FINAL DRAFT
ENVIRONMENTAL IMPACT STATEMENT
OF THE
PROPOSED LUXURY VILLAS AT WHITE BAY, TRELAWNY

Submitted to
WHITE BAY LTD.
Sandy Bay
Hanover, Jamaica

CL ENVIRONMENTAL
Taking Care of You and Your Environment.

JANAUARY 2005

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Submitted to
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Prepared by
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DESCRIPTION OF THE PROPOSED PROJECT

White Bay Ltd., proposes to construct 26 duplex units and 33 villa units on approximately 7 hectares (18 acres) of land at White Bay, Trelawny. The site is located approximately 7 km (≈4 miles) east of the town of Falmouth (Capital of Trelawny). The site falls within the north western corner of the Coral Spring/Mountain Spring Protected Area, most of which is covered primarily by a dry limestone forest. The Burwood public beach is situated on adjacent lands (≈1 km) and is currently used by members of the community and visitors alike. The project is expected to employ some 50 persons during the site clearance and construction phase and is anticipated to create approximately 200 direct jobs during operation. Approximately 115 indirect and induced jobs will be created during the site clearance and construction phase and another 460 indirect and induced jobs during the operation of the proposed development.

This is a positive impact and it is expected to provide an additional source of employment within the SIA. This coupled with the other proposed tourism developments will provide well needed employment in the area. The population educational attainment would suggest that they will be able to take advantage of this opportunity. This coupled with the fact that the developers are committed to employ locals where possible augur well for the future of the area.

Since the operation of the hotel will take place in Mountain Spring/Coral Spring Protected Area, the developer has mandated the isolation of its perimeter and will enforce protection from trash deposits, squatting and unrestricted human activity (e.g. logging). Approximately 83% of the property will remain undisturbed.

The design of the buildings will be based on Georgian proportion and detail, in order to complement the Falmouth Historic area. The planned duplexes and villas appear to be sited well above sea level, the risk of damage from storm surge, related to hurricanes and tropical storms is low.

The vegetation encountered on the property was typical of coastal vegetation. In total, seventy-two (72) species were the identified during the field exercises of which five (5) were endemic. The endemics included the orchids *Broughtonia sanguinea* (the dominant epiphyte) and *Oncidium tetrapetalum* (the Pimento Orchid) as well as the palm, *Thrinax parviflora* and the climbing cactus *Hylocereus triangularis*. The proposed development has the potential to impact negatively on the vegetation on the proposed site, however, the method of construction that is proposed will mitigate any potential negative impact that may have been expected.

Thirty-one (31) species of birds representing twelve (12) families were observed over the three (3) days. The high species diversity, the numerous nests encountered and the presence of the Yellow-billed Parrot together with the presence of feeding trees like *Capparis ferruginea* and *Clusia flava* all suggest that the entire Protected Area is an important bird habitat and foraging ground however few nests were found in the study area. Therefore, negative impacts on avifauna, associated with the loss of onsite vegetation/habitat, are expected to be insignificant.

In the Marine environment, observations of the typical progression from sandy shore, to algae, to sea grass to coral reefs along with the extensive and healthy condition of the sea grass bed, and diverse fringing coral reef system indicates a pristine and highly productive marine environment. The water quality within the Bay was generally within acceptable levels however, there are indications of non-point pollution sources that are impact some parameters. The development will benefit from the environment and appears to have minimal impact on the environment.

The proposed development is not expected to have a major negative impact as it relates to noise pollution in and around the proposed development site. The site is sufficiently located away from any potential receptors (e.g. buildings etc.). Additionally, the fact that most of the vegetation will be kept around the proposed development, will act as a kind of noise barrier.

The White Bay development is expected to diversify the Jamaican tourism product with its upscale villa type development, increase employment opportunities in the study area and increase the room stock in Jamaica. Provided the mitigative actions and continued monitoring suggested, the preferred alternative of construction as proposed should have minimal negative impacts and certainly will make positive contributions.

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

AGENCIES

1. Trelawny Parish Council
2. National Water Commission
3. The Solid Waste Management Authority
4. Water Resources Authority
5. Environmental Health Unit (Ministry of Health)
6. National Works Agency (NWA)
7. National Environment and Planning Agency (NEPA)
8. Town and Country Planning Authority (TCPA)
9. Jamaica Tourist Board (JTB) and Tourism Product Development Company Ltd. (TPDCo)

ACTS

- The Natural Resources Conservation Authority Act (1991)
- The Town and Country Planning Act (1948)
- Water Resources Act (1995)
- The Public Health Act (1974)

1.0 DESCRIPTION OF THE PROPOSED PROJECT

White Bay Ltd., proposes to construct 26 duplex units and 33 villa units on approximately 7 hectares (18 acres) of land at White Bay, Trelawny. The site is located approximately 7 km (≈4 miles) east of the town of Falmouth (Capital of Trelawny). The Starfish hotel is located approximately 2.5 km (≈1.5 miles) west of the proposed site. The site falls within the north western corner of the Coral Spring/Mountain Spring Protected Area, most of which is covered primarily by a dry limestone forest. The Burwood public beach is situated on adjacent lands (≈1 km) and is currently used by members of the community and visitors alike.

1.1 PROJECT DESCRIPTION

1.1.1 Site Clearance and Construction

The site clearance activities will involve minimal vegetation clearance around each villa in order to preserve the natural environment and to offer privacy between villas. This method offers a non intrusive natural barrier which is aesthetically pleasing and will be viewed with great interest from nature loving tourists.

The project involves the construction of approximately 26 duplex and 33 upscale villa units. Construction of these buildings will involve the use of ferro-cement structural cement skin applied to light gauge galvanized steel framing. Ferro-cement is a proven and widely respected type of concrete construction which employs a high ratio of reinforcing steel to cement creating earthquake and hurricane resistant structures from ⅛ the cement material and ½ the steel required by traditional design. The proposed development is illustrated in Figure 1. The design will be based on Georgian proportion and detail, in order to complement the Falmouth Historic area. The Amcorite cement surfaces will be tinted and textured to fit in with the traditional construction of the region (Figure 2).

Efforts will be made to re-establish the White Bay beach which has been substantially reduced by hurricane and storms. This will be done by a reputable coastal engineering firm.

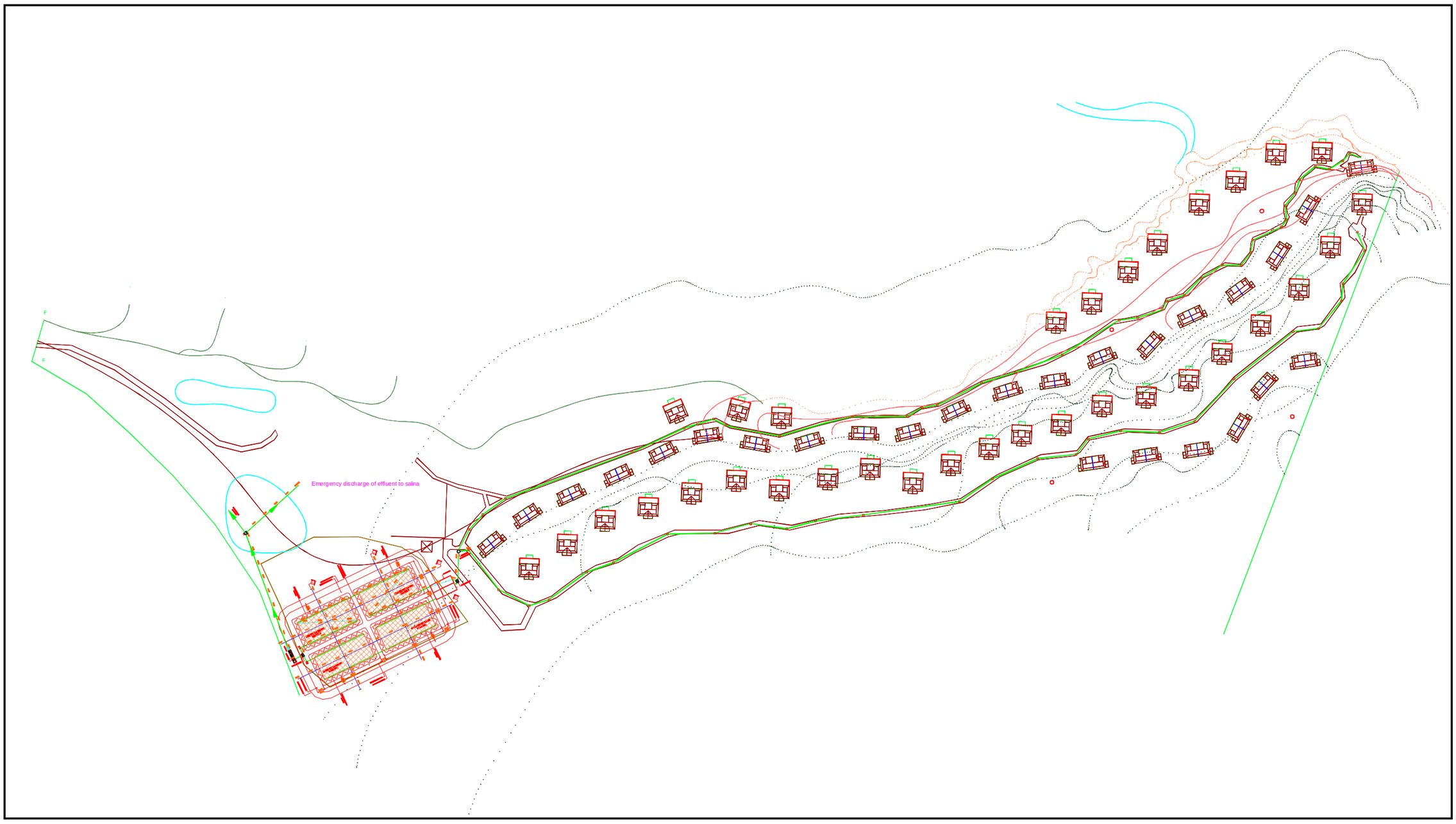


Figure 1 **Illustration of the proposed development layout (*adapted from MacDonald Architecture & Technology*)**

Figure 2 **Typical building designs of the proposed White Bay development (*adapted from MacDonald Architecture & Technology*)**

The waste water treatment plant (WWTP) has been designed to accommodate 26 duplexes and 33 villas (Table 1). The estimated total flow from the development is 211,179 litres per day (Table 2).

Table 1 Estimated population of White Bay Villas development

	100% occupancy
Type - Duplex	
Number of Units	26
Number of Bedrooms per Unit	4
Number of Persons per bedroom	2
Total Duplex Population	208
Type - Villa	
Number of Units	29
Number of Bedrooms per Unit	3
Number of Persons per bedroom	2
Total Villa Population	174
Total Population	**382**
Total Number of Bedrooms	**191**

Table 2 Estimated flow rate from White Bay Villas

	Flow Scenarios		
	1		Units
Bedrooms	**191**		
Design Parameters			
Water Consumption (JIE)	1365		l/day.room
Return Ratio	90%		
Infiltration	10%		
Summary			
Water Consumption		260,715	l/day
Wastewater Generation		**211,179**	**l/day**
Wastewater Generation		**46,413**	**IGPD**

The proposed WWTP will consist of the following:

- A splitter box
- A two-stream septic tank

- Four constructed sub-surface flow wetlands. These will be arranged with two wetlands in parallel to two others.
- A chlorinator
- Final disposal to a constructed wetland, with optional disposal to an outfall

The WWTP is expected to occupy approximately 1.2 ha (Figures 3 and 4). The final effluent is expected to meet the NEPA direct discharge standards as outlined in Table 3.

Table 3 Expected effluent quality

Parameters	Design Infuent	Design Effluent	NEPA Eff Standard		Units
			Direct discharge	Irrigation	
COD	650	10	100	<100	mg/l
BOD	250	5	20	15	mg/l
TSS	300	3	20	15	mg/l
Total Nitrogen	45	1	10		mg/l
Phosphates-P	10	0.77	4		mg/l
Oil and Grease				10	mg/l
$_{P}$H	7		6		
Faecal Coliform	4.00E+07	73	1000	12	MPN/100 ml
Residual Chlorine			1.5	0.5	mg/l
Giardia Cyst	30000			<1	# per 100ml

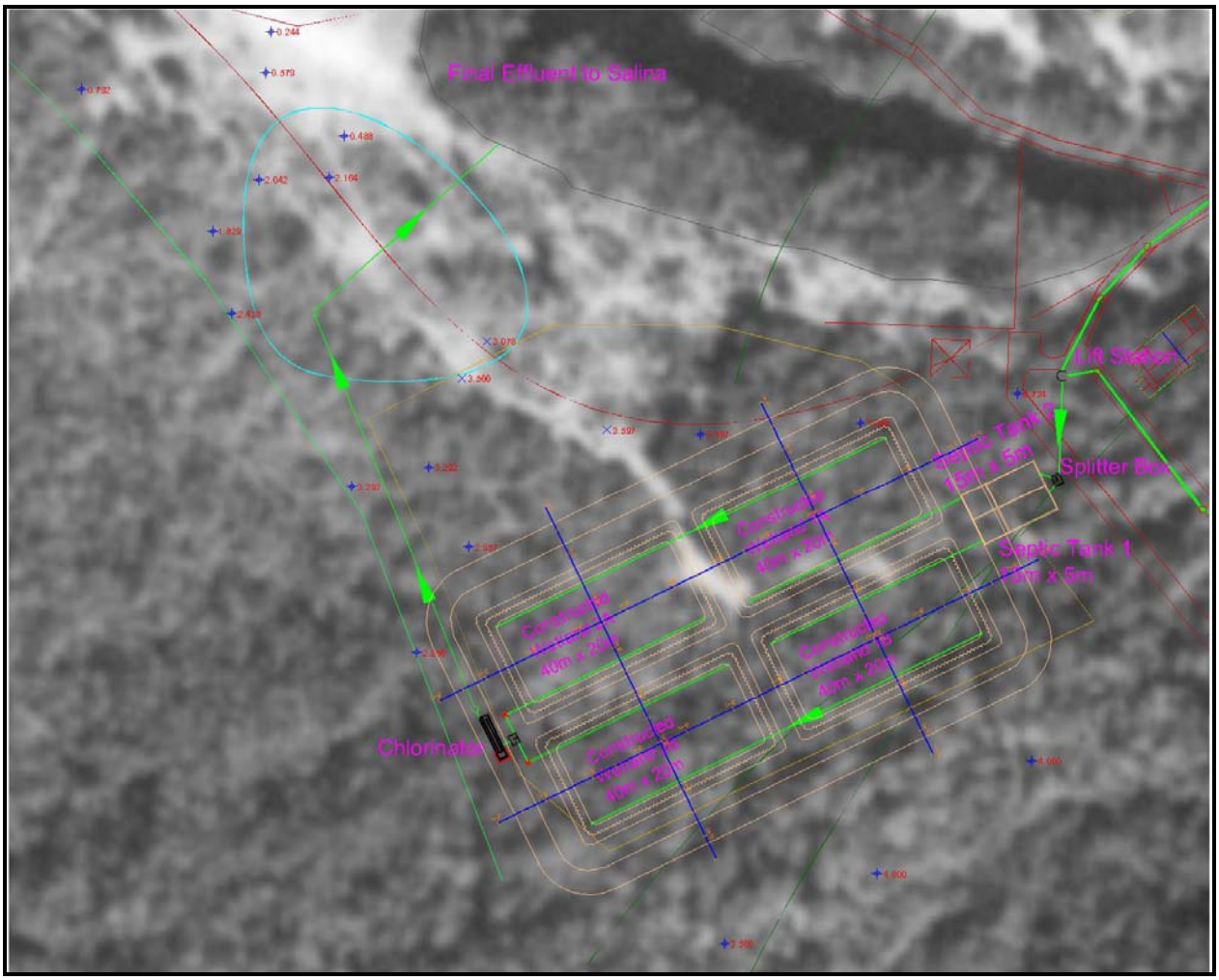


Figure 3 Layout of WWTP for White Bay

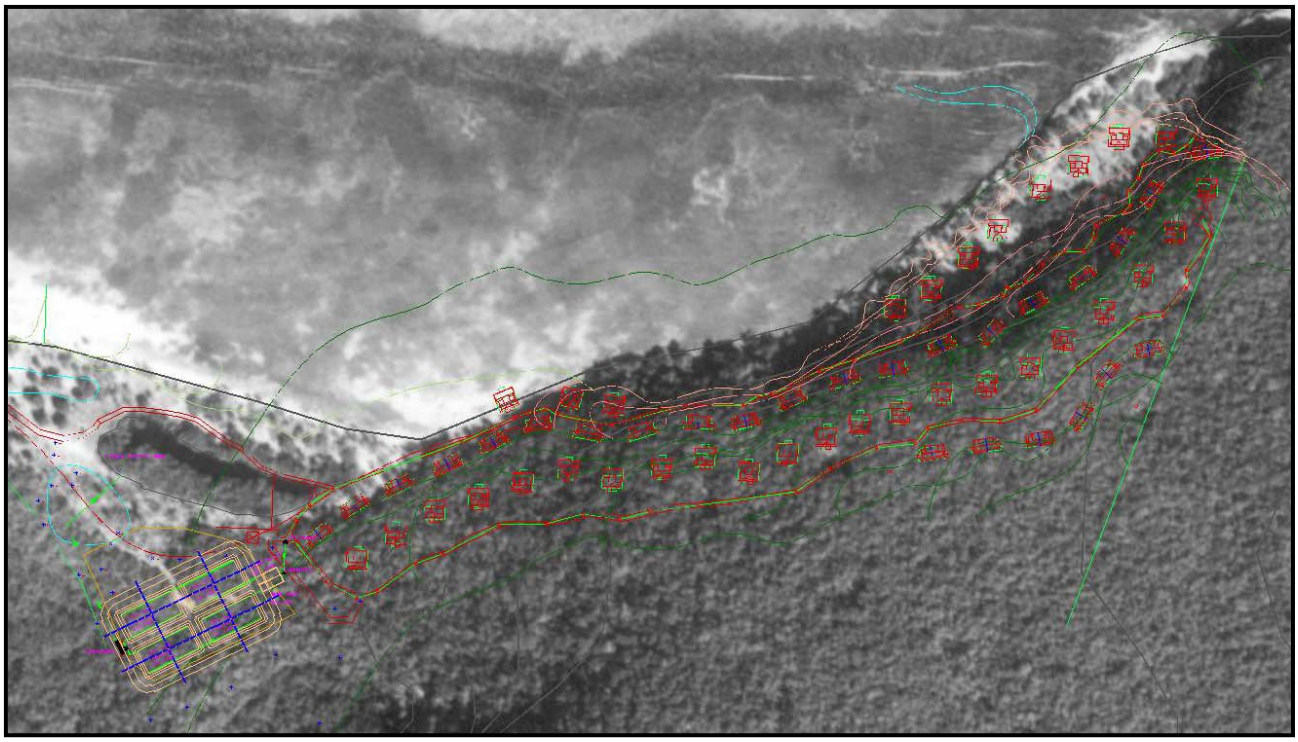


Figure 4 Site plan showing WWTP in SW corner of the development

1.1.2 Operation and Maintenance

White Bay Villas will demonstrate a 4-star hotel operation that may be energy independent. It will feature electrical power generated by rooftop photovoltaic arrays with battery storage, air conditioning by solar operated evaporated cooling and ceiling fans.

The visitor on arriving at White Bay will be transferred to a silent non-polluting hybrid solar-natural gas powered golf cart. There will be a narrow winding road from the reception area through undisturbed forest which lends a sense of discovery. Each villa will be separated from the next by natural undisturbed foliage so that each residence is secluded in the tropical Jamaican setting. This sense of privacy and remoteness is supported by the environmentally friendly services, utilities and architecture.

The operation of the hotel will take place in Mountain Spring/Coral Spring Protected Area and as such the developer has mandated the isolation of its perimeter and will enforce protection from

trash deposits, squatting and unrestricted human activity (e.g. logging). Approximately 83% of the property will remain undisturbed. This is in fact a potential positive impact of the development. In keeping in this line, the developer is proposing to have nature trails throughout the property, thus adding to the truly natural ambiance (nature tourism).

Water will be supplied by the National Water Commission from the Martha Brae water scheme. Water demand for the development is expected to be approximately 352,043 litres/day (93,000 gals/day). Solid waste will be collected by a private company and disposed of at Retirement landfill or any other approved sites.

1.2 STUDY TEAM

Dr Dale Webber – Marine survey
Carlton Campbell, M. Phil. – Socio economics/Noise Assessment/Water Quality
Professor Edward Robinson – Geology
Dr. Mona Webber – Marine survey
Christopher Burgess, M.Sc., P.E. – Hydrology
Philip Rose, M.Phil., Vegetation survey

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

BACKGROUND

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

The basis of EIAs has been summarised as follows[1]:

1 *Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.*

2 *It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytic method or technique, but uses many approaches as appropriate to the problem.*

3 *It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.*

4 *It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.*

5 *EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus it should be part of decision-making processes.*

6 *The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.*

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

Relevant Agencies and Laws of the Government of Jamaica

Trelawny Parish Council

The Trelawny Parish Council has portfolio responsibility for the provision of public services such as public health, fire protection, street cleaning and maintenance of recreational areas such as parks and play fields. The parish council's portfolio of solid waste collection and management of public markets was taken over by Western Parks and Markets. The government has however; more recently established the National Solid Waste Agency, which will be given overall responsibility of managing national solid waste.

It must be noted that one of the Parish Council's key responsibility is development control. This very important function serves to not just guide development but to shape and influence the pattern of development in any parish and or region. As a direct result development proposals have to be sent to the local parish council for development approval.

National Water Commission

The National Water Commission's chief portfolio responsibility in the land development process is to provide potable water and sewage services. Each proposal to develop land needs information and advice from the NWC as to whether or not the agency will be able to provide potable water. The issue of sewage is also important especially in the instances where central sewage plants are being used. The NWC is also the responsible body to comment and advice (approve or disprove) sewage proposals put forward by the project proponents.

The Solid Waste Management Authority

The new Solid Waste Management Authority Act (2001) subsumes the Litter Act and seeks to control the disposal of refuse in undesignated areas, as well as the delegation of garbage collection.

This Act seeks to control the disposal of refuse in undesignated areas, to include public places as described under Section 2 (c) of the Act, which includes public gardens, parks or open spaces,

or ‘any place of general resort to which the public have, or are permitted to have access with or without payment of any fees’…. Or ‘any other place in the open air to which the public has right of access without payment of any fees’. As such, disposal of refuse in the area during any phase of the development would constitute an offence under this Act.

Water Resources Authority

The Water Resources Authority was established to ensure the proper use of surface and ground water. This agency comments on proposed methods of sewage solutions in so much as it affects ground water contamination.

Environmental Health Unit (Ministry of Health)

The Environmental Health Unit of the Ministry of Health also comments proposed the methods of sewage disposal facilities. The agency is concerned about environmental degradation and human health, and ensures that sewage proposals are not designed to impact negatively on any of the two (i.e. the environment and human health).

National Works Agency (NWA)

The National Works Agency focuses on the designs of drains and road network (layout).

National Environment and Planning Agency (NEPA)

This Executive agency is an amalgamation of three agencies, the Town Planning Department, The Land Development and Utilization Commission and the Natural Resources Conservation Authority. The National Environment and Planning Agency seeks to ensure that proposed developments do not have adverse negative impacts on the environment. To ensure this, proposed developments are submitted to NEPA for a permit and or license to develop.
The agency’s mission, is to ensure protection of the environment and orderly development locally and nationally.

The Natural Resources Conservation Authority Act (1991)

The Natural Resources Conservation Act was enacted in 1991, and created the then Government environmental agency, the Natural Resources Conservation Authority.

Under this Act, the NRCA was mandated to effectively manage the physical and natural resources of Jamaica so as to ensure their conservation, protection and proper use; promote public awareness on Jamaica's ecological systems and their importance to the social and economic life of Jamaica; manage national parks, marine parks, protected areas, public recreational facilities; and advise the Minister on general policies relevant to the management, development, conservation and care of the environment.

The Town and Country Planning Act (1948)

This Act was enacted in 1948. There have been substantial amendments to the Act in 1999 to provide for effective enforcement of development controls. The major objectives of this Act are to control the orderly development of lands comprised within the established development orders (now outdated), protecting amenities, and conserving and developing the resources of the area as prescribed.

This Act also provides for the making of Tree Preservation Orders whereby a local authority may seek to preserve trees or woodlands in their area and prohibit the lopping or wilful destruction of trees or securing the replanting of trees.

Water Resources Act (1995)

The Water Resources Authority Act was established in 1995 to regulate and manage the abstraction and allocation of water resources. The Act also governs the preservation of water quality and the conservation of such resources. The Authority is required to gather data on the quantity and quality of water in above ground and underground resources.

The Public Health Act (1974)

The Public Health Act falls under the ambit of the Ministry of Health. Provisions are also made under this Act for the functions of the Environmental Health Unit of the Ministry of Health. The Environmental Health Unit functions through the Public Health Act to monitor and control pollution from point sources. The Central Health Committee would administer action against any breaches of this Act.

The Solid Waste Management Authority

The new Solid Waste Management Authority Act (2001) subsumes the Litter Act and seeks to control the disposal of refuse in undesignated areas, as well as the delegation of garbage collection.

This Act seeks to control the disposal of refuse in undesignated areas, to include public places as described under Section 2 (c) of the Act, which includes public gardens, parks or open spaces, or 'any place of general resort to which the public have, or are permitted to have access with or without payment of any fees'…. Or 'any other place in the open air to which the public has right of access without payment of any fees'. As such, disposal of refuse in the area during any phase of the development would constitute an offence under this Act.

Jamaican Environmental Requirements

EIAs are not only recommended in project design, but also required by Jamaican legislature. The following is a review of Jamaican *Environmental* policy and law that are relevant to the White Bay Development design, construction and operation.

National Environment and Planning Agency (NEPA)

NEPA is Jamaica's Regulatory Planning and Environmental Agency and represents a merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilisation Commission (LDUC).

Town and Country Planning Authority (TCPA)

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

a) *regulating the type of development to be carried out and the size and form of plots;*
b) *requiring the reservation of land for any of the public services referred to in Part V or for any other purposes referred to in this Schedule for which land may be reserved;*
c) *prescribing the character and type of public services or other works which shall be undertaken and completed by the applicant for subdivision as a condition of the grant by the authority to subdivide;*
d) *co-ordinating subdivision of contiguous properties in order to give effect to the scheme of development of such properties.*

The relevant local planning authority for the project is the Trelawny Parish Council. The Wastewater Treatment Plant plans and the development concept plans of the proposed subdivision will need to be submitted to the Parish Council for approval.

Natural Resources Conservation Authority (NRCA) Act

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

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

- *issuing of permits to persons responsible for undertaking any construction, enterprise or development of a prescribed category in a prescribed area*
- *issuing licences for the discharge of trade or sewage effluent*
- *requesting an Environmental Impact Assessment (EIA) from an applicant for a permit or the person responsible for undertaking any construction, enterprise or development*

- *revocation or suspension of permits.*

The Act binds the crown and therefore takes precedence over the authority of other state in environmental matters.

In recent times, the dynamic NEPA EIA process has been requiring written confirmation of the feasibility of infrastructure access from companies providing amenities and utility services to the proposed development, including the National Water Commission, the National Solid Waste Management Authority and the Jamaica Public Service. Negotiations with these agencies will be critical in this development where water supply, sewage disposal, garbage collection/disposal and electricity access have been highlighted in the Subdivision Plan as limited.

Further information on NEPA and EIAs is available from the NEPA website (*www.nepa.gov.jm*). In particular, documents providing guidance on EIA preparation and public participation in EIAs are available at the site and accessible available through the environmental consultant.

Jamaica Tourist Board (JTB) and Tourism Product Development Company Ltd. (TPDCo) Requirements

The JTB through the TPDCo has as a mandate to "To develop and improve the tourism product in order to position Jamaica as a preferred destination and to ensure that tourism is sustained as a major contributor to the development of the economy".

To achieve this the TPDCo facilitates the development of the tourism product by undertaking improvements to the physical, social, economic, cultural and environmental aspects of the product to ensure its sustainability and benefits to the community.

For guest house or villa to offer services to the public it has to obtain a licence from the Jamaica Tourist Board. Below is a list of documents required to obtain such a licence.

- Completed application form with required documentation submitted to manager, licence processing department, Tourism Product Development Co. Ltd.

- Copy of public liability insurance
- Copy of public health certificate (where applicable)
- Certificate of incorporation
- Valid food handler's permit (where applicable)
- List of directors
- Approval from local planning authority
- Proper security arrangements (certified personnel) in accordance with the villa security guidelines
- Tax registration number (TRN)/business enterprise number
- Beach licence (where applicable)
- TPDCo. recommendation

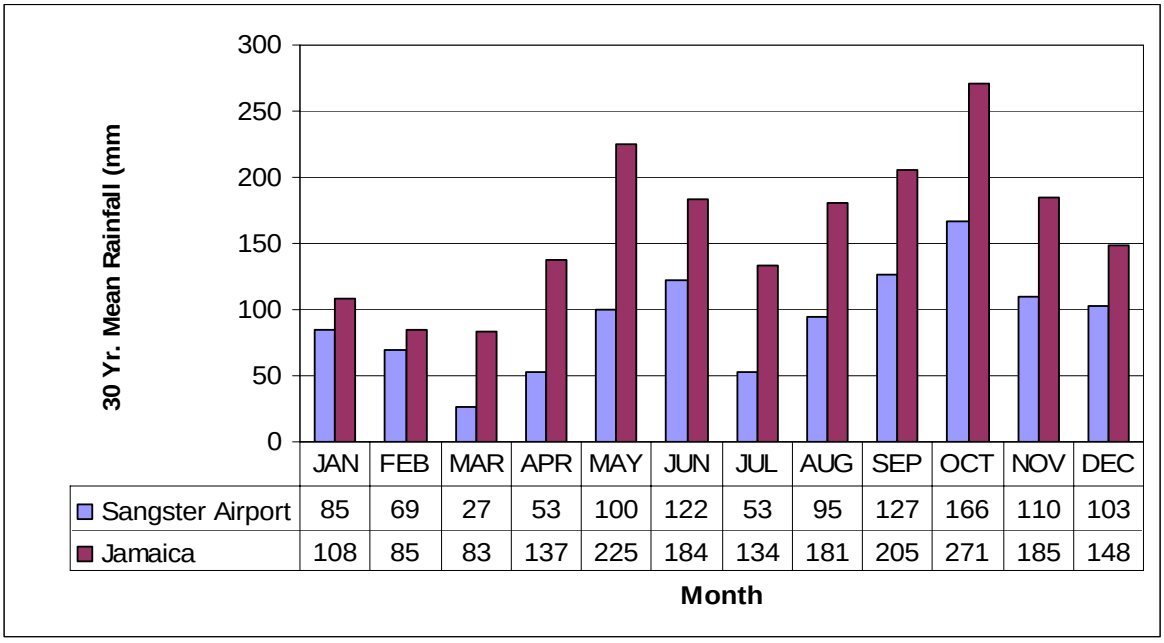
3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 METEOROLOGY

3.1.1 Rainfall

The closest station from which meteorological data was available, was Sangster International Airport in Montego Bay. This is approximately 38km west of the site. The meteorological station is at sea level. A comparison of the data with another meteorological station situated in Ocho Rios 62 km east of the site showed little variations in the data obtained from the Sangster station. This indicates that little variation in the actual climatic conditions being experienced at the Sangster station is expected at the proposed site.

The Island experiences two distinct wet seasons, May to June and September to November. These wet seasons occur as regular yearly cycles (Figure 5). Rainfall at the proposed site is no different. The rainfall data for the Island clearly indicates that May (225 mm) and October (271 mm) are the two rainiest months whilst for the proposed site it is June (122 mm) and October 166 mm).



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sangster Airport	85	69	27	53	100	122	53	95	127	166	110	103
Jamaica	108	85	83	137	225	184	134	181	205	271	185	148

Figure 5 Thirty year mean rainfall

The driest months at the proposed site location are March (27 mm), April (53 mm) and July (53 mm). This is different from the Island data which suggests the driest months are January (108 mm), February (85 mm) and March (83 mm).

3.1.2 Temperature

The proposed site has an average temperature 26.1 ^{o}C, average maximum temperature of 30.3 ^{o}C and an average minimum temperature of 22.3 ^{o}C (Table 4). This is similar to the Island data which has an average coastal temperature of 26.2 ^{o}C, average coastal maximum high of 30.3 ^{o}C and average coastal minimum low of 22.0 ^{o}C. The data indicates that January (20.7 ^{o}C) and February (20.4 ^{o}C) are the two coldest months. The hottest months are August (31.4 ^{o}C) and September (31.1 ^{o}C) (Figure 6). The temperature will remain fairly constant throughout the year under the moderating influence of the warm waters of the Caribbean Sea.

Table 4 Maximum, minimum and thirty year average temperatures

Parameter	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Max Temp. (°C)	27.9	28.2	28.8	29.5	30.2	30.9	31.3	31.4	31.1	30.4	29.7	28.4
Min Temp. (°C)	20.7	20.4	20.9	21.9	22.6	23.1	23.5	23.6	23.1	23.1	22.8	21.9
Avg. Temp. (°C)	24.3	24.3	24.9	25.7	26.4	27.0	27.4	27.5	27.1	26.8	26.3	25.2
JA Avg. Temp. (°C)	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2

Coldest Months
Hottest Months

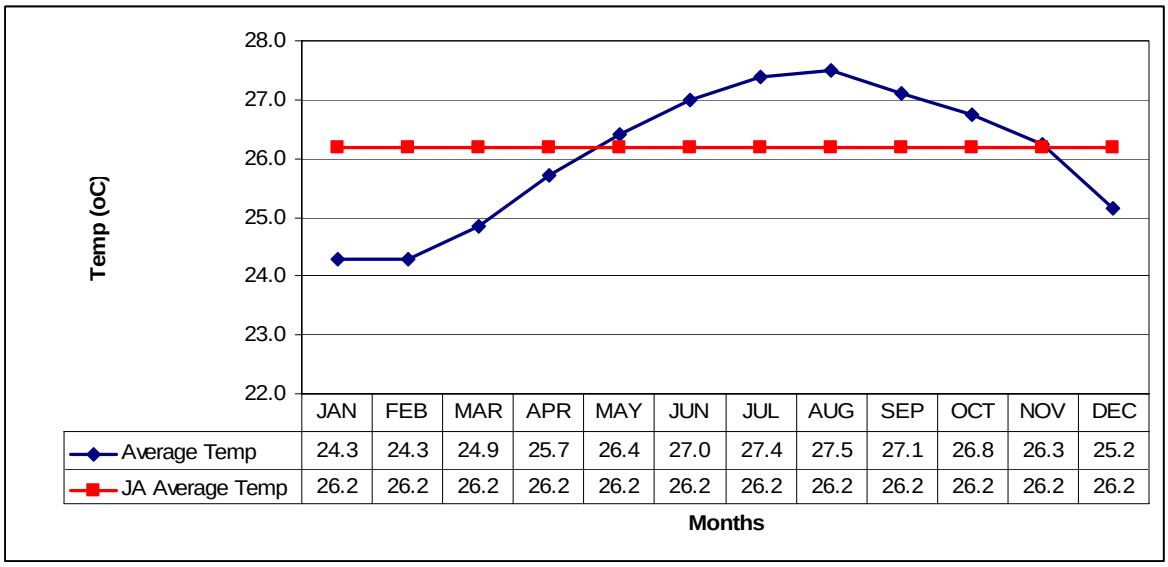


Figure 6 Thirty year averages

From Figure 6, the months of May to November have a higher average temperature when compared to the Island average temperature.

3.1.3 Relative Humidity

The thirty year mean relative humidity data indicates that the levels of relative humidity is usually higher in the mornings (7 am) and decreases throughout the day (Table 5).

Table 5 Thirty year average relative humidities

Parameter	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rel. Hum.-7am (%)	85	85	83	82	83	84	82	82	84	86	84	89
Rel. Hum.-1pm (%)	71	71	68	68	71	72	70	70	72	75	73	72

3.1.4 Wind

Winds from data from the Sangster International airport indicates that winds are normally from the east, east north east and are generally around 7-10 knots.

3.2 NATURAL HAZARD VULNERABILITY

3.2.1 Earthquake

In determining the possible seismic hazard associated with a potentially active fault, the history of recent activity must be used as a guide. In this case, where the total displacement in the last 120, 000 years is about two metres, assumptions about the frequency and amount of movement can be made. For example, assuming a constant rate of stress increase over time, and a uniform, intermittent strain accommodation of 5 cm displacement per seismic event, the notional "return period" for events of this kind would be around 3,000 years. But there might be several much smaller events in the meantime, say 5, causing displacement totalling 5 cm. Thus a larger, 5 cm event might occur only once every 6,000 years, thus posing an extremely low risk from local

events. There are a large number of possible alternative scenarios, and the initial assumptions may be wrong.

Seismic shaking resulting from larger regional events, as opposed to local ones is more likely to cause damage. There are published data for these, and a "return period" map for the island is shown as Figure 7.

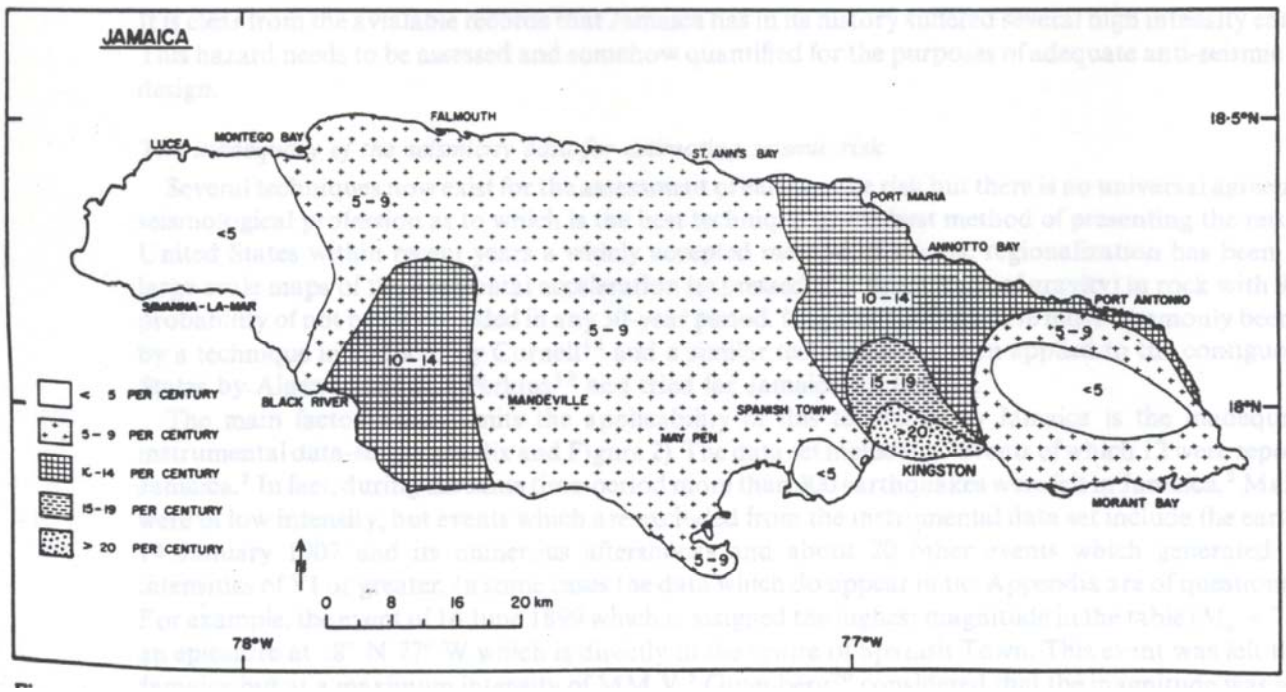


Figure 7 Map showing number of times per century that intensities of MM VI or greater have been reported, 1880-1960 (from Shepherd & Aspinall, 1980)

The villas and duplexes are to be built on what is probably a still-active fault zone. It is therefore recommended that the siting of each structure be carried out only after a detailed field survey has been carried out of observable joints and faults.

3.2.2 Hurricane

The incidence of hurricanes in the Jamaican region is given in Figure 8. The planned duplexes and villas appear to be sited well above sea level, the risk of damage from storm surge, related to hurricanes and tropical storms is low.

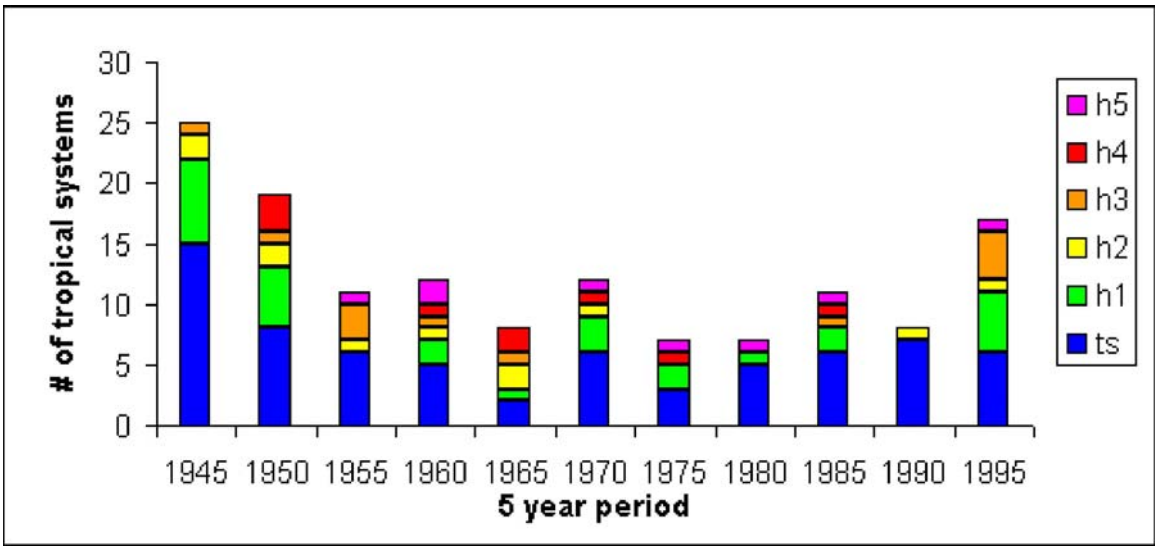


Figure 8 Five year analyses of the incidence of storms in the Western Caribbean (data from http://stormcarib.com)

The island also lies within the Caribbean hurricane belt and has been directly affected by several hurricanes over the last century (Figure 9). Hurricanes that pass within 100 kilometres of the island have caused considerable damage although the eye has not passed directly over the island. Natural disasters associated with hurricanes include flooding and damage due to gale force winds.

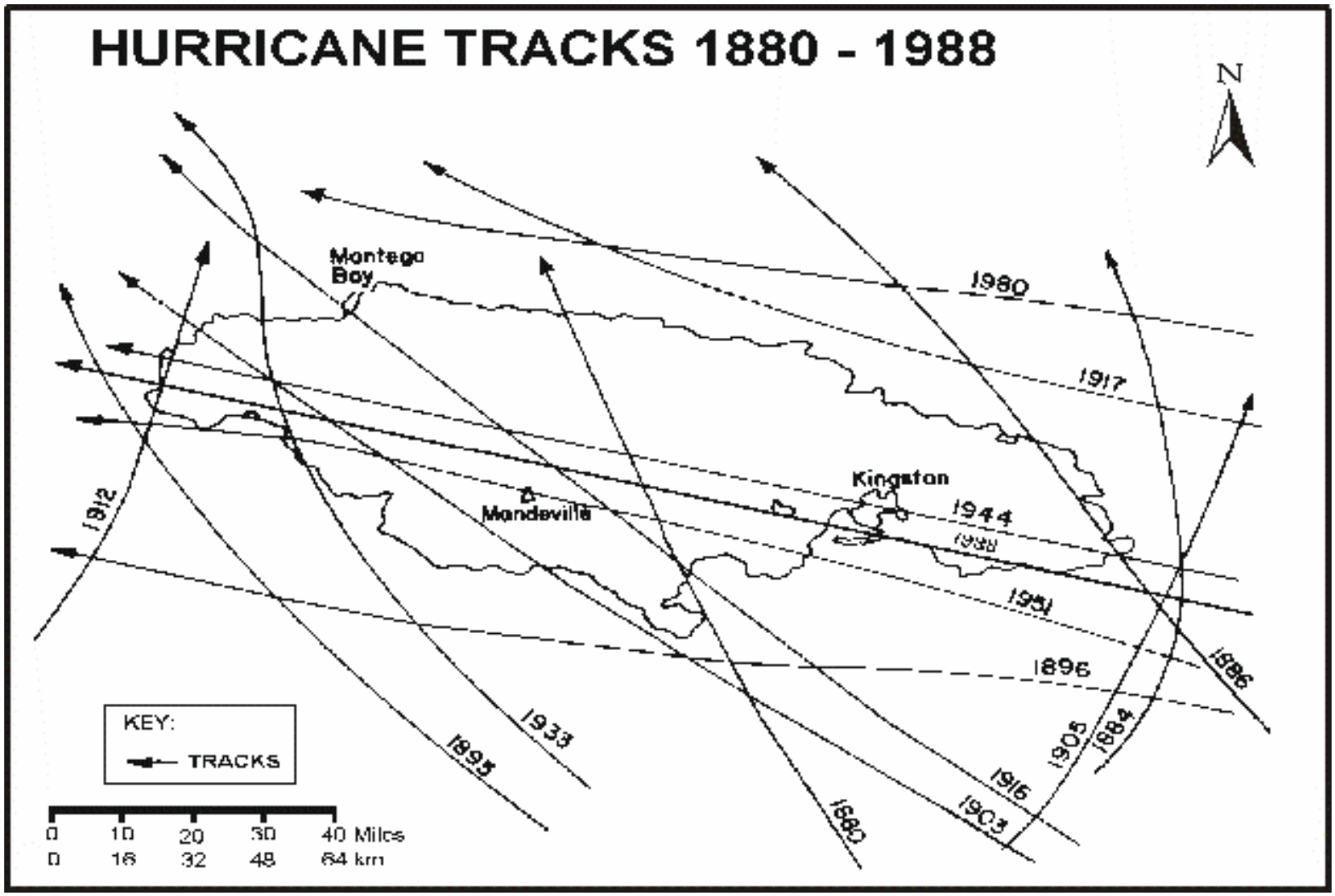


Figure 9 Tracks of hurricanes (1880 - 1988) directly affecting Jamaica

The structures on the west side of the property appear to be much more vulnerable to storm surge effects, as these lie below the 25 ft (7.6 metres) contour on the published 1:12 500 topographical map, Sheet 51D. On this map, spot heights of 6 ft (1.8 m) to 18 ft (5.5 m) are marked. The nearest data on the likely magnitude of storm surges is that given for Montego Bay (Table 6). Without the availability of detailed nearshore bathymetry for White Bay, the Montego Bay data is used here (Smith Warner, 1999).

Table 6 Montego Bay Storm Surge (m) using 2-Parameter Weibull Distribution (Doctors Cave)

Estimate/Confidence Limit	Return Period (years)			
	10	**25**	**50**	**100**
MLE	0.97	1.56	2.07	2.61
90% limit	1.15	1.90	2.56	3.28
95% limit	1.20	2.04	2.79	3.62
99% limit	1.34	2.28	3.11	4.06

3.2.3 Flooding

The main threat for flooding is from the sea for the low lying regions, either from storm surge, usually associated with the passage of tropical storms and hurricanes (see section on Hurricanes above), or from tsunami (see section below). Very intense rainfall may induce sheetflow on the hillsides and local ponding on the low-lying region in the west, but the affects should be short-lived as the limestone terrain favours rapid dispersal of floodwaters by underground drainage.

3.2.4 Tsunami

Although tsunami (seismic sea waves) is rare for Jamaica, there are a number of records of their occurrence along the north coast (Ahmad, 1998).

3.2.5 Drought

In a situation such as this, where the emphasis is on developing a resort product, the main threat of drought conditions would be on locally derived sources of water.

3.3 PHYSIOGRAPHY, GEOLOGY AND STRUCTURE

3.3.1 Physiography

The area of interest consists of a low-lying coastal platform backed on the southeastern side by a substantial limestone escarpment, forming an ancient sea cliff facing towards the sea and sloping back more gently in a southwesterly direction (Plate 1). The coast itself forms a beach where the coastal platform lies more or less at sea level. The beach is terminated on its eastern flank by a low cliff, varying from a few centimeters to some four metres in elevation. This low cliff is backed by a much narrowed coastal platform in front of the ancient, raised sea cliff mentioned above. A prominent wave or sea level notch has been carved into the base of the ancient cliff. The notch is in places accompanied by ancient sea cave systems. The proposed duplexes and villas are sited on the seaward facing slope of the ancient sea cliff.

Plate 1 General view of the site for the proposed Villa development at White Bay

The hill in the background, on which the units will be built, forms a scarp face, bordered at its foot by the White Bay Fault System.

3.3.2 Geology

The area on which the duplexes and villas are to be built is mapped on Geological Sheet 8 as the Montpelier Formation of the White Limestone Group. This formation consists of well and evenly bedded white frequently chalky limestone with flint nodules, interbedded with more lithified bands of fossiliferous limestone, and with softer beds of grey ashy marl and volcanic ash in the lower part. Inland of the development area a fresh cut in the new coastal highway exposes these rocks (Plate 2).

Plate 2 Vertical cut in the new North Coast Highway, immediately south of the White Bay property, showing dipping strata of the Montpelier Formation.

The low-lying coastal platform in front of and to the west of the hillside is made up of outcropping Falmouth Formation. This consists of fossilized reef and lagoonal deposits, dating back to the last Interglacial stage of the Pleistocene, now forming a low platform, varying in height from about 1 m to 6 m above sea level (Plate 3).

Plate 3 **Raised platform of the Falmouth formation in the foreground, behind which is the White Bay Fault scarp, forming an ancient sea cliff**

3.3.1 Structure

The rocks in the area of the proposed development and its surroundings are traversed by a northeast trending series of step faults with downthrows towards the northwest (Geological Sheet 8). There also appears to be at least a component of horizontal, sinistral offset along these faults, including the one, here named the White Bay Fault System, associated with the hill slope on which the development is planned. The apparent lateral displacement of the outcrop of the Falmouth Formation by about 500 m between White Bay and the west side of Stewart Bay could in part be due to horizontal movements along the White Bay Fault.

The rocks associated with the White Bay fault are characterized by numerous joints (Plate 4), some of which appear to have millimetric scale displacements.

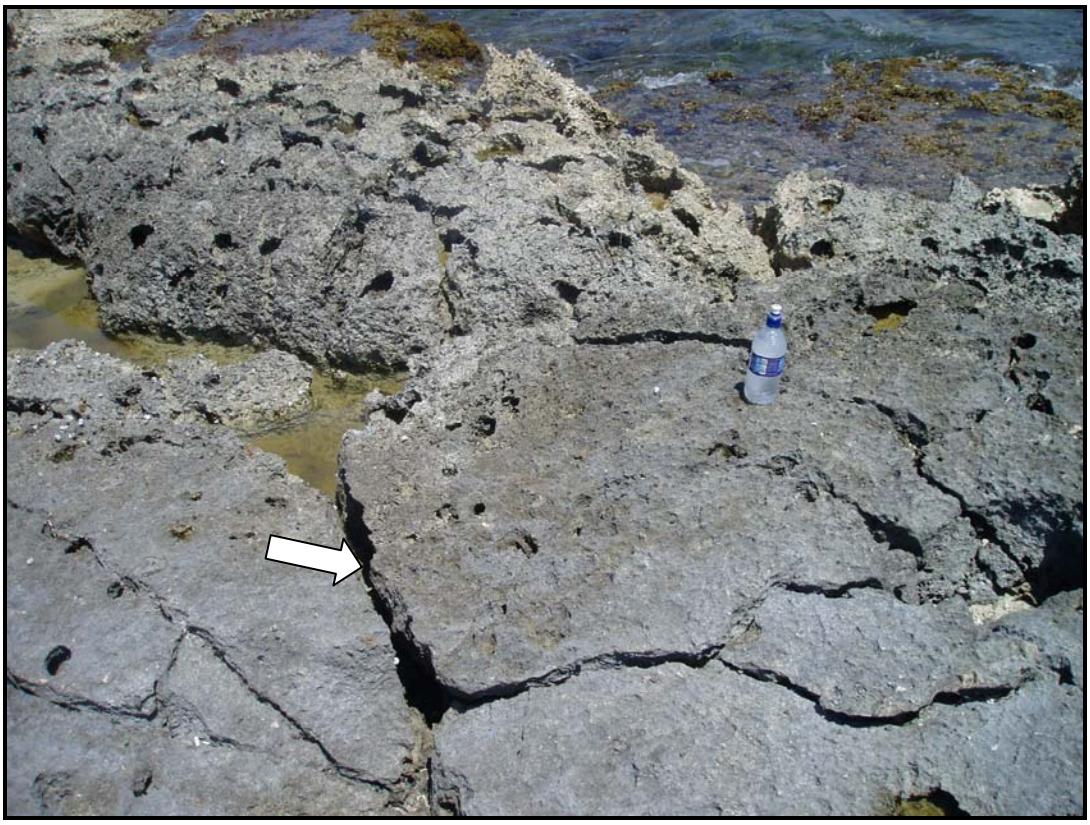


Plate 4 **Joints associated with the White Bay Fault, exposed in the Falmouth Formation platform**

3.3.2 Seismicity

Positive evidence of relatively recent fault movements in the White Bay area is provided by observations of the height, at different points, of the ancient sea level notch cut into the limestone cliffs behind the Falmouth Formation platform (Robinson, 1958; Horsfield, 1972). The notch indicates the former existence of sea level at a height different from that of the present day. Variation in height and /or displacement of the notch is indicative of earth movements post-dating the formation of the notch. Reviewing the evidence for that stretch of the coast between Discovery Bay and Falmouth, Horsfield states:

"Along three sections of the coast the notch shows only a moderate tilt, but along the White Bay cliffs, and at Flamingo Pond, there are much steeper gradients, downthrowing the notch to the west. At White Bay it is clear that faulting has contributed to this downthrow. Here the raised

reef terrace is cut, and downthrown to the northwest, by numerous, northeast-trending, joints or small faults, and across one of these the notch is visibly displaced by over a metre……..at White Bay, and Stewart Bay, it would seem that continued displacement along the existing major faults could account for the sharp downthrow of the notch at these localities".

The sea level notch is associated with several ancient sea caves, one of which is illustrated here (Plate 5).

Plate 5 **Sea level notch and sea cave cut into the base of the cliff behind the Falmouth Formation platform, White Bay**

The age of the Falmouth Formation and the raised reef platform behind which the notch was developed, is approximately 120,000 years old (Horsfield, 1972). Therefore, some two metres of vertical displacement, and possibly a significant amount of lateral movement, has occurred along the White Bay Fault System, through the east side of White Bay within the last 120,000 years. It must therefore be assumed that the system is still potentially active.

4.0 TERRESTRIAL VEGETATION AND FAUNAL STUDY

4.1 TERRESTRIAL VEGETATION

4.1.1 Introduction

The coastline of Jamaica exhibits a variety of vegetation communities, each with distinct micro and macroclimates. One of particular interest is that found on the southern and northern coasts of the island, which exhibits arid conditions, and fissured, honeycomb, white limestone. These areas, termed Dry Limestone Forests, provide a habitat for diverse groups of species rare, endemic and endangered.

The vegetation assessment of the project site, White Bay, focussed on three main regions, which were identified by superimposing the architectural layout plans and GPS data over aerial imagery via ArcGIS 9.0. The areas identified were:

1. The main area.
2. A lowland coastal zone, along which one set of the housing developments are to take place.
3. A higher elevated zone, further inland, where the upper tier of housing units will be built.

The vegetation present was assessed using walk-throughs and the point centred quarter method. Each plant species encountered along the walk through was identified and recorded and where species identification was not possible *in-situ*, the specimens were collected, tagged and pressed for further identification at the University of the West Indies (UWI) Herbarium. The physical and biotic environments were also recorded.

The point centred quarter was employed in five evenly spaced, pre-selected locations within region 3, which had the least evidence of disturbance. The method involved locating one pre-selected point with the aid of a Trimble® Geo XT GPS unit and dividing the area around this point into four 90 degree quarters. The nearest tree in each quarter was sought, identified and its

distance from the random point measured. The average distance for all the trees encountered at the end of the exercise was determined and from this, the overall density per hectare calculated.

{Density (per hectare) = 10,000/(avg. distance, in meters)^2}

4.1.2 Observations

The vegetation encountered at the beginning of the property on the seaward side was typical of coastal vegetation with species of *Thespesia populnea* (Seaside Mahoe), *Coccoloba uvifera* (Sea Grape), *Rhizophora mangle* (Red Mangrove) interspersed with *Avicennia germinans* (Black Mangrove) and *Conocarpus erectus* (Button Mangrove) (closer to the roadway) and occasionally, the pioneer species *Ipomoea pes-caprae* (Beach Morning Glory). The vegetation to the landward side exhibited similar coastal species, however, the stand of Red Mangrove and Black Mangrove was more extensive and where Black Mangrove trees were not evident, Black pneumatophores were observed. Occasionally, terrestrial species of *Helicteres jamaicensis* (Screw Tree), *Cleome spinosa*, *Drypetes ilicifolia* (Rosewood) and *Capparis ferruginea* (Mustard Shrub) to name a few were observed. Rarely, species of *Opuntia dillenii* (Seaside Tuna) and *Agave* sp. were observed throughout.

There were three zones identified within the major section of the project area, with associated vegetation types. They were:

Zone 1:

A sand dune/berm type community with associated vegetation of Seaside Mahoe, Sea Grape, Button and Black Mangroves. This area bordered a salina (approximately 30 – 50 m in width) in which the water present appears to be fed by rainfall and subsurface seawater intrusion (which apparently becomes a primary source during periods of low rainfall). Fruiting Red and Black Mangrove trees dominated the fringes of this wetland area to the front. An extensive stand of Red Mangroves was observed bordering the salina to the rear (Plate 6). Canopy height was homogenous at around 5 m high.

Plate 6 Fringe of Red and Black Mangroves bordering the salina (indicated by arrows)

Zones 2 & 3:

The overall plant community here was characteristic of a Dry Limestone Forest in the late stages of succession (Plate 7). Tree canopy height ranged between 5-15 m with a few emergents consisting mainly of the prominent *Bursera simaruba* (Red Birch) tree.

Plate 7 Picture showing late successional stage of the Dry Limestone Forest

Ground vegetation was very sparse except in cases where the endemic bromeliad *Hohenbergia spinulosa*, *Bromelia pinguin* (Ping Wing) and *Agave sp*. occurred in concentrated patches (Plate 8). In some instances, as many as 18 *Agave sp.* (most near maturity) were found occurring in a 25m^2 area.

Plate 8 One of several patches of *Agave sp.* observed throughout the forest

Typical endemics, such as the orchids *Broughtonia sanguinea* (the dominant epiphyte) and *Oncidium tetrapetalum* (the Pimento Orchid) as well as the palm, *Thrinax parviflora* were common within the tree canopy and lower levels (Plates 9, 10 and 11). Other endemic species encountered include the climbing cactus *Hylocereus triangularis*. *Tillandsia sp.* were occasionally observed in tree tops or close to ground level.

Plate 9 Picture of *Broughtonia sanguinea*, common endemic orchid

Plate 10 Picture of *Oncidium tetrapetalum* (Pimento Orchid)

Plate 11 Picture of *Thrinax parvifolia* observed throughout the forest

Zone 3 appears more or less undisturbed with an average tree density of 4034 trees per hectare. However, tree removal or loss was more evident nearer the coastline in Zone 2 where the tree-canopy height appeared lower (approx. 3-5 m) possibly due to wind cropping and sea-spray. Leaf litter was mainly high throughout, although Zone 2 tended to have higher detritus levels and less limestone outcroppings. Nonetheless, this was the area that had large limestone boulders as well as several caves and fissures (Plate 12).

Plate 12 One of several caves observed in the forest

The mineral soil layer was very thin and virtually non-existent further inland towards Zone 3.

In total, seventy-two (72) species were the identified during the field exercises of which five (5) were endemic (Appendix 1). Other species known to be characteristic of Dry Limestone forests, which were not encountered during the field exercises are listed in Appendix 2.

4.1.3 Historical Vegetation Changes

The dry limestone forest at White Bay, for the most part, has remained relatively undisturbed from 1968 (aerial photograph) to 2003 (Digital Globe Satellite Imagery) especially along the pronounced ridge and 90% of the project area. Two distinct areas of the property have undergone significant changes, the area encompassing the salina and the plateau below the ridge overlooking the sea (indicated by arrows on maps). In 1968, the salina was distinctly bordered by trees, probably mangroves whereas the surrounding land was sparse vegetation. However in

2003, the area exhibited an extensive stand of vegetation presumably that typical of coastlines as was observed in the present study. The plateau also exhibited this vegetational change, i.e., sparse in 1968 and extensive in 2003. The density of the forest as observed in 2003 was evident in the ground-truthing of the present study (Figure 10).

4.2 AVIFAUNA

4.2.1 Introduction

The avifauna of White Bay Trelawny was sampled on July 3, 4 and 10, 2004. Sampling took place between the hours of 9:30 am and 1:30 pm on July 3, between 6:30 am and 1:00 pm on July 4, and between 8:00 am and 2:00 pm on July 10. A point count sampling method was employed to assess the avifauna of the area. The birds were identified based on visual cues, with the assistance of a field guide (Raffaele *et al*, 2003) and based on their calls.

A different section of the property was sampled on each of the three sampling days creating a more extensive sample area and a better species account. The first sample was done while walking into the property and making point counts along a transect perpendicular to the coast. The second sample was done while walking into the property and doing point counts along a transect running parallel to, and a few metres from the coast. The final sample was done while walking into the property, and doing point counts along a transect parallel to, but approximately 100 metres inland from the coast.

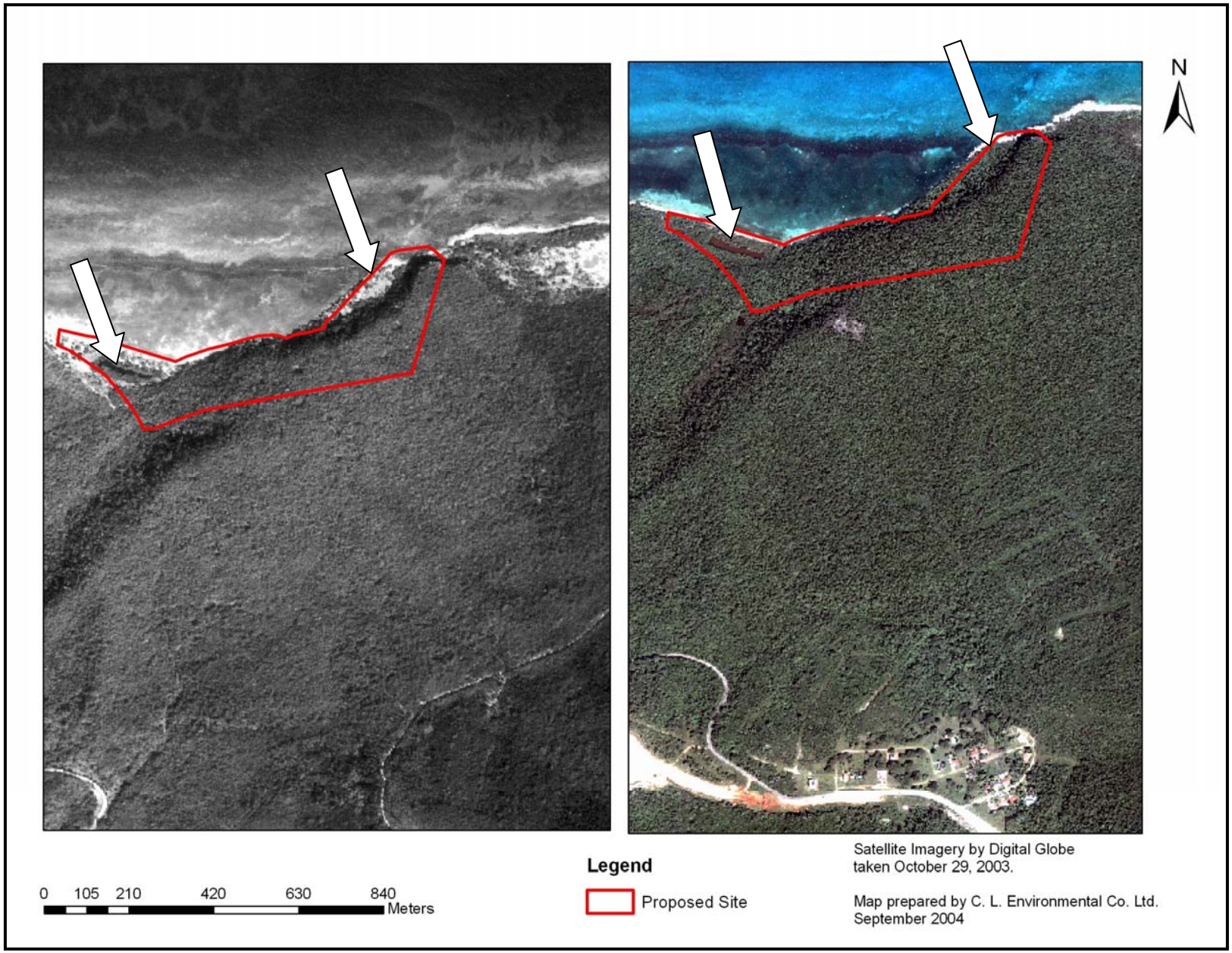


Figure 10 Comparison of the vegetation of White Bay, Trelawny – 1968 vs 2003

4.2.2 Observations

Thirty-one (31) species of birds representing twelve (12) families were observed over the three (3) days. A total of forty-five (45) birds were observed on the first day, fifty-three (53) birds on the second day and seventy-four (74) birds on the third day (Table 7). In addition, several bird nests belonging to the Columbidae and Emberizidae families were observed in the vegetation. These nests were all abandoned however, since the time of visit coincided with the ending of the breeding season.

On the final day of the survey a flock of six (6) Yellow-billed parrots (*Amazona collaria*) was observed resting in the crown of a Red Birch tree (*Bursera simaruba*). The natural habitat of the Yellow-billed Parrot is primarily mid-elevation wet forests of hills and mountains, particularly the Cockpit Country, Mount Diablo and the John Crow Mountains (Raffaele *et al*, 1998). Its occurrence here, in a coastal dry limestone forest is believed to be due to migration from the interior wet forests to forage.

The high species diversity, the numerous nests encountered and the presence of the Yellow-billed Parrot together with the presence of feeding trees like *Capparis ferruginea* and *Clusia flava* all suggest that this area is an important bird habitat and foraging ground.

Other types of fauna observed throughout the forest included Hermit Crabs (Plate 13), Duck Ants nests, Termites, a Mongoose, *Anolis grahami* and *A. lineatopus*, *Heliconius* sp. (Zebra Butterfly) (Plate 14), *Pseudophasma* sp. (Stick Insect) and *Acanthops* sp. (Praying Mantis).

Table 7 Species List and Number of Birds Encountered in White Bay, Trelawny

FAMILY	SCIENTIFIC NAME	COMMON NAME	3rd	4th	10th	STATUS
Laridae	*Sterna maxima*	Royal Tern	1		3	CYR-L
Ardeidae	*Egretta caerulea*	Little Blue Heron	2		1	CYR
	Egretta tricolor	Tri-colored Heron			1	CYR
	Ardea alba	Great Egret	1		1	CYR
	Bubulcus ibis	Cattle Egret	1	1		CYR
Recurvirostrinae	*Himantopus mexicanus*	Black-necked stilt	1	1		CYR
Cathartidae	*Cathartes aura*	Turkey vulture	4		3	CYR
Columbidae	*Columba leucocephala*	White-crowned Pigeon	1			CYR
	Zenaida asiatica	White-winged Dove	3	7	1	CYR
	Zenaida aurita	Zenaida Dove	1		1	CYR
	Leptotila jamaicensis	Caribbean Dove		1		CYR-L
Psittacidae	*Amazona collaria****	Yellow-Billed Parrot*			6	CE-L-T
	Aratinga nana	Olive-throated Parrakeet			3	CYR
	Forpus passerinus	Green-rumped parrotlet			3	CYR
Cuculidae	*Coccyzus minor*	Mangrove Cuckoo	1	1	1	CYR
Trochilidae	*Mellisuga minima*	Vervain Hummingbird	1	5		CYR
	*Trochilus polytmus**	Red-billed Streamertail*	1	4	5	CE
	*Anthracothorax mango**	Jamaican Mango*		1	2	CE
Picidae	*Melanerpes striatus**	Jamaican Woodpecker*	2	1	1	CE
Tyrannidae	*Myiarchus validus**	Rufous-tailed flycatcher*	1			CE
	*Myiarchus barbirostris**	Sad Flycatcher*		7	2	CE
	Tyrannus caudifasciatus	Loggerhead Kingbird	5	4	4	CYR
Vireonidae	*Vireo modestus**	Jamaican Vireo*	2	1	3	CE
	Vireo altiloquus	Black-whiskered Vireo	2	2	7	CBR
Emberizidae	*Dendroica petechia*	Yellow Warbler	3	3	2	CYR
	*Euphonia jamaica**	Jamaican Euphonia*	2		1	CE
	*Euneornis campestris**	Orangequit*	3		3	CE-L
	Coereba flaveola	Bananaquit	6	12	12	CYR
	Icterus leucopteryx	Jamaican Oriole		2	6	CYR
	*Loxipasser anoxanthus**	Yellow-shouldered Grassquit*			2	CE
	Loxigilla violacea	Greater Antillean Bullfinch	1			CYR
TOTAL			**45**	**53**	**74**	

Key:
* - Endemic birds
CYR - Common Year-round Resident
CYR-L - Locally Common Year-round Resident
CE - Common Endemic
CE-L - Locally Common Endemic
CE-L-T - Locally Common Endemic also considered Threatened
CBR - Common Breeding Resident

Definition of terms used to represent the overall status and chances of observing each species:

Endemic	A species which is confined to a specific island or small group of islands and is found nowhere else in the world.
Common	5 or more individuals likely to be seen daily within its habitat
Year-round Resident	A species which spends its entire life-cycle on a particular island or group of islands
Breeding Resident	A species which breeds on a particular island or group of islands and then migrates elsewhere during the non-breeding season (Summer migrant)
Local	This describes a species that is often secluded to specific (often pristine) habitats
Threatened	Species and subspecies, which have experienced moderate declines or face imminent threats thus warranting specific conservation measures.

Plate 13 **Hermit crab (indicated by arrow)**

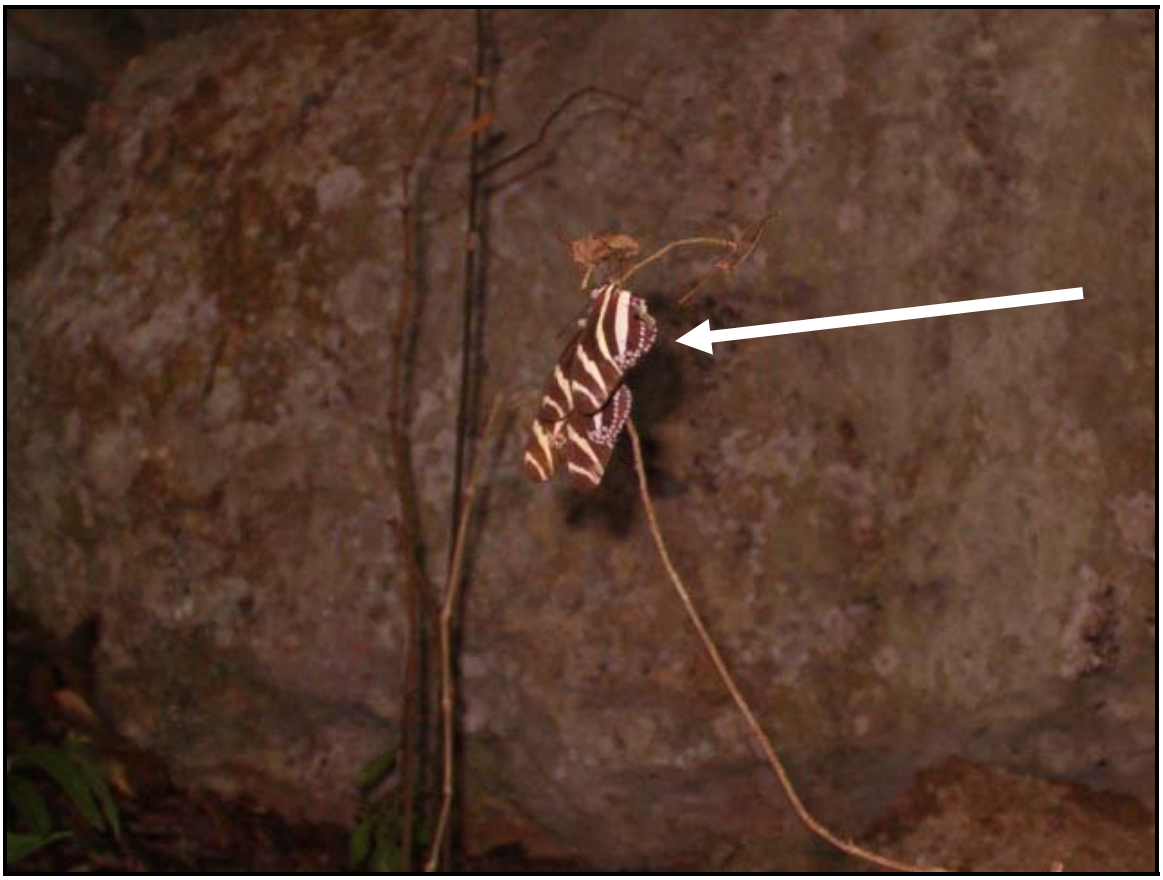


Plate 14 Picture of four Zebra Butterflies resting on a stick

4.3 PROTECTED AREA

The White Bay proposed development falls within the Coral Springs /Mountain Spring protected area (Figure 11). The development will occupy approximately 9% of the protected area. The location of the proposed development in proximity to the coastal environment means that systems have to be in place to prevent wastewater and solid waste from reaching this resource. This becomes even more critical as Jamaica is a signatory to the third Protocol of the Cartagena Convention, which is the protocol concerned with marine pollution from land based sources and activities (LBS/LBA). This Protocol was signed in 1999 and is concerned with the protection of the coastal and marine environment from land based sources of pollution. Jamaica is in the process of finalizing their National Programme of Action. The proposed development will have in place plans to deal with these two major pollutant streams.

Figure 11 **Location map of the Coral Springs/ Mountain Springs Protected area and the Proposed Development**

5.0 MARINE COMMUNITIES

Sampling was conducted using 6 transects running ~ 70 / 120 m from the sandy shore towards reef. These were numbered 1 – 6 from west to east (~ 40 m apart).

The area was relatively homogeneous from east to west so the description given with the 6 transects is collapsed. However, the eastern side of the bay was slightly deeper (1 m) than the west (0.5 m) and the sea grasses in the deeper area had longer blades (30 – 35 cm) and showed signs of heavier grazing.

The description will therefore focus on changes in the shallow benthic communities going from shore to reef.

Distance 0- 6 m. From the sandy shore to appearance of the algae *Penicillus* sp. (Plate 15). An encrusting (mustard coloured) sponge likely to be *Plakortis* sp.(Plate 16) also occurred as well as the gastropod, *Cerithium* spp. (Plate 17), which covered small rocks on the sandy bottom.

Plate 15 *Penicilius* sp.

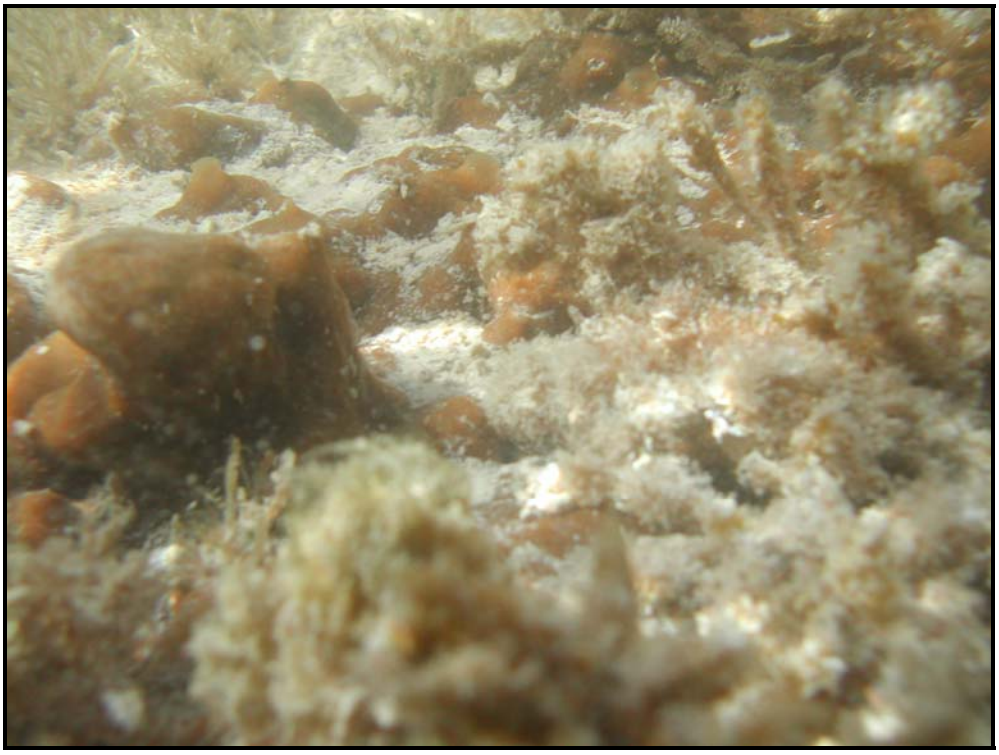


Plate 16 ***Plakortis* sp. Mustard sponge**

Plate 17 ***Cerithium* spp.**

Distance 6 – 10 m.- Soft substrate, *Halodule wrightii* and patchy *Thalassia testudinum* (~ 60% cover). *Diadema antillarium* (Black sea urchin) (Plate 18) and *Lytechinus variegates* (Green sea urchin).

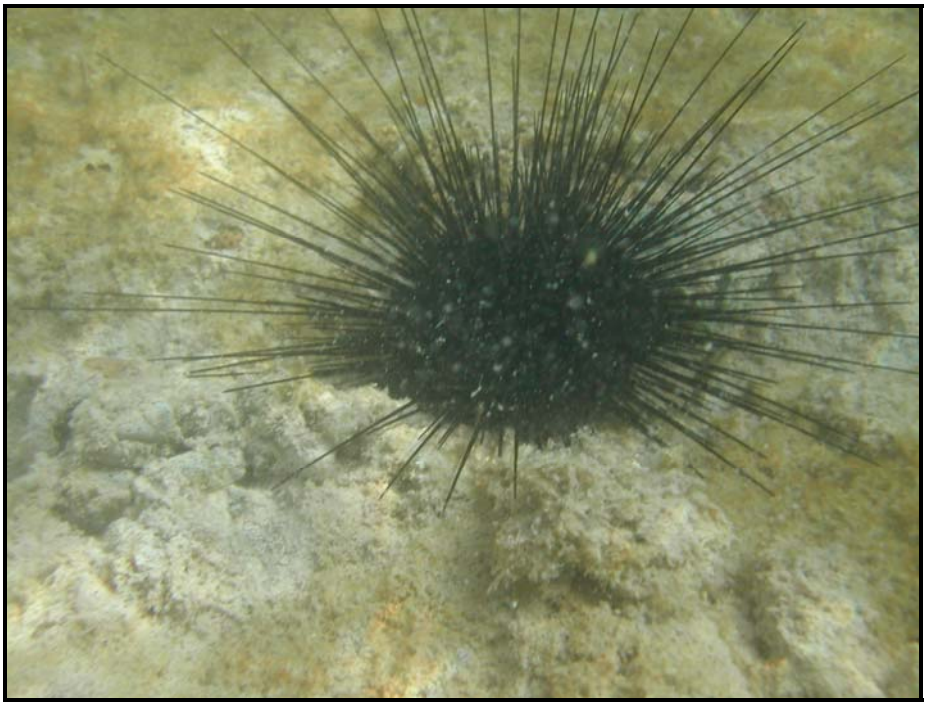


Plate 18 ***Diadema antillarium***

Distance 10 – 30 m. Small colonies of the coral *Siderastrea sidarea* (Plate 19). Algal genera: *Turbinaria* and *Udotea*, and dense *Thalassia* (80% cover) with 18 cm blades (Plate 20). Juvenile Wrasse and box fish seen. Giant anemone (*Condylactus* sp.) also occurred (Plate 21).

Plate 19 ***Siderastrea sidarea***

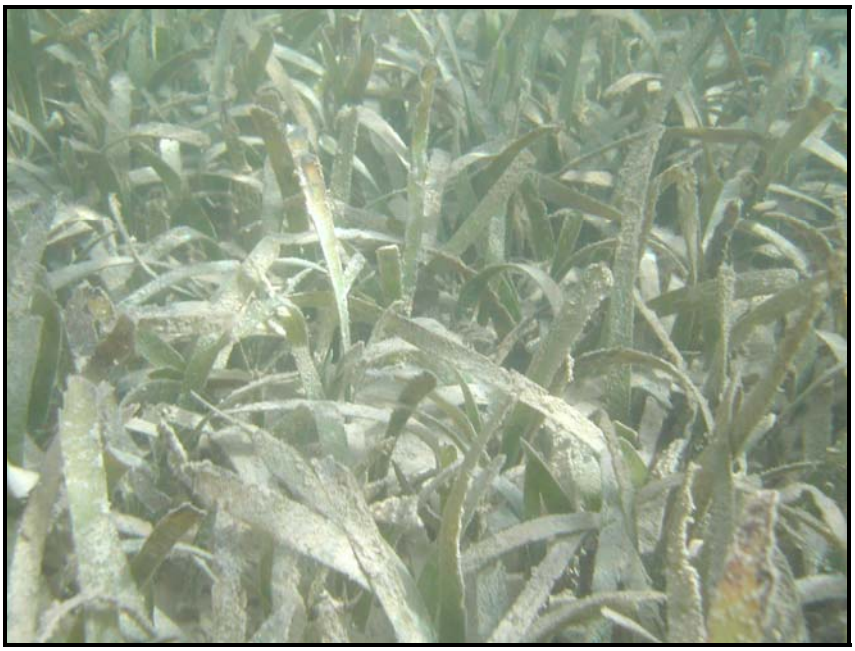


Plate 20 ***Thalassia***

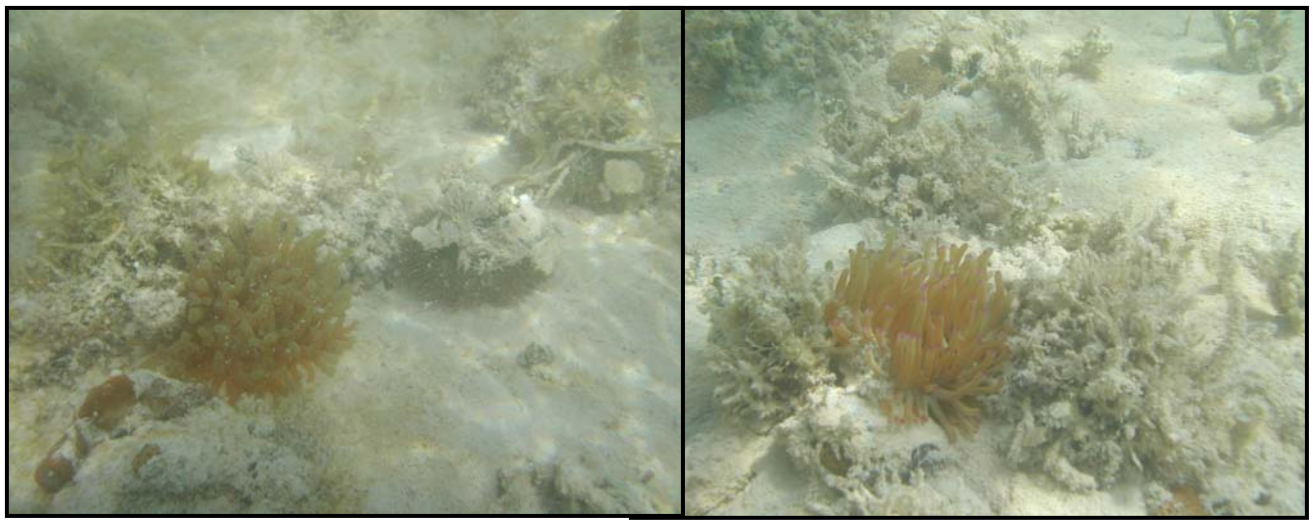


Plate 21 *Condylactus* sp.

Distance 30 – 70 m. Thick *Thalassia* bed with 30 cm blade length in ~ 0.5 m of water. Fan worms (Plate 22) and sea urchins (*Lytechinus*, *Tripneustes*, *Diademia*). Mantis shrimp mounds also occurred (Plate 23). These were also found in areas of bare sand (Plate 24).

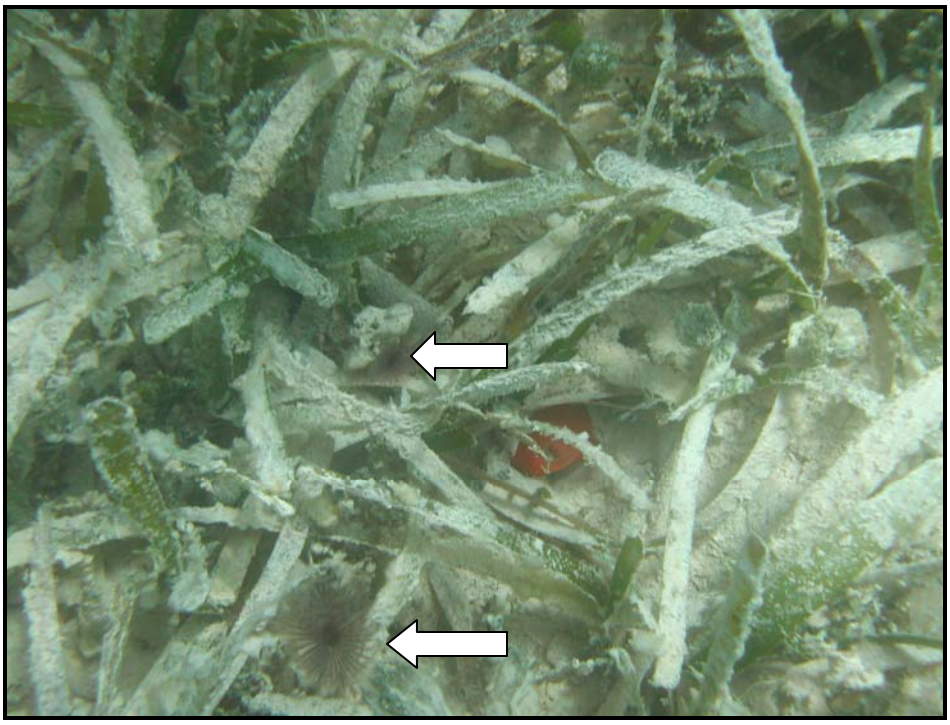


Plate 22 Fan worms

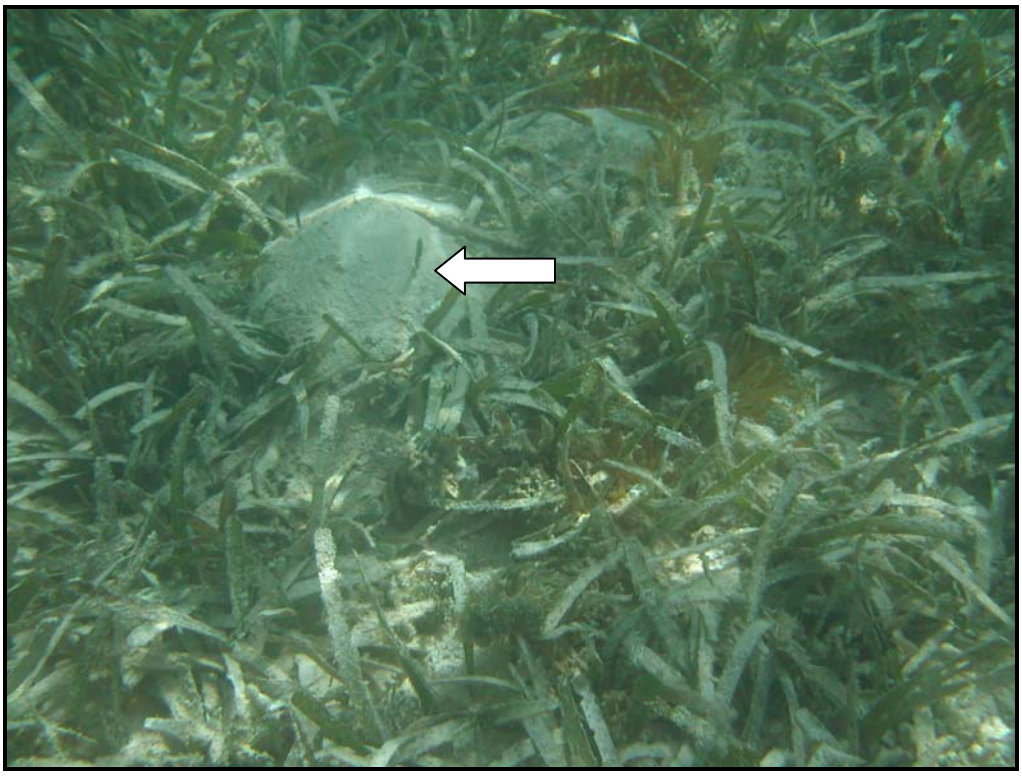


Plate 23 Mantis shrimp mounds in *Thalassia* bed

Plate 24 Mantis shrimp mounds on bare sand

Distance 80 – 120 m. Thick *Thalassia* with heavy epiphyte cover with signs of heavy grazing (Plate 25). Sea cucumbers occurred in this area (Plates 26 and 27), Donkey dung sea cucumber (*Holothuria mexicana*) and Brown sea cucumber (*Actinopygia* sp.), respectively.

Plate 25 Thick *Thalassia* blades with heavy epiphyte cover

Plate 26 *Holothuria mexicana*

Plate 27 ***Actinopygia* sp.**

Distance > 120 m . Back reef area where coral mounds begin to occur. Patchy *Montastrea annularis* occur (Plate 28).

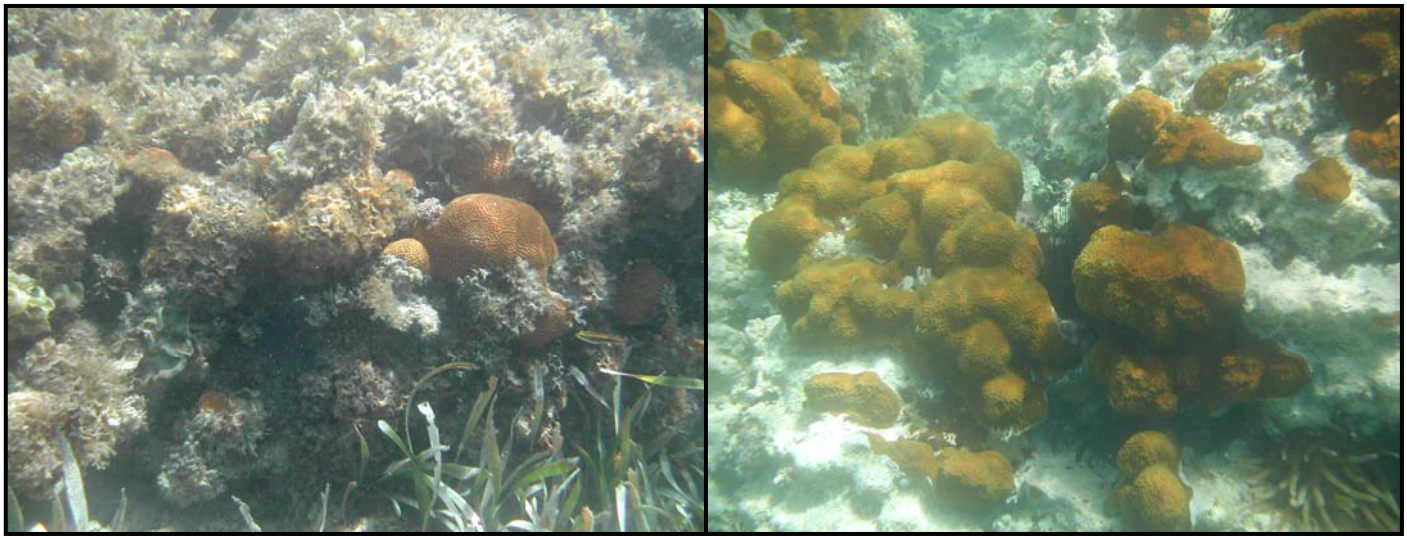


Plate 28 **Patches of *Montastrea annularis* observed in patches on the back reef**

Reef communities occur with the dominant coral being *Montastrea annularis* (Plate 29). Striped Parrot (Plate 30), Squirrel fish (Plate 31), Dusky Damsel, Yellow tail Snapper (Plate 32), Doctor fish and Angel fish occur (Plates 30 – 31).

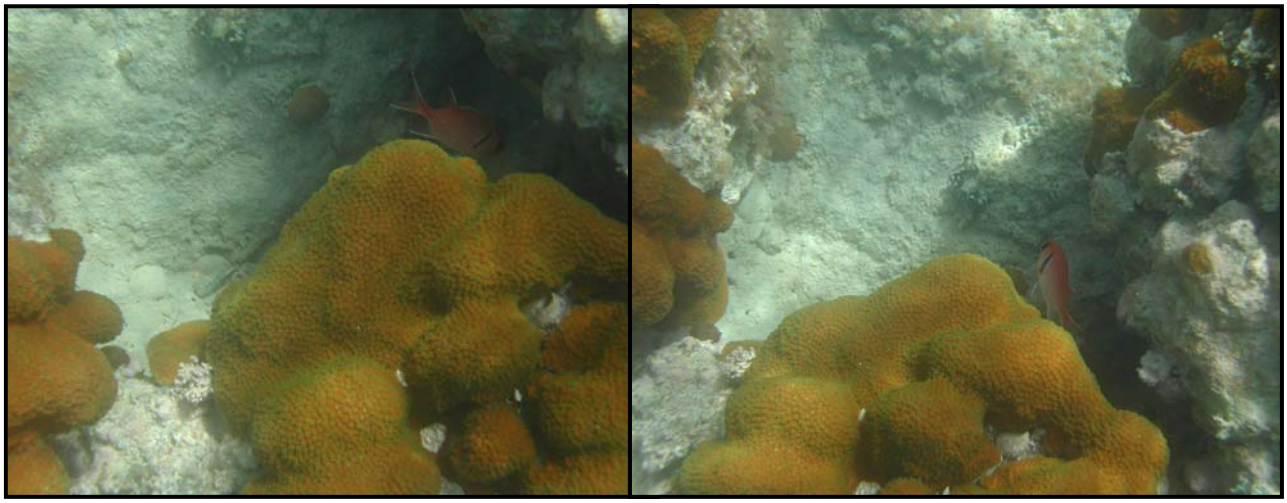


Plate 29 ***Montastrea annularis***

Porietes astroides (Plate 32) and *Siderastrea* were also seen in the area close to the reef as well as the algae *Syringidium* and *Udotea*. Carpet algae was also seen (Plate 33).

Plate 30 Striped Parrot

Plate 31 Squirrel fish

Plate 32 Yellow tail Snapper

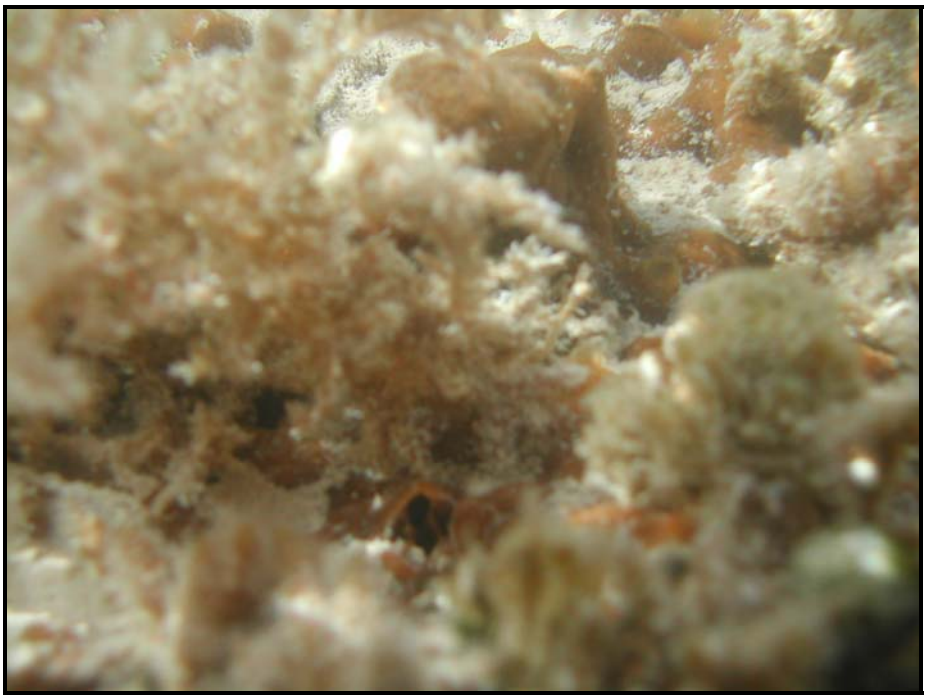


Plate 33 Carpet algae

Below is a list of taxa observed in the marine environment in proximity to the proposed development site.

Table 8 Species found in the marine environment in proximity to the proposed site

TAXA	SPECIES
ALGAE	*Padina* *Penicilius* *Udotea*
SEA GRASS	*Halodule wrightii* *Syringodium filiforme* *Thalassia testudinium*
INVERTEBRATES	*Plakortis* sp.(Mustard sponge) *Cerithi* (Bumpy gastropod) *Sabella* sp. (Fan worm) *Condylactis* sp. (Giant anemone) *Holothuria mexicana* (Donkey dung sea cucumber) *Actinopygia* sp. (Brown sea cucumber) *Diadema antellarium* (Black sea urchin) *Lytechinus variegatus* (Green sea urchin) *Trypneustes ventricosus* (White sea urchin) *Montastrea annularis* (boulder star coral) *Porietes astroides* (mustard hill coral) *Siderastrea siderea* (blushing star coral)
VERTEBRATES	*Acanthurus chirurgus* (Doctor fish) *Mobulidae* (Manta Ray) *Labridae* (Wrasse) *Ostraciidae* (Box fish) *Sparidae* (Sea bream) *Ocyurus chrysurus* (Yellow tail snapper) *Holocentrus adscensionis* (Squirrel fish)

The observations of the typical progression from sandy shore, to algae (usually *Penicilius*), to sea grass and the extensive and healthy condition of the sea grass bed, followed by extensive and diverse fringing coral reef system indicates a pristine and highly productive marine environment. Development of this pristine area may result in an attractive opportunity for ecotourism, snorkeling, fish watching etc., but has the

potential to be negatively impacted if the necessary preventative measures are not put in place during the construction and operation phases of the project.

6.0 WATER QUALITY

6.1 METHODOLOGY

Physical, chemical and biological data was collected at six (6) stations (Figure12). The water quality sampling was conducted on a one off basis. The following parameters were collected (Table 9).

Temperature, dissolved oxygen, salinity, total dissolved solids, pH, specific conductivity and turbidity levels were recorded *in situ* using a Hydrolab H2O datalogger. Nitrates, ortho-phosphates, total chlorophyll *a*, faecal and total coliforms levels were conducted on water samples collected. These samples were stored on ice in a cooler and transported to University of the West Indies and the Environmental Technical and Analytical Services laboratory for analyses. The results of these tests were compared with established water quality standards.

Table 9 Water quality parameters collected

Temperature (TEMP)	Nitrates (NO_3)
Dissolved Oxygen (DO)	Ortho-Phosphates (PO_4)
Salinity (SAL)	Faecal Coliform (F. Coli)
Total Dissolved Solids (TDS)	Total Coliform (Tot. Coli)
pH	Biochemical Oxygen Demand $_5$ (BOD_5)
Specific Conductivity (SPC)	

The locations of the water quality stations are listed in Table 10 and illustrated in Figure 12.

Table 10 Water quality stations and locations in JAD 2001

STATION #	EASTINGS	NORTHINGS
WQ 1	687464.581	704223.959
WQ 2	687699.326	704143.130
WQ 3	688003.703	704191.375
WQ 4	688155.494	704280.661
WQ 5	687661.290	704127.700
WQ 6	688253.032	704031.150

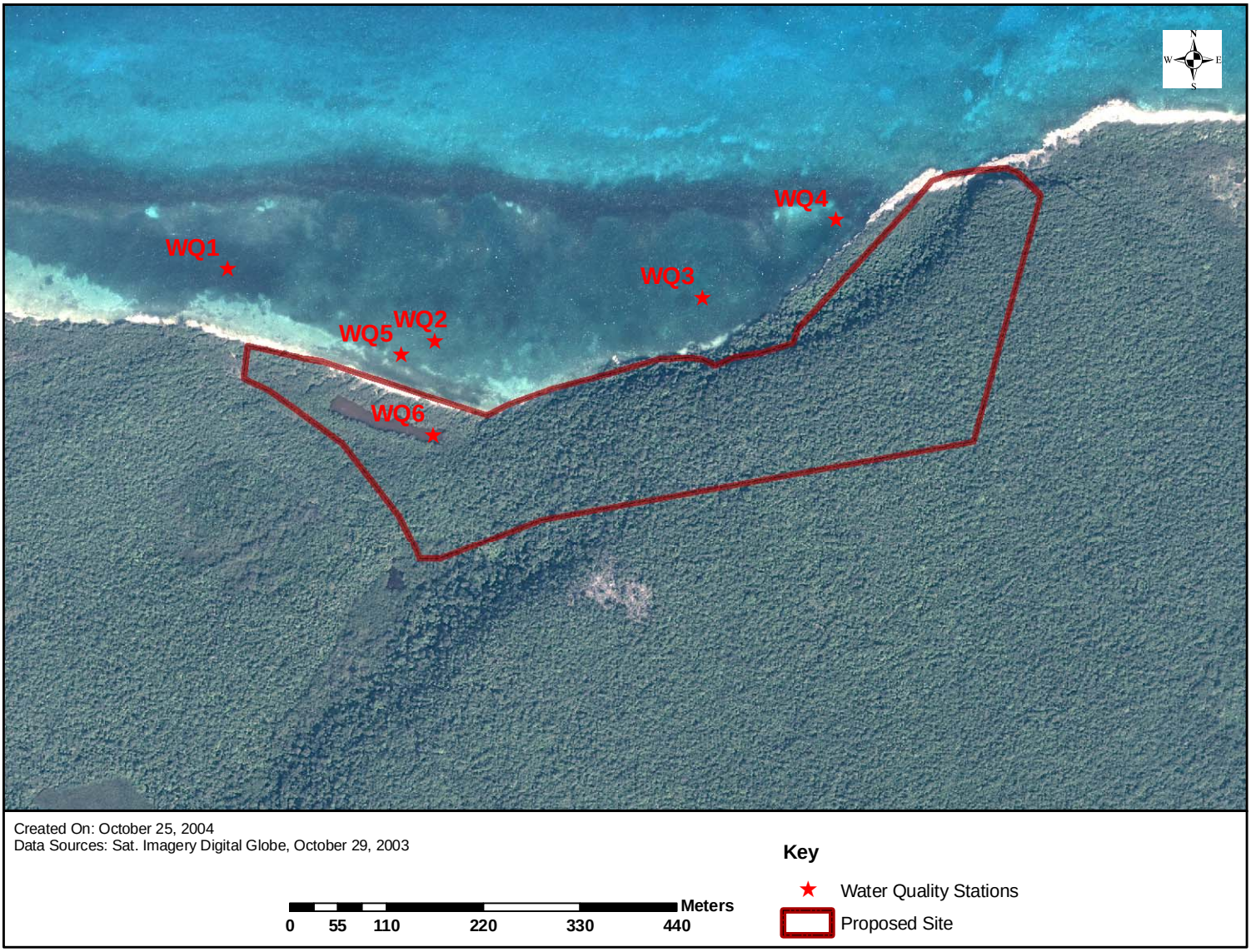


Figure 12 Locations of water quality stations

6.2 RESULTS

The results of the water quality monitoring exercise is listed below (Tables 11 and 12)

Table 11 Results of the physiochemical monitoring

STN #	TEMP (^oC)	SAL (ppt)	DO (mg l^{-1})	pH	SPC (mS/cm)	TDS (g/l)	TUR (NTU)	NO_3 (mg l^{-1})	PO_4 (mg l^{-1})
WQ1	29.92	36.57	6.47	8.34	55.06	35.26	0.00	9.68	0.10
WQ2	29.92	36.58	6.24	8.33	55.02	35.25	0.00	8.36	0.21
WQ3	29.58	36.61	7.08	8.28	55.19	35.28	0.00	11.88	0.06
WQ4	29.66	36.40	7.50	8.32	54.86	35.11	49.10	10.56	0.24
WQ5	30.44	35.52	6.36	8.34	55.79	34.43	87.70	11.00	0.29
WQ6	29.79	70.74	4.51	7.73	100.00	64.00	0.00	1.76	0.04

Table 12 Results of the biological monitoring

STN #	BOD_5 (mg/l)	F. Coli (MPN/100 ml)	Tot. Coli (MPN/100 ml)
WQ1	6.27	< 3	< 3
WQ2	0.17	< 3	< 3
WQ3	7.97	< 3	< 3
WQ4	6.8	< 3	< 3
WQ5	12.07	< 3	< 3
WQ6	0.23	230	500

6.3 FINDINGS AND DISCUSSION

Temperature, salinity, dissolved oxygen, pH, specific conductivity and total dissolved solids were within the expected range of marine water. However, the pH at station WQ6 which is in a salina showed some evidence of fresh water influence as normal marine water pH is of the order of eight (8). This results in hyper saline conditions evidenced by the extremely high salinity (70.74 ppt) and specific conductivity (100 mS/cm). The value of pH (7.73 units) indicates that there is some influence from fresh water. The pH values were within the Blue flag criteria of 6.5-8.5 pH units.

Nitrate and phosphate concentrations at the six stations ranged from 1.76 mg $l^{-1}$to 11.88 mg l^{-1} and 0.04 mg l^{-1} – 0.29 mg l^{-1} respectively. The Blue Flag water quality standards for nitrates is 0.6 mg l^{-1} and for phosphates 0.1 mg l^{-1}.

The nutrient levels within White Bay were generally higher than ambient marine water quality standards. Nitrate concentrations were elevated at all stations. Phosphate concentrations were elevated at all stations except stations WQ1, WQ3 and WQ6. Elevated nutrients (nitrates and phosphates) give an indication of eutrophic or potential eutrophic waters.

Biochemical oxygen demand (BOD) is indicative of the amount of organic matter present in the environment. Hence, it is indicative of inputs to the environment from sewage and other organic effluent. The BOD_5 at the six stations ranged from 0.17 –12.07 mg l^{-1}. Station WQ4 (12.07 mg l^{-1}) exhibited the highest concentration. Ambient marine water quality standard for BOD_5 range from 0.57 –1.16 mg l^{-1}. It is proposed by NEPA that BOD concentrations for coastal waters should range between 0.7 - 1.7 mg l^{-1}. Only the BOD_5 at stations WQ2 (0.17 mg l^{-1}) and WQ6 (0.23 mg l^{-1}) were in compliance with this standard.

Faecal coliform levels at all stations except at station WQ6 (230 mg l^{-1}) were within the standard 100 MPN/100ml. The presence of faecal coliform can be used as an indicator of sewage contamination. Faecal coliform are found in the bowels of mammals. Total coliform include other bacteria and viruses with faecal coliform. With the exception of station WQ6 (500 mg l^{-1}) all other stations were in compliance with the 200 MPN/100ml standard.

The water quality within the Bay was generally within acceptable levels however, there are indications of non-point pollution sources that are impact some parameters e.g. nutrients and BOD. The waters are generally phosphate limited and as such every effort should be made to reduce the concentration of phosphates reaching the water so as to prevent the rapid growth of algae.

7.0 NOISE

7.1 METHODOLOGY

A one off baseline noise measurement was taken at fourteen (14) locations between 9 am and 11:30 am using a Quest 2700 sound level meter (Figure 13). These locations are listed in Table 13. The sound level meter was calibrated with a Quest QC - 10 sound calibrator. The meter was turned on and the response was set to slow, the weighting to A and the mode to SPL. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone.

A baseline noise surface map was generated using the average noise levels measured at the eight stations and was generated using ArcGIS 9.0 Spatial Analyst using a tension spline interpolation method (Figure13).

Table 13 Noise station locations in JAD 2001 and results in dBA

STATION #	LOCATION		RESULTS		
	EASTINGS	NORTHINGS	HIGH (dBA)	LOW (dBA)	AVERAGE (dBA)
N 1	687592.38	704109.06	62.3	47.4	47.7
N 2	687744.85	704052.78	43.3	40.8	41.1
N 3	687780.48	704000.38	45.6	43.6	43.9
N 4	687902.36	703987.11	43.6	43.7	41.8
N 5	687863.56	704058.25	59.6	51.8	54.4
N 6	687904.02	704087.25	40.5	40	40.2
N 7	688081.48	704142.76	47.4	42.6	42.8
N 8	688234.4	704223.94	43.8	42.8	44.1
N 9	687832.3	704004.69	44.6	42.8	42.8
N 10	687918.81	704055.206	50.3	48	49.4
N 11	688008.343	704076.972	50.3	48.6	49.3
N 12	688119.5	704099.031	43.2	41.8	42.6
N 13	688253.032	704126.801	44.1	40.7	41.9
N14	687671.16	704060.18	50.1	44.8	48.8

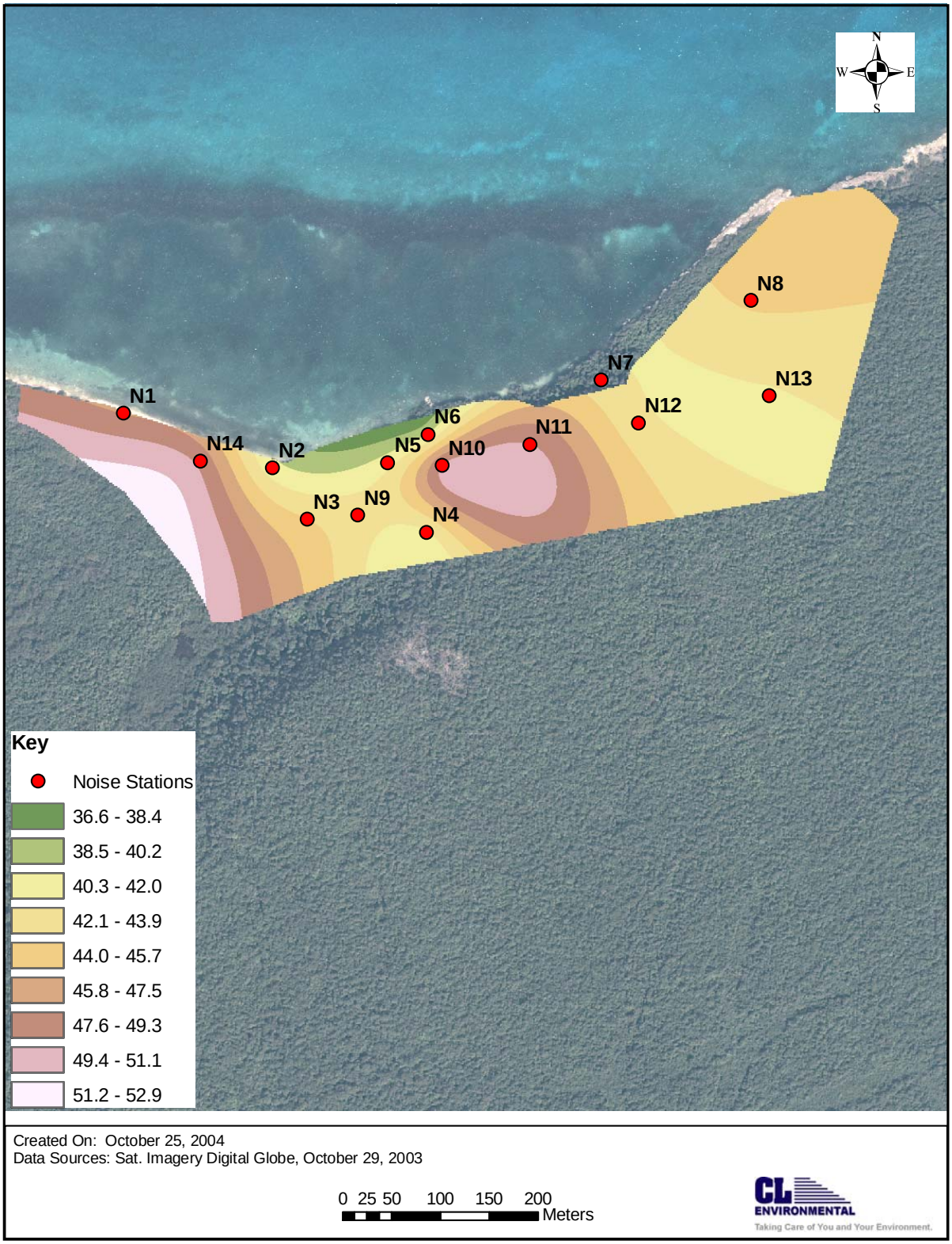


Figure 13 **Noise stations and the interpolated baseline noise levels across the proposed development site**

7.2 RESULTS

The results of the noise level assessment indicated that the noise on the proposed property was relatively low (Figure 14). All the stations had average noise levels within the World Health Organization guidelines of 55 dBA (serious annoyance) and the NEPA daytime guidelines (55 dBA) for residential areas.

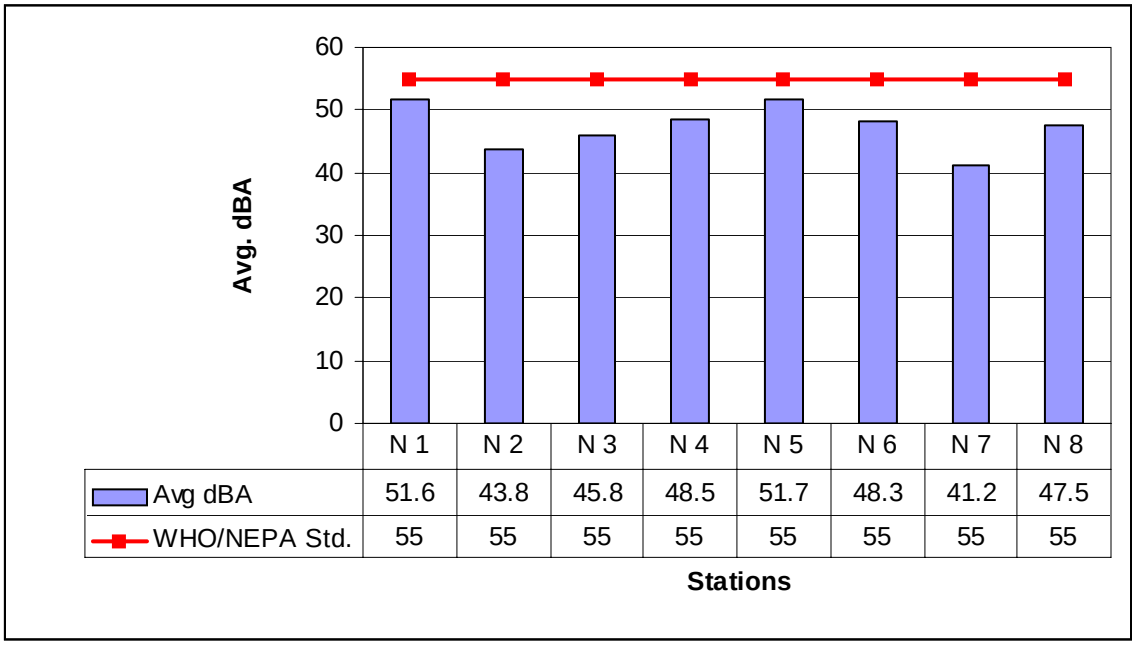


Figure 14 Average noise level readings in dBA

Noise generation is expected from engine and road/tyre friction from the increased vehicular traffic along the North Coast Highway which is situated approximately 750 metres southwest of the proposed site. However, due to the distance of the proposed development from the highway and the vegetation, this noise is not expected to impact negatively on the proposed development.

The proposed development is not expected to have a major negative impact as it relates to noise pollution in and around the proposed development site. The site is sufficiently located away from any potential receptors (e.g. buildings etc.). Additionally, the fact that most of the vegetation will be kept around the proposed development, will act as a kind of noise barrier, thereby reducing attenuation of noise waves. It also forms a semi-porous barrier which will

somewhat block the line of sight between the source and any receiver (most noise tends to travel along a line of sight).

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

8.0 AIR QUALITY

Actual ambient air quality readings were not conducted, however, due to the distance from major receptors and the vegetated state and terrain of the proposed site the potential for dust nuisance is low to medium.

The prevailing winds at the proposed site are from the northeast, which would in effect carry any dust or odour nuisance inland and away from the development. However, the proposed development would be at risk from an odour nuisance if the sewage system were to fail.

ODOUR FROM SEWAGE TRATMENT SYSTEM

Wastewater treatment plants have the potential to be odour nuisances if proper buffers between the treatment units and existing populations are not provided and the plant is not properly operated and maintained. A buffer of at least 100 metres has been provided on all boundaries as per NEPA recommendations.

Low influent sulphate levels in the water supply system associated with the WWTP can also reduce the chances of offensive odours from hydrogen sulphide generation. An influent sulphate level of 240 mg/l or higher is believed to be the threshold above which odour concerns might start to arise.

The prevailing winds at the proposed site are from the northeast, which would in effect carry any dust or odour nuisance inland. The proposed development has the potential to have a negative impact on the ambient air quality on the proposed site and areas in proximity.

9.0 SOCIAL BASELINE

The Social Impact Area (SIA) for this study was assumed to be the catchment for the proposed development. This was assumed to be approximately 5km (Figure 15).

9.1 INTRODUCTION

9.1.1 Methodology

Informal interviews were conducted with some residents and stakeholders within the study area. Additionally, windscreen surveys were conducted in the communities to verify and update the information on the maps. Current socio-economic data was obtained from the 2001 population census.

Population was calculated using the formula [$i_2 = i_1 (1 + p)^x$]; where i_1 = initial population, i_2 = final population, p = actual growth rate and x = number of years. The growth rate for the study area was determined from the 1991 to 2001 intercensal period, in which Trelawny had a growth rate of 0.26 % per annum. In the absence of the 2001 economic census data, the Parish employment rate for 2003 was used (STATIN).

Figure 15 The Social Impact Area (SIA)

9.2 DEMOGRAPHY

9.2.1 Population

The population of Trelawny in 2001 was 73,048 persons (STATIN 2001). The population within the catchment (referred to as study area from here onward) of the proposed Villa development was approximately 4,331 persons in 2001, which represents approximately 6 % of the population of Trelawny. Of this population, approximately 51% were males.

If the current growth trend in the study area continues (0.26 % pa - based on the last intercensal change), then the population at the time of this report within the study area was estimated to be 4,365 persons and is projected to grow to 4,658 persons over the next twenty five (25) years (2029).

The sex ratio (males per 100 females) within the parish in 2001 was 103.3. In the study area it was 103. This means that within the study area (local) there were more males than females. This is similar to the regional context (parish).

The child, old age and societal dependency ratios within the parish of Trelawny in 2001 were 590, 158 and 748 per 1000 persons of labour force age respectively. The child, old age and societal dependency ratios for the study area were 489, 147 and 636 per 1000 persons of labour force age respectively. This indicates that there is less dependency on the working population in the study area by the young (0-14 years) and elderly (65 and over years) in the population when compared with the parish.

A comparison of the dependency ratios in 2001 revealed that the parish statistics were higher than national dependency ratios. The dependency ratios for the study area were lower than the national levels except for the old age category (Figure 16).

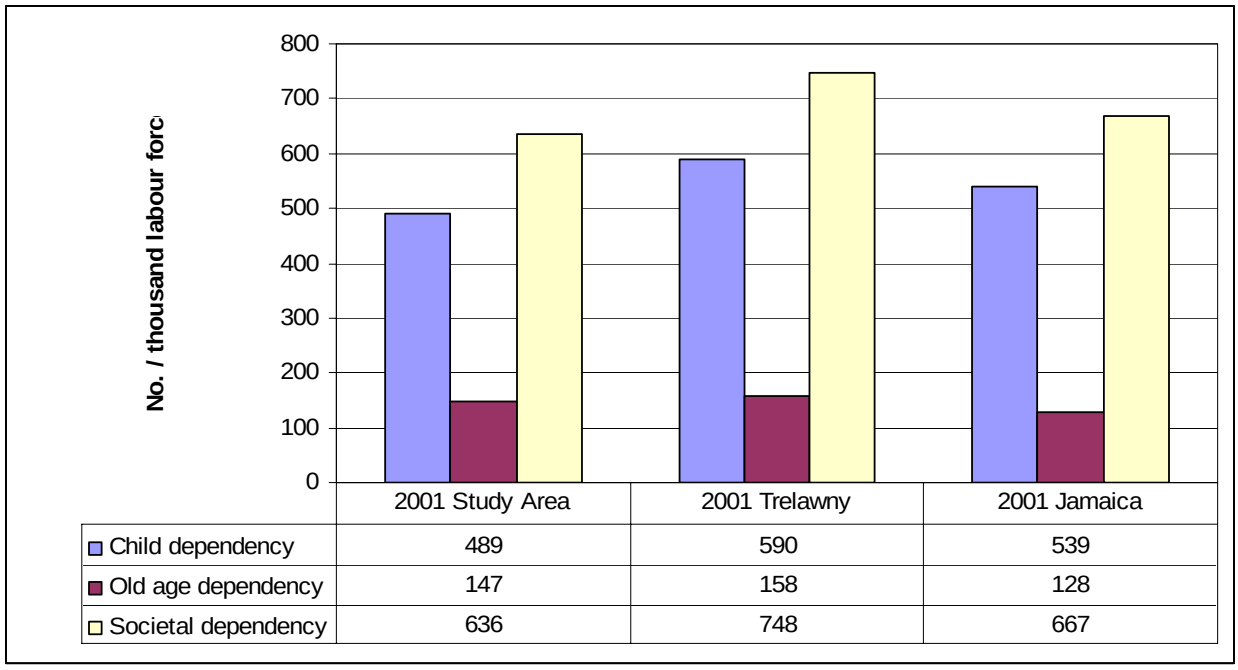


Figure 16 Dependency Ratios

9.2.2 Population Density

It is estimated that the land area within the study area is 4,526 hectares. The average population density of the study area is approximately 1 person per hectare (PPH) which is considered low.

9.3 EMPLOYMENT

The unemployment rate among the labour force in the parish in 2003 stood at approximately 18%. It was not possible to determine the unemployment levels within the study area, as the data was not presented at the Enumeration District level, but instead at a Parish level.

The project is expected to employ some 50 persons during the site clearance and construction phase and is anticipated to create approximately 200 direct jobs during operation. Based on the data it is estimated that approximately 115 indirect and induced jobs will be created during the site clearance and construction phase and another 460 indirect and induced jobs during the operation of the proposed development.

This is a positive impact and it is expected to provide an additional source of employment within the SIA. This coupled with the other proposed tourism developments will provide well needed employment in the area. The population educational attainment would suggest that they will be able to take advantage of this opportunity. This coupled with the fact that the developers are committed to employ locals where possible augur well for the future of the area.

9.4 EDUCATION

Educational attainment of persons within the study area when compared with the parish statistics showed that the population within the study area had a higher percentage of the population attaining a secondary, university and tertiary education (Table 14). Additionally, there was a lower percentage of the population in the Study Area when compared to the parish statistics having no formal educational training. The high percentage of persons in the population that have attained secondary education or higher (tertiary) and the low percentage of persons with no formal education, means that the population is trainable and should result in a pool of employable persons for the proposed development.

Table 14 Comparison of categories of educational attainment by the population in the Parish and the Study Area in 2001

Educational attainment	Parish (%)	Study area (%)
Pre-Primary	4.9	6.4
Primary	41.0	22.5
Secondary	46.0	57.5
University	0.7	1.9
Other Tertiary	2.7	6.2
Other	2.0	3.9
Not Stated	1.4	1.2
None	1.2	0.4

(Source: STATIN 2001 Census data)

While there are no schools within the Study Area, Table 15 lists some of the schools within proximity to the proposed development site. From the Table, schools that have generally

exceeded their capacities (overcrowded) and those that are close to exceeding their capacities can be identified. An indicator of crowding in schools is the advent of the shift system, which is a solution to deal with overcrowding in schools.

Table 15 Some schools, capacity, enrolment and percentage attendance

SCHOOL NAME	Enrolment	Capacities	% Attendance	Comments
Falmouth Infant	**421**	**240**	**76**	**Co-ed Whole Day**
Daniel Town All Age	71	215	84	Co-ed Whole Day
Duncans All Age and Infant	683	395	87	Co-ed Shift
Falmouth All Age	1,043	690	90	Co-ed Shift
William Knibb Memorial High	**1,172**	**910**	**94**	**Co-ed Whole Day**

NB. Enrolment based on the 2001- 2002 academic year. The names of schools that are in bold have exceeded their capacities.

9.5 LAND USE

Land use in the study area is mainly fishing, commercial, residential and recreational. The built environment dominates the land use of the study area. Commercially, the study area has bars, shops and a future sports complex at Greenfield. There are numerous existing and future housing schemes located in the study area. Recreationally, there are hotels (Starfish and FDR Pebbles), villas, beaches, the most notable being the Burwood Public Bathing Beach and the world renown Glistening Waters (one of six places around the world that has bioluminescence waters). Residentially, there is the Retreat Heights, Coral Springs, Stewart Castle, Carey Park, Refuge, Daniel Town developments and informal settlements in Coopers Pen and Rock.

Other land use practices within or in proximity to the study area include;

i. Improper solid waste disposal
ii. Charcoal burning
iii. Logging (providing material for craft and wood carving)

The proposed site is currently a disturbed limestone forest. It has been disturbed by both anthropogenic and natural phenomena (hurricanes and storms). The total area of the proposed development is approximately 7 hectares.

The proposed development has the potential to impact negatively on the vegetation on the proposed site, however, the method of construction that is proposed will mitigate any potential negative impact that may have been expected.

Landuse outside the study area includes;

1. A hospital
2. A police station
3. A fire station
4. A library
5. A recreational centre (Elleston Wakeland)

9.5.1 Housing

In 2001, there were approximately 19,290 housing units, 21,263 private dwellings and 21,732 households in Trelawny. The average number of dwelling in each housing unit was 1.1 and the average household to each dwelling was 1.02. The parish had an average household size of approximately 3.36 persons /household. When compared to the national levels, the average number of dwelling in each housing unit (1.2), the average household to each dwelling (1.03) and the average household size (3.48) were lower in the parish.

In 2001, there were approximately 1,211 housing units, 1,314 private dwellings and 1,370 households in the study area. The average dwelling in each housing unit was 1.1 and the average household to each dwelling was 1.04. The average household size was 3.16 persons/household. While the average household to each dwelling and average dwelling in each housing unit were similar to the parish statistics, the average household size was lower than the parish average.

Separate housing accounted for 92.3% of the housing units in the study area in 2001. Approximately seven percent (7.1%) were attached housing and 0.4% part of a commercial building, 0.1% improvised housing, 0.1% did not state and approximately none had other type of housing.

Most of the households (38.3%) in the study area occupied one (1) room for sleeping. Approximately thirty two percent (32.7%) of the households in the study area used two rooms for sleeping, 16.2% used three rooms, 9.5% used four rooms and approximately three percent (3.1) used five or more rooms for sleeping. Less than a percent (0.2%) did not report how many rooms they used for sleeping.

A comparison of the Parish and the Study Area statistics of the number of rooms in which households occupied in 2001 showed that the study area had a higher percentage of households occupying 1 bedroom and 4-9 bedrooms. The ten and over category were similar and there was a lower percentage of households in the Study Area not reporting how many rooms they occupied (Table 16).

Table 16 Comparison of Parish and Study Area households by rooms they occupy as a percentage

AREA	NUMBER OF ROOMS										
	1	2	3	4	5	6	7	8	9	10 & Over	Not Reported
Parish	27.4	22.8	21.8	12.8	7.5	3.7	1.4	0.7	0.3	0.2	1.4
Study Area	28.8	21.6	19.7	13.7	9.9	4.5	2.1	1.4	0.8	0.2	0.7

Source: (STATIN 2001 Census)

The plates below (Plate 34 and 35), gives an indication of the types of housing found in proximity to the proposed development site.

Plate 34 Examples of board structures west of the proposed site

Plate 35 An example of the concrete structure found at Retreat Height, south of the proposed development site

The proposed development is not expected to have any negative impact as it relates to housing provisions as the developers anticipate employing local persons, therefore it is not anticipated that there will be any pressure to provide additional housing solutions for workers for the proposed development.

9.5.1.1 Tenure

Table 17 is a comparison of household tenure for the parish and the study area.

Table 17 Percentage household tenure for the parish and the study area

CATEGORY	TRELAWNY (%)	STUDY AREA (%)
Owned	43.0	44.3
Leased	4.4	1.3
Rented	16.1	20.6
Rent Free	22.2	21.3
Squatted	4.7	9.2
Other	0.8	1.0
Not Stated	8.8	2.3

Source: (STATIN 2001 Census data)

In 2001, the percentage of households within the study area when compared with the parish were similar for those who had owned, live rent free and had other forms of tenure. Noticably, the percentage of households in the study area that leased or had not stated what form of tenure they had was lower than that obtained in the parish. Significantly, there were a higher percentage of households (almost twofold) in the study area who squatted (informal settlers).

9.5.2 Infrastructure

Electricity

In 2001, approximately 80.2% of the households in the parish of Trelawny used electricity. The use of kerosene was the next major source of lighting in households in the parish accounting for approximately 17.3%. Two percent (2%) of the households did not report what means they used for lighting, while less than one percent (0.5%) of the households in the parish had other means of lighting.

In the study area in 2001, approximately eighty percent (83.1%) of the households used electricity and 15% used kerosene for lighting. Less than one percent of the households used other means (0.7%) and 1.2% had not reported the type of lighting used in their households. There were a greater percentage of households within the study area using electricity than in the parish (Trelawny). The percentage of households using kerosene in the study area was lower when compared with the parish.

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

Telephone/Telecommunications

The parish of Trelawny and the study area are served with landlines provided by Cable and Wireless Jamaica Limited. Wireless communication (cellular) is provided by Cable and Wireless and Digicel Jamaica Limited.

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

Water Supply

Approximately 69% of the households in the parish in 2001 received water from the National Water Commission (NWC). Approximately 18% were supplied by private means, 8.3% from springs and rivers, 3.9% had other means of receiving their water supply and 1.8% did not report the source of their water supply (Table 18).

In 2001, the percentage of households (≈ 87%) receiving water from the NWC in the study area was higher than that obtained in the parish. Seven percent (≈6%), of the households received water from private means, 0.4% did not report the means of their water supply, 5.4% had other means and 0.9% received water from a spring or river (Table 18).

Water supply to the development is expected to be from the National Water Commission. The source will be from the Martha Brae water scheme, which is presently being upgraded. This system is expected to provide water to the Duncans area.

Table 18 Water supply by categories as a percentage of total households for the parish and the study area (2001)

	CATEGORY	TRELAWNY (%)	STUDY AREA (%)
Public Source	Piped in Dwelling	26.3	48.2
	Piped in Yard	13.9	10.7
	Stand Pipe	26.0	27.4
	Catchment	2.3	0.6
Private Source	Into Dwelling	6.0	3.9
	Catchment	11.6	2.5
	Spring/River	8.3	0.9
	Other	3.9	5.4
	Not Reported	1.8	0.4

(Source: STATIN Population Census 2001)

The development is expected to use approximately 93,120 gallons per day (352,497.5 litres/day) of water. Based on this demand, it is not anticipated that there will be any problems in the supply of water to the development by the National Water Commission.

Sewerage Disposal

A higher percentage of households in the study area compared to those within the parish use water closets to dispose of their sewage. With the higher percentage of households in the study area using water closets, there is a concomitant reduction in the percentage using pits. However, there were a greater number of households having no established facilities for disposal of their sewage. This is of concern as the study area is in close proximity to the coast, therefore increases the potential of coastal pollution (Table 19).

Table 19 Comparison between the parish and the study area by sewage disposal methods as a percentage of the households

METHOD OF DISPOSAL	LOCATION	
	TRELAWNY (%)	STUDY AREA (%)
Pit Latrine	56.8	41
Water Closet	38.1	54.6
Not Reported	1.3	0.2
No Facility	3.8	4.2

(Source: STATIN Population Census 2001)

Waste water from the proposed development will be treated by a waste water treatment plant consisting of a splitter box, two-stream septic tank, four constructed sub-surface flow wetlands which will be arranged with two wetlands in parallel to two others, a chlorinator with final disposal to the existing salina, with optional disposal to an outfall.

The system that will be designed for this development is expected to meet the new NEPA standards for sewage effluent discharge (Section 1.1.1). This system will reduce or mitigate the potential for negative impact as it relates to sewage treatment and disposal from the proposed development.

Solid Waste Generation

The Westerm Parks and Market (WPM) Waste Management Limited does solid waste collection within the study area. Presently, collection is done on a daily basis by a truck which can hold 7-8 tonnes (7,000 – 8,000 kg) of compacted solid waste. This service is provided free (partial covered by property taxes) for the households within the area. The waste is transported to the Retirement dump located in St. James, approximately 45 km (≈ 28 miles) from the proposed development.

It is estimated that households in the study area generated approximately 5,631kg (≈ 6 tonnes) of solid waste in 2001. Based on the growth of the population, it has been estimated that at the time of this study, approximately 4,365 kg (≈ 4.4 tonnes) of solid waste was being generated and it is expected that within the next twenty five years, if the population growth rate remains the same to be 4,658 kg (≈ 4.7 tonnes).

The 2001 census data indicated that approximately 20% of the households in the parish of Trelawny and 24% of the study area had their garbage collected by public means (WPM Waste Management Limited). It showed that the preferred method of disposal was by burning (≥ 70%) (Table 20). The data also showed that most households (≈ 71.4%) in the study area burned their garbage as a means of disposal. All the other categories of garbage disposal in the study area were lower than in the parish. However, the high percentage (71.4%) of households burning their garbage as a means of disposal is a cause for concern, as it has the potential to impact on ambient air quality by contributing to air pollution.

Table 20 Percentage households by method of garbage disposal

DISPOSAL METHOD	TRELAWNY (%)	STUDY AREA (%)
Public Collection	20.5	24.5
Private Collection	0.2	0.3
Burn	70.1	71.4
Bury	2.5	0.7
Dump	5.4	3
Other Method	0.2	0.1
Not reported	1	0

(Source: STATIN Population Census 2001)

Arrangements will be made with a private contractor to visit the site on a weekly basis to remove the solid waste to the Retirement Landfill as needed.

It is anticipated that the development will not have a negative impact on garbage collection within the study area or upon the disposal at Retirement landfill as it relates to space, as the proponent will have an established solid waste plan.

Roads, Transportation and Traffic

The proposed development site is located approximately 8 km (≈ 5 miles) east of Falmouth (capital of Trelawny) and approximately 39 km (24 miles) east of Sangster International Airport (Montego Bay) and approximately 41 km (25 miles) east of the City of Montego Bay

(Jamaica's second City). Depending on the traffic conditions, it takes anywhere between half an hour to an hour to drive to Montego Bay. The Duncans to Montego Bay main road and the North Coast highway passes approximately 1.5 km south west of the proposed site. The North Coast highway upon completion will replace the Duncans to Montego Bay main road. This highway upon completion will also reduce the time to travel to Montego Bay. The surfaces of these roads are in a relatively good state of repair.

Access to the proposed site will be via a secondary road, which at present had been destroyed by Hurricane Allen (Figure 17). The developers are in discussions with the Parish council in an attempt to arrive at a mutually acceptable agreement in which this road will be rebuilt. The access point to the North Coast highway is also shared with that of the Burwood Public Bathing Beach. It is at a point where the potential of vehicles travelling along the North Coast highway speeding is high thereby increasing the potential for accidents especially with large tour buses entering the Highway.

Transportation within the study area is provided by a fleet of taxis, "robot taxis" (unlicensed), buses and private cars.

There is an absence of a formal transportation centre in the town of Falmouth, which leads to traffic snarls and congestion. Currently taxis and minibuses stop at areas along the round-a-bout in the centre of the town.

Access to the proposed development will be achieved by rehabilitating approximately 1.5km of the old access road along the coastline. This will reduce the potential environmental impacts as it will not involve cutting a new route. It will have the potential to cause marine pollution.

The construction activities have the potential to have a negative impact on the area. It is expected that there will an increase in heavy equipment moving along the access roads. The activities will also have the potential to increase traffic snarls in the short to medium term.

During operation, it is expected that approximately two (2) buses per day will visit the proposed development. These tour buses have the potential to increase the potential of accidents at the

point of access to the main road. To mitigate this potential, adequate signage will be erected to warn oncoming vehicular traffic along the highway.

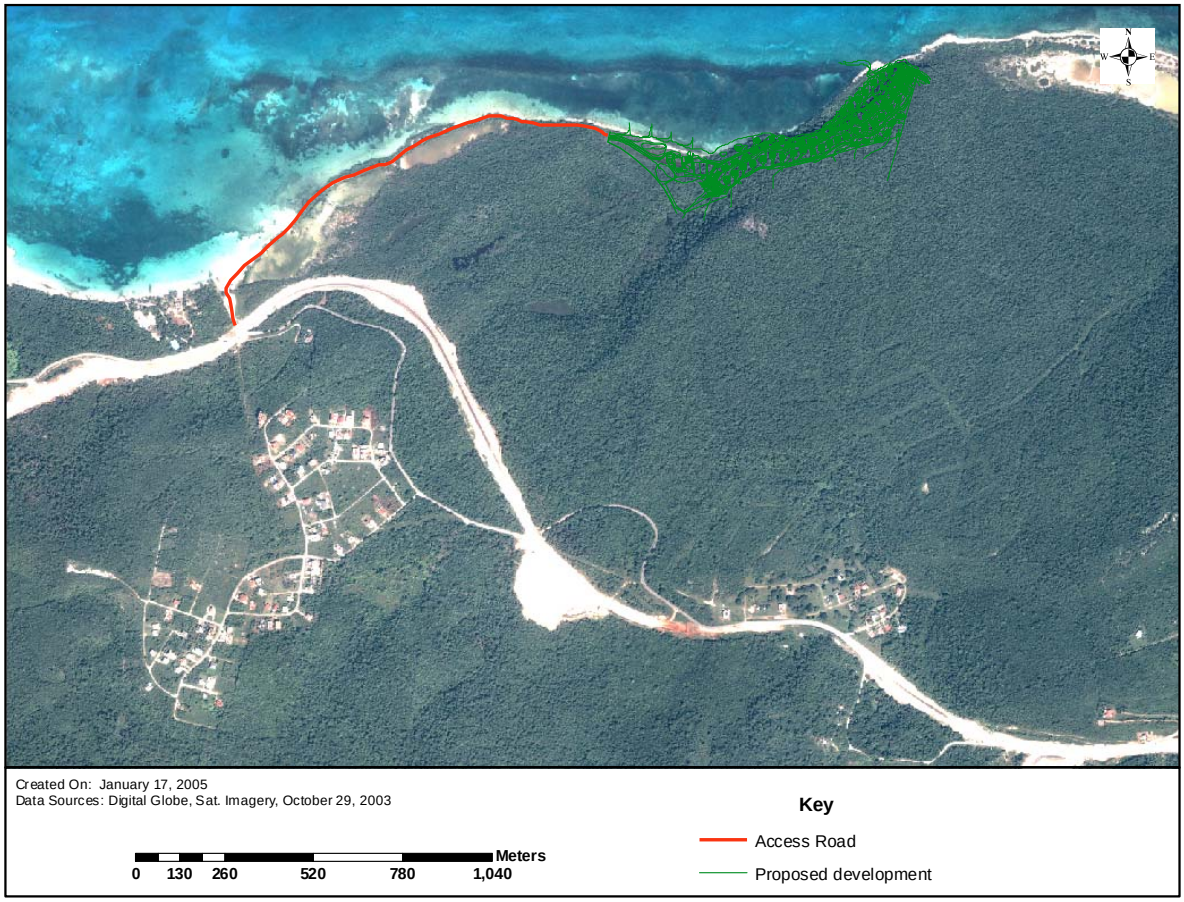


Figure 17 Map depicting the proposed site and access road

Health Care

Persons within the study area obtain their health care at a number of health centres and private doctors. The closest hospital to the proposed site is located in Falmouth. It is a Type C Public Hospital, located at approximately 8 km (5 miles) from the proposed site. This Hospital has approximately three hundred and twenty (320) beds and provides the following services; General medicine, General surgery, Paediatric surgery, Paediatric medicine, Obstetrics, Maternity services, Tubal Ligation, Other gynaecological services, X – Ray, Physiotherapy and a Pharmacy.

The health centres within proximity to the proposed site are the Duncans/Dewars Health Centre which provides the following services; Maternal, Antenatal, Postnatal, Child Health, Immunization and Family Planning. The other is the Falmouth Health Centre which provides services in; Maternal, Antenatal, Postnatal, Child Health, Immunization, Family Planning and Food Handlers permits.

There are three (3) pharmacies in Falmouth (Trelawny Pharmacy, Drug Care, and Best Care).

The construction and operation of the proposed development is not expected to have a negative impact on the health system within the study area as there will be a nurse on property and a doctor on call for any eventualities during operations. Only emergencies are expected to impact on the Public health care system.

9.5.3 Other Services

Fire Station

The fire station that would respond to an emergency at the proposed site is located within Falmouth, some 8 km (≈ 5 miles) from the proposed development site. Currently, this station has one fire engine which at the time of this study was in urgent need of repair, with a water capacity of 4,546 litres (1,000 imperial gallons). If needs be then the fire fighters would request assistance from the Rapid Response water truck to provide additional water (as a water tender). The proposed development will have its own designed fire control system, with a series of fire hydrants and fire extinguishers. It is not anticipated that there will be any problems as it relates to fire fighting and a fire event at the proposed development.

Police Station

The Falmouth police station is responsible for policing the area in proximity to the proposed development site. They have reported that incidence of major crimes are low if not non-existent.

Crime is not expected to be a major problem in proximity to the proposed site.

Emergency Response

There are twelve shelters that serve the Falmouth zone. Table 21 lists the location of these shelters.

Table 21 List of shelters within the Falmouth region

ZONES	AREAS SERVED	NAME OF SHELTERS
Falmouth	Falmouth	William Knibb High School
		N. T. Church of God
	Duke Street	Falmouth Anglican Church
		Hall
	Market Street	Salvation Army Building
	Hague	Hague Methodist Church
	Perth Town	Perth Town Junior High
	Mertha Brae	Martha Brea Community
		Centre
	Bounty Hall	Bounty Hall Community
		Centre
		Bounty Hall Baptist Church
	Granville	Granville All Age School
	Salt Marsh	Salt Marsh All Age School
	Johnson Hill	Deliverance Tabernacle
		Church
	Sherwood Content	Sherwood Content Basic Sch.
		Waldensia All Age School
		Sherwood Content Church of
		God
	Daniel Town	Daniel Town All Age School

Adapted from the Office of Disaster Preparedness & Emergency Management (ODPEM) website http://www.odpem.org.jm

Post Office

The residents in the study area are served by the Falmouth and Duncans post offices west and east respectively of the proposed site.

Financial Institutions

There are two main banks in Falmouth. These are the National Commercial Bank and the Bank of Nova Scotia (BNS). There is a building society (Victoria Mutual Building Society (VMBS)) and numerous bill payments and remittances agencies. These are Paymaster, Bill Express, Western Union, Money Express, Money Gram, FX Trader, Ria, Xtran, Rapid Remittance and 1st Remit. Additionally, there is the Trelawny Cooperative Credit Union.

Market

The study area is served by one market which is located in Falmouth. There are approximately 700 vendors with stalls that utilize the market, plus other itinerant vendors. The vendors are drawn from Falmouth, Kingston and Montego Bay. On a Wednesday the "Bend Down" market attracts over a thousand vendors; this is located on Tharpe Street and spills over into the adjoining streets. This impedes the free and safe movements of pedestrian and vehicles.

The proposed development is not expected to have an adverse impact on the operation of the market in Falmouth.

Tourism Product and Beach Use

The World Tourism Organization (WTO) reported a 1 % decline in International Tourist arrivals from 703 million in 2002 to 694 million in 2003. The causes of which include the Iraq war, SARS outbreak and weak world economy. The Caribbean market was a slightly different scenario in that the Caribbean Tourism Organization estimated that tourism arrivals in the region grew by 7% over the 2002 figures.

Jamaica has increasing become dependent on tourism. Visitor arrivals to Jamaica increased over the period 2002-2003. Stopover arrivals stood at 1,350,285 an increase of 6.6% and cruise

passengers stood at 1,132,596 an increase of approximately 30.9 % over the 865,419 over the same period.

The average intended length of stay of foreign nationals and the average lengths of stay in hotels in 2003 was similar to the 2002 figures and were 10.2 and 6.4 nights respectively.

Average hotel room occupancy rate in 2003 was 57.9 % up from the 55.2% recorded in 2003. Occupancy rates in all inclusive hotels in the three main resorts increased in 2003 when compared with 2002 showed that in Montego Bay annual room occupancy was 58.4 % up from 54.7% in 2002, Ocho Rios, 61.6 % up from 58.7% in 2002 and in Negril 57.4 % up from 55.9% in 2002. Gross visitor expenditure in 2003 was estimated at US$ 1,351 million, an increase of 11.7 % of the US$ 1,209 million earned in 2002. On average a foreign national spends an estimated US$95 per night while a cruise ship passenger spends an average US$80.

There was a 1 % increase in the number of persons directly employed in the accommodation sub-sector in the year 2003. The number of person increased from 30,434 in 2002 to 30,512 in 2003. Montego Bay, Ocho Rios and Negril accounted for approximately 89 % of the persons directly employed in the accommodation sector. Montego Bay accounted for 10,117 direct jobs (33 %), Ocho Rios – 9,288 (31%) and Negril – 7,773 (25 %). The average number of employees per room in 2003 was estimated at 1.24.

The White Bay development is expected to diversify the Jamaican tourism product with its upscale villa type development, increase employment opportunities in the study area and increase the room stock in Jamaica. This development is timely, as the upcoming Cricket World Cup opening ceremony and warm up games will be held at Greenfield (5 km east of the proposed development), which is within the SIA. The hosting of this ceremony requires that some 20,000 rooms are available for international guests and this development will be a step in the right direction as it will cater to the tourist with a discerning taste. It will offer upscale accommodation and service with unparallel views, natural points of interest and nature trails.

Beach Use

The major public bathing beach is located at Burwood, which suffers from illegal sand mining. This practice is especially damaging as beaches are fragile environmental areas and are not only recreation facilities but serve the purpose of protecting the shoreline from erosion.

Presently, there are two hotels (FDR Pebbles and Starfish) within the SIA, each having their own bathing beach. There are two official Public bathing beaches in proximity to the SIA (Burwood and Jacob Taylor) and three official Fishing beaches (Coopers – Good Hope, Stewart Castle and Silver Sands).

There is a proposal for a tourism development at Oyster Bay, approximately 5 kilometres from the proposed development at White Bay. This development is not expected to have a cumulative impact on the beach use at White Bay as beach provisions will be made for that development.

9.5.4 Historical/Cultural Site

The Jamaica National Heritage Trust has no historical or cultural sites on its register for the proposed villa development area. There are however, historic sites in proximity to the SIA. The Kettering Baptist Church located in Duncans, Trelawny was founded in 1844 and is associated with William Knibb, who founded the Kettering Free Village. It has Georgian features, and is constructed of brick, stone, mortar, and timber.

One of the best collections of Georgian architecture in the hemisphere is found in Falmouth. Most of these buildings are concentrated along Market Street and Duke Street. In 1996 the National Heritage Trust declared the town a National Monument (Adapted from Greater Falmouth Development Plan, 1998).

The streets of Falmouth were laid out using the grid system as in the case of Kingston. The streets were named after the royal family and heroes of the eighteenth century for example George, Charlotte, and Rodney. The town was laid out with all modern amenities, including a water supply piped to the houses from the Martha Brae River. This was achieved by a 20ft water wheel, known as the Persian Wheel which raised water up to a trough so that it could flow to the

tank in Water Square, Falmouth approximately two miles away. It received piped water before the city of New York.

Barrett House which is located at Market Street in Falmouth, is perhaps the best surviving example of an original Falmouth residence. The Falmouth Courthouse was built in 1815 on land purchased from Edward Barrett. The building was almost completely destroyed by fire in 1926 but it was later renovated in its original Georgian design. Today, the building houses the offices of the Trelawny Parish Council and the Resident Magistrate's Court.

Apart from buildings, many famous people are linked to Falmouth. Some of these include Governor and Lady Nugent, both of whom stayed at Waterloo House; William Knibb Baptist minister and abolitionist; and Joseph Bartholomew Kidd, Scottish painter who is known for his sketches of the island.

The proposed development is not expected to infringe on any sites of historic or cultural importance. In fact the proponents are planning to use Georgian architecture in the proposed development.

9.5.5 Aesthetics and Security

The proposed development has the potential to impact positively on the aesthetics of the proposed site. The Georgian architecture is expected to complement the architectural theme of Falmouth.

To provide security and limited access to the proposed development, the developer is planning to fence in the site. This will have the potential to sterilize the site; however, access to the site was already limited by the remoteness and the limited accessibility due to the disrepair of the parochial access road.

10.0 ANALYSIS OF ALTERNATIVES

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

This report has identified the major environmental impacts noted by scientific experts.

The following alternatives have been identified. They are discussed in further detail below:

- The "No-Action" Alternative.
- The proposed Development as described in the EIS.

10.1 THE "NO-ACTION" ALTERNATIVE

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

The development will have a minimal effect on the physical environment. The no-action alternative **should** minimize the effects on flora and fauna identified, this is not, however, a guarantee. If the land is not secured, damage to the special floral and faunal species and habitats may still occur from independent sources as is occurring at present.

The property also falls within a protected area. Similar to the discussion above, it is not guaranteed that if the hotel is not built, the area will remain in its present state.

There is a possibility of working with the hotel management in a positive way in an effort to have a possible useful on-site management solution for the management and monitoring of that section of the protected area.

In terms of the social environment, the "no-action" alternative would eliminate the job opportunities and the local economic inflow as discussed in Section 9.3. This alternative would also eliminate the creation of hotel rooms which will be needed for the upcoming ICC World Cup of Cricket which will be having matches at Greenfield which is within the SIA.

10.2 THE PROPOSED DEVELOPMENT AS DESCRIBED IN THE EIS

The project will consist of the construction of 26 duplex units, 33 villa units on approximately 7 hectares (18 acres) of lands at White Bay, Trelawny. It will also involve the construction of a wastewater treatment system and re-establish the beach area. Construction of these buildings will involve the use of ferro-cement structural cement skin applied to light gauge galvanized steel framing. Ferro-cement is a proven and widely respected type of concrete construction which employs a high ratio of reinforcing steel to cement creating earthquake and hurricane resistant structures. The design of the villas will be based on Georgian proportion and detail in order to complement the Falmouth Historic area. The Amcorite cement surfaces will be tinted and textured to fit in with the traditional construction of the region

The project is expected to employ some 50 persons during the site clearance and construction phase and is anticipated to create approximately 200 direct jobs during operation. Based on the data it is estimated that approximately 115 indirect and induced jobs will be created during the site clearance and construction phase and another 460 indirect and induced jobs during the operation of the proposed development.

10.3 OVERVIEW OF ALTERNATIVE ANALYSIS

Based on the above, the most environmentally sound and cost effective and socially beneficial option would be that described in section 10.2. It would have direct impact on tourism room and job creation, and "spin off" an indirect possibility of on-site management solution for the management and monitoring of a section of the Coral Spring/Mountain Spring protected area.

11.0 ENVIRONMENTAL IMPACT IDENTIFICATION & MITIGATION

An environmental impact is defined as any change to an existing condition of the environment.

11.1 SITE PREPARATION AND CONSTRUCTION

Site Preparation and Vegetation Clearance

Impacts:

Site clearance and construction practices generally mean the removal of existing vegetation. These practices remove protective plant cover and expose the soil to erosive surface runoff during heavy rainfall. The inappropriate disposal of the cleared vegetation could lead to burning onsite and associated negative impacts on local air quality.

As a result, there are no significantly important floral species or vegetation communities that would be negatively impacted by site clearance and construction practices.

Similarly, negative impacts on avifauna, associated with the loss of onsite vegetation/habitat, are expected to be insignificant. As previously mentioned under Section 3.5.2.1, diverse and abundant avifauna does not use the project site for nesting, breeding or feeding.

Mitigation:

i. Vegetation site clearance should be phased and the project site cleared as the need arises; as opposed to the practice of clearing the entire site in a single major clearance exercise. This will help to minimise the amount of bare/exposed soil present at the site, and thereby help reduce the risk of soil erosion during heavy rains and flash flooding.

ii. To reduce the amount of organic waste generated by the project, small- to medium-sized branches and bits of vegetation may be put through an onsite commercial wood chipper. The resulting wood chips may then be recycled (i.e. onsite/offsite) as soil cover and similar soil amendment undertakings associated

with either project-related or non-project related landscaping. With regards to a practical suggestion for recycling larger and harder tree trunks and branches, the latter may be made available to local charcoal burners.

iii. Failing the feasibility of the above recycling recommendations, organic waste (generated during the site clearance/construction phases of the project) must be disposed of at an approved disposal site (Retirement dump). Burning of the waste vegetation must not be allowed to take place either on or off the project site.

Impact: Noise Pollution

Site clearance and construction of the proposed development necessitates the use of heavy equipment to carryout the nature of the job. These equipment include bulldozers, backhoes, etc. They possess the potential to have a direct negative impact on the environment. However, due to the fact that the proposed location is isolated from human receptors the potential is slight.

Mitigation:

- Use equipment that has low noise emissions as stated by the manufacturers.
- Use equipment that is properly fitted with noise reduction devices such as mufflers.
- Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is a worker operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

Impact: Water Quality

Removal of the vegetation can result in high suspended sediment concentrations in the runoff from the site, during construction. Fortunately, the project is expected to remove only vegetation necessary for erection of the buildings as the vegetation will form apart of the nature attraction of the proposed development.

Mitigation:

- Surface runoff will be controlled by temporarily berming the outlet of the significant storm water features to provide some detention behind the berms.

Impact: Air Quality

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

Mitigation:

i. Site roads should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
ii. The access roads (unpaved sections) should also be wetted and the sections of the road monitored so that any material falling on it as a result of the construction activities be removed.
iii. Minimize cleared areas to those that are needed to be used.
iv. Cover or wet construction materials such as marl to prevent a dust nuisance.
v. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

Impact: Employment

The project is expected to employ some 50 persons during the site clearance and construction phase and is estimated that approximately 115 indirect and induced jobs will be created during the site clearance and construction phase of the proposed development.

Mitigation

Not required.

Impact: Solid Waste Generation

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

i. From the construction campsite; and
ii. From construction activities such as site clearance and excavation.

Mitigation:

i. Skips and bins should be strategically placed within the campsite and construction site.
ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iii. The skips and bins at the construction site should be adequately covered to prevent a dust nuisance.
iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
v. Disposal of the contents of the skips and bins should be done at an approved disposal site. The Retirement Landfill in St. James is recommended. Appropriate permission should be sought (The National Solid Waste Management Authority).
vi. Trees that are removed from the proposed site may be given to local persons to be used for lumber or for charcoal burning.

Impact: Wastewater Generation and Disposal

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

Mitigation:

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

Impact: Storage of Raw Material and Equipment

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

Mitigation:

i. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
ii. Raw material should be placed on hardstands surrounded by berms.
iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
iv. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by berms to contain the volume being stored in case of accidental spillage.

Impact: Transportation of Raw Material and Equipment

- The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along the entrance to the North Coast highway entrance.

Mitigation:

i. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example, reduced speed near the entrance roads. This should be done in conjunction with the Ministry of Transport and Works.
ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.

iii. The movement of equipment (trucks) during the construction of the wetland should be limited to the working hours, 8:00 am - 4:30 pm per day.
iv. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.
v. The use of flagmen should be employed to regulate when trucks have access to the main roads.

Impact: Beach Re-establishment

The re-establishment of the beach will involve the movement of sediment and possibly the establishment of groynes. This may affect both the faunal and floral ecosystem in the marine and in the terrestrial environment.

Mitigation:

i. Ensure that ecologically important species are marked and preserved as much as possible.
ii. During the beach establishment activities that have the potential to create sediment pollution, silt screens should be used to localize this impact.
iii. If groynes are being erected then the long shore drift and sediment movement along the beach area should be studied and properly understood, thereby reducing any potential negative impact (e.g. sand starvation).

Impact: Emergency Response

Construction of the proposed development will involve approximately 47 construction workers. The possibility of accidental injury is high. There maybe either minor or major accidents.

Mitigation:

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

ii. Make prior arrangements with health care facilities such as a Health Centre in proximity, a private doctor or the Falmouth Hospital to accommodate any eventualities.

iii. Material Safety Data Sheets (MSDS) should be stored onsite.

11.2 OPERATIONAL PAHSE

Impact: Earthquake Hazard

The proposed site is in a zone where approximately 5-9 earthquake events of frequency ≥ 6 on the Modified Mercalli scale occur over a hundred year period. At this magnitude, there is the potential for earth movement.

Mitigation

i. Any structure to be constructed at the site is low-rise and this implies a moderate to low earthquake hazard with respect to life and property.

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

iii. Ensure that buildings are not constructed on the fault line.

Impact: Flooding

Flooding potential of the proposed site is low except for the low lying area located at the western end of the property.

Mitigation:

i. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) be placed above a certain critical storm surge level. The overall strategy being to safe guard the operation of the hotel. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.

Impact: Employment

It is anticipated that approximately 200 direct jobs will be created during operation and another 460 indirect and induced jobs during the operation of the proposed development. This has the potential to be a major positive impact in the SIA.

Mitigation

Not required.

Impact: Solid Waste Generation and Disposal

The operation of the development has the potential of significantly increasing the solid waste at the site.

Mitigation:

i. Provision of solid waste storage bins and skips.

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

iii. Monitor beach garbage.

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

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

Impact: Emergency Response

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

Mitigation:

i. Make prior arrangements with health care facilities such as a Health Centre in proximity.

ii. Design and implement an emergency response plan.
iii. Coordinate with mutual aid organisations/agencies such as with the local fire brigade.
iv. Install fire hydrants within the proposed development.

Impact: Wastewater Disposal/Water Pollution

The discharge of treated effluent from the treatment system will be continuous and will meet the NEPA guidelines for both irrigation and direct discharge. The discharge to the existing salina has the potential to improve the existing mangrove stands surrounding the salina. This may increase the wildlife for example birds and may encourage reptilian population.

Mitigation:

i. To reduce the possibility of reptilian migration to the ponds, the area should be fenced off.

Impact: Odour

Wastewater treatment plants carry a risk of odour nuisance if proper buffers between the treatment units and existing populations are not provided. A buffer of at least 100 metres has been provided on all boundaries as per NEPA recommendations. Additionally, the perimeter of the proposed should be vegetated with trees and plants of varying heights thereby forming a windbreaker.

Mitigation:

i. Monitor and ensure that influent sulphate levels are below 240 mg/l.
ii. Ensure that the pond series have adequate water flow to reduce the potential of odour formation.

12.0 ENVIRONMENTAL MANAGEMENT PLAN

12.1 GREEN GLOBE CERTIFICATION

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

It operates on the following principles;

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

All members of staff are brought into the environmental policy and management system. The system also provides mechanisms for letting your customers know about your approach to environmental issues.

Adapted from Green Globe 21 www.greenglobe21.com

13.0 ENVIRONMENTAL MONITORING PROGRAMME/WASTE MANAGEMENT PLAN

13.1 MONITORING DURING SITE CLEARANCE AND PREPARATION OF THE PROPOSED DEVELOPMENT

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

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

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

- Daily monitoring to ensure that the cleared areas and access roads are not creating a dust nuisance.

  The project engineer / construction site supervisor should monitor or nominate a named person to carry out this activity. NEPA should conduct spot checks to ensure that this stipulation is followed.

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

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

13.2 MONITORING DURING THE CONSTRUCTION PHASE OF THE PROPOSED DEVELOPMENT

- Daily inspection of site clearance activities to ensure that the proposed building plans are followed and to ensure that site drainage is being constructed as planned. NEPA and the local Parish Council can provide checks and balances.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

  This is estimated to cost approximately **J$ 50,000** per monitoring exercise.

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

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

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

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

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

No additional cost is anticipated for this exercise.

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.

  Person(s) appointed by the developer and/or the Trelawny Chamber of Commerce may perform this exercise.

  No additional cost is anticipated for this exercise.

13.3 MONITORING DURING THE OPERATIONAL PHASE OF THE PROPOSED DEVELOPMENT

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

- It is recommended that both influent and effluent water quality be monitored on a monthly basis except for pH and residual chlorine (done daily) using qualified grab sampling. This recommendation is based on NEPA guidelines for the monitoring of wastewater treatment plants with discharges above 20 m^3/day. This information should be compiled and stored in a database by the facility manager or engineer and compared with NEPA guidelines for compliance. Corrective action should be undertaken in the event of non-compliance. The recommended list of parameters and the point of sampling is summarized in Table 22.

Table 22 List of Parameters to be monitored at the WWTP

Influent	Effluent
BOD^5 (mg/l)	BOD^5 (mg/l)
TSS (mg/l)	TSS (mg/l)
Total Nitrogen (mg/l)	Total Nitrogen (mg/l)
Phosphates (mg/l)	Phosphates (mg/l)
COD (mg/l)	COD (mg/l)
PH	PH
Faecal Coliform	Faecal Coliform
Residual Chlorine	Residual Chlorine
Oil and Grease	Oil and Grease

Dissolved oxygen and pH levels should also be monitored on a monthly basis in all of the ponds. Such monitoring should consist of monitoring of at least one location within each pond throughout the water column.

Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

This is estimated to cost approximately **J$ 50,000** per monitoring exercise.

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

Person(s) appointed by the developer may perform this exercise.

No additional cost is anticipated for this exercise.

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APPENDICES

Appendix 1 Species list for White Bay, Trelawny

Scientific Name	Common Name
Agave sp.	
Ateramnus lucidus	Crab Wood
Avicennia germinans	Black Mangrove
Bauhinia divaricata	Bull Hoof, Moco John
Bernardia dichotoma	
Brassavola cordata	
Bromelia pinguin	Pinguin, Ping Wing
Brosimum allicastrum	Breadnut
*Broughtonia sanguinea**	
Brya ebenus	West Indian Ebony
Bryophyllum pinnatum	Leaf-of-Life
Bursera simaruba	Red Birch
Caesalpinia bonduc	Grey Nickal/Nicker
Canella winterana	Wild Cinnamon, Canella
Capparis ferruginea	Mustard Shrub
Capparis flexuosa	Bottle-cod Root
Capparis sp.	
Cephalocereus swartzii	
Cleome spinosa	
Clusia flava	Card Gum, Tar Pot
Clusia rosea	Balsam Fig
Coccoloba uvifera	Seaside Grape
Colubrina asiatica	Hoop With
Commelina elegans	
Conocarpus erectus	Button Mangrove
Cordia sebestena	Red/Scarlet Cordia
Croton linearis	Rosemary
Croton sp.	
Cyperus sp.	
Dalbergia brownei	
Drypetes ilicifolia	Rosewood
Eugenia sp.	
Ficus sp.	
Fimbristylis sp.	
Helicteres jamaicensis	Screw Tree
Heliotropium indicum	Scorpion Weed

Scientific Name	Common Name
*Hohenbergia ?spinulosa**	
*Hylocereus triangularis**	God Okra, Prickle Withe
Ipomoea pes-caprae	Beach Morning Glory
Jacquinia arborea	
Leucaena leucocephala	Lead Tree
Mallotonia gnaphalodes	Seaside Lavender
Melicoccus bijugatus	Guinep
Morinda royoc	Red Gal, Strongback
Nectandra sp.	
Oeceoclades maculata	
*Oncidium tetrapetalum**	Pimento Orchid
Opuntia dillenii	Seaside Tuna
Oxandra lanceolata	Black Lancewood
Peperomia sp.	
Philodendron lacerum	
Pimenta dioica	
Piper amalago	Black Jointer
Piscidia piscipula	Dogwood
Pisonia aculeata	Cockspur
Plumeria obtusa	Wild Frangipani
Portlandia sp.	
Psychotria sp.	
Rhizophora mangle	Red Mangrove
Selenicereus grandiflorus	Queen-of-the-night
Sesuvium portulacastrum	Seaside Purslane
Sida sp.	
Simarouba glauca	Bitter Damson
Sporobolus sp.	
Stachytarpheta jamaicensis	Vervine
Suriana maritima	Bay Cedar
Syngonium auritum	Five Finger
Tabernaemontana laurifolia	
Thespesia populnea	Seaside Mahoe
*Thrinax parviflora**	Broom Thatch
Tillandsia sp.	
Turnera ulmifolia	Ram-goat Dashalong

* Endemic

Appendix 2 Other plant species known for Dry Limestone forests

Scientific Name	Common Name
Acacia sp.	
Abrus precatorius	Red Bead Vine, Crab's Eyes
Abutilon elatum	
*Acalypha scabrosa**	
Adelia ricinella	Wild Lime
Allophylus cominia	
Allophylus jamaicensis	
*Allophylus pachyphyllus**	
Amaranthus spinosus	Prickly Calalu
Amaranthus viridis	Garden Calalu
Amyris balsamifera	West Indian Sandalwood, Amyris Wood
Amyris elemifera	Torchwood
Amyris plumieri	Candlewood
Andrographis paniculata	Rice Bitters
Annona squamosa	Sweet Sop
Argemone mexicana	Yellow Thistle, Mexican Poppy
Argythamnia candicans	
Aristolochia odoratissima	
Asclepias curassavica	Redhead, Red Top
Ateramnus elliptica	Parrot Wood
Ateramnus lucidus	White Iron wood, Crab wood
Ateramnus sp.	
Atriplex pentandra	
*Auerodendron jamaicense**	Turtle Fat
Ayenia laevigata	
Bidens reptans	McKatty Weed
Blechum pyramidatum	
Bocconia frutescens	John Crow Bush
Borrichia arborescens	Seaside Ox-eye
Bumelia salicifolia	White Bullet/Bully
Caesalpinia decapetala	Wait-a-bit
Calyperanthes sp.	
Capparis cynophallophora	Black Willow
Cardiospermum grandiflorum	Heart Pea, Wild Supple Jack
Casearia guianensis	Wild Coffee

Scientific Name	Common Name
Casearia hirsuta	Wild Coffee, White Wattle
Casearia nitida	
Cassia emarginata	Senna Tree, Yellow Candle Wood
*Castela macrophylla**	
Centrosema virginianum	
Cestrum diurnum	Wild Jasmine
Chiococca alba	David's Root, Snowberry
Chrysophllum cainito	Star Apple
Chrysophyllum sp.	
Cionosicys pomiformis	Wild Melon
Cissampelos pareira	Velvet Leaf
Clematis dioica	Wild Clematis
*Coccothrinax jamaicensis**	Silver Thatch
Comocladia pinnatifolia	Maiden Plum
*Comocladia velutina**	Velvet-leaved Maiden Plum
Conyza canadensis	Canada Fleabane
Corchorus siliquosus	Slippery Bur
Cordia gerascanthus	Panchallon, Spanish Elm
Cordia globosa	
Cordia jamaicensis	
Cordia macrophylla	Fish-leaf, Manjack
Crescentia cujete	Calabash Tree
Crotalaria retusa	Rattleweed
Crotalaria verrucosa	Blue Rattleweed
Croton flavens	Yellow Balsam
*Croton grisebachianus**	
Croton humilis	Pepper Rod
Croton ovalifolius	
Cucumis anguria	Wild Cucumber, West Indian Gherkin
Cynanchum sp.	
*Daphanopsis occidentalis**	Burn Nose
Desmanthus depressus	
Desmodium canum	Sweetheart
Diospyros tetrasperma	Clamberry
Drypetes laterifolia	Whitewood
Echites umbellata	Deadly Nightshade
Erythroxylum rotundifolium	
Eugenia axillaris	Black Cherry

Scientific Name	Common Name
Eugenia monticola	
Eugenia rhombea	
Eupatorium dalea	Cigar Bush
Eupatorium odoratum	Jack-in-the-bush, Christmas Bush
Euphorbia hirta	
Euphorbia mesembrianthemifolia	
Euphorbia sp.	
Fimbristylis cymosa	
*Galactia pendula**	
Galactia sp.	
Gouania lupuloides	Chew Stick
Guaiacum officinale	Lignum Vitae
Guettarda argentea	
Guettarda elliptica	Velvet Seed
Heliotropium angiospermum	Dog's Tail
Hypelate trifoliata	Ketto
Hyptis capitata	Ironwort, Wild Caesar Obeah
*Ipomoea jamaicensis**	
Krugiodendron ferreum	Black Ironwood
Laetia thamnia	Scarlet Seed
Lantana involucrata	Wild Mint
Lasciacis divaricata	
Malpighia glabra	Wild Cherry
Malpighia punicifolia	Barbados/West Indian Cherry
Malvaviscus arboreus	Mahoe Rose, Sugar Bark
Merremia quinquefolia	Rock Rosemary
Merremia umbellata	
Metopium brownii	Burnwood
Mikania sp.	
Mucuna pruriens	Cowitch
Oxandra lanceolata	Black Lancewood
*Passiflora perfoliata**	
Passiflora rubra	Bat Wing, Dutchman's Laudanum
Passiflora suberosa	
*Paullinia barbadensis**	Supple Jack
Peltophorum linnaei	Braziletto
Phoradendron sp.	

Scientific Name	Common Name
Phyllanthus angustifolius	Seaside Laurel
*Pimenta jamaicensis**	Wild Pimento
Picramnia antidesma	Macary Bitter, Majoe Bitter
*Portlandia grandiflora**	Bell Flower
*Portlandia latifolia**	
*Psidium albescens**	
*Psychotria balbisiana**	
Randia aculeata	Box Briar, Indigo/Ink Berry
*Randia aculeata var. jamaicensis**	
Rivina humulis	Bloodberry, Dogberry
*Rondeletia hirta**	
*Rondeletia stipularis**	
Ruellia tuberosa	Duppy Gun, Menow Weed
*Sabal jamaicensis**	Bull Thatch
Salvia occidentalis	Field Basil
Schaefferia frutescens	
*Senecio discolor**	Whiteback
*Serjania laevigata**	
Sida glutinosa	
Sida procumbens	
Sida rhombifolia	
Solanum bahamense	
Sonchus oleraceus	Sow-thistle
*Spathelia sorbifolia**	Mountain Pride
Spigelia anthelmia	Pink Weed, Worm Grass
Spilanthes sp.	
Stigmaphyllon emarginatum	
Tabebuia riparia	White Cedar
Tabernaemontana sp.	
Tecoma stans	
Thunbergia fragrans	White Nightshade
Tillandsia recurvata	Old Man's Beard
Tournefortia astrotrichia	
Tournefortia hirsutissima	Cold With
Tournefortia volubilis	Chigger Nut (Jigger Nit)
Tragia volubilis	Twining Cowitch
Turnera sp.	
Verbesina pinnatifida	

Scientific Name	Common Name
Vernonia divaricata	Fleabane
Waltheria indica	Raichie
Wedelia trilobata	Creeping Ox-eye, Marigold
*Ziziphus sarcomphalus**	Bastard Lignum Vitae

*** Endemic**