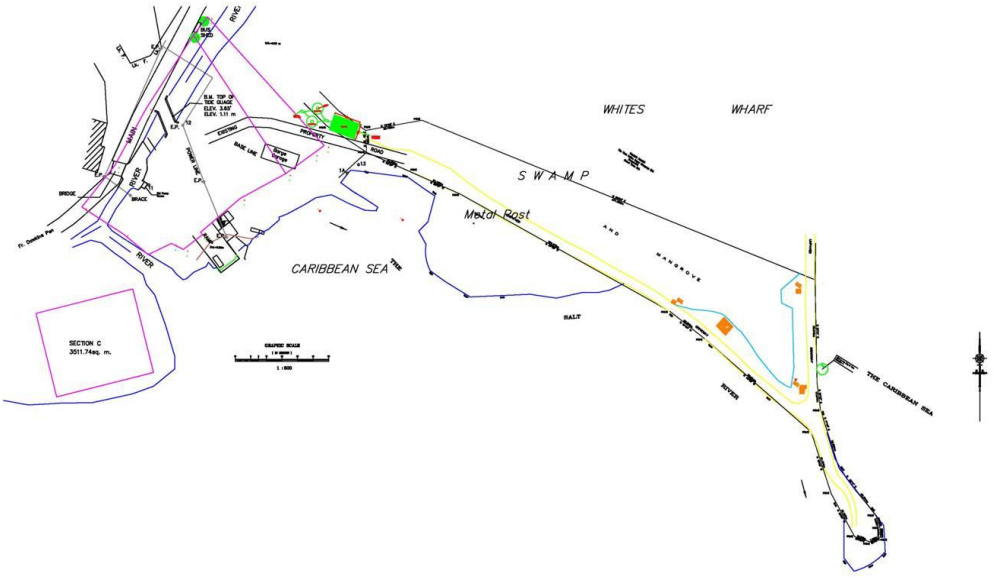
NOVEMBER 2007

ENVIRONMENTAL IMPACT ASSESSMENT

HERITAGE BAY HOTEL & MARINE RESORT DEVELOPMENT

[Prepared for Yosamini Holdings Limited]



ENVIRONMENTAL SCIENCE & TECHNOLOGY LIMITED [ESTECH]
A Division of Conrad Douglas & Associates Limited

14 Carvalho Drive
Kingston 10, Jamaica W.I.

Telephone: 929-0023/0025/8824
Email: estech@infochan.com;
cdaestech@hotmail.com; conraddouglasnassociatesltd@gmail.com

ENVIRONMENTAL IMPACT ASSESSMENT

HERITAGE BAY HOTEL & MARINA RESORT DEVELOPMENT

November 2007

Prepared for:

Yosamini Holdings Limited

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

APPENDIX

EXECUTIVE SUMMARY

The proposed site for the Heritage Bay Hotel, Marina and Spa is located at Salt River Bay in the Parish of Clarendon. The proposed site is a 'brown field' one, previously developed and used for sugar export and storage. At present it is used by boat operators, fishermen and vendors.

The size of the proposed site is approximately 2.7 hectares for Phase 1 and 51 hectares for Phase 2. The overall topography comprises flat land suitable for building. The vegetation is typical and consistent with the vegetation found along the Salt River main road, the distinction being the inclusion of mangrove stands on the north-eastern quadrant of the property.

The gross building area of the project is estimated at approximately 1,995 sq. m. (21,000 sq. ft.) in Phase 1 and 246,856.3 sq. m. (2,657,139sq. ft.) in Phase 2 and will offer a range of facilities that can be grouped as:

1. Hotel Guest Rooms
2. Supporting and Recreational Facilities
3. Infrastructure Services

It should also be noted that the exotic nature of flora and fauna located there, for example, turtles, crocodiles and mangroves, will be preserved and incorporated in the environmental best practices of the proposed operation in keeping with NEPA's policies, legislation and regulations for protection and preservation of natural resources in general and protected and endangered species in particular.

The environmental baseline and setting were studied, analysed and assessed. These included:

- Air quality & Climate
- Hydrology
- Geology & Soils
- Topography
- Drainage
- Coastal stability

- Natural hazards
- Terrestrial ecology
- Marine survey
- Oceanographic assessment

Alternatives to the proposed project were analysed and evaluated, and the proposed project was the preferred alternative.

Potential impacts arising from the proposed project were identified, analysed and evaluated. Potential negative impacts were identified as:-

- Gaseous emissions
- Fugitive dust
- Noise
- Solid waste management
- Siltation and sedimentation
- Sewage disposal/treatment

Suitable cost-effective mitigation measures were identified for all potential negative impacts identified.

Potential positive impacts were also identified. In all phases, investment, enhanced tourism product and job creation were the major positive impacts. There is also the potential for increased popularity for the area as a tourist destination, leading to increased revenue for the region and Jamaica.

Conclusion

The recent performance of the tourism sector and the prospects for further sustained growth confirm the potential for new tourism investments projects in Jamaica such as the proposed development at Salt River Bay, the Heritage Bay Marina and Spa.

All potential negative impacts identified are either short-term or may be easily and safely mitigated. The overall direct and indirect creation and sustenance of several jobs as well as the benefits to the tourism industry, weighed against the potential negative impacts make this project positive overall.

Recommendations

This development has the support of the community. The developers are willing to work with the regulatory agencies and community to insure that the development is pleasing and acceptable to all involved. Additionally, this development will have no major negative environmental impact and will result in several major positive socio-economic impacts on the surrounding communities and country as a whole. It is our recommendation that this project be approved for development and a permit granted.

The potential impacts identified if realized will be mitigated using proven technologies. No new or unfamiliar environmental impacts or risks have been identified with the proposed project.

The proposed project represents a continuance of the investment in tourism in Jamaica and specifically the South Coast and promises to bear substantial macro and micro economic growth and development to Clarendon and Jamaica.

1 DESCRIPTION OF THE PROJECT

1.1 BACKGROUND

The Jamaican economy is based primarily on remittances, tourism, the mining and export of bauxite and alumina, production of a range of domestic and export agricultural crops, an industrial, financial and commercial sectors.

For several decades Jamaica has been one of the best-known resort vacation destinations in the world. Known for its stunning physical beauty and, in the early days of the tourism industry, as a playground for the rich and famous, the island has seen its tourism industry experience significant growth and diversification in recent years. The island boasts one of the most diverse visitor accommodation sectors in the Caribbean, including all-inclusive resorts, upscale hotels and villas, and a range of distinct tourist accommodations and attractions.

The recent performance of the tourism sector and the prospects for further sustained growth confirm the potential for new tourism investments projects in Jamaica such as the proposed development at Salt River Bay, the Heritage Bay Marina and Spa.

Jamaica is currently a good market for investment in new tourism projects. There is and has been a decade of sustained growth in the tourism industry, with a slight decrease in 2001 as a result of shocks to the international travel market in that year. The total number of visitor arrivals to Jamaica has grown from 1,037,634 in 1987 to 2,116,853 visitors in 2001, an increase of 104% in fifteen (15) years (Table 1-1).

Table 1-1: Jamaica – Visitor Arrivals 1987 – 2001[1]

YEAR	STOPOVERS	CRUISE PASSENGERS	ARMED FORCES	TOTAL	ANNUAL % CHANGE
1987	738,827	292,156	6,651	1,037,634	
1988	648,873	367,732	3,688	1,020,293	-1.67
1989	829,288	444,054	4,411	1,277,753	25.23
1990	989,275	385,205	10,093	1,384,573	8.36

[1] Source: Ministry of Tourism

YEAR	STOPOVERS	CRUISE PASSENGERS	ARMED FORCES	TOTAL	ANNUAL % CHANGE
1991	1,006,804	490,473	5,426	1,502,703	8.53
1992	1,057,182	649,517	4,570	1,711,269	13.88
1993	1,105,382	629,587	8,038	1,743,007	1.85
1994	1,098,287	595,036	4,035	1,697,358	-2.62
1995	1,147,001	605,178	373	1,752,552	3.25
1996	1,162,449	658,478	669	1,821,596	3.94
1997	1,192,194	711,699	616	1,904,509	4.55
1998	1,225,287	673,690	2,275	1,901,252	-0.17
1999	1,248,397	764,341	2,532	2,015,270	6
2000	1,322,690	907,611	1,464	2,231,765	10.74
2001				2,116,853	-5.15
ANNUAL AVERAGE % CHANGE 1987 – 2001					5.22

The visitor accommodation capacity has also grown over the period 1987 - 2000. The island had a total visitor accommodation capacity of 23,640 rooms in 2000, an increase of 68% from 14,010 rooms in 1987. The total visitor capacity in 2000 can be broken down, 16,110 rooms in 197 hotels, 2,417 rooms in guest houses, 3,732 rooms in resort villas, and 1,381 rooms in apartments.

Visitor accommodation capacity of the islands tourism, according to 2000 data is concentrated in six (6) main resort destinations: Montego Bay 7,973 rooms, Ocho Rios 6,818 rooms, Negril 5,102 rooms, Port Antonio 910 rooms, Kingston 2,095 rooms, and the South Coast 742 rooms.

The proposed development seeks to enhance and diversify the tourism product by constructing a marina hotel and spa along the South Coast, as well as, contribute to sustained socio-economic growth within the immediate project environs and national economy.

1.2 SITE LAYOUT AND DESCRIPTION

The proposed site for the Heritage Bay Marina Hotel and Spa is located at Salt River Bay in the Parish of Clarendon. The location of the proposed development enjoys access by road, as well as, the Salt River Bay area infrastructural utilities and social services to support the project, including electricity, water supply and sheltered harbour. The development is located on the western coast of Old harbour Bay, approximately ten (10) miles south of the town centre of Old Harbour. Figure 1-1 shows the regional setting of the proposed marina hotel and spa. The recently constructed Highway 2000 gives easy access to and from Kingston, the Norman Manley International Airport and future expansion of the Highway will allow for connections to be made with tourist resorts of the North Coast – Montego Bay and Ocho Rios.

Figure 1-1: Regional Setting

The proposed site is not a 'green field' site but, a 'brown field' one as it was previously developed and used as port for sugar export in the 1700s. Export of sugar by sea from Salt River ceased in 1975 and since then the port installations have fallen into disrepair. In more recent times the site was used by the Monymusk Sugar Estates for the storage of sugar in large sheds. The site's present use can be characterised as active, despite dilapidated docking facilities. Its use

is by boat operators, fishermen and vendors. In addition there are derelict structures and scrap metal being stored on the site.

The size of the proposed site is approximately 2.7 hectares (6.7 acres). The overall topography of the site comprises flat land suitable for building purposes. The property can be characterised as being rectangular in shape and includes a relatively long strip of coastline beachfront which abuts the Caribbean Sea and the Salt River. The Salt River adjoins the South-western side of the property and is accessible and routinely used by members of the Monymusk Gun, Rod and Tiller Club.

The vegetation on the proposed site is typical and consistent with the types of vegetation found along the Salt River main road. The distinction being the inclusion of mangrove stands on the north-eastern quadrant of the property. This is discussed in detail in Section 4.

1.3 PROPOSED FACILITIES

The design for the proposed development will seek to take full advantage of the physical and scenic features of the proposed site. The main design objectives are to incorporate the technical features, the lush vegetation and landscaping of the site to meet needs of the visitors and operating staff, as well as, the required planning and environmental regulations. The proposed development will seek to adopt environmental sustainable best practices which will include, but not be limited to, water conservation measures, solid waste management, energy efficiency, renewable energy, the preservation of ecological aspects, and the use of sustainable drainage systems.

1.3.1 PHASE 1

The gross building area of the project is estimated at approximately 1,995 sq. m. (21,000 sq. ft.) and will offer a range of facilities that can be grouped under three (3) headings (see Figure 2 Preliminary Site Layout):

1. Hotel Guest Rooms
2. Supporting and Recreational Facilities
3. Infrastructure Services

1.3.1.1 HOTEL GUEST ROOMS

The main resort residential component of the project will be the construction of 75 – 100 hotel guest rooms. The rooms will be built in a three-storey block with eighty-four (84) standard and luxury rooms, and sixteen (16) penthouse rooms on the top floor. The hotel rooms are estimated at an average size of 30 sq. m. (320 sq. ft.) in floor area inclusive of bathroom and closet space. All rooms will be equipped with the amenities associated with a 3-4 star facility. Each hotel guest room will have a private balcony and ocean views of the marina and the Caribbean Sea.

1.3.1.2 SUPPORTING & RECREATIONAL FACILITIES

The main supporting and recreational facilities for the project include restaurants, an amphitheatre, a marina, commercial shops and beach. Two (2) on-site restaurants occupying approximately 93 sq. m. (1,000 sq. ft.) will be established, a Wharf-side Restaurant and Bar and Break-water Restaurant and Bar.

An amphitheatre will serve to show case live music productions and other performing arts, which will be an added attraction for tourist and the local market.

The development of the marina will be a key feature of the project and will provide berthing for twenty (20) vessels, at first, up to a total of forty (40) vessels. The marina will take advantage of the natural sheltered harbour of the Salt River Bay, with a draft of up to six (6) feet. The marina will appeal to the yachting market through the provision of services including electricity, water, telephone, dock hands, fuelling and other essential services. The marina will also provide a base for the hotel to offer excursions in the mangroves and the islands in Old Harbour Bay.

The property contains a good black sand beach on the coast of the Old Harbour Bay, which will be upgraded to add to the hotel's recreational and attraction facilities.

1.3.1.3 INFRASTRUCTURE AND SERVICES

The project proposes to incorporate existing features and use of the property, as well as upgrade infrastructure. Infrastructure upgrades will include but not be limited to:

- Improving beach and coastline
- Improving surface water drainage,
- Improving water supply and distribution
- The provision of a sewage treatment plant
- Access roads, including internal
- Perimeter fencing for security
- Renovation of workshop and dry dock
- Landscaping and parking

Layout of the site is depicted in Figure 1-2 below.

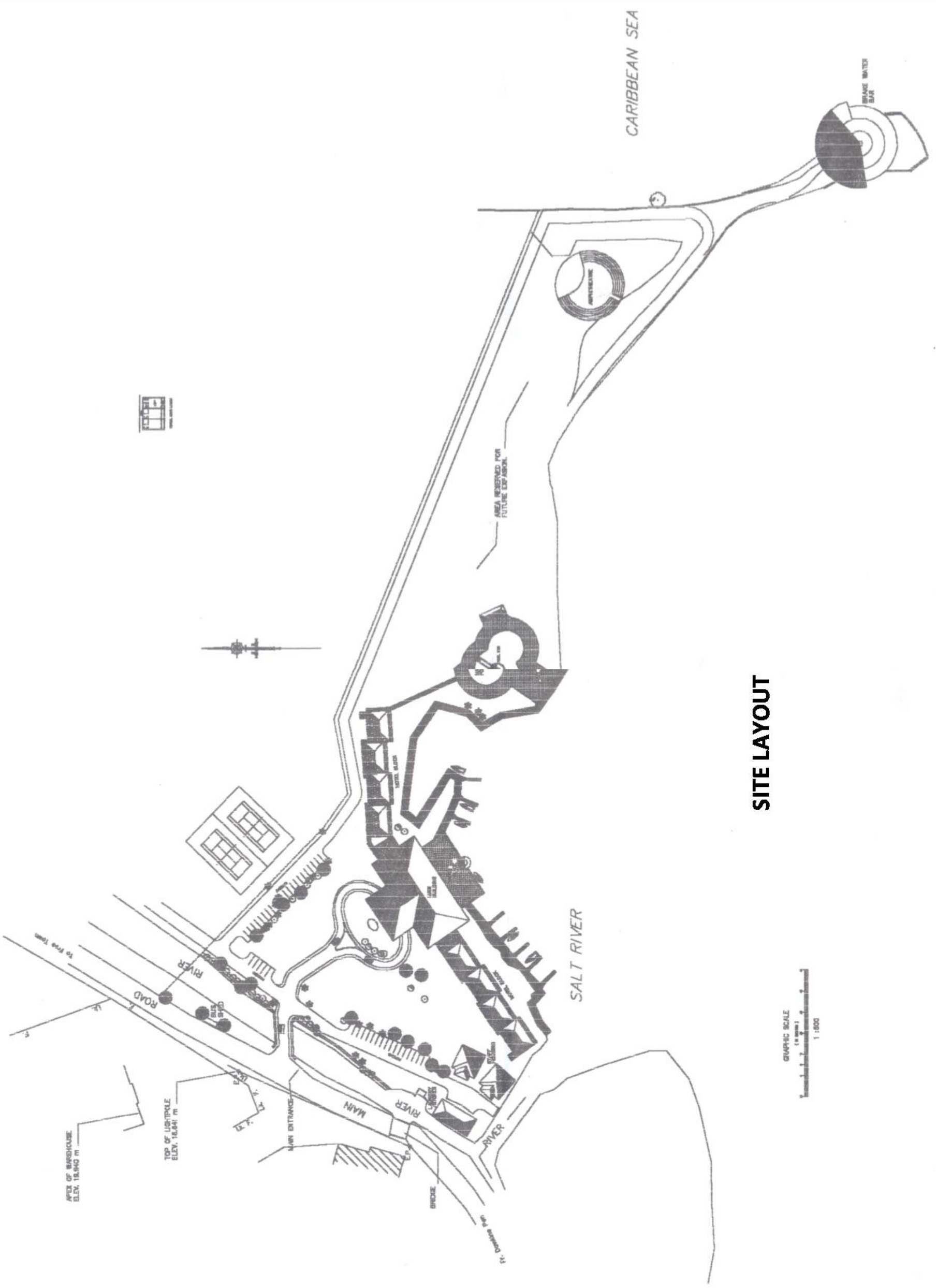


Figure 1-2: Site Layout

1.3.2 PHASE 2

This phase will incorporate approximately 126 acres of the northern section of the property. It is proposed to include:

Hotel Area with Cabins	40	Acres
Sports Centre	10	"
Golf Course	35	"
Nature Walks & Jogging Trails and Horseback Riding	30	"
Residence	5	"
Storage and Sewage	6	"
TOTAL	**126**	**"**

An additional 100 acres has been offered by the National Investment Bank of Jamaica for expansion of the golf course

1.3.2.1 HOTEL AND CABINS

A Four Star Hotel and 250 cabins, entertainment areas, restaurants, bars, and swimming pool are proposed for forty (40) acres of land. There will be land area remaining for further expansion.

1.3.2.2 SPORTS CENTRE

It is being highly considered that an investment in Sport Tourism, specifically a Sporting Centre, should be included in this development.

In winter, athletes in other countries for example, Europe, Asia, North America and Canada could be encouraged to use the facilities for their preparation in sports e.g. base ball, track and field, football etc.

These facilities are proposed to be constructed on ten (10) acres of land and will include a-running track, tennis courts, basketball courts, football field, swimming pool and gym.

1.3.2.3 GOLF COURSE

The sport of golf is fast becoming one of the worlds' most popular. The design of these courses has also become more challenging. Yosamini Holdings Limited is therefore committed to constructing an eighteen (18) hole course on 35 acres of sloping land, which will enhance this tourism venture.

1.3.2.4 NATURE WALK AND JOGGING TRAILS

Thirty (30) acres of land is proposed for nature walk, jogging trails and horse-back riding.

1.3.2.5 RESIDENCE

Four (4) acres of land has been proposed for the accommodation of managers and staff.

1.3.2.6 STORE, BARNS AND SEWAGE

Store rooms, barns and sewage ponds will be situated on six (6) acres of land.

1.3.2.7 GENERAL

All facilities will be environmentally friendly and will incorporate many large green areas.

Adequate irrigation water is available. It is also proposed that waste water will be treated for the purpose of recycling as irrigation water.

The following figures outline the layout within the regional Salt River area of Clarendon (Figure 1-3), the marina (Figure 1-4), and the room and suite schedules (Figure 1-5).

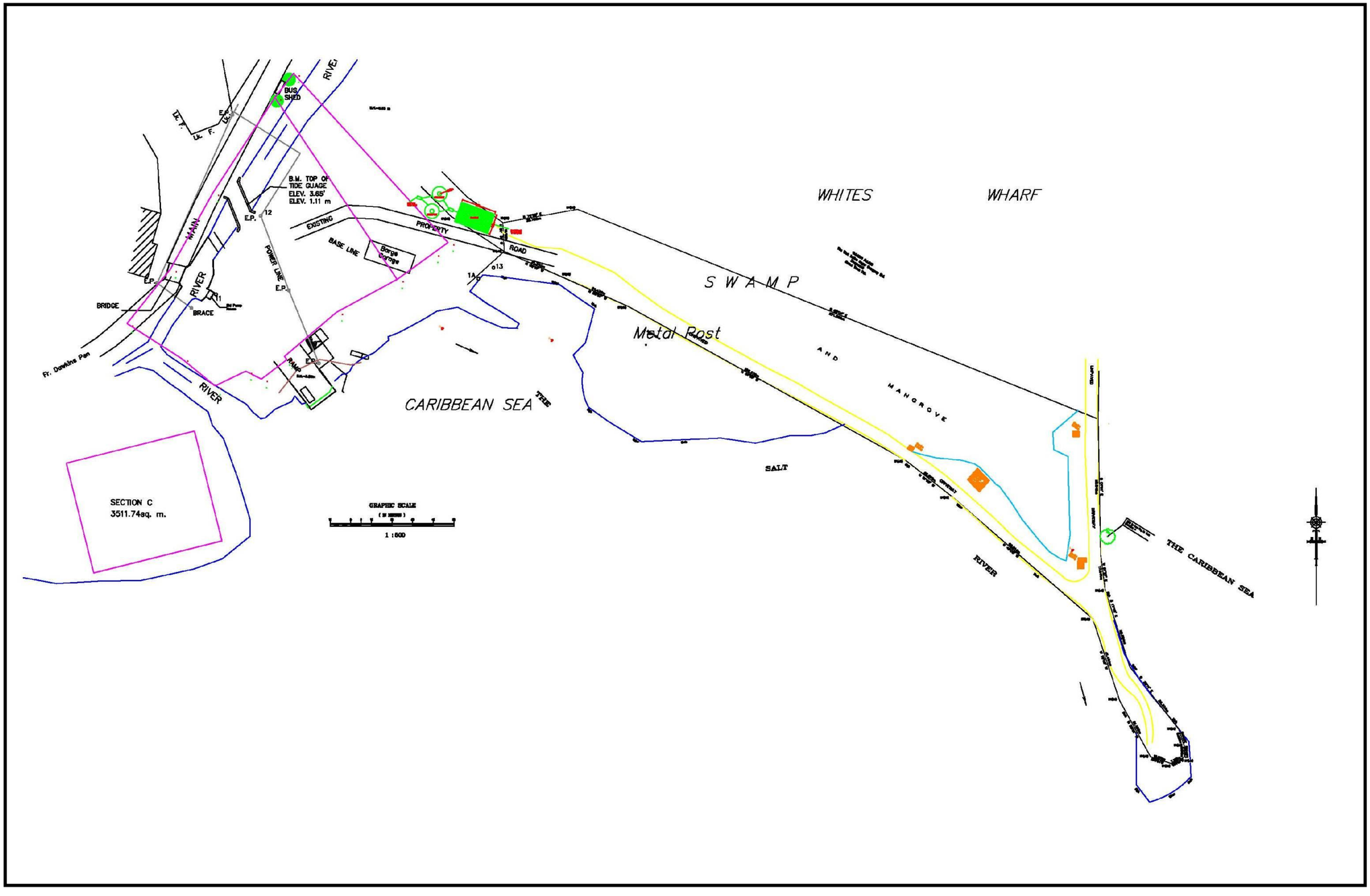


Figure 1-3: Regional Site Layout - Salt River Area, Clarendon

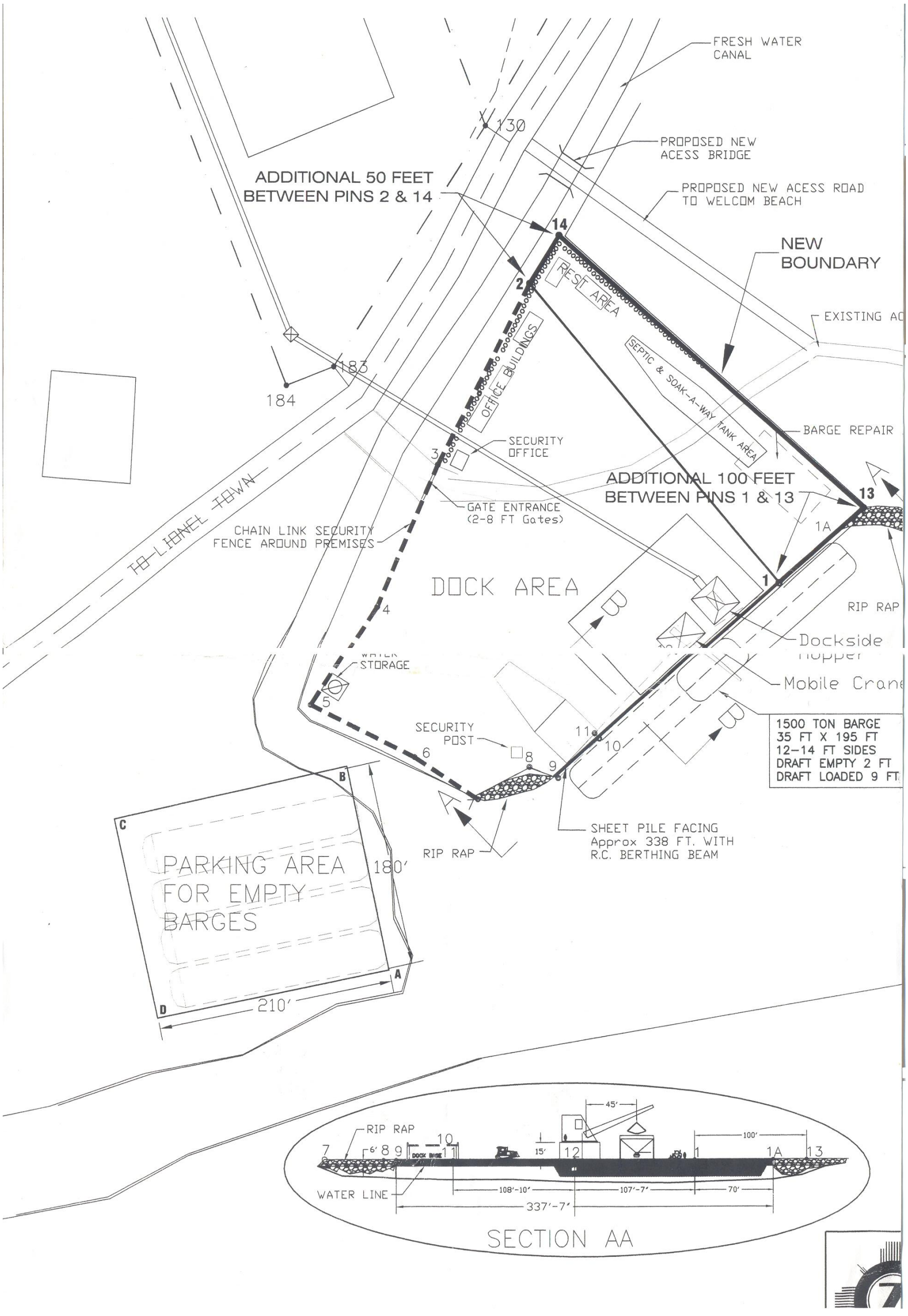
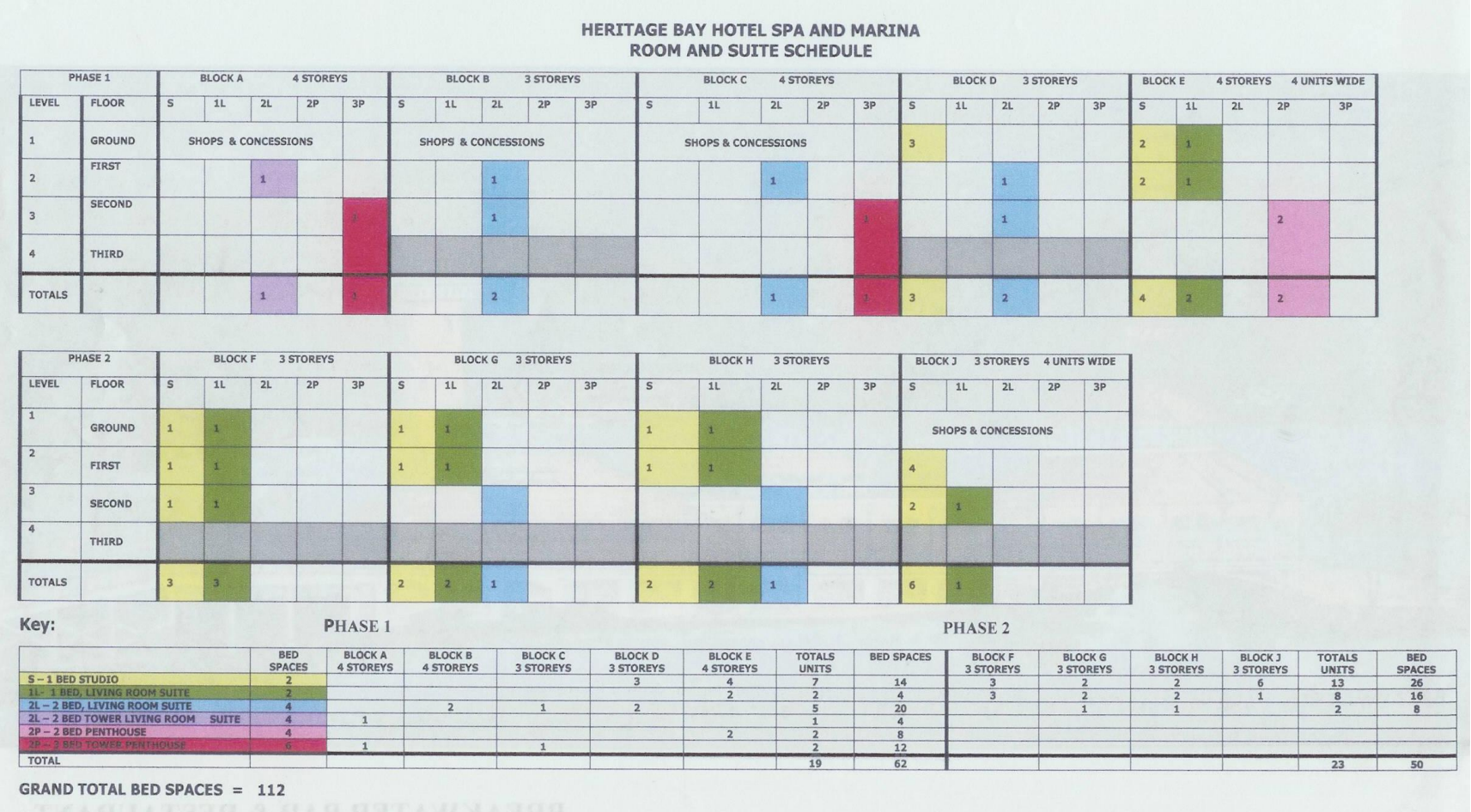


Figure 1-4: Marina/Dock Layout



HERITAGE BAY HOTEL SPA AND MARINA
ROOM AND SUITE SCHEDULE

PHASE 1		BLOCK A 4 STOREYS					BLOCK B 3 STOREYS					BLOCK C 4 STOREYS					BLOCK D 3 STOREYS					BLOCK E 4 STOREYS 4 UNITS WIDE				
LEVEL	FLOOR	S	1L	2L	2P	3P	S	1L	2L	2P	3P	S	1L	2L	2P	3P	S	1L	2L	2P	3P	S	1L	2L	2P	3P
1	GROUND	SHOPS & CONCESSIONS					SHOPS & CONCESSIONS					SHOPS & CONCESSIONS					3					2	1			
2	FIRST			1					1					1					1			2	1			
3	SECOND					1			1							1			1						2	
4	THIRD																									
TOTALS				1		1			2					1		1	3		2			4	2		2	

PHASE 2		BLOCK F 3 STOREYS					BLOCK G 3 STOREYS					BLOCK H 3 STOREYS					BLOCK J 3 STOREYS 4 UNITS WIDE				
LEVEL	FLOOR	S	1L	2L	2P	3P	S	1L	2L	2P	3P	S	1L	2L	2P	3P	S	1L	2L	2P	3P
1	GROUND	1	1				1	1				1	1				SHOPS & CONCESSIONS				
2	FIRST	1	1				1	1				1	1				4				
3	SECOND	1	1														2	1			
4	THIRD																				
TOTALS		3	3				2	2	1			2	2	1			6	1			

Key: PHASE 1 PHASE 2

	BED SPACES	BLOCK A 4 STOREYS	BLOCK B 4 STOREYS	BLOCK C 3 STOREYS	BLOCK D 3 STOREYS	BLOCK E 4 STOREYS	TOTALS UNITS	BED SPACES	BLOCK F 3 STOREYS	BLOCK G 3 STOREYS	BLOCK H 3 STOREYS	BLOCK J 3 STOREYS	TOTALS UNITS	BED SPACES
S – 1 BED STUDIO	2				3	4	7	14	3	2	2	6	13	26
1L- 1 BED, LIVING ROOM SUITE	2					2	2	4	3	2	2	1	8	16
2L – 2 BED, LIVING ROOM SUITE	4		2	1	2		5	20		1	1		2	8
2L – 2 BED TOWER LIVING ROOM SUITE	4	1					1	4						
2P – 2 BED PENTHOUSE	4					2	2	8						
2P – 2 BED TOWER PENTHOUSE	6	1		1			2	12						
TOTAL							19	62					23	50

GRAND TOTAL BED SPACES = 112

Figure 1-5: Heritage Bay Hotel & Marina Room and Suite Schedule

1.3.3 PROPOSED SEWAGE TREATMENT SYSTEM

Based on the conducted site assessment the sewage treatment system being proposed for this development is a Bio-digester Septic Tank (BST) of the appropriate size followed by a tertiary post treatment system consisting of a Reed Bed also of the appropriate design and size. The land area being proposed for the treatment system is large enough to accommodate the system and the slope of the area will allow for gravity flow through the system. The proposed system will allow for primary, secondary and tertiary treatment before final disposal to the mangroves onsite. The system will also meet the current sewage effluent standards set by the National Environment and Planning Agency (NEPA) and the Water Resources Authority (WRA). Further details along with the relevant drawings are presented in this report.

The BST is an on-site sanitation unit that provides for disposal of toilet (black) wastewater as well as of (kitchen and bathroom) sullage. It provides an environmentally sound treatment method for sewage as organic and pathogen loads are significantly reduced. The BST, however, has little effect on nutrient removal and so further treatment is needed by way of aerobic processes such as waste stabilization ponds or subsurface wetlands to remove the remaining pathogens and nutrients.

The BST totally relies on the bio-organic breakdown of organic waste under airless conditions and eventually produce biogas. This process is called “anaerobic digestion”.

The digestion process is done by putrefactive bacteria living in an interacting ecosystem and consists of two main phases:

- Acid formation and
- Methane formation

In the first phase, protein, carbohydrate and fat give rise to fatty acids, amino acids and alcohols. In the second phase, methane, carbon dioxide and ammonia are formed. The slurry becomes somewhat thinner during the process of digestion. The better the two phases merge into each other, the shorter the digestion process. The biogas produced consists mainly of methane, carbon dioxide and trace amounts of hydrogen sulphide.

The final treatment system for the proposed hotel development in Salt River, Clarendon will consist of two 150m^3 BST followed by a 170 m^2 reed bed for nutrient removal before disposal to onsite mangroves.

The following designs and/or methods will be employed:

1. Two 150 m^3 BST and a 170 m^2 reed bed will be built
2. A qualified contractor will do the construction of the treatment system with technical assistance from the SRC
3. The area designated for the implementation of the BST will be prepared under the supervision of the contractor
4. The reed bed will be lined
5. Storm water will be channelled away from the reed bed
6. Proper water conservation measures and WC flush toilet practices will be a feature of the hotel to avoid large solids entering and blocking the system
7. The gas generated by the system will be utilized for cooking or heating, as necessary. Gas not used will be flared

1.3.3.1 BENEFITS OF THE BST

The benefits of having such a system are as follows:

- A high treatment efficiency of sewage is guaranteed due to the longer retention time and better conditions for biological removal of the pollution load in the final wastewater.
- Low maintenance is required for the system.
- It helps to create a healthier and cleaner environment; (the discharge is odourless and there is a significant reduction in pathogen levels).
- The discharged effluent is high in nitrogen, phosphorus and potassium (N.P.K), and this nutritious liquid can be utilized as sub-surface irrigation water.
- The benefits will span for generations to come; (the system will last for approximately twenty years).
- With the BST, biogas produced can be used for cooking, water heating, refrigeration and electric power generation where appropriate.

- The energy cost and the frequency of Liquid Petroleum Gas (LPG) purchase can be reduced.

1.3.3.2 MAINTENANCE OF THE BST

The BST has a life span of over twenty years and because of the process (anaerobic digestion) involved requires little or no maintenance. The sludge production is relatively small, during the process, so there is no need for frequent withdrawal and disposal of sludge. There are minor maintenance activities, however, that have to be considered. These include:

- Routine checks for gas tightness and water loss from the neck of the BST
- Routine checks for cracks
- Routine checks of the inlets to the BST for blockages etc.

It should be emphasized that under normal circumstances persons do not at anytime come in contact with the waste. The system takes care of itself.

1.3.3.3 GAS PRODUCTION AND USES

Organic material when placed under anaerobic conditions (i.e. in the absence of oxygen) generates biogas by methane producing bacteria. Biogas consists mainly of methane and carbon dioxide as well as traces of other gases such as hydrogen and hydrogen sulphide (Table 1-2). The latter gives the gas a slight smell of rotten eggs that disappears when it is burnt. The gas is saturated with water vapour when it leaves the biodigester and is piped to the various sources of use such as stoves, refrigerators and diesel engines via PVC pipelines, which is used as gas lines. The gas mixture burns as long as the methane content is higher than 50%. The ultimate composition of biogas depends on the kind of organic matter being fermented in the biodigester and the condition of the fermentation process.

Table 1-2: Composition of Biogas

Component	Chemical Formula	Volume (%)	Combustibility
Methane	CH_4	60 - 70	Combustible
Carbon Dioxide	CO_2	30 - 40	Non-combustible
Hydrogen Sulphide	H_2S	0.5 - 1	Combustible
Hydrogen	H_2	< 1	Combustible

Benefits of the biogas include:

- To replace propane gas and diesel in many machinery
- Steam generation
- Electricity generation
- Lighting
- Water heating
- Cooking
- Refrigeration

1.3.3.4 CONCEPT OF THE REED BED

The reed bed, also referred to as subsurface flow system, is simple by principle and requires almost no maintenance under the condition that it is well designed and constructed. The reed bed is designed with slopes of 1% or slightly more and the basin is excavated, lined (to prevent percolation of water into the ground) and packed with a porous medium (usually gravel). A layer of soil is then spread on top to cover the gravel and to support the growth of vegetation. The primary objective of the reed bed is to provide post treatment of the effluent leaving the BST by removing the remaining organic matter, nutrients and faecal coliform present in the wastewater. The treatment of the water takes place as it flows through the porous medium, the gravel. The vegetation also plays a vital role by transferring oxygen through their roots to the bottom of the basin and providing a surface, in addition to the gravel, for the attachment of the bacteria that performs most of the water treatment. A well-designed reed bed would produce an effluent that will easily meet/exceed NEPA discharge standards.

1.3.3.5 DESIGN CALCULATIONS

1.3.3.5.1 Design Data

Number of guest rooms = 100

Estimated guests per guest room = 2

Total estimated number of guests = 200

Wastewater generation per guest = 180 l/capita/day

Maximum wastewater flow of guests per day = 200 guests x 180 l/cap/d

= 36,000 l/d = 36 m^3/d

Number of staff members = 50

Wastewater generation per staff member = 38 l/capita/day

Maximum wastewater flow of staff members per day = 50 staff x 38 l/cap/d

= 2,000 l/d = 2.0 m^3/d

Maximum wastewater flow of staff and guests per day = 38 m^3/d

1.3.3.5.2 BST Design

Using a retention time of 6 days and a 25% safety margin

Proposed digester volume = 38 m^3/d x 6 days x 1.25

= 285 m^3

Recommended Digester Size = Two 150 m3 BSTs

1.3.3.5.3 Reed Bed Design

Flow = 38 m^3/d

BOD_i = 50 mg/l

BOD_e = 10 mg/l

Retention time = 1.5 days

Porosity = 0.35

Vegetation = Reeds

Volume of reed bed = 163 m^3

Possible dimensions of the reed bed are:

Depth = 1.0 m

Length = 17.0 m

Width =10.0 m

1.3.3.6 ENVIRONMENTAL BENEFITS

The application of anaerobic technology in the form of the biodigester systems provides an environmentally friendly method of treating wastewater. A significant reduction occurs in both the harmful microorganism population and the Biochemical Oxygen Demand (BOD).

This means that after the wastewater is treated it is in a form that is less damaging to the environment. Principal pathogenic organisms killed in the biodigester unit are Typhoid, Paratyphoid, Cholera and Dysentery bacteria in addition to Hookworm and Bilharzias. The more fully digested the slurry, the more pathogens are killed. It is therefore rich in plant food and can be substituted for the common chemical fertilizer (ammonium sulphate). Additionally, there will be improvements in the general reduction of health risks due to untreated wastewater discharge and the area will be more pleasant including the area around the BST, which will be aesthetically pleasing in appearance.

The plan for the proposed sewage treatment facility is included as Appendix IV.

2 POLICIES, LEGISLATION AND REGULATIONS

2.1 INTRODUCTION

International and national policies, legislation, regulations and environmental standards pertaining to this project were researched and analysed. The objective was to ensure that the project complies with all policy, legal and regulatory requirements. The study examined those policies, legislation and regulations governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels that relate to or should be considered in the framework of the project.

The United Nations Earth Summit '92 environmental principles and a number of Acts of Parliament contain clauses or sections that have implications for the proposed Heritage Bay Marina Hotel and Spa. These include:

- The Natural Resources Conservation Authority (NRCA) Act, 1991
- The Wildlife Protection Act, 1945
- The Beach Control Act, 1956
- The Watershed Protection Act, 1963
- The Town & Country Planning Act, 1987
- The Water Resources Act, 1995/The Underground Water Control Act, 1959
- The Jamaica National Heritage Trust Act, 1985
- The Public Health Act of 1926 & 1974, Environmental Control Division (ECD).

2.2 THE POLICY AND PLANNING CONTEXT

The United Nations hosted what was dubbed the EARTH SUMMIT '92 and from this conference twenty-one (21) environmental principles were outlined. Some important principles are:

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

Principle 2: States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own

environment and development policies, and the responsibilities to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdictions.

Principle 3: The right to development must be fulfilled so as to equitably meet development and environmental needs of present and future generations.

Principle 6: The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, shall be given special priority. International actions in the field of environment and development should also address the interests and needs of all countries.

Principle 10: Environmental issues are best handled with the participation of all concerned citizens, at the relevant level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. Sates shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

Principle 17: Environmental impact assessments, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

It is within this context that Jamaica seeks to protect its biological diversity through the establishment of a system of parks and protected areas.

The approach recognizing, however, that effective and well-managed protected areas have to be integrated in all other parts of national life – meaning that protected areas should be embedded in regional planning and that policy for all sectors would be environmentally benign.

It is also recognized that the issue of private land management within special areas has to be carefully handled with management arrangements in place from the outset to avoid loss of market value resulting not simply from the imposition of restrictions on land use, but from uncertainty in the market place about the degree to which land use might be restricted.

This has been further supported by innovative institutional arrangements, with the merger of the Natural Resources Conservation Authority and the Town and Country Planning Authority into the National Environment and Planning Agency (NEPA).

The government therefore does not perceive a contradiction between the establishment of an Industrial Zone at Tarentum (1996) and the subsequent establishment of the Portland Bight Protected Area (1999).

2.3 NATIONAL ENVIRONMENT AND PLANNING AGENCY (NEPA)

The Natural Resources Conservation Authority Act, 1991

The Act is the overriding legislation governing environmental management in the country. It also designates National Parks, Marine Parks, and Protected Areas and regulates the control of pollution as well as the way land and sea are used in protected areas.

This Act requires, among other things, that all new projects or expansion of existing projects which fall within a prescribed description or category must be subjected to an Environmental Impact Assessment (EIA). Specifically, the relevant section(s) under the Act, which addresses the proposed Heritage Bay Marina Hotel and Spa, are:

Section 9: **S**ubject to the provision of this section and section 31, no person shall undertake in a prescribed area any enterprise, construction or development of a prescribed description or category except under and in accordance with a permit issued by the Authority.

Section 10: Empowers the Authority to request EIAs for the construction of development of any enterprise of a prescribed category.

Section 12: Stipulates that no person shall discharge any poisonous hazardous material into the ground, of which contamination of ground water resources may occur.

Section 15: Addresses the steps (stop orders and fines) which the Authority will take in the event that water has been, and is likely to be contaminated.

Section 16: Discusses the intervention of the Government and their Authority to intervene in order to prevent the contamination of ground water resources.

Section 17: Addresses the Authority of the Government to request in writing any information pertaining to the:

(a) performance of the facility;

(b) quantity and condition of effluent discharged;

(c) area affected by the discharge of effluents, and such owner or operator as aforesaid shall comply with the requirements of the notice

Section 18: where it appears to the Authority that the activities of an undertaking in any area are such as to pose a serious threat to the natural resources or to public health, the Authority may serve on the person who appears to have carried out or be carrying out the activity, a notice (hereafter referred to as an "enforcement notice") specifying the offending activity and requiring such steps as may be specified in the notice to be taken within such period as may be so specified to ameliorate the effect of the activity and, where appropriate, to restore the natural resources to their condition before the activity took place.

2.3.1 THE WILDLIFE PROTECTION ACT, 1945

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species.

The Act also provides for the protection of animals and makes it an offence to harm or kill a species that is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead" is illegal.

This Act was consulted for the proposed project due to the possibility of such animals being found on the proposed site or in the adjacent waters. In addition, under this Act, provision has been made for the pollution of rivers, whereby it is an offence to discharge any substances into any river, which may be harmful to fish.

2.3.2 THE BEACH CONTROL ACT, 1956

The Beach Control Act provides for the regulation of activities within 25 metres of the shoreline. This includes control over the construction of sheds and huts on beaches, and prohibits the use of public beaches for fishing activities. The Act is administered by the NRCA, which makes provisions for the creation of Marine Protected Areas

The stipulations of this Act would also apply to any construction or improvements to wharf or port facilities.

2.3.3 THE WATERSHED PROTECTION ACT, 1963

This Act governs the activities operating within the island's watersheds, as well as protects these areas. The watersheds that are designated under this Act include Rio Minho/Milk River management basin.

This legislation will be brought to bear on the proposed project as it falls within the Rio Minho/Milk River management basin.

2.3.4 THE TOWN & COUNTRY PLANNING ACT, 1987 & TOWN & COUNTRY PLANNING (CLARENDON) PROVISIONAL DEVELOPMENT ORDER 1978

This Act governs the development and use of land (excluding agriculture) in specified areas, through Development Orders, local planning authorities, development planning processes and Tree Preservation Orders. Under this Act the Town Planning Department is the agency responsible for the review of any plans involving land development. The Act allows for specific conditions to be stipulated and imposed on any approved plans. The planning decision is based upon several factors. These include:

- the location of the development
- the land use and zoning
- the effect of the proposal on amenities, traffic, etc.

With regards to the proposed site for Heritage Bay Marina Hotel and Spa, specific legal guidelines known as Development Orders exist for the parish (Clarendon) in which the site is located.

Town and Country Planning Law 1957 – The Town and Country Planning (Clarendon) Provisional Development Order, 1978 and the Town and Country Planning (Clarendon Parish Provisional Order (Confirmation) Notification, 1982 are the relevant legal instruments.

This Act was consulted for the proposed project due to proposed site plans being reviewed and approved by the Authority.

2.4 WATER RESOURCES AUTHORITY (WRA)

The Water Resources Act (1995) / The Underground Water Control Act, 1959

The Underground Water Control Act of 1959 is the legal instrument. However, the Water Resources Act is expected to provide for the management, protection, controlled allocation and use of the water resources of Jamaica. Thus, the water quality control for both surface and ground water are regulated by this Act.

Any activity that negatively influences the quality of the existing water, whether ground or surface, would be relevant to this Act.

2.5 JAMAICA NATIONAL HERITAGE TRUST

The Jamaica National Heritage Trust Act, 1985

The Act is administered by the Jamaica National Heritage Trust, formerly the Jamaica National Trust. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, buildings of historic and architectural importance in Jamaica.

This Act will prove applicable if any structures of archaeological and/or architectural importance are located on the site, affected by the site activities or unearthed during site activities.

2.6 ENVIRONMENTAL CONTROL DIVISION (E.C.D.), MINISTRY OF HEALTH

The Public Health Act, 1974

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the handling of food material. In addition, provisions are also made under this Act for the activities of the environmental control division (ECD), a division of the MOH. The ECD's functions include:

The monitoring of waste water quality, using NEPA wastewater standards

- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments
- Monitoring of air pollutants through its laboratory facilities

This Act has been consulted for the proposed sewage disposal system.

2.7 THE PORTLAND BIGHT PROTECTED AREA

The Portland Bight Protected Area (PBPA) was created on April 22, 1999 (Natural Resources Conservation Authority Act, The Natural Resources Conservation (Portland Bight Protected Area) Order 1999. The PBPA is 250 km2 (200 mile2) of land and 1,356 km2 (524 mile2) of marine space with a total of 1,876 km2 (724 mile2) (see Figure 4).

The complex ecosystem of the PBPA provides habitat for a wide variety of Jamaican wildlife. On the coastline is the largest remaining mangrove system in Jamaica, which together with the extensive seagrass beds provides the largest nursery area for marine fish, molluscs and crustaceans in the island's territorial waters. Beaches on the mainland and on the inshore coral cays are major nesting sites for sea turtles. Manatees are now rare, but many crocodiles inhabit the rivers and wetlands.

Overlooking Portland Bight are four tropical dry limestone forests, the most intact left in Central America and the Caribbean: the Hellshire Hills, Brazilletto Mountain, Portland Ridge and Kemps Hill. Over 50 rare and endemic plants are to be found there, as well as many endemic animals.

Over 50,000 people reside within the boundaries of the PBPA in over 40 communities.

Co-management (or stakeholder management) of natural resources is the approach where representatives of all the stakeholders in a natural resource – including the government – participate in the planning, execution and enforcement of the regulations and strategy for the proper management of that resource.

This is predicated on the notion that civil society participation in local decision-making is critical in implementing and enforcing decisions concerning the resources they use as stated in Principle 10 of Agenda 21.

The National Environment and Planning Agency, the government agency with legal responsibility for managing parks and protected areas, is preparing a legal instrument by which the management responsibility for the PBPA will be delegated to the Caribbean Coastal Area Management Foundation (C-CAM).

3 ANALYSIS OF ALTERNATIVES

In considering the development options, the following alternatives can be exercised:

1. The No Action Alternative
2. The Proposed Development
3. The Proposed Development with modifications
4. Proposed Development in another location
5. Sewage Treatment Technology Alternatives Considered

3.1 THE NO ACTION ALTERNATIVE

The selection of the "No Action" alternative would mean the discontinuation of project designs and result in the site being retained in its existing form. There are physical, biological and socio-economic implications of this alternative.

Physically, the site is unlikely to undergo any major changes from its present condition. Biologically, the vegetation present on the site is unlikely to be severely affected, other than the potential for uncontrolled growth of weeds, bushes and trees introduced by avifauna, wind or other means. Unless the area is maintained, this could result in an eyesore and a possible venue for illicit and otherwise objectionable activities.

The "No Action" Alternative is likely to have the greatest implications on the socio-economic environment of the area and surrounding communities. Due to the proposed quality of the development it is anticipated that it would provide a major opportunity for employment, foreign exchange revenue, benefits associated with the construction industry and potentially significant business opportunities for existing and new tourism support businesses. In addition, a development of this calibre will add to the islands' ability to market itself to visitors from markets previously under represented through previous marketing activities. It will also fuel the growth and development of Jamaica's South Coast Tourism Development thereby, alleviating sprawl and continued migration of people to the burdening tourism centres of the North Coast. If this alternative were adopted, the developers would need to find an alternative site for the development or decide to develop the product outside of Jamaica.

3.2 THE PROPOSED DEVELOPMENT

This alternative would see the construction of the development as proposed by the developers, and as outlined in this EIA document. This option has good support (based on results of socio-economic survey) by the persons who would be most affected by its implementation, i.e., residents within the greater Salt River area. Therefore, community support is anticipated for the development.

This alternative will provide positive benefits to the communities and Jamaica's tourism product. This includes benefits such as employment opportunities, foreign exchange earnings, increased property values and benefits to ancillary supporters/dependents of the tourism industry. If approved, construction at the facility is scheduled to last approximately 18 months, and will provide employment for an average of 40 individuals during pre-construction, 200 tradesmen and labourers during construction at its peak, and approximately 100 employees during the operational phase. Additionally, the multiplier effects to the construction and support industries during this period are likely to affect a much larger number of persons.

The proposed project will also make a positive contribution to social infrastructure, overall residential development, upkeep and renewal of the residential community. The proposed development is being designed and built to meet or exceed local and international standards and regulations. A key benefit also is the installation of a tertiary level sewage treatment facility that will produce an effluent suitable for use as irrigation water on the facility or for final release into mangroves while meeting, and in some instances exceeding, standards for coastal water quality.

3.3 THE PROPOSED DEVELOPMENT WITH MODIFICATIONS

If there are issues concerning the project that may be enhanced, changed or modified to increase the acceptability of the project, then these issues should be considered. At this time based on communication with residents of surrounding communities, it appears that there are several issues that once resolved satisfactorily, whether through modification or compromise, would further increase support for the development. These include but are not limited to:

- Guarantees that the sewage treatment system will treat wastewater to be used for irrigation to the tertiary level (the system has been designed to achieve irrigation standards which are more stringent than discharge standards)
- Utilization of different sewage treatment options (due to the availability of space at the proposed site, very few sewage treatment technologies could be implemented that would treat to the same level, with the low operational and maintenance costs and reliability anticipated for this system)
- impact on the existing water supplies in the area
- Establish lines of communication with the possibility of a liaison officer between the developers and the community
- Aesthetics, particularly the timely removal of zinc fencing surrounding the site and construction of an aesthetically pleasing fence.

Some of these concerns will not exist on project completion e.g. water supply. All other issues are easily resolvable through either modification or compromise and we do not foresee these issues resulting in disapproval of the development by interested community and regulatory agencies. The developers will work with the communities and residents to design, construct and operate a quality facility that will be the pride of all involved or partake in its operation.

This alternative retains the same positive benefits as with maintaining the proposed development option.

3.4 THE PROPOSED DEVELOPMENT IN ANOTHER LOCATION

Other locations were considered in conjunction with the proposed Salt River, Clarendon location for implementation of this project. However, the proposed site offered the following advantages over other locations considered:

- Size of available land was desirable
- Waterfront location was ideal with high quality marine environment
- Size of property allowed for inclusion of a tertiary level sewage treatment system with capability to treat to a level satisfactory for use as irrigation water

No other location was able to offer the comprehensive package of available land, size, natural resources and access. As a result, no location that was more suitable or amenable t was identified in the area. Additionally, lands exist in the area for extension to the intended project should the need arise.

The recommended alternative is the "Proposed Alternative" because it recognizes the viability and need for the proposed development, is designed to address environmental issues and concerns, meets or exceeds all local regulatory requirements and supports communication and close relations during all stages of the development between the developers and the surrounding communities.

3.5 SEWAGE TREATMENT ALTERNATIVES

Difference between Bio-Digester Septic Tank (BST) and Ordinary Septic Tank (ST)

The BST should not be confused with the ordinary septic tanks, commonly found in our everyday homes. The differences between the two are:

- In a bio-digester septic, the tank is gas-tight, whilst in the ordinary septic tank ventilation is required under law.
- A main focus of the bio-septic tank is to stabilise the sewage, making it environmentally friendly and produce biogas under anaerobic conditions whilst in the ordinary septic tank, it's main purpose is to separate most of the solid from the liquid waste, under semi-anaerobic conditions.
- A significant quantity of biogas can be stored in the tank for useful purposes; Up to $2m^3$ of biogas can be stored in the system of a $10m^3$ digester. The gas can be used for cooking, refrigeration and lighting.
- Within the bio-digester there is a longer retention time, meaning that the organic waste remains in the tank for a longer period, so as to allow the organic matter to be broken down more intensely (higher conversion factor). The end result is that the effluent is far less polluted.
- The wastewater from a bio-septic tank is discharged at grass root level and, being rich in nutrients, can therefore be used for irrigation, whilst in a normal septic tank, the wastewater is usually discharged to a sewage treatment plant, or soak-away pit. The

implications are that a traditional septic tank does not prevent pollution of underground water.

- A second inlet can be attached to the system to receive organic kitchen and garden waste. This will increase the gas production considerably.

4 ENVIRONMENTAL SETTING

The environmental setting of the project site and immediate environs were assessed to determine the existing status of environmental resources. This was primarily done to ascertain existing environmental conditions prior to the establishment of the proposed development, to facilitate the preservation of natural resources within the projects sphere of influence. Aspects of the environment that were assessed, were selected on the basis of the likelihood of the project impacting on these resources, and included the following:

- Air Quality and Climate
- Ambient Noise Levels
- Hydrology
- Geology & Soils
- Topography
- Natural Hazards
- Terrestrial and Marine Ecology
- Land-Use
- Social Environment

4.1 AIR QUALITY & CLIMATE

4.1.1 APPROACH AND METHODOLOGY

Weather and climatic data collected in the general area were reviewed to determine possible trends for the region. The meteorological parameters assessed were:

- Global Radiation (sum of direct and diffused)
- Air Temperatures, Ground Temperatures
- Rainfall
- Wind Speed
- Wind Direction
- Atmospheric Pressure

4.1.2 GENERAL OVERVIEW OF JAMAICA'S CLIMATOLOGY

Two major features influence Jamaica's climate. The first relates to its geographical position in the Caribbean Sea and the second arises from its topography. Both these factors help to create regimes of moderate climatic conditions offset only on occasions by the occurrence of severe weather events such as tropical storms.

Temperatures are fairly constant and for most of the year, the Northeast Trades dominate the daily wind pattern. By day, a combination of Trade Winds and sea breezes produce east-south-easterly winds along the south coast, with an average speed of 18 knots (9 m/s). At nights, a northerly land breeze with an average speed of knots (3.5 m/s) is usually the norm.

4.1.3 RAINFALL

Rainfall is the most variable of the climatic parameters. However, over the years, it has been shown that rainfall along the south coast and for the most of the Island, exhibits a bimodal character, with two dry seasons and two wet seasons.

The thirty (30) year (1951-1980) average monthly rainfall values, highlight the typical rainfall pattern for the region and follow the general pattern of rainfall over the Island, with the driest period running from November to March and a primary wet season during September/October and a secondary one near May. An annual average rainfall amount of between 850 and 1000 millimetres makes this region as one of the driest regions in the country. Figure 4-1 below shows the 30 year average for the parish of Clarendon between the period 1951-1980.

Table 4-1: Average Monthly Rainfall Values (mm) for the Period 1951-1980

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tarentum	37	26	29	42	113	112	55	80	118	218	83	49	962

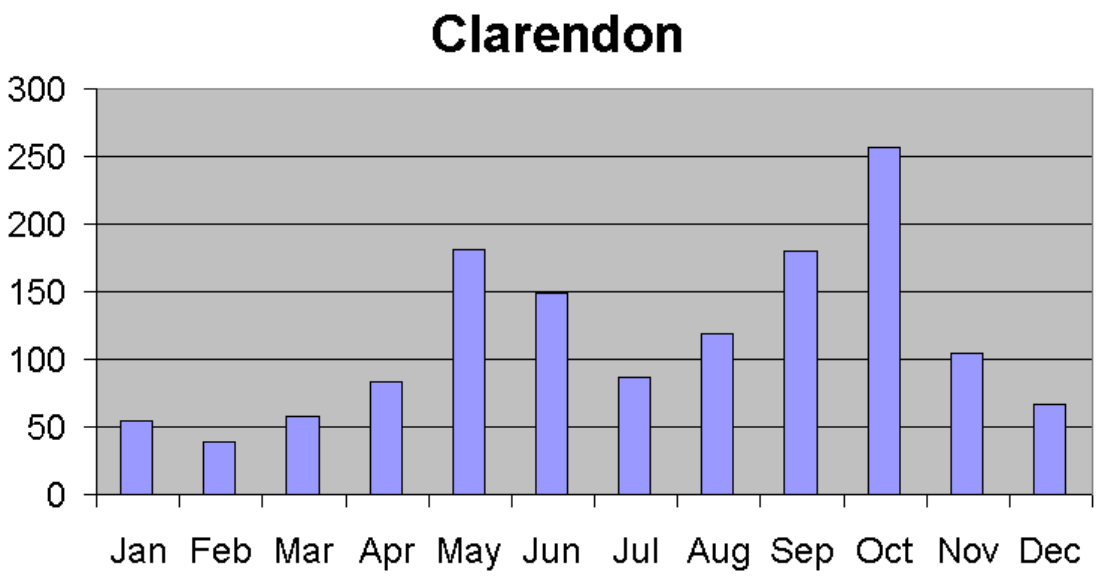


Figure 4-1: Rainfall Distribution (mm) (1951-1980) - Clarendon[2]

Rainfall data was acquired from the state of the art weather station at Jamalco Refinery at Halse, Hall, Clarendon. This weather station is the closest weather station to the Salt River area. Over the period 1983 – 2003 the rainfall totals for the southern Clarendon region averaged 988.1 mm (38.9 inches) of rainfall with a monthly average of 83.1 mm (3.27 inches). The area experiences its wettest period during the months of May-June (90 – 163 mm) and August-November (89 – 154 mm).

Table 4-2: Rainfall Annual Averages (mm) at Rocky Point (1983-2003)

YEAR	MONTH												YEAR'S TOTAL	MONTHLY AVERAGE
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER		
1983	0.44	6.68	0.40		2.54	6.48	0.06	6.36	1.42	5.29	2.01	0.16	31.84	2.89
1984	0.52	2.17	5.39	0.58	5.37	3.62	2.13	1.76	5.88	3.86	1.75	0.07	33.10	2.76
1985	0.14	-	-	-	-	-	-	2.45	1.86	8.62	7.74	1.12	21.93	1.83
1986	1.95	0.78	1.05	3.53	-	22.56	1.36	0.52	3.36	8.87	2.01	0.78	46.77	3.90
1987	1.86	0.28	0.16	6.90	6.48	1.31	1.70	3.04	1.46	17.38	5.52	3.10	49.19	4.10

[2] Source: Jamaica Meteorology Service

YEAR	MONTH												YEAR'S TOTAL	MONTHLY AVERAGE
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER		
1988	0.10	0.63	1.63	2.20	5.62	1.59	1.65	8.70	8.81	1.24	6.53	1.81	40.51	3.38
1989	2.99	1.60	3.01	0.74	4.64	1.40	0.21	1.61	7.15	0.98	1.22	0.36	25.91	2.16
1990	2.04	0.79	1.78	2.51	1.43	2.11	2.26	0.60	1.33	6.59	7.68	1.80	30.92	2.58
1991	0.39	0.26	1.58	1.46	7.52	0.37	1.66	1.67	2.36	2.24	3.37	0.37	23.25	1.94
1992	0.21	2.22	0.38	1.61	9.11	2.95	0.47	2.14	4.36	2.82	1.24	0.22	27.73	2.31
1993	3.60	3.54	4.62	7.89	27.45	0.75	1.82	0.75	4.76	0.68	3.59	7.27	66.72	5.56
1994	1.74	0.07	2.62	3.29	4.10	0.00	1.70	4.10	3.22	0.58	13.85	0.70	35.97	3.00
1995	2.75	0.80	2.31	5.09	6.19	3.05	1.13	13.08	8.32	17.70	0.87	1.83	63.12	5.26
1996	1.40	0.17	0.90	0.94	0.60	0.92	2.17	4.40	6.12	6.83	7.22	0.03	31.70	2.64
1997	1.03	0.89	1.26	1.36	0.85	7.88	0.33	0.64	5.70	6.47	3.14	2.15	31.70	2.64
1998	0.74	1.54	8.55	2.53	0.67	1.14	4.96	4.15	11.36	5.71	2.21	4.66	48.22	4.02
1999	0.87	3.10	6.93	0.93	2.43	3.67	2.96	1.75	13.63	11.73	8.87	1.99	58.86	4.91
2000	0.77	1.75	1.65	3.47	1.28	0.85	2.47	2.00	9.28	3.80	1.05	6.19	34.56	2.88
2001	1.75	0.35	0.49	1.48	6.14	0.09	1.73	0.55	2.31	5.30	8.55	5.78	34.52	2.88
2002	3.27	1.81	2.39	3.80	20.05	6.68	0.34	0.47	22.48	6.04	0.94	1.60	69.87	5.82
2003	1.31	0.91	1.97	3.00	14.72	3.46	1.08	12.64	2.28	3.30	1.46	1.11	47.24	3.94
2004	1.07	0.16	0.24	0.16	1.07								2.70	0.54

It is not envisioned that the effects of rainfall will have any significant impact on the proposed project.

4.1.4 WIND SPEED & DIRECTION

The wind direction regime is of utmost importance in pollutant transport studies and careful attention has to be paid to the complete analysis of the wind regime in respect of sphere of influence, direction and intensity.

Preliminary analysis suggests that local radiative heating processes to a great extent govern the wind regime in the vicinity of Tarentum.

In the absence of significant weather features, the wind regime seems to follow the radiative pattern, displaying a maximum value almost simultaneously with the time of greatest isolation. The interesting feature of this wind regime as described by the data is that the dominant direction from which it is blowing is North-North-West to South-South West during the daytime. This direction is usually seen to be sustained for as many as seven hours per day beginning from as early as 9:00 a.m. on some days but mostly becoming stable at 11:00 a.m. and continuing until 6:00 or 7:00 p.m. daily.

From the data, there are a few cases of sustained south-easterly component, thought to be the dominant wind direction for southern coastal areas. After 6:00 p.m. the wind direction begins to shift and remains variable for the next few hours until approximately 8:00 p.m. when a sustained light night wind from the North-North East to East North East quadrant dominates.

4.1.5 TEMPERATURE

Temperature values are fairly uniform for the region. Averaging in the high twenties to lower thirties during the day to lower twenties in the early morning and late nights. Daily temperature regime appears constant and shoes little variation in regime. The maximum values occur usually between the hours of 1 and 2 p.m. local time coinciding most times with the times of occurrence of the maximum global radiation values and the incidence of lowest relative humidity values.

4.1.6 AMBIENT AIR QUALITY

The existing ambient air quality of the proposed site and its immediate environs were examined. The ambient air quality was primarily assessed and monitored to determine baseline concentrations for sulphur dioxide. The following locations were monitored:

(1) Tarentum
(2) Salt River

Analysis of the data indicates that an average concentration of 0.017 ppm was measured at Tarentum. The SO_2 concentration recorded at Tarentum was 95% less than National Environment and Planning Agency Ambient Air Quality Standard, 0.36 ppm/l hour average (Table 4-3).

Table 4-3: Background SO2 Concentrations

LOCATION	1ST SAMPLE	2ND SAMPLE
Tarentum	0.017 ppm	N.S.
Salt River	0.002 ppm	0.017 ppm

Note: N.S. = Not Sampled
Source: Conrad Douglas & Associates Limited

4.1.7 NOISE LEVELS

Present noise levels in the vicinity of the proposed development (baseline conditions) have been recorded at an average of 50 decibels.

4.2 HYDROLOGY

The development site falls within the lower catchment of the Rio Minho/Milk River Water Management Basin (IV) (Figure 4-2). Only a fraction of the safe surface water yield of this Basin is used as stream flows tend to be seasonal. Groundwater supplies are utilized to a greater extent, with only about 20% of the safe yield being unused (UWA, 1990). Limestone and alluvial aquifers comprise the main storage for the groundwater in the Rio Minho/Milk River basin, the latter being considerably more important in the lower catchment.

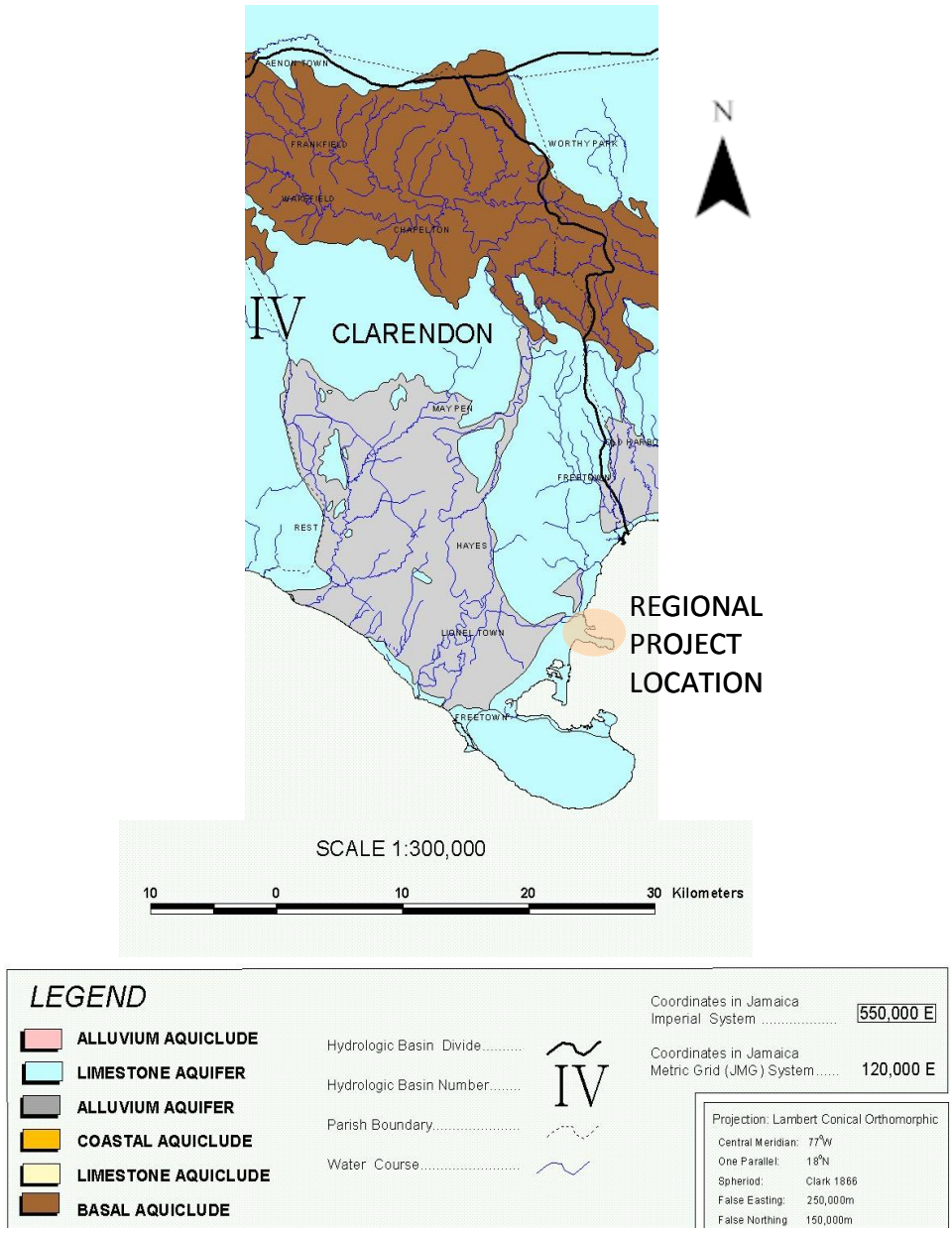


Figure 4-2: Rio Minho/Milk River Water Management Basin (IV) [3]

4.3 GEOLOGY & SOILS

Figure 4-3 shows the generalized geology of the region. Two geological unites outcrop within the vicinity of the site: Coastal Group Limestone and Quaternary Alluvium. Coastal Limestone of Pliocene age is present. This rock is less pure, and fossiliferous. Fresh outcrops tend to be rubbly, weakly cemented and cream in colour. The soil developed over the Coastal Group

[3] Hydrostratigraphy Map of Jamaica - WRA

limestone is a dark imperfectly drained soil, categorized as the Nonsuch Clay. The other soils found in the vicinity of the site are all developed over alluvium. These include the Agualta Loam, The Agualta Clay, and the Halse Hall Loam. The latter two are poorly drained heavy soils. The Halse Hall Loam is distinguished by grey or mottled sub-soils. The Agualta Loam is a well-drained light soil.

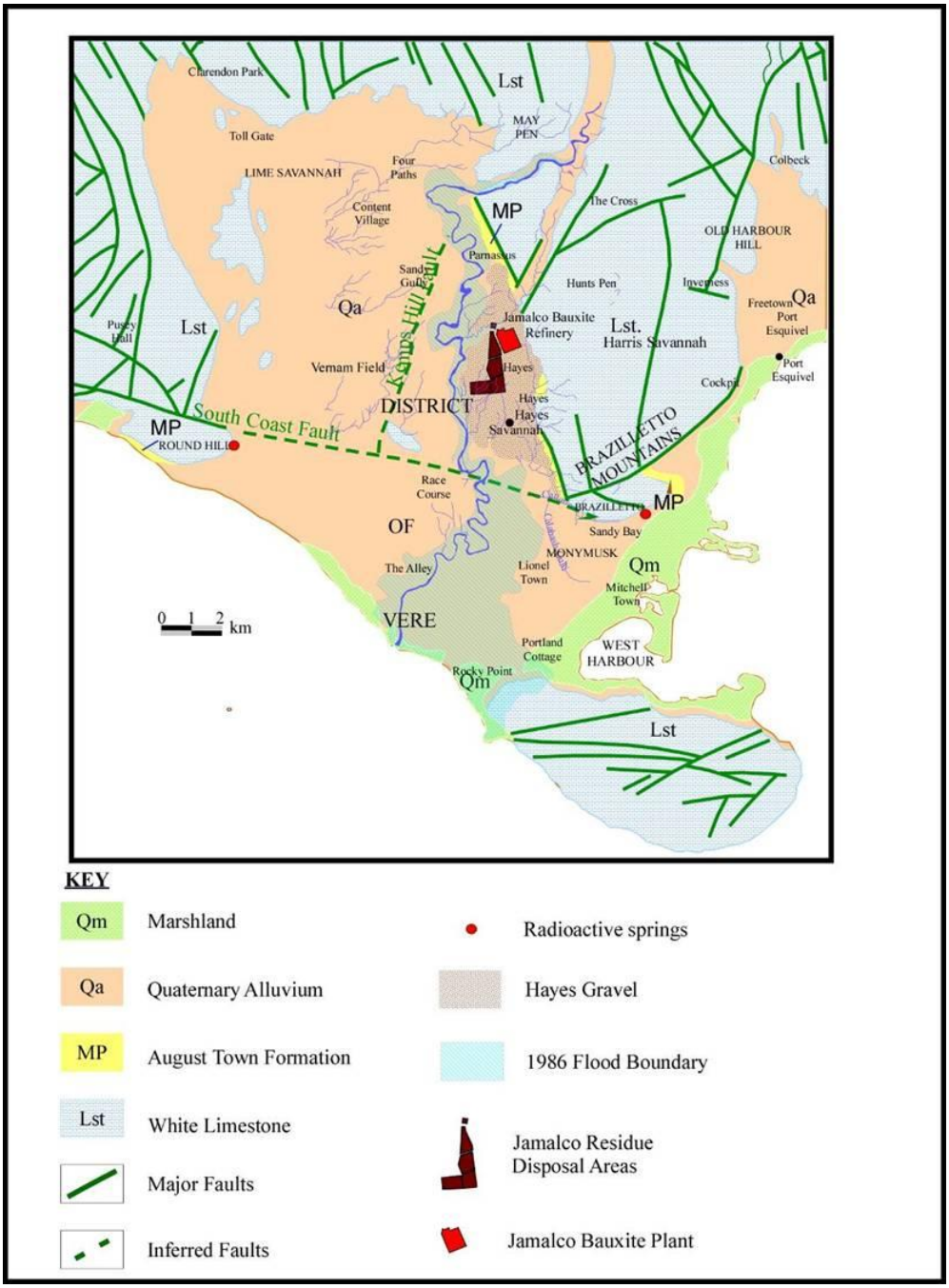


Figure 4-3: Regional Geological Setting

4.4 TOPOGRAPHY

The development impacts on an area that may be defined as a coastal zone.

The coastal zone is delimited by the Salt River, which traverse the coastal plain in a roughly southerly direction. A high water table and marshy conditions characterize the area.

4.5 DRAINAGE

The east-drainage branch of the Salt River develops from a fault-related spring occurring at the southern limit of the Brazilletto Mountains. This branch of the Salt River is navigable out to sea. The Cockpit gully also emerges from a fault-related spring near the town of Cockpit. The latter traverses the mangrove swamp and joins the south-draining branch of the Salt River converge near the Gun Club. The Salt River discharges slightly brackish water immediately north of Burial Ground Point, into the Salt River Bay.

Surface drainage is not well developed on the limestone hills; dry river valleys and gullies observed are likely to be fault and joint controlled, and may only transmit storm water or is essentially seasonal. A waterway drains eastward through the Tarentum alluvial plain and connects with the south-draining limb of the Salt River.

4.6 COASTAL STABILITY

The coastline around Salt River Bay occurs in a very well protected location within the Portland Bight. Waves approach from the southeast but are defracted at the Rocky Point. The fringing reefs, which have formed around Rocky point and Burial Ground Point, absorb some of the energy of storm waves. Salt Island is fringed on the eastern side by a coral reef, which provides an additional barrier to oncoming high-energy waves. Submarine sandbars between Salt Island and Burial Ground point may eventually develop to a point where the former may become tied to the coastline as well.

Dissipation of destructive wave energy by these offshore features creates an environment of relative stability and net accumulation of sediment. Rocky point appears to provide enough protection to allow for pro-gradation of the shoreline north of it.

There are reasonably continuous barrier reefs occurring north of the mouth of the Salt River and along the eastern margins of Long Island and Short Islands. These barrier reefs provide adequate

protection to the back reef lagoon and shoreline. Back reef lagoons are important generators of the carbonate component found in the beach and along this shoreline (although the clastic component appears to be more significant at Welcome Beach). The extensive development of wetlands along the shoreline suggests that the shoreline is well protected from high wave energy. Welcome Beach (north of the Salt River Pier) is likely to benefit from a net accumulation of sediment, and may pro-grade (become wider) in the long term.

4.7 NATURAL HAZARDS

4.7.1 FLOODING

The physiographic catchment of the Salt River is quite small, but both the south draining and east draining limbs are supplied by springs. These springs may transmit, subterranean, through-flows originating in and around the Harris Savannah. Tarentum is part of the general floodplain of the Salt River, but most of the property occurs at elevations well above expected flood levels.

Flooding of low-lying areas by tsunamis (waves generated by offshore earthquakes) is a possibility in the event of an offshore earthquake. Storm surges are temporary rises in sea-level (resulting in partial flooding of low lying coastal areas) which result from the combined effect of the fall in barometric pressure and the effect of high velocity winds forcing water onto the land. It is estimated that for every drop of 100 millibars in the barometric pressure a sea-level rise of 1m (3.28 feet) can be expected. The average atmospheric pressure in Jamaica is about 1013 mb (good weather).

The bathymetry and general configuration of the Portland Bight, suggests that the area might be at risk from storm surges, especially if the eye of a hurricane passes over the Bight. The lowest barometric pressure ever recorded in the Atlantic was associated with Hurricane Gilbert (880 MB); when it actually hit Jamaica barometric pressure was in the range of 960 Mb.

4.7.2 EARTHQUAKES AND ASSOCIATED HAZARDS

The proposed site is located in a very broad zone which is reported as having 5-9 earthquakes of Modified Mercalli Scale VI or greater between the period 1880-1960. An earthquake classified as MM VI is felt by all. Figure 4-4 indicates the average number of felt earthquakes of MMVI or over per century.

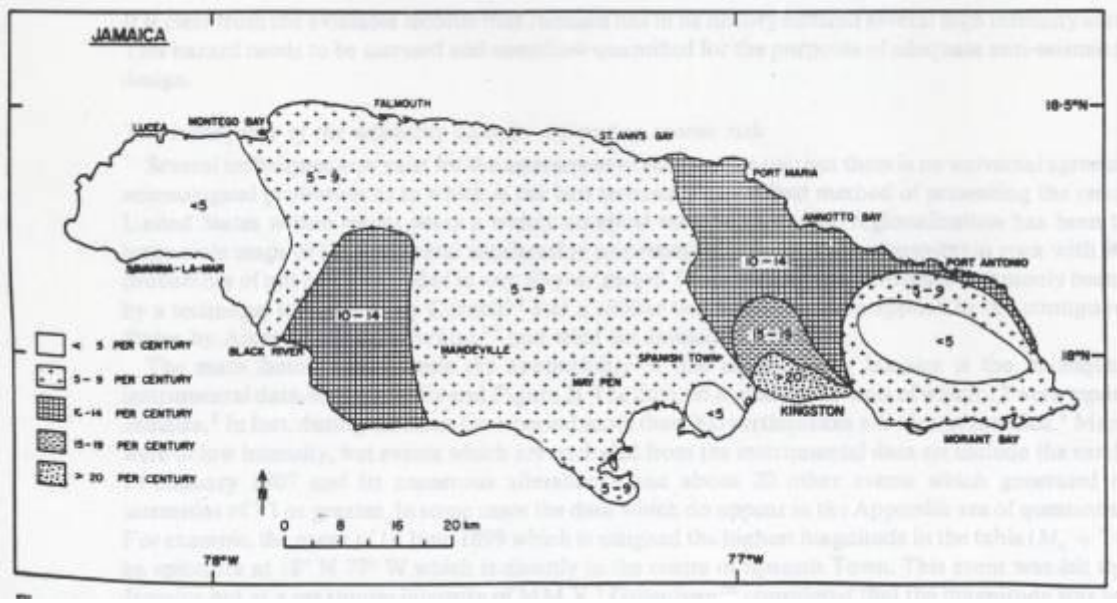


Figure 4-4: Map showing number of times per century that intensities of MM VI or greater have been reported, 1880-1960 (from Shepherd & Aspinall, 1980)

Figure 4-5 and Figure 4-6 below outline the Horizontal Ground Acceleration with 10% probability of exceedance in any 50-year period, and the expected maximum Mercalli Intensity with 10% probability of exceedance in any 50-year period. Salt River, Clarendon is situated in the area of Jamaica which experiences an exceedance of 14 cm per second in any 50-year period for Horizontal Ground Acceleration or expected Maximum Mercalli Intensity (MMI) 7.

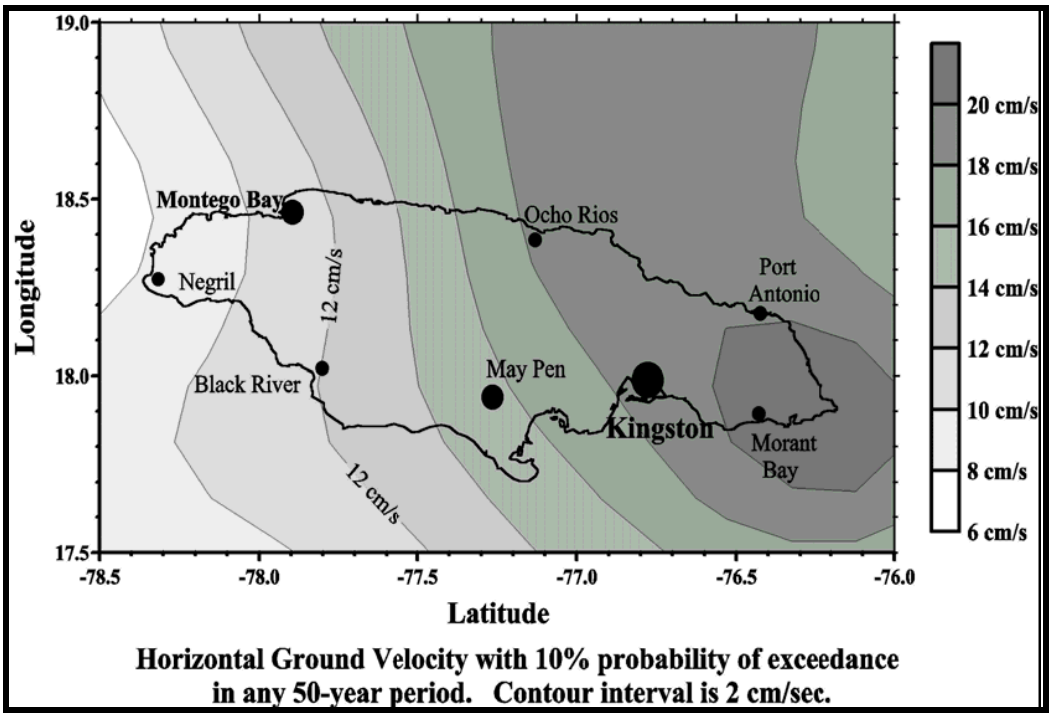


Figure 4-5: Horizontal Ground Acceleration in Jamaica[4]

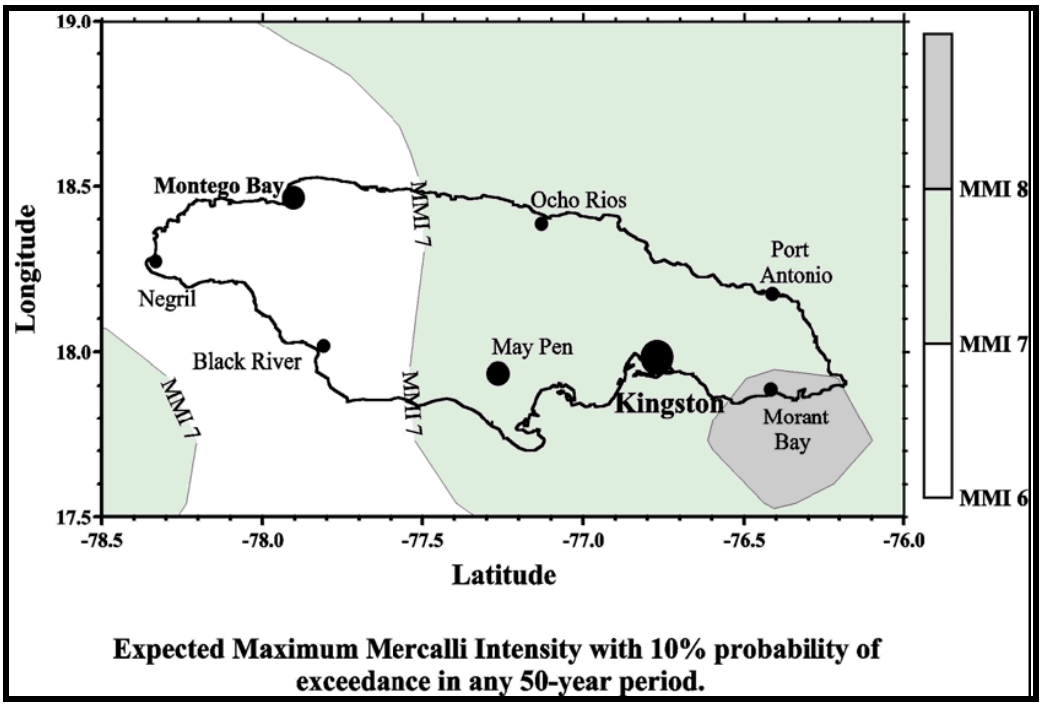


Figure 4-6: Maximum Mercalli Intensity in Jamaica[3]

[4] OAS **Sub-regional Seismic Hazard Maps for Jamaica,** http://www.oas.org/CDMP/document/seismap/

Damaging earthquakes to have affected Jamaica in recent times are, most notably, those of 1907 and 1957. The 1907 earthquake appears to have caused some damage in the Vere Plains. Intensities of MM (VII) were reported in Alley with incidence of damage to chimneys and buildings (Tomblin & Robson, 1977). The 1957 earthquake had intensities of MM (IV) to MM (V) in the Lower Vere Plains (Robinson *et al.*, 1959). In each 50-year period, starting with 1991 and counting backward for four 50-year cycles, at least one damaging earthquake, of MM (VI) or higher, has occurred in the area. Shepherd (1971) reported that Lower Vere had a frequency of 5-9 damaging earthquakes per century on average.

4.7.3 HURRICANES & EXTREME WEATHER CONDITIONS

Hurricanes pose the most serious risk to the development site. Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. Tsunamis are also a major risk.

The recent hurricanes to affect the development region were Ivan (2004), Dennis (2005), and Dean (2007) all considered major hurricanes, had significant impact on the infrastructures and persons residing along the South Coast such residents and industries within the Salt River and Portland Bight area. The greatest hazard associated with hurricanes is the high wind velocities. Hurricane wind speeds can reach up to 250 km/hour (155 mph). The damage caused by the wind and debris entrained by the wind usually accounts for a relatively large proportion of damages. Rainfall associated with hurricanes is extremely variable. Intense rainfall can lead to floods and landslides.

Considerations have been given to issues related to storm water and potential for erosion during the construction and operational phases of the development. As such, a storm water management system, involving the use of drains and absorption pits (French drains) has been recommended.

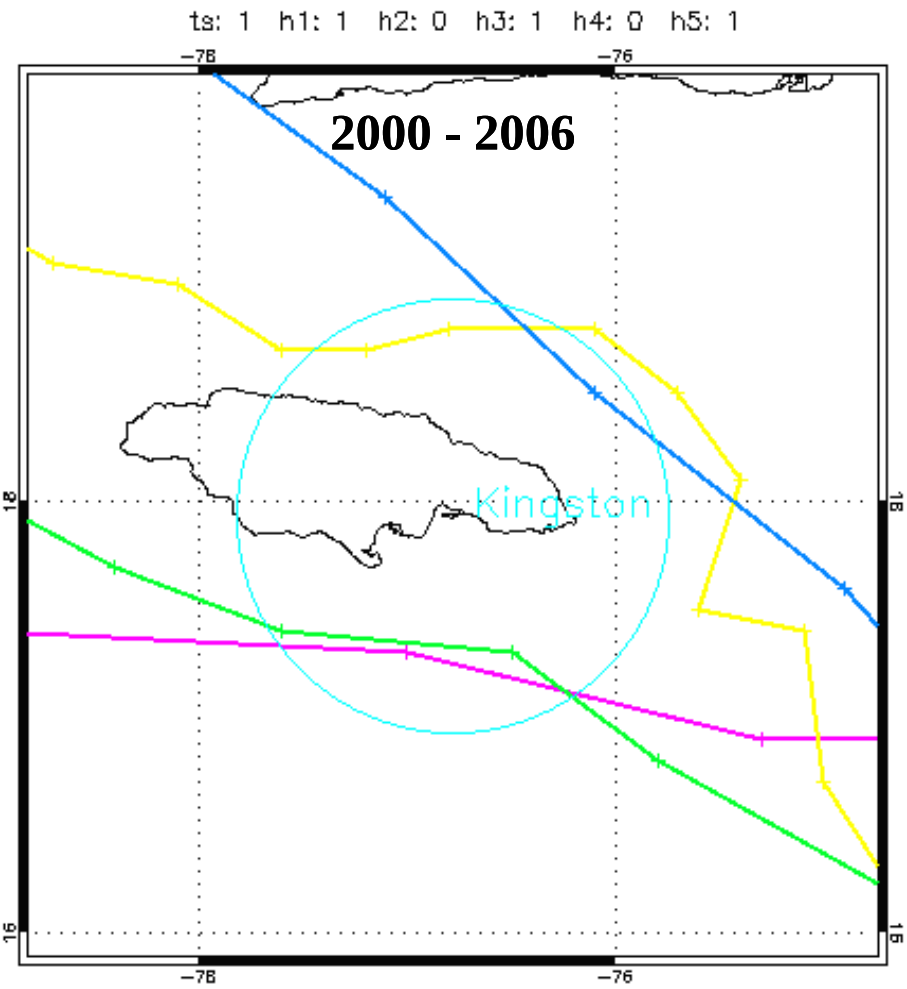
All recorded tropical storm and hurricane activity over a period of 100 years were considered to estimate any trends related to the hurricane activity and the return period of such activities to the island, using Norman Manley International Airport in Kingston as a reference point location:

17.93N, 76.78W[5]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

Analyses of tropical systems passing within 60nm (= 60mi.) of the island is shown below. Figure 4-7 below shows the storm track for tropical systems passing by for the period 2000-2006. Figure 4-8 shows whether there are more storms lately or which 5-year period in the last 60+ years was most active.

Based on the design specifications, the kiln will be able to withstand winds up to 60 m/s which equates to a category 4 wind gust.

[5] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/



Date	Wind	Cat.	cpoa	Name
07 Oct 2001	86	**h1**	46	IRIS
29 Sep 2002	58	**ts**	58	LILI
11 Sep 2004	155	**h5**	41	IVAN
07 Jul 2005	115	**h3**	59	DENNIS

Figure 4-7: Hurricane Storm track for the Period 2000-2006[6]

[6] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm

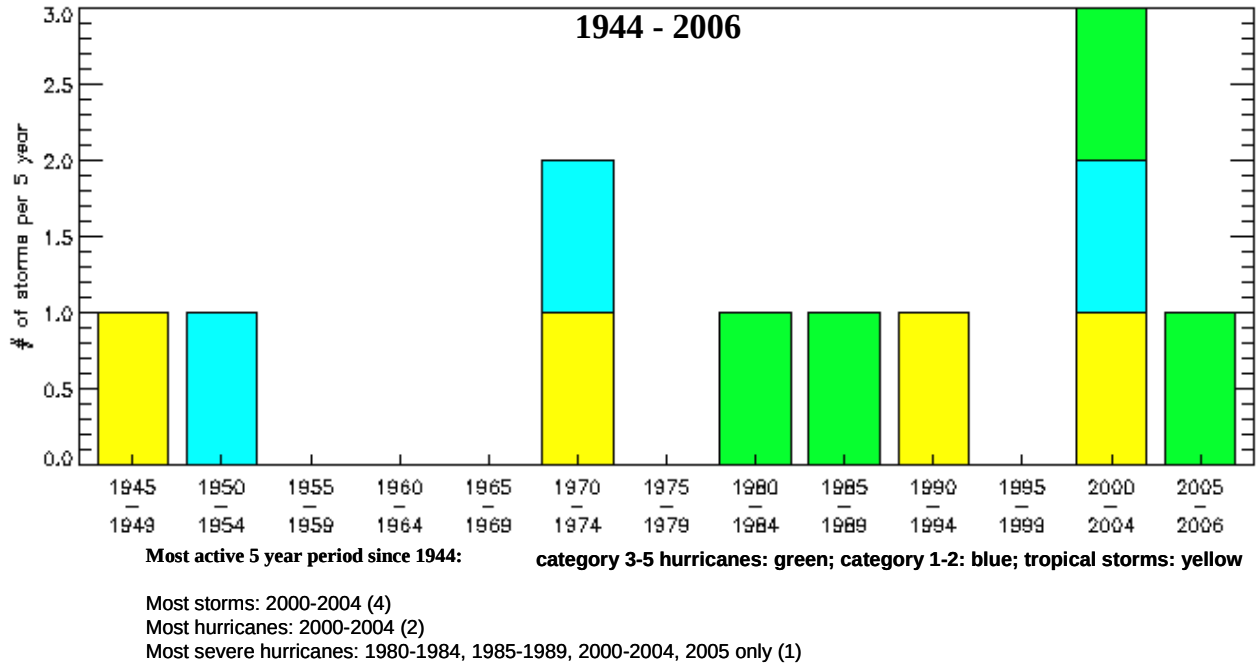


Figure 4-8: Hurricane Activity for the Period 1944 – 2006[7]

Figure 4-9 below outlines the varied return periods for 50 and 100 year return wind at Rocky Point, Clarendon. A 10 year return period has winds at 28 ms^{-1} compared with a 100 year return period of 52 ms^{-1}.

Using the TAOS model, Caribbean Disaster Mitigation Project (CDMP) has produced maximum likely estimates for surge and wave height throughout the Caribbean basin for 10-, 25-, 50- and 100-year return periods. Estimates were made for each cell in a 30 arcsecond (approx 1km x 1 km) grid, covering the entire Caribbean. These maps are a result of new techniques for modelling storms and estimating the probabilities of storms, developed in part under the patronage of CDMP.

The projection of the illustrations is Plate Carrée, a square grid of latitude and longitude. Resolution is 30 arc-seconds. North-South distances are true to scale. East-West distances are stretched 4.6% at 17 degrees North, and stretched 5.8% at 19 degrees North. All model results were calculated using great-circle distances based on the WGS84 datum.

[7] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm

- **WINDS** represent sustained 1-minute winds at 10 m above the surface, and include both surface friction and topographic effects at a resolution of 30 arc-seconds. Friction factors derive from a Level I land-cover classification, with water, forest and open land predominating.

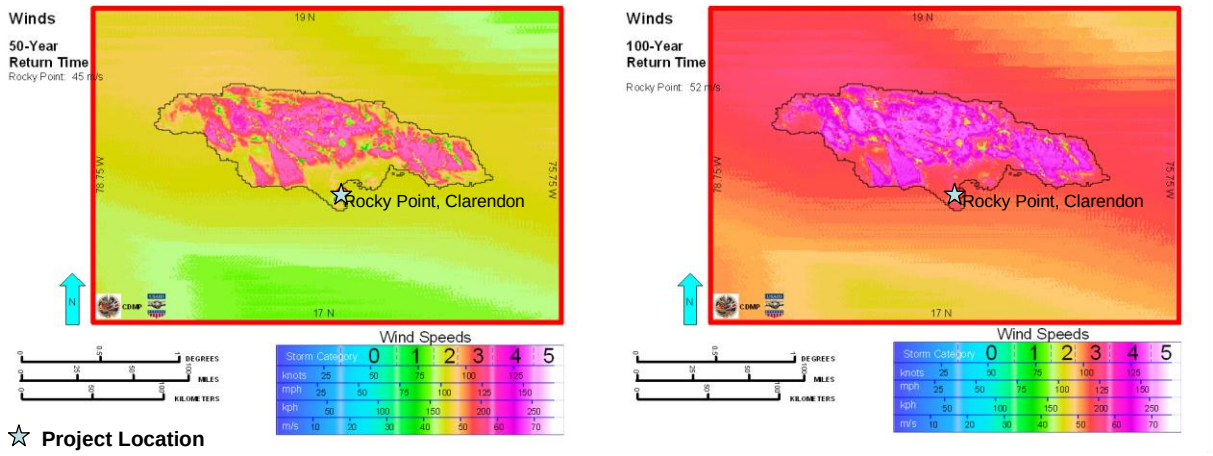


Figure 4-9: 50 and 100 Year Return Period for Wind at Rocky Point, Clarendon[8]

- For a 10 year return period, the project site can anticipate winds on the order of 100.8 kph (62.6 mph).
- For a 25 year return period, the project site can anticipate winds on the order of 136.8 kph (85.0 mph).
- For a 50 year return period, the project site can anticipate winds on the order of 180.0 kph (111.8 mph).
- For a 100 year return period, the project site can anticipate winds on the order of 187.2 kph (116.3 mph).

[8] Data adapted from www.oas.org/CDMP/document/reglstrm/**jamaica**.ppt, Accessed March 24, 2006

4.8 ECOLOGY

4.8.1 TERRESTRIAL SURVEY

4.8.1.1 INLAND TERRESTRIAL

Inland terrestrial regions comprise two vegetation types: thorn savannah and dry limestone forest. The distribution of plants within this region appears to be a function of elevation and depth to bedrock.

The thorn savannah is found primarily on the Tarentum alluvial plain. Species such as dogwood (*P piscipula*) and rosemary (*Croton linearis)* were common plants along with wild poponox (*Acacia tortuosa*). Species diversity was low, with two species dominating the area: wild poponox and a stoloniferous grass. Bare areas were only in disturbed areas. The grass accounted for almost 100% coverage. The *Acacia* showed even distribution with specimens 2.5-3m on average. There was no continuous canopy in this zone. There was evidence of charcoal burning utilizing *Acacia*. The herb layer was under-represented. The avifauna observed was primarily observed in this region with nests observed in the *Acacia* plants.

Vegetation found in the dry limestone was more evident at the higher elevations and in areas where the substrate showed a change from red bauxitic soil to karstic limestone rock. Plants were mainly thin-boled with minimal leaf litter. Plants identified in this zone included bull thatch (*Thrinax parviflora*), red birch (*Bursera simaruba*), and climbing cacti. Red birch appeared to be the dominant plant in this zone.

4.8.1.1 NEARSHORE TERRESTRIAL

The vegetation along the Salt River in the vicinity of the main road is composed mainly of small, opportunistic species such as *Batis maritima* and *Allamanda sp*. These species are common along the sandy areas of rivers and inshore areas. A few *Pinus caribbea* (Caribbean Pine) are also found in this area.

The vegetation is also composed of stands of *Avicennia germinans* (Black mangrove), *Rhizopha mangle* (Red mangrove), *Typha domingensis* and patches of *Acacia sp*. on the nearshore banks. The Black mangrove is the dominant vegetation in this area, with healthy stands and tree heights of 4m to 6m. However, the stands of Red mangrove are also healthy in appearance, and reach

heights of 2m to 3m. The understory is poorly developed, with only one layer developed beneath the canopy. This layer is comprised mainly of smaller individuals of Black mangrove.

Along the inlet of the pier, the vegetation changes to homogenous stands of Red mangrove. These individuals are 6m to 8m in height, and are the dominant vegetation in this area. They act primarily as nursery grounds for fish, etc. and as resting and feeding places for crocodiles.

The vegetation in the river consists of large clumps of *Elodea sp*.

Table 4-4: Species Composition within the Area

Common Name	Species Name
Red Mangrove	*Rhizophora mangle^*
Black Mangrove	*Avicennia germinans^*
White Mangrove	*Laguncularia racemosa^*
Freshwater Fern	*Acrosticum aureum^*
Salt Wort	*Batis maritima*
Yellow allamanda	*Allamanda cathartica*
Caribbean Pine	*Pinus caribbea*
Reed	*Typha domingensis^*
Acacia	*Acacia tortuosa*
Bull thatch	***Thrinax parviflora****
Red cordia	*Cordia sebestena*
Cacti	*Stenocercceus sp.*
Rosemary	*Croton linearis*
West Indian Ebony	***Brya ebenus****
Pigeon plum	*Cocoloba diversifolia*
Maypole	*Agave sobolifera*
Red Birch	*Bursera simaruba*
Dildo Pear	*Stenocereus hysterix*
Bottle-cod Root	*Capparis flexuosa*
Mustard Shrub	*Capparis ferruginea*
Wild tobacco	*Pluchea carolinesis*
Seaside laurel	*Phyllanthus angustifolius*
Yellow Candle wood	*Cassia emarginata*
Susumber	*Solanum torvum*

Common Name	Species Name
Dumb Cotton	*Calotropis procrea*
	Sporobolus virginicus
Natal grass	*Rhynchelytrum repens*
Seaside Mahoe	*Thespecia populnea*
Burnwood	*Metopium brownei*
Water grass	*Commenlina elegans*
Guava	*Psidium guajava*
	Ipomea sp.
Guinea grass	*Panicum maximum*
Devils Horsewhip	*Achyranthes indica*
Nightshade	*Urechites lutea*
Milkweed	*Asclepias curassavica*
Almond	*Terminalia catappa*
Broomweed	*Sida acuta*
Wild caia	*Cleome viscose*
Strongback, red gal	*Morinda royoc*
Vervine	*Stachytarpheta jamaicensis*
	Ruellia tuberosa

*** Endemic**
^in river (More common in river mouth and adjacent marine area)

4.8.1.1 AVIFAUNA

A combination of literature review and in field survey was used to identify the avifauna of this area. The list provided in this document is a combination of those observed and those documented as being residents or transients. Twenty-four (24) species were identified during field surveys. The list includes the columbids which were common such as the common dove.

Only two local endemic birds, that are not dependent on forest habitats, were observed during the survey. Most of the birds seen in the survey are typical of a coastal wetland habitat.

Birds such as Wilson's Plover, Kildeer, Little Blue Heron, Cattle Egret and the Great egret were observed.

The area also has mangrove trees in which the saffron finch and the grass quit were seen. The proposed project will in no way affect the mangroves. No modification is contemplated and as such this reserve will be protected. Healthy mangrove seedlings were also seen in the area.

Table 4-5: Bird Species (Resident & Endemics) Identified within the Region

Common Name	Scientific name	Local name	Status
American Kestrel	*Falco sparverius*	Lizard Hawk /Killy-killy	R1
Antillean Palm Swift	*Tachornis phoenicobia*	Swift	R1
Bananaquit	*Coereba flaveola*	beeny, bird sugar bird	R1
Cattle Egret	*Bubulcus ibis*	Ticks bird, Gaulin	R1*
Common Ground Dove	*Columbina passerinus*	Ground dove	R1
Great egret	*Casmerodius albus*	Crane	R1*
Greater Antillean Grackle	*Quiscalus niger*	Cling cling	R1
Kildeer	*Charadrius vociferus*	Tell tale	R1*
Laughing Gull	*Larus atricilla*	Sea Gull	R1*
Little Blue Heron	*Ardea Herodias*	Blue Gaulin	R1*
Loggerhead kingbird	*Tyrannus caudifasciatus*	Loggerhead	R1
Magnificent Frigatebird	*Fregata magnificens*	Man-o- war Bird	R1*
Merlin	*Falco columbarius*	Pigeon hawk	R1
Northern Mockingbird	*Mimus polygottos*	Nightingale	R1
Sad Flycatcher	***Myiarchus barbirostris***	**Little Tom Fool**	**E1**
Saffron Finch	*Sicalis flaveola*	Canary	R1
Snowy Egret	*Egretta thula*	White Gaulin	R1*
Tricoloured Heron	*Egretta tricolor*	Gaulin	R1*
Turkey Vulture	*Cathartes aura*	John Crow	R1
White-crowned Pigeon	*Columba leucocephala*	Bald Pate	R1
Wilson's Plover	*Charadrius wilsonia*	Thick-billed Plover	R1*
Yellow-Crowned Night Heron	*Nycticorax violaceus*	Crab- Catcher	R1*
Yellow-faced Grassquit	*Tiaris olivacea*	Squit	R1
Yellow Warbler	*Dendrocia petechia*		R1

Note: Endemic species in bold.
Coastal birds with *
Most of the coastal birds observed, were seen in the mudflats and only one endemic bird was observed during the survey.

Table 4-6: Table showing the additional birds (excluding the birds from Table 4-5) observed during a survey of the surrounding areas including the area for the proposed development in 2004 and 2006

Common Name	Scientific name	Local name	Status
Mangrove Cuckoo	*Coccyzus minor*	Rainbird	R1
Smooth-billed Ani	*Crotophaga ani*	Tick bird	R1
Mourning Dove	*Zenaida auritia*	Long-tail Pea Dove	R1
Brown Pelican	*Pelecanus occidentalis*	Old Joe	R1*

4.8.1.1 OTHER WILDLIFE FAUNA

At least five species of birds were observed. Note that although a single crocodile was observed, crocodiles have frequently been seen in this area by several observers, so their abundance is given as common on that basis. A few seagrass beds were observed near the mouth of the river. In general, however virtually all the aquatic organisms were observed in the water at the edges of the river associated with the mangroves roots.

Only two species of reptiles were observed at the site, both are lizards and endemics, *Anolis grahami* and *Anolis lineatopus*. Both have wide distribution in Jamaica. Jamaica's largest reptile, the protected crocodile (*Crocodylus.acutus*) is known to inhabit areas within Portland Bight, however, none were observed during the surveys.

Other fauna observed were dragonflies, grasshoppers, snails, ants and flies. However, literature reviews indicated the likely occurrence of certain species of reptiles and amphibians generally within Portland Bight.

Insects are fairly well represented in the Portland Bight area, with butterflies and bees being the most obvious of the group. Butterflies observed included: the tropical silverspot (*Dione vanillae insularis),* the soldier (*Danaus eresimus*), the queen (*Danaus gilippus*), the Monarch (*Danaus plexippus),* the tropical Buckeye (*Junonia genoveva*), and the Julia (*Dryas iulia delila*). At least 27 different species of Lepidoptera (butterflies etc,) are known to exist in the area, representing at least 7 different families. More importantly is the ecological functions of these insects where they act as pollinators. Other insect's species included ants, beetles, stinkbugs, dragonflies, wasps and honeybees.

At least four species of the snake *Arrhyton sp* are known to exist in the Portland Bight area, three of which are endemic. None were observed *in-situ*. The snakes feed on other reptiles and amphibians such as *Anolis spp., Eleutherodactylus* adults and eggs as well as *Sphaerodactylus spp* (Gecko). Of the *Sphaerodactylus spp* one, not endemic, has a range extending to the study area.

In addition, at least six *Anolis spp* are suspected to occupy the area. Of these six species at least five are endemics with one species thought to be extinct.

Portland Bight is thought to have at least 15 species of amphibians, thus the potential exist for occurrences in the study area, and of these fifteen species twelve are endemic. Furthermore, nine of those species are *Eleutherodactylus spp* (frogs). No amphibians were observed in the field, but they are known to exist. Anecdotal evidence suggests the presence of the introduced species, *B. marinus*.

4.8.2 MARINE SURVEY

The proposed Salt River development is a coastal project, which will include marine frontage on the south coast of the island. While the development does not include any large stretches of sandy beaches, it will involve some modification of the foreshore and seafloor and there exists a potential for other marine related impacts through:

- . Recreational usage
- . Storm water Management
- . Waste Management
- . Environmental Management

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

4.8.2.1 STUDY AREA

The area for the marine assessment was selected using the mouth of the Salt River as the southern boundary and the Welcome Beach as the northern boundary (Plate 4-1). The seaward

limit was approximately 100 meters from the high water mark and this was determined based on the length of the tape used to lay the transects. The area studied also encompasses the site for the proposed seafloor modification.

While the study was confined to the immediate near shore and offshore vicinity of the proposed development site, determinations made for the marine environment at this location could not be definitively used to interpret the character and status of marine resources immediately adjoining the study area. This is due to the fact that the study area is the only such location in the immediate vicinity heavily impacted by a river (Salt River).

Plate 4-1: Demarcation of Salt River Marine Study Area

4.8.2.2 ASSESSMENT METHOD DESCRIPTION

4.8.2.2.1 Aerial Photo Interpretation

The marine assessment was initiated using photogrammetry[9] to remotely identify and determine the spatial distribution of marine seafloor characteristics, which can be discerned with these methods. These characteristics relate to colour, 3-dimensional form and texture patterns, which can be used by a suitably trained and experienced remote sensing technician to identify the various types of bottom substrates and marine benthic features and organisms attached permanently to the seafloor existing within Jamaica's waters. Vertical aerial coverage of the area for the year 1991 was accessed through the Survey Department and examined for the interpretation process. After the process of aerial assessments was completed, ground truthing was conducted to verify interpretations made during aerial photo-assessments.

4.8.2.2.2 Transects

A visual transect was conducted by two divers with slates, a 100 meter transect line, a 1 m^2 quadrat and an underwater still camera to facilitate information gathering. The transect was laid out perpendicular to the shore (Plate 4-2 below) and the quadrat used to evaluate the substrate composition at 5 meters intervals along the transect. This allowed for the categorization of the substrate into four general types:

- Rock/Rubble
- Coral
- Sand/Silt
- Algae

This categorization combined with the transect was expected to give an indication of the dominant types of benthic marine organisms living on the seafloor as well as a spatial distribution of hard and soft bottom types. Estimates of the percentage area of seafloor covered by the different types of substrate within the study area were obtained using the quadrat.

In addition all fish and other motile species observed along the transect were to be identified and estimates of their sizes and numbers made. Depth assessments were also conducted along the

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

transect at five meter intervals which facilitated the representation of a cross section using a linear scale estimated from the 1991 aerial photo scale reference (Plate 4-3 below).

Plate 4-2: Salt River Benthic Study Transect

Plate 4-3: Salt River Benthic Study (1991 aerial)

4.8.2.3 OCEANOGRAPHIC ASSESSMENT

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

Two approaches were adopted for the evaluation of the study's target oceanographic processes. Firstly, wave crest movement and patterns exhibited by the movement of turbid water within the study area, as shown on aerial photographs, were examined. This was done to obtain general water movement trends for the time at which the images were taken (usually before 9:00 am). Again, the 1991 aerial coverage of the area proved useful for this purpose. Secondly, average day and night time wind directions and speeds for the area were obtained from communications with technical officers at the Meteorological Service. This weather information was important in the evaluation of sea current movement, since a major driving force behind sea current movement is wind movement (Williams, 1997).

4.8.2.3.1 Limitations

Water visibility was the major limiting factor for the survey, with horizontal visibility being poor for the entire area assessed (less than two feet). This affected the ability of the survey team to adequately assess benthic and mobile species as such the substrate had to be determined using a feel method and mobile species were not observed. Consequently, the original objective of surveying several transects extending from the shoreline to a limit of 100 meter out to sea could not be done. Instead, the survey team opted to do one transect which ran from the high water mark to 100 meters offshore. The survey was conducted in a direction from land to the open sea.

4.8.2.3.2 Observations

Aerial Photo Analysis – Marine Observations:

The form, colour and texture patterns observed during aerial photo analysis of the study area as well as its immediate surroundings led to the conclusion that there were both hard and soft substrate areas within the area assessed. It was also noticed that the spatial distribution of these substrates defined areas characteristic of fringing coral reefs to the north and south of the study area (figure 2). It was also concluded that the study area would be composed of sediments mostly of terrestrial origin due to the direct effect of the discharge from the Salt River. This was supported

by the 1991 aerial photograph, which showed a plume of land-derived sediments exiting the mouth of the river and then being pushed southwards by the prevailing current (Plate 4-4). This plume significantly influences the overall sediment composition on the seafloor within the study area.

Plate 4-4: Prevailing Currents & Sediment Plume

4.8.2.3.3 Diver Observations

As can be seen from the table (Table 4-7) and graph below (Figure 4-10), 18 of the 20 quadrats assessed were dominated by sand. The sand was black and predominantly terrestrial based; mainly material swept down by the river. It consisted of silt and a combination of broken down shells from marine as well as fresh water organisms. Rock/Rubble was only dominant for the first 10 meters of the transect closer to the swash and intertidal zones and consisted mostly of large land derived aggregates that have been claimed by marine erosion (Plate 4-5). Algae was only recorded within the first five meters of the transect where it represented approximately five percent of the substrate coverage. No corals were observed along the transect and a general 'swim through' of the study area also confirmed this.

Table 4-7: Substrate Composition along Transect

	Percentage Coverage				
Distance (m)	**Sand/Silt**	**Rock/Rubble**	**Algae**	**Coral**	**Depth (m)**
5	0	95	5	0	0
10	20	80	0	0	0.1
15	100	0	0	0	0.3
20	100	0	0	0	0.5
25	100	0	0	0	0.7
30	100	0	0	0	1.0
35	100	0	0	0	1.1
40	90	10	0	0	1.1
45	90	10	0	0	1.0
50	100	0	0	0	1.4
55	100	0	0	0	1.7
60	90	10	0	0	1.9
65	95	5	0	0	2.1
70	95	5	0	0	2.3
75	85	15	0	0	2.6
80	95	5	0	0	2.9
85	95	5	0	0	3.1
90	95	5	0	0	3.4
95	100	0	0	0	3.6
100	100	0	0	0	3.7

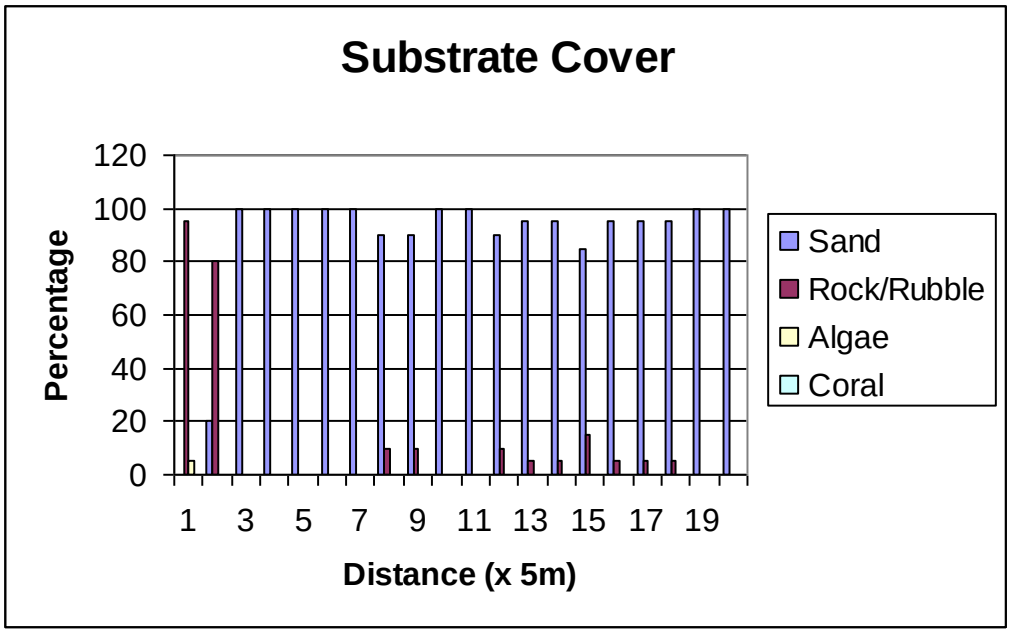


Figure 4-10: Percentage substrate cover along Transect

Plate 4-5: Rock and Rubble in swash zone

4.8.2.3.4 Algae

Eight species of algae were observed during the assessment of which two are *Enteromorpha* spp. (Plate 4-6)

Plate 4-6: Algae found at site

4.8.2.3.5 Fish and Other Mobile Marine Organisms

Twelve species of fish were observed during the marine assessment. The local fishermen gave anecdotal evidence of the area being populated by several brackish water fish species, the most common of which was the "Snook". Other species known to be in the marine waters include the grunt (*Haemulon* sp.), angelfish (*Holocentrus ascensionis*) and shad[10].

4.8.2.3.6 Adjacent Reef

The adjacent reef system is characteristic of reefs found on the south coast of Jamaica. A visual assessment (snorkel) of the fringing reefs to the south presented a list of marine species shown in table below (Table 4-8). Turtle grass was observed to be growing at a depth of 1.5 m to approximately 3.5 m, similarly manatee grass. Turtle grass was more abundant with larger size patches of pure stand, approximately 40-100% cover. Blade length was 24 cm on average. Manatee grass was also observed further away from the mouth of the river in less turbid waters.

Coral species found in adjacent reef areas included the brain coral (*Diplora* sp.), the mustard coral (*Porites* sp.) and the fire coral (*Millipora* sp.). The area was known to be dominated by the staghorn coral. However this was not observed. This may be partly due to ravages of past hurricanes which have decimated the species; they are very susceptible to wave action.

[10] 2005, Conrad Douglas & Associates Limited, Marine Assessment for Jamalco's Temporary Barge Docking Facility

Table 4-8: Fish, Invertebrates and Marine Plants Characteristic of the adjacent reefs

Common Name	Scientific Name
FISH	
Bluehead Wrasse	*Thalassoma bifasciatum*
Creole Wrasse	*Clepticus parrae*
Parrotfish (princess)	*Sparisoma*
Beaugregory Damselfish	*Stegastes leucostictus*
Bi- color Damselfish	*Stegastes. Partitus*
Three Spot Damselfish	*Stegastes planifrons*
Doctor Fish	*Acanthurus chirurgus*
Barracuda	*Syhyraena barracuda*
Gray Snapper	*Lutjaanus griseusr*
Schoolmaster	*Lutjanis apodus*
Silversides/Herrings	*Unidentified*
Mullet	*Mugil spp.*
Snook	*Centropomus sp.*
INVERTEBRATES - MOBILE	
Sea cucumber (Echinoderm)	*Holothuria exicana*
Mangrove crabs	*Aratus pisoni*
Blue Crabs	*Callinectes sapidus*
Ragged Sea Horse	*Bursatella leachii*
Unidentified Whelk	*Unidentified*
Feather Dusters	*Sabellid worm*
Mud-boring worm	*Arenicolid*
INVERTEBRATES - BENTHIC	
Brain coral	*Diploria* sp.
Fire coral	*Millipora alcicornis*.
Mustard Hill Coral	*Porites asteroides*
Lesser star coral	*Siderastrea radians*
Mussels	*Crassostrea rhizophorae*
Mangrove Tunicate	*Ecteinaacidia turbinata*
False Oyster	*Isognomon alatus*
PLANTS	
Y Branching Algae	*Dictyota* sp.
Green Algae	*Halimeda opuntia*
Red Algae	*Gracilaria tikvahiae*

Common Name	Scientific Name
Green Algae	*Chaetomorpha linum*
Green Algae	*Caulerpa sp.*
Green Algae	*Enteromorpha flexuosa*
Green Algae	*Enteromorpha intestinalis*
River Algae	*Potamageton sp.*
Turtle grass	*Thalassia testudinum**
Manatee grass	*Syringodium filiforme*
Seagrass	*Halodule beaudettei*

***in river (More common in river mouth and adjacent marine area)**

4.8.3 CONCLUSIONS

4.8.3.1 REEF STATUS

The area studied could not be classified as a reef (figure 1) but was for the most part a deposit area for materials brought in by both the Salt River and prevailing ocean currents (figure 4). The study failed to reveal the presence of both corals and other marine organisms. This is a direct effect of the poor visibility brought on by the high incidence of suspended particulate matter from the river discharge. This is, however, not a confirmation of the areas potential as organisms (especially mobile ones) may have been missed during the survey exercise.

The nature of the area does not promote a healthy reef structure, as the main requirements (stable substrate and relatively good light penetration) are absent. The health of a reef is usually defined by accessing the ratios of the dominant seafloor-covering organisms as an indicator. Healthy reefs are defined as those with a higher ratio of coral to algal cover (Hughes 1970's and 1990's). In the early 1970's, Jamaica's north coast reefs had an average live coral cover of 52%. Algae cover at the time was approximately 4% (Hughes 1970's). Studies conducted at the north coast in the 1990's revealed a significant change in the relationship, with live coral cover dropping to 5% while algae cover increased to 95% (Hughes, 1994). Factors such as land-based eutrophication of marine waters (contamination with nutrients), over fishing and tropical storm events have contributed to this drastic change (Woodley, 1998).

4.8.3.2 FRESHWATER INFLOW

The effect of freshwater inflows from the Salt River has resulted in low salinities (brackish water). This influences the type of marine flora and fauna that can survive in the area.

4.8.3.3 SUBSTRATE

The substrate (land based sediment and broken down shells) is characteristic of the location which is at the mouth of a river (Salt River) and receive particulate matter both from the marine and terrestrial environment.

4.8.3.4 ALGAE

The algae were only found in the extremely shallow regions (>0.1 meters deep) and are all typically found in nutrient rich brackish water. The Salt River is the major source of nutrients, brought down from the land it drains in south east Clarendon. The increased nutrient has led to the domination of the three species of algae recorded.

4.8.3.5 CURRENT MOVEMENT

Current movement was generally towards the west. Surface water current movement was determined to be a factor of wind movement. There was a gyre effect as a consequence of water movements within the bay and this resulted in the current being deflected to the south-east.

4.8.3.6 IMPLICATIONS FOR FUTURE DEVELOPMENT AT THE SITE

Any construction works within the study area will see minimal impact on marine resources determined to be at this location. More consideration should be given to the natural impacts (surge and waves from marine environment) as well as currents (marine and terrestrial) on any structures placed within the study area. Proper protective devices would be necessary and essential to the survival of any such structure. In addition, considerations would have to be given to the extent to which these structures would impinge on the movement of currents along the shoreline. Currents are known to transport sediments, which may be vital to the stability of any marine sediment bearing areas down current of any structure that may be deployed in its path.

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

4.8.4 PROTECTED AREA ENVIRONMENT – PORTLAND BIGHT

The proposed site is located within the Portland Bight area which is a designated protected area under the NRCA Act of 1991 and under the management of the non-governmental organization, Caribbean Coastal Area Management. Please see Plate 4-7 below.

It is not envisioned that this project will result in significant and irreversible negative impacts of the protected area. This will be discussed in detail in the Impact Identification and Mitigation sections of this report.

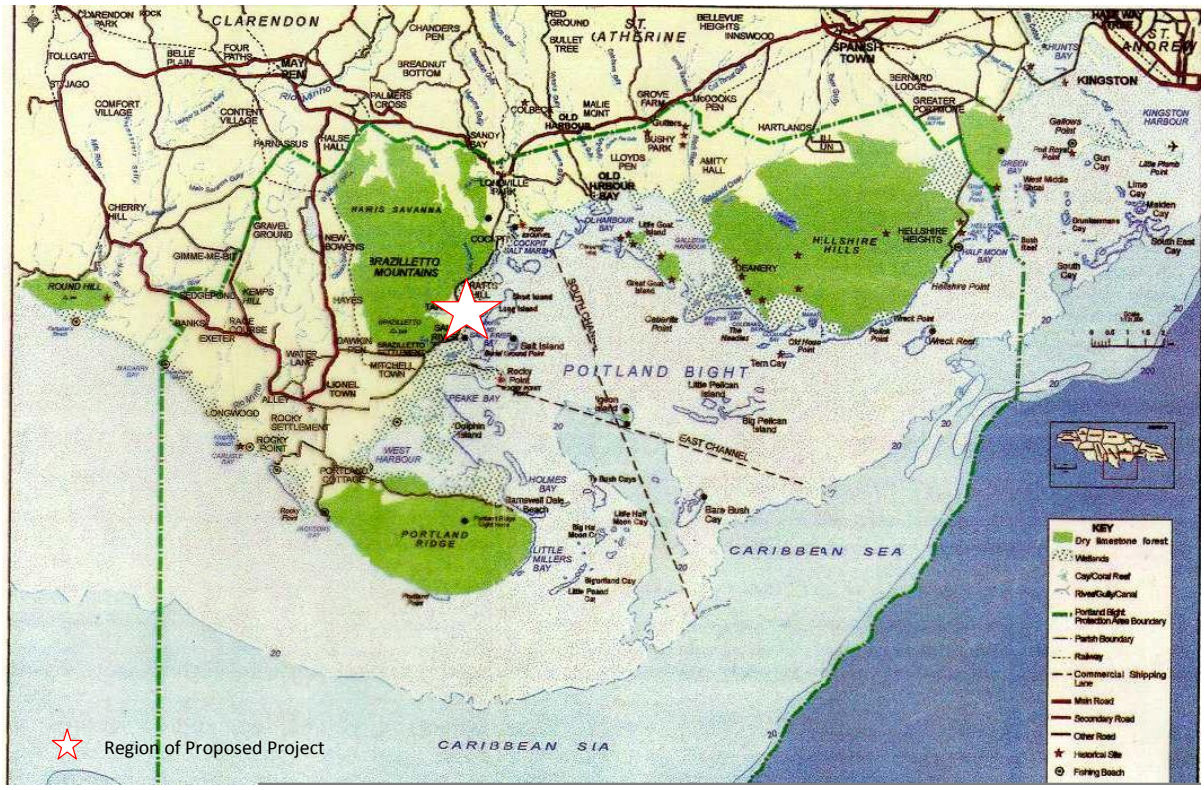


Plate 4-7: Portland Bight Protected Area (Source: www.portlandbight.com.jm)

5 LAND-USE

5.1 APPROACH & METHODOLOGY

To accurately represent the existing land use situation within the study region the following approach was taken:

(1) The use of the Land Cover/Use Classification Map produced by the Ministry of Agriculture (MOA).
(2) Field surveys incorporating regional observations and documentation of existing land usage. This provided verification (ground truthing) of the land use patterns depicted on the maps.

5.2 PRESENT LAND USE/COVER

The area under investigation is rural, and accordingly reflects the various land use/cover classifications. The land use classification types for the area, include, but are not limited to in descending order of coverage:

1. Coastal Wetlands
2. Brush
3. Deciduous Forest/Non Commercial
4. Industrial, Commercial and Institutional
5. Rural Residential
6. Recreational
7. Fishing Beach
8. Rivers

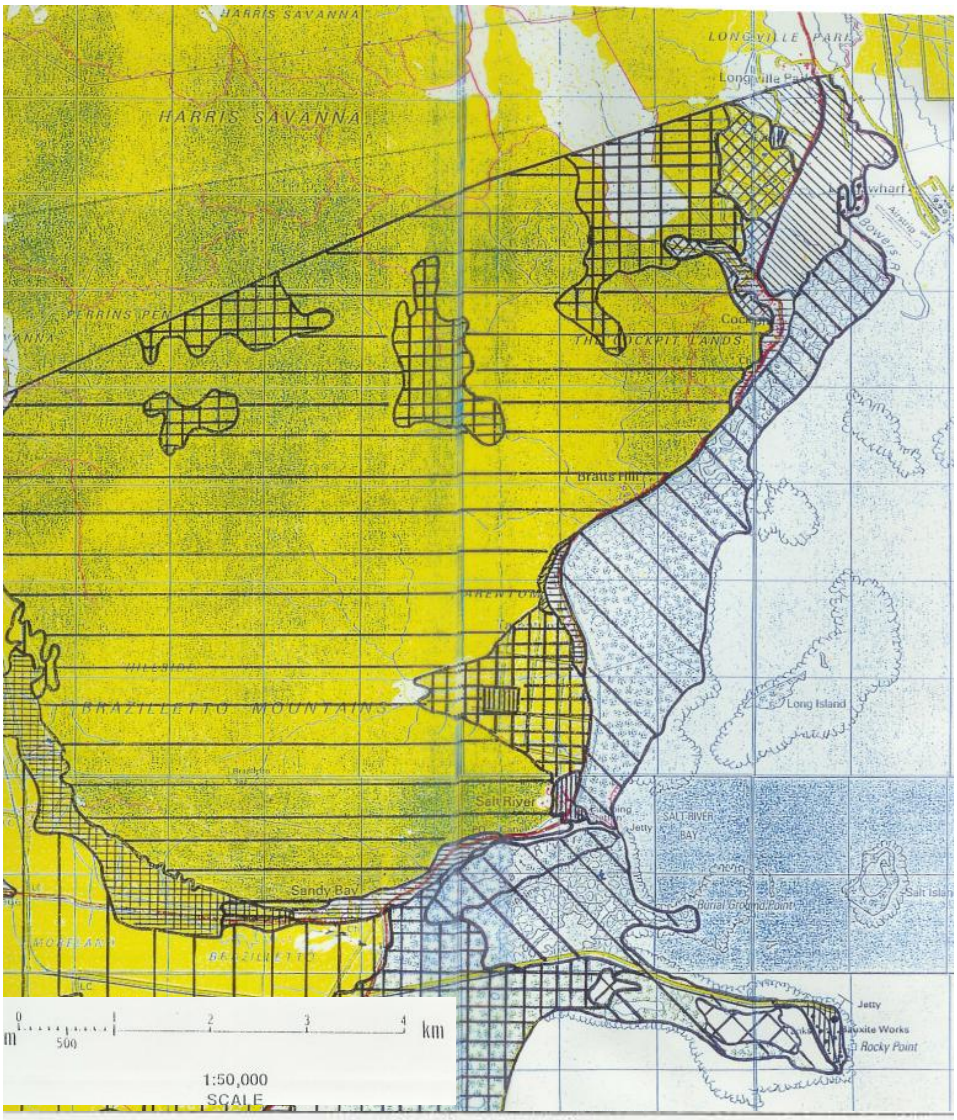


Plate 5-1: Land-Use within the Region

5.2.1 COASTAL WETLANDS

The coastal area is comprised of mangal forest and swamps.

5.2.2 BRUSH

The brush coverage consists mainly of cashew and cacti.

5.2.3 DECIDUOUS FOREST/NON COMMERCIAL

This land cover type provides a source of income for some residents as the vegetation is utilized for charcoal burning and lumber as well as bird shooting.

5.2.4 INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL

The industrial activities within the region vary in type but can be grouped as large-scale industries. The existing industries within the region include the following:

- JAMALCO alumina port located at Rocky Point
- Monymusk sugar factory located at Lionel Town and
- The Tarentum Industrial Zone (presently housing a coffee processing plant)

Although the bauxite plant and the sugar factory facilities falls outside of the enumeration district (study boundary) they may be include in the regional setting in order to give an insight into the level and type of existing industrial activities.

Commercial activities, like the residential development, are found along the main road of the various communities.

The institutional facilities within the region include schools, churches, post office, and police station.

5.2.5 RURAL RESIDENTIAL

The Residential development within the area is typical rural. The layout of the closest communities, Tarentum and Salt River, is linear along the major roadways. These communities are not well planned and represent sparse *ad hoc* residential settlements.

5.2.6 RECREATIONAL

The areas surrounding the Salt River community provide three basic forms of recreational activities, namely bird shooting by members of the Gun, ROD and Tiller Club, pleasure boating and swimming at Welcome Beach.

5.2.7 FISHING BEACH

One of the most prominent fishing beaches within the study area is located at Welcome Beach situated along the Salt River Bay.

5.2.8 WATER

The river found within the study area is the Salt River.

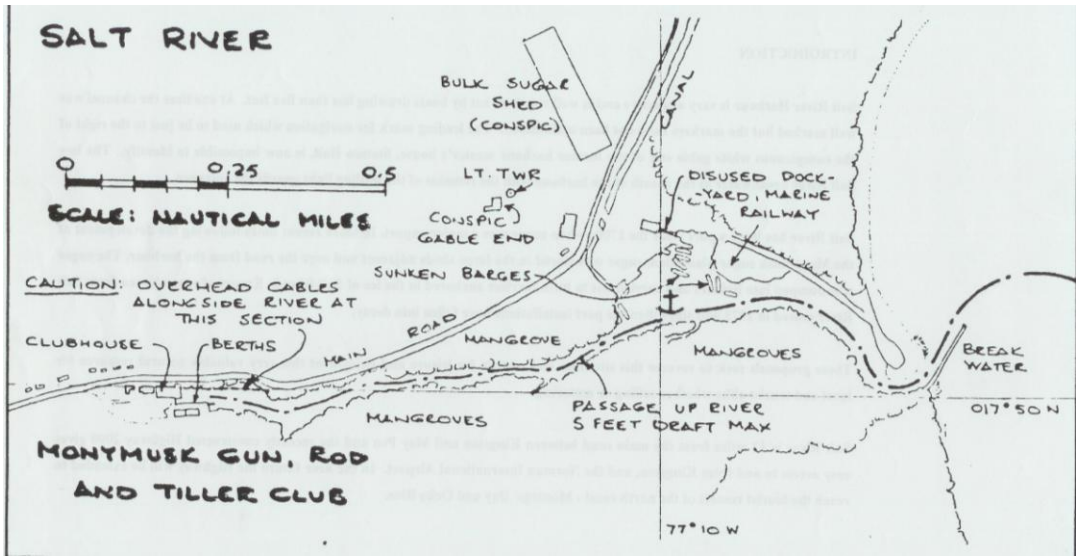


Figure 5-1: Schematic of Salt River Area

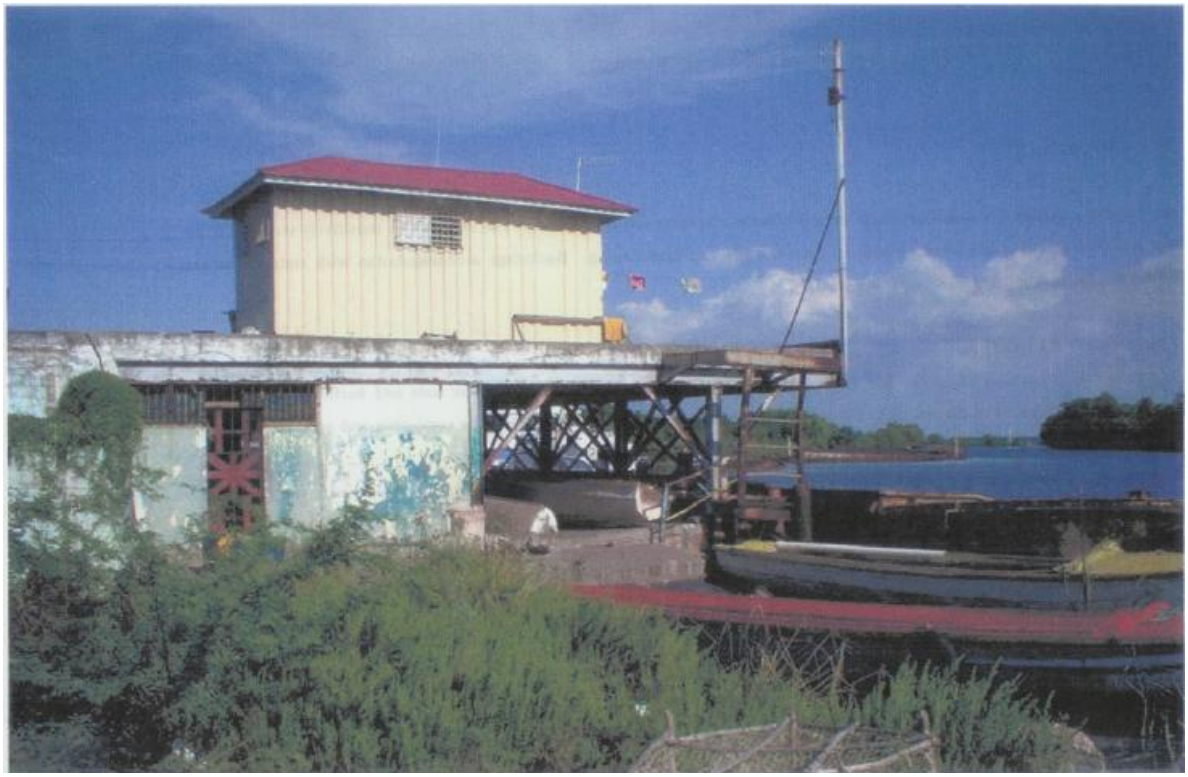


Plate 5-2: Existing Dock & wharf Building which will be demolished to allow for construction of the hotel. The fisherman's corner is in the foreground and the breakwater is in the far distance.

5.3 CULTURAL & HISTORICAL HERITAGE

According to information gleaned from the JNHT website, no heritage site is located within the Salt River area. The following outlines a list of Heritage Sites in Clarendon, none of which are in the Salt River area.

- St. Peter's Church (Alley)
- Portland Point Lighthouse
- Halse Hall Great House
- Milk River Spa
- Suttons Railway Station
- Four Paths Railway Station
- Claude McKay's Birthplace
- May Pen Clock Tower

Possible historic sites in the region include an old stone building on Salt River road which is not in the vicinity of the proposed project site. No known specific artefacts of an ethno-

archaeological significance have been retrieved or identified from the Salt River/ Tarentum / Braziletto area. Provisions will be made for retrieval or conservation in collaboration with the JNHT in the event that any cultural or historical artefacts are discovered during site preparation or construction activities.

Plate 5-3: Old Cut Stone building off Salt River Road

6 THE SOCIAL ENVIRONMENT

Social surveys, expert interviews and a literature review were undertaken to facilitate characterization of the demographic and socio-economic features of Salt River.

6.1 REGIONAL SETTING

The project area is located at Salt River (ED SE 48) with a total population of just over 400 persons and is located in a sparsely populated region of south eastern Clarendon (approximately 7,000 persons). The overall density is about 1 person per hectare. Seventy percent (70%) of Clarendon live in rural areas. There was a 57% increase in the total urban population of Clarendon for the period 1979-1991. The nearest fire station is located in May Pen. The nearest schools are Mitchell Town All Age/Primary and Bustamante High School in Lionel Town.

6.1.1 POPULATION CHARACTERISTICS

Table 6-1 shows the age/sex structure of the population in the immediate project area. As the table indicates, there were approximately 435 persons residing in the area in 1991. The table also indicates the numbers who are dependent on the local labour force. There were 183 dependents (<15 and over 65 years) or 42% of the population in the study area. For every two working people there are approximately 1.5 dependents. However, this burden on the working population is likely to be higher than this statistic implies since neither unemployed nor non-waged female work is calculated into the equation. In 1991, of the 62% of females who were 'economically inactive', 37% stated 'home duties' as their principal activity (Table 6-3).

As Table 6-2 indicates approximately 42% of the population had primary level education, while 37% had attained secondary level education.

Table 6-1: Population by Age & Sex – Salt River

POPULATION								
Youth Dependents 0-14		Labour Force 15-64		Old Age Dependents 65+		Sub-Total		Total
Male	Female	Male	Female	Male	Female	Male	Female	
72	90	132	120	10	11	214	221	435

Table 6-2: Population by Level of Educational Attainment – Salt River

Educational Level	**No.**	**%**
Nursery/Infant	14	3.2
Primary	181	41.5
Secondary	160	36.8
University	1	0.2
Other	2	0.4
None	69	16
Not Stated	8	1.8
Total	**435**	**100**

Table 6-3: Population 14 Years and Over by Economic Situation – Salt River

Economic Situation	**Male**	**%**	**Female**	**%**	**Total**	**%**
Worked	78	53	25	18.7	103	36.7
With Job and working	2	1.4	2	1.5	4	1.4
Seeking first Job	4	2.8	-	-	4	1.4
Other Seeking Work	11	7.5	-	-	11	3.9
Wanted work & available	1	0.7	-	-	1	0.4
Home Duties	-	-	65	48.5	65	23.1
Student	14	9.5	18	13.4	32	11.4
Retired	9	6.1	14	10.4	23	8.2
Disabled	3	2	2	1.5	5	1.8
Other	25	17	4	3	29	10.3
Not Stated	-	-	4	3	4	1.4
Total	**147**	**100**	**134**	**100**	**281**	**100**

6.1.2 WELCOME FISHING AND BATHING BEACH

The existing beach and its dilapidated facilities, particularly to the west of the old pier, are used by fishermen within the project area to mend their nets and berth their canoes. The proposed development envisages retaining this use in the same area and incorporating these activities into the overall feature of the hotel.

The Ministry of Agriculture, Fisheries Division, indicates that there are fifty-nine (59) registered fishermen on Welcome beach and eighteen (18) registered boats. There are no sanitary conveniences or gear houses on the beach. The development also proposes to improve berthing facilities as well as provide toilet and bathing facilities.

6.2 THE SURVEY

The area was surveyed according to Enumeration Districts. The boundaries of the Enumeration Districts are specified by the Statistical Institute of Jamaica (STATIN), and those surveyed are shown in the map below.

A total of thirty-two (32) survey instruments were issued. This number represents 5% of the households of those Enumeration Districts identified in the area of the proposed development. This represented the major communities of Mitchell Town, Portland Cottage and Salt River.

It was intended that each survey would represent one household. In this regard, no two surveys were issued to members of the same household. It was also only issued to adults and if possible at the time, specifically the heads of the households. Of the households surveyed there were 59 males and 58 females.

The location of the respective EDs is shown below (Figure 6-1). Appendix II shows the Survey Instrument administered.

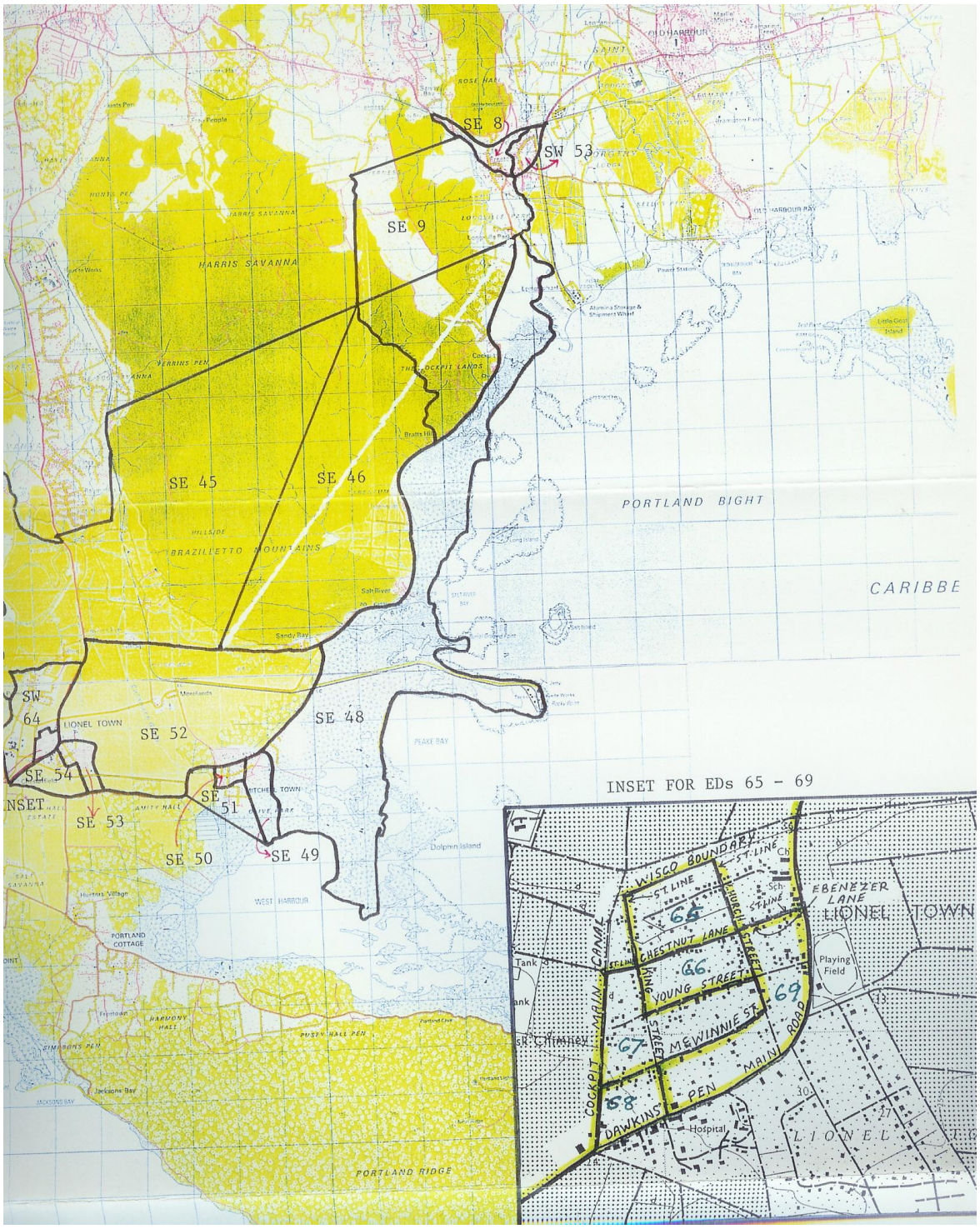


Figure 6-1: Enumeration Districts Surveyed in South Clarendon

6.2.1 DEMOGRAPHICS

Detailed data on the personal characteristics of the respondents interviewed can be seen in the tables and charts below:

The survey shows that the greater Salt River community had the most representation of respondents within the age range of 0-14 and 20-35. The age range least represented throughout the communities was 56+ (Table 6-4). The category presenting the amount of years respondents have lived in the community spans from 0 years to 20 or more years. Respondents who have lived in their communities for more than 20 years (25) were more prominent within this category across all 3 communities with 0-10 years being the lowest category.

Table 6-4: Gender of Respondents

Community ▶ / Parameter ▼	Salt River	Mitchell Town	Portland Cottage	TOTAL
GENDER				
Male	1	3	7	**11**
Female	8	5	8	**21**
AGE RANGE				
0-14	8	11	11	**30**
15-19	5	7	5	**17**
20-35	8	7	11	**26**
36-45	3	4	8	**15**
46-55	3	9	8	**20**
56-64	3	1	-	**4**
>65 Yrs	2	1	1	**4**
No Response	-	-	1	**1**
YEARS OF RESIDENCY				
0-5 Yrs	1	-	1	**2**
6-10 Yrs	-	-	-	**-**
11-20 Yrs	1	1	2	**3**
20+ Yrs	6	7	12	**25**
No Response	2	-	-	**2**

The number of persons who also live with respondents was asked to ascertain if the amount of individuals in the same household share the same socio-economic background.

The category was divided into male and female in addition to age range and employment status. The surveys show approximately an equal ratio of females to males living within the households of respondents in most communities. The majority of persons living with respondents were employed. Figure 6-2 show the gender characteristics of the persons living with respondents.

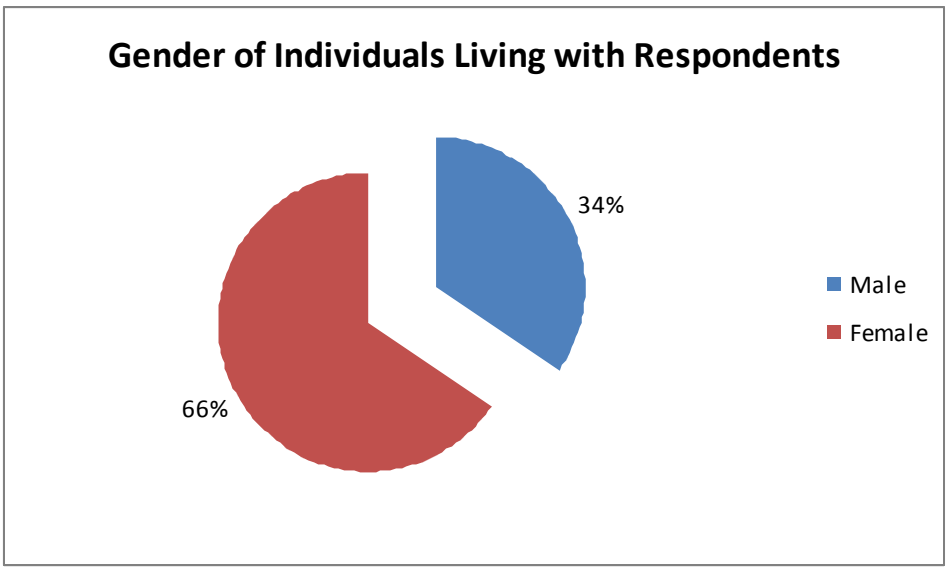


Figure 6-2: Gender of Individuals living with Respondents

6.2.2 SOCIAL AND ECONOMIC FINDINGS

6.2.2.1 HOUSING

The majority of respondents (72%) interviewed own a separate and detached house. Those owning semi-detached housing accounted for 9% of respondents interviewed (Table 6-5).

Table 6-5: Type of Housing Unit

Housing Type	Total
Separate House, detached	23
Semi-Detached	3
Part of a house(Apartment)	3
Part a commercial building	1

Housing Type	Total
Other	2
Total	**32**

Seventy-two percent (72%) of those interviewed had houses made of block and steel. Most of the Houses of respondents were made of Block and Steel and Concrete. Approximately 16% had accommodations made of wood, with 3% made of Stone or Brick.

Seventy-two percent (72%) had toilet facilities with water closets with 44% linked to a sewer. Respondents also have pit toilets which accounts for 28% of the survey population. Only 2 respondents identified with having shared toilet facilities including those linked to water closets and those not linked etc.

According to respondents surveyed, 33% of the respondents use indoor pipes as their main water source. Forty-seven percent (47%) use tanks with rainwater as their primary water source. Nine percent (9%) use outside private pipes.

The source of lighting of respondents varied between electricity and kerosene. Electricity accounted for 81% with 12.5% using Kerosene.

The ownership of houses by respondents is not uncommon as 66% owning their own shelter. Twenty-two percent (22%) utilise rented space, while another 6% had rent free accommodation.

6.2.2.2 EMPLOYMENT

The majority of respondents are unemployed. This is seen equally across all communities (Table 6-6). When asked about the employment status of people in their household, the survey revealed that 28 were in paid employment. Eight percent (8%) voiced the opinion that unemployment was a major concern. The stated occupations of respondents included fishermen, business, teachers, and farmers among others (Figure 6-3) With regards to the proposed development, 8 of respondents were of the view they would be able to secure job opportunities, while 3 were looking forward to establishing or expanding their small business, and 3 additional income. All respondents were of the view the area was in need of development.

Table 6-6: Employment status of individuals living with respondents

	Mitchell Town		Portland Cottage		Salt River		TOTAL
	Male	Female	Male	Female	Male	Female	
Paid Employment	2	3	7	7	1	4	**24**
Unemployed	1	1	-	1	-	4	**7**
No Response	-	1	-	-	-	-	**1**

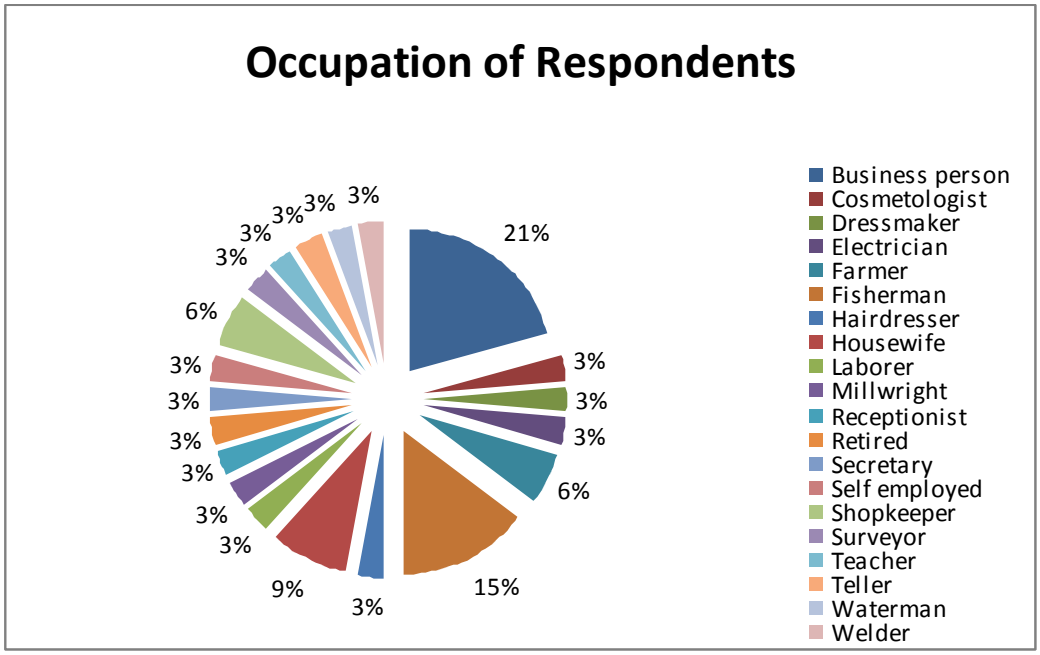


Figure 6-3: Occupation of Respondents

6.2.2.3 COMMUNITY VIEWS

When asked about their likes and dislikes of their respective communities, 19% of respondents expressed their satisfaction with the lack of crime and violence in their community, compared with 2% which found it a problem (Figure 6-4). Twenty-four percent (24%) of respondents also like quietness and friendliness of their communities. The three main dislikes voiced were; lack of

piped water/inadequate water at 26%, poor roads (19%) and mosquito infestation (14%) (Figure 6-5). Lack of regular transport was also expressed strongly with 13% of respondents of that view.

The main impacts expected from this development on the community are as follows:

- Jobs - 15
- Better standard of living - 6
- Water - 1
- Tourism - 3
- Increased opportunities - 2
- Better market - 1
- Opportunities for small businesses - 1
- Better roads - 1
- Exposure - 1

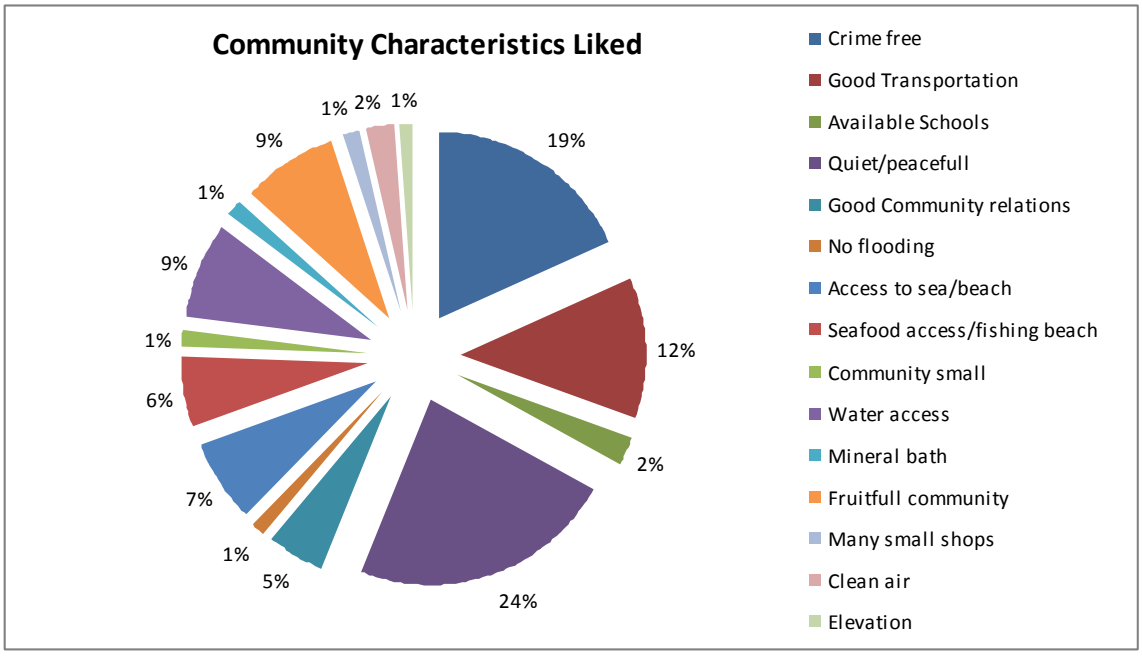


Figure 6-4: Characteristics Respondents Liked about their Community

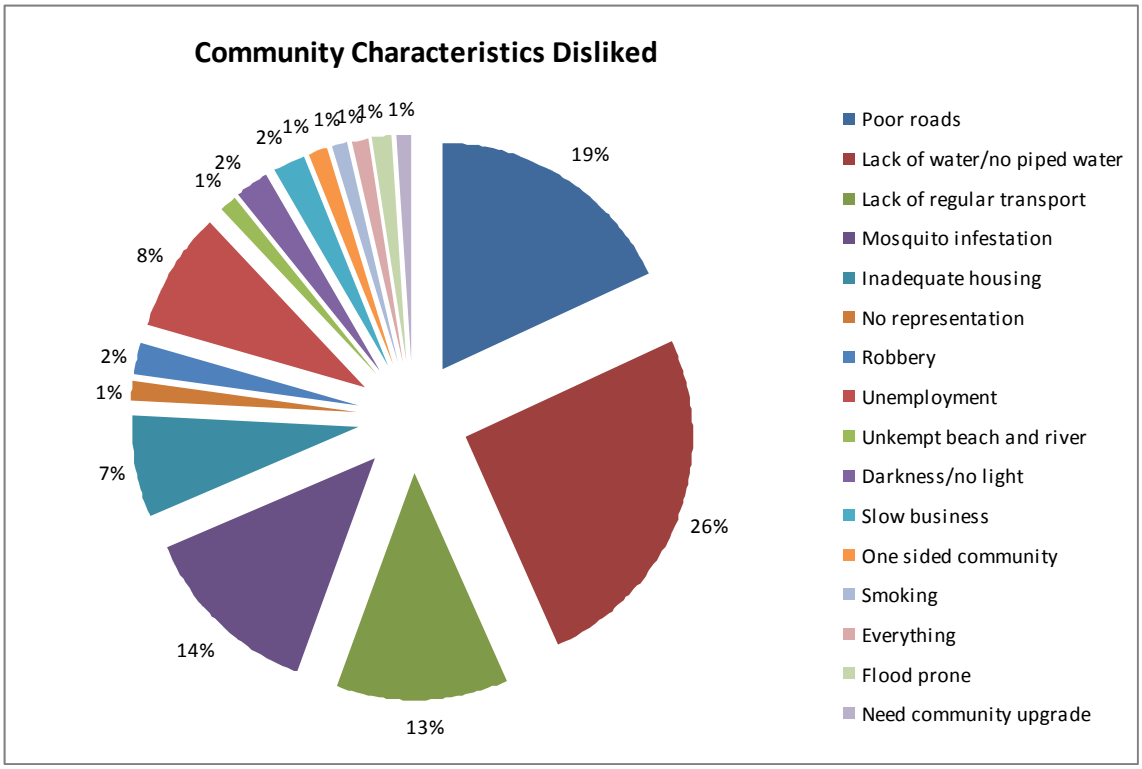


Figure 6-5: Characteristics Respondents disliked the most about their Community

6.2.2.4 AWARENESS OF PROJECT

Approximately one third (11) of respondents were aware of the proposed development, of which all were in favour of the project. Six were strongly in favour of this development.

Twenty-eight respondents were looking forward to the new development. The majority (16) thought it would provide an opportunity to gain employment. The construction and operation on the proposed development was not viewed by anyone as being a potential impact on the availability of any of their resources (e.g. water, light, aesthetics etc.).

Figure 6-6 below outlines the perceived benefits to be gained from the proposed development. Employment accounts for the majority with 45%.

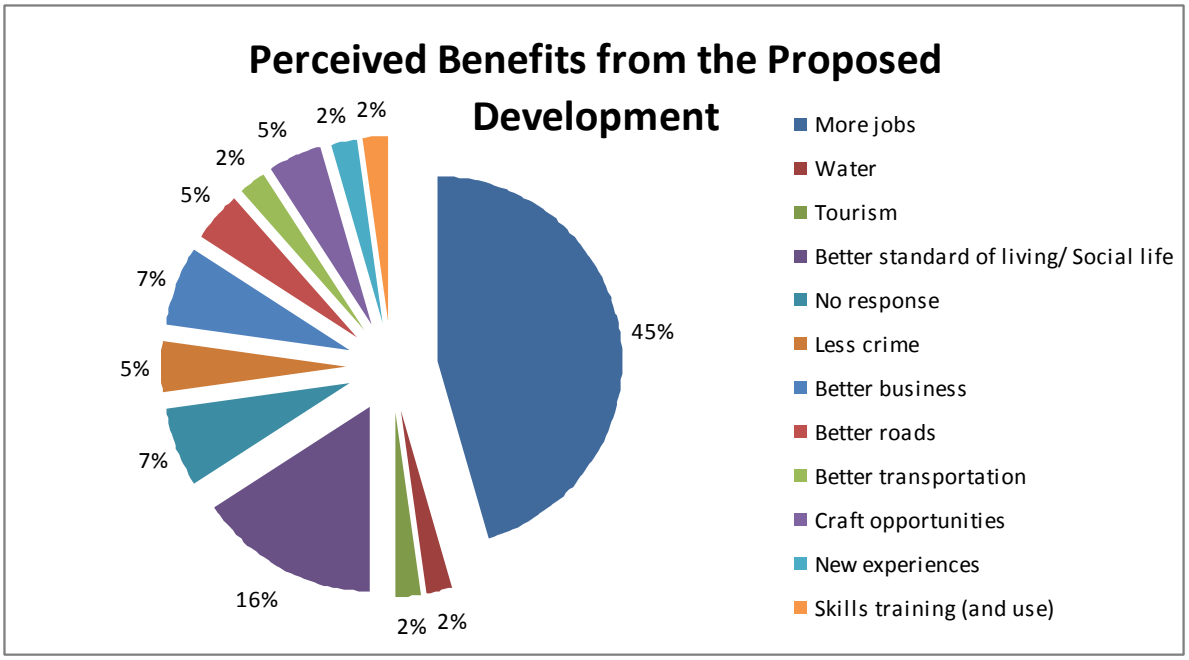


Figure 6-6: Perceived Benefits of the Development

6.2.2.5 ENVIRONMENTAL VIEWS

Twelve of the 32 respondents were of the view that the project would have an impact on the environment. The reasons included river and beach maintenance and better roads. Only four respondents identified a natural resource in the area where the proposed development will occur. All identified the water as the natural resource.

Only four respondents stated they use the general location for any activities. These activities were primarily fishing and swimming.

6.2.2.6 CULTURAL AND/OR HISTORICAL INFORMATION

At least 8 respondents identified a cultural or historical resource in the area where the proposed development will occur. Those identified were:

- Old Sugar storage and shipping area
- Arawak settlement
- Tower in Salt River Brazilleto

7 IMPACT IDENTIFICATION

7.1 INTRODUCTION

Potential negative and beneficial impacts are identified for the proposed development prior to, during and after construction activities.

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

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

7.2 PRE-CONSTRUCTION PHASE

7.2.1 MARINE & TERRESTRIAL IMPACTS

Endangered, rare and protected species such as crocodiles and sea turtles were identified in the *marine environment* of the area proposed for development; these species will not be affected during the project.

The species identified within the *terrestrial* study area are not endemic to the area and are no endangered, rare or protected, in addition, they will not be affected by the project.

These terrestrial animals are highly mobile and it is expected that fauna will move easily to nearby areas at the first signs of major disturbance. Species such as lizards and birds will co-exist with the operation, as they have done in most cases of disturbance by man.

Terrestrial flora, the mangrove stands will be protected by the design layout of the property incorporating this feature. In the event that mangrove stands are affected, the developers will work with NEPA to ensure that the affected mangrove area will be re-established and further protected, as it is envisaged that this ecology feature will be used as an attraction tours by the development.

7.2.2 LAND & LAND USE

The proposed development is in keeping with previous and existing land use.

7.2.3 WATER

No negative impact is anticipated in respect to ground water. However, there is the potential for surface run-off to affect the physical water quality by increasing or generating a sediment load.

7.2.4 SOLID WASTE

There are a number of sunken barges rotting in the estuary. However, these derelict barges do not impede sailing into the dock or along the estuary. Nevertheless, the developers will work with NEPA and any other appropriate agencies to safely remove and discard these barges. It is suggested that the barges be considered as a source of scrap metal and relinquished to the appropriate industries (local and/or international) once or if proper ownership of these barges can be established.

7.2.5 GASEOUS EMISSIONS

The use of heavy equipment powered primarily by diesel engines will produce gaseous emissions. However, these will be maintained to comply with emission standards.

7.2.6 SOCIO-ECONOMICS

There will be employment opportunities for several skilled and unskilled workers in the area. The developers will work with the area Councillors and local employment force unions to ensure that equal opportunity employment is realized for all interested parties in the area.

7.3 CONSTRUCTION PHASE

7.3.1 AIR POLLUTION (DUST CONTROL)

The potential for fugitive dust formation will be minimal during construction activities and will be associated with the movement of heavy vehicles and aggregate storage.

7.3.2 NOISE

The potential for loud noise during this phase can result from the use of heavy equipment and general construction activities. This could potentially become a nuisance to nearby settlements, however, this impact is assumed to be minimal as construction activities will not consistently (if at all) exceed regular work hours.

7.3.3 WATER QUALITY

Potential impacts on water quality within the project and surrounding areas will be addressed in two segments, as it relates to:

i. Surface Water
ii. Groundwater

7.3.3.1 IMPACTS ON SURFACE WATER

The potential impacts on surface water quality may arise from increased sediment loads from the stockpiling of construction aggregates and excavation activities during heavy rainfall. These impacts will be mitigated through bunding and berming and the use of settling ponds. Further, susceptible areas will be monitored on a regular basis in accordance with an approved monitoring plan. At a minimum, the turbidity of these susceptible water bodies will be measured to ensure the effectiveness of the mitigating or preventative measures.

7.3.3.2 IMPACTS ON GROUNDWATER

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

7.3.4 SOLID WASTE

Solid waste and topsoil will be stockpiled to be later used in the rehabilitation procedures whereas waste packaging materials will be disposed of through contracted disposal services at a NEPA approved landfill.

Solid waste generated during the construction of the pier will be minimized through the use of construction methods that will not create excessive disturbances in the marine environment. The findings of the marine survey have indicated that there is very little marine life in the proposed region. Regardless, conservative approaches will be undertaken in constructing the pier and the water quality of the area will be actively monitored in accordance with the NEPA approved monitoring plan. Also, if necessary, NGOs will also be consulted to ensure that thorough considerations have been made on the part of the developer in constructing the pier

7.3.5 GASEOUS EMISSIONS

The usage of heavy equipment, powered primarily by diesel engines, will produce gaseous emissions. However, if they are properly maintained they should operate within local standards for both particulate and noxious gas emissions.

7.3.6 SILTATION AND DISTURBANCE OF MARINE WATERS IN THE VICINITY OF THE PROPOSED PIER

There is the potential for impact on the marine environment primarily through the construction of the proposed pier facilities.

Siltation in this area will have minimal impact on marine life in the immediate vicinity as the marine assessment depicted an area of heavy siltation and sedimentation due to the proximity of the location to the mouth of the Salt River. If sedimentation due to construction is limited to that area then no significant impact will be realized.

7.3.7 SOCIO-ECONOMICS

There will be employment opportunities for skilled and unskilled workers in the area. As during the pre-construction, the developers will work with the area Councillors and local employment force unions to ensure that equal opportunity employment is realized for all interested parties in the area.

7.4 OPERATIONAL PHASE

The impacts that are likely to result from this phase of the development are related to the following:

- Solid Waste
- Sewage Treatment System
- Natural Hazards

7.4.1 SOLID WASTE

The potential exists for negative impacts related to solid waste disposal. If the established system does not take into consideration the many scenarios that could arise such as, strike action, no disposal area, inclement weather, etc. then problems may arise.

Potential problems could include, odours, visual aesthetic problems, infestation and health problems. Steps should be taken to prepare for any eventuality that may arise.

7.4.2 SEWAGE TREATMENT SYSTEM

Obvious negative potential impacts are easily recognised when dealing with sewage treatment systems. System failure, partial or complete can result in situations such as, odours, health conditions, infestation, and loss of use of facilities, uncontrolled releases, etc. Steps must be taken to ensure that human well being and the natural environment are protected.

7.4.3 NATURAL HAZARDS

Due to the susceptibility of the project area to natural hazard such as hurricanes and storm surges, consideration must be given to these possibilities. Potential impacts could arise from the destruction of buildings, damage to the sewage treatment system, damage to water storage facilities, etc.

7.4.4 SOCIO ECONOMICS

The proposed development is in a favourable position to generate and sustain stable levels of employment, increase foreign exchange earnings, wage levels, continued improvements in living standards and the quality of life in the study area. During both its construction and occupational phases the project will have a potentially positive impact on local economy and society. Additionally, the improved tourism product that will be provided will assist in the image building and offerings of our island.

7.5 IMPACT IDENTIFICATION MATRIX

Table 7-1: Impact Identification of the Proposed Development

	EIA Activities																
	Site Preparation				Construction								Operation				
	Site Surveying	Site Clearance	Site Access	Solid Waste Disposal	Materials Sourcing	Materials Transport	Construction Camp/Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Surfacing/Paving	Landscaping	Traffic	Solid Waste Disposal	Water Supply	Electricity Generation	Increased Migration
Physical Parameters																	
TOPOGRAPHY																	
GEOLOGY & GEOTECHNICAL																	
AMBIENT NOISE & VIBRATION																	
WINDS																	
RAINFALL																	
NOISE AND DUST																	
DRAINAGE																	
TEMPERATURE																	
NATURAL HAZARD VULNERABILITY																	
Ecological Parameters:-																	
TERRESTRIAL ECOSYSTEMS																	
VEGETATION																	
AVIFAUNA																	
OTHER FAUNA																	
AQUATIC & MARINE ECOSYSTEMS																	
VEGETATION																	
FAUNA																	
SENSITIVE HABITATS																	
Socio-Economic Parameters:-																	
AESTHETICS																	
LAND USE COMPATIBILITY																	
EMPLOYMENT																	
STRUCTURES/ROADS																	
WASTE MANAGEMENT																	
TRAFFIC ON THE ACCESS ROAD																	
INCREASED CRIME POTENTIAL																	
HAZARD VULNERABILITY																	
SOLID WASTE DISPOSAL																	
SEWAGE DISPOSAL																	

	EIA Activities																
	Site Preparation				Construction								Operation				
	Site Surveying	Site Clearance	Site Access	Solid Waste Disposal	Materials Sourcing	Materials Transport	Construction Camp/Materials Storage	Construction Works	Solid Waste Disposal	Sewage Treatment	Surfacing/Paving	Landscaping	Traffic	Solid Waste Disposal	Water Supply	Electricity Generation	Increased Migration
OCCUPATIONAL HEALTH & SAFETY																	

Key	
No Impact	
Minor Negative	
Major Negative	
Minor Positive	
Major Positive	

8 IMPACT MITIGATION

8.1 INTRODUCTION

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

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

- Ambient noise
- Fugitive dust formation
- Marine disturbance/silting of Salt River Bay due to marina rehabilitation and surface run-off

The following mitigation measures are recommended for the three phases of the proposed project.

8.2 PRE-CONSTRUCTION PHASE

8.2.1 GASEOUS EMISSION

The use of heavy equipment powered primarily by diesel engines will produce gaseous emissions, however, these will be maintained to comply with emission standards Therefore, a regular maintenance schedule will be developed in accordance with the manufactures' specifications and followed as much as is practicable.

8.2.2 SILTING OF SALT RIVER BAY

The endangered, rare and protected species such as crocodiles and sea turtles identified in the marine environment of the area proposed for development will not be affected during the project as the marine environs is heavily silted as shown by baseline studies.

Those species identified are highly mobile and it is expected that they will move easily to nearby areas the first signs of major disturbance.

8.3 FACILITY CONSTRUCTION PHASE

8.3.1 AIR POLLUTION (DUST CONTROL)

All trucks transporting aggregate to the site will be covered by tarpaulin, materials being stored on site will be bermed and wetted to prevent fugitive dust formation. A sprinkling/wetting regime will be employed for access roads to avoid and reduce the potential for dust formation.

8.3.2 GASEOUS EMISSIONS

The use of heavy equipment powered by diesel engines will produce gaseous emissions; however, these will be maintained to comply with emission standards. Therefore, an identical maintenance schedule, similar to that employed in the pre-construction phase, will be modified for existing machinery and developed for newer machinery being used for the construction phase in accordance with the manufactures' specifications. This schedule will be followed as much as is practical.

8.3.3 NOISE

An increase in the noise levels is unavoidable; hence the possibility of noise nuisance is highly probable (depending on the tolerance of the receptors). However, the developer will ensure that the noise level, though it maybe at nuisance levels, will not exceed hazardous levels of 75dba beyond the property boundary of the site. Further, this impact is assumed to be a minimum as construction activities will not consistently (if at all) exceed regular work hours, extending into nightfall when the propagation of noise through the open air is easier.

8.3.4 WATER QUALITY

Siltation in this area will have minimal impact on marine life in the immediate vicinity. The marine assessment shows an area of heavy siltation and sedimentation caused from the proximity of the location to the mouth of the Salt River Hence, the scale of any subsequent siltation and or sedimentation caused from construction activities is comparatively less to that caused by the Salt River.

The construction of the facility will employ standard methods used within the industry to prevent or reduce disturbance of surface waters. These methods include, but are not limited to, the provision of channelling of water, silt traps and settling ponds. Regardless, susceptible areas will be monitored on a regular basis in accordance with an approved monitoring plan. At a minimum,

the turbidity of these susceptible water bodies will be measured to ensure the effectiveness of the mitigating measures.

8.3.5 SOLID WASTE

Effective solid waste management of the construction phase will be achieved through regular collection and disposal to a NEPA approved disposal site.

8.4 OPERATIONAL PHASE

8.4.1 SEWAGE TREATMENT SYSTEM

Based on site assessment, the sewage treatment system proposed for the development is a Bio-digester Septic Tank (BST) followed by a tertiary post treatment system consisting of a Reed Bed. The land area designated for the treatment system is large enough to accommodate the system and the slope of the area will allow for gravity flow through the system. The proposed system will allow for primary, secondary and tertiary treatment before final disposal to the mangroves onsite. It will also meet the current sewage effluent standards set by the National Environment and Planning Agency (NEPA) and the Water Resources Authority (WRA).

The BST will be designed to treat 285 m^3 of wastewater over a six day retention period. It is therefore proposed that two BSTs will be installed, each having a capacity of 150 m^3.Each phase will have its own sewage treatment facility, and the design previously described will apply to both phases

8.4.2 MARINA FACILITIES

The provision of services such as fuel for boats berthing at the pier will require the training of staff in waste spill, handling and disposal, as well as the enforcement of standard operating procedures.

8.5 IMPACT MITIGATION MATRICES

Table 8-1: Impact Mitigation Matrix (Pre-Construction Phase)

	Proposed Mitigation Measures													
	Detailed Topographic Surveys	Effective Site Management	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Installation of Sediment Traps	Security & Fencing	Positive Impact No Mitigation	Community Relations	Flora & Fauna Relocation
Impacts - Preconstruction Phase														
Clearing of Site														
Levelling of Site														
Transportation of														
Increase in Noise														
Increase in Dust														
Disturbance of flora and fauna														
Aesthetics														
Increased Traffic														
Increased Employment														
Road Wear														
Increased Sedimentation														
Change in the Natural														
Solid Waste Generation														
Disturbance of Wetland														
Increased Earning														
Traffic Inconveniences														

Key	
No Impact	
Minor Negative	
Major Negative	
Minor Positive	
Major Positive	

Table 8-2: Impact Mitigation Matrix (Construction Phase)

	Proposed Mitigation Measures															
	Detailed Topographic Surveys	Phasing of Building Plans	Scheduling of Construction Activities	Waste Management Plan	Regular Solid waste collection	Placing of Solid waste Receptacles	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Landscaping Measures	Effective Site Management	Security & Fencing	Installation of Sediment Traps	Scheduling of Heavy Vehicles	Positive Impact No Mitigation	Community Relations
Impacts - Construction Phase																
Increased Employment																
Levelling of Site																
Transportation of Construction Material																
Increase in Noise																
Increase in Dust																
Occupational Health & Safety Concerns																
Aesthetics																
Increased Earning Potential for Community																
Increased Traffic																
Road Wear																
Increased Sedimentation of Coastal Waters																
Change in the Natural Drainage Patterns																
Solid Waste Generation																
Sewage Disposal																
Disturbance of Wetland Communities																

Key	
No Impact	
Minor Negative	
Major Negative	
Minor Positive	
Major Positive	

Table 8-3: Impact Mitigation Matrix (Operation Phase)

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

Key	
No Impact	
Minor Negative	
Major Negative	
Minor Positive	
Major Positive	

9 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

9.1 INTRODUCTION

An Environmental Management Plan (EMP) is necessary for this project, particularly during the operational phase of the project. The primary objective of the EMP is to ensure that the project complies with the terms and conditions of the National Environment and Planning Agency and other applicable and relevant Authorities. The plan will provide guidance in the following areas:

1. Training of managers and staff
2. Solid waste handling and disposal
3. Hazardous material storage and disposal
4. Sewage treatment and disposal
5. Natural Hazards Management

As required or as necessary, active environmental monitoring will be undertaken to provide quantitative information on the state of the environment as it relates to the phases of the project.

Areas of concern are:

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

9.2 EMERGENCIES: RESPONSE, PREVENTATIVE MEASURES & CONTINGENCY PLANS

9.2.1 NATURAL HAZARD MANAGEMENT

It is necessary to develop a hazard response plan to offset the worst effects of hurricanes on the project area. This plan will be prepared as a separate document on the advice from the Office of Disaster Preparedness Emergency Management (ODPEM).

Losses due to hurricanes can be reduced through an effective response plan. The principal features of such a plan are:

- Comprehensive risk assessment based on historical precedent and vulnerability of the site. Distribution of occurrences, frequencies of wind strengths and direction, and frequencies of storm surges.
- Appropriate preventative design and engineering (e.g. structures built to withstand hurricane force winds etc.)
- Public awareness and staff training in disaster response
- An effective national warning system

9.2.2 OPERATIONAL HAZARD MANAGEMENT & SAFETY

A clearly defined emergency response and preparedness policy will be developed and brought to the proposed project. An effective response is seen as the direct outcome of quality environmental management and comprehensive training and awareness of safety procedures. The principal objective of emergency preparedness is to localize accidents, and if possible contain and minimize them.

9.2.2.1 RESPONSE PLAN

Taken into consideration that the pier is to be rehabilitated, this report can only provide systems and general procedures necessary to effectively respond to emergencies.

The proposed development will have an Emergency Response Plan, which will provide guidelines to allow for flexible response to a range of potential circumstances. The plan would include:

- Chain of command and coordination procedures
- Lines of communication
- Means of obtaining needed information and assistance

Copies of the plan or relevant portions will be strategically located at vantage points across the property to allow for immediate access.

All employees will receive safety and emergency response training as a part of the initiation process.

9.2.2.2 FIRE SAFETY

All water stored on site for both domestic and potable use will be piped into a fire response system. This will involve connections to fire hydrants and fire hoses, which will be distributed across the project area to assist in the event of a fire emergency.

Specialized fire fighting equipment will be provided as necessary.

9.3 MONITORING PLAN

The Monitoring Plan to be devised for the development should be implemented during the pre-construction and construction phases of the project. Monitoring involves the observation, review and assessment of onsite activities to ensure adherence to regulatory standards and the recommendations made to reduce negative impacts. The plan must be comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies based on a mutually agreed frequency. It is recommended that a minimum monthly monitoring report be submitted to NEPA.

The monitoring report will include at a minimum:

- Raw data collected
- Tables/graphs (where appropriate)
- Discussion of results with respect to the development in progress, highlighting parameters which exceed standards
- Recommendations

- Appendices with photos/data, etc.

At a minimum, the following activities will be monitored in the various phases:

9.3.1 PRE-CONSTRUCTION PHASE MONITORING

- During site clearing activities, those trees that will be saved and incorporated into the development must be identified and protected. The plants to be retained should be flagged, and if necessary fenced. It is suggested that the developers assess a monetary value to be placed on each plant, for which the contractor will be made liable. Should the contractor damage or remove a flagged tree, the penalty should be assessed. An inventory and map (if applicable) of all trees to be retained must be developed. (Weekly Monitoring)
- Where identified, endemic and rare species should be preserved in place or collected for transplanting (As Observed)
- Stockpiles of soil and vegetative debris generated during site clearing activities should be monitored and maintained to eliminate generation of fugitive dust. (Daily Monitoring)
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

9.3.2 CONSTRUCTION PHASE MONITORING

- Sewage - Ensure that temporary portable chemical toilets are available for construction personnel and that the contents are disposed by an approved waste hauler in an appropriate waste disposal facility. (Weekly Monitoring)
- Sand/Marl/Aggregate Supply - Routinely monitor sourcing of quarry materials to ensure supplier is obtaining supplies from licensed operations. (Monthly Monitoring)
- Solid Waste Management - Ensure that solid waste management plan is prepared, and that workers are aware that no solid waste material should be scattered around the site. Monitor availability and location of skips/dumpsters. (Weekly Monitoring)
- Monitor the disposal of refuse to ensure that skips/dumpsters are not overfilled. (Weekly Monitoring)
- Routine collection of solid waste for disposal must be implemented, and disposal monitored to ensure use of approved disposal facilities. (Weekly Monitoring)

- Exposed soil areas must be monitored to determine potential for erosion, silting and sedimentation particularly during storm events. (Weekly Monitoring)
- If erosion, silting or sedimentation is a potential or occurs, immediate steps must be taken to negate the impact on the coastal waters and other receptors where applicable. (As Needed)
- Equipment staging and parking areas must be monitored for releases and potential impacts. (Weekly Monitoring)
- If any cultural heritage resources are unearthed during construction, activities should be stopped and an Archaeological Retrieval Plan implemented. (As Needed)
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

9.3.3 OPERATION PHASE

- Sewage - Monitor effluent quality periodically to determine compliance with regulatory standards and appropriateness for use as irrigation water and or flushing to the salina/mangrove swamp. (Monthly Monitoring or as determined by regulatory standards)
- Solid Waste - Monitor solid waste skips/dumpsters and removal contractor to ensure proper waste handling and disposal. (Weekly Monitoring)
- Drainage - Regular inspections of drainage systems should be performed to ensure that the drains remain clear of blockages to safeguard against flooding or damage to salina/swamp/marine environment. (Monthly Monitoring).

10 REFERENCES

Adams, C.D. 1972. *Flowering Plants of Jamaica*. University of the West Indies

Cornish, V. 1908**.** The Jamaican earthquake (1907). The Geographical Journal 31(3), 245-271.

Downer and R. Sutton, 1990. *Birds of Jamaica – A Photographic Field Guide*. Cambridge University Press

Horsfield, W.T. 1972**.** A late Pleistocene sea level notch, and its relation to block faulting on the north coast of Jamaica. *Journal of the Geological Society of Jamaica*, **12**, 18-22.

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

Mines and Geology Division 1974. *Jamaica 1:50 000 Geological Sheet* 8.

Shepherd, J.B. & Aspinall, W.P. 1980. Seismicity and seismic intensities in Jamaica, West Indies: a problem in risk assessment. *Earthquake Engineering and Structural Dynamics* 8, 315-335.

Smith Warner International Ltd. 1999. Storm Surge mapping for Montego Bay, Jamaica. USAID-OAS Caribbean Disaster Mitigation Project.

Williams D. D., 1997. The Oceanography of Kingston Harbour, A Tropical Polluted Embayment. M Phil thesis UWI 226pp

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

APPENDICES

Appendix I: Approved Terms of Reference

HERITAGE BAY

DRAFT TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT - CONSTRUCTION OF A HOTEL AND MARINA IN SALT RIVER BAY, CLARENDON

DRAFT TERMS OF REFERENCE

The Environmental Impact Assessment will:

1. Provide a complete description of the existing site proposed for development. Detail the elements of the development, highlighting areas to be reserved for construction and the areas which are to be preserved in their existing state.
2. Identify the major potential environmental impacts and issues of concern through the presentation of baseline data, which will include natural, social, cultural and health considerations.
3. Assess public perception of the proposed development.
4. The development will also be evaluated in the context of the area being in a declared protected area and a designated RAMSAR site.
5. Outline the Legislations and Regulations relevant to the project.
6. Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
7. Identify mitigation action to be taken to minimize or eliminate adverse impacts and quantify associated costs and options for the same.
8. Design a Monitoring Plan to evaluate the impact of the development during and after the construction phase and to monitor the implementation of the approved mitigation strategies, which should ensure that the mitigation plan is adhered to.
9. Describe the alternatives to the project that could be considered at that site inclusive of the No Action alternative.

A thorough Environmental Impact Assessment will be carried out, with the following tasks being undertaken:

Task #1. Description of the Project

The project is to be implemented in two phases as outlined in the introduction. Each phase will be described as follows.

A comprehensive description of each phase the project will be provided, noting areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment that also includes risks associated with wildlife (crocodiles) on the proposed development.

The areas to be preserved will also be evaluated to determine if they will be enough to perform

the values and functions necessary for the continued health of the ecosystem that will be affected.

Proposed landscaping activities at the site will be done using species found naturally in the area and any species identified as invasive will not be included in the landscape plan, additionally, any existing species identified as invasive will be removed from the project area.

The description of each phase will include the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post construction plans. We will also include maps, diagrams, photographs and other appropriate visual aids where appropriate.

Task #2. Description of the Environment

Environmental Science and Technology Limited will generate baseline data, which will describe the study area as follows:

i) physical environment

ii) biological environment

iii) socio-economic and cultural constraints.

The methodologies employed to obtain baseline and other data will be clearly detailed in the Report.

Baseline data will include:

(A) Physical

i. a detailed description of the existing **geology** and **hydrology**. Special emphasis will be placed on storm water run-off. This includes the dynamics of the existing storm water flow and modelling of what is proposed.

ii. drainage patterns, effect on groundwater and availability of potable water. Any slope stability issues that could arise will be thoroughly explored.

iii. **Water quality and quantity** of any existing wells, ponds and any other standing water, rivers, streams or coastal waters in the vicinity of the development. Quality Indicators will include, at a minimum, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates, phosphates, faecal coliform, and suspended solids.

iv. Climatic conditions and air quality in the area of influence including particulate emissions from stationary or mobile sources, NOx, SOx, wind speed and direction, precipitation, relative humidity and ambient temperatures,

v. Noise levels of undeveloped site and the ambient noise in the area of influence.

vi. Existing, obvious sources of pollution and extent of contamination

vii. Availability of solid waste management facilities.

(B) Biological

ESTECH will present a detailed description of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, wetland and protected or endangered species. Migratory species will also be considered. If necessary, micro-organisms will be considered in order to obtain an accurate baseline assessment. Generally, species dependence, niche specificity, community structure, diversity, population estimates and population needs will be considered.

(C) Socio-economic & cultural

ESTECH will explore present and projected population; present and proposed land use; planned development activities, issues relating to squatting and relocation, community structure, employment, goods and services including health care providers and facilities; recreation; public health and safety; cultural peculiarities, aspirations and attitudes. The historical importance and the impact on fisher folk of the area will also be examined.

ESTECH will also conduct a social survey to ascertain public perception of the proposed development. The survey, design and methodology will be outlined, and the raw and analyzed data obtained included in the Report. The survey design should benefit from prior NEPA/EHU approval.

Task #3 - Legislative and Regulatory Considerations

We will outline the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include at minimum, the Watersheds Protection Act, the Forestry Act, the Local Improvement Act, the Clean Air Act, the NRCA Act, the Housing Act, the Town and Country Planning Act, the Public Health Act, Beach Control Act, Water Resources Act, Jamaica National Heritage Trust Act, National Solid Waste Management Act, Building Codes and Standards, Development Orders and Plans. In addition, international conventions regarding wetlands and marine pollution as well as other environmental sites which are of international importance will also be included in the examination of the legislation.

Task #4 - Identification of Potential Impacts

ESTECH will seek to identify the major environmental and public health issues of concern and indicate their relative importance to the design of the resort. Potential impacts will be identified in relation to, (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- landscape impacts of excavation and construction
- loss of natural features, habitats and species by construction and operation
- pollution of potable, coastal, surface and ground water
- Air pollution

- capacity and design parameters of proposed sewage treatment facility.
- socio-economic and cultural impacts.
- risk assessment
- noise
- solid waste as well as oily wastes from boats
- the carrying capacity of the proposed site
- the minimum environmental needs of the area's ecosystem
- the minimum environmental needs of the area's wildlife interaction
- shoreline protection
- environmental public health including air pollution, noise and solid waste.
- **Coastal Areas**: Issues such as Coastline stability, coral reef, mangrove and wetland, seagrass impacts, unique coastal environments, nutrient loading in coastal waters and impact on the various types of fishing practiced in the area will also be examined.
- **Protected Areas - Sites located within and adjacent to areas listed as protected or as having protected species**: The impact of the development on the RAMSAR designated protected area will be highlighted.
- Special consideration will also be given to any possible effect on protected species and habitats, during the operational phase of the development, for example, offshore cays and mangroves wildlife interaction.

Distinction will be made between significant positive and negative impacts, direct and indirect, long term and immediate impacts. Impacts will also be characterized by their avoidability and reversibility. We will characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. Project activities and impacts will be represented in matrix and written forms with separate matrices for pre and post mitigation scenarios.

Task #5 Mitigation

As part of the preparation of the Report, ESTECH will prepare guidelines for avoiding or reducing as possible, any adverse impacts due to proposed usage of the site and utilization of existing environmental attributes for optimum benefit. We will examine several options for mitigation measures, and quantify and assign financial and economic values to mitigating methods wherever possible.

The impact mitigations will be assessed to ensure that the post mitigation status is acceptable in the context of a Protected Area.

Task #6 - Monitoring

A plan to evaluate and monitor the implementation of the mitigation generally, and project

impacts during construction and occupation/operation of the facility specifically, will be designed. An Environmental Management Plan for the long term operations of the site will also be prepared.

An outline monitoring programme will be included in the EIA, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development. At the minimum the monitoring programme and report will include:

1. Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.
2. The activity being monitored and the parameters chosen to effectively carry out the exercise.
3. A description of the physical, biological, socio-economic and cultural findings.
4. The methodology to be employed and the frequency of monitoring.
5. The sites being monitored, which will include a control site where no impact from the development is expected.
6. Frequency of reporting to NEPA
7. The Monitoring report will also include, at minimum:
8. Raw data collected, with tables and graphs where appropriate
9. Discussion of results with respect to the development in progress, highlighting any parameter(s), which exceeds the expected standard(s).
10. Recommendations
11. Appendices of data and photographs if necessary.

Task #7 - Project Alternatives

We will examine alternatives to the project including the no-action alternative. This examination of project alternatives will incorporate the use history of the overall area in which the site is located and previous uses of the site itself. Rigorous evaluation will be done concerning alternative sites, effecting the preservation of Protected Areas or species within the proposed project area.

All findings will be presented in the **EIA report** and will reflect the headings in the body of the approved TOR, as well as references. Thirteen hard copies and an electronic copy of the report will be submitted to the National Environment & Planning Agency. The report will include appendices with items such as maps, site plans, the study team, photographs, and other relevant information.

Appendix II: Socio-Economic Survey Instrument

ENVIRONMENTAL SCIENCE AND TECHNOLOGY LIMITED

SURVEY INSTRUMENT

Heritage Bay Hotel and Marina in Salt River Bay, Clarendon

Social Impact Assessment

Community _____ ED | | | | Gender M | | F | |

_____

1. How long have you lived in the community? _____
2. How many people live in this household? M | | F | | Total | |
3. How old are they?

Age Range	#
0-14	
15-19	
20-35	
36-45	
46-55	
56-64	
65 and over	

4. How many persons are employed? _____
5. How many persons are unemployed? _____
6. Are you in paid employment? Yes No
7. If yes, what is your occupation?

Community Profile

8. What are the **three** main things that you **most like** about living in this community?
   I _____

   II _____

III _____

9. What are the **three** main things that you **least like** about living in this community?

I _____

II _____

III _____

Public Awareness

10. Are you aware of the proposal to set-up a hotel and marina on the property where the old sugar warehouses are?

Yes ☐

No ☐

11. If yes, are you:

Strongly in favour ☐

In favour ☐

Neither in favour or against ☐

Against ☐

Strongly against ☐

What are your reasons? _____

_____

_____

12. Do you know when the proposed development will begin?

Yes ☐

No ☐

Social Attitude

13. Do you look forward to this?

Yes ☐

No ☐

14. If yes, why? _____

_____

_____

15. If no, why not? _____

_____

16. Do you think that the area needs any new development?

Yes ☐ No ☐

17. Do you think that the construction and operation of the proposed development will affect the availability of any of your resources (e.g. water, light, aesthetics etc)

Yes ☐

No ☐

18. If Yes, please state which of the resource(s) you suspect will be affected?

_____ _____

_____ _____

_____ _____

19. For each affected resource, describe briefly, the nature/extent of the effect

Resource	Nature/ extent of effect

20. Do you use the site for any activity?

Yes ☐

No ☐

21. If Yes, what do use the site for? _____

_____

_____

22. Are there any natural resources on the site?

Yes ☐

No ☐

23. If Yes, what are these? _____

_____

_____

_____

24. What impacts do you think the proposed hotel resort development will have on this community?

_____

_____

_____

25. Will the development have any impact on your livelihood?

Yes ☐ No ☐

26. If yes, what are the impacts?

_____

_____

_____

27. Do you think the proposed development will have any impacts on the environment?

Yes ☐ No ☐

28. If yes, please explain.

_____

_____

29. What benefits do you think the proposed development will have on the community?

30. Do you have any other expectations?

Yes ☐ No ☐

31. If Yes, what are these?

32. Is the site of any cultural/historical interest?

Yes ☐ No ☐

33. If Yes, what/where?

34. Do you have any involvement in the proposed development?

Yes ☐ No ☐

35. If Yes, how are you involved?

HOUSING CONDITIONS

TYPE OF DWELLING

Separate house, detached ☐

Semi-detached ☐

Part of a house ☐

Part of a commercial building ☐

Other ☐

CONSTRUCTION MATERIAL

Block and Steel ☐

Wood ☐

Concrete ☐

Stone/Brick ☐

Wattle and Daub ☐

Other ☐

AMENITIES

TOILET FACILITIES

Type: _____

WC linked to sewer ☐

WC not linked to sewer ☐

Pit ☐

Other ☐

None ☐

Shared

Yes ☐

No ☐

SOURCE OF WATER

Indoor tap/pipe ☐

Outside Private tap/pipe ☐

Public stand pipe ☐

River/Pond/Well ☐

Rainwater (tank) ☐

Kitchen (exclusive of)

Yes ☐

No ☐

SOURCE OF LIGHTING

Electricity ☐

Kerosene ☐

Other ☐

None ☐

TENURE

Owner ☐

Rent-free ☐

Rented ☐

Squatter-occupied ☐

Other ☐

END OF QUESTIONNAIRE

Surveyor's Name:

Signature:

Date:

Appendix III: Team Members

Dr. Conrad Douglas

Mr. Paul Thompson

Ms. Deonne Caines

Mr. Vance Johnson

Mr. Orville Grey Jr.

Mr. Wayne Morris

Appendix IV: Sewage Treatment Facility Details

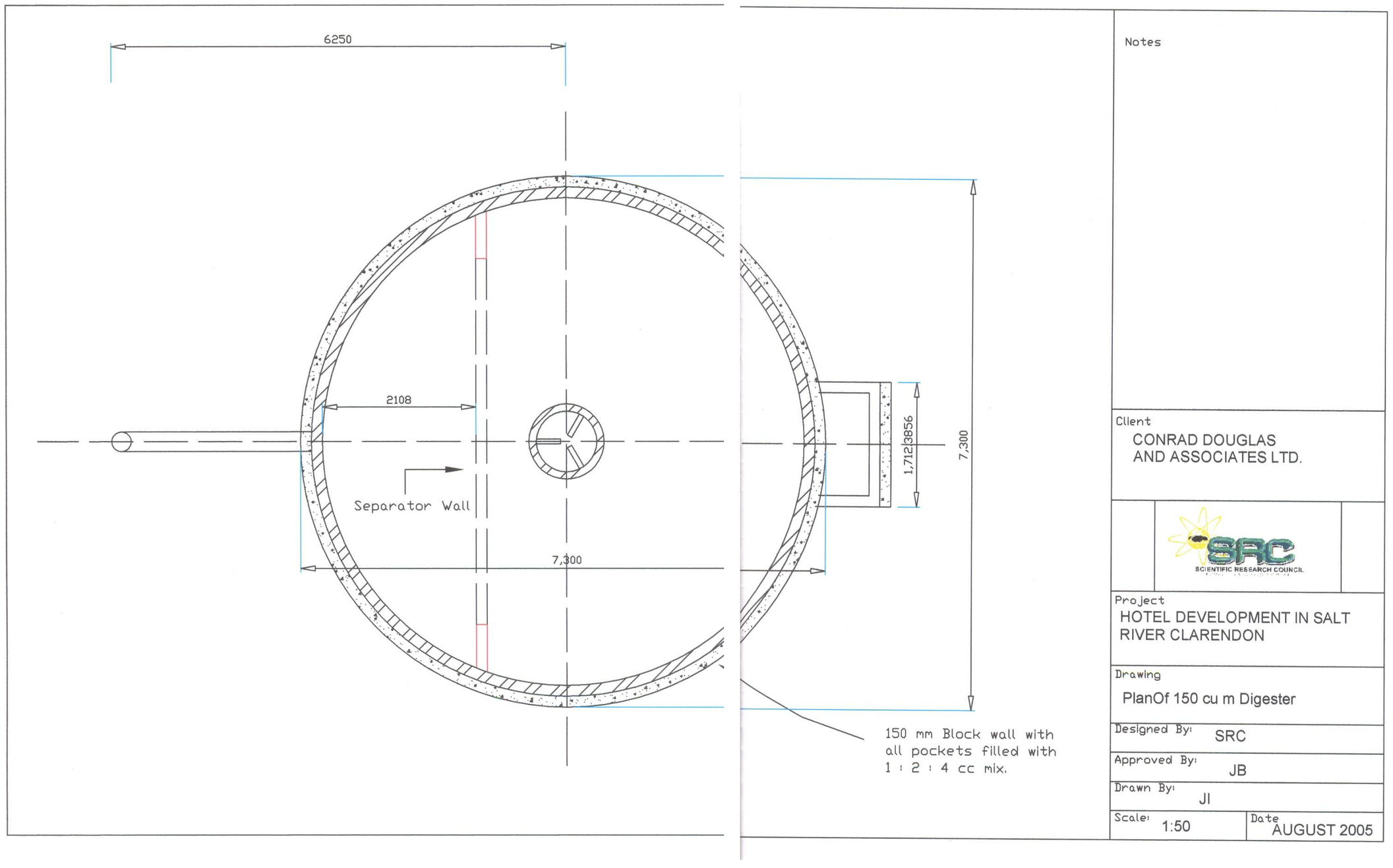


Figure 10-1: Plan of Proposed Digester

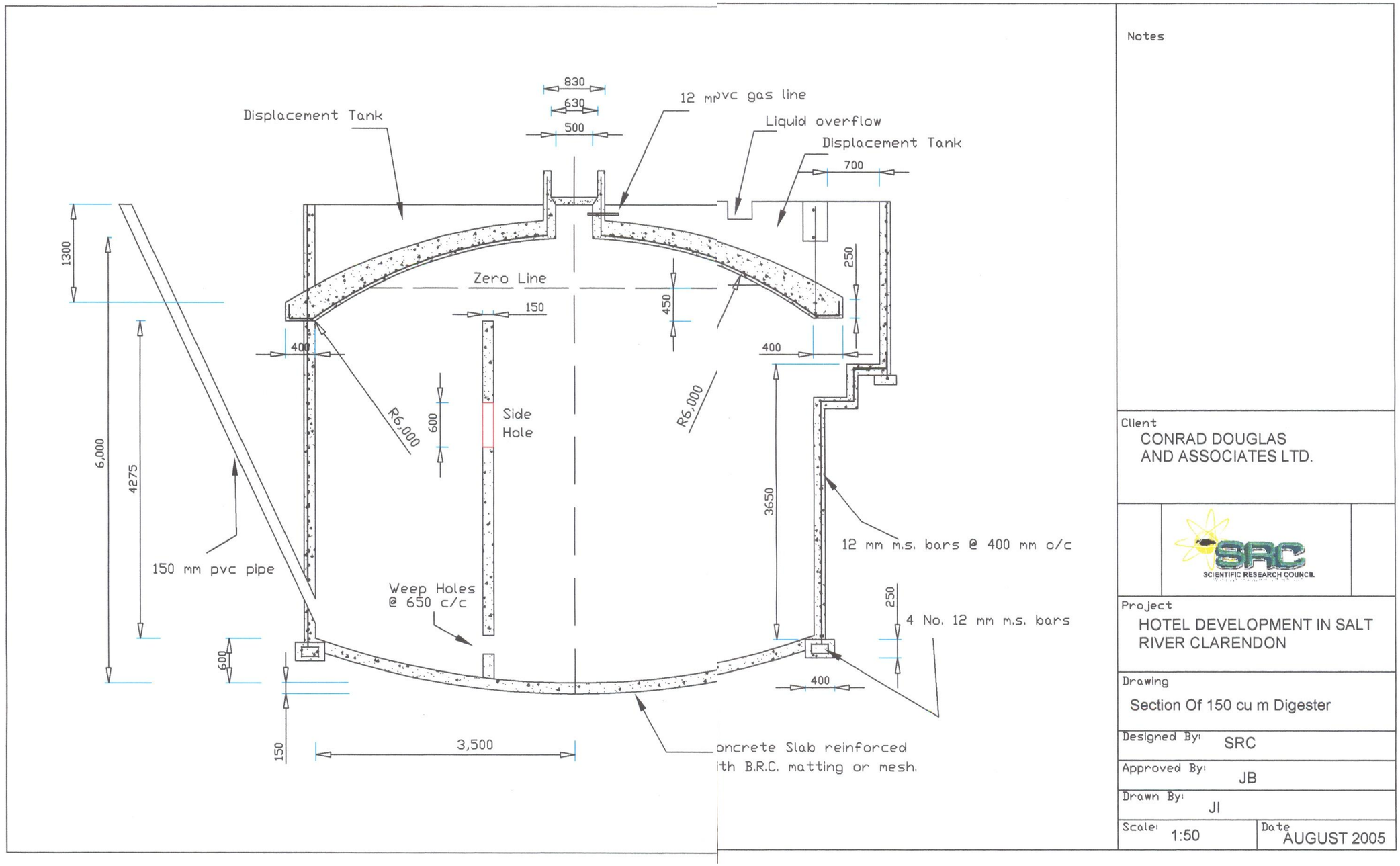


Figure 1-2: Section through Proposed Digester

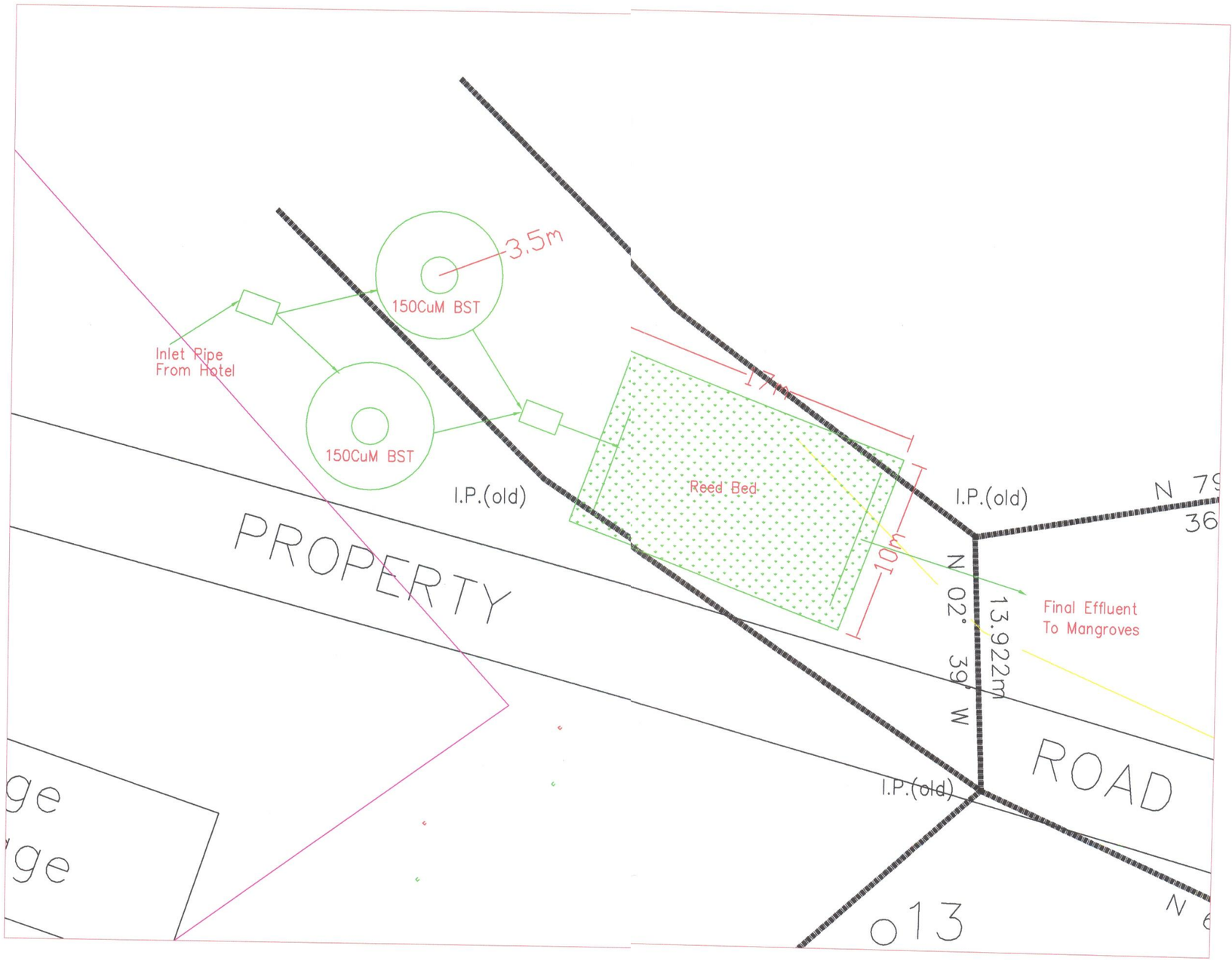


Figure 1-3: Reed Bed in Relation to Mangrove area and BST

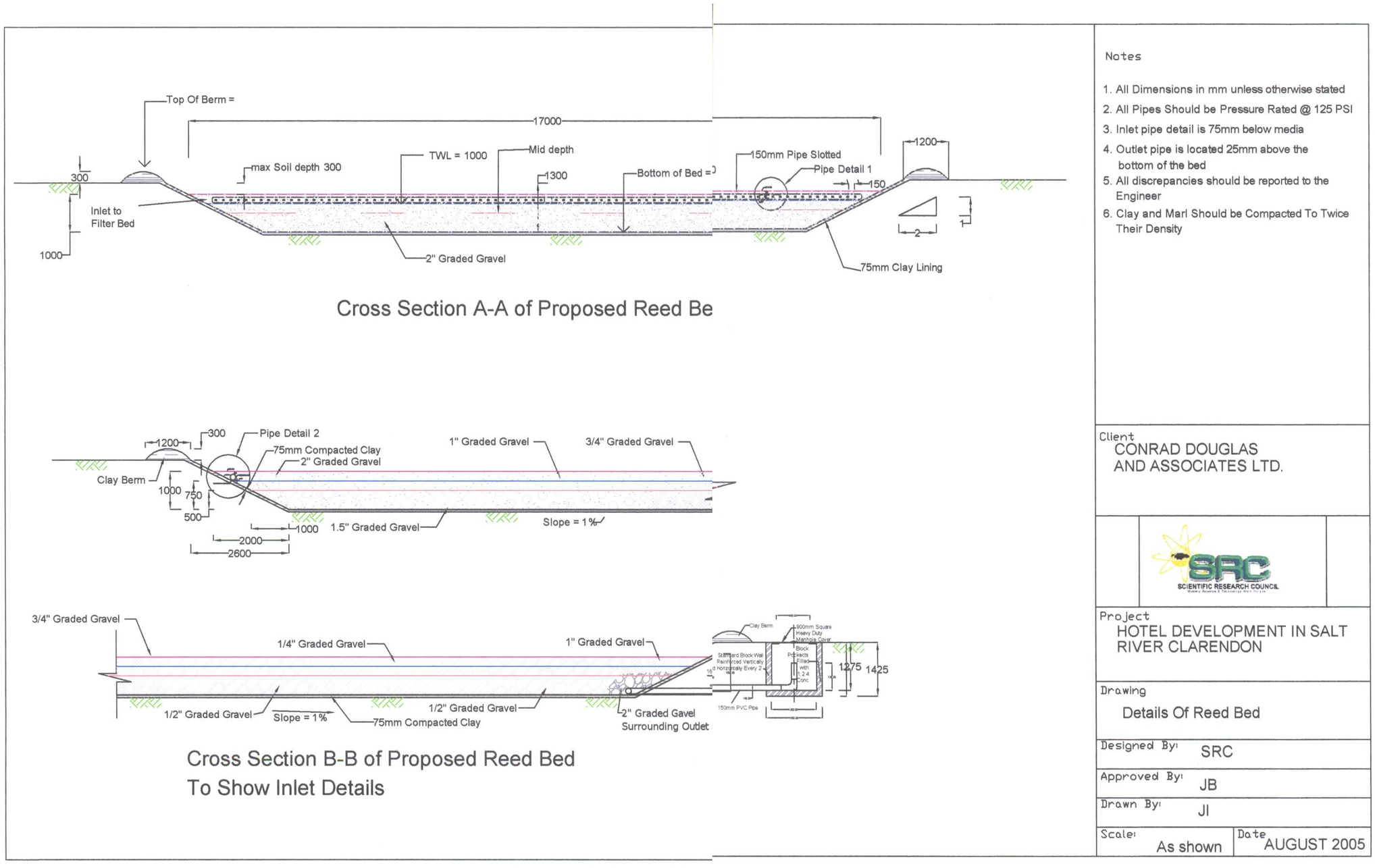


Figure 1-4: Cross-Section of Proposed Reed Bed showing Inlet Details

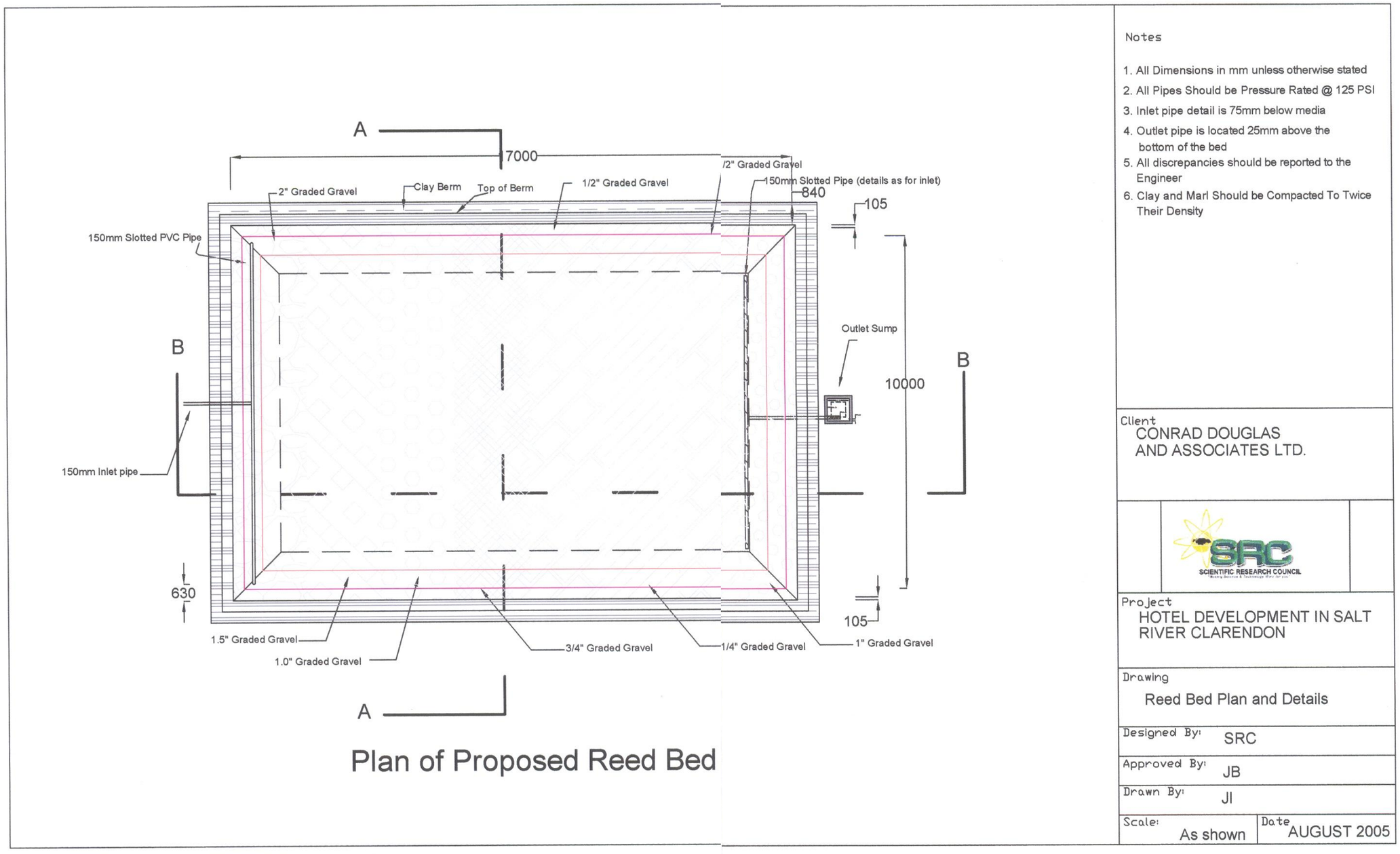


Figure 1-5: Plan of Proposed Reed Bed