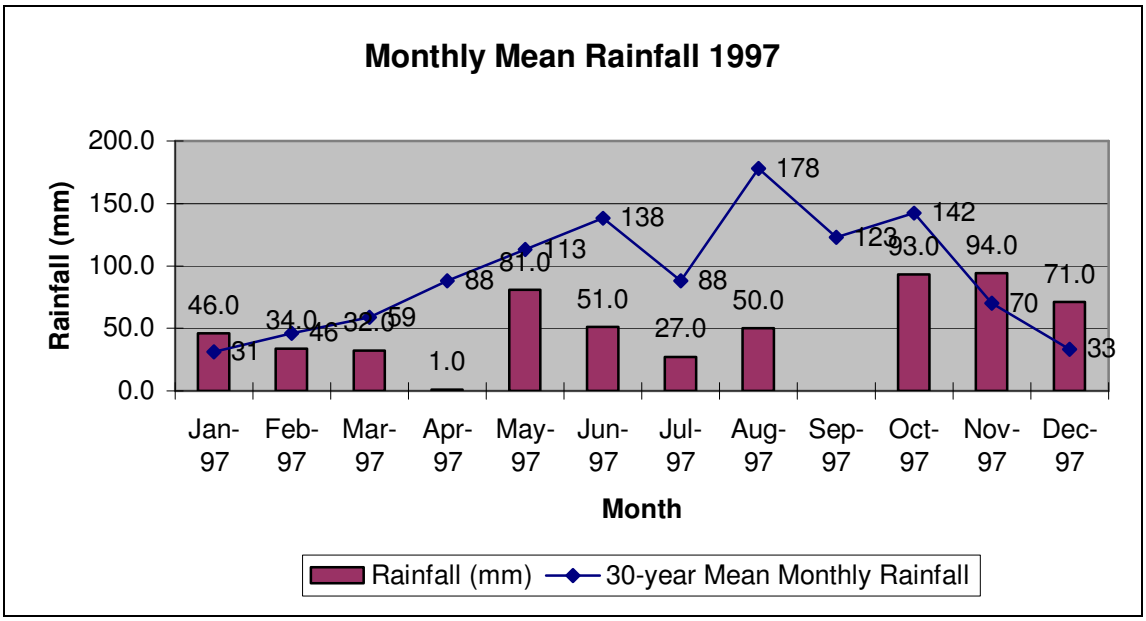
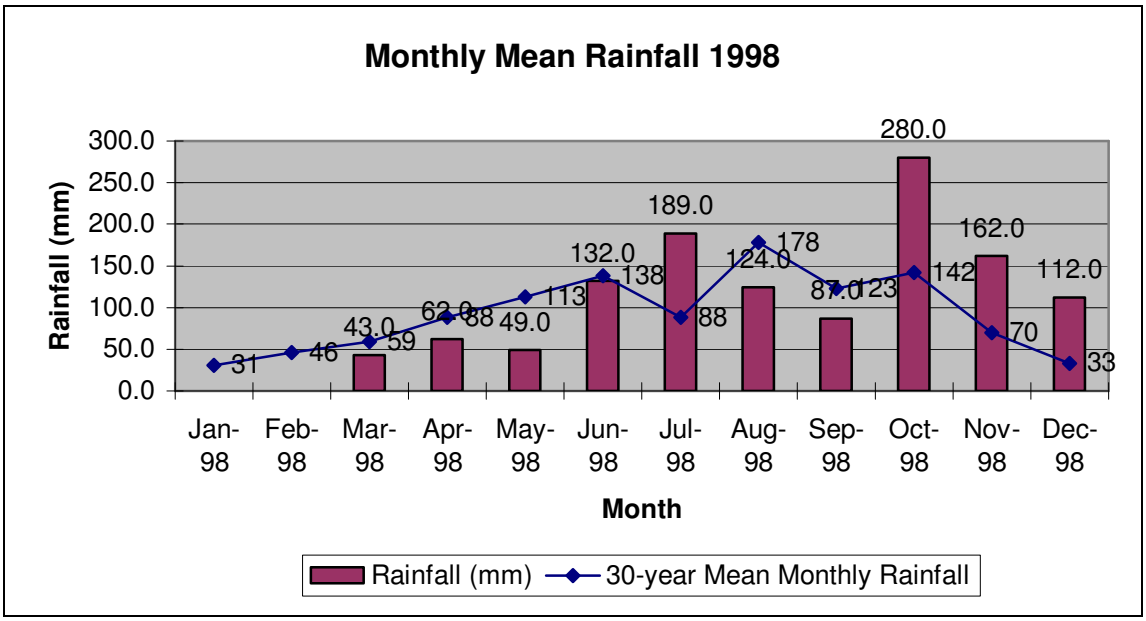


Figure 3-5:Monthly Mean Rainfall for 1998



The pattern is typical of national trends with May through October showing the highest rainfall averages. Generally the area trends below the 30 year mean rainfall totals. Rainfall levels do not appear to be such that flooding would be a major concern in this general area.

3.3 Biological Environment

This section provides descriptive analyses and classification of the various life zones and habitats at the project site. In addition, a quantitative analysis of the vegetation is provided as well as list of plant and bird species observed on the site

The biological environment can be summarized as having a fauna that is dominated by bird species (numerically, species and by habitats) and a wide diversity of vegetation classes. The project site is, however, to the west of the designated Font Hill Conservation Area/Font Hill Wildlife Sanctuary and is less influenced by the wetland conditions.

3.3.1 Marine Environment:

The proposed Font Hill development is a coastal project and includes marine frontage on the south coast of the island. While the development does not include any large stretches of sandy beaches, there exists a potential for marine related impacts through areas such as:

- Recreational usage
- Storm water Management
- Waste Management
- Environmental Management
- Construction on the shoreline and seafloor (jetty)

In order to provide information, which could be used to support the development and to assist in the evaluation of any impacts that the development could have on marine resources, a marine assessment of the environment immediately adjoining the Font Hill development property was conducted.

3.3.1.1 Study Area Demarcation:

Figure 3-6: Demarcation of Font Hill oceanographic Marine Bethink Study

The area defined for the oceanographic and benthic assessment was selected using the property's boundaries as the eastern and western limits. The island shelf, which was located approximately 500 meters offshore, was used as the southern limit, while the shoreline demarcated the study area's northern limit (***see*** Figure 3-6*)*.

While the study was confined to the immediate near shore and offshore vicinity of the proposed development site, determinations made for the marine environment at this location could be used to interpret the character and status of marine resources immediately adjoining the study area by a process of extrapolation.

3.3.1.2 MARINE ASSESSMENT METHOD DESCRIPTION:

3.3.1.2.1 Aerial Photo Interpretation:

The marine assessment was initiated using photogrammetry to remotely identify and determine the spatial distribution of marine seafloor characteristics, which can be discerned with these methods[2]. These characteristics relate to colour, 3-dimensional form and texture patterns, which can be used by a suitably trained and experienced remote sensing technician to identify the various types of bottom substrates and marine benthic[3] features (organisms attached permanently to the seafloor) existing within Jamaica's waters. Vertical aerial coverage of the area for the year 1991 was accessed through the Survey Department and examined for the interpretation process. Ground Verification:

After the process of aerial assessments was completed, ground truthing was conducted to verify interpretations made during aerial photo assessments.

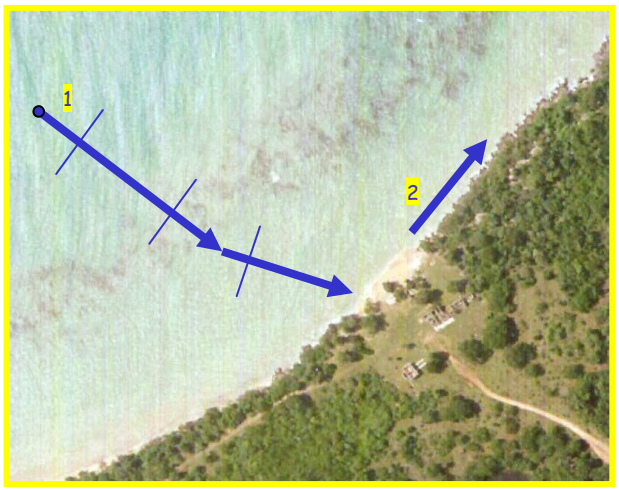
In addition, verification was conducted to provide information on the status of natural resources that may exist within the immediate study area.

Figure 3-7: Font Hill Benthic Study Transect 1 and 2

[2] Photogrammetry is the science of using aerial photographs and other remote sensing imagery to obtain measurements of natural and human-made features on the earth www.Physical Geography.net

[3] benthic organism being defined as those which are permanently attached to the seafloor substrate

Figure 3-8: Font Hill Benthic Study Transect 5 and 6



It was proposed that ground truthing be conducted along three long visual transects traversing the area from shore to the island shelf (***see*** Figure 3-6**,**Figure 3-7 ***and*** Figure 3-8) and three running along and parallel to the shoreline. Transects were defined with a 20 meter surveyors tape measure. If seafloor character changes were observed, assessments were then conducted along a 20 meter transect deployed perpendicular to the main transect. This was done so that an assessment of the lateral continuity of the character change could be determined. These types of transect deployment also served to identify any substrate type or character changes, which may be governed by depth.

Visual transects were conducted by two divers with slates, laminated pictures of marine resources and a Nikonos 5 underwater still camera to facilitate information gathering. The use of transects facilitated the determination of two types of seafloor characterizations. The first was an indication of the spatial distribution of hard and soft bottom types. The second was an indication of the dominant types of benthic marine organisms living on the seafloor.

Estimates of the percentage area of seafloor covered by the dominant benthic marine organisms within the study area were obtained using underwater photographs taken with a vertical orientation.

A vertical orientation would permit a map-like view of the seafloor. Reference objects within the field of view of the camera were measured with a 10cm ruler prior to taking

the photograph so as to establish a scale reference. Once an indication of the size of objects within the photograph is obtained, then areas covered by various features within the photo can be determined.

In addition to the determination of information to characterize the seafloor, all fish and other mobile species observed within a 2 meter strip along each of the transects deployed were identified and estimates of their sizes and numbers made.

Finally, The contour of the seafloor along each transect was determined by cross section using a linear scale estimated from the 1991 aerial photo scale reference and using depths read from depth gauges during the visual survey.

3.3.1.2.2 Oceanographic Assessment Methods:

The oceanographic process examined during the study was sea current movement. This was examined in order to determine the means by which the marine environment within the study area could be influenced by agents transported to, from and through the system.

Three approaches were adopted for the evaluation of the study's target oceanographic processes. Firstly, wave crest movement and patterns exhibited by the movement of turbid water within the study area, as shown on aerial photographs, were examined. This was done to obtain general water movement trends for the time at which the images were taken, usually before 9:00 am. Again, the 1991 aerial coverage of the area proved useful for this purpose. Secondly, average day and night time wind directions and speeds for the area were obtained from communications with technical officers at the Meteorological Service.

This weather information was important in the evaluation of sea current movement, since one of the driving forces behind sea current movement is wind movement[4]. Thirdly, actual sea current speed and direction, within the study area were determined through the use of two drogues. Each drogue was constructed by interlocking two-1 meter square plates to form a vane, which was suspended from a white fish pot marker float. The float

[4] Williams D. D., 1997. the Oceanography of Kingston Harbour, A Tropical Polluted Embayment. Mphil thesis UWI 226p.

would suspend the vane in the water column while the vane would present a surface upon which currents would exert a force, resulting in lateral displacement. For the determination of surface currents, the vane was suspended one meter below the float.

Drogues were tracked from land positions contiguous with the shoreline termination points of each of the visual transects conducted using bearings obtained from hand held Silva compasses. Bearings were taken every 5 minutes for total time period of 30 minutes. Once bearings were obtained, these were plotted onto the 1991 aerial image of the site to show movement direction and speed.

3.3.1.2.3 Limitations:

Horizontal water visibility at both survey locations was generally poor, being less than 2 meters at the location of transect 1 and about 4 meters at the location of transect 5. This may have affected the ability of the survey team to adequately assess benthic and mobile species, particularly at transect 1

The survey team had not been able to access a boat for the survey. Consequently, the original objective of surveying an area extending from the shoreline to the island shelf drop-off (which extended to 500 meters offshore) could not be done. Instead, the survey team opted to survey within a 200-meter distance from the shore, with the seaward most survey point being accessed by a surface swim and the survey being conducted underwater in a direction towards shore.

Transects 3 and 4 were not surveyed due to the fact that the shoreline could not be as conveniently accessed as transects 1-2 and 5-6.

Access would have meant either traversing approximately 500 meters of Ironshore limestone formations with diving and surveying equipment or cutting a pathway through the naturally occurring vegetation existing in the hinterland behind the transect location. Instead, a process of extrapolation was used to remotely assess this location.

3.3.1.3 OBSERVATIONS:

3.3.1.3.1 Aerial Photo Analysis – Marine Observations:

The form, colour and texture patterns observed during aerial photo analysis lead to the

conclusion that there were both hard and soft substrate areas within the study area. The spatial distribution of these substrates defined an area characteristic of a fringing coral reef. By deduction (due to locations adjoining the fringing reef) and colour, the soft substrate area was inferred to be composed of sediments of a marine origin. The 1991 aerial photographs, however, did show plumes of land derived sediments moving westwards from the adjoining Malcolm Bay and Black River bay areas. These plumes would probably contribute to the overall sediment composition on the seafloor within the study area.

3.3.1.3.2 Diver-assisted Visual Observations – Substrate Zonations and marine species:

Fig 4 and 5 outline cross-section summaries of the observations made along the two main transects deployed within the study area. Both hard and soft bottom substrate characteristics were observed.

Figure 3-9: Bottom Profile, Substrate and Life form Character - Transect 1

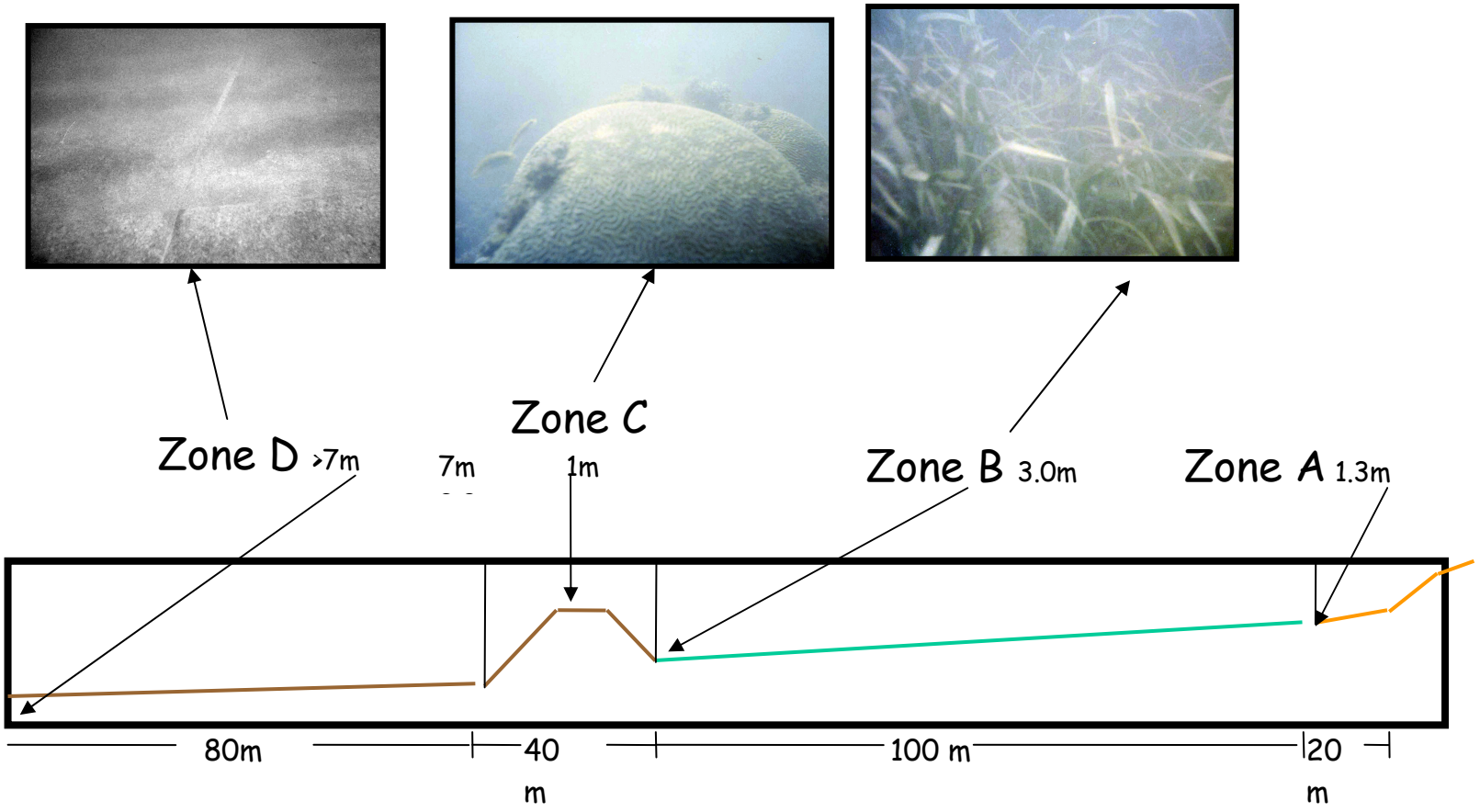
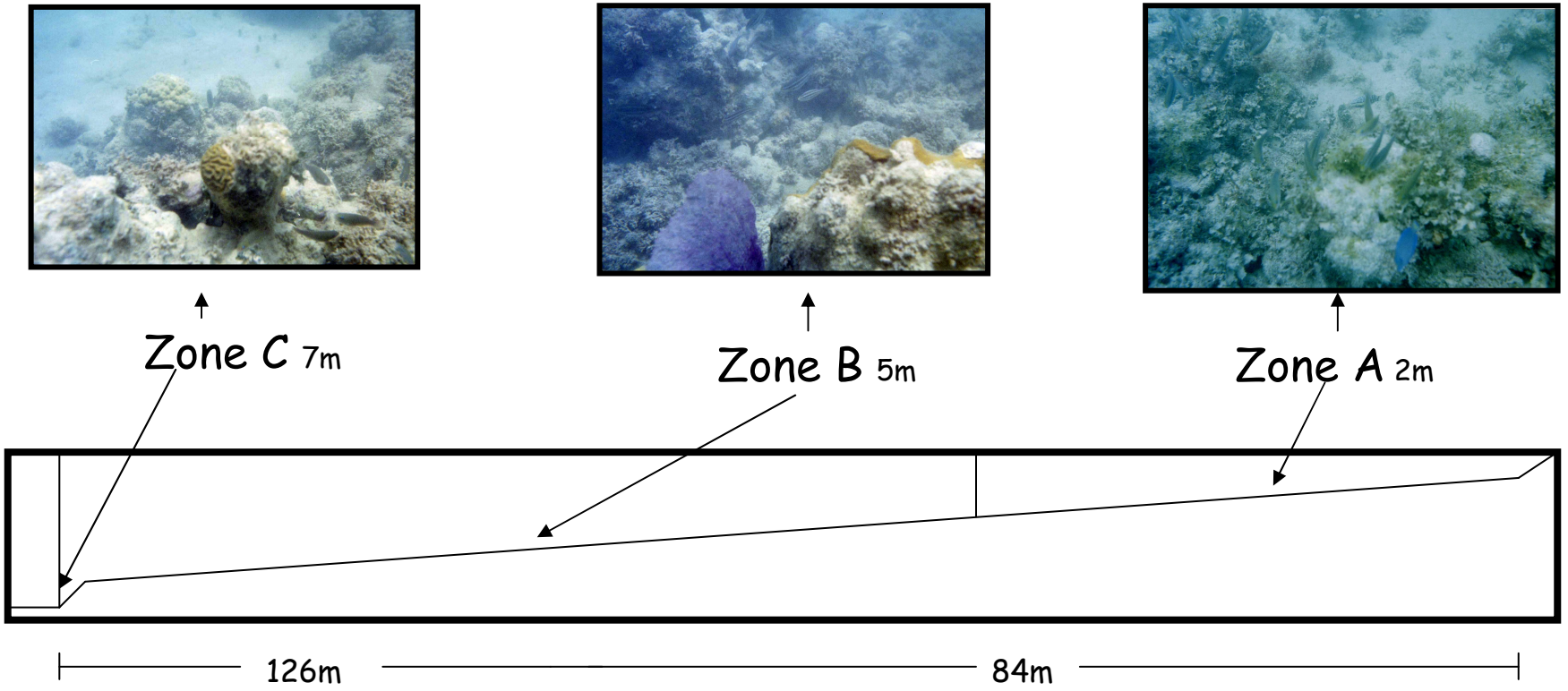


Figure 3-10: Bottom Profile, Substrate and Lifeform Character - Transect 3



3.3.1.3.2.1 Observations on Transect 1

Four zones were identified. These are described as follows:

Zone A:

This zone extended from the shoreline to about 20 meters seaward and to a depth of 1.3 meters. Coarse to medium grained marine sand was located on the seafloor within this zone, emerging above the waterline at the shore as the beach at the Font Hill Beach Park. No marine life forms of a benthic or mobile nature were observed within the area defined by both the main transect and the perpendicular transect deployed.

Zone B:

This zone extended from the seaward limit of Zone A for a distance of approximately 100 meters and to a depth of approximately 3 meters. Fine grained marine sand and silt was the dominant substrate found within this zone. The dominant marine life form found within this area was sea grass, specifically Turtle Grass (*Thallassia testudinum*).

Turtle grass blade lengths were estimated to be 20 cm in length and blade numbers were approximately 15 shoots per 100 cm2 of seafloor. It was also estimated that 30% of the sea grass blades were covered with epiphytes [5].

No vertebrates, such as fish were observed within this zone and the only type of mobile invertebrate observed were sea cucumbers (sp).

Zone C:

This zone extended from the seaward limit of zone B for about 40 meters and extended over a depth profile of 3 meters at its landward extent, to a meter depth and then dropping to 7 meters depth at its seaward extent. The seafloor was composed of a hard coralline substrate[6]. This zone had high rugosity[7] and was covered with various species of boulder

[5] Epiphytes are non-parasitic organisms which take no nutrients from the plants on which they are supported.
[6] Coralline substrates are reference
[7] rugosity being defined as the level of complexity that a reef has, for example, the extent to which a reef area has holes, crevasses and overhangs within its substrate. Ref. Friedlander Allan & Parrish James 1998.

type corals, which represented the dominant invertebrate species within this zone. Boulder coral diameters generally exceeded 30 cm in diameter. The coral framework at this location, due to its orientation and closeness to the surface, was categorized as a shore-parallel reef crest.

It was apparent from visual estimates and percentage area coverage estimates that the dominant benthic life forms were turf and macro algae, while the dominant mobile life form was fish. Three types of fish species were observed within Zone C, two of which were herbivores and most of the fish observed were juveniles.

Zone D

This zone extended seaward of Zone C to the seaward limit of Transect 1 and beyond. Coarse-grained white marine sand, with traces of sediments of a terrestrial origin (possessing a dark brown-black colour) was the dominant substrate within this zone. No life forms of a benthic or mobile kind were observed within the transect area.

Both zones B and C had the greatest variety of attached, mobile and free swimming organisms associated with them and were thus regarded as the most important life-bearing areas within this section of the study area.

Habitat characteristics affecting fish assemblages on a Hawaiian coral reef. Journal of Experimental Biology and Ecology 224:1-30.

Table 3-1 lists the species observed in each zone within transect 1, both visually while in the field and identified from underwater photographs taken during the survey.

Table 3-1: Species List, Transect 1

Marine Plants
Halimeda sp.
Turf Algae
Y-branched Algae (*Dictyota* sp.)
Sargassum sp.
Benthic Invertebrates
Corals
Brain Coral (*Diploria* sp.)
Startlet Coral (*Siderastrea* sp.)
Mustard Hill Coral (*Porites asteroids*)
Octocorals
Fire Coral (*Millepora* sp.)
Mobile Invertebrates
Echinoderms
Donkey Dung Sea cucumber (*Holothuria mexicana*)
Fish
Blue Head Wrasse
Princess Parrot Fish
Damsel Fish varieties – Beaugregories and Three-Spot (*Stegastes* sp.)
Doctor Fish (*Acanthurus chirurgus*)

3.3.1.3.2.2Observations on Transect 5

Three zones were identified. These are described as follows:

Zone A:

This zone extended from the shoreline to about 84 meters seaward and to a depth of 2 meters. A mixture of hard coralline and marine sand substrates was observed within this zone with the softer substrate dominating. Various species of boulder type corals, with diameters generally larger than 30 cm in diameter, were observed represented the dominant benthic invertebrate species within this zone. The coral framework at this location, due to its orientation and closeness to the surface, was categorized as a shore-parallel reef crest.

As it was with transect 1, it was apparent from visual estimates and percentage area coverage estimates that the dominant benthic life forms were turf and macro algae, while the dominant mobile life form was fish.

Zone B:

This zone extended from the seaward limit of Zone A for a distance of approximately 126 meters and to a depth of approximately 5 meters. Both coralline and marine sand substrates were found within this zone. This zone, however, differed from the characteristics of zone A in that hard substrate dominated. Boulder corals again were the dominant type of benthic invertebrate species observed within this zone, with marine algae being the dominant benthic life form. Fish and the Spiny Black sea urchin were the dominant mobile marine organisms observed within this zone.

Zone C:

This zone extended seaward of Zone B to the seaward limit of Transect 5 and beyond. Coarse-grained white marine sand, with traces of sediments of a terrestrial origin (possessing a dark brown-black colour) was the dominant substrate within this zone. No life forms of a benthic or mobile kind were observed within the transect area.

Table 3-2 lists the species observed in each zone within transect 5, both visually while in the field and identified from underwater photographs taken during the survey. The presence of hard substrate and corals, and the location of the zones in relation to the shoreline, lead to the area being categorized as a fringing reef.

Table 3-2: Species List, Transect 5

Marine plants
Halimeda sp.
Turf Algae
Y-branched Algae (*Dictyota* sp.)
Sargassum sp.
Benthic Invertebrates
Corals
Brain Coral (*Diploria* sp.)
Startlet Coral (*Siderastrea* sp.)
Mustard Hill Coral (*Porites asteroids*)
Elkhorn Coral (*Acropora palmata*)
Octocorals
Fire Coral (*Millepora* sp.)
Soft Coral (*Pseudoplexaura* sp.)

Mobile Invertebrates
Rock Boring Urchin (*Echinometra lucunter*)
Long Spined Urchin (Diadema *Echinometra vividis*)
Fish
Grunt (*Haemulon sp*)
Damsel Fish varieties – Dusky, Yellow tail, Bi-colour (*Stegastes* sp.)
Doctor Fish (*Acanthurus chirurgus*)
Blue Tang (*Acanthurus coeruleus)*
Sergeant major (*Abudefduf saxatilis*)
Striped Parrot Fish (*Scarus croicensis*)
Indigo hamlet (*Hypoplectrus indigo*)
Spotted Drum (*Equetus punctatus*)
Fairy Basslet (*Gramma loreto*)
Blue Chromis (chromis cyanea)
Other Vertebrates
Hawksbill Turtle (Eretmochelys imbricata)

3.3.1.3.2.3 Observations on Transects 2 and 6

Observation made revealed that substrate and life form characteristics were common to both locations. Hard coralline substrates dominated. The skeletal remains of coral-like structures were observed embedded in both submerged and emergent sections of the surveyed area, leading to the assumption that shoreline was once a submerged reef.

Macro algae dominated where benthic life forms were concerned, however, one species of coral was observed to be recruiting onto the surface of the shoreline substrate. Chitons and at least two other types of marine gastropods[8] were observed adhered to the shoreline substrate.

Table 3-3 lists the species observed within both transects 2 and 6, both visually while in the field and identified from underwater photographs taken during the survey.

Table 3-3: Species List Transect 2 and 6

Marine Plants

[8] A gastropod is a group of mollusks that travel on a single muscular foot and often secrete a shell for protection. Snails, slugs and limpets are all gastropods.

Padina sp.
Chaetomorpha sp.
Benthic Invertebrates
Smooth Startlet Coral (*Siderastrea sp.*)
Mobile Invertebrates
Boring Urchin (*Echinometra sp*)
Fuzzy Chiton *(Acanthropleura sp*

3.3.1.3.3 Percentage/Spatial Cover Reef Resources:

Within the study area, estimates of seafloor surface area covered by algal and coral indicators of reef health, as determined from area analysis made of underwater photos taken, and visual estimates made in the field, indicate coverage of approximately 20% for Coral and 80% for algae at transects 1 and 5.

The evaluation of transects 1, 2, 5,and 6 also lead to the determination of the spatial distribution of marine resources within the study area, which have been illustrated on Figure 3-11 and Figure 3-12. An overall representation of the spatial distribution of marine resources over the entire study area was then extrapolated, using the information presented on Figure 3-11 and Figure 3-12 outlined on Figure 3-13.

Figure 3-11: Spatial Distribution Marine Resources and Substrate Character in the vicinity of Transects 1 and 2

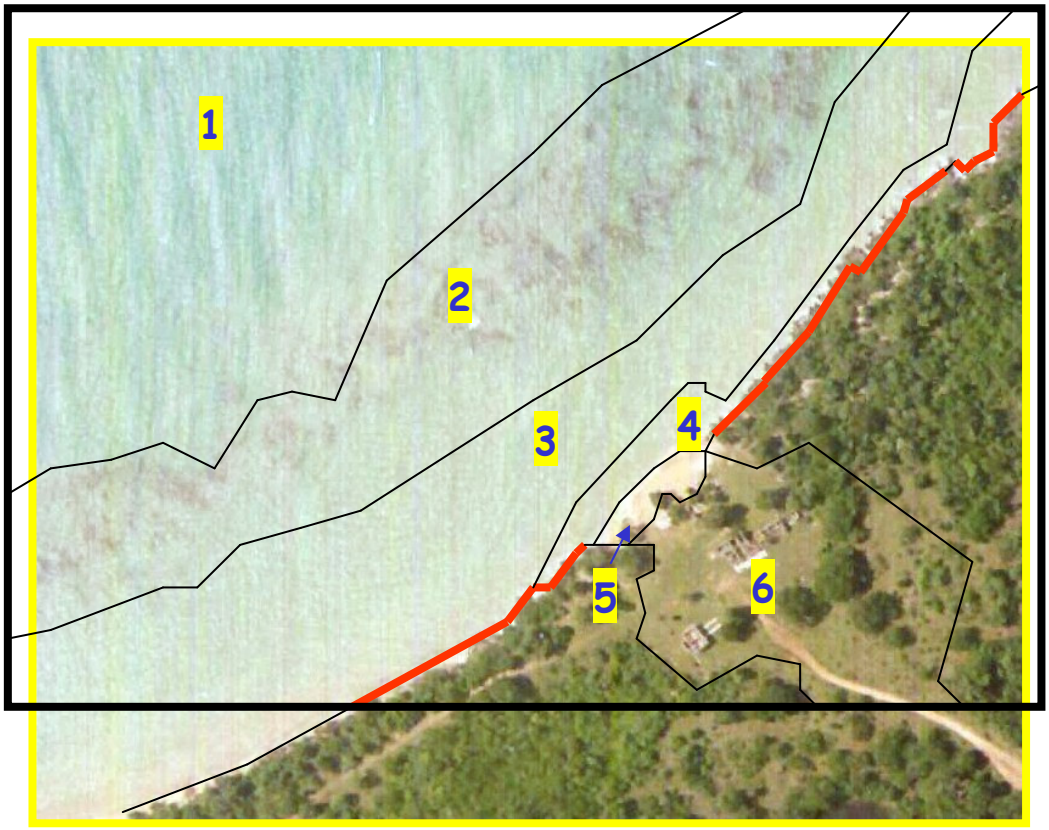


Figure 3-12: Spatial Distribution Marine Resources and Substrate Character in the vicinity of Transects 5 and 6

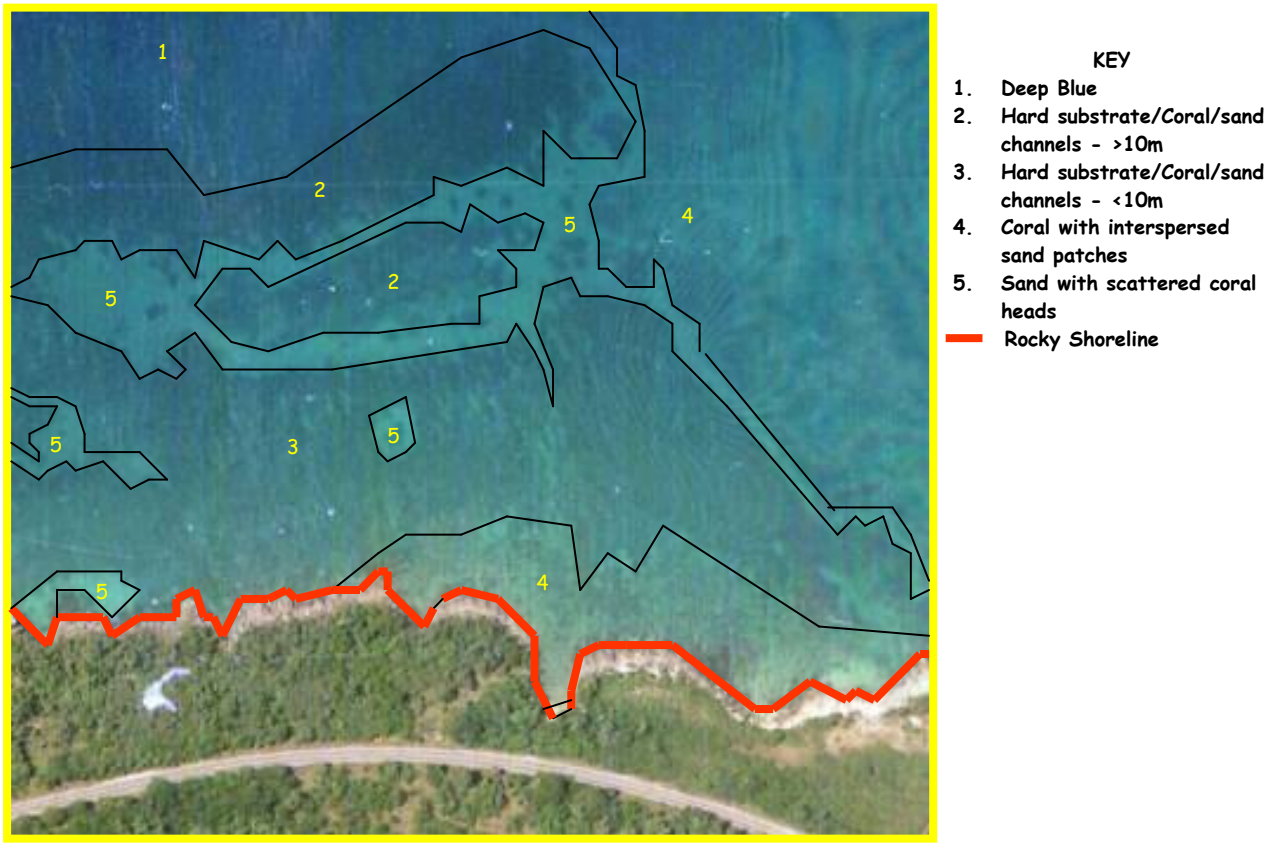
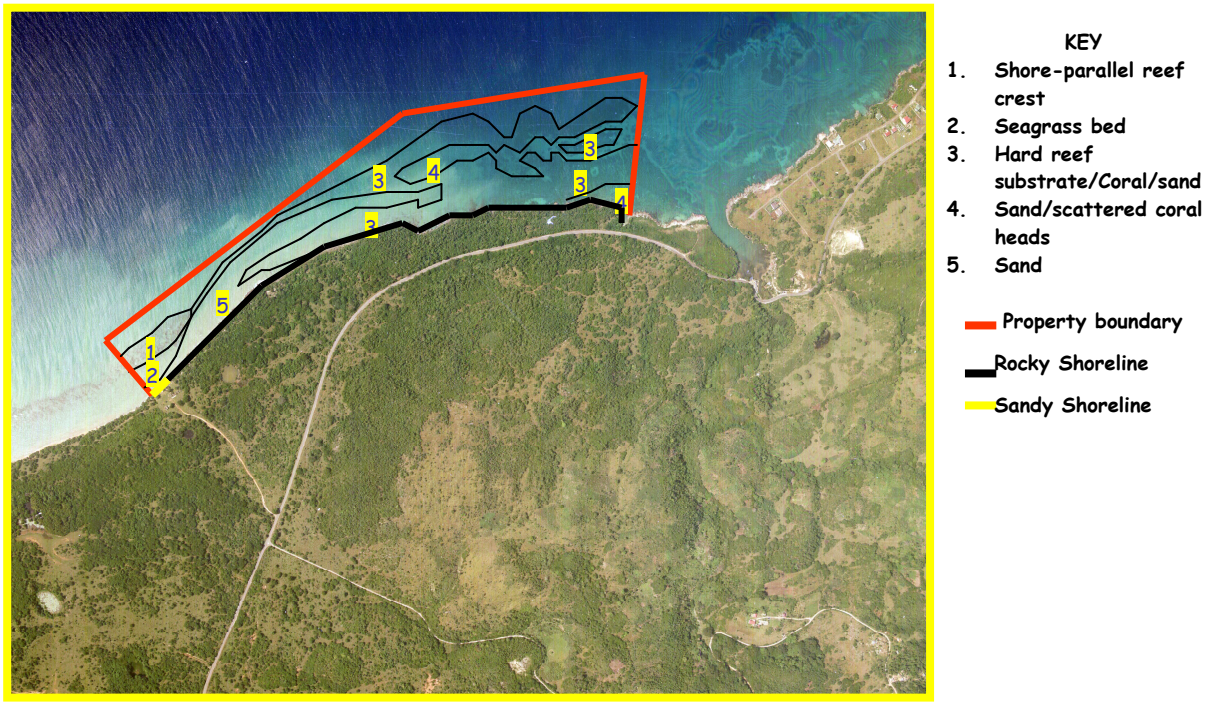


Figure 3-13: Spatial Distribution Marine Resources and Substrate Character extrapolated over the Study Area



3.3.1.3.4 Oceanography - Aerial photo and Drogue Tracking Observations:

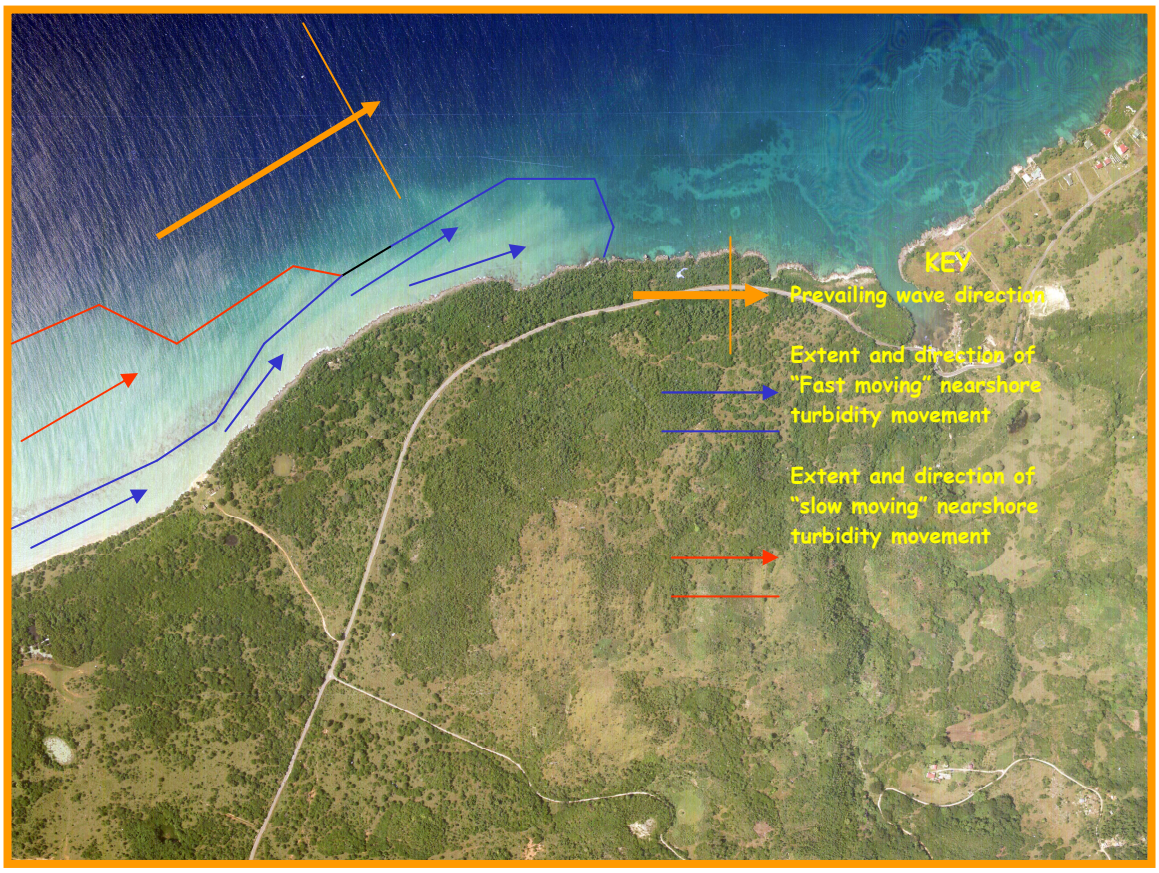
The 1991 aerial photos of the study area were useful in the determination of the manner in which sea currents moved in the vicinity of the study site. The 1991 photos showed water turbidity, possibly originating from either the disturbance of seafloor sediments in Malcolm Bay or discharges from the Black River. Both sources lie to the east of the study area.

The prevailing wave movement, as illustrated on the 1991 photos, was towards the north-northwest. These waves would have been propelled by prevailing winds blowing from the south-southeast.

This turbidity would be moved by the currents and would thus show water movement. It was clear from the aerial photographs that there were areas of turbid water that were moving faster than others. Figure 3-14 shows two bands of turbid water, with the band closer to shore advancing ahead of the more offshore band. This would suggest that

current movements were faster nearer to shore.

Figure 3-14: Current Movement as interpreted from turbidity movement - image source, Survey Department

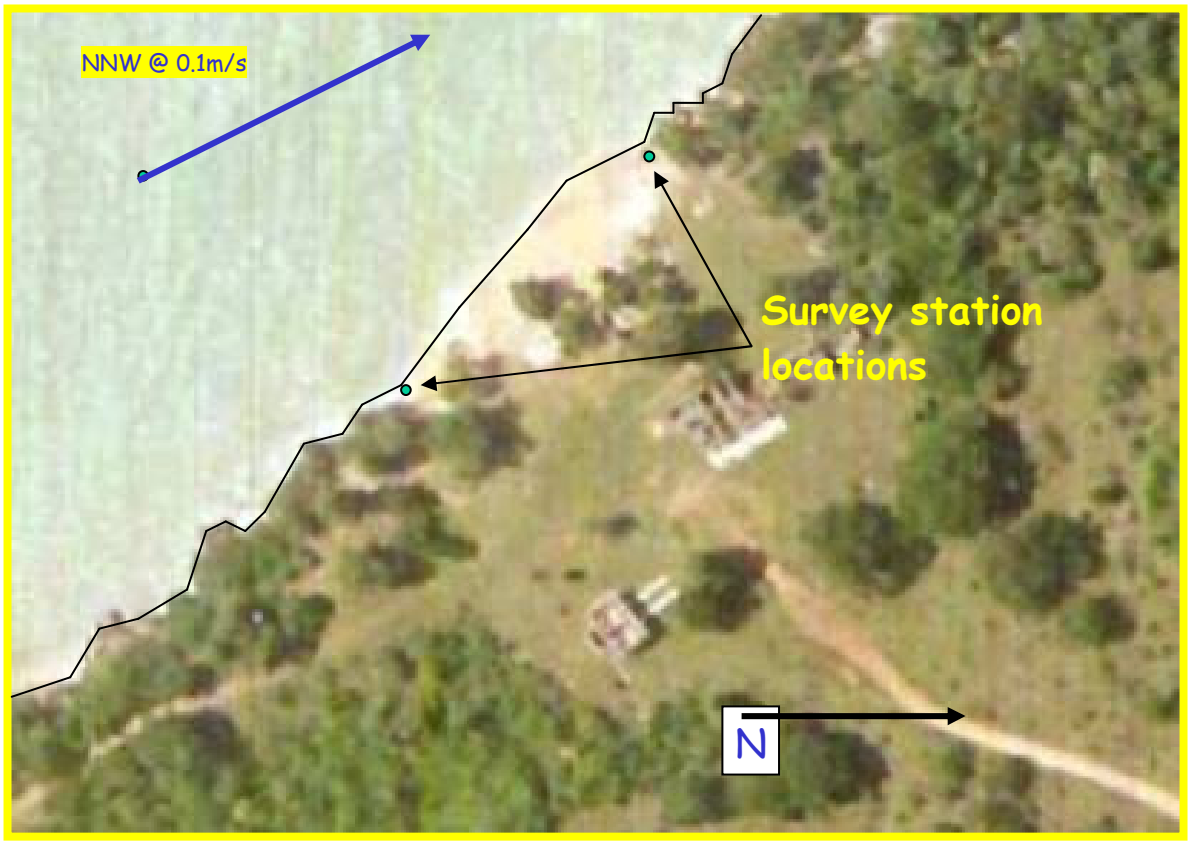


Drogue measurements for surface currents conducted at the study site revealed movement in a direction consistent with that of the wind. Wind direction at the time of the study, however, was from the south-southeast. Surface currents were tracked moving in a west northwesterly direction at speeds of 0.1 m/s (*See* Figure 3-15 *and* Figure 3-16). A drogue deployed at the entrance of what is called Joseph's Cove, at the western section of the study area, revealed currents moving into the cove. This was an expected observation, since a process of wave refraction was occurring at this location, leading waves and, as a consequence, currents into the cove[9]. This process of refraction was also evident at the location of transect 1. At zone D, wave like structures were observed on the seafloor

[9] Refraction is process by which a wave approaching the shore changes direction due to slowing of those parts of the wave that enter shallow water first, causing a sharp decrease in the angle at which the wave

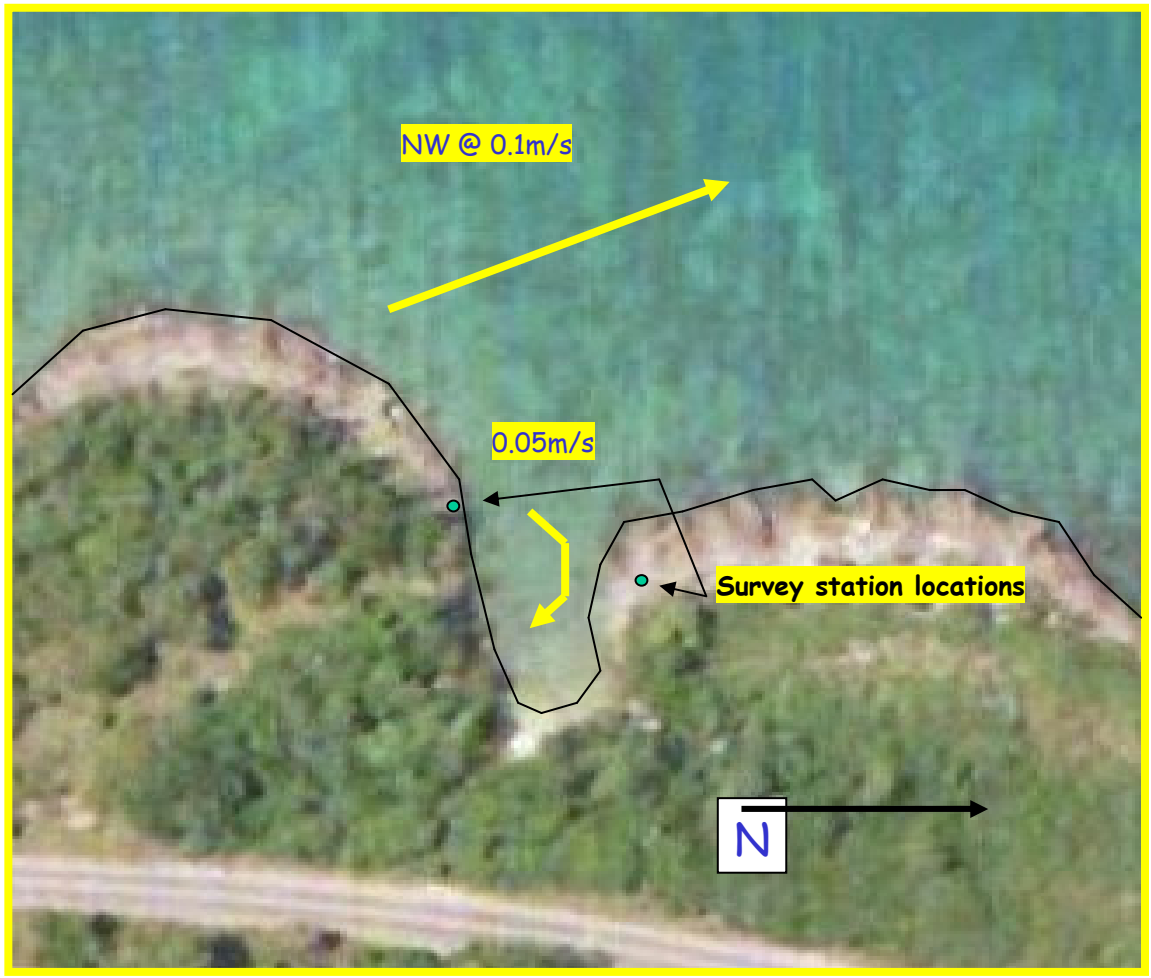
sediment surface. These "sediment waves" were aligned in a direction running towards shore, suggesting a shoreward movement of both waves and currents. Once contact is made with the shore, currents would then move in the general direction of wind movement as a long shore current.

Figure 3-15: Current Speed and Direction as measured by Drogues - Image Source Survey Department



approaches until the wave is almost parallel to the coast.

Figure 3-16: Current Speed and Direction as measured by Drogues - Image Source Survey Department



3.3.1.4 CONCLUSIONS:

3.3.1.4.1 Reef Resources Status:

The species lists for the transects deployed illustrate a typical assemblage of coral reef, fish and sea grass resources adjoining the shoreline of the study area. The sizes of fish resources observed are indicative of an area supporting juvenile resources and as a result, can be categorized as a marine nursery area.

Standards for reef quality were interpreted from studies conducted by Hughes in both the 1970's and 1990's. Hughes had looked at ratios of the dominant seafloor-covering organisms on reefs as an indicator of reef health. In the early 1970's, Jamaica's north coast reefs had an average live coral cover of 52%. Algae cover at the time was approximately 4%. Reef health was good at this time and this coral to algae relationship

was accepted as a high standard for coral reef health. Similar studies conducted at the north coast in the 1990's revealed a significant change in the relationship, with live coral cover dropping to 5% while algae cover increased to 95%[10]. Factors such as land-based eutrophication of marine waters (contamination with nutrients), over fishing and tropical storm events have contributed to this drastic change[11].

The percentage cover results observed for the study area (20% coral, 80% algae) are indicative of a reef undergoing coral stress. The main sources of stress at this location appear to be turbidity, as indicated by the poor prevailing visibility and eutrophication, as indicated by the percentage cover of algae estimated.

Examples of coral diseases, such as Black Band and Dark Spots diseases were observed on some of the boulder corals surveyed within the study area, particularly so at the vicinity of Transect 5.

It is useful to note that the sources of stress outlined above have their origins from land-based influences, particularly freshwater inflows. A seasonal drainage system enters the marine environment at Joseph's Cove (see Figure 3-17**).** It is also known that other shorelines with similar character to that observed at the study site have often demonstrated freshwater movement from land to sea by way of underwater springs. The porous nature of the limestone rock at the shoreline could easily facilitate this movement.

[10] Hughes T.P,1994. Catastrophes, phase-shifts and large-scale degradation of a Caribbean coral reef. Science 265: 1547-1551

[11] Woodley J. D. 1998. Status of coral reefs in the South-central Caribbean. In Status of coral Reefs of the World:1998 C. Wilkson (Ed) Australian Institute of Marine Science.

Figure 3-17: Joseph's Cove showing the point of discharge of a seasonal drainage system into the Marine Environment at Transect 5

3.3.1.4.2 Oceanography:

Current movement was generally towards the North-north west. Surface water current movement was determined to be a factor of wind movement. The contour of the seafloor would have an influence on the final direction of movement, once close to shore.

3.3.1.4.3 Implications for Future Development at the Site

Any construction works, which will have components that will extend beyond the shoreline and onto the seafloor within the study area, will have to be planned and designed so as to ensure that there is minimal impact on marine resources determined to be at these locations.

In addition, considerations would have to be given to the extent to which these structures would impinge on the movement of currents along the shoreline. Currents are known to transport sediments, which may be vital to the stability of any marine sediment bearing areas down current of any structure that may be deployed in its path.

Finally, careful consideration will have to be given to the impacts that any land-based development could have on the marine environment. Past experience has determined that development areas adjoining the coastline exert their influence on the marine environment by way of direct or indirect discharges of storm water, solid waste and sewage. Development plans for the project site will have to carefully define the ways in which these three elements will be controlled so that no net increases in the transmission of these elements to the marine environment is caused by the implementation and operation of the development.

3.3.2 Terrestrial Habitats

The project area has five general habitats.

- Aquatic (freshwater ponds).
- Rocky shore (coastal fringes).
- Sandy habitat
- Secondary forest.
- Open grassland

In general, the aquatic and rocky shore habitats are influenced by their degree of exposure to water while the sandy, secondary forest and open grassland habitats are terrestrial, influenced by soil type, vegetation and rainfall.

3.3.2.1 Aquatic Habitats.

The aquatic habitat is formed from two separate pond systems, one each on the western and eastern sections of the project site. Two ponds joined by a shallow channel ("Twin Ponds") were located on the western side of the project area in close proximity to the existing beach park (Figure 1-9 and Figure 1-10). The Twin Ponds have a north-east/south-west orientation. The southwestern pond (approximately 40 meters from the existing beach park) is shallow (<1 meter). It is reported[12] that this pond retains water

[12] Reported by Assistant Farm Manager and also the conservation area Warden during site visits 2003.

year-round, possibly made impervious due to its rocky limestone foundation (Ecotech Inc. Ltd., 1999).

3.3.2.1.1 South-western Pond – Twin Pond (See APPENDIX VII - Plate 28)

This pond is a thriving habitat for avifauna in particular (Pond Coots – *Fulica*, Killdeers – *Charadrius vociferous* and Diving Dappers). No other aquatic life was defined for this habitat. The northeastern pond approximately 90 meters from the beach park) is also shallow but the water volumes fluctuate seasonally (low in summer). During the time of the site visits, this pond was filled with morass reeds and almost dry. Of the Twin Ponds, the northeastern pond will become the pond that is closer to the development. Both ponds were located within a relatively open area, with a low density of fringing Logwood stands.

3.3.2.1.2 North Eastern Pond – Twin Pond (See APPENDIX VII - Plate 29)

The eastern pond within 60 meters of the existing beach park was also a perennial pond. This pond was the habitat for a greater variety of species. Among the bird species, Diving Dappers, Killdeers and Pond Coots were seen. Numbers exceeded 5 of any one bird species at a time. Seven turtles (*Pseudamys terrapen*) were observed, one of which had a carapace length of approximately 0.5 m. This species of turtles is endemic. Crab holes were also seen around the ponds. This pond was hidden and surrounded by a thicket of trees, providing shaded and humid conditions for most of the day.

3.3.2.2 Rocky Shore (See APPENDIX VII - Plate 11)

The rocky shore could be categorized into two sections; a rocky foreshore devoid of plants and eroded by water and further inland a narrow band of rocks (approximately 10 meters) with sandy patches, where vegetation emerges and is subject to constant sea spray.

The rocky foreshore is a harsh environment composed of a consolidated limestone substrate weathered by waves and wind and therefore the surface was very uneven and sharp. The fauna at the fringes were molluscs principally chitons (Polyplacophora) and some snails. By utilizing a powerful suction created by a modified muscular foot, these species are able to withstand the strong flow of water on and off shore.

Crabs were also present on the rocky coastal foreshore.

Seven to ten meters from the foreshore the habitat changes. Though the substrate is composed of limestone rock, there is less direct influence from water movement (i.e. erosion and moisture). Further from the edge, sea spray aerosols becomes predominant and a dehydrating habitat exists from air saturated with saline aerosols, strong wind, direct sun exposure and heated rocks.

With this change in habitat there was a succession of vegetation beginning with small herbaceous plants containing sap and a waxy coating to reduce water loss. The dominant species in this regard was the sea Purslane (*Sesuvium portulacastrum*). Further inland, succession in vegetation type was expressed in a sudden transition to shrubs and trees forming an effective barrier to the free movement of saline aerosols further inland (see APPENDIX VII -Plate 13)**.**

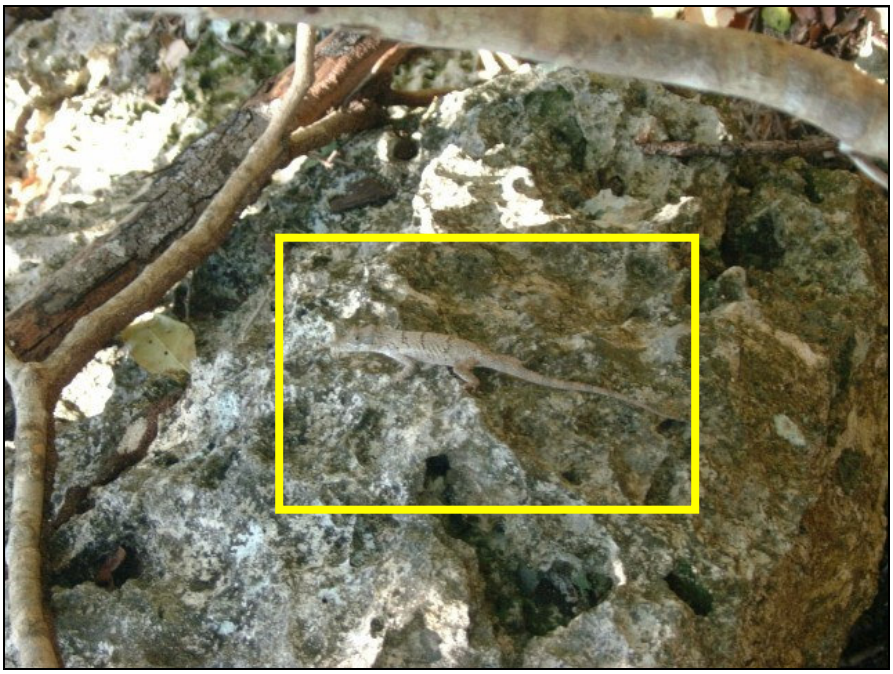
Protection against desiccation remained similar; waxy coating on leaves and leathery leaves with or without sap. Some species found in this narrow band of the rocky shore were seaside Mahoe (*Thespesia populnea*), Sea Grape (*Coccoloba uvifera*) and shrubs. The majority of the substrate was rocky but had variations including fractured rocks with sandy patches or sandy soil.

3.3.2.3 Sandy Habitat.

The terrestrial environment began with a transition from a consolidated limestone rocky surface to a sandy soil which became more fine and mingled with loamy soil. This was consistent along the south side of the project site. The habitat could be described as arid as demonstrated by the type of vegetation found there. Most plants exhibited xerophytic characteristics (leathery leaves, copious sap in the leaves, waxy coatings on leaves etc.). The dominant species was Thatch Palm (*Thrinax parviflora* – see APPENDIX VII **-** Plate 19)**,** and common were various cacti and Wild Rosemarie (*Croton linearis*).

Rock outcrops were present in this habitat and a species of Anole lizard was present on these rocks (the species presence was rare) (see Figure 3-18). No other animal was seen in this habitat.

Figure 3-18: Anole Lizard



3.3.2.4 Secondary Forest

This habitat was for the most part a dry limestone forest on the southern-side typified by the limestone rock/sandy substrate and xerophytic features of some vegetation forms. This soil type gradually changed to areas with thin layers of soil and a crumbly loam soil northward.

The existing forest that occupies the majority of the proposed development site is principally a secondary forest as most of the trees were introduced to the area. In this regard, Logwood (*Haematoxylum campechianum)* was the most abundant species.

Shading was estimated at about 80% for the majority of the habitat based on shade cast on the ground and openness of the canopy. In these conditions, two general growth patterns were noted for rooted plants; most vegetation were either relatively straight trees with branching higher up on the stem (e.g. Wild Cherry - *Malphigia glabra* and Red Birch – *Bursera simarouba*), or were shrubs, vines or grasses with fine leaves (e.g. Chinese Bamboo and Wild Rosemary). Saplings were not abundant. Epiphytes such as orchids, cacti and bromeliads were common.

3.3.2.5 Open Grassland

The open grassland, mainly scattered between stands of trees, and close to the roadways were characterized by grasses with fine leaves and had various shrubs interspersed. Included among them were Chinese Bamboo and Wild Rosemary.

3.4 VEGETATION SURVEY

A vegetation survey was conducted in keeping with developmental plans for the proposed site. The objective was to create a plant species inventory, determine their relative importance and to note the various ecological factors present at the study site. The area was surveyed using both qualitative and quantitative measures.

3.4.1 Qualitative Measures

The DAFOR scale was used to provide an initial idea of species composition at the site. On the DAFOR Scale, D- dominant, A-abundant, F- frequent, O-occasional and R-rare. The assessment was based primarily on reconnaissance visits to the study area, but species importance was based predominantly on field sampling.

3.4.2 Quantitative Measures

3.4.2.1 Transect method

The vegetation was assessed using a belt transect running from the sea to the main road, one was run on either side of the existing beach house, for the purpose of establishing a species profile from the sea to inland.

Quadrats (3m x 3m) were placed at specific intervals along the transect in order to ascertain values such as:

- Frequency
- Percentage cover
- Density
- Similarity indices

3.4.2.2 Random Quadrat sampling

In addition to running transects, random quadrats of a similar size were placed throughout the study area, with like variables considered and determined.

3.4.2.3 Modifications to methodology

In conducting actual sampling, it was noted that, quadrat sampling was revealing repetitive data, hence the distance between plots was extended to capture more data. It should be noted that although an equal number of quadrats were laid for each transect there were not all equidistant nor were sample distances coordinated.

Transect 1 – Quadrats were laid out in the following order: 7, 21, 49, 63, 77, 112, 147, 287, 357 m

Transect 2 – Every 30m between 0-300m and every 60m between 300-425m

3.5 Results

3.5.1 Description of Vegetation

Font Hill vegetation is a coastal type, which indicates that vegetation in this area is subject to water stress due to salinity of the surrounding areas, as well as increased levels of transpiration due to high winds. Accordingly, the plants that have colonized the study area demonstrated classic adaptations to survive this harsh environment.

In general the following adaptations were noted:

- Small, thick and/or shiny leaves to reduce transpiration loss.
- Succulent parts for increase water storage.
- Presence of salt glands for excreting excess salts e.g. mangroves.
- Presence of spines, prickles and hairs to reduce herbivory [13].
- Modified root systems to avoid oxygen deprivation e.g. pnuematophores[14] of

[13] Herbivory-consumption of plant/plant parts by animals
[14] Pnuematophores- roots with straight, erect, blunt branches

Black Mangrove.

Stratification in this community was not very complex and primarily consisted of a tree layer, with few emergent trees some hosting epiphytic plants. Generally, plants were thin-boled with more open and thin-depth canopies. Ground cover was for the most part absent, except in disturbed areas, which were mainly colonized by invasive grass or herb species. Leaf litter was evident throughout the site but decomposition rates were slow, assumedly due to the low moisture levels. Nutrient recyclers were noted in many termite mounds and a few bracket fungi.

3.5.2 Vegetation Parameters

3.5.2.1 Species composition

A total of fifty-seven (57) species were recorded of which fifteen (15) species were unidentified. All but two (2) species were relatively common and widespread in their natural distribution. Of the two uncommon species one was confirmed to be endemic[15] while the other, identified to the genus level, maybe an endemic species.

Please refer to the species inventory (APPENDIX VI)

Logwood (*Heamotoxylum campechianum*) was the most frequent plant species recorded, appearing in 20 of the 28 quadrats accounting for 71.1%, suggesting that the plant is widely distributed through the study area. The second most frequent species was *Lasiacis lithosperma* having a frequency of about 46%. The remaining species had low frequency values ranging from 0.03% - 0.13%.

Similar trends were noted for other parameters such as density with Logwood (*Heamotoxylum campechianum*) having the highest density of 0.43 plants per m^2. For other species such as *Lasiacis lithosperma,* density was not able to be determined as the number of rooted individuals was not readily identifiable .

Percentage cover was also high for Logwood (*Heamotoxylum campechianum*) with values averaging around 30-40% per quadrat. Other larger tree species such as, Prickly Yellow (

[15] Endemic- found only in one area or location

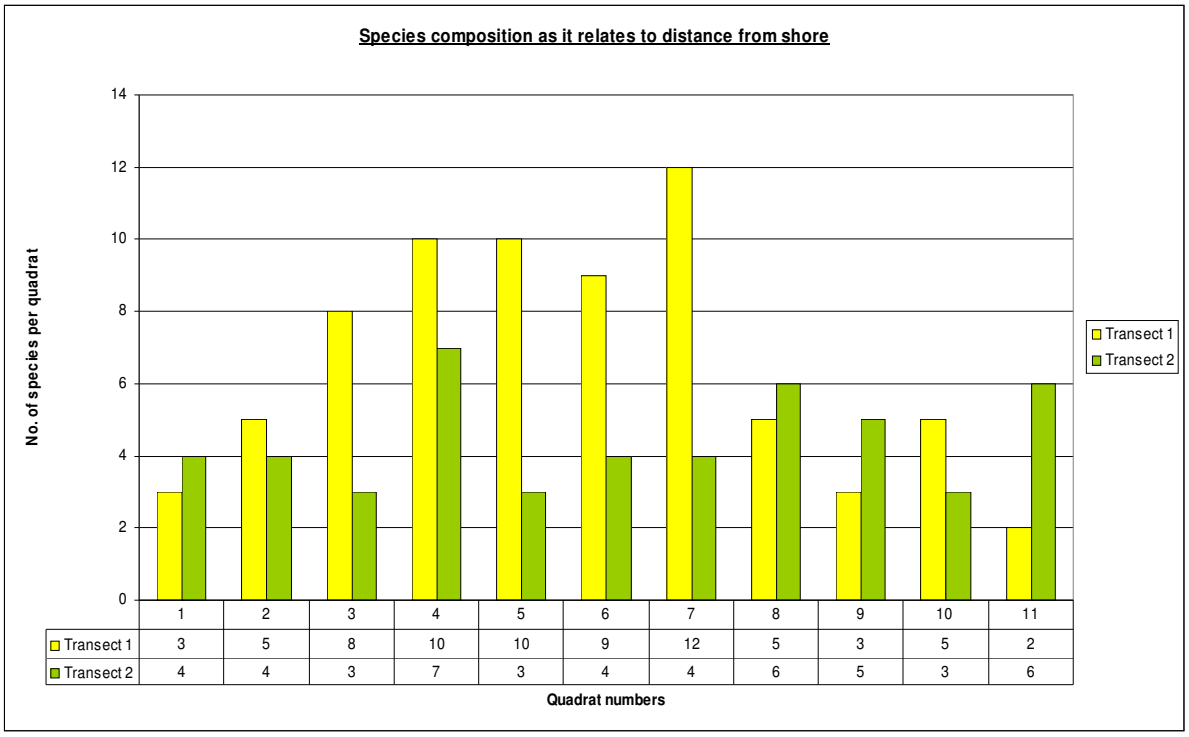
Fagara martinensis), Red Birch (*Bursera simaruba*) and Wild Cherry (*Malpighia glabra*)also accounted for high percentage cover, as high as 100%. As previously mentioned ground cover was not always noted but in quadrats where it was recorded, *Lasiacis lithosperma* , and *Teramnus labialis* were the primary species.

3.5.2.2 Species profile

Transect 1 overall displayed a greater number of species per quadrat than Transect 2 but both communities showing similar trends in species number as it related to distance from the sea. The midpoint of both transects showed greater number of species suggesting that human influence as well as environmental factors were influencing species composition. See Figure 3-19 below.

Ends of the transect would have experienced the greatest impact from human influence through beach activities and roadways. The middle areas would have had the least influence and hence demonstrated higher species composition.

Figure 3-19: Species composition as influenced by distance from the sea



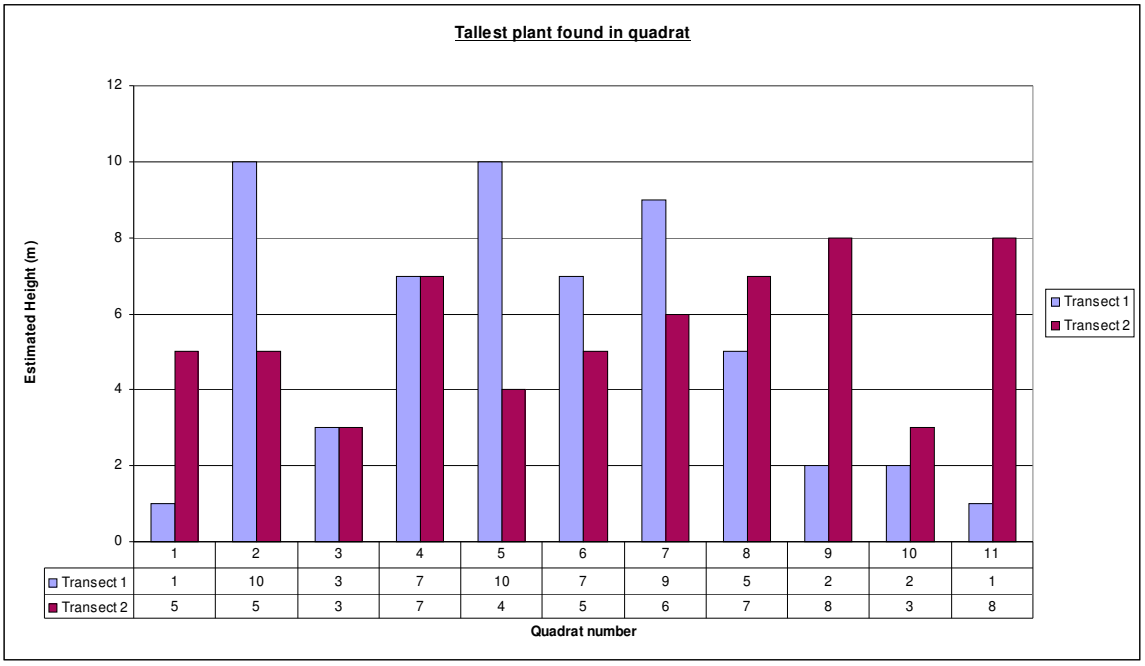
Special note:

- Transect 1 – Quadrats were laid out in the following order; 7, 21, 49, 63, 77, 112, 147, 287, 357 m - NW of beach

- Transect 2 – Every 30m between 0-300m and every 60m between 300-425m - NE of beach

Similar trends were noted in plant height distribution. However, the tall species noted at the end of Transect 2 may be accounted for by invasive species having been allowed access through roadways and other human influences**.** See Figure 3-20

Figure 3-20: Tallest Plant found in Quadrat



	1	2	3	4	5	6	7	8	9	10	11
Transect 1	1	10	3	7	10	7	9	5	2	2	1
Transect 2	5	5	3	7	4	5	6	7	8	3	8

Special note :

- Transect 1 – Quadrats were laid out in the following order; 7, 21, 49, 63, 77, 112, 147, 287, 357 m - NW of beach

- Transect 2 – Every 30m between 0-300m and every 60m between 300-425m - NE of beach

3.5.2.2.1 Similarity indices

Similarity indices indicated that the transects had few species in common, the calculated index was 0.18. This clearly suggested that only a few species were widely distributed throughout the study area and there was some irregular distribution of most species.

SOCIAL ENVIRONMENT

4 SOCIAL ENVIRONMENT

4.1 Introduction

This component of the study provides a concise socio-economic analysis of the human settlements, which fall within the sphere of influence of the proposed project area. This analysis represents a socio-economic profile of the potential impact communities, respondents' social attitudes and perceptions towards the proposed project and the major concerns expressed by its attentive public are herein addressed.

The requirements of the Terms of Reference for the proposed development were considered by this survey. In order to conduct these exercises, four basic sources of data collection were pursued:

1. Review of the literature and secondary data sources viz. Population Census 2001, Jamaica (STATIN, 2003), other official statistics, and survey data, historical and archival material from the PCJ's library.

2. Field observations and a windscreen survey were carried out at the research site to give the research process a clear feel for what the proposed development entails.

3. A social survey, based on written, structured questionnaires was used to collect primary data. The survey employed both interviewing and sampling to produce quantitative data sets, amenable to socio-economic analysis.

4. In-depth interviewing of community leaders was also done to glean a deeper understanding of the local economy and society.

Once the survey instrument was designed, reviewed and approved, a pilot study was carried out on a one per cent (1%) sample of the total number of households in the research area and its periphery to test and measure the instrument's reliability. The questionnaire was then revised on the basis of the findings of the pilot study, and the sample defined and selected from Enumeration District (EDs) used in the 2001 population census, Parishes of St. Elizabeth (SW EDs 12, 17, 18 and 19) and

Westmoreland (East EDs 86, 96, 97, and 98).

In addition, field work, planning, supervision, training and debriefing of interviewers, coding of completed questionnaires, consistency checks and editing of the resulting data set were executed. The survey used a sample size that would be representative, valid and reliable. The full survey instrument was administered to 10 percent of the households in the study area i.e. 120 household heads (53 males, 67 females). Interviewing was conducted during May 2003 in the 8 EDs that comprised the research site.

4.2 Demographic Profile

The total impact population of the study area was 4,370 (2,231 males; 2,139 females). (Please see Table 4-1). The table shows the distribution of the population by area, age and sex structure. It also shows the relationship between the working age group (15 – 64) and the youth (0-14) and old age (65 years and over) dependents. There were 1476 youth and 305 old age dependents along with 2, 489 persons in the working age group. This gave rise to a dependency ratio of 76.00 which was higher than the estimated values given in the last census. The age-dependency ratio is a useful indicator of the economic burden that the productive segment of the population must carry and in 2001 the census estimated the dependency ratio for St. Elizabeth to be 70.89; Westmoreland 72.61 (i.e. for every 100 persons of working age there were approximately 76.00 dependents in the study area). In real terms the dependency burden was most likely to be greater given that some persons in the 'productive' ages were economically dependent. One shopkeeper at the research site stated the problem in the following terms:

The area has low levels of employment; some people do day's work in Whitehouse, work in shops, domestics…it is a bad situation. The project therefore, should generate employment…any type of work for the poor.

In the 120 households 173 persons were in paid employment and approximately 215 were unemployed. Among household heads 58 percent indicated that they were in paid employment, 22 percent were not, and 20 percent were outside the labour force.

Table 4-1:Impact Population of the proposed Sub Division of Lots and Resort Development at Font Hill, St. Elizabeth by Area Age/Sex Structure and Labour Force[16]

	MALES				FEMALES			
Age groups / **St. Elizabeth** / **SW EDs**	**0-14**	**15-64**	**65 years and over**	**Total**	**0-14**	**15-64**	**65 years and over**	**Total**
012	100	163	35	298	79	175	31	285
017	63	110	19	192	71	99	18	188
018	122	211	30	363	102	193	31	326
019	99	185	6	190	114	187	16	317
Sub-total	384	669	90	1143	366	654	96	1116
Westmoreland								
EAST EDs	..							
086	116	173	11	300	85	138	26	249
096	120	196	41	357	120	191	41	352
097	81	123	20	224	85	121	19	225
098	53	123	31	207	66	101	30	197
Sub-total	370	615	103	1088	356	551	116	1023
Total	754	1284	193	2231	722	1205	1205	2139

Total Impact Population = 4,370 (2231 males; 2139 females)

A ranking of occupations in the study area is given below:

- Self-employed
- Farming (arable and pastoral)
- Fishing
- Clerical
- Teaching
- Elementary occupations
- Electrician

[16] Source: STATIN (2003) Population Census 2001 Jamaica: Volume 1, Country Report (Kingston

- Mason
- Beach warden

4.2.1 Social Context of the Survey Population

The sampled population comprises rural and semi-urban household heads that have been living in the sphere of influence of Font Hill for an average of 40 years (i.e. 48 years in Westmoreland East; 31.5 in St. Elizabeth South West). The 120 household heads (44 percent male, 56 percent female) were largely in the economically active population. The average size of the households was 4.8 (cf 3.31 for Westmoreland, 3.51 for St. Elizabeth and 3.48 for Jamaica, STATIN, 2003: xcix).

4.3 Community Profiles

Most respondents cited the peace and quiet, low crime rate, fruitfulness and ease of transportation (taxi service and good roads) as the things that they most liked about their communities.

The high level of unemployment (especially among youths aged 15 – 29), bad road conditions (poor drainage), the need for development and improvement in the supply of utilities were cited, as things that were least liked about the study area. In the words of one community leader:

This side of the island lacks development. The proposed sub-division will cancel out the negative effects of this. In fact, development is also needed to enhance real estate value…

A respondent in Crawford (which is outside of the project area) pointed out that she lived in a flood prone area where culverts were needed and that the road needed proper drainage.

4.4 Housing

A number of respondents spoke positively about the potential for increasing the housing

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Statistical Institute of Jamaica)

stock, which the proposed development was likely to entail. It is anticipated that workers will migrate to the area and in some cases establish permanent residence in the area. They spoke about affordability, lot ownership and housing development. The data below indicate the housing conditions as observed in the field.

The main type of housing unit in the study area was the '*separate house, detached'* variety (86%), but others were 'semi-detached' (5%), part *of a commercial building'* (5%) and '*part of a house'* (4%). The materials most widely used were block and steel and wood. Approximately 66.3 percent of dwelling units were constructed by block and steel and 57 percent of wood.

The adequacy of water and sanitary services are useful indicators of the quality of the housing stock. Just over half (59%) of the households had access to a water closet of which 33.7 percent were linked to a sewer system. Approximately 51 percent of households relied on pit latrines.

The proportion of households with access to indoor, piped drinking water was 47%; 25% relied on outside private taps; 32% relied on public standpipes; 19 % relying on 'river/pond/well and rainwater.

Electricity provides lighting for 93% and 88.2 % owned the house in which they lived.

Elsewhere in the report, references are made to concerns about squatter settlement. It is important to note that respondents felt that during the construction phase workers were most likely to obtain temporary shelter on the site. Or once they have employment people would find a place to live that was regulated by law, otherwise workers would commute. It was not anticipated that the proposed development would place unnecessary stresses and strains on the existing housing stock. There are no plans for encampments to be located on the project site for workers. It is anticipated that workers from outside the community will be transported to and from the site on a daily basis.

4.5 Social Attitudes and Perceptions

Despite the low level of awareness of the project (33 %), seventy per cent (70 percent) of the respondents were favorably disposed towards the sub-division of lots and resort development at Font Hill. The community generally felt that the proposed development was a '*brilliant idea as the area needs development, amenities. It was to be a social asset for the community.*

Just one person was negative and he gave as his reason, forced eviction from the property without adequate compensation.

The vast majority of the respondents (97 percent) had no idea when the proposed development would take place.

Most respondents (94.2 percent) looked forward to the proposed development as they felt that it would yield positive benefits for their communities. In the socio-cultural perceptions of those respondents, economic benefits would flow from the project (job opportunities, improvements to the housing stock, the possibility of home/lot ownership, improved social amenities and community development, increased purchasing power ability, better business for retail outlets, and foreign exchange earnings from an increased influx of returning residents to the area). The development was seen as:

A good idea…the subdivision into lots and resorts were good developments. Employment would be provided during construction and in the long-term.

Seven percent (7%) of the respondents were negative because they felt that *resorts bred crime* – a threat to the peace and tranquility of their rural existence. But on the positive side some respondents felt that to develop the land was one way of reducing the potential for criminality – by denying them of a hiding place.

Other respondents wanted to see the proposed development take place in order to reduce encroachment, squatment. In St. Elizabeth SW 19 there were about 100 housing units to the east of the Font Hill Estate that were built on captured land. This squatter settlement was seen to be problematic to some residents.

Thirty nine percent (39%) of the respondents used the site for:

- Recreation (relaxation, beach, sport)
- Fishing
- Vending
- Farming (arable and pastoral)
- The collection of fish pot sticks: red wood (shrub) mostly found there

The majority of respondents (55 percent) were not aware of any natural resources at the proposed site, but the others in the sample identified the following:

- Logwood trees
- Wildlife reserve– crocodiles (in the mangrove), crabs, turtles (on the coastline), birds (baldplate, ducks, white wing, pea dove),
- Fish - lake fish, blackfish
- Sand mining
- The beach and
- Agricultural produce

4.6 Positive Expectations

In socio-economic terms the respondents had high expectations of the potential of the proposed project. Sixty-eight percent (68%) of the residents had high expectations of the socio-economic benefits, which they felt would flow from the development (employment, economic development, increased commercial activities, more money in circulation). One community leader in Long Acres pointed out that he was

Aware of the proposed development, was strongly in favour because of the income to be

generated by employment, the housing potential and the boost that it would give to his fish sales.

Forty per cent (40%) expected jobs (for locals) to be generated from the development. With high levels of unemployment in the locality (this was seen to be of top priority in the 15-29 age cohort), the multiplier effects of increased money/income in circulation would go a long way to alleviate the burden of joblessness. Forty percent (40%) expected positive impacts on their livelihood especially in their personal business activities (fishing, vending and other retail outlets).

The majority of respondents did not expect any negative impacts on the environment. In the view of community leaders the environmental impacts would work in favour of a balanced ecology. The planning was most likely to be environmentally friendly and in the direction of sustainable development. The developers should plan to reduce the impacts on vegetation by saving those trees that could be saved.

It was felt by 38 % of the respondents that in the short term the environmental impacts would be negligible. They were enthusiastic about the long-term however, as the project was seen to be preserving something for future generations, giving the good planning ability of the PCJ.

Forty-six percent (46%) indicated that the owners of the property were 'environmentally friendly' and had always demonstrated that they knew how to take care of Font Hill. In the words of several respondents:

- *The area is well looked after, well maintained*
- *The PCJ always take care of the area*
- *The PCJ always kept the place well maintained*

Other expectations were:

- Affordability

- Jobs – for all categories of workers and the spin-off effects on taxis/ground transportation, recreation, fish/bammy people

- Resort – sponsor sport events/meets and facilities.

The need for improvement to the physical infrastructure was also stated and this was against the background that 72% of the respondents observed that the bad road conditions, the need for development (of a commercial centre, sporting facilities and a fire station at White House) and improved utilities (electricity, land telephones, piped running water) were among the things that they least liked about their communities.

Those social perceptions and attitudes indicated that the respondents recognized that although there was a cost to development, positive socio-economic benefits were expected. Social impact assessments usually indicated that public concerns were related to:

- Quality of life indicators

- Jobs

- Improved physical and social infrastructure

- Greater purchasing power and

- The development of the local economy and society.

By far the greatest expectation of the respondents in the vicinity of Font Hill was job creation and the resultant contraction in unemployment. The spin-off benefits would lead to more money in circulation, greater purchasing power ability and increased sales local business (including fishing) outlets. The multiplier effects of those were expected to be great.

POLICY, LEGISLATION, AND REGULATORY FRAMEWORK

5 POLICY, LEGISLATION AND REGULATORY FRAMEWORK

5.1 Agenda 21

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED). One of the main outputs of the conference was a plan of global action, titled Agenda 21 which is a "comprehensive blueprint for the global actions to affect the transition to sustainable development" (Maurice Strong). Jamaica is a signatory. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those relevant to this project, which Jamaica is obligated to follow are outlined below:

Principle 1 – Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 3 – The right to development must be fulfilled to equitably meet developmental and environmental needs of present and future generations.

Principle 10 – Environmental issues are best handled with the participation of all concerned citizens, at the relevant level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in the decision making process.

Principle 11 – States shall enact effective environmental legislation, environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply.

Principle 15 – In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

5.2 The NRCA Act

The NRCA Act is the overriding legislation governing environmental management in Jamaica. The Act binds the Crown and therefore supersedes the authority of other state agencies in environmental matters. The Act also subsumed a number of previous, older environmental laws including the Watersheds Protection Act and the Wildlife Protection Act. The NRCA Act requires that all new (or expansion of existing) facilities which involve ten (10) or more units be subject to an EIA. The regulations require that eight (8) copies of the EIA Report be submitted to the Authority for review. The Authority has ten (10) days of preliminary review during which it is determined if additional information is needed. After the preliminary review, the Authority has up to ninety (90) days for approval. If upon review of the EIA the required criteria are met, a permit is granted. In the event that the EIA is not approved, there is provision for an appeal to be made to the Minister.

Sections of the NRCA Act that are important to this project include:

9 (2) Subject to the provisions of this section and section 31, no person shall undertake in a prescribed area any enterprise, construction or development of a prescribed description or category except under and in accordance with a permit issued by the Authority.

10 (1) (b) Where it is of the opinion that the activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an environmental impact assessment containing such information as may be prescribed,
and the applicant or, as the case may be, the person responsible shall comply with the requirement.

17 (1) The Authority may by notice in writing require the owner or operator of any sewage treatment plant, industrial waste treatment facility or any facility for the disposal of solid waste or for the abatement of air pollution or any other facility for controlling pollution, to submit to the Authority at such intervals as the Authority may specify in the notice, information relating to all or any of the following-

(a) the performance of the facility;

(b) the quantity and condition of effluent discharged;

(c) the area affected by the discharge of effluents.

In the case of this project, the sewage effluent standards for plants in existence after 1997 applies. These are given below.

Table 5-1: Sewage Effluent Standards

PARAMETER	EFFLUENT LIMIT
BOD_5	20 mg/l
TSS	20 mg/l
Total Nitrogen	10 mg/l
Phosphates	4 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	200 MPN/100 ml
Residual Chlorine	1.5 mg/
Floatables	Not visible

5.3 Town & Country Planning Act

This Act governs the development and land use (excluding agriculture) in specific areas in Jamaica. The Town & Country Planning Authority is only authorized to issue planning permission for areas in Jamaica for which there are Development Orders (i.e. one mile around the coast and specific parishes and towns).

The Town Planning Department (now a part of NEPA), through the Parish Councils, allows for specific conditions to be stipulated and imposed on any development plans as a condition for approval. The planning decision is based upon several factors, including;

* The location of the development

* The land use and zoning

* The effect of the proposal on amenities, traffic, etc.

5.4 The Beach Control Act (1956)

The Beach Control Act provides for the regulation of activities within twenty-five (25) metres of the shoreline. It includes control of the construction of sheds and huts on beaches, and prohibits the use of public beaches for fishing activities. The Act is administered by NEPA, and also makes provisions for the creation of Marine Protected Areas. The sections of the Act relevant to the project are:

Section 7: (1) Notwithstanding anything to the contrary in this Act, the Minister may, upon the recommendation of the Authority, make an order declaring:

(a) any part of the foreshore and the floor of the sea defined in the Order together with the water lying on such part of the floor of the sea to be a protected area for the purpose of this Act; and

(b) such activities as may be specified in the Order to be prohibited activities in the area defined in the Order, being any or all of the following activities:

- fishing by any means specified in the Order;

- the use of boats other than boats propelled by wind or oars where such boats are used for purposes other than for the doing of anything which may be lawfully done under the Harbours Act, the Marine Board Act, the Wrecks and Salvage Law, the Pilotage Act or the Exclusive Economic Zone Act;

(c) the disposal of rubbish or any other waste material;

(d) water-skiing;

(e) the dredging or disturbance in any way of the floor of the sea.

Section 9: (1) Subject to the provision of Section 8 (this does not apply to docks wharves pier etc. constructed prior to June 1, 1956), no person shall erect, construct or maintain any dock, wharf, pier or jetty on the foreshore or the floor of the sea, or any structure, apparatus or equipment pertaining to any dock, wharf, pier or jetty and encroaching on the foreshore or the floor of the sea, except under the Authority of a license granted by the Minister on behalf of the Crown.

5.5 Water Resources Act (1995)

The Water Resources Act provides for the management, protection and sustainable use of Jamaica's surface and groundwater reserves. This Act supercedes all other legislation regarding water resources, and particularly groundwater, in Jamaica. This includes the Underground Water Control Act of 1959.

5.6 National Solid Waste Management Act (2001)

The National Solid Waste Management Act replaces the Anti-Litter Act, and prescribes:

WT 8: Garbage dumps and land fills should be sited so that there is no detrimental effect on surface water resources and pollution of other resources is prevented.

WT10: That commercial and other business places should provide receptacles on the premises for the storage and disposal of garbage

WT11: Solid waste management plans showing the separation, use and disposal of solid waste shall be submitted with development plans

5.7 Public Health Act (1974)

This Act falls under the ambit of the Ministry of Health (MOH). Provisions are made under this Act for the activities of the Environmental Control Division (ECD), a division

of the MOH. The ECD has no direct legislative jurisdiction, but works through the Public Health Act and in conjunction with NEPA to monitor and control pollution from point sources. The functions of the Department include the monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments, monitoring of air pollutants through its laboratory facilities and responding to public health nuisance complaints such as fugitive dust and smoke.

5.8 The Jamaica National Heritage Trust Act

Section 13 : Section 13 of this act applies to the project in respect of designation of protection of national heritage and states that any place name, thing, or any species of animal or plant-life or any place or object, which has not been declared a national monument.

Section 21 also addresses preservation schemes.

NATURAL HAZARD VULNERABILITY

6 NATURAL HAZARD VULNERABILITY

6.1 Earthquake Hazard Vulnerability[17]

Property 1imits: 18.02°N to 18.05°N; 77.9°W to 77.95°W

Recent Seismicity: Within approximately 20 km of the property i.e. 17.82°N to 18.25 °; 77.7 ° to 78.1 5 ° W, from July 1997 to December 2002, some 43 micro-earthquakes occurred with magnitudes from 2.0 to 4.1, and focal depths of 0 to 28 km. Magnitudes are calculated using the local coda magnitude scale. Some of these focal depths have uncertainties larger than 5 km, particularly those that are offshore. The Negril station came into operation in April 2002. See Figure 6-1.

Seismic hazard: A probabilistic seismic hazard assessment was done for the Font Hill area which considered the effects of 5 source zones (SZ) selected based on historic and instrumental seismicity in and around Jamaica from 1692 to 2002. These are (SZl) east Jamaica, (SZ2) west Jamaica, (SZ3) Offshore NE Jamaica, (SZ4) Offshore SW Jamaica and the (SZ5) Oriente Fracture Zone (offshore south-eastern Cuba).

In the absence of a local attenuation relation, the Joyner-Boore-Fumal attenuation relation was used to determine Peak Ground Acceleration and spectral accelerations at periods of 0.2 second and 1.0 second for both average rock sites and soil sites. This does not take into effect special soil conditions that might lead to liquefaction and other forms of ground failure, which is beyond the scope of this study. It also does not include direct effects of near-field fault ruptures the direct effects of fault throw or heaving. According to the Kingston Metropolitan Area Seismic Hazard Assessment (1999), commissioned under the Caribbean Disaster Mitigation Project, the Joyner- Boore attenuation relation matches observed fall off in earthquake intensities in Jamaica better than other available relations.

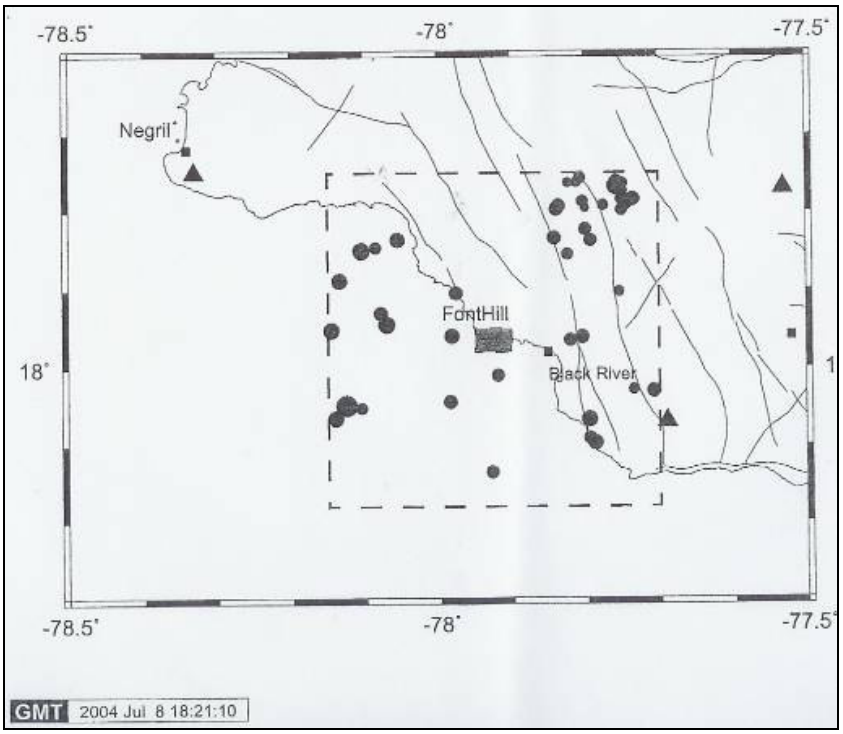
[17]Information provided by Dr. Margaret Wiggins-Grandison, Seismologist, of the Earthquake Unit, Faculty of Pure & Applied Sciences, U.W.I, Mona Campus

Twelve sets of results are provided as laid out in a table below. Peak Ground Acceleration (pGA) for a 10% Probability of Exceedance (PE) in a 50-year period is the conventional measure of seismic hazard. This defines a 475-year return period. The International Building Code which is being adopted by the local authorities requires Peak Spectral Acceleration (PSA) to be determined at periods of (1) 0.2 second and (2) 1 second for a 2% PE in 50 years, which represents a 2475-year return period. These are presented for two ground types - rock and soil. For each set the minimum and maximum value computed for Font Hill are given. The area is small and the range in each case does not exceed about 60 gals. In general the higher values are seen to the north and east of the property.

Table 6-1: Minimum and Maximum Horizontal Ground Accelerations in gals for various Measures of Intensity

Intensity Measure	475-YR **RP** on Rock		475-YR on Soil		2475-YR on Rock		2475-YR on Soil	
	Min (gals)	Max (gals)	Min (gals)	Max (gals)	Min (gals)	Max (gals)	Min (gals)	Max (gals)
Peak Ground Acceleration	164	182	212	236	257	278	332	359
Peak Spectral Acceleration at 0.2 Second	267	302	309	350	447	480	514	553
Peak Spectral Acceleration at 1.0 Second	350	397	427	481	574	616	680	735

Figure 6-1: Fonthill Microseismicity 1997-2002, Magnitude 2-2.41



6.2 Flood Hazard Vulnerability

There are no reports of flooding in this area. The area is considered to be a wetland, with several ponds being located within the wildlife reserve. Setback distances for housing units from the high water mark should be adhered to and future sea level rise due to global warming has to be taken into consideration.

The site as it exists consists of three ponds, lots 108 through 110, lots 79 & 62 and a section of lot 9, the former has been reserved for recreational purposes; however lot 9 is to be developed with the pond as a feature of the development.

6.3 Landslide Potential

There is very little potential for landslides to occur during the development of this project as the site is relatively flat with gentle slopes and average a 2% grade. In addition, the site has very little soil coverage and visible limestone outcrops throughout. Typically, landslide concerns originate in areas with slopes steeper than 15degrees with unconsolidated soils naturally prone to sloughing.

While there are no faults traversing the site, the area by virtue of its location is susceptible to seismic activity. The site may experience liquefaction occurrences owing to the height of the water table within the area. However, the seismic data, both natural and local, does not indicate the probability for this to occur.

6.4 Hurricane Risk

Jamaica is prone to hurricanes (severe tropical depressions) primarily during the defined hurricane season from July to November. It is not impossible, though relatively unlikely that hurricanes will occur outside of this "season." Fifteen major hurricanes have impacted Jamaica since 1722. This project is in an area that may be affected by hurricanes and the risk should be considered during the developmental stages. Hurricane wind speeds usually exceed 33 m/s and can reach up to 70 m/s (average wind speed for the coastal plain of southern Jamaica is ~3 m/s). The majority of the damage sustained during hurricanes is caused by wind, rainfall and debris. Rainfall associated with hurricanes is very variable, intense rainfall can increase other risk factors such as flooding and landslides.

Table 6-2: Tropical Cyclones Affecting Jamaica (1900-2003)[18]

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
1	1900	August 3	Hurricane		St. Mary, Portland, St. Thomas and St. Ann	115 miles	
2	1901	July 5-6	Tropical Storm		South Coast	173 miles	
3	1901	September 13-14	Tropical Storm		North Coast	115 miles	
4	1903	August 10-11	Hurricane		Manchester, Clarendon, St. Elizabeth and Westmoreland		
5	1904	June 12-13	Tropical Storm		Westmoreland and Hanover		
6	1904	October 13-14	Tropical Storm		Western Jamaica	86 miles	
7	1905	October 4-5	Hurricane		Eastern Jamaica	23 miles	
8	1906	October 14	Hurricane		South Coast	115 miles	
9	1906	November 6-7	Tropical Storm		Western Jamaica	58 miles	
10	1907	June 24-25	Tropical Storm		South Coast	138 miles	
11	1908	September 29	Tropical Storm		Portland, St. Thomas and St. Mary	173 miles	
12	1909	July 16-17	Tropical Storm		South Coast	29 miles	
13	1909	August 6	Tropical Storm		South Coast	86 miles	
14	1909	August 23-24	Hurricane		Portland, St. Thomas, St. Mary and St. Ann	46 miles	

[18] Provided by Jeffrey Spencer, Climate Branch Head, Meteorological Service

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
15	1909	September 15-16	Tropical Storm		Westmoreland and St. Elizabeth	115 miles	
16	1909	October 08	Hurricane		Westmoreland and St. Elizabeth	115 miles	
17	1909	November 11-12	Tropical Storm		St. Thomas and St. Andrew	144 miles	
18	1910	August 25-25	Tropical Storm		Manchester, St. Elizabeth and Clarendon		
19	1910	September 8-9	Hurricane		Portland, St. Mary, St. Ann and Trelawny	29 miles	
20	1911	October 24	Tropical Storm		Portland and St. Mary	58 miles	
21	1912	October 11	Tropical Storm		Hanover and Westmoreland	144 miles	
22	1912	November 18	Hurricane		Hanover and Westmoreland		
23	1915	August 12-13	Hurricane		St. Ann		
24	1915	September 01	Hurricane		Westmoreland	86 miles	
25	1915	September 25	Hurricane		St. Elizabeth and Clarendon	115 miles	
26	1916	August 15-16	Hurricane		Clarendon, St. Elizabeth, Manchester and Hanover		
27	1916	August 30-31	Hurricane		South Coast	69 miles	
28	1916	October 13	Hurricane		South Coast	144 miles	
29	1917	September 23	Hurricane		St. Mary	29 miles	
30	1918	August 3-4	Tropical Storm		South Coast	58 miles	
31	1923	October 18	Tropical Storm		Western Jamaica	144 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
32	1924	November 7-8	Tropical Storm		Clarendon and St. Ann		
33	1927	October 18	Tropical Storm		Hanover	86 miles	
34	1928	August 10-11	Hurricane		Portland, St. Mary and St. Thomas	115 miles	
35	1928	September 2-3	Tropical Storm		St. Catherine, Clarendon and Manchester		
36	1930	September 4-5	Tropical Storm		North east Coast	173 miles	
37	1931	August 13-14	Tropical Storm		South Coast	173 miles	
38	1931	September 8-9	Tropical Storm		South Coast	58 miles	
39	1931	September 12-13	Tropical Storm		St. Thomas, St. Catherine, Manchester Clarendon and St. Elizabeth		
40	1932	September 28-29	Tropical Storm		St. Thomas, St. Catherine, Manchester and Clarendon		
41	1932	November 8-9	Hurricane		Hanover and Westmoreland	150 miles	
42	1933	July 1-2	Hurricane		South Western Coast	173 miles	
43	1933	July 16-17	Tropical Storm		St. Mary and St. Ann		
44	1933	August 16	Tropical Storm		St. Elizabeth and Westmoreland	96 miles	
45	1933	September 19-20	Hurricane		South Coast	81 miles	
46	1933	October 29-30	Hurricane		Westmoreland, Hanover and St. James		

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
47	1934	October 20-21	Tropical Storm		St. Catherine, St. Ann and Trelawny		
48	1935	September 24	Hurricane		Hanover and Westmoreland	58 miles	
49	1935	October 21-23	Hurricane		East- north- west coast	58 miles	
50	1938	August 11-12	Hurricane		South Coast	58 miles	
51	1938	August 23-24	Hurricane		South Coast	144 miles	
52	1939	November 1-3	Hurricane		North west coast	58 miles	
53	1942	August 24-25	Hurricane		North Coast	144 miles	
54	1942	September 18-19	Tropical Storm		North Coast	29 miles	
55	1944	July 26-27	Tropical Storm		South Coast	115 miles	
56	1944	August 20-21	Hurricane		St. Thomas to Negril		
57	1944	October 13-14	Hurricane		West Coast	144 miles	
58	1945	October 11	Hurricane		West Coast	144 miles	
59	1947	August 11	Tropical Storm		South-west coast	173 miles	
60	1947	September 20	Tropical Storm		St. James and Hanover		
61	1948	September 18	Tropical Storm		Hanover		
62	1949	October 12-13	Tropical Storm		Westmoreland, Hanover and St. James		
63	1950	October 15-16	Hurricane	King	Westmoreland and Hanover	58 miles	
64	1951	August 17-18	Hurricane	Charlie	St.Andrew, St. Catherine, Manchester and Clarendon		
65	1951	September 4-5	Tropical Storm	Dog	South Coast	144 miles	
66	1953	September 23-24	Tropical Storm	Florence	South Coast	46 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
67	1953	October 3-4	Tropical Storm		North-west Coast	58 miles	
68	1954	October 11-12	Hurricane	Hazel	Eastern Coast	115 miles	
69	1955	August 23	Tropical Depression		South Western Coast	115 miles	
70	1955	September 14	Tropical Storm	Hilda	North Coast	127 miles	
71	1955	September 26-27	Hurricane	Janet	South Coast	144 miles	
72	1956	October 30-31	Tropical Depression	Greta	East Coast	58 miles	
73	1958	September 1-2	Hurricane	Ella	North-east Coast	115 miles	
74	1958	September 15	Tropical Storm	Gerda	North Coast	58 miles	
75	1961	October 15-16	Tropical Depression	Gerda	Kingston, St. Andrew, St. Catherine and St. Ann		
76	1963	October 4-6	Hurricane	Flora	Eastern half	173 miles	
77	1964	August 24-25	Hurricane	Cleo	St. Ann, St. Mary and Portland	58 miles	
78	1966	September 29-30	Hurricane	Inez	St.Mary and Portland	144 miles	
79	1967	September 12-13	Tropical Storm	Beulah	St. Thomas	52 miles	
80	1969	August 31	Tropical Storm	Francelia	South Coast	144 miles	
81	1970	May 20-22	Tropical Storm		Hanover and Westmoreland	121 miles	
82	1973	October 17	Tropical Storm	Gilda	Hanover, Westmoreland and St. James	121 miles	
83	1974	August 31	Hurricane	Carmen	South Coast	46 miles	
84	1974	September 15	Tropical Storm	Fifi	South Coast	52 miles	
85	1975	August 25	Tropical Depression	Caroline	North Coast	150 miles	
86	1975	September 18	Tropical Storm	Eloise	North Coast	115 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
87	1979	June 12	Tropical Depression		St. James, Hanover, St.Elizabeth and Westmoreland	86 miles	
88	1979	September 02	Hurricane	David	Eastern half	173 miles	
89	1979	September 11-13	Hurricane	Frederic	South eastern section	127 miles	
90	1980	August 5-6	Hurricane	Allen	East and North Coasts	35 miles	
91	1981	August 7-21	Tropical Depression	Dennis	Southwestern Jamaica		
92	1988	September 8-19	Hurricane	Gilbert	The entire island E-W		
93	1994	November 8-21	Tropical Storm	Gordon	Central Jamaica		
94	1996	November 18-26	Hurricane	Marco	Southern Jamaica	479 miles	
95	1998	September 15-October 1	Hurricane	Georges	Northern and Eastern Jamaica	151 miles	
96	1998	October 22- November 5	Hurricane	Mitch	Southern and Western Jamaica	138 miles	
97	1999	November 13-15	Hurricane	Lenny	Southern Jamaica	90 miles	
98	2000	August 22-25	Hurricane	Debby	Eastern Jamaica	90 miles	
99	2000	September 19-20	Tropical Depression 10		Kingston, St.Andrew, St. Thomas, St. Catherine & Clarendon		
100	2001	August 15-23	Tropical Storm	Chantal	Southern Parishes of Jamaica, and Pedro Banks		
101	2001	October 4-9	Hurricane	Iris	Southern Parishes of Jamaica, and Pedro Banks		

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
102	2001	October 5	Tropical Depression 11				News Release- System could affect the island
103	2001	October 9	Tropical Wave, Remnants of Tropical Storm	Jerry			News Release
104	2001	Oct 30-31	Tropical Depression		Most Parishes		2 Flash flood Warnings for northeastern and southern parishes, Flash flood watch for the rest of the island. 2 Flash Flood Warnings for northern and southwestern parishes. Flash flood watch for the rest of the island
105	2001	October 29-November 6	Hurricane	Michelle	Indirect effect on entire island, especially northeastern parishes		4 Flash flood warnings for northern and southwestern parishes. Flash flood watch for the rest of the island. 3 Flash flood warnings for entire island. 1 News Release
106	2001	November 26	Hurricane	Olga			News release not expecting direct impact but system could affect the island
107	2002	September 15	Tropical Depression 10				Special news release
108	2002	September 16-17	Tropical Wave		Northern and Southeastern		2 flash flood watches, flash flood watch for the entire island

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
109	2002	September 17-19	Tropical Depression 10 Regenerates		Northern and southeastern parishes, Gale force winds over southeastern sections		Bulletin 1-6, Tropical Storm Warning.Bulletin 1-6 Tropical storm warning . Bulletin 1-6 Tropical Storm Warning, Bulletin 7 Tropical storm Warning Lifted, 9 Flash Flood warnings
110	2002	September 20-24	Tropical Storm Spiral Bands from Hurricane Isidore	Isidore			
111	2002	September 24-October 1	Tropical Storm, Tropical Depression, Hurricane	Lilli	All parishes and some offshore areas		Bulletin 1-5 (No watch or warning) Bulletin 6-8 Tropical Storm Watch in effect , Bulletin 9 Tropical storm watch Lifted, Bulletin 10, Bulletin 11, Bulletin 12-26 Tropical storm Warning Bulletin 27 Tropical Storm Warning Bulletin 28 Tropical Storm Warning Lifted, Flood warning in effect. *Flash flood warning, news release (warning lifted)*
112	2002	October 14-16	Tropical Depression 14		Southern and Western Parishes		4 Flash Flood Watches, 1 Flash Flood Warning, 1 News Release
113	2003	July 8-9	Tropical Storm	Claudette	Most Parishes		Bulletin 1 Tropical Storm Watch Bulletin 2-8 Tropical Storm Warning Bulletin 9 Tropical Storm Warning Lifted
114	2003	July 23	Tropical Wave, Remnants of Tropical Depression 6		St.Mary, Portland, St. Thomas, St. Ann, Trelawny		2 News Releases

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
115	2003	August 29	Tropical Wave, Remnants of Tropical Depression 9		Most Parishes		1 News Release, 1 Severe Weather Alert
116	2003	December 4	Tropical Depression 20 Tropical Storm	Odette	North- Central and northeastern parishes, sections of southern parishes		Bulletin 1-2 Tropical Storm Watch Bulletin 3-9 Tropical Storm Warning Bulletin 10 Tropical Storm Warning Lifted.

IMPACT IDENTIFICATION

7 IMPACT IDENTIFICATION

7.1 INTRODUCTION

Potential adverse and beneficial impacts are identified through all phases of the development (pre-construction, construction and operation). These are illustrated in the Impact Identification Matrix (Table 7-1) and essentially show that the greatest potential for impact in all phases is on the vegetation and bird life.

The identification and assessment of potential impacts seek not only to identify the potential impacts, but also to evaluate the impacts within the framework of the proposed preventative measures and relative to the existing impacts in the area.

The impacts relating to the pre-construction, construction and operational phases of the development are described and summarized in the impact matrix below.

7.2 PRE-CONSTRUCTIONS PHASE

Pre-construction involves site clearing and general site preparation activities. During this phase, the site is surveyed, areas of the site for construction will be stripped and over-burden materials removed.

7.2.1 Marine & Terrestrial Impacts

Maximum potential impacts to floral and faunal species are likely to occur during the pre-construction phase and are expected to primarily come from vegetation removal of approximately 37 hectares, and the potential for erosion or fugitive dust formation during construction of service roads. Marine life, including but not limited to coral reefs, sea grass and fish, may be affected by any silt run-off that may occur during heavy rainfall during this phase; the absence of vegetative matter from cleared areas of the project site will increase the potential for sheet flows and erosion of the soils in the cleared areas.

While general vegetation will be negatively impacted, floral species of endemic or national importance will be preserved during this phase. The Silk Cotton Tree. *Lignum*

vitae and endemic species should be specially tagged for preservation prior to site preparation activities.

Terrestrial animals found in the area are highly mobile and it is expected that the fauna will move easily to nearby areas at the first signs of major disturbance. The adjoining conservation area/wildlife reserve will provide adequate refuge for displaced animals. Species such as lizards and birds are expected to re-colonize the affected area upon completion of landscaping operations.

7.2.2 Impacts on Surface Water

The potential impacts on surface water quality may arise from increased sediment loads caused by the removal of vegetation during clearing operations. There is a potential of affecting for impact of surrounding ponds through silt run-off, which may occur during heavy rainfall. This is not envisaged to be a significant issue as no significant earth works activities will be undertaken during this phase of the operation; and all efforts will be made to protect the ponds which are slated to be developed as features of the completed project. No pond water will be used for dust suppression or other means during this phase.

7.2.3 Impacts on Groundwater

Potential impacts on groundwater in the area will be negligible as no situation with the potential to generate contaminated materials capable of impacting adversely on groundwater is anticipated.

7.2.4 Solid Waste

Solid waste (top soil and boulders) will be stockpiled to be used later in back filling and landscaping procedures, where appropriate. Other unsuitable solid wastes, such as those generated from human activity and any vegetative matter inappropriate for back filling, in the form of stumps, brush roots, trees, bushes, will be handled appropriately, placed in controlled storage and disposed in a landfill through contract disposal services.

Biomass materials may be donated to charcoal burners or Scott's Cove food vendors as a one-time supply (where practicable).

7.2.5 Air Pollution

7.2.5.1 Gaseous

The use of heavy equipment powered primarily by diesel engines will produce gaseous emissions. Particulates generated from the combustion of diesel fuel may enter the atmosphere where they may be carried by wind currents, or the natural propulsion from the exhaust, into the surrounding environs. In general, it is anticipated that the potential gaseous impacts from heavy equipment will be temporary and will decline substantially as the development progresses towards completion.

7.2.5.2 Dust

Clearing of land, handling of materials and the general preparation of the site construction activities have the potential for generating fugitive dust.

Dust formation can be pre-empted and prevented in most cases through effective site management and other standard and proven methods, such as sprinkling with tank trucks or by hand with hoses as necessary.

7.3 FACILITY CONSTRUCTION PHASE

7.3.1 Flyrock from Blasting

The possibility exists that blasting may be employed during the construction phase of the proposed development. If blasting is deemed necessary, all applicable permits and licenses will be acquired prior to any blasting activity on site. During blasting, there is a possibility for the propulsion of rock and/or debris. Such an occurrence is commonly labeled as Flyrock, and, if not properly addressed, may jeopardize lives, animals and the infrastructure within the blast range of the flyrock material.

In the event that blasting is necessary, mat blasting will be used to contain any flyrock. This will be done in preference to uncontrolled blasting, which may result in several hazards including the loss of lives and property. For the purpose of environmental management, mat blasting, which is of short duration, is superior to the use of jackhammers, which would take place over a much longer period of time and result in prolonged disturbances to avifauna and other potential receptors.

7.3.2 Sewage

During this phase of construction it is likely that individuals who work directly on the construction site will need toilet facilities. Portable sanitary toilet facilities will be on site during the construction phase. These portable toilets will be monitored, maintained and disposed of by a company licensed to do so. PCJ will require documentation from these companies on how waste removed from the site is being handled.

7.3.3 Noise

During this phase, the potential exists for loud noise from heavy equipment and general construction activities. Noise levels will be monitored during construction to ensure that levels are within regulatory requirements. Adjustments and appropriate actions will be taken as necessary to meet the standards.

7.3.4 Impacts on Surface Water

The potential impacts on surface water quality may arise from increased sediment loads from the stockpiling of construction aggregates and excavation activities during heavy rainfall. These impacts can be mitigated through bunding and berming, and the use of settling ponds.

No water from the existing ponds will be used for irrigation and dust suppression on the site.

7.3.5 Impacts on Groundwater

Potential impacts on the associated groundwater in the area will be negligible as no situation with the potential to generate contaminated materials capable of impacting negatively on the groundwater has been identified.

7.3.6 Solid Waste

Solid waste and top soil will be stockpiled to be later used in the back filling and landscaping rehabilitation procedures, while other wastes, such as those generated from human activity and any vegetative matter inappropriate for back filling, will be disposed at an appropriate landfill through contracted disposal services.

Garbage receptacles will be established throughout to allow for proper garbage collection

and disposal. Every effort will be made to keep litter off the ground and out of the environment.

7.3.7 Gaseous/Dust Emissions

The usage of heavy equipment powered primarily by diesel engines will produce gaseous emissions – as described in section 7.2.5. The potential impacts from diesel engines will decrease considerably as the development gets closer to completion and the number of vehicles on site decrease.

Owing to the prevailing climatic condition and soil type within the project area, the potential for dust emissions may occur during earth movement activities. Effective monitoring and implementation of a sprinkling regime (by truck or hand) will contain this potential impact.

7.3.8 Siltation and Disturbance of Marine Waters and Ponds

Marine waters and ponds may be impacted through site run-off from stockpiled materials and exposed areas on site. These are particularly prone to weathering and transportation during heavy rainfall. Various standard methods such as bunding and berming will be used for controlling the potential for water borne dispersion of sediments. If it is observed that marine/aquatic impacts are occurring, then options such as silt screens will be implemented to further contain the run-off

7.3.9 Aesthetics

The aesthetics of the area will be adversely disturbed during construction. This will result from the removal of vegetation and construction activities. This will be reversed on completion of construction through landscaping activities and the presence of the completed development.

7.3.10 Social-Impact

As with most developments commissioned in Jamaica, the majority of the labor-force and trades men will tend to come from the surrounding communities. It is anticipated that the construction phase of the development will undoubtedly alter the demographic and community profile of the area. It was cited in sections 4.2 and 4.5, that one of the evident

problems of the community was the scarcity of a range of jobs that fit the community profile. Hence, the development will not only provide employment, but will also encourage positive and hopeful social attitudes in the people(s) of the surrounding communities.

With the onset of the development it is impractical to imagine that only individuals from the surrounding communities will be granted employment, or the opportunity for such employment. As such, this will result in the existence of migrant workers and or 'job hunters.'

Also expressed in section 4.5, is the fact that the development may impact on squatter settlement, which has been seen as a problematic and an undesirable aspect of the community. While the PCJ will have little control over this activity, it is expected that with the advent of the development, issues pertaining squatting and illegal residences maybe addressed.

7.3.11 Traffic Impacts

The impact of traffic during normal working hours is estimated to be at a minimum during this phase of the development. Most, if not all the materials needed for construction, inclusive of heavy machinery, will have been transferred to the site by the time this phase of the development is slated to begin. Therefore, there should be no notable extra movement during this phase of the development during regular working hours. Any foreseeable extra movement would most likely occur during the times when any construction material, such as cement and aggregate are being replenished. Such an event should not constitute a significant impact on the traffic as the main road adjacent to the Font Hill site is a major inter-parish roadway which regularly facilitates the movement of a range of materials between St. Elizabeth and other parishes using haulage trucks.

With regards to before and after work hours, the influx and efflux of on-site workers into and out of the site, is most likely to culminate at the entrance to the site. However, because the entrance to the proposed development is located some distance inside the property, away from the main road, there should be relatively little hindrance on motor

vehicle movement.

7.3.12 Health and Safety

All employees on the development site will be briefed on the health and safety policies governing work on the site. Requirements for safety gears and equipment will be included in this briefing. The site code of conduct will be reviewed with all employees and consequences for failure to comply will be addressed.

7.4 OPERATIONAL PHASE

7.4.1 Water Quality

The potential impacts to surface and ground water quality will be minor if any due to controls to be put in place to protect the ponds, marine environment and groundwater. Additionally, plans for the operation of the resort and cottages include recycling and reuse of treated water. The presence of the asphalted ground cover and buildings on the site will reduce percolation and may increase any surface run-off to the sea. Recharge of the aquifer will be enhanced through the use of recycling water for irrigation purposed

Improvements will be made to the water supply system at the property. Upgrades to the Dalentober well system including filtration and chlorination is a potentially positive upgrade to the area.

7.4.2 Socio-Economics

The proposed project will bring substantial economic benefits to the area. It is expected to provide several jobs during the construction and operation phases. In the operation phase, there will be an increased baseline demand for services and goods which will increase seasonally and with the staging of special events. In addition, there will be increased demand for goods and services and various opportunities will be created for entrepreneurial activities.

The provision of housing and any related new construction will have positive impacts on the wider community. It is anticipated that infrastructure upgrades will follow new development, housing and residents in the area.

The development involves a major investment and will also contribute to increased foreign exchange earnings, not just for the development, but for other tourism products regionally such as YS Falls, Black River Safari, Lovers Leap, Little Ochi and others. Additionally, businesses such as hardware and supermarkets will see an increase in patronage as a result of this development.

7.4.3 Aesthetics

In order to satisfy the intended purpose of the development, the aesthetic component needs to be at a standard that meets or even surpasses expectations. As such, it is in the developers' best interest that the aesthetic value of the site be preserved and even improved so that the facility is profiled as ideally as possible. PCJ will, through its designers and construction activities, work to maintain, or where possible improve on the aesthetic expectations of the site.

7.4.4 Solid Waste

During the operational phase of the development, the facility's regular maintenance activities along with guest activities will generate solid wastes such as pruned shrubbery, discarded reusable items, containers, paper, and general municipal waste. The development will be provided with adequate garbage collection bins, placed through-out the property and regular collection service provided by an approved company, with permission to dispose waste at the municipal landfill.

7.4.5 Traffic Impacts

During the operational phase, there will be seasonal shifts in peak traffic related to the property. The residential aspects of the development and the potential for long term visitors/residents may result in steady, predictable traffic impacts year-round. The relatively low density of resort properties in the area and low number of industrial operations will keep the anticipated traffic impacts within the capacities the existing road framework.

7.4.6 Gaseous Emissions

No appreciable increase in gaseous emissions is anticipated (over existing background levels) as the potential increases envisioned during construction will be reduced, and the facility is not expected to generate the number of emission sources that would be required to result in a noticeable impact. The transition from construction to occupancy of the property will result in less heavy duty diesel vehicles and the associated emissions and more gasoline and light duty diesel vehicles. Since the occupancy of the development is envisioned to be phased as described in Section 1.1.2 – Project Description, the air quality impact of increased gaseous emissions will also be phased and extended over a wider timeframe.

7.4.7 Beach Area

The adjoining Font Hill Park Public Beach (which is not a part of this development) is expected to see increased beach usage since the proposed development does not include a sandy beach. Potential impacts on the beach will be managed much as they are at the existing beach with improvements being made to facilitate the expected clientele. Where necessary, signs will be posted indicating dangerous or environmentally sensitive areas and trash/garbage collection will be maintained.

7.4.8 Noise

Background noise levels will be significantly diminished during the operation phase. The levels of noise expected during the construction phase will be greatly reduced and noise is not expected to be an issue during operation.

Table 7-1: IMPACT IDENTIFICATION MATRIX

Key

	Major negative
	Minor negative
	No Impact
	Major Positive
	Minor Positive

	Development Activities																		
	Site Preparation				**Construction**								**Operation**						
	Site Surveying	Site Clearance	Site Access	Solid Waste Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Disposal	Increased Migration/Workers	Sewage Treatment	Landscaping	Traffic	Solid Waste Disposal	Water Supply	Surfacing/Paving	Sewage Treatment	Increased Migration/ Workers	Water sports and Beach Usage
SITE TOPOGRAPHY																			
SITE GEOLOGY																			
NOISE																			
VIBRATION																			
AIR QUALITY																			
GASEOUS EMISSIONS																			
SURFACE WATER (PONDS)																			
GROUND WATER																			
DRAINAGE																			
NATURAL HAZARD VULNERABLITY																			
Ecological Parameters:-																			
TERRESTRIAL ECOSYSTEMS																			
VEGETATION																			
BIRDS																			
TURTLES & CROCODILES																			
OTHER FAUNA																			
MARINE/FAUNA																			
SENSITIVE HABITATS																			
Socio-Economic Parameters:-																			
AESTHETICS																			
EMPLOYMENT																			
FOREIGN EXCHANGE EARNINGS																			
WASTE MANAGEMENT																			
TRAFFIC ON THE ACCESS ROAD																			
INCREASED CRIME																			
TOURIST HARASSMENT																			
HAZARD VULNERABILITY																			
SOLID WASTE DISPOSAL																			
SEWAGE TREATMENT																			
OCCUPATIONAL HEALTH & SAFETY																			

IMPACT MITIGATION

8 IMPACT MITIGATION

8.1 INTRODUCTION

Various potentially negative impacts have been identified, most of which can be avoided, minimized, or mitigated through the use of standard construction practices, conservation and environmental management technologies.

The impact mitigation matrices shown below, illustrate the mitigative measures to be implemented in the pre construction, construction and operational phases.

Table 8-1: Impact Mitigation Matrix – Pre-construction Phase

	Proposed Mitigative Measures													
	Detailed Topographic Surveys	Effective Site Management	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Site Monitoring Plan	Sprinkling and Irrigation	Proper Vehicle Maintenance	Installation of Sediment Traps	Security & Fencing	Positive Impact No Mitigation	Community Relations	Flora & Fauna Relocation/Relocation
Impacts - Preconstruction Phase														
Site Preparation Vegetation Removal	■	■	■	■	■		■	■		■	■			■
Topography & Geology	■	■	■				■							
Transportation of Construction Material		■	■	■			■	■	■		■		■	
Noise		■	■						■		■		■	
Dust/Air Quality		■	■		■		■	■	■		■		■	
Disturbance of flora and fauna	■	■	■				■	■						■
Aesthetics		■	■	■	■	■		■		■	■		■	
Traffic Impacts		■	■										■	
Increased Employment												■	■	
Occupational Health & Safety		■	■	■	■	■	■	■	■		■		■	
Change in the Natural Drainage Patterns	■	■					■							
Solid Waste Impacts		■	■	■	■	■	■						■	
Marine Impacts		■	■	■	■	■	■			■				
Increased Earning Potential for							■					■	■	
Surface Water/ Ground Water	■	■	■	■			■			■				

KEY	
■	Mitigation

Table 8-2: Impact Mitigation Matrix – Construction Phase

	Proposed Mitigative Measures															
	Detailed Topographic Surveys	Phasing of Building Plans	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Site Monitoring Plan	Sprinkling and Irrigation	Proper Vehicle Maintenance	Landscaping Measures	Effective Site Management	Security & Fencing	Installation of Sediment Traps	Scheduling of Heavy Vehicles	Positive Impact No Mitigation	Community Relations
Impacts - Construction Phase																
Increased Employment															■	■
Topography and Geology	■	■	■				■		■		■					
Transportation of Construction Material		■	■	■			■	■			■			■		■
Noise		■	■				■		■	■	■	■		■		■
Dust/Air Quality		■	■				■	■	■	■	■	■		■		■
Occupational Health & Safety Concerns		■	■	■	■	■	■	■	■		■	■				
Aesthetics		■	■	■	■	■	■	■	■	■	■	■				■
Increased Earning Potential for community															■	■
Increased Traffic		■	■				■	■			■			■		■
Surface Water/Ground Water	■	■	■	■	■	■	■			■	■		■			
Change in the Natural Drainage Patterns	■	■	■				■			■	■					
Solid Waste Generation		■	■	■	■	■	■				■					
Sewage Disposal				■	■	■	■				■					
Trespassers into Conservation Area												■				
Accommodations for workers		■	■	■	■	■	■				■	■				■
Marine Impact		■	■	■	■	■	■			■	■	■	■			

KEY	
■	Mitigation

Table 8-3: Impact Mitigation Matrix – Operational Phase

	Community Wide Plan	Operation & Maintenance Plan	Regulatory Monitoring	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Security & Fencing	Landscaping Measures	Positive Impact No Mitigation
Impacts - Occupational Phase									
Increased Employment opportunities									
Sewage Treatment System Management									
Drainage Patterns									
Solid Waste Management									
Water Conservation/Reuse									
Energy Conservation									
Aesthetics									
Regulatory Compliance									
Trespassers in Conservation Area									
Fugitive Dust/ Gaseous Emission									
Increased Earning Potential for Community									

KEY	
	Mitigation

Those impacts which have been identified as being unavoidable include the following:

- Loss of vegetation resulting from land clearance and site preparation
- Loss of habitats
- Disturbance of bird life
- Increased levels of fugitive dust during gusts of wind or storms
- The exposure of workers and users of recreational facilities to noise and dust
- Visual intrusion resulting from land clearance

Though these impacts are unavoidable, their intensity and duration can be drastically reduced in the medium to short term. The following mitigative actions are recommended for the three phases of the proposed project.

8.2 PRE-CONSTRUCTION PHASE

8.2.1 Air Pollution (Dust Control)

Dust control is a primary concern during this phase of the project. Standard and appropriate mitigative measures inclusive of an irrigation regime, such as sprinkling done by specially adapted trucks, will be implemented.

Every effort will be made to minimize the extent of soil exposure and the total surface area exposed to wind action, which will reduce subsequent dust formations.

8.2.2 Land & Land Use

Decline in quality and aesthetic value of the proposed project area during site preparation and construction can be mitigated by a landscaping plan for the developed site. Landscaping will not await completion of construction but will be initiated on a phased basis.

This action will have a number of benefits:

- utilization of materials generated during site operations.
- Improved aesthetics
- Possible use of *Acacia* or other trees on the property for shade and aesthetics
- Rehabilitated and additional vegetation areas may help to reduce elevated surface temperatures that may arise from the construction of asphalt roads and other infrastructure.
- Quicker re-establishment of ecological habitat at the micro-level.

In addition to landscaping of the site, the entrance to the development will be landscaped. This will provide a natural screen, which addresses the issues of visual intrusion and the effects of gusts and storms.

8.2.3 Tree Preservation

The Silk Cotton tree in the north western Area of the site and the *Lignum vitae* tree, in the eastern area and any other endemic or important flora will remain on the site, and be prominently tagged prior to the commencement of any site clearing activities. In addition, a prescribed buffer zone should be established around these trees for their protection.

8.2.4 Water Quality

The activities associated with the pre-construction of the development will not bring about a significant increase in sediment load unless uncharacteristically heavy rainfall is experienced. The use of settling ponds, bunds and berms will effectively trap, marshal and contain sediments before they can impact on surface or marine waters

Mitigative measures are not envisaged for ground water resources since there will be no changes to the baseline activities that are capable of affecting ground water.

8.2.5 Gaseous Emission

Gases will be emitted into the atmosphere by the operation of heavy equipment. This environmental impact is unavoidable and irreversible and can only be minimized by ensuring that the equipment being utilized on the project are well maintained, inspected and operating properly.

During the overall monitoring exercises, any equipment observed to be emitting large quantities of noxious or aesthetically unpleasant emissions, will be removed from operation until repairs are made or replacement is brought in.

8.2.6 Creative Conservation

To mitigate against the losses of flora and the fauna, creative methods are recommended. Where possible important plant species which can be physically moved (e.g. orchids) will be collected and relocated.

Where possible seeds or propagative structures of important plant species will be collected and used for later reclamation practices. The species naturally found in this area will be used to seed the top-soil where appropriate.

If possible, a temporary nursery should be established to preserve the species until relocation.

8.3 RESORT CONSTRUCTION PHASE

8.3.1 Flyrock from Blasting

The magnitude of the occurrence of flyrock is usually mitigated in two primary ways:

1. Covering the flyrock (Backfilling)

2. Containing the flyrock (Blasting Mats)

Both methods seek to reduce the momentum, and by extension, the range, of any rock or debris as they are propelled by the blast force before they become aerial projectiles. The chosen method of blasting constitutes the use of blasting mats

8.3.1.1 Covering the Flyrock (Backfilling

Backfilling is covering a blast with soil, preferably sand, to control or prevent undesirable flyrock. The rule of thumb for backfilling is that the amount of backfill is equal in depth to the amount of stemming; however, backfill must be a minimum of 3 ft (0.9 m). For example, a shot in which one is holding 3 ft of stemming would require at least 3 ft of backfill.

Backfilling is advantageous in that it requires less equipment than blasting mats, it can produce better breakage, and the whole blast can be shot at once. An example of the reduced equipment requirement is doing a trench for a utility contractor; often the contractor has a backhoe or loader there for laying pipe. In this case the blaster needs only a powder truck, whereas if blasting mats were used, the blaster would also need a crane to handle the mats and a truck to transport the mats. (Producing better breakage and shooting the entire shot at once, can also be the main disadvantage)

8.3.1.2 Containing the Flyrock (Blasting Mats)

Blasting mats are netting or matting constructed of either cable or rubber tires and designed to contain the rock or prevent it from flying when blasted. The common steel-cable blasting mats measure 10 ft x 12 ft (3m x 3.65 m) and weigh approximately 3000 lb (1365 kg). When the blast holes are loaded and wired into the lead wire, one or several blasting mats are placed on the blast, covering all the holes to be blasted. The cost of blasting with mats is greater and the speed is less than with traditional open shooting. The main rule for blasting mats is never to blast more holes than can be safely covered with the mats

8.3.2 Sewage

Temporary/chemical toilets will be located through-out the site during construction phases. The provision, installation and maintenance of these facilities will be done by RENTALOT Equipment Ltd. Rentalot has assured the developers of their ability to meet the load dictated by the site's activity and have guaranteed that their facilities are biodegradable and are not hostile towards the environmental. Their assurance has also been secured that the materials which they collect from the provided facilities will be disposed of in the government's National Water Commission (NWC) sewage treatment facilities. A copy of their capability and quality assurance statement to the PCJ is shown in Appendix XI. The completed development will be serviced by a sewage treatment system using waste stabilization technology to treat sewage to the tertiary level.

8.3.3 Air Pollution (Dust Control) and Gaseous Emissions

The potential point sources of dust pollution during this phase are:

- Loading, hauling and unloading of surface materials removed during site preparation and construction
- Drying of exposed soil surface
- Stockpiling of aggregates

These point sources could generate varying quantities of dust if not controlled. They will be marshaled and sprinkled with water as necessary, depending on weather conditions, to

suppress dust emissions.

8.3.4 Noise

The potential for loud noise will primarily occur during the construction phase with the operation and usage of heavy equipment.

Noise and emission levels from heavy equipment usage will be minimized by proper maintenance, muffling of equipment and regular checks on vehicles.

Background noise levels will also be monitored and compared with baseline decibel ratings or against the regulatory standard. measured for the baseline conditions. This will be assessed to determine compliance with accepted standards.

In the event of non-compliance, corrective action will be taken, such as removal or repair of the equipment from the fleet.

8.3.5 Water Quality

As stated during the impact identification, increased sediment loads resulting from excavation activities have the potential to impact on surface water resources. Marshalling of exposed materials as well as construction aggregates will be necessary throughout the entire construction period.

8.3.6 Solid Waste

All solid waste materials generated through construction activities will be stockpiled to be used as fill material during construction or for landscaping purposes. Materials not suitable for backfilling will be disposed at municipal landfills of through contract services.

8.3.7 Traffic Management

Should it become necessary for large numbers of heavy vehicles to move to and from the site, flagmen may be employed to regulate the traffic flow.

8.4 OPERATIONAL PHASE

8.4.1 Water Quality

The project envisages the recycling and reuse of water treated for irrigation purposes and possibly for maintaining the levels of the ponds which are not perennial, during the dry seasons.

8.4.2 Solid Wastes

Solid waste generated will be managed using appropriate disposal methods carried out by a qualified and NEPA approved waste disposal entity. Where applicable, reuse and recycle programs will be employed. It should be noted that strategically placed solid waste receptacles will be placed though-out the property so as to encourage guests and staff to dispose of their solid wastes appropriately. Local municipal landfills will be utilized for water disposal.

8.4.3 Traffic Management

Management of the ingress and egress of traffic into and out of the facility during the operational phase of the facility has been considered, and the designs for the facility have incorporated all of the NWA's requirements and recommendation (APPENDIX IV), including a single entry roadway to the subdivision (see Figure 1-8) and should address the issue of safety regarding ingress and egress.

Management of the traffic along the internal roads of the facility will be controlled through the use of structures such as islands, roundabouts, 'sleeping policemen' (speed bumps) and approved road signs.

ENVIRONMENTAL ACTION PLAN

9 ENVIRONMENTAL ACTION PLAN

The environmental action plan will address all factors related to the management and operation of the proposed resort development. The plan will provide guidance in the following areas:

- Training of managers and staff
- Tree preservation - Cotton Tree and *Lignum vitae*. As far as practicable, bird feeding trees should be preserved
- Protection of the avifauna
- Creative conservation
- Guidelines and instructions to users of the resort on the importance of the natural assets in the environment and on acceptable and unacceptable practices
- Preventative maintenance of equipment
- Waste handling and disposal
- Security and
- Natural Hazards Management.

Active environmental monitoring will be undertaken to provide quantitative information on the state of the environment as it relates to the operations. Areas of concern are:

- Water quality
- Air quality
- Loud noise
- Land rehabilitation
- Creative conservation.

All the mitigative actions identified above, must be clearly communicated to all members of the project team prior to project start up, i.e., Architects, Engineers and Contractors. In addition, a brochure highlighting each potential impact identified and the proposed mitigative action should be prepared and delivered to them, with appropriate documentation of receipt prior to project start up. Any violations should attract a penalty to agreed and written into the respective contracts.

Responsibility for ensuring that mitigative actions are adhered to should be a part of the Architects mandate. In addition, the Proponents should employ the services of an independent Environmental Management Consultant to monitor the project. A monitoring programme with strict schedules and clear reporting directives to the Proponents and to NEPA should be developed.

APPENDICES

APPENDIX I:
APPROVED TERMS OF REFERENCE

1. Tasks and Responsibilities:

Although an interactive approach will be generally taken, the lead organization with primary responsibility for each task is named first as set out below. ESTECH will be responsible for overall synthesis of the EIA Report and EIA statement. Details of each task are provided in the TOR at appendix 1.

1.1 Project Description

Existing environment

1.2.1 Physical Environment

1.2.2 Biological Environment

1.2.3 Social Environment

1.3 Legislation and Regulatory Considerations

1.4 Analysis of alternatives

1.5 Impact Identification

1.6 Impact Mitigation

1.7 Environmental Monitoring and Management

1.8 Public participation - ESTECH/PCJ

APPENDIX II:
LETTER SHOWING THE AGREED AMENDMENTS TO BE COMPLETED

TEL: (876) 929-5380-9 FAX: (876) 929-2409
EMAIL: ica@pcj.com

URGENT

June 28, 2004

Mr. Krishna Desai
Director
Conservation Protection Division
National Environment and Planning Agency (NEPA)
10 & 11 Caledonia Avenue
Kingston 5.

Dear Mr. Desai,

Re: Permit Application for Sub-division Part of Font Hill – St. Elizabeth

We apologize for the delay in responding to your letter of May 26, 2004, however we believe that an appropriate response would have necessitated first meeting with the relevant parties of captioned exercise and yourself. In this regard, we thank you for facilitating the meeting with Mr. David Barrett on Wednesday, June 23, 2004, to discuss the concerns and pre-requisites highlighted by NEPA, and the concerns of PCJ in meeting the requirements for approval of the Environmental Permit.

PCJ personnel and consultants (ESTECH, Barry Brown, Morris Chin) on the project met on Friday, June 25, 2004 specifically to accelerate the amendment and finalization of the EIA. At that meeting it was identified that some of the concerns of members of the NEPA review committee may be related to a miscommunication of the project's score. **We therefore wish to clarify that the approved TOR and related environmental application submitted for your consideration includes the following;**

- **The Font Hill Resort and Residential Subdivision plan with constructed features consisting of cottages, hotels, jetty, jogging trail, park, shopping complex and country club.**
- **Preserved natural features consisting of 3 ponds and rocky shore coastline.**

The proposal for consideration <u>does not</u> include the following;

- **The Font Hill Wildlife Sanctuary, Eco-tourism Park, visitor facilities for viewing turtles, manatees, crocodiles or birds.**

Based on the meeting between PCJ and NEPA, we wish to confirm the salient understanding for moving forward as itemized below.

1. The approved Terms of Reference will be incorporated into the EIA document by PCJ (8 copies to be submitted)

PETROLEUM CORPORATION
OF JAMAICA
36 TRAFALGAR ROAD,
BOX 579, KINGSTON 10, JAMAICA.

2. Figures 1, 2 and 3 from Section 1.1 Project Description will be replaced with larger, clearer diagrams, folded and placed as inserts in the EIA document (8 copies). The Conservation Area and Wildlife Sanctuary mentioned will be illustrated on one of the maps along with the location of the Font Hill Beach Park.

3. Information related to earthquake, flooding and storm vulnerabilities would be requested of the Earthquake Unit UWI, Water Resources Authority and The Meteorological Office respectively, to be incorporated in the document.

   As discussed, there will be difficulties in developing an assessment of sea level rise vulnerabilities as there is uncertainty regarding sources and validity of estimates for the project area.

4. The error in numeration regarding the absence of section 3.2.2 will be corrected.

5. Related to Section 1.2.2 - Biological Environment, a marine diver will be identified and deployed to conduct an underwater survey of the marine habitat within the foreshore and back reef spanning Joseph Cove to the Beach Park. The extent of this work would be decided on by an interpretation of the approved TOR. Information from any available documents will be used to complement the results of this activity.

6. As discussed, there has been no contact between marine turtles or crocodile and users of the project area, whether accidental or by design. There are no plans in this proposal to facilitate any such interaction for any reason (educational, economic or otherwise).

   As mentioned, the areas noted as Turtle Nesting Preserved Area in Figure 4 are not related to the present proposal and only served to indicate a proposed turtle attraction submitted by an independent group to PCJ. After evaluation, the proposed turtle attraction was not approved by PCJ and is not being considered.

   PCJ will attempt to secure the most current information on the status of the crocodile population and turtle landing patterns at Font Hill from NEPA and other sources.

   In this regard, we are willing to mention information on the potential for impacts on turtles and crocodiles and potential of interactions with them in the document.

   We understand that NEPA will re-evaluate the subsequent need for a Turtle and Crocodile Management Plan and if deemed necessary, NEPA may permit this requirement as a conditionality following approval.

7. The table containing information on the Demographic Profile is with the ESTECH consultant and would be included in the document.

8. Recognizing that a process of analysis was undertaken in developing the existing proposal, section 1.3 on the Analysis of Alternatives will be expanded by indicating the rationale for site selection, selection of combination of planned features particularly in the context of their relationship with the Existing Font Hill Development Plan. New analysis of optional designs, different scales and other locations would not be required.

9. A commentary will be inserted regarding the influence of this proposal on traffic and the safety of road use regarding issues of ingress and egress.

10. Regarding the Environmental Monitoring and Management Plan, NEPA would be willing to have this requirement as a conditionality of approval which should be submitted 30 working days before implementing any construction activity.

11. It was emphasized in the meeting that a proposal outlining the development of the lands owned by the Petroleum Corporation of Jamaica (PCJ) at Luana Point for the purpose of constructing an oil refinery has not been submitted by PCJ for consideration. The Petroleum Corporation of Jamaica, currently remains the legal owner of the property mentioned and has no plans at this time to construct the facility referred to by NEPA, therefore there being no conflict with the subdivision proposal, this matter would be considered.

    However for completeness, the potential uses previously approved by Cabinet of adjacent plots by PCJ (proposed or existing) will be mentioned in the EIA and any conflicts identified along with mitigation approaches.

12. It was agreed that the stated Black River National Park proposal could not be identified/located by NEPA or PCJ. It was also agreed that mixed uses may be permitted and therefore the sub-division proposal does not conflict with the purpose of any such proposed area. Inclusion of this proposed national park would therefore not be relevant.

13. PCJ will include in the document the fact that the traditional block and steel construction method will be used for buildings within the project.

14. The possibility of using blasting methods **only if necessary** will be included in the document. In this regard, the methodology of steel mat blasting will be included in the document along with potential impacts and impact mitigation benefits of this method.

15. PCJ will indicate if the sewerage and wastewater standards specific to NRCA's Irrigation Standards (1997), can be met by the proposed treatment plant.

    It was agreed that irrigation water would be used exclusively by the development.

16. The explicit use of temporary toilets/chemical toilets will be stated, as this is the method recommended by PCJ and its consultants.

17. Sludge removal, cleaning and maintenance will be stated in the EIA document.

18. An Environmental Permit Application for the construction of the Sewage Treatment Facility and Environmental Licence for the Discharge of Sewage Effluent will be submitted along with the revised draft EIA submission.

19. The means of access to the beach by the public will be stated, and as discussed there will be no barriers for access as the Beach Park and the sub-division are two separate applications with separate commercial/business management which are not contingent on each other.

20. It was clarified that the entire jogging trail/recreational area will be constructed external to the wetland area and therefore not impinge on the future activities of the wetlands or other areas. This will be reiterated in the document.

21. Storm water flows and methods for reducing marine impact in particular will be outlined in the document.

22. A Beach Licence for the Seaside Park and jetty will be prepared and submitted before approval of the Environmental Permit.

We wish also to confirm that NEPA has kindly extended the deadline for submission of the draft EIA document considering that it was unlikely that the document could be suitably modified to meet the 30-day deadline. The new deadline agreed on will be Monday, September 6, 2004.

These points constitute the summary of the critical actions necessary before resubmission of the draft report to NEPA. We would therefore appreciate if you could kindly review and comment regarding same. Also in your comments, please indicate what conditions and requirements may no longer apply considering the defined boundaries of the project proposal which we have outlined herein.

Please contact me or Mr. David Barrett directly at 929 5380-9 or by e-mail at ruth.potopsingh@pcj.com or david.barrett@pcj.com.

Yours sincerely,
PETROLEUM CORPORATION OF JAMAICA

Ruth Potopsingh (Mrs.)
Deputy Group Managing Director

RP/DB

c.: Mr. David Barrett
Environmental Coordinator

APPENDIX III:
LETTER FROM TOWN AND PLANNING AUTHORITYAPPROVING THE PROPOSED DEVELOPMENT

IN REPLY OR SUBSEQUENT REFERENCE TO
THIS COMMUNICATION SHOULD BE ADDRESSED
TO THE GOVERNMENT TOWN PLANNER AND
NOT TO ANY OFFICER BY NAME AND
THE FOLLOWING REFERENCE QUOTED

TOWN AND COUNTRY PLANNING AUTHORITY

10 Caledonia Avenue

Kingston 5

Jamaica

Tel: (876) 754-7547(-50)
Fax: (876) 754-7595-6

TPD55/AP/10BA2752/4

February 12, 2003

Petroleum Corporation of Jamaica
Font Hill
St. Elizabeth

Re: Planning permission for the construction of a resort consisting of 7 two-storey hotels 30 rooms each to be located at Font Hill, St. Elizabeth
By: Petroleum Corporation of Jamaica for Ministry of Agriculture

The Town and Country Planning Authority (TCPA) at a meeting held on December 17, 2002, granted permission for the captioned development, as illustrated on plans (Annex 1) date stamped by the National Environment and Planning Agency October 31, 2002.

The proposal consists of : 7 two storey hotels 30 rooms each, 118 single storey cottages 4 bedrooms each , a shopping complex consisting of 12 single storey shops, recreational areas which includes an existing beach park, country club with tennis courts, seaside park with jetty access for boating, jogging trail and park, an eco tourism park with visitor facilities to view turtles, manatees, crocodiles and several species of birds in their natural habitat.

The granting of permission is subject to the following conditions:

Statutory Reserved

1. Fully detailed drawing illustrating the siting, the design, the means of access and external appearance of the buildings to be erected, shall be submitted through the Westmoreland Parish Council for approval by the TCPA. There shall be no occupation until plans requested are submitted and approved.

Reason: To accord with section 6 (3)(a) of the Town and Country Planning Act.

Non Statutory Reserved
Site Plan

2. The submission of a layout plan showing the disposition of building (s) on land together with the associated parking and circulatory system. There shall be no occupation until plans requested are submitted and approved.

Reason: To ensure satisfactory standards of development

Sewage

3. Submission through the Westmoreland Parish Council, of detailed plans for sewage disposal, for approval by the Town and Country Planning Authority. There shall be no occupation until plans requested are submitted and approved.

Reason: To ensure satisfactory health and environmental standards.

Landscaping

4. Landscaping plans, showing existing proposed trees, ornamental shrubs and enhanced vegetation as well as plans for the screening of the waste disposal service and any maintenance building, should be submitted to the Westmoreland Parish Council for

approval by the Town and Country Planning Authority. There shall be no occupation until plans requested are submitted and approved.

Reasons:

- To ensure satisfactory environmental standards of development
- To preserved the existing vegetation of the area.

Solid Waste

5. The submission of a solid waste management plan to the Westmoreland Parish Council for the approval of the Town and Country Planning Authority. This plan should show the separation, use and disposal of the solid waste. There shall be no occupation until plans requested are submitted and approved.

Reason: To encourage recycling, the use of biodegradable solid waste on the property and to minimize the amount of waste going to the municipal dump. To ensure safe and satisfactory standards of development.

Disabled

6. A minimum of 5% of the total number of parking spaces, along with access and sanitary facilities (example ramps and grip rails) are to be provided for the disabled. These facilities should be clearly identified on the plan, which should be submitted to the Westmoreland Parish Council for the approval of the Town and Country Planning Authority.

Reason: To ensure that the adequate provision is made for the disabled persons.

Sanitary Conveniences

7. Plans showing the public sanitary conveniences for use by patrons of the development should be submitted through the Westmoreland Parish Council for the approval of the Town and Country Planning Authority.

Reason: To ensure that adequate public sanitary convenience is provided for patrons of the development.

Drainage

8. The submission to the Town and Country Planning Authority through the Westmoreland Parish Council, of drainage plans showing:
    1. The topography of the site
    2. The direction of surface flow to and from the site.
    3. The proposed levels.

Reason: To reduce hydrological impacts on the site and to facilitate assessment of the drainage proposal

Security

9. The submission of plans outlining all details for security of the occupants and development.

Reason: To ensure adequate provision is made for security.

Lighting

10. No occupation until the proposed security lighting system for the development is in place.

Reason: To ensure that adequate provision is made for security lighting.

Workers/staff accommodation

11. The submission to the Town and Country Planning Authority, through the Westmoreland Parish Council, of a scheme for workers'/ staff accommodation.

Reason: To ensure that adequate accommodation is made for workers.

Parking

12. Parking shall be provided in accordance with the Town and Country Planning (Westmoreland Coast) Confirmed Development Order 1981. Loading/unloading bay as well as off-street parking area for delivery vehicles shall be provided within the curtilage of the site.

Reasons: To ensure that adequate parking facility is provided to serve the development.

Pedestrian

13. The submission of a Scheme for the safe crossing of pedestrians.

Reason: To ensure safe passage of the guests and staff.

Temporary Water Storage

14. The applicant providing temporary water storage facilities for construction purposes on the site.

The construction of a permanent water storage facility with a capacity of Min 120,000 gallons to served the hotel during operation.

Reason: To ensure that water is available for construction and for use in the Hotel.

Heritage

15. The developer should afford access at all reasonable times to persons appointed by the Jamaica National Heritage Trust of the Planning Authority and notify such persons when excavations are taking place and allow him/her to take notes, to observe the excavations and record items of interest and findings.

Reason: To ensure that adequate provisions are made for the preservations of the Taino cultures.

16. The plans requested shall be submitted within 6 months of the date of this approval. The development must begin not later than the expiration of 2 years beginning with the date on which permission was granted.

Time

This approval is for a period of 2 years and the development must commence within this period of time. This approval is for a period of two years.

Reason: To ensure that the development commences as soon as possible.

Density

17. Density shall be provided at a rate of 20 Habitable Rooms per Acre.

Reason: To ensure satisfactory standards of development.

INFORMATIVE

APPEAL

(1) " If the applicant is aggrieved by the decision of the Planning Authority to refuse permission for the proposed development, or to grant permission subject to conditions, he may, by notice served within one month of the receipt of this notice, appeal to the Minister in accordance with Section 13 of the Town and Country Planning Law, 1957. The Minister has power to allow a longer period for the giving of a Notice of Appeal and he may exercise his power in cases where he is satisfied that the applicant has deferred the giving of notice because negotiations with the planning authority in regard to, the proposed development are in progress. The Minister is not, however, required to entertain such an appeal if it appears to him that the planning permission for the proposed development could not have been granted otherwise than subject to the conditions imposed by them, having regard to the provisions of Section 11 of the Law and of the Development Order and to any directions given in Order.

In certain circumstances provided in Section 17 of the Town and Country Planning Law, 1957, a claim may be made against the Town and Country Planning Authority for compensation where permission is refused or granted subject to conditions by the Minister on appeal".

(2) The various proposed parking arrangements should be separated and clearly identified on the plans.

(3) The operator is required to obtain a permit pursuant to the Natural Resources Conservation Act 1991 and the Natural Resources Conservation Permit and License Regulation 1996.

Yours faithfully,
TOWN AND COUNTRY PLANNING AUTHORITY

Laleta Davis-Mattis (Mrs.)
Secretary

c.c. The Secretary Manager
St. Elizabeth Parish Council

Annex 1

Title	Sheet	TPD#
Location Plan	1	55/AP/10BA2752/4/1
Overall site layout	A-01	55/AP/10BA2752/4/2
Part site plan, layout #1-134 small Hotel & Holiday Cottages	A-02	55/AP/10BA2752/4/3
Part site plan layout lot #11-14 & 52-61 Ecotourism & Shops	A-03	55/AP/10BA2752/4/4
Floor plans, small Hotel	A-04	55/AP/10BA2752/4/5
Site plan/Floor plan/elevation – Visitors center and Commercial Complex	A-05	55/AP/10BA2752/4/6
Site plan/Floor plan/elevation - Holiday cottages	A-06	55/AP/10BA2752/4/7

APPENDIX IV:
COPY OF LETTER FROM NWA SHOWING RECOMMENDED ROAD DESIGN FEATURES

NATIONAL WORKS AGENCY

140 Maxfield Avenue, Kingston 10, Jamaica Tel: (876) 926-3210-9 - Fax: (876) 926-2572

ANY REPLY OR SUBSEQUENT REFERENCE SHOULD BE ADDRESSED TO THE CHIEF EXECUTIVE OFFICER AND THE FOLLOWING REFERENCE NUMBER QUOTED:

Ref. No.:

KMA Regional Office
15 Hanley Park Road
Kingston 10
Tel: 926-6499
929-7755, 968-1568
Fax: 929-7307

Central Regional Office
1a Caledonia Road
Mandeville, Manchester
Tel: 962-2259
Fax: 961-5172

Western Regional Office
Barnett Main Road
Catherine, St. James
Tel: 940-7337
940-4466, 979-3106
Fax: 940-7973

North Eastern
Regional Office
32 all Street
Port Antonio
Portland
Tel: 993-2571
Fax: 993-9189

7th July 2003

Barry Brown Limited
Consultisng Engineers
5 Clieveden Avenue
KINGSTON 6

Dear Sir:

Re: Outline Application for Proposed Resort Development Comprising of 682 Bedrooms, Shopping Complex, etc. at Font Hill, St. Elizabeth by Petroleum Corporation Jamaica – Reference No. 2752/4

With reference to your letter dated 23rd April 2003, received 5th May 2003, re the above captioned, I am to advise that at this preliminary stage this Agency can only give guidelines to assist in the preparation of the detail plans for the proposed development.

With regard to the design of the road junction the following guidelines should be adhered to.

Northern Approach

- Minimum radius (northbound lane) = 12m
- Minimum radius (southbound lane) = 15m
- No stop bar is to be marked at the entrance to the northbound lane.

Southern Approach

- Minimum radius (left turn lane - northbound) 12m
- Minimum radius (southbound lane) 15m
- Southbound lane must not be divided

Western Approach

- Minimum taper length on westbound left turn lane = 70m
- Minimum taper length on westbound merge lane = 70m
- $T_1 > 105$m (see sketch)
- $T_2 \geq 55$m (see sketch)

Eastern Approach

- Minimum length of merge lane and diverge lane = 50m
- Merge lane and diverge lane must not be less than 3.5m wide at intersection.

Drainage

The information submitted in my opinion seeks approval which cannot be given based on the information submitted at this time. The detail drainage plans showing profile of the system and all other relevant information should be submitted with the final plans for approval.

Yours truly,

WINSTON HARTLEY
Physical Planner
For Chief Executive Officer

'Developing Safe, Reliable and Quality Roads'

APPENDIX V:
PROJECT AREA PROFILE WALK-THROUGH OBSERVATIONS

PROJECT AREA PROFILE
WALK-THROUGH OBSERVATION

Terrestrial Environment: Biota

VEGETATION	COMMENTS/OBSERVATIONS
Shrubbery	Exemplified by "rosemary" shrubs. Rosemary abundant on the western portion within 100 meters of the coast. Other shrubs present. Some xerophytic features such waxy layers on leaves in some cases. Shrubs on eastern portion of proposal are more densely spaced. More inland type phenotypic characteristics when compared to the western side.
Trees	Western portion of the plan has hardwood species e.g. Sea grape, red birch = "budge gum", burn wood, dog wood, pimento, nickel tree = donkey eye, prickle alla, cockspur (cat claws), tamarind, hog plums, wild cherry, logwood. Very significant is the presence of a large cotton tree near to the selected location of a proposed clubhouse. Cotton tree is 19 meters (63 ft) from fence, 13 meters (42 ft) circumference at breast height (1.5 meters) and an estimated 2.1 meters (7ft) diameter at 6 meters (20 ft) from the ground. Eastern portion also wooded. Species included calabash (gourd) tree, black olive and Lignum Vitae.
Epiphytes/ bromeliads	Wild pine, orchids, running cacti (round and tri-lobed species equally frequent), old man's beard occasional in wooded areas; abundant at western bird pond. Epiphytes and bromeliads abundant on west portion. On the west side a species with similar features as orchids was seen growing on the ground in an area of deep leaf litter. Possibly an orchid/epiphyte. To be revisited and confirmed. Epiphytes and bromeliads sparse to absent on eastern side. Cacti seen.
Palms	Thatch palm is the dominant palm spp. Abundant on western portion. No palms seen on eastern portion.
Grasses/ monocotyledons	Grass cover complete on western side and eastern side within the dry savannah areas approximately 200 – 300 meters north of the coast. Western portion had abundance of "Chinese bamboo" grass species.
Herbaceous plants	Mostly salt tolerant species on the west coastal area.

Terrestrial Environment – Biota

FAUNA	COMMENTS/OBSERVATIONS
Birds	On the western side, pelicans seen at sea (2), mocking bird (nightingale), John twit, white belly (dove), ground doves, king fishers (logger head), red head woodpecker (possibly Jamaican Woodpecker – *Melanerpes radiolatus*), Kildare (black and white), diving dappers, pond coote. On the east, flock of diving dappers (8+), Kildare (2) by inland pond, Dr. Bird.
Reptiles	One lizard on rocks on western side (brown/grey with 3 – 4 lateral brown bands on the dorsal side. Anole lizards).
Mammals	None seen.
Insects	On the west side there were butterflies (spp. to be confirmed) (yellow, pale yellow, orange). Diversity of colours and numbers increased northward (inland). Dragonflies on west end close to ponds. None seen on eastern side. Caterpillar on east side. Otherwise insect population considered comparatively occasional - rare.
Other	Frequent evidence of crustaceans (crab holes) on west side. Eastern side no evidence of crabs. 7 turtles counted in "turtle pond" east of Beach Park. One large turtle (estimated at 0.45 meters). Freshwater turtles assumed considering distance from coast and presence of thick tree/shrub barriers, elevation from shore and recharge source for pond maintaining low salinity environment.

Marine Coastal Environment: Biota

ORGANISMS	COMMENTS/OBSERVATIONS
Barnacles/muscles/oysters/ snails/crustaceans etc	At western section, chitons were primarily at fore front of rocky shore; secondarily at edges of inter-tidal pools approx 1- 1.5 m from natural sea wall. Also presence of other gastropods (Sub Class: Prosobranchia – marine snails). Small crabs abundant at rocky shore marine environment interface and tidal pools.
Fishes	None seen in tidal pools. No investigations in ponds ("turtle pond" and "bird pond") or near shore environments at time of visit. Turtle pond is reported to have fish biomass and bird pond to have occasional crocodile sightings.
Sea grass	None in project areas.
Mangroves	None in project areas.
Other	Vegetative transition in a south-north direction - sea parsley, sea grape species, and other xerophytes, palms and shrubbery, then trees (birch, logwood, wild cherry, other) including introduced spp of *Leuacena leucocephala*.

Marine/Coastal Environment – Abiotic

PHYSICAL ENVIRONMENT	COMMENTS/OBSERVATIONS
Beach	Though not a part of the project areas, is located in-between the designated project development areas and as such may be susceptible to activities within the built environment. Pristine in appearance. Small swimming area (est. 80m x 20m). Rocky areas on beach but predominantly a sandy shore. No berms. Absence of sea grass in demarcated areas. On the naturally elevated areas beyond the water-land interface is a grassed and build environment of kiosks, buildings, walk areas and concrete entertainment decking.
Rocky shore	Dominant feature being weather worn/pitted calcareous rock formations except for beach on south-eastern boundary of western portion of the development. Wide (15 – 20 meters).
Coral reef	Reef exists xxxx meters beyond beach location.
Tidal Pools	Principally on the rocky shore. 2 – 4 meters inland from water-rocky shore interface.
Mangrove	None seen in project areas
Other	Varied substrates within spray zone. Particle size range from coarse pebble beach specifically at Joseph Cove to coarse sand grains approx 15 meters from water-rocky shore interface. Fine sand and soil further inland. Occasional rock outcrops within 20 meters of dry rocky shore environment. Sea spray mild at time of site visit. Windy. Dry environment.

Terrestrial Environment – Abiotic

PHYSICAL ENVIRONMENT	COMMENTS/OBSERVATIONS
Ponds	Two ponds, "Twin Pond" west and "Turtle Pond" east. Essentially Twin Pond is a double pond connected by a low "overflow" area; the pond on the northern side has reeds/marsh grass which is occasionally dry (as at the time of the visits); other pond south had water and waterfowl. Twin Pond south is clear with finely divided green flocculants suspended above the substrate. Identified as a rock lined pond recharged from land runoff and/or subsurface recharge. Located in a clear opening and surrounded by logwood and other tree species. Turtle pond is partially hidden and completely surrounded by an overgrown hanging thicket. Trees and shrubs surround the pond. Normally filled with water (brown/green in colour). Appears to have a soft muddy substrate.
Streams	None seen. Four areas of natural drainage; 3 in western portion, one in eastern portion.
Elevations	On the western side, steep drop from rocky shore to sea; gradual slope from rocky shore to beyond the spray zone; steeper incline from terrestrial zone to main road. On the eastern side gradual slope from sea to beach; steep rise from beach to narrow rocky shore; gradual slope from rocky shore to terrestrial zone and main road. The project area on the eastern side includes the inland terrestrial area only.
Rock outcrops/soil etc.	Frequent rock outcrops within spray zone, rare in terrestrial zone on western side. Eastern portion had occasional rock outcrops. Sandy substrate in spray zone (except coarse pebbles at Joseph Cove). Typically crumbly loose brown/red soil. Grassy open areas and grasses in forested areas with open canopy.
Caves/sinkholes etc	None seen.
Other	Typical characteristics of dry limestone forest.

Other

	COMMENTS/OBSERVATIONS
Vista	Views from rocky shores across to beach and Joseph's Cove out to sea are visual highlights. Ingress to ponds provides a sudden and surprising vista.
Noise	Principally bird calls which could be heard from an estimated 100 – 150 meters. No unpleasant sounds from the sanctuary. Music played at the Beach Park and could be heard over 300 meters from the park. Vehicular traffic could be heard nearer to the road (est. 500 meters)
Proximity to road etc	

APPENDIX VI:
SPECIES LIST OF PLANTS AND BIRDS

SPECIES INVENTORY

List of Birds Present in the Font Hill Conservation Area

COMMON NAME	SCIENTIFIC NAME	STATUS[6]
American Coot	*Fulica americana*	C
American Kestrel	*Falco sparvarius*	C
American Redstart	*Setophaga ruticilla*	A
Antillean Nighthawk		C
Antillean Palm Swift	*Tachornis phoenicobia*	R
Arrow-headed Warbler	*D. pharetra*	U
Bananaquit	*Coereba flaveola*	A
Bank Swallow	*Riparia riparia*	C
Barn Owl	*Crotophaga ani*	A
Barn Swallow	*Hirundo rustica*	C
Belted Kingfisher	*Ceyle alcyon*	A
Black-and-white Warbler	*Moniotilia varia*	A
Black-bellied Plover	*Squatarola squatarola*	C
Black-crowned Night-Heron	*Nycticorax nycticorax*	C
Black-faced Grassquit	*T. bicolor*	A
Black-necked Stilt	*Himantopus mexicanus*	C
Black-throated Blue Warbler	*D. caerulescens*	C
Black-throated Green Warbler	*D. virens*	R
Black-whiskered Vireo	*V. altiloguus*	A
Blue Grosbeak	*Guiraca caerulea*	U
Blue-winged Teal	*Anas discors*	C
Blue-winged Warbler	*V. pinus*	U
Brown Booby	*Sula leucogaster*	U
Brown Pelican	*Pelecanus occidentalis*	A
Cape May Warbler	*D. tigrina*	C
Caribbean Coot	*F. caribaea*	R
Caribbean Dove (White-bellied)	*Columbina passerine*	A
Caribbean Martin	*Progne dominicensis*	A

COMMON NAME	SCIENTIFIC NAME	STATUS[6]
Caspian Tern	*Larus atricilla*	U
Cattle Egret	*Bubulcus ibis*	C
Cave Swallow	*Petrochelidon fulva*	C
Chestnut -sided Warbler	*D. pensylvanica*	C
Chuck-will's-widow	*Capnmulgus carolinensis*	C
Common Ground-Dove	*Zenaida macroura*	R
Common Moorhen		C
Common Potoo	*Nyctibius griseus*	U
Common Snipe	*Limnodromus griseus*	U
Common Tern	*T. sandvicensis*	C
Common Yellowthroat	*Geothlypis trichas*	U
European Starling		A
Glossy Ibis	*Plegadis falcinellus*	R
Golden-winged Warbler	*Vermivora chrysoptera*	U
Grasshopper Sparrow	*Ammodramus savannarum*	U
Gray Catbird	*Dumetella carolinensis*	U
Gray Kingbird	*Tyrannus dominicensis*	A
Great Blue Heron	*Ardea herodias*	C
Great Egret	*Egretta alba*	C
Greater Antillean Bullfinch	*Loxigilla vilacea*	A
Greater Antillean Grackle	*Quiscalus niger*	A
Greater Yellowlegs	*Tringa melanoleuca*	U
Green-backed Heron	*Butorides virescens*	C
Green-nunped Parrotlet (Guiana)	*Arotinga nana*	A
Hooded Warbler	*Wilsonia citrina*	C
House Sparrow	*Passer domesticus*	R
Indigo Bunting	*Passerina cyanea*	C
Jamaican Crow	*Corvus jamaicensis*	R
Jamaican Elaenia	*Myiopagus cotta*	U
Jamaican Euphonia	*Euphonia jamaica*	A
Jamaican Mango	*Anthracothorax mango*	A

COMMON NAME	SCIENTIFIC NAME	STATUS[6]
Jamaican Oriole	*Icterus leucopteryx*	A
Jamaican Owl	*Tyto alba*	C
Jamaican Tody	*Todus todus*	C
Jamaican Vireo	*Vireo modestus*	A
Jamaican Woodpecker	*Melanerpes radiolatus*	C
Killdeer	*C. vociferous*	C
Laughing Gull	*Gallinago gallinago*	C
Least Bittern	*Ixobrycnus exillis*	R
Least Grebe	*Podiceps dominicus*	U
Least Sandpiper	*Calidris maun*	U
Lesser Yellowlegs	*T. flavipes*	C
Limpkin	*Aramus guarauna*	R
Little Blue Heron	*Florida caerulea*	C
Loggerhead Kingbird	*T. caudifasciatus*	U
Lousiana Waterthrush	*S. motacilla*	A
Magnificent Frigatebird	*Fregata manificens*	A
Magnolia Warbler	*D. magnolia*	C
Mangrove Cuckoo	*Coccyzus americanus*	C
Merlin	*Falco columbarius*	C
Mourning Dove	*Zenaida aurita*	A
Northern Jacana	*Jacana spinosa*	C
Northern Mockingbird	*Mimus polygottos*	C
Northern Oriole	*Icterus galbula*	R
Northern Parula		A
Northern Rough-winged Swallow	*Stelgidopteryx ruficollis*	C
Northern Waterthrush	*S. noveboracensis*	A
Olive-throated Parakeet	*Leptotila jamaicensis*	C
Orangequit	*Euneornis campestris*	A
Osprey	*Pandion haliaetus*	C
Ovenbird	*Seiurus aurocapillus*	U
Palm Warbler	*D. palmarum*	A

COMMON NAME	SCIENTIFIC NAME	STATUS[6]
Pectoral Sandpiper	*C. minutilla*	C
Peregrine Falcon	*Falco peregrinus*	U
Pied-billed Grebe	*Podilymous podiceps*	C
Prairie Warbler	*D. discolor*	A
Prothonotary Warbler	*Protonotaria citrea*	U
Purple Gallinule	*Porphyrula martinica*	U
Red-eyed Vireo	*Vireo olivaceus*	R
Red-tailed Hawk	*Buteo jamaicensis*	U
Rock Dove	*Sterna hirundo*	U
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	U
Royal Tern	*Hydroprogne caspia*	C
Ruddy Turnstone	*Actitis macularia*	C
Sad Flycatcher		C
Saffron Finch	*Sicalis flaveola*	C
Sanderling	*Arenaria interpres*	C
Sandwich Tern	*Thalasseus maximus*	U
Scarlet Tanager	*Piranga olivacea*	R
Semipabnated Plover	*Charadrius semipalmatus*	U
Shiny Cowbird	*Molothus bonariensis*	C
Short -billed Dowitcher	*Micropalama himantopus*	R
Smooth-billed Ani	*Coccyzus minor*	A
Snowy Egret	*E. thula*	C
Solitary Sandoi	*Tringa solitaria*	U
Spotted Sandpiper	*Catoptrophorus semipaimatus*	C
Stilt Sandpiper	*C. melanotos*	R
Stolid Flycatcher	*Myiarchus stolidus*	A
Streamertail	*Trochilus polytmus*	A
Stripe-headed Tanager	*Spindalis zena*	C
Swainson's Warbler	*Limnothlypis swaisonii*	C
Tennessee Warbler	*V. peregrima*	U
Tree Swallow	*Iridoprocne bicolor*	C

COMMON NAME	SCIENTIFIC NAME	STATUS[6]
Tricolored Heron	*Hydranassa tricolor*	C
Turkey Vulture	*Cathartes aura*	C
Vervain Hummingbird	*Mellisuga minima*	A
West Indian Whistling-Duck	*Dedrocygna arborea*	C
Western Sandpiper	*Crocethia alba*	U
White Ibis	*Eudocimus albus*	R
White-chinned Thrush	*Turdus aurantius*	C
White-collared Swift	*Streptoprocne zonaris*	C
White-crowned Pigeon	*Columba livia*	U
White-tailed Tropicbird	*Phaethon lepturus*	R
White-winged Dove	*Columba leucocephala*	A
Wilson's Plover	*Charadiius wilsonia*	C
Worm-eating Warbler	*Helmintheros vermivorus*	C
Yellow Warbler	*Dendroica petechia*	A
Yellow-bellied Sapsucker	*Sphyrapicus varius*	C
Yellow-billed Cuckoo	*Forpus passerinus*	A
Yellow-crowned Night-Heron	*N. violacea*	C
Yellow-faced Grassquit	*Tiaris olivacea*	A
Yellow-rumped Warbler	*D. coronata*	C
Yellow-shouldered Grassquit	*Loxipasser anoxanthus*	C
Yellow-throated Warbler	*D. dominica*	U
Zenaida Dove	*Zenaida asiatica*	A

[6] Status: A = abundant; C = common; U = uncommon; R = rare

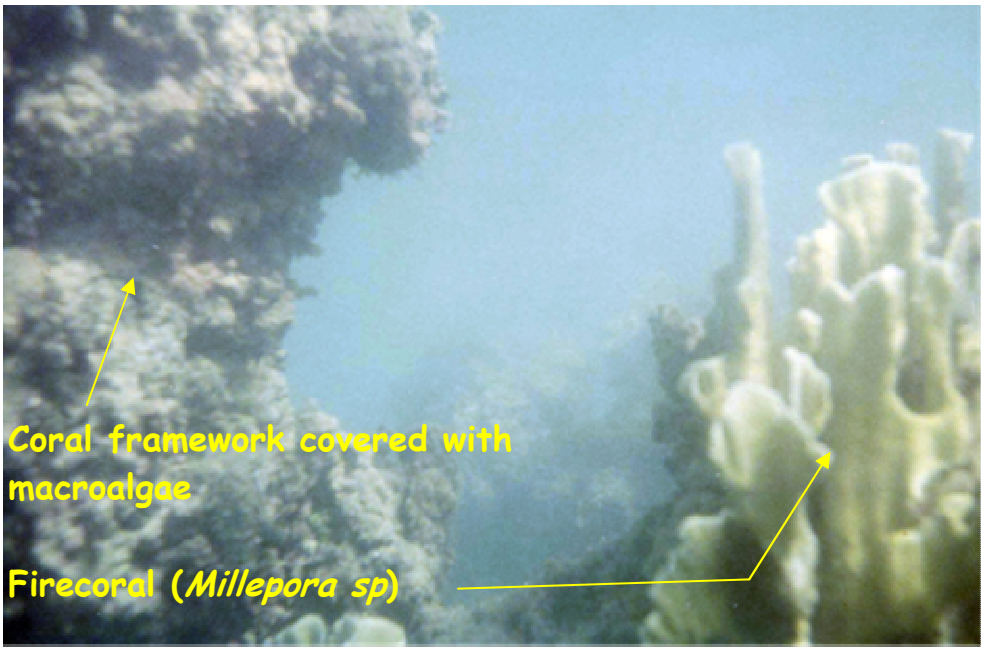
Flora of Font Hill Conservation Area

COMMON NAME	SCIENTIFIC NAME	STATUS
Ball Moss	*Tillandsia recurvata*	
Bastard Cedar	*Guazuma ulmifolia*	
Bermuda Grass	*Cvnodon dactvlon*	
Black Mangrove	*Avicennia nitidia*	
Black Olive	*Buceras bucida*	
Broom Thatch	*Thrinax parviflora*	
Bull Thatch	*Sabal iamaicenciss*	
Bullrush	*Typha domingensis*	
Bum Wood	*Metopium brownii*	
Cacia	*Acacia mimosa*	
Calabash	*Crescentia cujete*	
Cowitch	*Mucuna ururiens*	
Crowfoot	*Dactyloctenium aegylptum*	
Deadly nightshade	*Echites unbellata*	
Devil's Horsewhip	*Achyranthes indica*	
Duppy Gun	*Ruellia tuberosa*	
Duppy soursop	*Morinda citrifolia*	
Giant Swamp Fern	*Acrostichum aureum*	
Guango	*Samanea saman*	
Guinep	*Exothea paniculata*	
Jointed Piper	*Piper sp.*	
Kingston Buttercup	*Tribulus cistoides*	
Lignum vitae	*Guaiacum Officianale*	
Logwood	*Haematoxvlum campechianum*	
MilkWeed	*Euphorbia prostrata*	
Morass Reed	*Ceratophyllum demersum*	
Morning Glory	*Ipomoea pes-caprae*	
Nightshade	*Urechites lutes*	
Old Man's Beard	*Tillandsia usneoides*	
Orchid	*Broughtonea sanguinea*	

Pencil Flower	*Stylosanthes hamata*	
Pepper Rod	*Croton humilis*	
Pimento	*Pimento dioica*	
Pinguin	*Bromelia pimguin*	
Prickly pear	*Opuntua dillenii*	
Purslane	*Sesuvium portulacastrum*	
Red Birch	*Bursera simarouba*	
Red Mangrove	*Rhizophora mangle*	
Sanbur	*Cenchrus incertus*	
Seagrape	*Coccoloba uvifera*	
Seashore rush grasS	*Svorobolus vinzinicus*	
Seaside bean	*Canavalia maritima*	
Seaside Mahoe	*Thespesia populnea*	
Seymour Grass	*AndroPogonpertusus*	
Silk Cotton	*Ceiba vetandra*	
Silk Cotton Tree	*Ceiba pentandra*	
Water Lily	*Nymphae ampla*	
Weed	*Sida fhombifolia*	
White Mangrove	*Laguncularia racemosa*	
Wild Cherry	*Malphigia glabra*	
Wild Rosemary	*Croton linearis*	

APPENDIX VII:
PHOTO INVENTORY

Plate 1: Transect 1



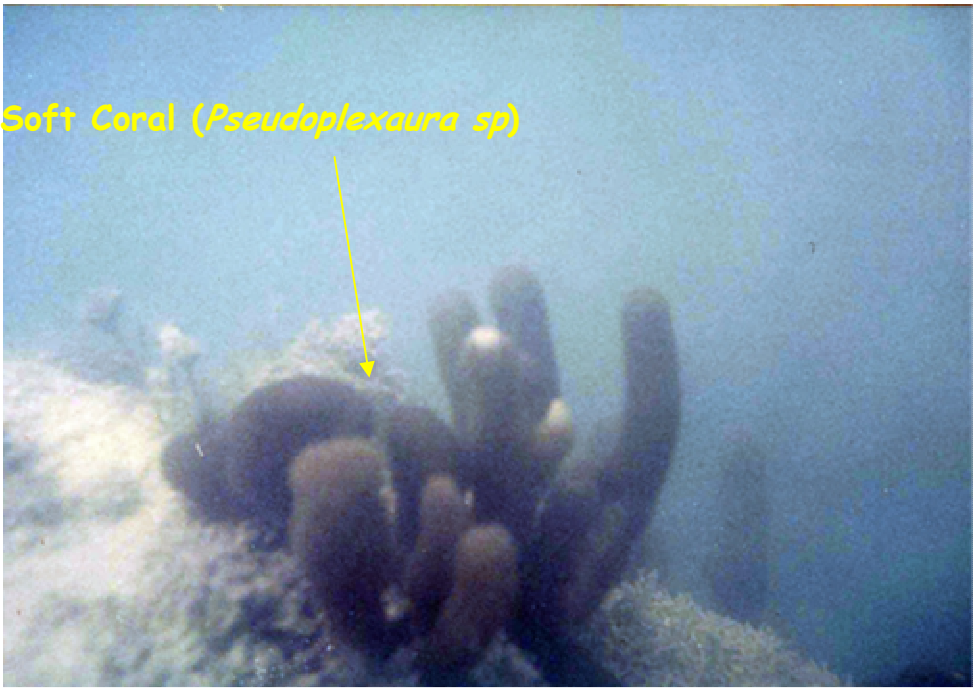
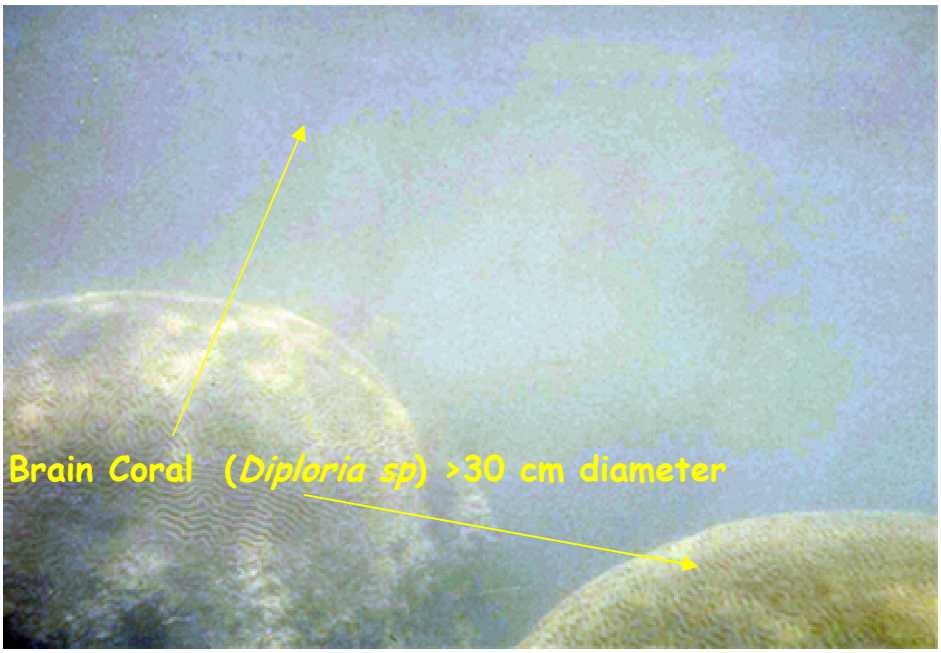


Plate 2: Transect 1



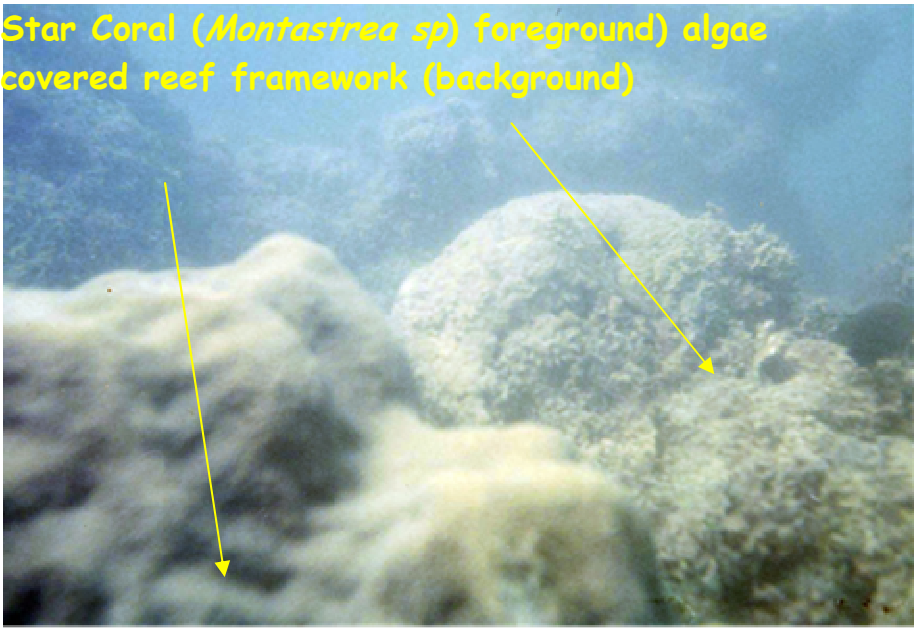


Plate 3: Transect 1 (continued)

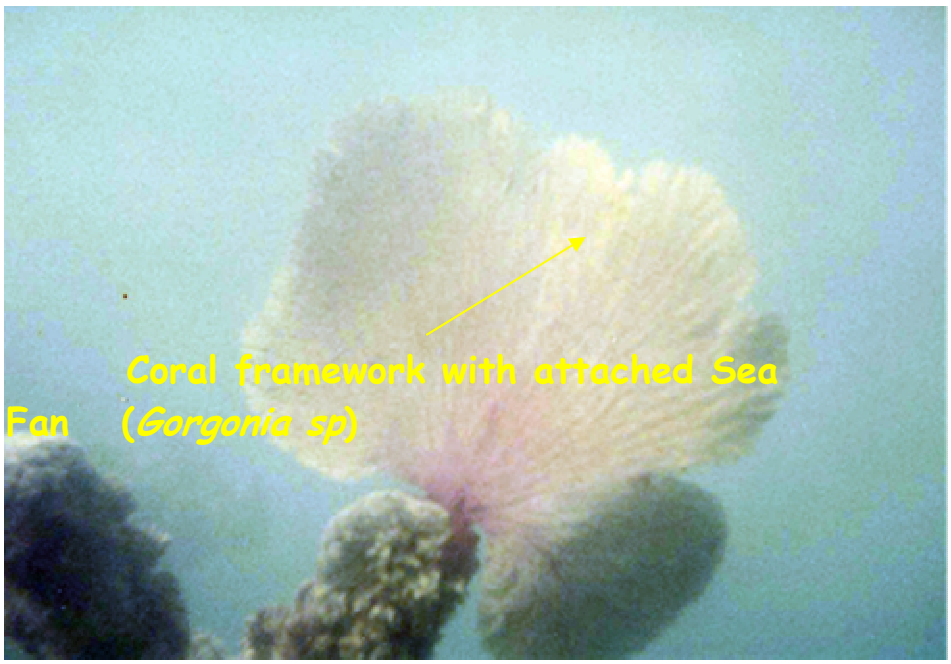
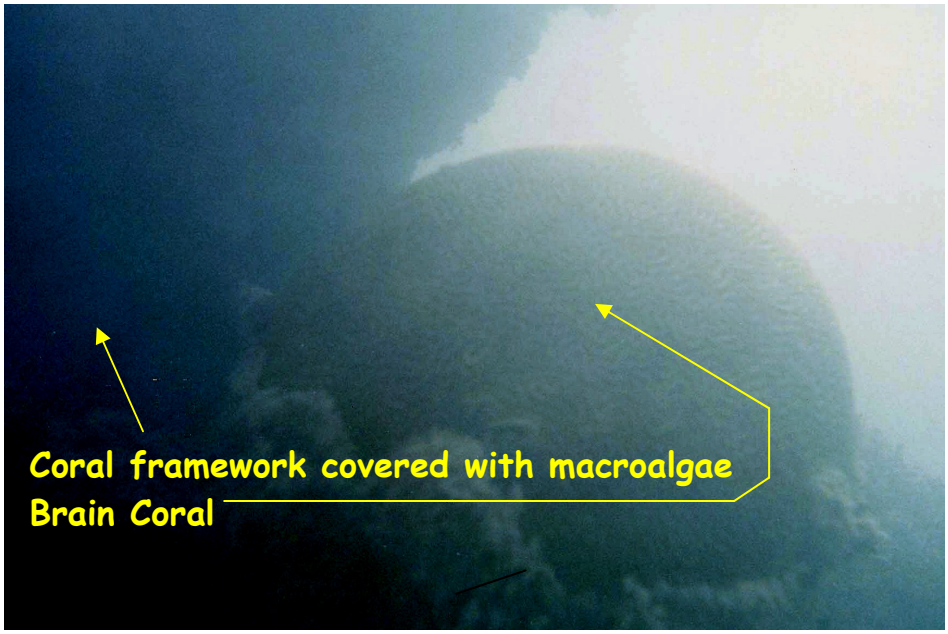


Plate 4: Transect 1(continued)



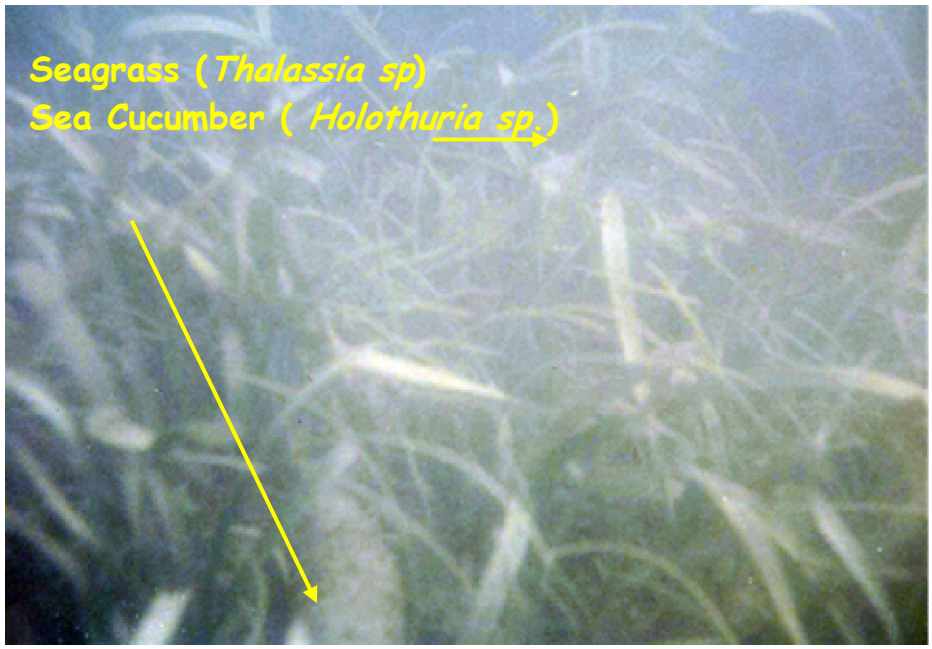
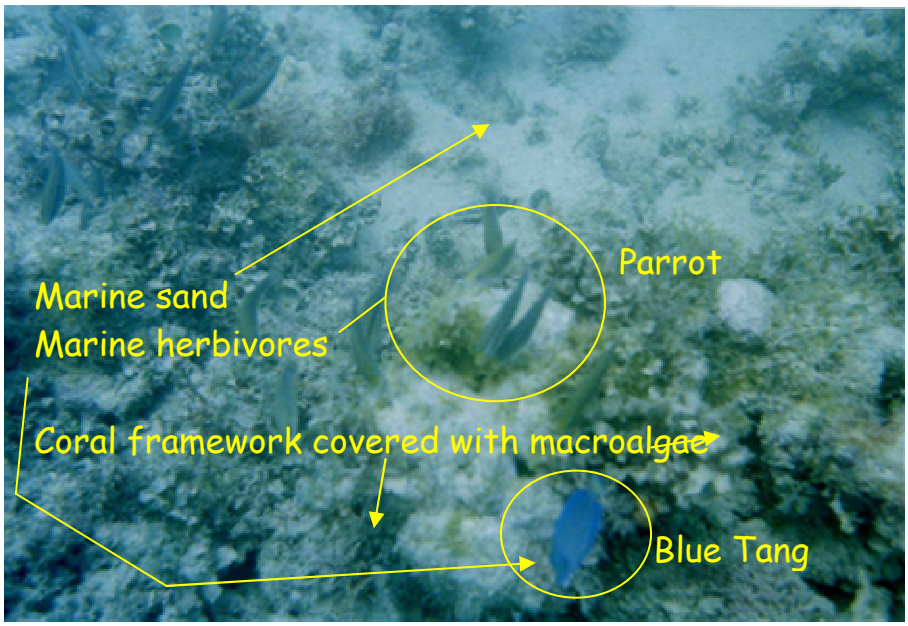


Plate 5: Transect 5



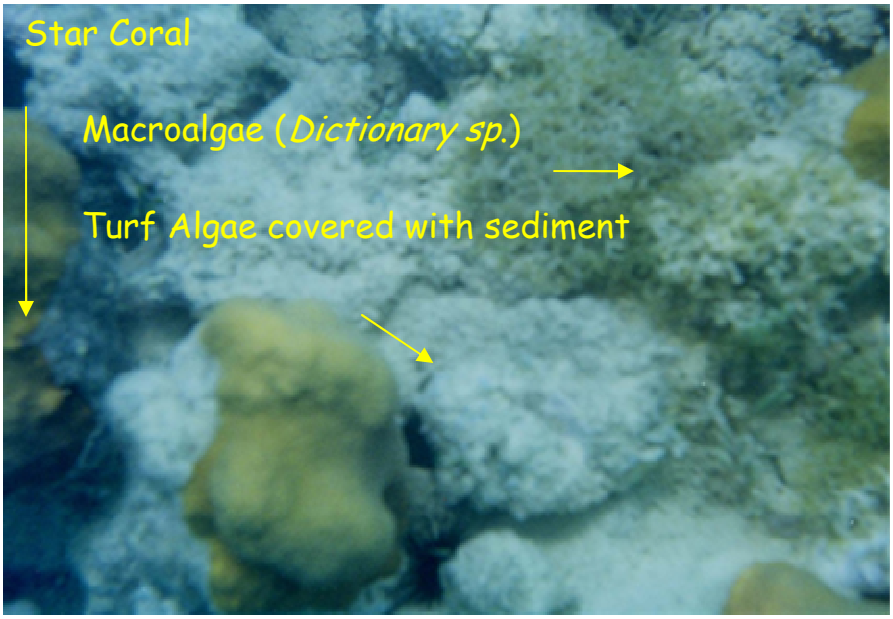


Plate 6: Transect 5 (continued)

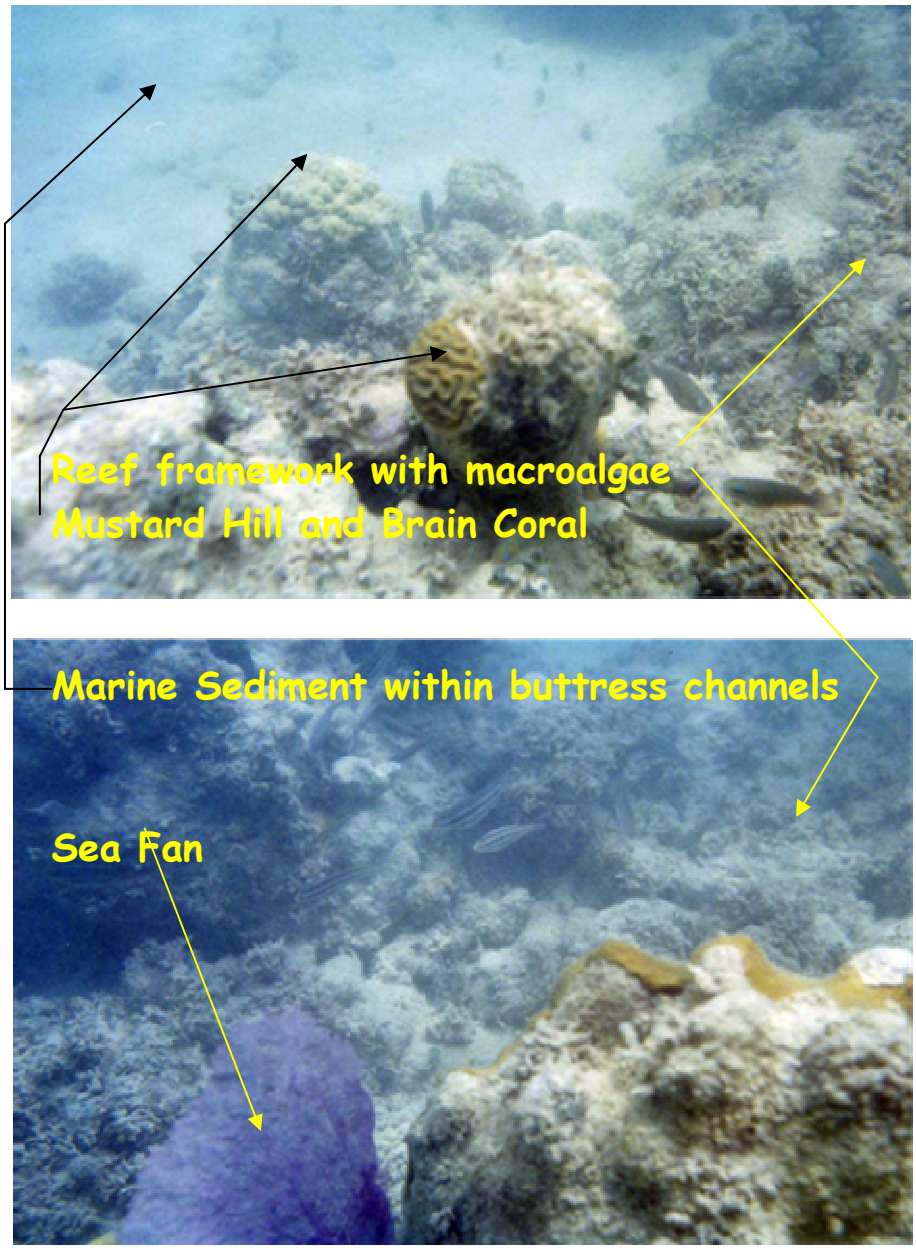


Plate 7: Transect 2 and 6

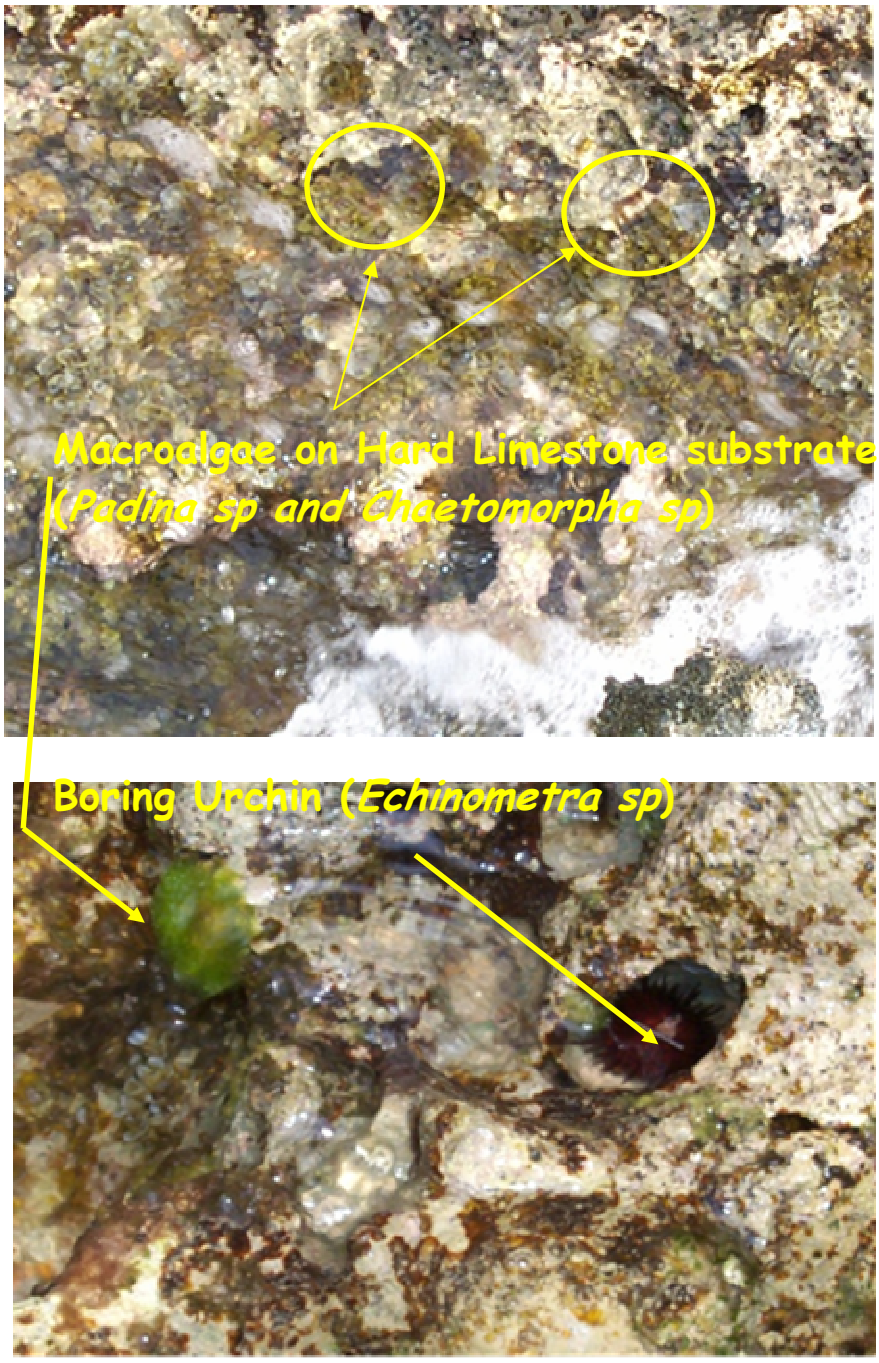


Plate 8: Transect 2 and 6 (continued)

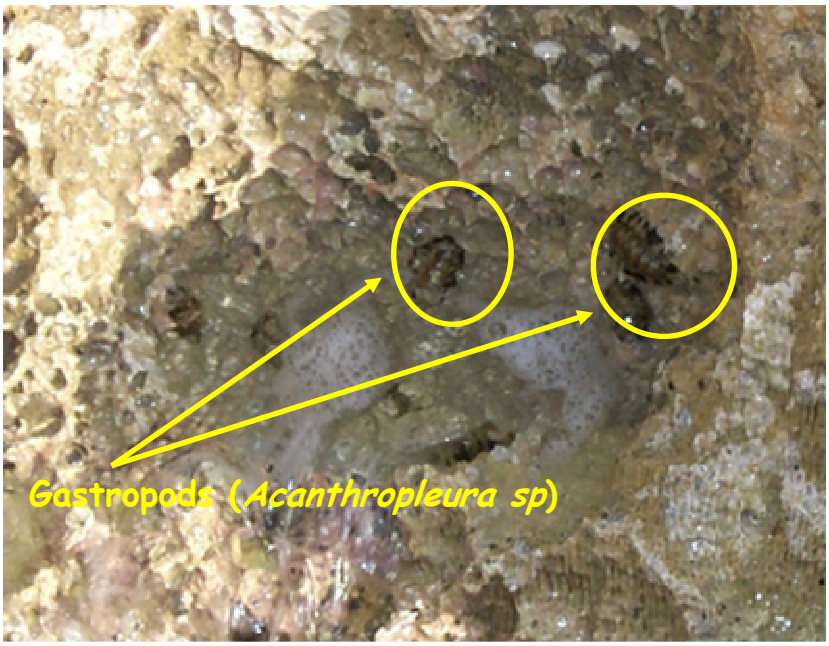


Plate 9: Entrance to Font Hill Beach Area

Plate 10: Exit from Font Hill Beach Area

Plate 11: Coastline showing: jagged rocks, beach (recreational activity) and mangrove

.Plate 12: Offshore coastal features forming a natural barrier against beach erosion

Plate 13: Typical Water Store, showing thin bladed shrubs and loose leaf mosaics

Plate 14: South western Pond with surface totally covered by Reedmace (*Typha Domingnisis*)

Plate 15: Part of *leucaena* plantation and grassland on property

Plate 16: Part of *leucaena* plantation on northern boundary

Plate 17: Typical Low Leaf Litter found in northern section of the property. Low moisture would reduce decomposition rates

Plate 18: Opportunistic grass species dominating undergrowth. Human activities such as land clearance probably allowed this.

Plate 19: Common preponderant *Thrinax* species found on site. Positive identification was not made, but at least one *Thrinax* species, *Thrinax parviflora* is endemic

Plate 20: Inflorecence of climbing cactus, *Hylocereus triangularis*

Plate 21: Common emergent tree, Red Birch (*Bursera simarouba*) found through study site

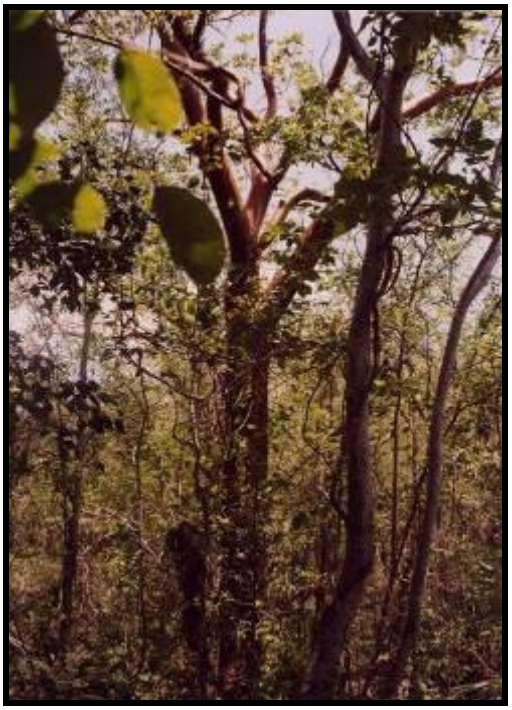


Plate 22: Epiphytic cacti

Plate 23: Climbing cactus, *Selenicereus grandiflora*, also noted in the study area

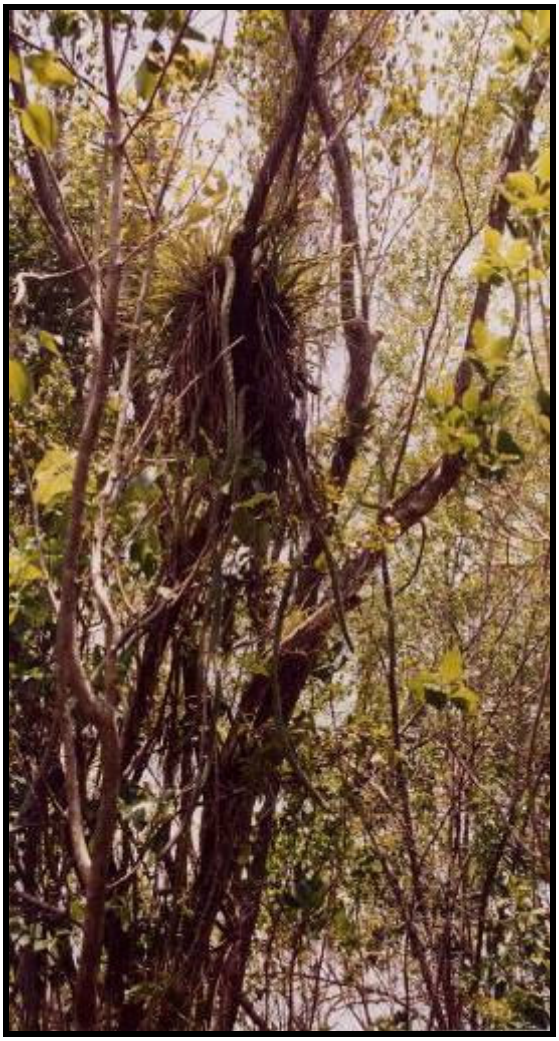


Plate 24: Climbing cactus and other epiphyte species on large logwood (*Haemotoxylum campechianum*) tree

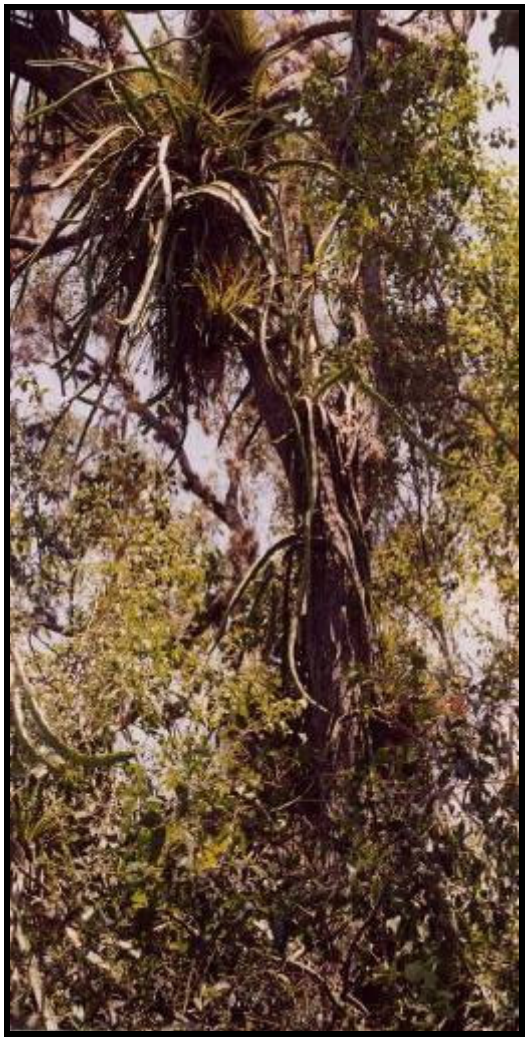


Plate 25: Epiphytes, *Tillandsia* species commonly found on tree species on site.

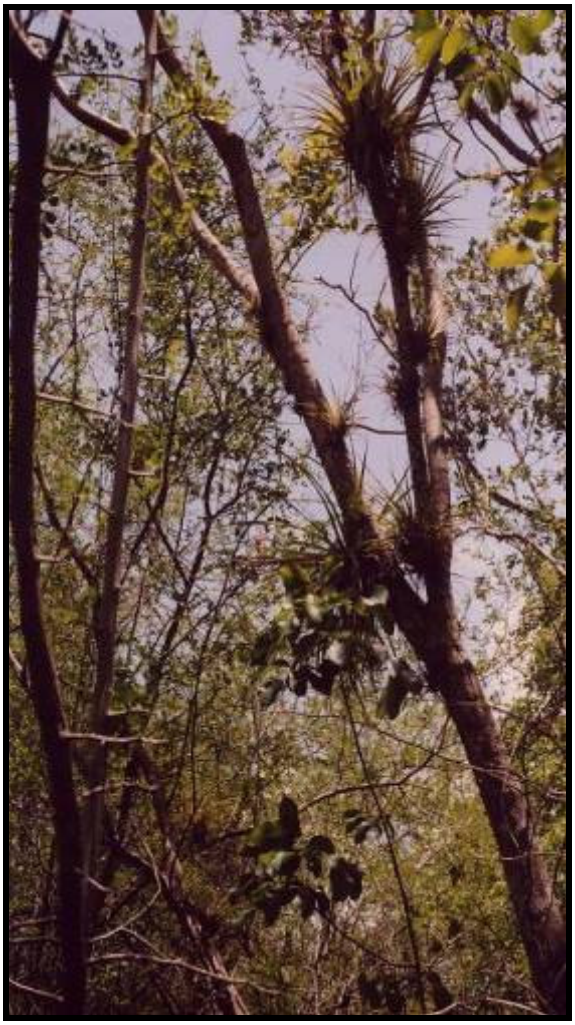


Plate 26: Silk Cotton Tree

Plate 27: North western saline twin pond found on site, surrounded by Mangrove and *Acacia* species

Plate 28: South western saline pond

Plate 29: North eastern saline pond

Appendix VIII:
Wildlife Reserve - *Turtles and Crocodiles*

Aquatic Wildlife Reserve

Turtles

Turtle Population

There is an existing turtle nesting area reserved within the ecopark designated to the east of the development. This ecopark is approximately 200 hectares and was reserved after consultations with the St. Elizabeth Environmental Protection Association (S.E.E.P.A.) should be noted that the above mentioned nesting area is not located in project site, which is in phase one of the development, and is therefore not a part of this project

Along the coastline from Parottee to Font Hill, the highest concentration of nests was found in an area 200 yards east if the existing Font Hill Beach Park. There were seventeen new and eighteen old nests. Turtle activity was also evident through to Malcolm Bay and to a lesser extent, the Parotee area.

Threats to Sea Turtles

Sea Turtles live throughout the tropics and spend most of their lives in the sea, coming on to land only long enough to lay their eggs. The coral reefs and coastal areas are important to turtles for feeding and breeding.

The turtle population in Jamaica is on the decline as a result of illegal hunting and destruction of the coral reefs through sand mining and coastal development.

CROCODILE

According to Mr. Charles Swaby in his Interim Report concerning the proposal to develop a wildlife reserve at Font Hill, presented in February of 1985, the Font Hill area is a “stronghold of the crocodile in Jamaica”. This condition appears to have been maintained through incidents of encroachment and even killing of the crocodiles.

Further surveys have since been conducted, and work up to 2004 indicates that the Font Hill property remains a viable crocodile habitat. The information for 2004, gathered by a post-graduate student form the University of the Wes Indies and an Officer of the National Environment and Planning Agency, reveals that all the ponds indicated on the Proposed Font Hill Management Resource Protected Area Map contained crocodiles.

Several nests were found along the beach parallel to Flat Pond, as well as on the bay adjoining Luana Point which had a high density of crocodile as well as turtle nests.

A more thorough study is required to determine the movements of the crocodiles within and outside this habitat.

APPENDIX IX:
BIOLOGY AND CHEMISTRY OF SEWAGE TREATMENT PROCESS & CALCULATIONS

BIOLOGY AND CHEMISTRY OF SEWAGE TREATMENT PROCESS AND CALCULATIONS

WASTE STABILIZATION PONDS

Waste stabilization ponds are large shallow basins enclosed by earthen embankments in which raw sewage is treated by entirely natural processes involving both algae and bacteria. Since these processes are unaided, by man (who merely allocates a place for their occurrence) the rate of oxidation is rather slow and as a result long hydraulic retention times are employed, 30-50 days not being uncommon. Ponds have considerable advantages (particularly as regarding cost and maintenance requirements and the removal of faecal bacteria) over all other methods of treating the sewage from communities of more than 100 people. They are without doubt the most important method of sewage treatment in hot climates where sufficient land is normally available and where the temperature is most favorable for their operation. Their use is not of course restricted to hot climates: they are used at all latitudes, even as far north as Alaska. They are important method of treatment in many industrialized countries for example, nearly one-third of all municipal wastewater treatment plants in USA are stabilization ponds.

There are three major types of ponds: facultative, maturation and anaerobic ponds.

These three are the most common. They normally receive raw sewage or that which has received only preliminary treatment; they are, however, becoming increasingly used to treat the settled effluent from septic tanks and anaerobic pretreatment ponds. The term 'facultative' refers to a mixture of aerobic and anaerobic conditions and in a facultative pond aerobic conditions are maintained in the upper layers while anaerobic conditions exist towards the bottom. Although some of the oxygen required to keep the upper layers aerobic comes from reaeration through the surface, most of it is supplied by the photosynthetic activity of the algae which grow naturally in the pond where considerable quantities of both nutrients and incidents light energy are available. Indeed, so profuse is the growth of algae that the pond contents are bright green in color. The pond bacteria utilize this 'algae' oxygen to oxidize the organic waste matter. One of the major end products of bacterial metabolism is carbon dioxide, which is readily utilized by the algae

during photosynthesis since their demand for it exceeds its supply from the atmosphere. Thus there in association of natural benefit ('symbiosis') between the alga and bacteria in the pond. Since photosynthesis is a light dependent activity there is a diurnal variation in the amount of dissolved oxygen present in the pond and a similar fluctuation in the level of the 'oxypause' (the point below the surface at which the dissolved oxygen concentration becomes zero) occurs. The pH of the pond contents also follows a daily cycle increasing with photosynthesis to a maximum which may be as high as 10. This happens because at peak demand algae remove CO_2 from solution more rapidly than it is replaced by bacterial respiration: as a result the bicarbonate ions present dissociate to prove not only more CO_2 but also the alkaline hydroxyl ion which increases the pH value.

Mixing

Wind and heat are two factors of major importance, which influence the degree of mixing that occurs within a pond. Mixing fulfils a vital function in a pond: it minimizes hydraulic short-circuiting and the formation of stagnant regions and it ensures a reasonably uniform vertical distribution of BOD, algae and oxygen. Mixing is the only means by which the large numbers of non-motile algae can be carried up into the zone of effective light penetration (the 'photic' zone); since the photic zone comprises only the top 150 -300mm of ponds, much of the pond contents would remain in permanent darkness if mixing did not occur. Mixing is also responsible for the transportation of the oxygen produced in the photic zone to the bottom layers of the pond. Good mixing thus increases the safe BOD load that can be applied to a pond.

Sludge Layer

As the sewage enters the ponds most of the solids settle to the pond bottom to form a sludge layer. At temperatures >15 °C intense anaerobic digestion of the sludge solids occurs; as a result thickness of the sludge layer is rarely more than about 250mm and often much less. Desludging is only rarely required once every 10-15 years. At temperatures >22°C the evolution of methane gas is sufficiently rapid to buoy sludge particle up to the surface where drifting sludge mats are formed. These must be removed (together with any other floating debris or scum) so that they do not prevent the penetration of light into the photic zone.

The soluble products of fermentation diffuse into the bulk liquid of the pond where they are oxidized further. The seasonal variation of the rate of fermentation (which increases approximately sevenfold with each 5 °C rise in temperature) explains why the BOD_5 in the pond often remains sensibly constant throughout the year in spite of the changes in temperature:

During summer, the degradation rate is high and, from the theory, a low equilibrium BOD in the pond is established. However, the BOD load received from the sludge is high. During winter the degradation rate is low, establishing a relatively high equilibrium BOD in the pond, .but a low BOD load is received from the sludge. The two processes operating simultaneously tend to cancel out and decrease the cyclic variation of pond BOD.

Depth

Depths less than 1.0m do not prevent the emergency of vegetation. This must be avoided, as otherwise the pond becomes an ideal breeding ground for mosquitoes and midges. With depths greater than 1.5m the oxypause is too near the surface with the result that the pond is predominantly anaerobic rather than predominantly aerobic.

Climatic Influences

A hot climate is ideal for pond operation. Solar radiation is intense and as a result, pond temperatures are high and there is more than adequate intensity of light. The long daylight hours enable algal photosynthesis to occur for extended periods and so provide a reserve of dissolved oxygen for use during night. There is however usually a month or more of seasonal cloud cover and although light intensities during this time are sufficient for algal activity, the temperature falls to its annual minimum and is this that limits both algal and bacterial growth.

Maturation Ponds

Maturation ponds are used as a second stage to facultative ponds. Their main function is the destruction of pathogens. Faecal bacteria and viruses die off reasonably quickly owing to what is to them an inhospitable environment. The cysts and ova of intestinal parasites have a relative density of about 1.1 and as a result of the long retention times they settle to

the bottom of the pond where they eventually die. The removal of BOD_5 in maturation ponds is small: two ponds in series each with a retention time of 7 days are required to reduce the BOD_5 from about 50 - 70mg/1 to less than 25mg/l.

Parameters. Analysis for two rows of ponds.	**US**	**Metric**
Total avg. flow		**461** m^3/day
Average Flow (Q)	0.061 mgal/day	231 m^3/day
Infiltration at 10%	0.006 mgal/day	23.1 m^3/day
Peak Factor	**2.5**	2.5
Peak Flow (Q_p)	0.17 mgal/day	576 m^3/day
Influent BOD (L_i)		**250 mg/L**
Lowest average monthly temp. (T)	78.8 deg far.	**26** deg cent.

Maturation ponds are wholly aerobic and are able to maintain aerobic conditions at depths of up to 3m. Usually, however, the depth of a maturation lagoon is taken as the same as that of the associated facultative lagoon (1 - 1.5m). This is advisable, as well as usually being convenient sine the destruction of viruses is better in shallow ponds than in deep ones. The effectiveness of maturation ponds in removing pathogens is conveniently assessed by the removal of faecal coliforms with proper design removals greater than 99.99 percent can be achieved. In these circumstances no difficulty should be experienced in satisfying an effluent standard of <1000 FC/100 ml.

Extract from sewage treatment in hot climates - Duncan Mara

FONT HILL SUBDIVISION WASTE STABILIZATION PONDS SEWAGE TREATMENT CALCULATIONS

FACULTATIVE PONDS

Assume completely mixed reactors with BOD removal following first order kinetics.

To maintain aerobic conditions Le is in the range 50-70 mg/L

Choose L_e **60** mg/L

Pond depth (D) **1.2** m

Rate constant $k_1(T)$ 0.402 /d $<k_1(20) = 0.3,\ k_1(T) = (1.05)^{T-20}$

From MARA eq 7.11 Min. average area $A = (Q/Dk_1)*(L_i/L_{e-1})$

Minimum average Area (A) 1664 m^2

Modified Average Area (A^*) **2800** m^2

Hydr. Ret. time ($t^* = AD/Q$) 13 days Permissible 400kg/ha d.

Surface BOD loading ($10L_iQ/A$) 226.4 kg/ha d. >< Range 130-270 kg/ha d

Volumetric BOD loading (L_i/t^*) 18.9 g/m^3 d. >< Range 15-30 g/m^3 d.

MATURATION PONDS

Faecal bacteria removal following first order kinetics

From MARA eq 7.20 $N_e = N_i/[(1 + K_b t_1^*)....(1 + K_b t_n^*)]$

Assumed number FC influent N_i =38,000,000 MPN/100 ml ><3.5 - $4x10^7$

Rate constant $K_b = 2.6(1.19)^{(T-20)}$ 7.4 /d

Required Hydr. ret. time (t^*) 6.0 days

Number of ponds 2.0

Number coliform in effluent (N_e) 187.3 FC/100 ml < 1000 MPN/100 ml required

Effluent BOD_5 $L_e = L_i/(1 + k_1 t^*)$ 10.3 mg/l < required 20 mg/l

Average Pond Area $Q t^*/D$ 1268 m^2 each

Pond top dimensions with slope 3:1and 0.6 m freeboard:

2 No. Facultative 71x26 x1.2m deep

4 No. Maturation 36x15x1.2m deep

2 No. Hyacinth 36x15x1.2m deep

FONT HILL SUBDIVISION

Nitrogen Removal

First 3 ponds due to volatilization:

$N_e = N_i\ (1/(1 + t(0.000576T - 0.00028)\ \exp^{((1.08 - 0.042T)(pH - 6.6)}$)

Influent Nitrogen N_1 = 30 mg/l N_e = 17.0 mg/L from 3rd pong

Water Hyacinth in additional polishing pond. Final effluent Nitrogen $N_{e1}\ N_e\ \exp^{(-kt^*)}$

Removal from 4th pond with 80% or more of pond covered from last pond.

N_{e1} = 4.6 mg/l <10.0 mg/L

PHOSPHORUS REMOVAL

Phosphorus removal shown by testing to be limited by nitrogen uptake and be about 30 to 50%

Expected Phosphorus uptake at 30% min. 10.5 mg/l from the last pond >4.0 mg/L

To bring effluent phosphorus to below 4.0 mg/L Allum will be added to the last pond as required up to 150 mg/L.

EFFLUENT REUSE

Final number coliform in effluent N required. 19.0FC/100ml<100MPN/100 ml

Chlorination of the effluent will bring the coliform levels to within 12MPN/100ml required.

The effluent from the Hyacinth ponds will be recycled to the adjacent farm, or used to irrigate lawns and verges in the subdivision

Pump Station #1

Average flow: **BBL**

Source	No.	Occupancy	Flow/each	Flow Q
Cottages	**14**	**4**	**0.6**	33.6 m^3/day
Small Hotels	**2**	**30**	**0.6**	36.0
Club House	**1**	**1**	**5.64**	75.2 m^3/day

Infiltration @10.0% = 7.5

Total = **82.8** m^3/day

Peak Factor = **2.5**

Peak flow = 206.91 m^3/day

Storage Volume for Pump Well

Use max 10 starts/hour for Pump. Equivalent to 6 minutes Cycle time.

Cycle time (T) = (V/(P-Q) + (V/Q)) = **6 minutes**

Storage Volume = Vm^3

Pump capacity = P L/sec

Incoming Flow (Q) = L/sec

Incoming Flow Q = 2.39 L/sec

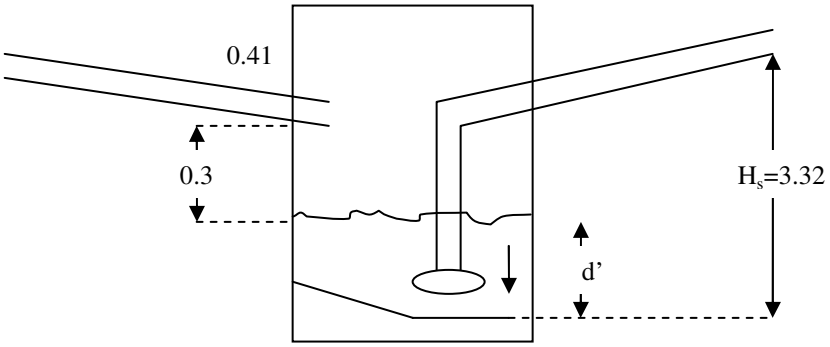
Pump Capacity (P) = 150.0% Q = 3.59 L/sec

Volume (V) = 0.29 m^3

Using a **1200** mm dia. Well depth (d) = 257.15 mm

Max. cycle time Tmax = 60 minutes

Pump Design



Influent Invert = **0.41** m

Effluent Invert = **2.72** m

d'=d + 300mm = **0.56** m

Freeboard = **0.30** m

Sump Invert = -0.45 m

Pipe Length = 20.00 m

Pipe diameter = 0.08 m

Exit pressure (H_x) = 1.32 m

Pipe friction (H_f) = 0.21 m

Flow velocity = 0.79 m/sec > 0.76 m/sec

Static discharge head = 3.32 m

Select pump type **Submersible Sewage**

Power = 0.5 kW 0.7bhp

220 V, 50 cycles 220 V 50 cycles

Total Head (H) = 4.85 m 16 ft

Pump capacity (P) = 3.59 L/sec 58 US gal/min

Pump Station #2

Average flow: (Total flow – Flow to pump #1) **BBL**

Flow (Q) = 378.2 m^3/day

Infiltration @10.0% = 37.8

Total = **416.1** m^3/day

Peak Factor = **2.5**

Peak flow = 1040.149 m^3/day

Storage Volume for Pump Well

Use max 10 starts/hour for Pump. Equivalent to 6 minutes Cycle time.

Cycle time (T) = (V/(P-Q) + (V/Q)) = **6 minutes**

Storage Volume = Vm^3

Pump capacity = P, L/sec

Incoming Flow = Q, L/sec

Incoming Flow (Q) = 12.04 L/sec

Pump Capacity (P) = 150.0% Q = 18.06 L/sec

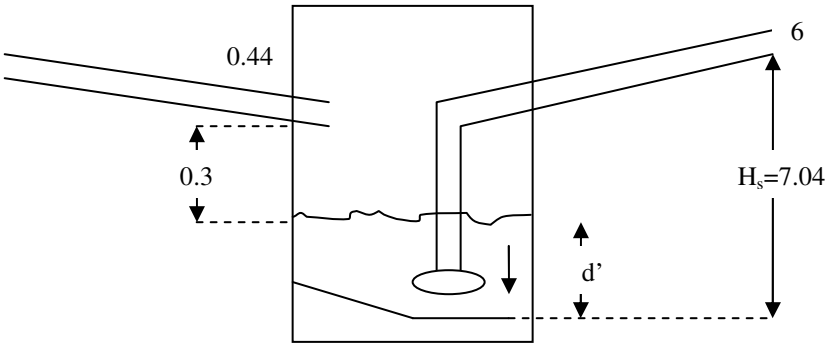
Added flow pump #1 = 59.7% of pump over capacity ***OK***

Volume (V) = 1.46 m^3

Using a **1600** mm dia. Well depth (d) = 727.14 mm

Max. cycle time Tmax = 60 minutes

Pump Design



Influent Invert = **0.44** m

Effluent Invert = **6** m

d'=d + 300mm = **1.03** m

Freeboard = **0.30** m

Sump Invert = -0.89 m

Pipe Length = **822.00** m

Pipe diameter = 0.15 m

Exit pressure (H_x) = 1.32 m

Pipe friction (H_f) = 6.80 m

Flow velocity	=	1.08 m/sec	> 0.76 m/sec
Static discharge head	=	7.04 m	
Select pump type		**Duplex Submersible Sewage**	
Power	=	5.8 kW	8.1bhp
		220 V, 50 cycles	220 V 50 cycles
Total Head (H)	=	15.15 m	50 ft
Pump capacity (P)	=	18.06 L/sec	290 US gal/min

APPENDIX X:
VEGETATION SURVEY – CALCULATIONS

APPENDIX X:

VEGETATION SURVEY – CALCULATIONS

CALCULATIONS

a) **The frequency** :$\frac{\text{number of plots in which species occurs}}{\text{Total number of plots}} \times 100$

b) **Density:** $\frac{\text{number of plants of a certain species}}{\text{Total area sampled}} \times 100$

c) **Cover:** $\frac{\text{total area covered by a species}}{\text{Total area sampled}} \times 100$

The method is used to determine cover depends on the type of plant. If the plant is a circular one that hugs the ground, you simply measure its diameter and then use arithmetic to determine the area that it covers. If the plant is a tall herb or shrub, you can measure the downward projection of the crown on the ground. Again, you convert diameter to areas. For trees, you obviously have to determine cover by using the downward projection of the crown. Much time will be saved if you do this. Foresters commonly measure the diameter of a tree trunk 4.5 feet from the ground. This value is called the dbh (diameter, breast height). Tree calipers measure dbh directly. Diameter tapes, wrapped around a tree, give the diameter. Regardless of how you obtain the diameter, you convert it to area and use the area to calculate cover. You merely wrap the basal area tape around a tree at the 4.5-foot level and read the basal area directly.

Community similarity index –

We consider communities to be similar when they have many species in common. You can calculate an index of similarity using the following formula:

COMMUNITY SIMILARITY INDEX = NO. SPECIES IN COMMON/TOTAL NO. OF SPECIES

This index varies between zero and 1. Two communities with an index of zero have no species in common. Those with an index of 1 share all of their species.

APPENDIX XI:
CAPABILITY AND QUALITY ASSURANCE STATEMENT TO PCJ FROM RENTALOT

RECEIVED JUL 2 1 2004

Rentalot Equipment Ltd.

(Suppliers of John's Johns portable toilets.)
19 Derrymore Rd., Half-Way-Tree.
P.O. Box 132, Kgn.10. Email:kmiller51@hotmail.com.
T:754-3518, 754-9566 F:754-3507.

July 9, 2004

Attn: Mr. David Barrett
Environmental Coordinator
Petroleum Corporation of Jamaica
36 Trafalgar Road
Kingston 10.

Dear Mr. Barrett,

Re: Collection and Disposal of Waste from Portable Toilets

Rentalot Equipment Ltd. provides safe, clean portable sanitation services island-wide to outdoor sporting and entertainment events, construction companies, governmental agencies, churches and all gatherings in need of the facilities. We pride ourselves on our flexibility, meeting the needs of both the long-term user and the single day function.
Our units also offer the client the flexibility of having:

g) a standard portable toilet with a urinal inside;
h) a standard portable toilet with a wash basin inside;
i) a flushing portable toilet with a urinal inside;
j) a flushing portable toilet with a wash basin inside;
k) a separate hand washing station that four (4) persons may use simultaneously;
l) all of the above portable toilets may have wash stands fixed to the outside.

The combinations should meet all the client's needs and provide the satisfaction of knowing that they are dealing with people who care about the environment. That is why we are in the business. We were the first to offer the service in Jamaica; first to use an environmentally safe non-formaldehyde deodorizer (Exodor) in portable toilets.

Directors: Karl A.D Miller, Beverley C. Miller

Our Exodor porta-pak offers a bio-degradable product that is formaldehyde free and it's use is safe and clean in that it comes pre-packaged in appropriate portions in a water soluble easily dispensed pouch. No fear of shorting the client on deodorizer. It's blue non-staining colour also makes it easy to verify that a portable toilet has been charged.

Emptying the units is by our own sewage trucks that are all equipped with modern vacuum suction devices that guarantee a thorough and efficient evacuation of all the contents of the unit. These are then discharged solely in the government's National Water Commission's (NWC's) waste treatment plants island-wide.

Sincerely,
RENTALOT EQUIPMENT LIMITED

.....

for Karl A.D Miller
Managing Director.

Directors: Karl A.D Miller, Beverley C. Miller