ENVIRONMENTAL IMPACT ASSESSMENT
For Phase 1 of the Proposed 7th Harbour Development at Gunboat Beach, Palisadoes

Final Report

Prepared for Treasures Ltd.

May 22nd 2007

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ENVIRONMENTAL IMPACT ASSESSMENT FOR PHASE 1 OF THE 7TH HARBOUR DEVELOPMENT, GUNBOAT BEACH, PALISADOES

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Acknowledgements

This Environmental Impact Assessment (EIA) was prepared by emc^2. The principal author was Dr. Ravidya Burrowes with contributions from Ms. Loureene Jones (Ecology Baseline) and Dr. Edward Robinson (Physical Baseline). Ms. Beverline Brown-Smith prepared the socio-economic baseline. Ms. Shakira Khan assisted with the Physical Baseline, and Mr. Lascelles Fearon assisted with the identification of floral species and avifauna at the site.

Mr. Tyrone Rose co-ordinated the field sampling of sediment and water, and the analytical testing for water and sediments. The following laboratories conducted analyses:

1. Scientific Research Council Faecal coliforms
2. Mines and Geology: Metals (in sediments), Total Suspended Solids, nutrients
3. Environmental Technical and Analytical Services: Biological Oxygen Demand and Oil and Grease

Ms. Kadean Mitchell assisted in the analysis of sand samples.

Ms. Sheilah Forward assisted with the review and copy editing of the final report.

The authors also wish to acknowledge contributions from Treasures Ltd. to the project description, and stakeholders who took the time to comment on the proposal.

EXECUTIVE SUMMARY

The National Environment and Planning Agency (NEPA) received applications for Environmental Permits from Treasures Ltd. for the development and operation of a small marina and entertainment complex at ~12 acres (4.8 ha) of coastal land at Gunboat Beach Palisadoes, Kingston. These applications were made in accordance with the Natural Resources Conservation Act (1990). Pursuant with the NRCA Schedule, permits are indicated for the proposed marina and entertainment centre. An environmental license was sought for the discharge of sewage effluent (tertiary) from the proposed the sewage treatment plant. Beach licenses are required under the Beach Control Act for any proposed foreshore works. NEPA has requested that an Environmental Impact Assessment (EIA) be prepared in support of these applications. A Terms of Reference (TOR) for the preparation of this document has been approved by NEPA and is included as Appendix 1.

The 7th Harbour Project involves development of a "*multi-functional recreational, entertainment and hospitality facility*"[1] at a 109-acre parcel of land on the Palisadoes located just to east of the Norman Manley Airport, which has been leased from TPDCo by the developers, Treasures Ltd.

The Project is defined by a Master Plan, which outlines two phases of development; with Phase 1 (12 acres at Gunboat Beach) being the subject of the applications in support of which this Environmental Impact Assessment (EIA) has been prepared.

The location of Phase 1 within the Master Plan for the 7th Harbour Development is given in Figure 1. This phase focuses primarily on the re-development of the Gunboat Beach area including the following design elements.

1. A small **Entertainment Centre** (5000 persons) – open air seating with 2 VIP bars, concession amenities, box office, restrooms, and proper backstage facilities.
2. **Mini-Marina**: the 1st section of the marina (80 slips) and associated marina facilities (inclusive of a refuelling facility, sewage pump out facility; laundry, launch and haul-out, boat storage and workshop).
3. A **Boat Tour Facility** (inclusive of a 150-person capacity catamaran).
4. A **Harbour Mart** (a convenience store catering to the marina users stocking food items, toiletries, tackle and other basic supplies).
5. A **Restaurant; bar and grill**. The restaurant will have a capacity for 200 guests. A small gaming lounge will be located in the restaurant building.
6. **Associated infrastructure** (parking and main road access, sewage treatment plant, storm water drainage, water, power, cable).

The EIA process for the proposed 7th Harbour Development at Gunboat Beach is proceeding according to the schedule outlined in the table below.

[1] ABC Development 2000, Seventh Harbour Development: Business Plan

Project Development Schedule

Benchmark	Date
Draft TORs submitted to NEPA	November 14th 2006
Mobilization of EIA consultants	November 26th 2006
Revised TORs submitted to NEPA further to comments	January 9th 2007
Draft TORs accepted by NEPA (revised)	January 22nd 2007
EIA is submitted to NEPA for technical review	May 22nd 2007
Public Meeting (*date to be confirmed*)	June 12th 2007
Verbatim Report Available (*date to be confirmed*)	June 19th 2007
End of Public Review Period (*date to be confirmed*)	July 18th 2007
Review of application by the NRCA Board *(estimated)*	August 8th 2007

Issues raised by community stakeholders in the consultation process included: increased crime and traffic, and potential losses of income and biodiversity. Other stakeholders also raised concerns about the following:

- Vulnerability of the proposed marina to hurricanes.
- Monitoring of the (effluent) of the STP.
- Consumption of energy.
- Proper disposal of garbage (public health issues).
- The location of the site within the Palisadoes-Port Royal Protected Area, and the designated Ramsar area.
- Effects on the mangroves and their function as a habitat and wind break.
- The effect of dune and vegetation removal on the stability of the Palisadoes and the shoreline.
- Adequacy of parking facilities.
- Potential for traffic congestion on the airport road.
- Increase in vessel traffic (from the reported baseline of 1500 per year).
- Inadequacy of nearby fire response capabilities.

Many community stakeholders felt the project would benefit the area by creating jobs, improved utilities services, security and living standards. In addition, there other stakeholders indicated the potential for the following positive impacts to occur:

- Public health and safety are assured by effectively preventing bathing in contaminated waters.
- Helps in the protection of the Kingston Harbour from pollution.
- Takes advantage of the uniqueness of the site: climate, geography, history, and culture.
- Improve recreational infrastructure and improve tourism

These matters, in addition to the issues identified in the Terms of Reference (Appendix 1) have been addressed in Section 5 of this report.

The main objective of the EIA is to determine whether there are any environmental considerations that need to be taken into account in reviewing the applications for environmental permits, and whether there is any environmental reason why the project should not proceed as proposed. A total of 18 negative environmental impacts were identified, with scores ranging from 1.6 (minor) to 3.5 (high moderate).

Half of these (nine) were classified as minor negative impacts:

1. Creation of ecological barriers
2. Conflict with Protected Area status
3. Change to air quality
4. Drainage modification
5. Introduction of pests, invasive or alien species
6. Fuel consumption
7. Demand for municipal services and utilities
8. Impacts on protected species and biodiversity
9. Change to micro-climate

Of the nine classified as moderate negative impacts, 2 were limited to the construction phase, 5 were reversible with the removal of structural elements or cessation of causative activities, and 2 were regarded as permanent. Construction Impacts (short-term effects that will not persist after the completion of construction activities) included construction haulage effects and dredging. Long to medium-term impacts that can be effectively reversed with removal of structural elements or project activities included:

1. Effects of noise (disturbance of wetland birds)
2. Increased lighting near coastal habitats (disturbance of wetland birds)
3. Decline in coastal water quality
4. Traffic and parking effects
5. Increased risk (because of the presence of visitors and structures).

Both of the impacts that are likely to result in a permanent change to the environment were classified as moderate impacts, and were relatively acceptable given the benefits of the project.

1. Effects on macro-benthic community. No rare, endangered or protected species were encountered at the site.
2. Removal of the dunes (alteration of topography). The proposed modification was assessed as unlikely to affect the stability of the Palisadoes.

Six positive effects were assessed, with rated effect levels between 2.3 (moderate) and 4.2 (significant). Stabilization of the shoreline, and the improvement to the appearance of the place (visual change) ranked as significant positive impacts arising from the project. Other positive impacts included

1. Effects on local economies
2. Development of marine tourism
3. Provision of a new social amenity
4. Change of land use

The findings of this environmental impact assessment are that:

1. **None of the negative environmental impacts identified has been assessed to be significant.**
2. **Negative environmental impacts can be cost effectively mitigated, and there are good opportunities for environmental enhancement of the performance of the project. These are outlined further in the environmental management plan of the EIA.**
3. **There are significant environmental benefits that are likely to accrue from implementation of the project as proposed.**

1 PROJECT DESCRIPTION

1.1 INTRODUCTION

1.1.1 Preamble

The National Environment and Planning Agency (NEPA) received applications for Environmental Permits from Treasures Ltd. for the development and operation of a small marina and entertainment complex at ~12 acres (4.8 ha) of coastal land at Gunboat Beach Palisadoes, Kingston. These applications were made in accordance with the Natural Resources Conservation Act (1990). Pursuant with the NRCA Schedule, permits are indicated for the proposed marina and entertainment Centre. An environmental license was sought for the discharge of sewage effluent (tertiary) from the proposed the sewage treatment plant. Beach licenses are required under the Beach Control Act for any proposed foreshore works. NEPA has requested that an Environmental Impact Assessment (EIA) be prepared in support of these applications. A Terms of Reference (TOR) for the preparation of this document has been approved by NEPA and is included as Appendix 1.

1.1.2 Project Overview

The 7th Harbour Project involves development of a "*multi-functional recreational, entertainment and hospitality facility*"[2] at a 109-acre parcel of land on the Palisadoes located just to east of the Norman Manley Airport, which has been leased from TPDCo by the developers, Treasures Ltd. The Project is defined by a Master Plan (Figure 1), which outlines two phases of development, with Phase 1 (12 acres at Gunboat Beach, located as shown on Figure 2) being the subject of the applications in support of which this Environmental Impact Assessment (EIA) has been prepared.

This development represents a $5.6 million USD investment into building the tourism product of Kingston, and will provide much needed recreational infrastructure in the corporate area. With its protected waterfront location and low number of rain-days per year, Gunboat Beach is seen by the developer as the ideal location for the development of a range of outdoor recreational activities including music concerts, dining, and boating.

The facility will serve two main tourism markets: the domestic tourism market and the sea-based tourism market (recreational vessels and cruise passengers). Urban dwellers in the Kingston Metropolitan Area (KMA) are seen as the primary market for the entertainment centre. According to STATIN (http://www.statinja.com/census.html accessed on December 12th 2006), the population in the KMA alone was ~0.58 million persons in 2001, which represented 22.2 % of the national population. The second largest urban area in Jamaica in 2001 was Spanish Town (located ~ 30 minutes drive of Kingston Harbour) with a population of 0.13 million

[2] ABC Development 2000, Seventh Harbour Development: Business Plan

persons. The marina will target both domestic boat owners as well as visiting pleasure craft. Phase 2 of the development will seek to develop Kingston as a port of call for cruise ships as well as yachts.

Historically, there have been many plans to develop tourism in the Palisadoes and the Port Royal area that have not materialized (Hamilton, 2006). Development of the historic city of Port Royal (founded in 1655) has been complicated. The plan put forward by the Port Royal Development Company Ltd. supported the development of Port Royal as a cruise ship port of call along with restoration of historical buildings and development of infrastructure. According to Hamilton (2006) the latest plan by the Port Royal Development Company proposed in 1998 has the potential to negatively impact on the archaeological records of the area. Gunboat Beach was developed in 1959 as a municipal recreational beach, however, with increasing pollution of the water of Kingston Harbour, swimming in this area has been strictly prohibited by the National Environment and Planning Agency (NEPA).

The location of Phase 1 within the Master Plan for the 7th Harbour Development is given in Figure 1. This phase focuses primarily on the re-development of the Gunboat Beach area including the following design elements.

7. A small **Entertainment Centre** (5000 persons) – open air seating with 2 VIP bars, concession amenities, box office, restrooms, and proper backstage facilities.
8. **Mini-Marina**: the 1st section of the marina (80 slips) and associated marina facilities (inclusive of a refuelling facility, sewage pump out facility; laundry, launch and haul-out, boat storage and workshop).
9. A **Boat Tour Facility** (inclusive of a 150-person capacity catamaran).
10. A **Harbour Mart** (a convenience store catering to the marina users stocking food items, toiletries, tackle and other basic supplies).
11. A **Restaurant; bar and grill**. The restaurant will have a capacity for 200 guests. A small gaming lounge will be located in the restaurant building.
12. **Associated infrastructure** (parking and main road access, sewage treatment plant, storm water drainage, water, power, cable).

After the approval and implementation of Phase 1, further expansion of the facilities will be the subject of separate applications and supporting environmental documentation. Consequently, the environmental impacts of these are not specifically considered in this EIA, but only in so far as there would be a cumulative impact in the long term. Plans for subsequent development of the rest of the site are likely to include the following components:

1. A Water-park.
2. A Large entertainment centre (20,000 persons).
3. A Retail/Entertainment Complex.
4. A Fine Dining Restaurant.
5. A 350-Room Waterfront Hotel with Conference and Gaming Centres.
6. Expansion of the marina to 200 slips.
7. A cruise ship pier.

8. Remediation and rehabilitation of the mangrove lagoon area, and replanting of mangroves at other viable locations within the Palisadoes Ramsar site).
9. Associated infrastructure to accommodate the expansion.

Figure 1 Master Plan: 7th Harbour Development

1.1.3 Project Location

The proponents (Treasures Ltd.) have leased 109 acres (44 ha) of land from TPDCo in an area immediately to the east of the airport lands on the Palisadoes in Kingston. The parcel is bound in the north by the shoreline of the Kingston Harbour and on the south by the Norman Manley highway. To the east, it is bound by open lands (TPDCo) and to the west it shares property boundaries with the Caribbean Maritime Institute (CMI), the Royal Jamaican Yacht Club and the Norman Manley International Airport. The proposed site is located approximately 2 km across the harbour from the Bellevue Hospital and Bournemouth Gardens. It also occurs in close proximity to the Norman Manley International Airport, and the community of Port Royal. The location of Phase 1 is shown on Figure 2.

Although the Gunboat site is not located within the historic Port Royal area, it is located within a designated Ramsar site (for the protection of wetlands in the Palisadoes area). Figure 2 shows that the footprint of Phase 1 does not extend to any existing wetland areas, and that much of the proposed developed is limited to a heavily disturbed site, requiring minor vegetation clearance and demolition of existing structures.

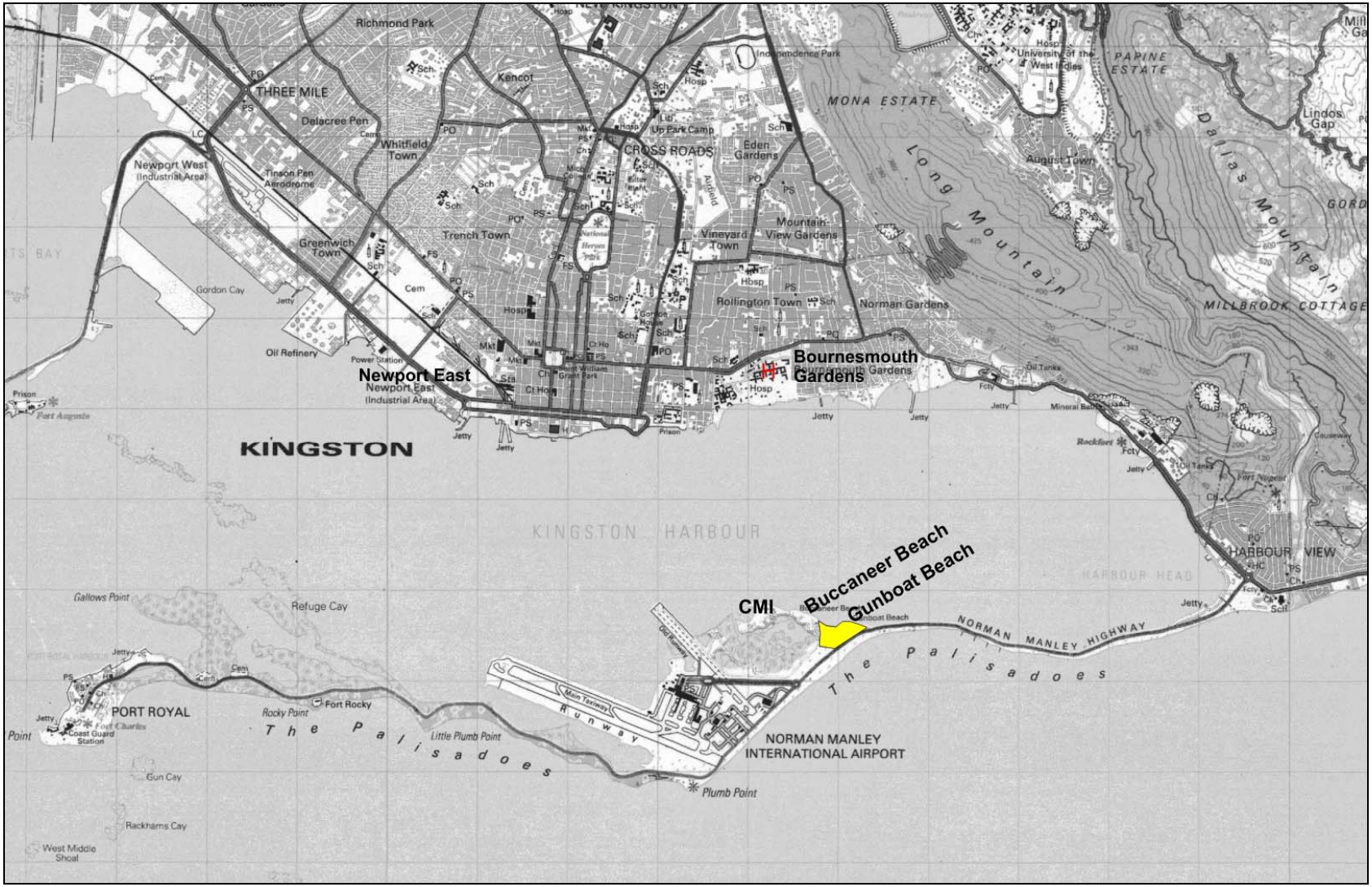
1.1.4 Project Schedule/Phasing

As discussed above, the entire 109-acre site will be developed in two main phases. Details of the implementation schedule of the second phase are not yet available and are not the subject of this EIA. It is anticipated that a decision on the application for an Environmental Permit may be given by the NRCA Board within 3 months of submission of the EIA. During this time it is expected that the Public Meeting will be held (3 weeks after submission of the EIA) and the document will be reviewed and commented on by public and private sector stakeholders. A breakdown of the implementation schedule for Phase 1 is given in Table 1.

Table 1 Implementation Schedule (Phase)

Project Benchmark	Schedule
Environmental Impact Assessment	November 2006 – May 2007
EIA Review Period	May – July 2007
Final Approvals	July - August 2007
Finalize Financing	May – July 2007
Negotiate and Finalize Construction Contract	July – August 2007
Estimated Construction Time	12 months
Grand Opening of the Facility	September 2008

Figure 2 Phase 1 of the 7th Harbour Project



(1 grid square represents one square km)

1.2 CONSTRUCTION PHASE FOOTPRINT/SITE PLAN

1.2.1 Specifications

1.2.1.1 Marina and Associated Earth Works

A Report on the Coastal Engineering Aspects of the 7th Harbour Development was prepared by Smith Warner International in April 2007. This report summarizes the field investigations of design parameters for the proposed marina. These included evaluations of the storm surge hazard bathymetry, and shoreline profiles (discussed in Section 4), with aim of determining the implications of these for the design floor elevations, landfill requirements, dock, finger piers for berthing and possible impacts on the prevailing sediment regime along this section of the Palisadoes spit. Although the developers intend to develop a marina of ~200 berths plus one or two cruise ship piers, the present application and design (Phase 1) only addresses the first 80 berths. The proposed layout of Phase 1 of the marina (Figure 3) is designed to berth power and sail boats ranging between 10 m to 20 m in length. The key design elements associated with the marina include:

1. **Two timber jetties**: vessel slips will be aligned perpendicular to the jetties (east-west direction), in line with the main wind direction. There will be a phased build-out of these slips. Given a preliminary cost assessment, SWIL (2007) recommended a piled-supported dock with a fixed superstructure. The piling can be constructed with concrete, timber or steel and the superstructure can be constructed mainly from timber (imported marine treated pine or hardwood such as Ipe or Greenheart). The jetty surface will be at a level of 1.5 m above sea level. The existing derelict structure offshore of Gunboat will have to be removed to accommodate the marina. The design width of the fairways between the jetties is 20 m.
2. **A rock groyne** on the eastern end of the marina: ~140 m long and 13 m wide at the base. The finished elevation will be 1.5 m above mean sea level, with a crest width of 2 m. This structure is designed to reduce the effect of winds coming from the east and north-east on berthing conditions. Although the fuel dock is located on this structure, no slips are to be accommodated on the groyne.
3. **Dredging** the sea floor within the marina footprint to a depth of 2.1 to 2.6 m below mean sea level. The fairways between the finger piers and the groyne will be 2.1 m deep. Outer areas around the perimeter of the marina will be 2.6 m deep.
4. **Revetment and promenade**. A revetment is needed to protect the reclaimed land from wave action, and to prevent slippage. The sea wall will be comprised mainly of boulder rip rap (1.2 m thick), and will be constructed at a slope of 1: 1.5. The emergent section of the structure (i.e. above sea level) will be hidden from view under a concrete promenade (3.4 m wide by 220 m long). Geotextile placed under the rip rap will prevent undermining. The revetment and promenade will run along the entire length of marina shoreline as shown in Figure 3.
5. **Reclamation** of lands immediately behind the promenade and docks to the design elevation of the docks of 1.5 m above mean sea level. This area will have to be compacted and graded so that it can be used.

Figure 3 Proposed Marina Layout

NOTES

1. All dimensions and elevations are in meters unless otherwise shown.

2. All elevations are relative MSL.

3. Survey to be verified on site prior to start of works.

4. The density of armour stones shall not be less than 2400kg/m.

5. Survey information taken from topogarphical survey and near–shore survey along a section of Palisadoes called Gun Boat Beach done by E.H. Williams & Associates (dated Feb. ,2004 & Sept., 2005 respectively.)

7. Hydrographic contours were generated from topographical and near shore survey.

8. Individual stones shall be free of seams splits or bedding planes that may affect its durabilty.Stones shall be clean from silt, clay, organic or other deleterious materials.

9. The largest dimension of any stone shall not be more than 2 times the smallest dimension.

10. The weight and size of the stones shall fall within the following ranges:

Rip Rap Layer (Revetment)
W_{50} = 363kg
D_{50} = 0.53m

Armour Layer (Groyne)
M_{max} = 2000Kg
M_{min} = 1000Kg
D_{max} = 0.91m
D_{min} = 0.72m

11. Geotextile under armour stone breakwater shall be terrafix non–woven grade 1200r or better.

rev.	description	date
02	Issued for EIA Approval	24–04–07
01	Issued for client review	24–01–06

project title
SEVENTH HARBOUR MARINA AND SHORELINE ENHANCEMENT

client
SEVENTH HARBOUR MARINA

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PLAN OF MARINA LAYOUT AND PROPOSED WORKS

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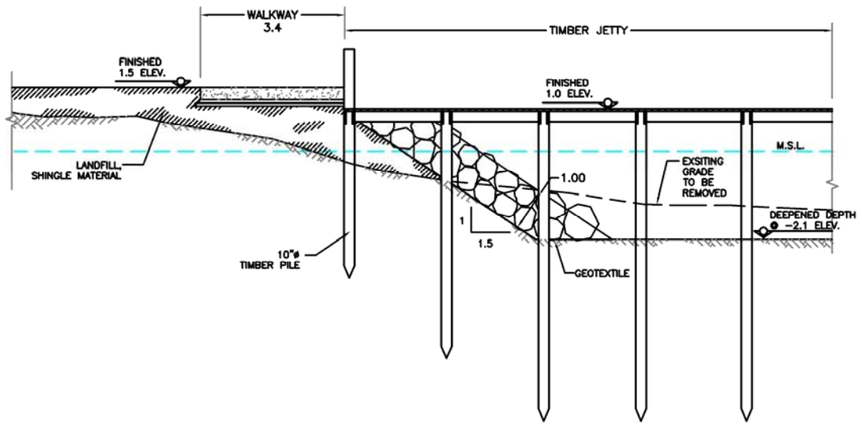
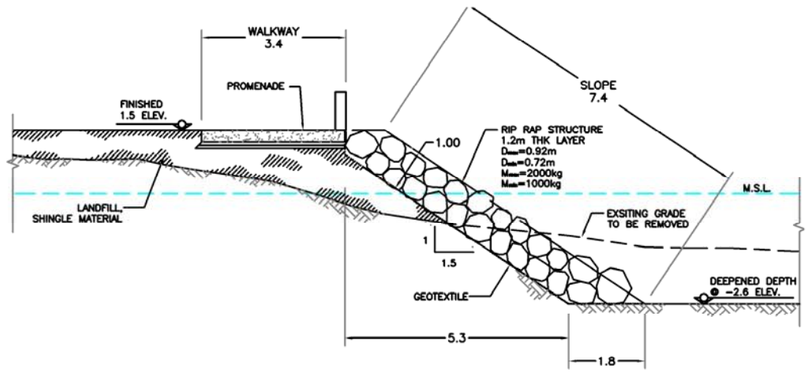
drawn	Roberto Lyn	Mar '07	drawing no.	rev.
checked	B. Francis	Mar '07	SH01	
scale	AS SHOWN	sheet no.	1 of3	

Figure 4 Proposed Marina Layout: Cross Sections



CROSS SECTION A–A THROUGH RIP–RAP REVETMENT



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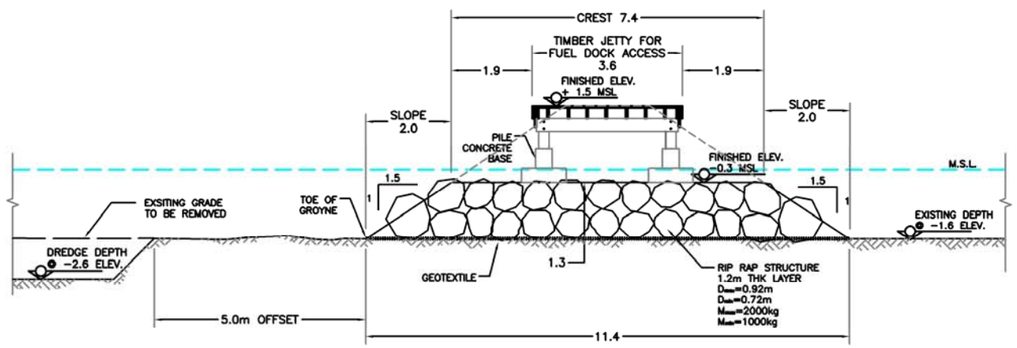

CROSS SECTION C–C THROUGH GROYNE

SCALE 1:75

NOTES

1. All dimensions and elevations are in meters unless otherwise shown.
2. All elevations are relative MSL.
3. The density of armour stones shall not be less than 2400kg/m.
4. Individual stones shall be free of seams splits or bedding planes that may affect its durabilty.Stones shall be clean from silt, clay, organic or other deleterious materials.
5. The largest dimension of any stone shall not be more than 2 times the smallest dimension.
6. The weight and size of the stones shall fall within the following ranges:

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   Dmin = 0.72m

7. Geotextile under armour stone breakwater shall be terrafix non–woven graade 1200r or better.

rev.	description	date
02	Issued for EIA Approval	24–04–07
01	Issued for client review	24–01–06

project title

SEVENTH HARBOUR MARINA AND SHORELINE ENHANCEMENT

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SEVENTH HARBOUR MARINA

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MARINA WORKS CROSS SECTIONS

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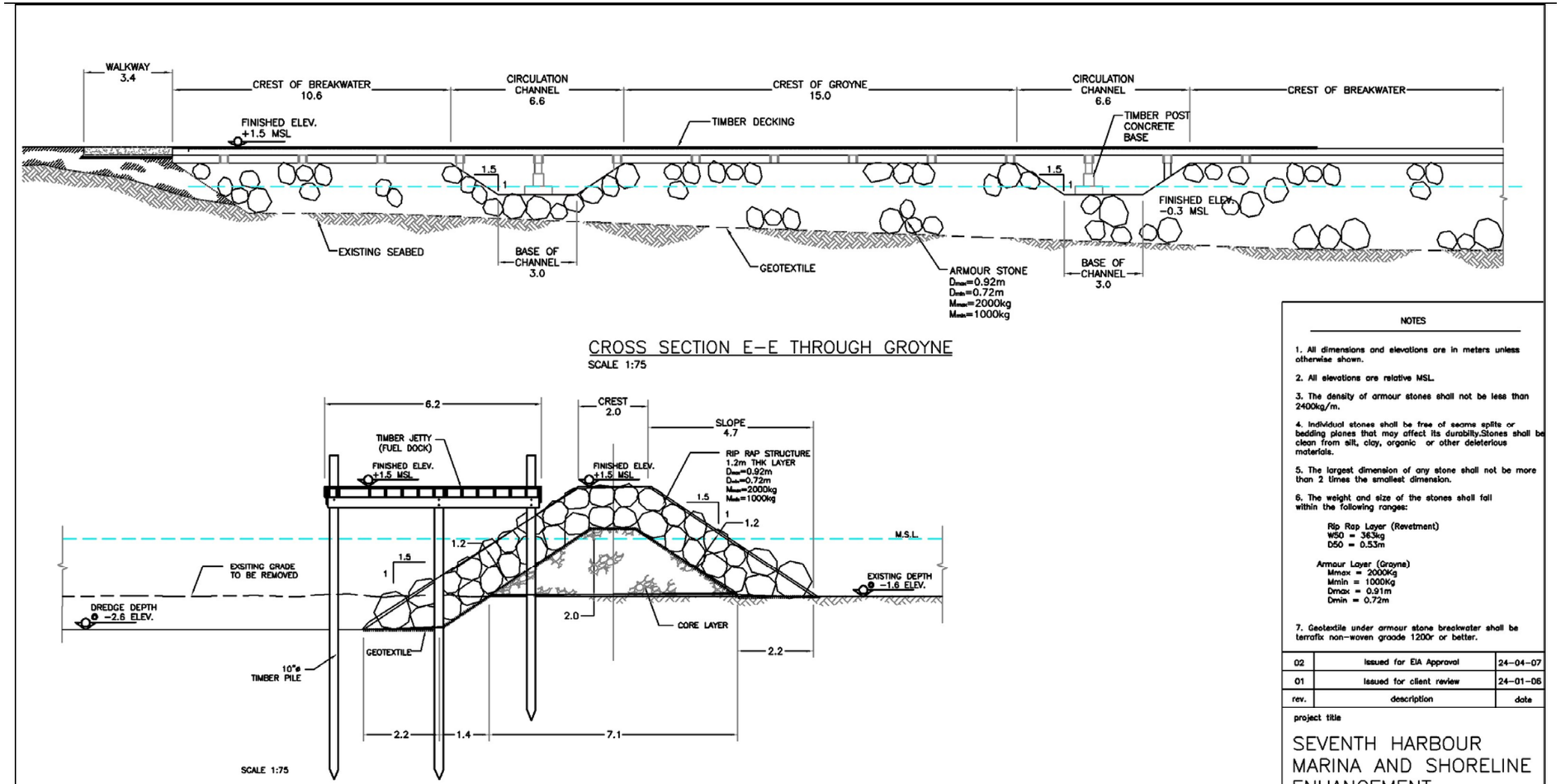
checked	B. Jones	Mar '07	SH02	
scale: AS SHOWN	sheet no.: 2 of 3			

Figure 5 Proposed Marina Layout: Cross Sections



CROSS SECTION E–E THROUGH GROYNE
SCALE 1:75

CROSS SECTION D–D THROUGH GROYNE

NOTES

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02	Issued for EIA Approval	24-04-07
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project title
SEVENTH HARBOUR MARINA AND SHORELINE ENHANCEMENT

client
SEVENTH HARBOUR MARINA

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MARINA WORKS
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checked	W. Smith	Mar '07	SH03	
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1.2.1.2 Landside Construction & Associated Earthworks

The proposed side layout for the landside operations is given as Figure 8 and 9. The entertainment centre is designed to accommodate a maximum of 5000 persons standing or 1200 open air seating with 2 VIP bars. Figure 10 shows the detailed floor plan for the proposed entertainment centre. This design makes provision for:

1. A central box office with ticket booth with 2 adjoining ticket offices on the south side of the pavilion
2. Three offices on the west wing, adjacent to the 2 VIP lounges.
3. Eight (8) Male and 8 Female toilets (16 toilets in total) evenly distributed on the west and east wings.
4. Permanent concession kiosks (8 stalls) on the south side of the pavilion on either side of the ticket booths.
5. Two bars on either wing (including VIP bars on either side).
6. Staff changing rooms located on the east wing.
7. Stage area (circular dimensions) area - (710 m^2 /7665 sq ft) on the north-western side of the centre.
8. Backstage facilities for artistes and crew (including dressing rooms).

The entertainment center (with ticket booths, open pavilion, VIP bars and changing rooms) is located on the western side of the marina as shown in Figure 8. There are restrooms on both the east and west wing of the pavilion.

Visitor amenities form a cluster on the eastern side of the marina boardwalk: bar and grill, changing rooms, harbour mart, gaming lounge and restaurant (with meeting rooms). The permanent structures (all except the bar and grill) are located beyond the required 30 m (100 ft) set back from the shoreline. Restrooms are located near the restaurant. The service area will be located behind the restaurant near the loading bay

Table 2 shows the land use breakdown for the 11.82 acres that will be developed in Phase 1. Approximately half (53%) of the total site will be built up (inclusive of buildings, paved area, parking area, and service area). Most of this built area comprises designated parking and open paved areas. The remainder (~47%) will be left as landscaped green areas.

Table 2 Proposed Spatial Allotments

	m^2	ft^2	Acres	% Total Area
Buildings	1724.1	18551	0.43	3.6%
Paved Area	15614.7	168014	3.86	32.6%
Parking Area	7405.8	79686	1.83	15.5%
Service Area	635.5	6838	0.16	1.3%
Landscaped Area	22456.3	241630	5.55	46.9%
			11.82	**100.0%**

1.2.2 Project Implementation Schedule and Activities

1.2.2.1 Marina Works

The following activities are identified as possibly impact causing activities associated with the project during the planned construction phased (August 2007 to August 2008)

1. Erection of a fence around the construction site. This will be necessary to reduce visual intrusion along the main road to the airport, and to ensure public safety as the site has been previously open to the public.
2. Clearance of coastal vegetation and solid waste. This is shown in Figure 6 below and described in more detail in Section 4 of this EIA.

Figure 6 Typical Coastal Vegetation and Waste along Shoreline at Gunboat Beach

3. Demolition of derelict structures shown in Figure 7. This will involve decommissioning of disused septic system associated with the public park facilities. Concrete rubble shall be re-used as fill material as far as possible. Dredged spoil will also be used as fill in areas that will be completed paved.

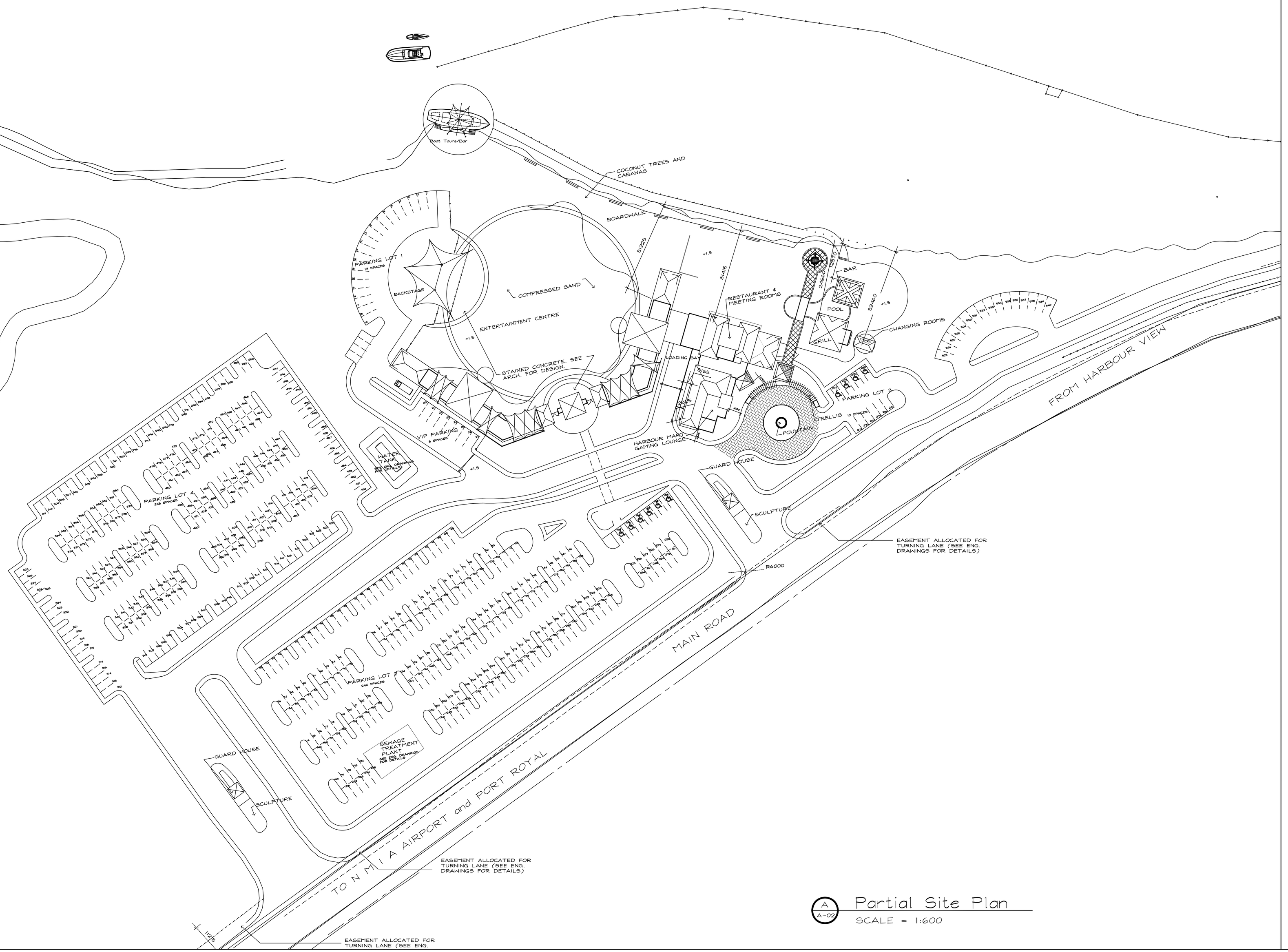
Figure 7 Structures slated for Demolition

4. Stockpiling of rubble and fill material in paved area behind shoreline above the 1 m contour. In addition, land fill, rip rap and boulders from nearby quarries will be stockpiled in this area.
5. Establishment of a temporary construction site and staging area: this will involve supply of changing rooms, portable lavatories.
6. Construction of the revetment and groyne. This can be done from the existing shoreline with an excavator. The excavator would move between the staging area and the edge of the structure being built out, using the surface of the structure for access.
7. Piling for the jetties can be done using a barge with a mounted pile driver or a pump that uses a high velocity water jet to sink the pile into position. Both will produce vibrations in the water and sediment column.
8. Deepening of the sea bed to the design depth (2.1 to 2.5 m) can be done by suction dredger or excavator.
9. The area behind the revetment will then be filled to the design elevation (1.5 m) using imported fill and demolition debris.
10. Finishing: construction of jetty boardwalks, groyne boardwalk and marina promenade. Conduits for cables to the slips will also be put in place at this time.
11. Construction of the refuelling station on the groyne boardwalk.

1.2.2.2 Landside Works.

12. Vegetation clearance. Figure 8 shows the extent of encroachment into the mangrove area on the western side of the property.
13. Grading and compaction particularly in areas slated for construction or pavement. This will involve removal of the dunes located in the vicinity of the proposed parking area.
14. After the dredging and earthworks, this staging area will be used to stockpile aggregate, cement, lumber, pre-fabricated concrete paving tiles and other construction materials. Concrete mixing will not be done on site. Ready-mixed concrete will be purchased and trucked to site as needed.
15. Commencement of construction works including foundations and installation of infrastructure inclusive of sewage treatment package plant, roads, drainage system etc.
15. Scaffolding (imported planks) will be needed for entertainment centre and other buildings.
16. Servicing and washing of heavy equipment and trucks.
17. Handling, collection, temporary storage, and transportation of solid wastes.
18. Construction of access roads and parking areas using asphalted, concreted or pre-fabricated paving tiles.

Figure 8 Phase 1 Site Plan Overlain on a Recent Google Image



A / A-02 Partial Site Plan

SCALE = 1:600

General Notes

1. Contractors should field verify all existing conditions prior to construction.
2. All existing areas and elements in areas not involved in new construction should be protected during the demolition and construction phase at all times.
3. All debris shall be properly disposed of at the end of the working day. Debris shall not be allowed to accumulate on site.
4. All dimensions indicated must be cross checked by the contractor before and during the works and any discrepancies are to be noted and reported immediately to the architect.
5. Please do not scale drawings
6. N.B. Ownership of the copyright of all designs, drawings, presentations, specifications and works executed from these documents remain with the architect. They may not be reproduced in any form without the written consent of and appropriate compensation to the architect.

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Firm Name:
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Project Name:
Proposed "Seventh Harbour" Development at Gunboat Beach Palisadoes, Jamaica
- PHASE ONE -

Sheet Name:
Partial Site Plan

Drawn by:	Designed by:	Checked by:
GB/SS	.	.

Project #:	Filename
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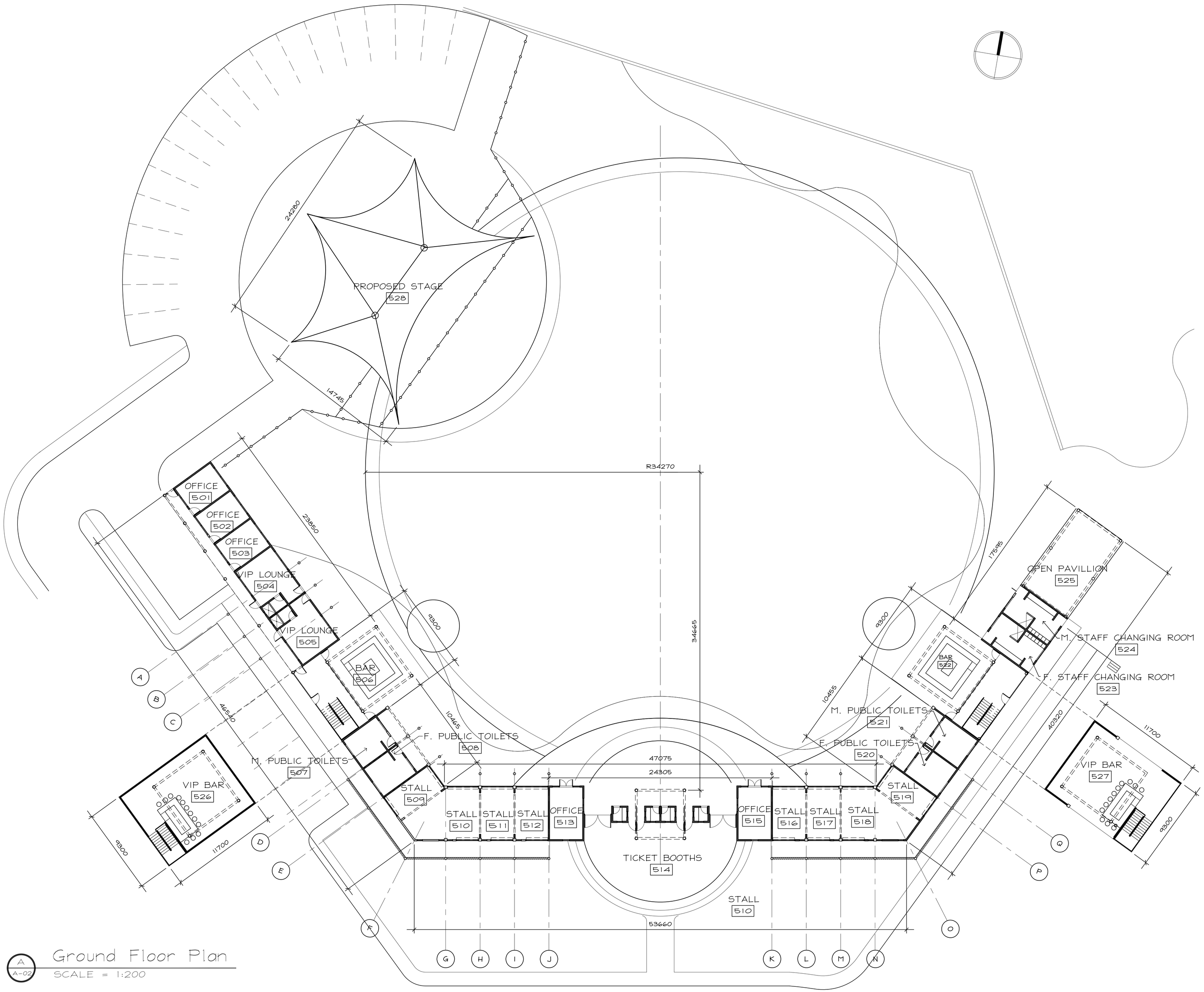
Figure 10 Detailed Floor Plan for the Proposed Entertainment Centre



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Ground Floor Plan

SCALE = 1:200

General Notes

1. Contractors should field verify all existing conditions prior to construction.
2. All existing areas and elements in areas not involved in new construction should be protected during the demolition and construction phase at all times.
3. All debris shall be properly disposed of at the end of the working day. Debris shall not be allowed to accumulate on site.
4. All dimensions indicated must be cross checked by the contractor before and during the works and any discrepancies are to be noted and reported immediately to the architect.
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Project Name:
Proposed "Seventh Harbour" Development at Gunboat Beach Palisadoes, Jamaica - PHASE ONE -

Sheet Name:
Entertainment Complex - Ground Floor Plan

Drawn by:	Designed by:	Checked by:
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Project #:	Filename:	
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1.2.3 Resource Consumption

1. Materials:
    a. Imported timber for jetty board walks: treated marine pine or hardwood (Ipe or Greenheart).
    b. Concrete for piles and promenade decks.
    c. An estimated 3,700 m^3 of armour stone and 1,900 m^3 rubble material will be needed to construct the groyne
    d. An estimated 1500 m^3 of armour stone will be needed to construct the revetment.
    e. An estimated 15,000 m^3 of landfill material (limestone shingle) is required for the proposed reclamation and filling of low lying lands.
2. Fuel consumption: diesel for operation of excavator and pile driver.
3. Equipment: barge, excavator, compactor, haulage trucks.
4. Labour: excavator and barge contractors. Divers and other site workers.
5. Land space on site: staging area for stockpiles and waste materials
6. Landfill space for disposal of solid waste including dredged spoil, demolition waste, vegetation debris, construction packaging materials etc. (off-site impact).
7. Construction and potable water will be supplied from the National Water Commission (NWC) mains that presently serve the site.
8. Power: electricity will be supplied by the JPSCo lines which presently serve the site. Fuel (diesel) will be required for heavy equipment.
9. Labour: approximately 100 workers will be needed during the construction phase. These will include the following jobs: 40 labourers, 20 skilled workers, 7 supervisors/clerks, 10 security personnel and 15 specialists (plumbers, carpenters, masons, electricians etc.).
10. Supply of services for construction camp: offices, portable lavatories, changing rooms, vendors, transportation.
11. Subsidiary inputs:
    a. Concrete (to be sourced from a local ready mix batching facility).
    b. Imported timber for scaffolding.
    c. Construction materials: steel, pipes, roofing, windows, fixtures, zinc etc.
    d. Aggregate, concrete, marl and asphalt for road and parking areas.
    e. Importation of 280 m3 of sand for amphitheatre area.
12. Construction fencing for the perimeter of the property.
13. Signage to advise beach users that the site is closed for construction and that swimming is prohibited.
14. Vegetation for landscaping: indigenous ornamental trees and shrubs.
15. Booms and silt traps for containment of construction-related plumes.

1.2.4 Waste Streams

1. Emissions:
    a. Combustion emissions from diesel engines.
    b. Construction noise (demolition, pile driving, dredging) and heavy vehicular noise.
    c. Fugitive dust from haulage vehicles, stockpiles, land clearance, demolition and earthwork activities.
    d. Light: during construction night time lighting will be limited to security purposes only.
2. Effluents:
    a. Sewage from any portable lavatories (off site disposal).
    b. Suspended sediment plumes associated with the dredging, bare soils, and materials stockpiles.
    c. Site run-offs (storm water that may contain mobilized material such as cement or fine sediment).
    d. Oil and grease from vehicle and equipment servicing during construction period.
    e. Sewage from portable lavatories in construction camp and disposal by contractor.
3. Solid Waste:
    a. Vegetation debris.
    b. Earth materials from grading of dunes on the western side.
    c. Demolition debris from the structures to be removed – roofing, concrete slabs, tiles, wood etc.
    d. Garbage collected from the shoreline.
    e. 13,000 m^3 of dredge spoil (silty sand).
    f. Packaging materials associated with imported wood, pre-fabricated concrete piles, pallets, bags, boxing etc.
    g. Domestic waste associated with workers on site: food and beverage containers.
    h. Oily rags from vehicle and equipment maintenance.

1.2.5 Upset Conditions

The environmental impact assessment must also consider probability events as well as the routine events. During the construction period, there is a risk of the following upset conditions:

- Construction site accidents: injury or loss of time. It is assumed that suitable worker safety protocols will be implemented by the contractors.
- Work stoppage due to hurricane watch or warning; and potential damage to incomplete structures. This risk is greatest during the period June 1 to November 30. It is assumed that an effective hurricane preparedness plan will be implemented.
- Loss of containment of plume during dredging. Booms/silt curtains will be installed as a matter of course.
- Disruption of the main access road between Kingston and the site due to breach (storm surge, earthquake etc.) or traffic congestion.

1.3 Operational Phase Footprint/ Site Plan

1.3.1 Specifications

1.3.1.1 Marina and Boat Tour Complex

Phase 1 of the 7th Harbour Development makes provision for the creation of 80 slips and all associated marina facilities, including facilities for refuelling, sewage pump-out, launch and haul-out and boat storage/repair.

1. **Marine Fuel Station**: A fixed ship-to-shore re-fuelling facility will be designed with a maximum fuel (diesel and gas) storage capacity of 30,000-gallons. The re-fuelling station will be located on the western end of the dock and will be supplied by an above ground pipeline running the length of the dock from the onshore storage tank. The storage tank will be stored above-ground and will be constructed within the appropriate level of containment. The main storage of the fuel will be located near the small parking lot on eastern end. A licensed contractor will be responsible for installing and operating the fuelling station.

   Refuelling will not undertaken during inclement weather to reduce the risk of spillage, and the marine area between the fuel supply tank and the vessel will be protected with the use of oil spill booms. Best management practices recommended by the USEPA (2001) for fuelling station design will be adopted. These include:

   - The use of automatic shut-offs in the fuel lines and hose nozzles to reduce fuel loss. Fuel nozzle triggers that hold the line open without being held will not be used.
   - Regular inspection, maintenance and replacement of fuel hoses, pipes and tanks.

- Installation of a spill monitoring system. This will be part of the oil spill plan for the marina that will be submitted to the National Oil Spill Coordinator/Office of Disaster Preparedness and Emergency Management (ODPEM) as part of the post-permit requirement.
- Training of dock staff in spill prevention, containment and clean-up measures.
- Appropriate signage to explain proper fuelling procedures.
- Location and design of the fuelling station so that spills can be easily contained and cleaned up.
- Establishment of clearly marked spill containment equipment storage close to the station.

2. **Pump Out (sewage):** Provision of a pump out facility at the marina will reduce the effects of sewage discharges from recreational vessels, and is recommended in most developed countries with marina regulations and guidelines.

   The pump-out will be located in proximity to the fuel station in such a way as to not prevent another vessel from re-fuelling, and usually marked by appropriate signage (Figure 11, bottom right) to show boaters where the facility is located.

Figure 11 Pump-Out Facility

Source: http://www.epa.gov/owow/oceans/regulatory/vessel_sewage/ and http://federalasst.fws.gov/cva/cva.html **Bottom left logo (US Clean Vessel Act)**

The system will be permanently fixed to the dock (as opposed to mobile units or pump-out boat). This system utilizes a flexible hose that can be connected to the wastewater tank of the vessel. Sewage will be pumped directly from the vessel's holding tank through the hose to on-shore pipes that pump the sewage directly to the sewage treatment plant. Sewage will not be stored for more than 4 hours in the pump well. Redundancy will be built into the site with duplex wells. It will be necessary to ensure that there are adequate cleansing velocities in the pipes.

The following best practices shall be implemented:

- The marina will be declared a "no discharge" area.
- The system will be maintained and monitored according to the manufacturer's specifications.
- During peak boating seasons, the efficiency of the system will be routinely tested by measuring the time taken to empty a 5-gallon bucket of water.
- Waste (rinse water or residual waste in the hoses) will not be allowed to drain into the marina waters. The pump will be kept running until it has been rinsed with clean water.
- Shore-side restrooms will be available to boaters docked at the marina.
- Slip leasing agreements will mandate the use of pump-out facilities specifying penalties for non-compliance, and will prohibit the use of Y-valves on boats in the marina. The slip fee will include pump out fees.

3. Marina Facilities

- Launch and Haul-Out facilities – marine fork lift.
- Boat storage (dry dock capacity for 30 vessels on the eastern end). No repairs, sanding or painting will be done in Phase 1 of the marina.
- Dockside utilities: each berth will be supplied with water, power, telephone and cable television

4. Other Visitor Facilities

- Harbour Mart (a convenience store catering to the marina users stocking food items, toiletries, tackle and other basic supplies)
- Laundry facilities;
- Gaming lounge, bathrooms and changing rooms.

5. Boat Tours

Operation of the boat tours will involve running boat tours along approved navigation routes. There will be landside ticketing and management of visitors. It is proposed that a boat tour will be launched from the dock to take visitors round the harbour (for

sightseeing and dinner), to the Southern Cays (charter and regular serviced trips) and on Chartered Fishing trips. Three vessels will be used in this venture, including a 60-foot catamaran (140 passenger capacity), a 24-foot boat (10 passenger capacity) and an 18-foot boat (6 passenger capacity). The catamaran will be diesel fuelled, and the charter boats will use gas. Licensed coxswains with training in seamanship and emergency procedures will operate the tour vessels. Staff training will occur at least twice per year. The vessels will be equipped with standard safety gear:

- Depth finders
- Radio communication
- Fire extinguishers
- Flares and other signalling devices
- GPS
- Cellular communication
- Life vests

Fisheries Department, Maritime Authority and TPDCo. licenses will be sought once the NEPA environmental permit is granted.

1.3.1.2 Entertainment Centre

It is expected that during the operational phase, the entertainment center will be used 30 times per year (including public holidays), and will operate between the hours of 9:00 am and 7:00 pm and 9:00 pm and 4:00 am. The design life of the facility is of the order of 50 years.

The main impact-causing aspects involved in the operation of the entertainment centre are expected to include:

a. Staff recruitment and maintenance of a staff complement of ~83;
b. Visitor presence (maximum of 5000 persons) arising from the operation of the entertainment centre, restaurant, bar/grill and marina and boat tour, gaming lounge and harbour mart;
c. Increased vehicular traffic, solid waste and sewage generation;
d. Increased demand for goods and services;
e. Increased numbers of visitors to the Palisadoes, increasing the risk in the event of a major earthquake;
f. Use of loudspeaker systems during events, emanating maximum noise levels from speaker systems located on the perimeter will be between 100 and 110 dB, which would be lower than a jet take off from the adjacent airport;
g. Management of VIPs and parking;
h. Operation of food and beverage concessions;
i. Janitorial activities in public areas (amphitheatre, public restrooms, lounges, bars etc.); and
j. Routine landscaping & grounds maintenance.

1.3.1.3 Restaurant & Harbour Mart Operations

The restaurant will have an indoor air-conditioned seating capacity for 200 guests. There will be an additional al fresco boardwalk with seating capacity for 100 guests. The restaurant is to be accommodated in a 2-storey building designed by MODE, with a total floor area of 1383 m^2, inclusive of 670 m^2 on the first floor. The plan makes provision for 4 female toilets and 2 male toilets and 2 urinals. Grease traps will be installed on all sinks (kitchen and bathroom). Grey water from the sinks will be routed to the sewage treatment system. The bar and grill will be temporary structures located closer to the shoreline (Figure 4) and will have a combined area of ~160 m^2.

The following guidelines shall be observed in the design and layout of the food storage areas for the restaurant:

- Cold, dry and wet storage shall be kept separate;
- There shall be no cracks and crevices leading into voids in food storage and handling areas that could form insect breeding and harbourage areas;
- Cabinets and kitchen equipment shall be sealed to the wall or floor, or have at least six inches of clearance to allow for accessible, adequate, routine cleaning;
- Where practical, stack items shall be 18 inches off the floor and 18 inches away from walls;
- Doors and windows shall be tight fitting and with screens on all windows and doors that can be opened;
- Screened doors shall open to the outside;
- Food handling and storage areas shall be rodent proof and bird proof, with no openings greater than ¼ inch in diameter;
- Waste food or garbage shall be removed to proper storage or disposal sites daily;
- A routine cleaning schedule shall be designed for food storage and handling areas that anticipates spot cleaning of spills and accidents, daily sweeping and mopping of all floor surfaces, daily cleaning and sanitizing of all counter tops; and,
- Maintenance personnel shall be trained in best sanitation practices.

1.3.1.4 Parking and Access Roads

There are six parking lots in the facility with a total of 540 parking spaces.

a. The two main parking areas (lots 2 and 4) are located on the western side of the development, containing 243 and 244 spaces respectively.

b. The entertainment center has 2 small parking lots (including lot 1 and VIP parking) with a total of 27 parking spaces.

c. The bar and grill on the eastern side of the development has 2 small parking lots with a total of 26 parking spaces.

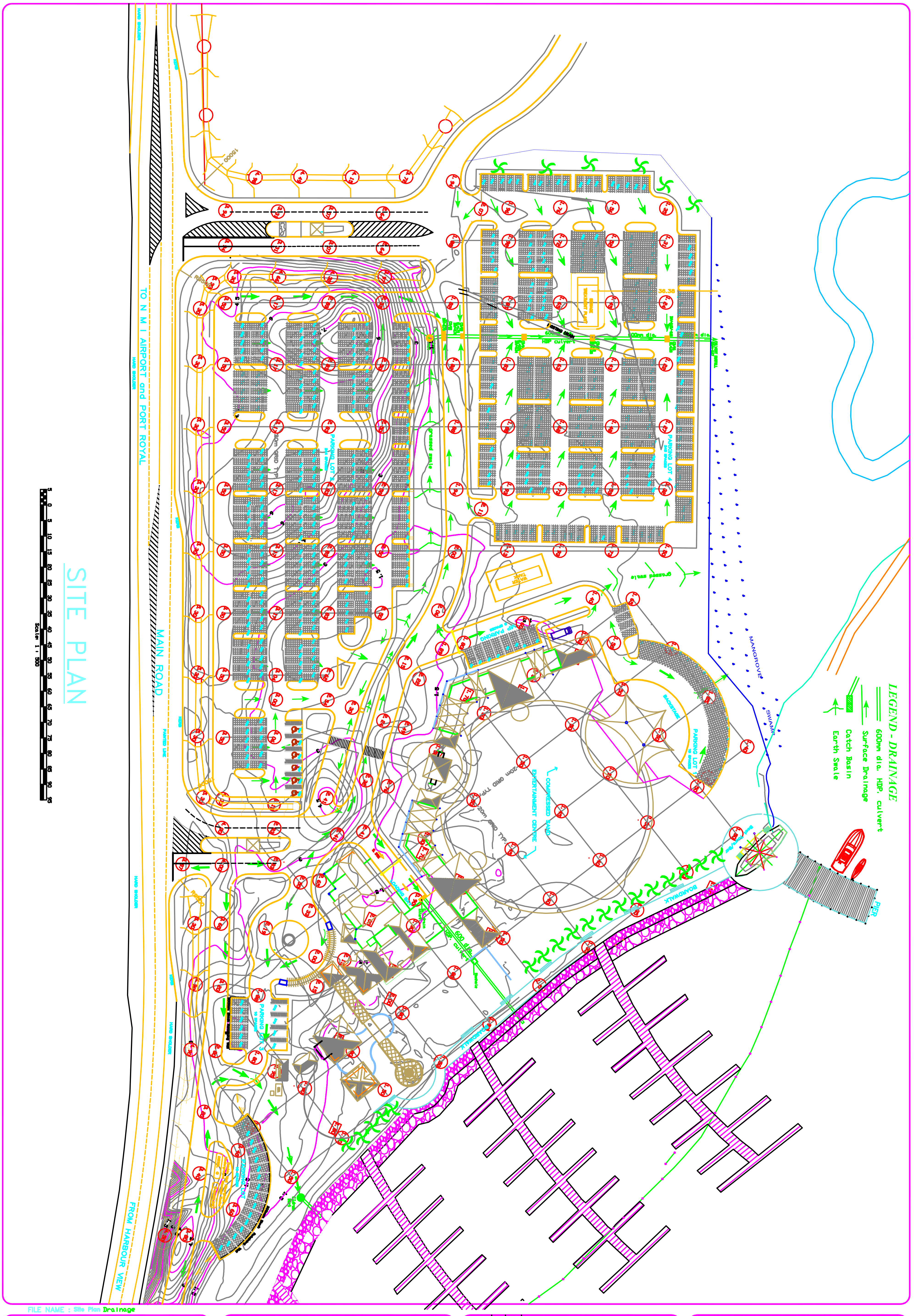
The entrance to the complex will be on the far western side of the property off the main road to the airport. This will have separate entrance and exit lanes. A secondary VIP reserve entrance will be maintained further east of the main entrance. Both entrances are served by guard houses and are landscaped (with sculpture). All parking lots and facilities shall be accessible by paved access roads.

The main entrance and exits will be gated and manned by a security guard at all times. The basic ideas would be incorporated into the final exit/entrance design will be as stipulated by the National Works Agency guidelines. A lay-by would be constructed to filter traffic from and onto the main road, and to enable safe off-road drop-off and pick-up. The lay-by will be one-way, with in-coming traffic filtered from an eastern entrance, and exiting traffic flowing out on the western exit. Parking bays will be clearly delineated (parallel), and will be a standard 5.48 m x 2.44 m for cars. The dimensions and reserves of the main access roadways and access aisles to parking areas shall be within standard specifications.

1.3.1.5 Drainage Plan

Creation of the parking areas as proposed by the Master Plan will alter the natural pathways for storm flows, which presently drain from higher ground toward the mangrove pond on the west of the property. The proposed drainage plan is designed to re-establish the natural flow of water towards the pond, and maintain the level of freshwater presently entering that system. Surface flows will be routed towards three 600 mm diameter culverts located on the western, central and eastern area of the property as shown on Figure 11. The western drain outfalls to the pond system, whereas the other two drains outfall directly to the sea.

An earthen swale will route storm water along the main access road between the eastern entrance and the western parking lots. Another earthen swale running on the western side of the Entertainment Centre will route storm water towards the sea via the mangroves. This system has been designed to accommodate the 25-year storm event, and is not expected to produce flooding as the final receiving pond overflows directly to the sea.



FILE NAME : Site Plan Drainage

BARRY BROWN LIMITED
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e-mail : barryp_brown@yahoo.com

CLIENT	TREASURES LTD.
PROJECT	SEVENTH HARBOUR DEVELOPMENT
TITLE	SITE PLAN - DRAINAGE

DATE	MK	BY	Revisions & Issues
MAY 01, 07		BB	FOR APPROVAL

ARCHITECT M • O • D • E Architects

DESIGNED BY	CHECKED BY	APPROVED BY	DRAWN BY
B.B.	B.B.	B.B.	BB
DATE	SCALE	JOB No.	SHEET No.
JUNE'06	AS SHOWN	0205	C- 04

1.3.1.6 Sewage Treatment Plan

A package extended aeration system will be used. The plant consists of a ¼ inch thick steel tank compartmentalized into zones for aeration, clarification, sludge holding and chlorination. The manufacturer (Florida Aquastore and Utility Construction Inc.) shall furnish all equipment, piping, fittings and valves within the system. The proposed sewage treatment plant (STP) shall be capable of treating an average daily flow of 20,000 gpd. This design capacity will be able to accommodate maximum populations in the entertainment centre.

The process is as follows:

1. Raw sewage is fed into the Aeration Chamber where it is mixed with activated sludge from the clarifier. This is aerated so that sewage and bacteria are in constant motion. Mixing continues for 24-hours during which time the bacteria oxidizes carbon and the ammonia-nitrogen compounds.
2. The mixed liquor exits the aeration chamber and enters the Clarifier. Biological solids are separated from the clear supernatant through settling. These are then picked up by the Sludge Removal Mechanism and transferred to the Sludge Return Trough, then through the Sludge Manifold Outlet into the Aeration Chamber and the cycle is repeated.
3. Effluent from the Clarifier goes to the Chlorine Contact Chamber, which provides ~30 minutes of detention time before discharge. The STP will have a final wastewater effluent that is in compliance with the NRCA sewage effluent discharge criteria. Final tertiary effluent shall be monitored for suitability for the proposed outfall to the mangrove system or reuse for irrigation purposes.

The site plan locates the STP in Parking Lot 2 with easy access to the main road, at a distance of 180 m from the Harbour shoreline and the pond on the west end.

1.3.1.7 Solid Waste Disposal

The main solid waste collection area is located near the service area (behind restaurant) for easy truck access and wash down. Solid waste can also be collected after an event near the VIP Parking area.

1.3.1.8 Water Supply

Water shall be supplied by the NWC. Emergency water will be stored in a tank located near the VIP parking area. There will be two fire hydrants located on the property: one near the building complex and one that would serve an emergency on the docks.

1.3.2 Resource Consumption

- The estimated potable water demand is ~61 m^3 per day. This will be supplied from NWC mains that presently serve the site.
- Electricity demand will be met from the existing JPSCo mains (150 kVa).
- Approximately 5000 gallons of diesel and 5000 gallons of petrol will be stored on site in associated with the refuelling station.
- It is estimated that a total of 83 jobs will be created. This includes 33 employees in the restaurant, 18 in the marina and boat tour, 22 in the management company (management-6, security-10, groundsmen-6), and another 10 permanent staff for the entertainment center.
- Transportation is required for staff commuting to Gunboat Beach on a daily basis.
- There will be increased demand for emergency planning and services in the area due to presence of staff, visitors and property.
- Inputs from landscaping may include fertilizer, plants, irrigation water, pesticides, mulch.
- There will be a demand for staff food and beverage.
- Air conditioning will be required (in offices, gaming lounge and restaurants).
- Landfill space (off-site) will be required for domestic solid waste disposal.
- The demand for food and beverage can be satisfied locally with a supplies of seafood from Port Royal, Kingston, and St. Thomas, fresh produce from St. Thomas and Downtown Kingston, and processed food from St. Thomas.

1.3.3 Waste Streams

- Air emissions: vehicular emissions and fugitive dust; hot air from air conditioners.
- Light emissions: Night time lighting of marina, restaurant and entertainment centre, and security lighting at entrances and exits.
- Noise emissions: Vehicular and equipment emissions; noise from entertainment events (amplified music and crowds).
- Effluent discharges:
    - Suspended solids.
    - Oil and grease from vehicle and boat maintenance, and parking lot.
    - Storm water run-offs arising from increased impervious surface at site.
    - Sewage effluent from sewage treatment plant.
    - Grey water from sinks and bathrooms in offices, restaurant and entertainment centre. This is expected to contribute to phosphate and oil and grease loading.

- Solid waste:
    - Domestic waste from staff.
    - Entertainment centre wastes: domestic wastes, plastic and glass bottles, tins, styro-foam, plastic bags.
    - Oily rags from vehicle and equipment maintenance.
    - Restaurant wastes: organic and packing wastes, bottles, used cooking oils etc.
    - Cuttings from pruning vegetation.

1.3.4 Upset Conditions

During operational conditions, there will be a risk of the following upset conditions. Environmental impacts of the following upset conditions shall be included in the relevant section:

- Vessel collisions in the marina area;
- Hurricane/storm surge;
- Earthquake;
- Oil spill and or fire;
- Sewage treatment plant malfunctions.

2 REGULATORY AND INSTITUTIONAL FRAMEWORK

2.1 SECTION OVERVIEW (TOR)

The aim of this section is to outline the environmental and other specific regulatory approvals and legislation relevant to the project at the national, international and local levels.

2.2 PLANNING CONTEXT

2.2.1 Physical Planning

The major planning document for the Kingston and St. Andrew area is the Kingston Confirmed Development Order of 1966, which has become outdated. According to the Confirmed Development Order, the location of the proposed project is zoned for public or private open space. Additionally, lands from the Harbour View round-a-bout to Gunboat Beach were designated Public Open Space by the Urban Development Corporation in 1998.

More recently the Draft Kingston and St. Andrew Sustainable Development Plan (2005) has become available. One of the goals of the plan is to promote growth and increased productivity. This includes promotion of the growth of tourism facilities such as those being proposed by the developers. This plan suggests the rebuilding of Victoria Pier to accommodate cruise shipping. It also suggested that Port Royal could be used as an attraction to stimulate cruise shipping tourism. Although identifying the potential of Port Royal for "sea based" tourism, the plan does not adequately address the urban population's needs for recreational opportunities and properly maintained infrastructure.

In 2004-5, NEPA was involved in a major harbor initiative, entitled "*Institutional Strengthening and Preparation of a Zoning and Physical Development Master Plan for the Kingston Harbour".* A description of this project is available at the NEPA website at http://www.nrca.org/projects/kingstonharbour/index.htm. The purpose the project is to "*kick-start activities that will contribute to a unified and sustainable effort towards a cleaner Kingston Harbor*". The project sought to develop a Physical Plan for the Harbour, which was to include a Basic Zoning Plan of the harbor, which would complement the Master Plan of the KMA, focusing on the water quality and land/water uses around Kingston Harbour. According to the Institutional and Legal Framework Report (SWIL, 2005), opportunities for development of the Kingston include grand waterfront and theme parks, marina developments and cruise ship berthing facilities, waterfront residences (page iii).

2.2.2 Tourism Master Plan (2002)

The Tourism Master Plan is most relevant Master Plan in evaluating tourism related development proposals. The plan suggests that "*if Port Royal is developed as a cruise port as planned, the result would be one of the most attractive cruise ports in the Caribbean with the potential to draw much higher visitor numbers than Ocho Rios does at present.",* although it suggests that this would divide the market presently controlled by other ports of call in Jamaica. This would be equally valid for the development of a port of call at Gunboat Beach.

The Plan does not address the potential for marina tourism in the Kingston area. Although in reference to Port Antonio, the Plan does suggest that JAMPRO should be mandated to attract international operators of marinas and yacht charters to facilitate the development and operation of marinas.

The master plan identifies a major void that could be met in Jamaican tourism in terms of the provision of conference facilities (for corporate retreats and special interest groups). It identifies the following factors as critical to the success of that type of tourism: "*minimum flight times, proximity to the airport, ability to provide efficient, ground transport, attractive physical setting, good weather, value for money accommodation and food, and ability to provide conference rooms for large numbers…*" (p 35). Upon completion of both phases of the proposed 7th Harbour development, it will be an ideal venue to promote this type of tourism.

In terms of the domestic market, the plan alludes to the case for development of attractions and entertainment venues. However, the plan does not begin to address the issue of developing recreational infrastructure geared towards the domestic, particularly the urban, market. The plan does identify the importance of events such as Reggae Sumfest with visitors and the domestic market, as well as the importance of reggae music to heritage tourism. Although the plan notes "*there is a striking shortage of man-made attractions and leisure complexes"*, it overlooks the urban domestic market and suggests Ocho Rios and Montego Bay as feasible locations because of the numbers of stop-over, cruise and domestic visitors there. The plan suggests that this sector should receive similar incentives to the hotels to stimulate its development.

2.2.3 Protected Area Status

The entire Palisadoes and Port Royal Cays area was declared to be a Protected Area in May 1998, under The Natural Resources Conservation Authority Act. One of the goals of the policy is to "*provide recreational opportunities and services for the Jamaican public and visitors, in ways and at levels compatible with the protection and sustainable use of natural areas".* The Palisadoes-Port Royal Plan (May 1998) refers specifically to the former recreational use of Gunboat Beach and Buccaneer Beach, and its decline because of water pollution in the Harbour. According to the plan, Buccaneer and Gunboat beaches fall within Zone 2 of the plan. The plan suggested that "*opportunities exist for further restoration of these beaches and new uses such as recreational environmental education facilities".* It also mentions that the mangroves and lagoons surrounding the airport are severely disturbed, and stipulated that "*In*

view of its already intensively humanized landscape, additional development of the Tombolo should be restricted to this segment." The proposed development within Zone 2 is therefore consistent with the plan.

The Palisadoes - Port Royal Ramsar Site was designated as such in 2005. The PPR covers an area of 7,523.08 ha and falls within eco-region 236 (Western Tropical Atlantic Greater Antillean Marine). This designation is in compliance with the system established under the **Convention on Wetlands** (Ramsar), which provides a framework for the national action and international cooperation for the conservation and sustainable utilization of wetlands and their resources. Currently, there are 153 contracting parties to the Convention, with 1634 wetland sites, totaling 145.6 million hectares. These wetland sites are designated for inclusion in the Ramsar List of Wetlands of International Importance. The Ramsar datasheet for this site is included as Appendix 2. Section 22. (b) indicates that "*The urbanized areas of the Tombolo not designated as part of the Ramsar site are predominantly State controlled but there are a few areas that are in the control of private companies or citizens".* With the exception of a relatively small mangrove stand on the western perimeter, the Phase 1 does not call for removal of any significant removal of mangroves or modification of mangrove hydrology.

The site is also listed by the Jamaica National Heritage Trust (JNHT) as a heritage site[3]. According to the JNHT the site was named after a rusting Haitian Gun Boat that is found there.

2.2.4 The Palisadoes Protection and Rehabilitation Project

The Ministry of Land and Environment and the Ministry of Housing, Transport, Water and Works, National Works Agency in the collaboration of UNEP Regional Office and the Ministry of Science, Technology and Environment of Cuba (CITMA) facilitated a technical study on the protection of the Palisadoes. This study was concerned with the stretch of the highway between the airport and Kingston. The draft report of that study became available in February 2007. The area of greatest concern is the narrow eastern strip of the Palisadoes between the Harbour View Roundabout and the the area immediately east of the project area (Figure 13).

From the eastern boundary of the development site, the Palisadoes is wider. The leeward side (on the northern side of the highway), on which the site is located, is less vulnerable to extreme wave processes associated with the open sea (on the southern side of the highway). Modeling of storm waves also showed that the eastern end secton of the Palisadoes was most exposed to very destructive storm surges (3 to 5 m above mean sea level).

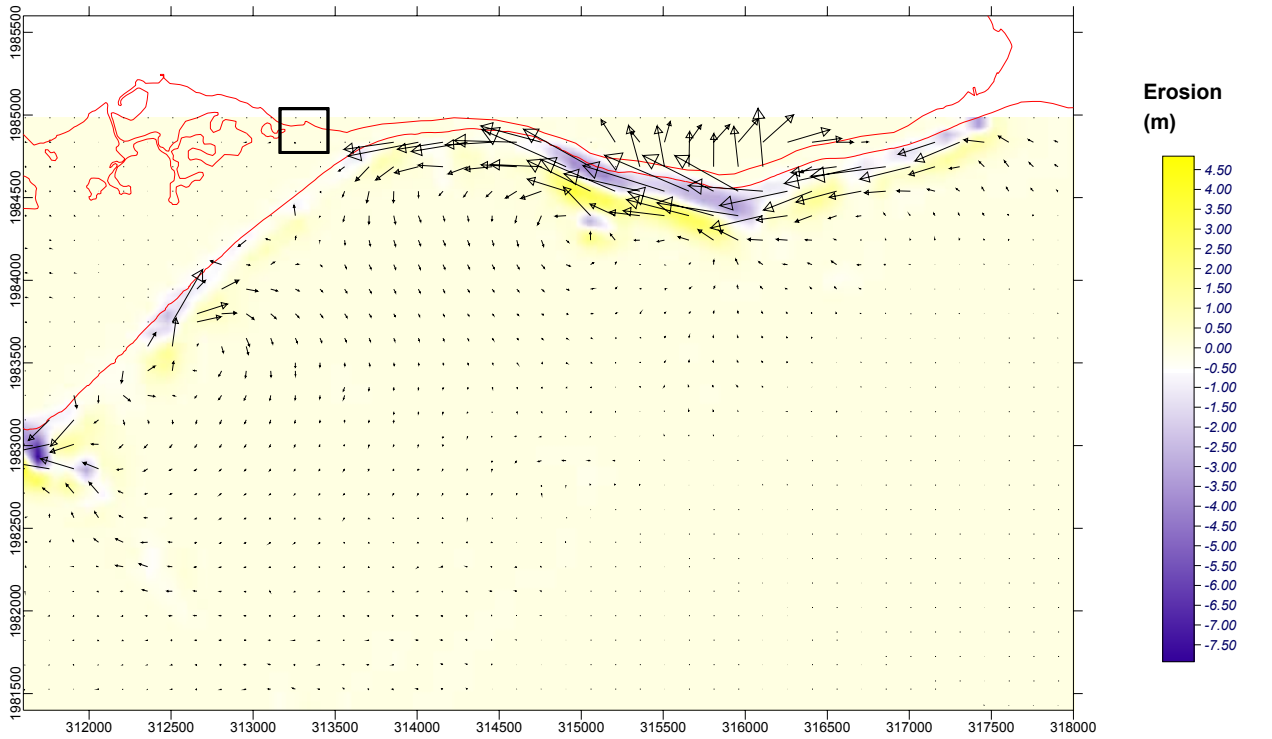
Plans for protection of the Palisadoes are therefore related to erosion on the windward (southern) exposure of this vulnerable strip of land, which the study concluded may be related to sediment deficit, hurricanes, and sea level rise. Erosion of beaches and dunes on the southern side of the strip is seen as a form of self-regulation of the system given these negative factors.

[3] http://www.jnht.com/disndat/gunboat.php

For the backshore area, the study recommended consideration of seawall, breakheads, revetment, groynes in the long term. Amongst the immediate options for protecting the most vulnerable sections on the Palisadoes, the study recommended:

1. Dune reconstruction and reconstruction of the westernmost groyne.
2. Placement of stone revetment on the most eroded section of the shoreline.
3. Construction of 400 m of new road, north of the existing alignment, which will be elevated to a level 2 m above the present road surface, with a system of drainage inlets/culverts that allows water to pass toward the harbour during storm events.

Figure 13 Sediment-Erosion Trend



Reproduced from Figure 9 from the February 2007 Draft Report prepared by Inversiones Gamma SA.

The study site does not fall within the zone of concern, and the sedimentary/geomorphic assessment of the site (see Section 3.2.7) concluded that although the dunes on the site represent accumulations of sand that may have been removed from the southern side of the shoreline, they do not necessarily contribute to the stability of the southern shoreline at the present time.

2.3 REGULATED ASPECTS OF THE PROJECT

2.3.1 Development Control

2.3.1.1 Permitting

The National Environment and Planning Agency (NEPA) is in charge of land use and development and natural resource conservation under the **Natural Resources Conservation Authority** (NRCA) Act, (1991) which makes stipulations for Environmental Impact Assessments (EIA) in addition to the requirements of the Permit and Licensing System for a development proposal. Marinas and theme parks require an environmental permit under the NRCA schedule. A license is also required for the construction of any works, such as, a sewage treatment plant. Encroachments onto the foreshore (e.g. dredging, reclamation or establishment of permanent structures on the foreshore) require a Beach Licence under the **Beach Control Act**, which is administered by the NRCA.

The Town and Country Planning Authority governs the **Town Planning Act** which regulates the development order and use of land in Jamaica. All development projects must be granted planning and building permission, with due consideration to planning constraints such as zonation, parking and availability of municipal services, from the local and Planning Authority and the Town and Country Planning Authority, which in this case is the Kingston and St. Andrew Parish Council. The area for the proposed development falls under the Town and Country Planning Act (1957) and is governed by the Town and Country Planning Act (Kingston) Confirmed Development Order, 1966, which falls under this Act and guides physical development in the Parish. **The Kingston and St. Andrew Building Act** controls building in the Kingston Metropolitan Area (KMA).

The Developer's Manual produced by The Town Planning Department outlines a requirement for an entertainment facility (Dance Halls, Clubs, Bars) : 1 car per 20 square feet while for motels it is 1 space for each guest unit plus 1 for each 50 square feet of public dining room.

The **Office of Disaster Preparedness and Emergency Management** (ODPEM) is an advisory body with responsibility to implement pro-active and timely procedures to prevent or reduce the impact of hazards on Jamaica. The ODPEM provides recommendations to NEPA and the **Kingston and St. Andrew Parish Corporation** (KSAC) with regards to vulnerability to hazards for proposed development. The **ODPEM Act** is currently being amended and will include policies on high risk areas such as Palisadoes.

2.3.1.2 Approvals for Specific Project Elements

Marinas: The **Shipping Act (1998)** provides for the establishment of Maritime Authority. The Authority has responsibility for the wide-ranging activities regulated by this Act, including

- Manage a shipping registry for Jamaica
- Regulate seafarer certification.
- Regulate the safety of shipping (construction of ships and navigation).
- Inspect ships for maritime safety and prevention of marine pollution.
- Investigate ship accidents and charges of incompetence or misconduct on the part of seafarers in relation to such accidents.
- Establish maritime training and safety standards.
- Administer policy for the development of shipping in general.

Section 60 of the Shipping Act makes special provisions for pleasure craft in Jamaica waters, and deems that the requirements of the Act are met, provided that it complies with the requirements of the Part VI of the Customs Act (relating to departure and clearance of craft).

The **Pilotage (Waiver of Compulsory Pilotage) Order** (1981) pertains to navigation within a pilotage area like Kingston Harbour, and makes provision to waive the pilotage requirement for yachts entering marinas and cruising Jamaica waters soley for pleasure. In order to obtain approval for this waiver, the ship's master must provide the Authority with the following information:

- *the name, nationality, call sign, draft and gross registered tonnage of the ship;*
- *the immediate and ulitimate destination of the ship within the compulsory pilotage area;*
- *the nature of any cargo on board the ship;*
- *whether the master of the ship is familiar with the route and marine traffic regulating system in the compulsory pilotage area;*
- *whether the master of the ship is prepared to proceed without the service of a pilot.*

The **NRCA Guidelines Pertaining to Marinas and Small Craft Harbours** (1996) provides basic definitions, and guidelines for design, construction and operation of marinas as well as hurricane preparedness and monitoring. These guidelines stipulate *inter alia* that:

- only limited repairs should be done while the boat is in its berth, and that major paint work, sanding and engine overhaul must be carried out in areas designated for boat maintenance.
- "No Wake" signs must be exhibited prominantly in places in the entrance channel and within the marina. Jet skis are not allowed in marinas.
- In the event of a storm, there must be nobody on board any of the vessels.

Other stipulations in respect of pollution (noise and other wastes) are described under the relevant headings below.

Fueling Stations: The **NRCA Guidelines Pertaining to Marinas and Small Craft Harbours** (1996) stipulate that fueling facilities must comply with the requirements of the relevant Jamaican Authorities, properly maintained and monitored. A contingency plan for the control and mitigation of spills must be prepared and ratified by the JDF Coastguard, ODPEM and the NRCA. There should also be clearly visible notices that indicate that smoking is prohibited, and where fire-fighting and oil spill clean up equipment is located. Section 6 of the **Petroleum and Oil Fuel (Landing and Storage) Act** requires that a special storage facility be constructed and approved by the Minister where more than 120 gallons of petroleum is to be stored. Section 7 stipulates that retailing of petroleum requires a license in accordance with this act.

Tourism and Recreational Activities: **The Ministry of Tourism, Entertainment & Culture** is responsible for regulating watersports (including boat tours) and recreational attractions in Jamaica through the Tourism Product Development Corporation (TPDCo) and the Jamaica Tourist Board. Section 8 of the **Fishing Industries Act** prescribes that registration and licensing under the act is required for recreational and sport fishing.

Restaurants: The operation of restaurants must comply with the **Public Health Act**, which gives the local health board the right to inspect the sanitary conditions of restaurants and eating establishments. Restaurants must be inspected by the Kingston and St. Andrew Health Department and must hold a Public Health Certificate. Individuals involved in food preparation are required to have a Food Handler's Permit, issued by the Ministry of Health. The **Food Storage and Prevention of Infestation Act** provides for inspection in order to prevent infestation by pests such as rodents, insects or fungi.

2.3.1.3 Approvals for Utilities, Civil Works and Infrastructure

Roads: **The National Works Agency (NWA)** operates under the **Main Roads Act (1932)** as it relates to maintenance of roads and road construction. The Act regulates the detailed procedures and requirements for major roads, inclusive of the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing of main roads.

Drainage: **The National Works Agency (NWA)** administers the **Flood Water Control Act** which regulates the management of watercourses concerning flood regulation, specifically, terms of surveys, civil works or clearance. The NWA reviews and approves the development proposal of any road or drainage works particularly as they connect to municipal roads or drainage systems.

Water Supply: The National Water Commission (NWC) Act (1980) regulates public water supply systems and public sewerage and sewage treatment. **National Water Commission (NWC)** provides potable water and sewage services for proposed development. All water supply and sewage disposal plans must be granted approval by the NWC. This is done in conjunction with the **Water Resources Authority**, which administers the Water Resources Act and is thereby mandated to regulate ground and surface water resources, specifically, supply, flood risk and water quality.

2.3.2 Environmental Protection

2.3.2.1 Air Quality

The Natural Resources Conservation Authority (NRCA) Act administers the **Natural Resources Conservation Authority (Air Quality) Regulations (2006)** under its mandate. The **Ambient Air Quality Standards (AAQS)** are the maximum concentrations of air pollutants allowed in the atmosphere. The Jamaican Ambient Air Quality Standards are listed in Table 3.

There are major six contaminants referred to as criteria pollutants. These pollutants are particulate matter (PM) expressed as total suspended particulate matter (TSP) or PM with aerodynamic diameter less than mimimal 10 µm (PM_{10}), photochemical oxidants, for example ozone (O_3), lead (Pb), sulphur dioxide (SO_2), carbon monoxide (CO) and nitrogen dioxide (NO_2). However, the criteria pollutants are not the only ones emitted into the atmosphere. Therefore, there are maximum guideline concentrations set for Priority Air Pollutants (PAPs) available from the NRCA.

The Clean Air Act (1964) regulates air emissions of any noxious or offensive gases which include alumina, cement, lime and sulphur resulting from petroleum, gypsum and sugar processing as well as electrical generation stations. The proposed development is not expected to generate any of the above listed activities in either its construction or operational phases.

2.3.2.2 Noise Emissions

The Noise Abatement Act (1997) regulates "public peace" in terms of the generation of nuisance noise audible beyond 100 m from the source in day or night time. According to this act, "*specified equipment*" shall not be operated later than 11 o'clock at night at "*a public meeting*" and later than midnight at a political meeting held between nomination and elections nor from Sunday to Thursday. Under the act, a person who wishes to operate equipment providing music for entertainment in a public area in which such music is capable of disturbance to any persons occupying or residing in any private premises, is required to make a written application to the Superintendent of Police in charge of the division for permission to do so, no later than ten clear days before the date on which it is proposed to hold such activity.

The **NRCA Guidelines Pertaining to Marinas and Small Craft Harbours** (1996) stipulate that VHF and other radios and music systems must not be used in the marina where they may be a source of annoyance to other boat users and marina guests.

World Bank Health Organization and the **World Health Organization Noise Standards** may be used for noise emission regulations. These standards fall into one of three major categories – residential, commercial and industrial. According to McTavish (2006) an industrial zone includes lands "*where protection against damage to hearing may be required, and the necessity for conversation is limited."*

As the Caribbean Maritime Institute and the Royal Jamaican Yacht Club are located in proximity to the site, the area cannot be designated industrial. A commercial zone includes lands where conversation is essential to the intended use of the land, and includes retail trade, business and professional services, amusements (recreational) land use. A residential zone generally includes areas where people sleep or where quiet is essential. Some countries have also introduced a silence zone near noise-sensitive receptors (such as hospitals and educational institutions), which involves the prohibition of certain activities (e.g. car horns and loudspeakers) within 100 m of the receptor.

Commercial and industrial zones are required to operate within 70 dBA for both night and day. Residential zones have a 55 dBA restriction in general, although the World Bank night time (10:00 pm to 7:00 am) for residential zones is 45 dBA.

The **Noise Pollution Rules of the Environment Management Act (2000) of Trinidad and Tobago** use three zones in which a sound may originate: industrial, environmentally sensitive areas and general. The maximum sound pressure level (SPL) must not exceed 75 dBA, 60 dBA and 65 dBA respectively in these zones.

The US **Federal Aviation Administration** (FAA) uses a DNL (i.e. day-night average sound level) of 65 dB as the threshold at which significant noise exposure from airport occurs. Levels between 55 – 65 dB are considered moderate exposure. In comparison, the **United States Environmental Protection Agency** (USEPA) uses a DNL of 55 dB for outdoor noise for the protection of public health and welfare with an adequate margin of safety.

The McTavish (2006) review of the special provisions from the Indian noise standards framework indicate guidelines such as directing loudspeakers towards audiences rather than away from the crowd. These provisions also recommend regulation of the power amplifiers to be just adequate to cover the audience level.

2.3.2.3 Forestry, Wildlife and Biodiversity

The Town and Country Planning Authority (The Kingston and St. Andrew Parish Council), under Section 25 of Town Planning Act which regulates the development order and use of land in Jamaica administers the preservation of forests, woods, trees, shrubs, plants and flowers.

The Palisadoes-Port Royal was designagted a protected area under the NRCA Act (1991) in 1998, and a management plan for the protected area that was drafted in 1999 is currently being updated with a view towards implementation. In addition, it was announced in 2006 that a **wetlands policy** for Jamaica is to be formulated during the fiscal year 2006/7.

2.3.2.4 Harbour and Coastal Areas

The Beach Control Act (1956) is administered by the **Natural Resources Conservation Authority (NRCA)** which regulates coastal and marine resources by administering licensing of activities on the foreshore and the floor of the sea for specific purposes. The Act also enforces access to the shoreline, and other legislation addressing fishing and public recreation, in addition to the development of marine protected areas. NEPA, under the Act, approves the proposal for development on the foreshore and the floor of the sea. These include the building of docks, wharfs, piers or jetties.

The Harbours Act (1874) is administered by the Marine Board and regulates activities within the harbours or channels of Jamaica, such as, the movement of boats, vessels and other sea craft, the placement of buoys and the removal of sunken vessels or structures and the removal of sand, stone and ballast from harbours, reefs and shores. The Act also enforces penalties for the release of refuse and waste matter from vessels.

The Harbour Fees Act (1927) allows for the payment of a prescribed harbour fee by a vessel entering Jamaican harbours and required to be paid to the Port Authority of Jamaica (PAJ). The Harbour Fee Order (1978) regulates different harbour fees for various categories of ships primarily based on the contents of the vessel (cruise passengers, containers, petroleum, gypsum, bauxite and alumina).

The Port Authority Act (1972) is administered by **The Port Authority of Jamaica (PAJ)** which is the Statutory Corporation primarily responsible for providing and regulating port facilities in Jamaica. This Act establishes a Marine Board to make rules for the regulation and control of harbours and ship channels. This Act prohibits the discharge of rubbish, earth, stone, ballast, mud, oil, mixtures with oil or its residues, as well as the removal of stones and gravel from reefs, shoals, or cays. Kingston Harbour requires designation of ship anchoring zones, and authorization from the Harbour Master in respect of control of all sources of sewage, pollution, oil discharge, chemical releases, garbage disposal, etc. to the harbour from all land-based and ship-based sources. Shore reception facilities for ship-based garbage and sewage treatment should be provided under the supervision of the Harbour Master before the marina can be approved.

The Harbour Lights and Lighthouses Act (1900) authorizes the ownership of all lighthouses and harbour lights in the Commissioner of Lands. The Harbour Master along with the Port Authority authorized to construct the lighthouses and harbour lights is in charge of the care and management.

2.3.2.5 Heritage Resources

Jamaica National Heritage Trust (JNHT) is a branch of the Ministry of Youth and Culture. It enforces its mandate under the Jamaica National Heritage Trust Act (1985) which serves to identify and preserve anything that can be designated as part of the national heritage, including physical structures and objects, underground, above ground and beneath the sea. In the event of the discovery of submarine archaeological artifacts during construction, the JNHT will be notified as it is responsible for declaring all national monuments.

2.3.3 Waste Management

Pollution in the Kingston Harbour has long been recognized as a major environmental issue facing the city. Several important environmental assessments and rehabilitation initiatives have produced numerous recommendations for legislation, policy and planning controls on waste management. The main pollutants in the harbour include sewage, solid waste, ship waste, sediment, industrial and agricultural effluents and oil spills.

The **NRCA Guidelines Pertaining to Marinas and Small Craft Harbours** (1996) stipulate that:

- Wastewater from clubhouse, kitchens, bars, restaurants associated with the marina must be collected and treated prior to disposal.
- Wastewater from boat maintenance areas must not be allowed to flow into the marina or coastal areas but be pumped to a storage tank and overflow liquid disposed of ashore in a tile farm or soakaway. The tank sludge must be removed and taken to an appropriate land fill to be disposed of as toxic material.
- Wastes generated on board small crafts and yachts cannot be thrown overboard (except food wastes when a certain distance offshore). Thus the marina must be willing to accept waste from any vessel wishing to dispose of its waste. The marina must provide suitable containers for disposal of oily wastes, garbage, and sewage.

2.3.3.1 Marine Wastes and Marine Pollution

The **Shipping Act** (1998), under Section 366, permits the Director of the Maritime Authority to "*take measures in accordance with generally recognized principles of international law to protect the environment from pollution following a maritime casualty or acts relating to such casualty which may reasonably be expected to result in harmful consequences."* This act also specifically empowers the Minister to make legal provisions and regulations to put into effect any international agreement, such as Marpol, relating to shipping or prevention of pollution of the marine environment.

Marpol 73/78 (which stands for marine pollution 1973 and 1978) is the International Convention for the Prevention of Pollution from Ships, 1973 and was later modified by the 1978 Protocol. The Marpol 73/78 is the most important international marine environmental convention and was established to preserve the environment by completely eliminating pollution by oil and other harmful substances and the minimization of accidental discharge of such substances into seas. There are six annexes in Marpol which are concerned with the prevention of different forms of marine pollution from ships. These are oil, noxious liquid substances, harmful substances carried in packaged form, sewage, garbage and air pollution respectively. A State that becomes party to Marpol must accept Annexes I and II, however, Annexes III and VI are voluntary.

The London Protocol provides a framework protecting the marine environment from dumping activities, and establishes the "precautionary approach" as a general obligation which requires that "*appropriate preventative measures*" must be taken when it is possible that waste being discharged into the marine environment may be harmful. The London Protocol also states that "t*he polluter should, in principle, bear the cost of pollution*".

2.3.3.2 Land-Based Waste Management

The Pollution and Prevention Control Branch of the **National Environment and Planning Agency (NEPA**) regulates the control of groundwater contamination under Sections 15 and 16 of the NRCA Act. Section 12 of the NRCA Act stipulates that licenses are required for the discharge of sewage or any polluting matter. Section 17 allows for the periodic performance reporting from the owner or operator of any sewage treatment plant, industrial waste treatment facility or any facility for the disposal of solid waste or any other facility for controlling pollution.

This can include information pertaining to the performance of the facility; the quantity and condition of effluent discharged and the area affected by the discharge of effluents. Table 4 summarizes the effluent criteria for Jamaica (NRCA standards)

Table 3 Jamaican Water Quality Standards (Key Parameters)

Parameter	Freshwater	Sewage Effluent	Trade Effluent
Nitrates mg/L	0.10 - 7.5	10 (Nitrogen)	10
Phosphates mg/L	0.01 - 0.8	4	5
Biological Oxygen Demand mg/L	0.8 - 1.7	20	<30
Total Suspended Solids mg/L	-	20	<150
Faecal Coliform - MPN/100 ml	-	1000	100

The **Public Health Act (1985)** makes provision for the establishment of the **Central Health Committee (appointed by the Minister chaired by the Chief Medical Officer).** The Public Health Act under Section 7 makes provision for the local health boards (Parish Council) to regulate *inter alia* such areas as public sanitary conveniences, lodging houses and camps, swimming pools, restaurants, public nuisances, garbage and waste. This is done in conjunction with the Central Health Committee. The **Environmental Health Unit (EHU)** of the Ministry of Health has responsibility for administering the act, including the review of designs for sewage treatment. The **Public Health Regulations** (First Schedule, paragraph 10) prohibit the discharge of sewage into the sea.

The National Solid Waste Management Act (2001) regulates solid waste management in Jamaica. This includes the regulation of environmentally sound waste collection, transportation, re-use and re-cycling, and the development of a licensing system for operators of solid waste management and collection facilities. The **National Solid Waste Management Authority (NSWMA)** is the governing body in charge of solid waste management in Jamaica.

3 DESCRIPTION OF THE ENVIRONMENT

3.1 SECTION OVERVIEW

The purpose of this section of the EIA is to describe Valued Environmental Components (VECs) within an area that could be impacted should the project be implemented. It is therefore not limited to a description of the site. The level of study given to any one VEC in this baseline is commensurate with the degree of change to baseline condition that may be expected as a result of project implementation. Information presented in this section allows for:

1. Evaluation of existing trends in environmental systems if the project were not implemented and the carrying capacity of the environment in respect of specific stresses;
2. Determination of existing environmental effect levels to which the project may contribute; and
3. Establishment of a baseline against which future monitoring data can be compared to determine whether and how a project is actually impacting specific receptors.

This section is organized according to the broad classification of physical environment, biological environment and human and built environment. Methodologies and data sources with respect to each sub-section are given at the start of that sub-section.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Climate

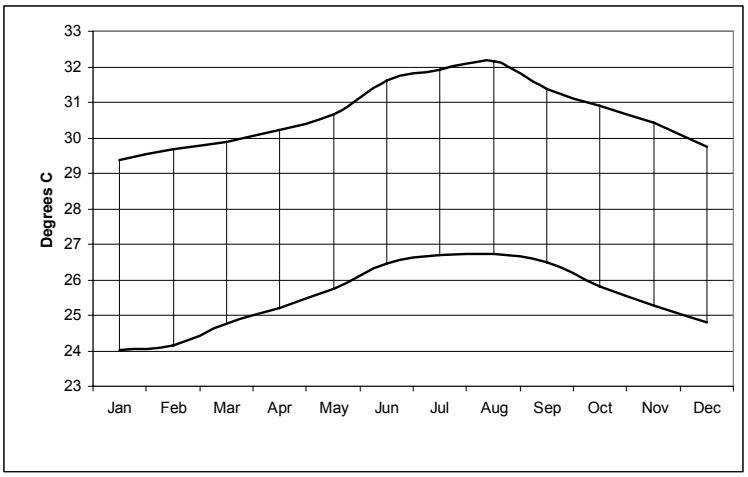
The site is located at a latitude of N17°56'44" in a coastal area. It may therefore be described as a tropical maritime climate. The development site is located ~2 kilometres from the NMIA; therefore the meteorological data from the airport can be considered representative of the study area. Available data from this station (from wunderground.com) for the 2001-2005 are used in conjunction with other available data.

3.2.1.1 Temperature

Figure 14 shows the mean annual temperatures for the period 2001 to 2005 for the NMIA (wunderground.com). This graph shows that on average there is ~5 degree C difference between temperature highs and lows for each month, and reflects the diurnal range.

Temperatures are coolest in January (~24 degrees C), gradually increasing until ~June (31.6 degrees C). After June high temperatures remain above 31 degrees C until September, and then begin gradually falling again. The maximum mean high temperature for this period was 32.6 degrees C during August 2001. The lowest mean low temperature for this period was 23 degrees C in January 2001.

Figure 14 Mean Temperatures for NMIA (2001-5)

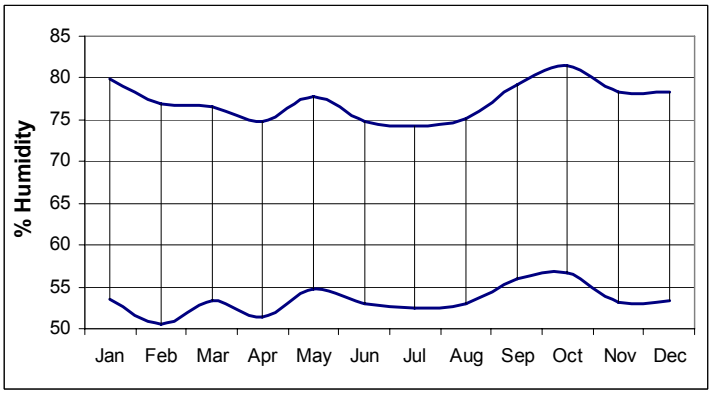


Data sourced from www.wunderground.com

3.2.1.2 Humidity

Figure 15 shows the annual fluctuation of average high and low humidity for the 5-year period 2001-5. On average there is a 24% difference between monthly high and low humidity, but over the course of a year this difference varies between 23-22% (March to September) and 25% to 26% (October to February). This difference probably reflects the effects of daytime heating. Both average high and low humidity follow the same annual trends, with higher humidity in the wet season months of September-October (78% to 82%), and May (78%). Humidity is lowest in June (75%/53%) and July (74%/52%). On average the high humidity for the remainder of months is 77%.

Figure 15 Average High and Low Humidity (%) for NMIA for 2001-5

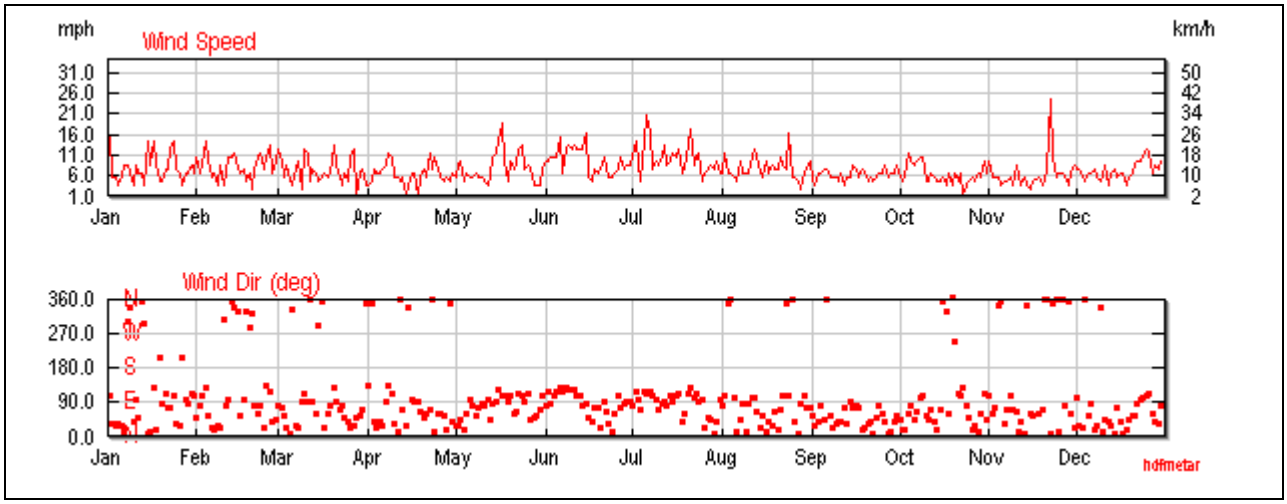


Data sourced from www.wunderground.com

3.2.1.3 Winds

The north-east trade winds are the dominant winds in Jamaica. They tend to be at their strongest during the cooler months between December and March. Figure 16 shows the available data for the year 2006 (wunderground.com). This shows that most winds come from between 0/360 degrees (North) to ~135 degrees (South East). The North East trade winds dominate the area for most of the year. However, between May to August (the summer months) a greater proportion of the winds appear to come from the East and South East.

Figure 16 Wind speed and wind direction frequencies at the NMIA (2006)



http:www.wunderground.com

Wind speeds are more variable as can be expected. In general monthly wind speeds for 2006 show an increase in wind speeds between May and August. An examination of five-year average high wind speed data for 2001 to 2006 shows a similar pattern of higher wind speeds in the summer months of May to August when average highs range between 37 to 39 kph. In general, between October and January average high winds are less than 30 kph for the period 2001 to 2006.

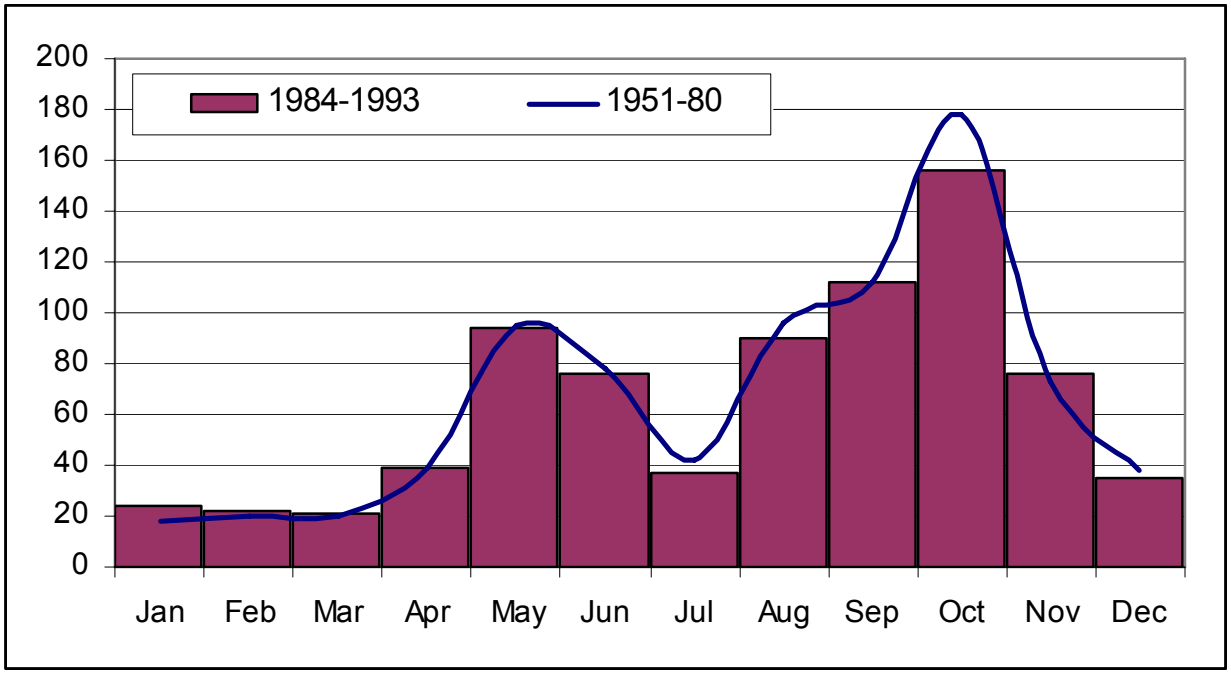
3.2.1.4 Precipitation

Available data for the Norman Manley International Airport for the periods 1950 - 1980 and 1984 -1993 were analyzed (WRA), and are represented in Figure 17. In general these data show that there is very little difference between the earlier 30 year period and the more recent 10-year period. The 30-year average total annual rainfall for the area is 810 mm per year, allowing for a relatively dry coastal climate.

The annual rainfall distribution is bi-modal, with a minor peak in May (~95 mm) and the major wet season occurring in October (with over 150 mm). In general the dry season occurs between

December and April when mean monthly rainfall is below 40 mm. July is also a very dry month with a similarly low mean monthly rainfall.

Figure 17 Rainfall Distribution for the NMIA (1951-1980)



Source: WRA

3.2.2 Ambient Air Quality

As the project is not expected to generate major air pollution, this parameter is only described qualitatively in terms of existing sources of air pollution. The major existing source of emissions in proximity to the site is the extremely busy main road between the Kingston (Harbour View Roundabout) and the NMIA.

The main air pollutants in this area are associated with exhaust emissions and fugitive dust (from trucks and heavy construction equipment using this roadway). The Carib Cement Plant is located less than 4 km to the north east of the site, and under some wind conditions may affect the site. In general dustiness in the area is related to wind and rainfall conditions, and is predicted to be at its maximum levels during the period June to August.

3.2.3 Ambient Noise Levels

Ambient day time and night time noise levels and the effects on communities in the Palisadoes area (the noise footprint) are likely to be controlled by the following factors:

1. Existing sound sources. The loudest of these would be planes taking off from the NMIA. As the noise is associated mainly with taking off and landing, the flight path direction plays an important role in skewing the noise footprint.

2. The duration of the sound. Again the most significant source of noise would be planes taking off. Aside from the duration of sound measured for a single plane to take off, the number of aircraft movements per day on average (frequency) would also be taken into account in examining the duration of the sound. Statistics[4] (Jamaica Civil Aviation Authority, 2007) for the NMIA indicate an average number of aircraft movements (inclusive of both arrivals and departures) of 33,949 per year (1981-2005). This gives a daily average of ~93 aircraft movements per day. As this is an average, there may be significant seasonal variation in movements over the course of a year with higher daily movements in busy seasons. Normal airport flight operating hours range between 6:35 am and 8:40 pm for scheduled flights. Unscheduled delayed flights sometimes arrive later than midnight.

3. The distance of the sensitive receptors to the noise source. The site of Phase 1 of the 7th Harbour Development occurs within 2 km of the runway at the Norman Manley airport. Assuming the maximum noise level emitted at the end of the runway is from a plane taking off, at about 115 dBA at 10 m and that every doubling of distance the sound decreases by 6 dBA (Therivel and Breslin, 2004), it may be extrapolated that at 2 km away, the sound level is ~69 dBA or within what would be considered an industrial noise zone level.

   Noise levels do not approach the recommended WHO guideline for night time residential zones for about 10 km from the runway. Thus all residential communities within a 10 km radius of the airport that are not shielded by mountains will probably be affected by airport noise from the NMIA.

4. The topography of the area and the presence of natural sound barriers. With the exception of the Long Mountain, the area within 10 km of the airport is relatively low-lying and flat (alluvial terraces).

5. Wind conditions: wind data from the National Meteorological Service for the NMIA (1981 -1990, *loc cit* ESL, 2005) indicates that the dominant winds comes from between 80 to 140 degrees (ENE, E, SE, ESE)

[4] http://www.jcaa.gov.jm/EconomicRegulation/StatisticalAResearch.htm

These factors will affect the sound level from a site, and how the sound travels. How receptors respond to sound will depend on the sound level at their location, their sensitivity to noise and the time of day.

3.2.4 Water Quality

Samples were collected from three locations around Gunboat Beach in triplicate during the wet season (November 10th, 2006) and the dry season (January 15th 2007). Station 1 was located inside the bay in relatively shallow water (5 m) where the proposed marina will be located, Station 2 was located outside the bay in deeper water (15 m), and Station 3 was located on the eastern end of the small pond located on the eastern side of the property, which is expected to also be a potential area for receiving run-offs from the site. These stations are shown in Figure 18. Samples were transported on ice to the laboratories indicated in Table 7. Methods used are also given in Table 4.

Figure 18 Water and Sediment Sampling Stations

Image: Google. Phase 1 boundary shown.

Table 4 Water Quality Test Methods and Laboratories Used

Parameter	Test Method	Laboratory
Biochemical Oxygen Demand	HACH method	ETAS
Total Suspended Solids	Gravimetry	Mines and Geology
Faecal Coliform	Filtration	Scientific Research Council
Nitrates	Colorimetry	Mines and Geology (wet)/ETAS (dry)
Phosphates	Colorimetry	Mines and Geology (wet)/ETAS (dry)
Oil and grease	Gravimetry/Partition	ETAS

3.2.4.1 Basic Water Variables

Basic water variables include pH, salinity, temperature and dissolved oxygen, which were measured during the rainy season at the three locations using a YSI meter. These data are presented in Table 5.

Table 5 In Situ Meter Readings

	Station 1	Station 2	Station 3
Measured Parameter	**Inside Bay**	**Outside Bay**	**Pond**
PH	8.36	8.33	7.26
Electrical Conductivity/Salinity mS/cm	36.9	38.0	62.9
Temperature ^{o}C	30.12	30.01	32.56
Dissolved Oxygen (DO) %	3.76	5.45	1.21

pH values of the two stations in the harbour were very similar (8.3) and fall within the ambient range for marine waters (7.5 to 8.5). The pond had a lower pH than the marine stations. This is expected due to the presence of vegetation.

Salinity is measured by the YSI meter in milli-Seimens per cm which is a measure of electrical conductivity. In general the salinity of the pond was found to be much greater than the marine stations, probably as a result of evaporation of brackish waters in an enclosed basin (hyper saline). The deeper water Station 2 had a higher salinity than the Station 1, which was located closer to shore.

Temperatures recorded in the marine stations were similar (30 degrees). The recorded temperature in the pond was slightly higher, as expected from a shallow enclosed water body with little circulation.

Dissolved oxygen readings were more variable, with the pond having the lowest value and the outside Station having the highest. This is likely to be controlled by both ambient temperature as well as circulation. The USEPA[5] recommends that saltwater DO levels above 4.8 mg/L for the protection of aquatic life. DO levels below 2.3 mg/L are considered insufficient for aquatic life. Using these limiting criteria, an adequate concentration of DO was only reported from the outer station.

3.2.4.2 Pollution Parameters

The results of the analytical tests for all samples are given as Appendix 3. Sources of industrial pollution in the north-eastern shores of the Upper Basin include the JPSCo (Rockfort), Jamaica Flour Mills, Shell Co. Ltd., Jamaican Ethanol Plant, Caribbean Cement, and the NWC Harbour View West Sewage plant outfall. The NMIA and the Royal Jamaican Yacht Club are located west of the site, and may also contribute contaminants given a counter-clockwise circulation gyre in the Upper Basin.

BOD is a measure of the amount of oxygen required to decompose sewage and other organic matter present in a water sample. NRCA has established BOD criteria (0.8 to 1.7 mg/l) for freshwater, which may also be applied to saltwater systems. Table 6 shows that the mean BOD concentration inside the bay (Station 1) in the wet season (51.25 mg/l) was significantly higher than in the dry season (1.25 mg/l). The dry season BOD concentration in the deeper water station (Station 2) was similar to concentration found at Station 1 in the dry season (1.45 mg/l). The wet season BOD concentration (0.63 mg/l) was significantly lower than the dry season concentration. Wet season BOD concentrations (averaging 0.92 mg/l) in the pond (Station 3) were also found to be much lower than the dry season concentrations (averaging 5.58 mg/l). Therefore, with the exception of Station 1, the dry season BOD levels were higher than the wet season levels. In the dry season there are fewer run-offs to the pond and the harbour in general, so while there may be less organic contamination coming from land-based sources, this effect is off-set by lower freshwater inputs, and organic material being produced within the aquatic system. In the case of the inshore wet season samples (Station 1), where the BOD concentration was a whole order of magnitude higher than any of the other samples, the elevated BOD concentrations may be attributed to the circulation pattern which appears to result in the accumulation of debris in this particular area.

[5] http://www.epa.gov/waterscience/criteria/dissolved/dofacts.html

Table 6 BOD Concentrations (Wet and Dry Seasons)

	Mean Values in mg/l (std dev)	
Stations	**Wet Season**	**Dry Season**
Station 1: Inside	51.25 (8.53)	1.25 (0.13)
Station 2: Outside	0.63 (0.03)	1.35 (0.17)
Station 3: Pond	0.92 (0.34)	5.58 (0.48)

TSS is an indicator of the amount of suspended solids in the water, and is usually indicative of run-off from land, or high levels of nutrients in the water, as well as the energy conditions. The wet season samples for both the inner and outer marine stations showed very low TSS (~1 mg/l) (Table 7). The dry season samples showed very similar levels (both having an average of ~7 mg/l), which is still quite low, and probably indicative of windier conditions on the day of sampling. As expected, TSS concentrations in samples from the mangrove pond were very high in the rainy season (1514 mg/l) and still relatively high in the dry season (123 mg/l).

Table 7 TSS Concentrations (Wet and Dry Seasons)

	Mean Values in mg/l (std dev)	
Stations	**Wet Season**	**Dry Season**
Station 1: Inside	<1	7 (4)
Station 2: Outside	<1	7 (4)
Station 3: Pond	1514 (1265)	123 (85)

Faecal Coliforms: there was considerable variability in the faecal coliform concentrations so that averages and standard deviations were not calculated from the samples. The raw data obtained from the triplicate sampling are given in Table 8.

Table 8 Faecal Coliform Concentrations (Wet and Dry Seasons)

Sample	Wet Season (MPN)	Dry Season (MPN)
1a (Inner)	43	1100
1b (Inner)	240	150
1c (Inner)	150	1100
2a (Outer)	150	>2400
2b (Outer)	>2400	240
2c (Outer)	1100	460
3a (Pond)	43	93
3b (Pond)	9	9
3c (Pond)	7	9

Generally, the faecal coliform levels were higher in the marine stations than in the pond. This could be attributed to the fact that there is very little sewage entering the pond, and what is

there might be coming from birds and animals in the area. The outer marine station samples generally had the highest levels of faecal contamination, which exceeded the Blue Flag criterion of 200 MPN. Only 1 of the 3 samples taken in the wet season exceeded this criterion for the inner marine station, whilst 2 of 3 samples taken in the dry season exceeded the criterion for that station. A large quantity of faecal contamination on this part of Palisadoes is not generated from the land, but is likely to be coming from sewage outfalls located along the northern shoreline of the Kingston Harbour, thus it is expected that the outer station may be more contaminated than the inner station. The NMIA has a sewage inflow (to its treatment plant) of 546 m^3/d. These levels of faecal coliforms support the position that recreational primary contact with these waters should not be encouraged either in wet or dry seasons.

Nitrates (Table 9a): In general, mean wet season concentrations of nitrates were significantly lower than dry season concentrations. The pond in the wet season had the highest concentrations recorded. The concentrations did not exceed the NRCA standard for freshwater (0.1 mg/l to 7.5 mg/l). No criteria are available for saltwater.

Phosphates (Table 9b): Although dry season concentrations were generally lower, the highest recorded concentrations were in the pond wet season samples. With the exception of the wet season pond data, these levels were within the NRCA criteria (.01 to 0.8 mg/l for freshwater). No criteria are available for saltwater.

Table 9 Mean Nutrient Concentrations (Wet and Dry Seasons)

	(a) Nitrates		(b) Phosphates	
Station	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**
Station 1: Inside	<0.05	1.32 (0.00)	<0.01 (0.00)	0.08 (0.01)
Station 2: Outside	<0.05	1.17 (0.25)	0.24 (0.12)	0.08 (0.02)
Station 3: Pond	<0.05	3.23 (0.25)	2.81 (0.64)	0.05 (0.03)

Oil and Grease (Table 10): Concentrations of oil and grease were generally higher in the wet season than the dry season, probably reflecting pollution from surface run-offs from Kingston.

Table 10 Mean Oil and Grease Concentrations (Wet and Dry Seasons)

Station	Wet Season (mg/l)	Dry Season (mg/l)
Station 1: Inside	5.3 (5.7)	1.7 (1.1)
Station 2: Outside	11.8 (4.7)	1.1 (0.6)
Station 3: Pond	6.4 (3.1)	4.2 (0.5)

3.2.5 Sediment Quality

Sediment samples were collected on November 10, 2006 from Station 1 at a depth of 5 m, from Station 2 at a depth of 15 m and from the pond at a water depth of 0.5 m. These samples were screened for five heavy metals of concern in ports and marinas: copper, lead, cadmium, manganese and zinc using a Flame Atomic Absorption Spectrometer by the Mines and Geology Laboratory. The data are given in Table 11.

Table 11 Sediment Quality Parameters

	Dry weight concentrations (mg/kg)				
	Cadmium	**Copper**	**Lead**	**Manganese**	**Zinc**
Station 1: Inside	BDL	**353.0**	**198.0**	154	67.9
Station 2: Outside	BDL	**21.8**	6.4	166	25.8
Station 3: Pond	BDL	**34.0**	7.1	156	29.2
ISQG[a]	*4.2*	*18.7*	*30.2*	*n/a*	*124*
SQUIRTs PEL[b]	*4.21*	*108.2*	*112.18*	*260*[c]	*271*

[a] ***Marine Sediment Interim Sediment Quality Guidelines: Canadian Environmental Quality Guidelines 2002 Update.***
[b] ***Screening Quick Reference Tables (NOAA, 1999) – Probable Effects Level for marine sediments. These tables were developed for screening purposes only.***
[c] ***Screening Quick Reference Tables (NOAA, 1999) – Apparent Effects Threshold (AET) for marine sediments.***

In marinas and recreational boating areas, copper and lead are generally the main contaminants of concern in sediments (USEPA 2001). This is because marine antifouling paints contain active biocides such as cuprous oxide. Metals accumulate in the sediments and may be re-suspended in the water column if they are attached to fines. High levels of copper and lead have been found near maintenance area drains and fuel docks in marinas.

The baseline levels of copper already exceed the 2002 Canadian Interim Sediment Quality Guidelines (ISQGs) in all three stations including the pond. However, the levels in the inshore marina area significantly exceed the recommended levels. Lead levels in the sediments in the inshore area also indicate significant contamination. More comprehensive testing will be required to confirm these preliminary screening data.

3.2.5.1 Solid Waste

Floatables appears to deposit on the beach at Gunboat and Buccaneer Beach (Figure 19). Although this area is used for public recreation, it is unlikely that all of the solid waste found at the site were primarily disposed there. Most of the solid waste found at the beach consisted of non-biodegradable materials such as plastics. It is likely that these floatables originate from elsewhere on the Palisadoes and the Harbour (particularly from gullies emptying into the harbour from communities), and accumulate here because of the current patterns within the harbour (Section 3.2.6.2).

According to Massa (2003) "*The recreational value of beaches remaining on the harbour shoreline, such as Gunboat and Buccaneer on the north side of the Palisadoes, and Port Henderson, is limited until considerable rehabilitation of water quality has been effected. Additionally, there are also the problems of oil and solid waste pollution. All beaches are polluted and garbage strewn*."

Figure 19 The Shoreline at Gunboat Beach

3.2.6 Oceanography

3.2.6.1 Physiography

Kingston Harbour is the seventh largest natural harbour in the world. It is an elongated bay with a total surface area of approximately 51 km^2 and has been zoned into specific areas, namely the outer harbour, the inner harbour and the upper basin (Goodbody, 1970; Wade, 1976a in Goodbody 2003). The upper basin is the most-eastern end of the harbour and is surrounded by land on three sides (Dunbar and Webber; 2003). It is bordered on the south by the Palisadoes

and by the city of Kingston on the north (Figure 20). It is about 18 m in depth with soft muddy sediment which often gives rise to an anoxic benthic environment (Goodbody 2003). At times the water in the upper basin adjacent to the Palisadoes is very clear which suggests that there may be some connection between the Caribbean Sea and the Upper Basin

The Palisadoes is an extensive peninsula forming a spit complex, almost 13 km in length that almost completely encloses and forms the southern boundary of Kingston Harbour (Figure 21). On the Caribbean Sea side the Palisadoes is situated on a coastal shelf, which widens from less than half a kilometre at the eastern, Harbour View end of the spit, to some 10 km to the south of the town of Port Royal, at the western tip of the spit. The shelf edge lies at ~ 40 m bsl from which there is a sharp drop off to depths exceeding 600 m. The shelf surface is dotted with numerous hummocks crowned with coral reefs, together with several small islands or cays.

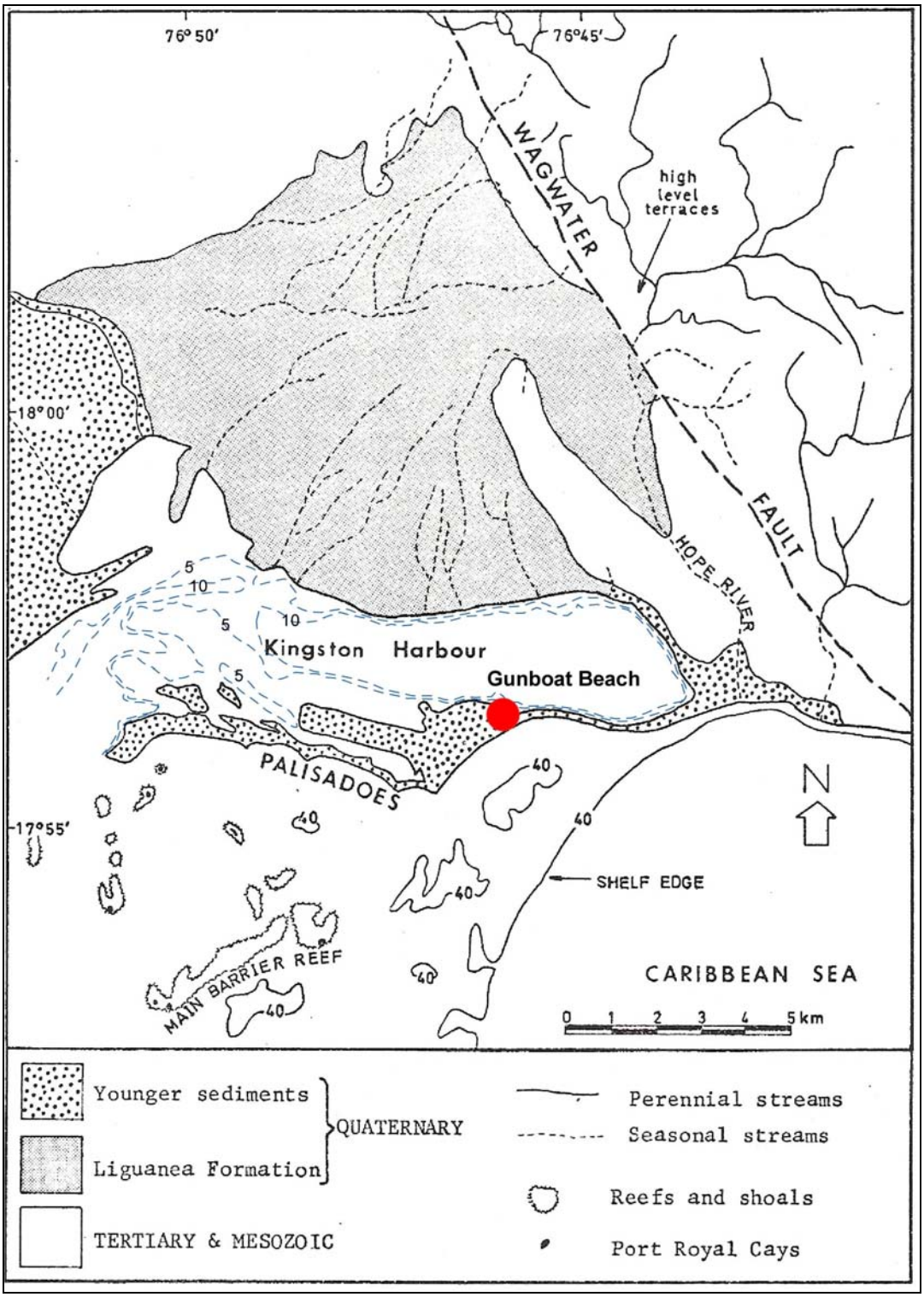
The city of Kingston on the north side of the harbour is built on an alluvial fan the Liguanea Fan, now inactive, that was deposited mainly by the Hope River and other drainages off the hinterland into the harbour. The sediments of the fan are sands and gravels that extend beneath the harbour into the region of the Palisadoes (Goreau & Burke, 1966). The diversion of the river's course rendered the fan inactive, and its sediment load has constructed a small alluvial fan at Harbour View, and also has supplied most of the sediment leading to the formation and growth of the Palisadoes spit. The Liguanea fan is now being degraded through dissection of its sediments by several gully systems of which the largest is Sandy Gully.

Three main physiographic regions have been identified in the harbour (Wade, 1976). The Inner Harbour with its eastward (Upper Basin) extension deepens eastward from some 10 m in the west (Figure 9) to water depths reaching 18 m near Harbour Head, forming a basin with steeply sloping flanks. The Inner Harbour is separated from the Outer Harbour by water depths of less than 10 m. The Outer Harbour in turn extends from the area just south of Newport West south along the ship channel to the harbour entrance where depths exceed 18 m.

3.2.6.2 Circulation

The site is located in a much protected basin that is referred to as the Upper Basin (Figure 21). Webber et al, (2003) conducted a 15-month study using 20 stations in the Kingston Harbour to determine the relative importance of rainfall, winds and tides on circulation patterns in the harbour. These authors concluded that while circulation in the Outer Harbour is influenced primarily by density/salinity gradients, circulation in the Inner Harbour is largely influenced by tides and high winds. The Upper Basin of the harbour is primarily affected by winds "*which induce horizontal and vertical gyres in the area with little net horizontal movement*". They found that the fastest currents were recorded in the eastern section of the Upper Basin, which occurred under conditions of "*high wind (> 4 m s−1), high rainfall (> 65 mm) and a flooding tidal cycle, which produced the greatest movement throughout the harbour".*

Figure 20 Geomorphic Units of Kingston and the Palisadoes (after Hendry, 1979)



The older rocks (no ornament) include granodiorite, siliciclastic sedimentary rocks and limestone.

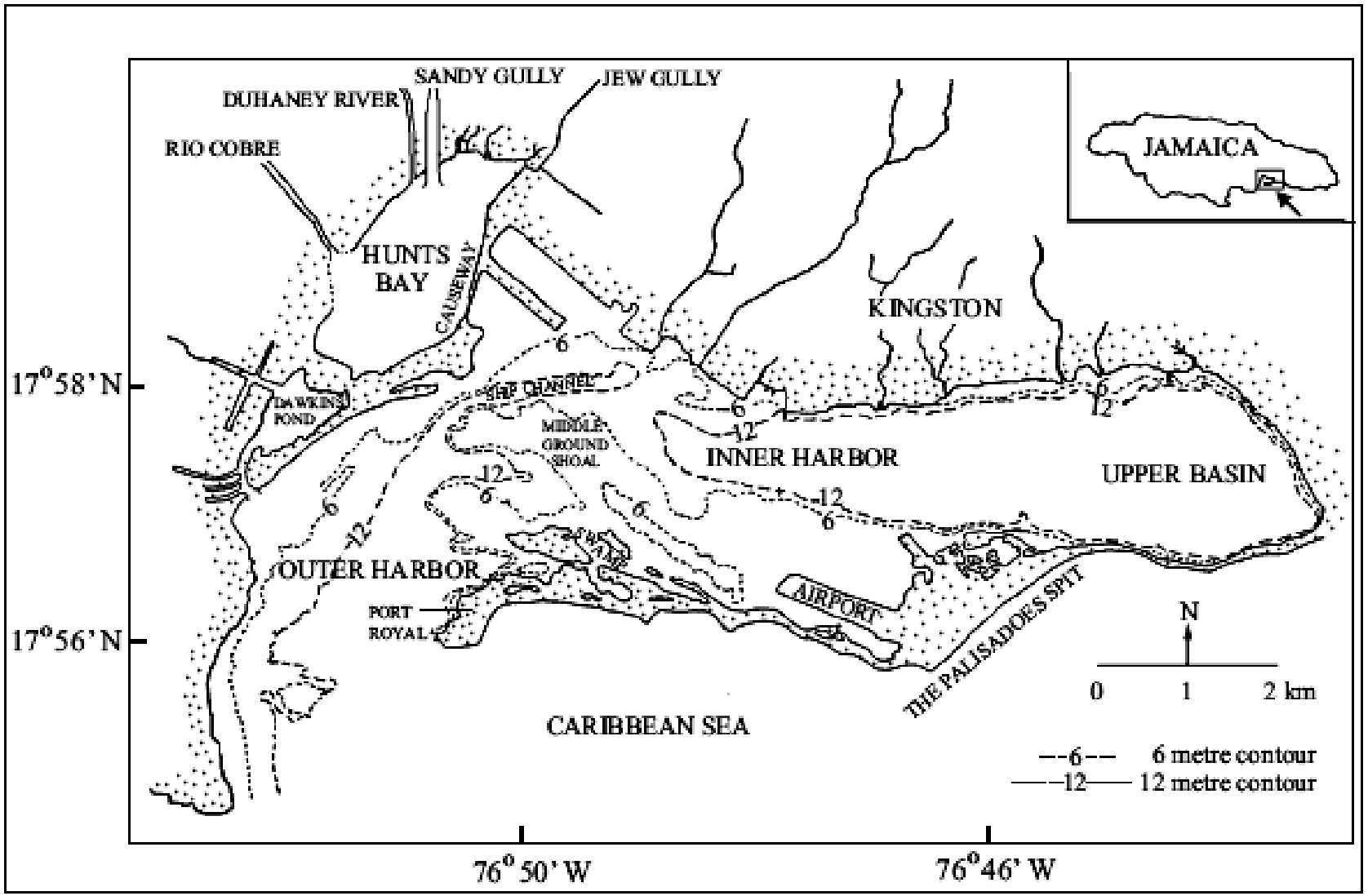
The Liguanea Formation (fine stipple) makes up the Liguanea sub-aerial fan, now inactive and currently being degraded.

The two areas of Younger sediments (coarse stipple) are all of Holocene age, at least at the surface, and comprise the alluvial fill of the Rio Cobre and Ferry Rivers (top left) and the sands, gravels and mangrove peaty deposits of the Palisadoes.

Generalized depths in the harbour and outside Palisadoes are in metres.

Red dot is site of Gunboat Beach.

Figure 21 Marine Physiography of the Kingston Harbour



Source: E. Ranston, Centre for Marine Sciences, University of the West Indies.

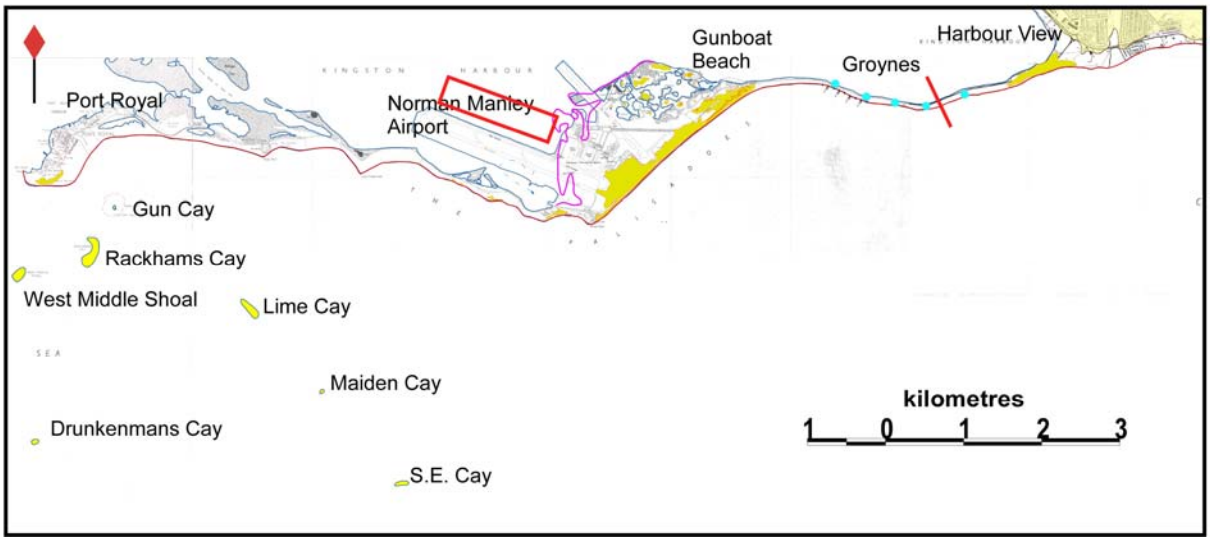
Whilst circulation patterns in the Inner and Outer harbour are relatively known (SWIL, 2004) from modelling, circulation in the Upper Basin is less well understood. Modelling done by Bigg and Webber (2003, loc cit SWIL 2004) indicated a counter-clockwise circulation pattern north of the NMIA in the Upper Basin, suggesting a west to east current movement near Gunboat Beach. In general, tidal amplitudes in the Kingston Harbour are small, with a mean tide level for Port Royal of ~9 cm and a spring tide range of ~21 cm (NOAA[6]).

3.2.7 Topography

3.2.7.1 Regional Geomorphology

The Palisadoes (Figures 22 and 23) is a geomorphic feature that has been called a peninsula, a spit and a tombolo by previous workers. Despite some evidence that the sediments of the spit may have tied together a number of former cays, giving rise to the descriptor 'tombolo', the term "spit complex" is preferred to describe the feature. No outcrops of cay-forming rocks have been noted, although beachrock forms an almost continuous shoreline feature along the ocean side of the spit. Boreholes both at Gunboat Beach, the airport, and Port Royal (Goreau & Burke, 1966) have not penetrated any undoubted bedrock at or above sea level.

Figure 22 Palisadoes



Elevations above 3 m in yellow; blue spots are points near the groynes breached by the 1722 hurricane; purple line marks western boundary of the central section prior to airport construction, beginning about 1938. Red rectangle, approximate location of boreholes in borrow site for airport runway. Red line across eastern part of Palisadoes, sections recorded in Steers (1940). Areas of extensive mangrove shaded grey.

[6] http://tidesandcurrents.noaa.gov/tides05/tab2ec4.html

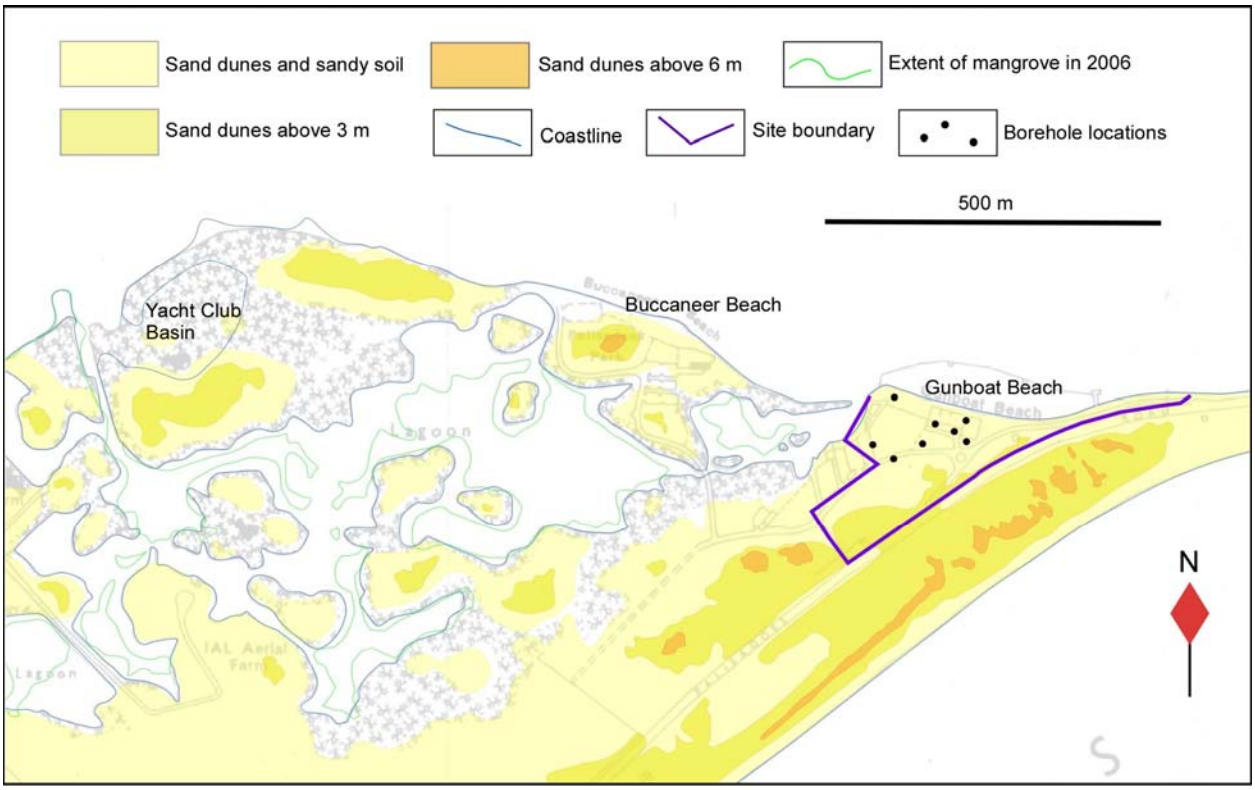
The historical fact that Port Royal was an island at the time of the British occupation does not in itself warrant using the term tombolo, as its sediments are indistinguishable from those of the rest of the spit. Many spits become dissected during their lifetime, usually because of adverse weather conditions. Port Royal may have been only temporarily separated from the rest of the Palisadoes. On the other hand there is much evidence in the distribution of the bathymetry north of the western part of Palisadoes to suggest that a succession of spits have developed in turn over past 5000 years (Robinson *et al*., 2006).

These elongate banks and shoals are partly covered by mangrove forest at the present day, but, on the evidence of boreholes drilled at the airport, are underlain by beach deposits of sand and shingle.

The spit complex may be divided into a narrow, eastern section, a broad central area of mixed sand dunes and mangrove swamp, and a narrower western section extending to Port Royal. The narrow eastern section, extending from Harbour View to Gunboat Beach, slopes steeply down into the harbour on its north side and is bordered by a beach system on its ocean side. Along this section dune formation is relatively unimportant and at its narrowest part the Palisadoes is only some 100 m wide and not more than 2 m asl. The broad, central section consists of a beach system developed normal to the prevalent trade winds and associated ocean swells travelling from the southeast.

Behind the beach there is an extensive, shore-parallel series of dunes reaching heights of up to 6-7 m asl. Behind the shore-parallel dunes the remainder of this section consists of irregularly scattered rounded dunes, interspersed with shallow mangrove flats. On its western side the original topography has been greatly modified through the construction of the Norman Manley International Airport. West of the airport the spit continues to Port Royal with extensive beaches along the ocean side and mangrove flats and on the harbour side. Also, west of the airport, the adjacent harbour is shallow, with several shoal areas that have been interpreted to have been formed in the earlier evolution of the spit (Robinson *et al.* 2006)).

Figure 23 Geomorphology and Geology of the Study Area



Sand sheets and dunes are in yellow. The shoreline is based on the 1968 air photographs and 1:12 500 scale topographic map. The irregularly distributed ovoid dunes associated with the lagoons are based on photo-interpretation of air photographs dated 1949 and ground-truthed for this report. The shore-parallel dunes facing the ocean are based on the same air photographs with height information derived from the 1:10,000 scale topographic maps of Kingston.

The Yacht Club Basin is a post-1968 excavation in formerly mangrove and small sand dunes area. These have been retained on this figure to indicate the existence of former dune deposits in the basin area. Borehole locations from AdeB Consultants report, 2005. The present extent (green line) of mangrove growth in the lagoons is based on interpretation of 2006 Google imagery.

3.2.7.2 Site Geomorphology

The topography of the site ranges from sea level on the harbour shoreline to +6 m on the south western corner. Figure 24 (based on a detailed topographic survey of the site) shows three sets of contours: 6 m (~20 feet), 3 m (~10 feet) and 0.9 m (~3 feet). Based on the coastal engineering design report, lands below the 0.9 m contour are prone to coastal flooding. Much of the terrain is very gently sloping to flat. The steepest slopes are found associated with a small

rounded hill on the south western side of the Phase 1 boundary. To the west of the site, where elevations are generally below 1 m, there is a mangrove area (Figure 25) which is likely to be a receiving area for site run-offs.

Figure 24 Topography of the Phase 1 Site

Relic sand dunes are the main land forms on the site. The highest dunes reach about 6 m asl. Water depths in the lagoons are of the order of 1 to 2 m. The orientation of the vegetated dunes on site (the main axes of which are shown as red dashed lines in Figure 24 above) appears to be more or less shore-parallel and to some extent curved. These appear to be different from the more linear vegetated coastal dunes seen on the other side of the highway, which are transverse to the shoreline of the open ocean.

Despite the difference in orientation, it is likely that dunes on either side of the highway once formed a continuous dune field, driven by prevailing winds and sediments from the east, with the orientation of the dune gradually changing as they approached the harbour shoreline.

The unvegetated coastal front of the dune field on the Caribbean side (across the highway from the development site) may to some extent be part of the modern beach system, serving as a store of sand. The vegetated back dunes on the Caribbean Sea side are unlikely to be active unless there are sustained periods of very high winds and lower than normal rainfall (that

causes the vegetation cover to die back) or during periods of coastal flooding (e.g. during storms). The dunes on the site have been effectively cut off from the system by the presence of the highway, and are very unlikely to contribute in any way to the stability of the shoreline or dune system on the Caribbean Sea side of the road. This is confirmed by evaluation of aerial photographs taken in 1949 and 1960 and Google imagery taken in 2006, which indicates that the dunes on the site have not shown any signs of being active in the past 67 years. At the present day the dune morphology is degraded (rounded) and covered with grasses, shrubs and small trees. The low areas between dune crests (interdunal areas) serve as preferred pathways for surface run-offs (blue dotted arrows).

There is a narrow sand and pebble beach along the shore of the Gunboat Beach area. Beach development at Buccaneer Beach is insignificant. The widths are a product of the low energy, short period waves developed in the harbour, with limited fetch. The sand in the beach material is evidently derived from the relic dune system, and ultimately coastal sediments from the Caribbean Sea shoreline.

3.2.8 Geology

The following geological report is based on observations at the surface during field visits and borehole and other excavation records. Borehole records from Port Royal suggest a basement of Liguanea Formation at about 15 m bsl and limestone at depths of 20 to 40 m (Goreau & Burke, 1966).

Superficial deposits visible at surface (late Holocene) include mangrove flats and lagoons, aeolian sand (rounded dunes and shore-parallel dunes). The site boreholes (AdeB, 2005) indicate the following summary succession (elevations corrected to sea level): fine, occasionally peaty sand (1 to 4 m) underlain by gravely sand over dense sandy gravel with some cobbles and boulders down to T.D. (8.5 to 9.5 m bsl). Boreholes drilled in the borrow area for the then “new” airport runway in the 1950’s, indicated a layer of shelly sand and silt (0.5 to 1.2 m up to 2.1, in one hole), underlain by mixed series of sand, fine and coarse-grained gravel down to T.D. (13 to 14 m bsl).

In summary the borehole data indicates that the uppermost layers belong to the superficial deposits: onshore as fine sand and peaty sand; offshore as shelly sand and silt. These rest on a basement of sandy gravels at depths below sea level of between 0.5 and 7.2 m, the deeper parts being on the west side of the old airport runways.

Based on the interpretations of borehole and seismic data from the western part of the Palisadoes by Goreau & Burke (1966) and Hendry (1979), the sandy gravels are considered to form some part of the Palisadoes spit gravel of Goreau & Burke, rather than the underlying Liguanea Formation. Steers (1940) mentions a section across the narrow eastern part of the Palisadoes. The details of Steers Table are repeated here (metric equivalents added) in Table 12.

Table 12 Steers Table

	Feet	Meter
North		
Sand	0 - 2	0-0.61
Sand and loam	2 - 6	0.61-1.83
Mixture sand, sandstone & pebbles	6 - 34	1.83-10.36
Sand, pebbles, fine clay	34 - 45	10.36-13.72
Middle		
Sand	0 - 4	0-1.22
Sand and loam	4 - 8.5	1.22-2.59
Mixture sand, sandstone and pebbles	8.5 - 38.5	2.59-11.73
Sand, sandstone and boulders	38.5 - 46	11.73-14.02
South		
Sand	0-7	0-2.13
Gravel, sand and clay	7-22	2.13-6.71
Sandstone and boulders	22-26	6.71-7.92
Quicksand	26-32	7.92-9.75
Sand, sandstone and boulders	32-42	9.75-12.80

This is interpreted to indicate an upper covering, about 2 m thick, of mobile sediments, underlain by a more stable basement of mixed sand, beach-rock and boulder gravel down to excavation limit of about 10 m depth, with the sediments on the harbour side being finer grained than those on the ocean side.

3.2.9 Soils

The soil at the study site has been classified as sand and is consistent with the descriptions of Vernon's (1959) soil classification of the Palisadoes, in which he identified beach sands along the North-Eastern most stretch of the spit. During field visits four samples were collected from the dunes, 2 from the rounded dune group and 2 from the shore-parallel group, to investigate the textural differences of these sediments.

Sediment samples taken from the dune were sieved to determine the grain size distribution. These are medium sands with average grain size ranging from 1.26Φ – 1.60Φ. Of the four dune samples, sample 1 (N 17.94534° W076.76601°) and sample 2 (N 17.94411° W076.76564°) were collected from the dunes at Buccaneer Beach.

These are poorly sorted slightly gravelly sandy muds with grain sizes of 1.26 Φ and 1.52 Φ respectively. Sample 3 (N 17.94307° W076.76314°) and Sample 4 (N 17.94400° W076.76024°) were collected from the shore parallel dunes south and south east of Gun Boat Beach, both samples are poorly sorted however sample 3 is coarser of the two and is classified as a slightly gravelly sandy mud and compared to sample 4 which is a muddy sand. The samples described above were collected from the dune surfaces and could be described as sandy loam.

3.2.10 Hydrology

Limited observations of the hydrology indicate (from boreholes) a static water level at mean sea level. The extent of inundation during high tide is defined as the high water mark. Recent high tides are clearly marked by the debris layer landward of the sea wall at Buccaneer Beach and indicate a level higher than the top of the wall.

3.2.11 Natural Hazards

The hazards which affect the area include earthquakes, hurricane winds, coastal flooding and sea level rise. The possible effects of these are summarized below.

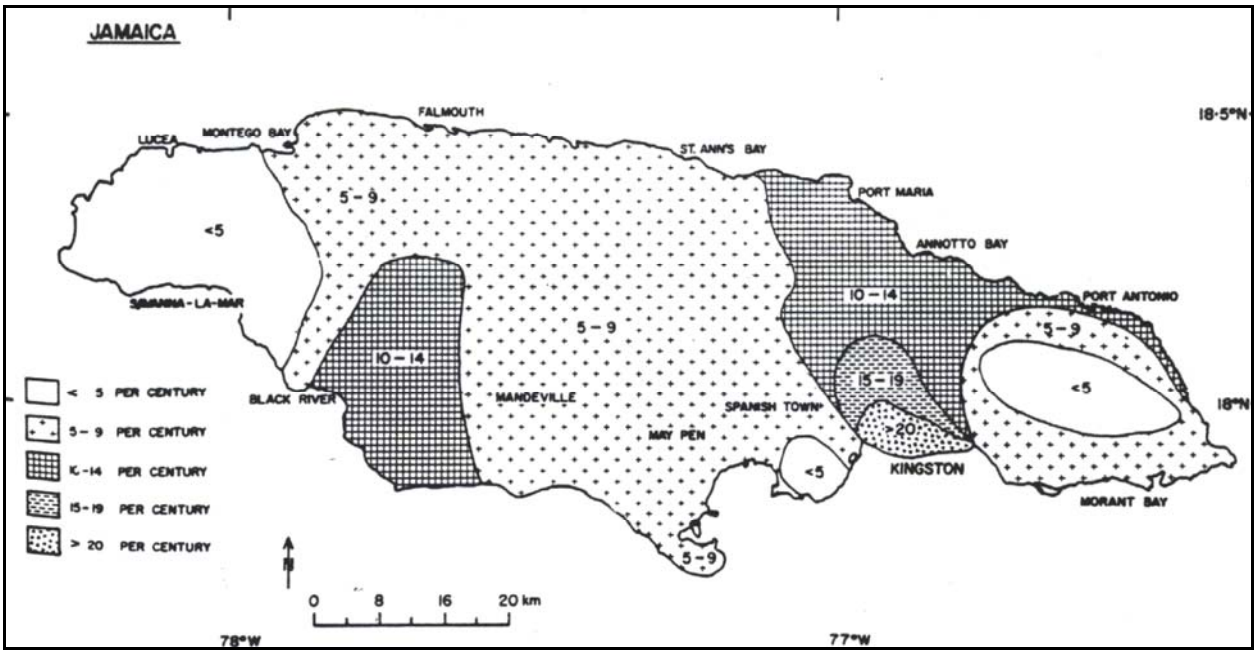
3.2.11.1 Earthquakes

The site is located in the most earthquake prone region of Jamaica (Figure 25) with more than 20 recorded MM VI earthquakes per century (for the period 1880 and 1960). At least fourteen earthquakes of VI or higher on the Modified Mercalli scale have been recorded for the Port Royal/Palisadoes area (Tomblin and Robson, 1977). These have resulted in Port Royal being cut of from the rest of the Palisadoes spit on at least 5 occasions (Hendry, 1977-78). Hendry (1977-78) discussed the historical changes occurring along the Palisadoes coastline over 200 years between 1655- 1957. He outlined the various mechanisms that have resulted in beaches of the Palisadoes spit, the earliest being the earthquake of 1667, M. M. VIII and/or a cyclone during October 1670 which were the probable causes of the breach recorded in the Palisadoes. This breach was subsequently closed as reports of Port Royal being an island after the 1692 Earthquake, M.M. X, were documented by Beeston (1693, in Hendry 1977-78).

More recently, the Earthquake Unit (University of the West Indies) has put out a new generation of seismic hazard maps of Jamaica, which places the site in a zone with 25% (acceleration due to gravity) for the 1 second and 60% for the 0.2 second. These maps were created in accordance with the International Building Code (IBC), which requires, according to Wiggins-Grandison (written communication, 2007):

- Expression of the hazard in terms of spectral response acceleration, given as a percentage of gravity. This is an indicator of ground motion as a function of earthquake magnitude, distance, path effects.
- Separate maps for spectral responses at 0.2 and 1.0 second.
- Conservative values are used in respect of Probability of Exceedence of 2,475 year return period.
- Maps apply to average rock (with an average shear wave velocity of 620 m/s in the upper 30 m). With wet unconsolidated sands, the shear response is expected to be much greater. The acceleration rates at the site are expected to be amongst the highest in Jamaica.

Figure 25 Earthquake Intensity Zonation Map



Map showing number of times per century that intensities of MM VI or greater have been reported, 1880-1960 (from Shepherd & Aspinall, 1980). The Palisadoes is within the zone of more than 20.

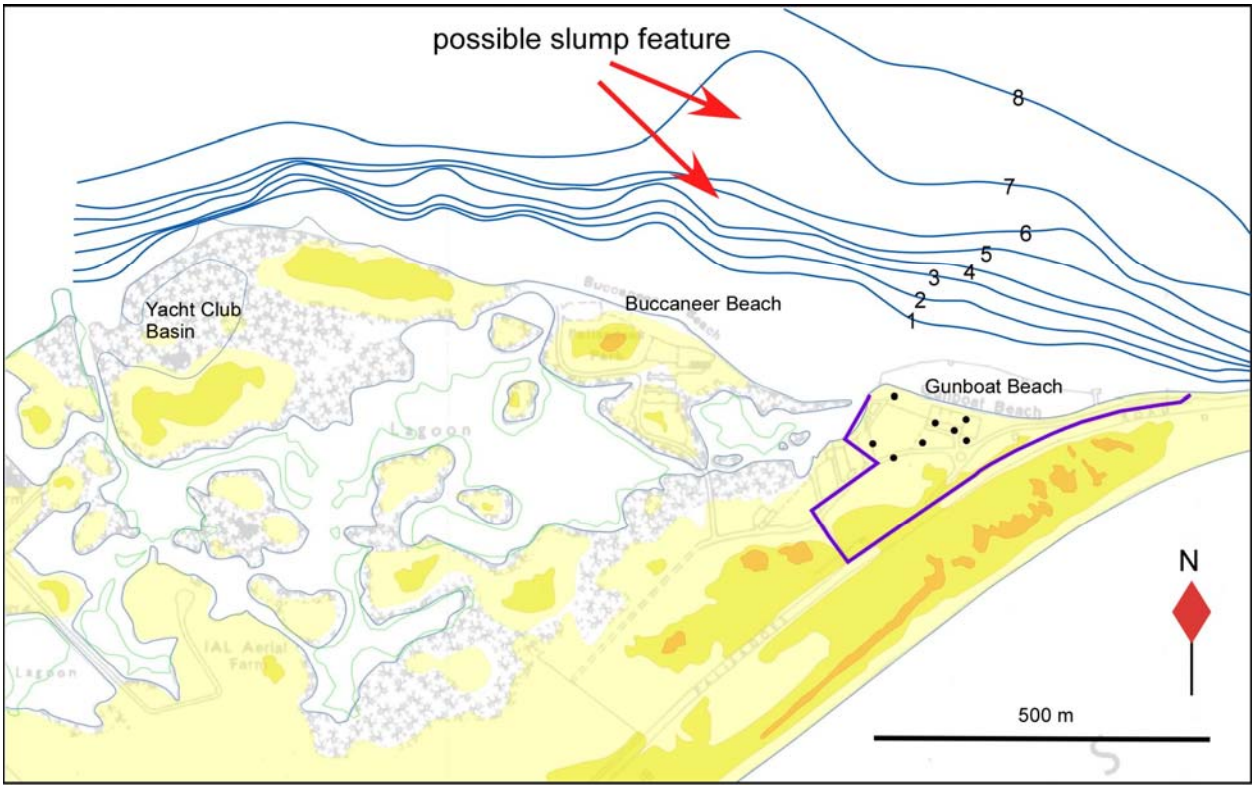
There is considerable anecdotal and historic documentation about the effects of serious earthquakes on structures on the Palisadoes. In 1667 an earthquake reportedly separated Port Royal from the Palisadoes. The famous 1662 earthquake resulted in a major slumping of sediments into the sea, and structural damage that can still be observed on some historic buildings. Other significant earthquakes were recorded in 1762, 1766, 1771, 1907, 1914, 1957 and 1993.

The area is also susceptible to a number of other events which are usually triggered by earthquakes. These include submarine landslides, as occurred at Port Royal during the 1907 earthquake, M. M. IX, during which a section of land 45 and 55 m wide on the southern and eastern areas of the town was lost, and again during the 1957 earthquake, M. M. VIII, during which approximately 438 m^2 of land was lost due to slumping on the southern side of Port Royal (Hendry, 1979). The earthquake of 1907 also triggered liquefaction at the eastern end of the Palisadoes. Bathymetry of the region immediately offshore of Gunboat Beach includes features that may be indicative of submarine slumping (Figure 26).

The upper 40 m of the Palisadoes spit consist predominantly of unconsolidated to semi-consolidated material (the Palisadoes spit gravel of Goreau & Burke, 1966). The widespread occurrence of beach rock has also been recorded by Steers (1940) and Hendry (1979). Thus, while the spit appears to be stable, at least in the eastern (narrow) and central parts, the presence of unconsolidated sand (e.g. the quicksand of the section recorded by Steers, see

above, Geology) makes the region locally susceptible to events such as liquefaction and slumping, which are usually triggered by earthquakes.

Figure 26 Detail of offshore features near site



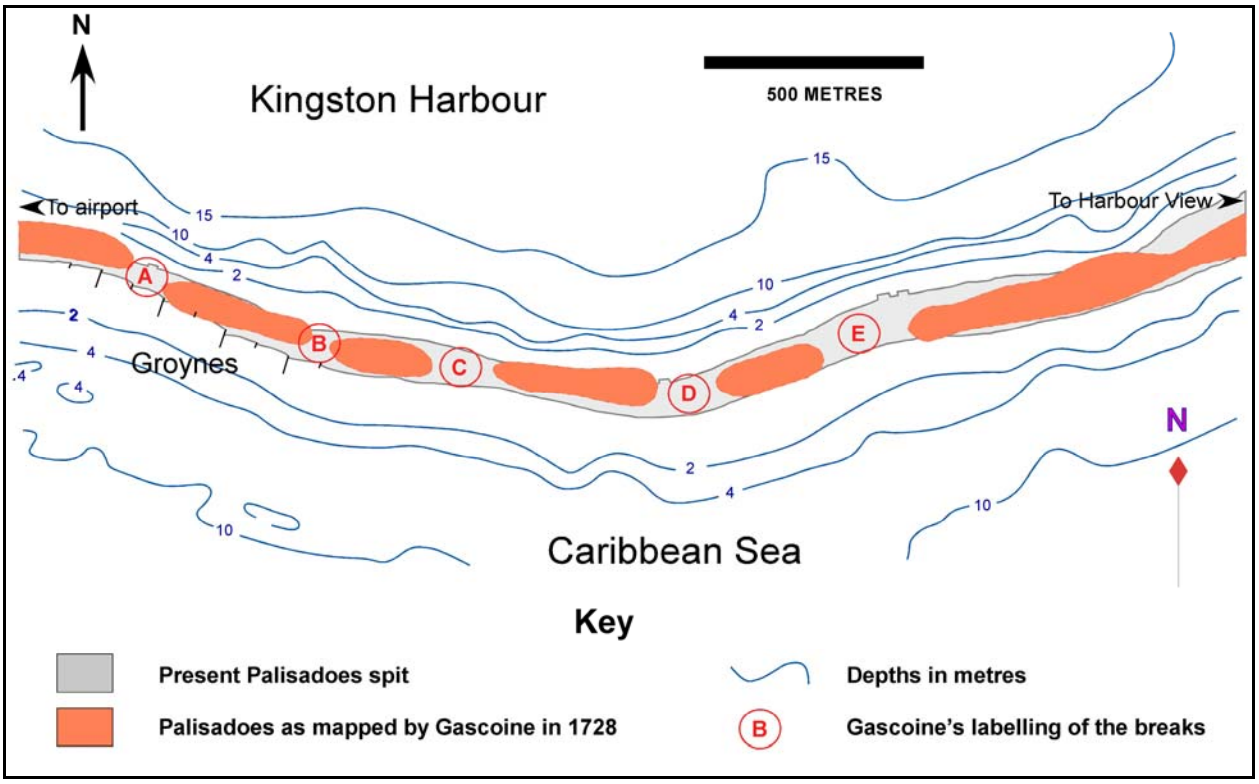
Isobaths derived from Stanley Consultants map. Irregularities in the contouring in the region indicated by the red arrows is suggestive of slumping

3.2.11.2 Hurricanes and Coastal Flooding

Hurricanes are comparatively rare events that can have major impacts on the coastline, as witnessed for Hurricane Ivan in September 2004, and, to a lesser extent, Hurricane Emily in 2005. Large waves generated during the passage of Hurricane Ivan, classified as a Category 4 hurricane and generating a surge and run-up of 2 to 3 metres, pushed sand, pebbles and small boulders from dunes and the foreshore over the main road into Kingston Harbour rendering the road impassable and cutting off access to the study site as well as the airport and Port Royal.

Previous hurricane events have also had an impact on the development of the spit complex in the past. Although the site is located on the sheltered north western side of the spit strong winds and waves will affect the main access to the site. At least 4 hurricane events have breached the Palisadoes in the vicinity of Harbour Head (Hendry 1977-1978). The hurricane recorded in 1722 resulted in 5 breaches at the eastern end of the Palisadoes (Figure 27).

Figure 27 Breaches in the Palisadoes (A to E) from the 1722 hurricane.



Depths inside the harbour from the 1960 Kingston Harbour Study; outside the Palisadoes compiled from British Admiralty surveys. Coastline based on 1:10,000 scale topographic series, Kingston.

At the same time it should be noted (Hendry, 1979) that no breaching of the eastern part of Palisadoes has occurred since 1788 when a breach made in 1782 was closed. This may be in part due to the absence of hurricanes of the severity of 1782 and in part due to the increasing effectiveness of beachrock as a bonding mechanism for the foreshore region on the ocean side.

3.2.11.3 Sea level rise

Presently the main road situated on the eastern part of the Palisadoes and access road to the site experience flooding when there are high tides driven by persistent trade winds. The loss of the dunes on the south eastern side of the road by Hurricane Ivan and the subsequent removal of sand during the clean-up process have left sections of the road increasingly vulnerable to flooding from the sea. Rising sea levels (perhaps as much as 40 cm over the next 50 years) will also increasingly exacerbate the effects of future bad weather (meteorological) events. The low elevation (less than 1 metre) of the Gunboat Beach waterfront makes that region, and the shoreline at Buccaneer Beach, particularly susceptible to inundation.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Flora

As reported in an earlier environmental survey conducted at this site (ESL, 1999), the plant community in the project area consists of dune shrub vegetation and mangrove forest. The vegetation at the site was characterized by the ecologist from observation and literature review.

3.3.1.1 Mangroves

Today only small remnants of mangrove forests remain of what is believed to have been an extensive stand of mangrove along the Harbour coastline. The most significant of this remnant mangrove occurs east of Port Royal on the southern shore of the harbour. Coastal modifications have irreversibly replaced mangroves with marinas, airports, dredged channels, housing solutions and other commercial ventures.

Much of the forest was destroyed during the 1960s and 1970s due to the construction of Portmore and Independent City, the modern airport, the marina for the Royal Jamaican Yacht Club and the Caribbean Maritime Institute formerly known as the Maritime Institute of Jamaica.

Figure 28 Red mangroves displaying typical prop roots

The Port Royal mangrove swamp is the largest, most studied mangrove system in Kingston Harbour. It is an area of mangrove lagoons and channels between large islands of mangrove forests and is influenced by the polluted waters of the Kingston Harbour (McDonald *et al*; 2003). The forest structure is said to consist of mature red mangrove (*Rhizophora mangle*) and white mangrove (*Laguncularia racemosa*) with *Rhizophora mangle* being the dominant species (Figure 28). The mangrove has several uses such as removing nutrients and suspended particulate matter from the polluted harbour. According to Lindo (2005) water clarity in the mangrove lagoons has been observed to be much better than that of the open waters of the harbour.

The mangrove community was mainly found on the fringe of the lagoons within the northwestern section of the site. Although four species of mangrove were observed at the site, the main species encountered were red mangrove (*Rhizophora mangle)* and black mangrove (*Avicennia germinans*). The white mangrove (*Laguncularia racemosa)* abundant to the west of the project site within the Port Royal mangroves and the Button Mangrove (*Conocarpus erectus)* were rarely encountered.

3.3.1.2 Dune and Other Flora

Table 13 provides a listing of the non-mangrove floral species identified on the site. The vegetation community found at the site is typical of a disturbed coastal environment and dominated by open dune/coastal grass areas.

Table 13 Floral Species (Gunboat Beach, Dec 2006)

Common Name	**Scientific Name**	Comments
Lead tree	*Leucaena* sp.	
Coconut	*Cocos nucifera*	few trees
Seaside Mahoe	*Hibiscus tiliaceus*	
Privet	*Pithecellobium unguis-cati*	common, attracts birds
West Indian Almond	*Terminalia catappa*	
Cashaw	*Prosopis juliflora*	small trees
Willow	*Casuarina equisetifolia*	old trees
Woman's Tongue	*Albizia lebbeck*	
Wild Grape	*Coccoloba* sp.	
Lignum Vitae	*Guaiacum officinale*	one tree was seen
Manjack	*Cordia macrophylla*	
Coolie Plum	*Ziziphus mauritiana*	
Oleander	*Thevetia peruviana*	
Purple Allamanda	*Allamanda violacea*	common
Nightsage	*Vinca lutea*	
Sweet Cup	*Passiflora maliformis*	vine
Cactus	*Cactus* sp.	

3.3.2 Fauna

3.3.2.1 Birds

Historically the Palisadoes/Port Royal mangroves and those at Refuge Cay serve as important feeding grounds and nesting areas for coastal birds (Table 14). According Webber and Goodbody (1998 *loc cit* Lindo 2005) reported that some areas provide roosting, feeding and breeding habitats to water birds such as pelicans, ibis, egrets and herons.

Table 14 Avi-Faunal Species List (Gunboat Beach, Dec 2006)

Common Name	Scientific Name	Comments
Northern Mocking Bird	*Mimus polyglottos*	common
Bananaquit	*Coereba flaveola*	common
White-Winged Dove	*Zenaida asiatica*	common
Yellow-Faced Grassquit	*Tiaris olivacea*	common
Smooth - Billed Ani	*Crotophaga ani*	common
Brown Pelican	*Pelecanus occidentalis*	common
Orange-Crowned Warbler	*Vermivora celata*	vagrant

3.3.2.2 Reptiles

Crocodylus acutus (American Crocodile) is the only crocodile found on the island. It is indigenous to the island and is protected by the Wildlife Protection Act as it is listed as an endangered species. It ranges from fresh to brackish water but has been sighted in salt water. The American Crocodile has been sighted occasionally in the Inner Harbour of the Kingston Harbour along the tombolo and is known to frequent the areas adjoining the airport. The occasional sighting in the Inner Harbour has been linked to periods of heavy rain. The most frequent sighting was January 2007 by staff of the Port Royal Marine Laboratory. However, no evidence of their presence has been reported at the Gun Boat Beach or adjacent mangrove and none was observed during the assessment.

Two species of lizards were found to be common at the site, the Common Lizard (*Anolis sp.)* and the Ground Lizard (*Ameiva dorsalis).*

3.3.2.3 Butterflies

Several species of butterflies are residents on the island. They range from the mountains to coastal areas. Species in the families listed below are typical of the lowlands and coastal areas.

Table 15 Coastal Butterflies of Jamaica

Common Names	Family
Goatweed butterfly	*Apaturidae*
Monarchs	*Danaidae*
Zebras, Dionne, Julia	*Heliconidae*
Skippers – few species rare	*Hesperiidae*
Blues	*Lycaenidae*
Buckeyes, common Peacock	*Nymphalidae*
Citrus butterfly	*Papilionidae*
Sulphurs	*Pieridae*

Source: Natural History Division, Institute of Jamaica

A survey of literature on the occurrence of butterflies in this area suggests that Sulphurs *(Phoebis spp*) are commonly found in the dry coastal areas near Windward Road and environs.

3.3.2.4 Other Fauna

Of the 20 wild life species protected by the law, only six are terrestrial, including the Coney, Crocodile, Iguana, Giant Swallowtail Butterfly, Yellow Snake and Jamaican Kite Swallowtail Butterfly. Most of these have very restricted bio-geographic ranges in Jamaica and are unlikely to be found in Gunboat Beach site. Crabs were seen at the edge of, and in swamp waters and were not specifically identified. No threatened or endangered species are reported to occur in this area.

3.3.3 Marine Ecology

3.3.3.1 Benthic Cover

A marine survey was conducted to provide baseline information of the footprint of the phase one of the project. The size of the study area measured approximately 350 m by 75 m at its widest and longest areas out to the old pier. There is no beach present as most of the shoreline consists of large boulders/rocks, which are present up to the high water mark. To the east of the property there is a narrow black sand beach (Figure 29 and 30) which is littered with solid waste that has been deposited there as a result of being washed into the harbour from rivers, gullies and storm water drains.

Figure 29 Eastern shoreline of project area.

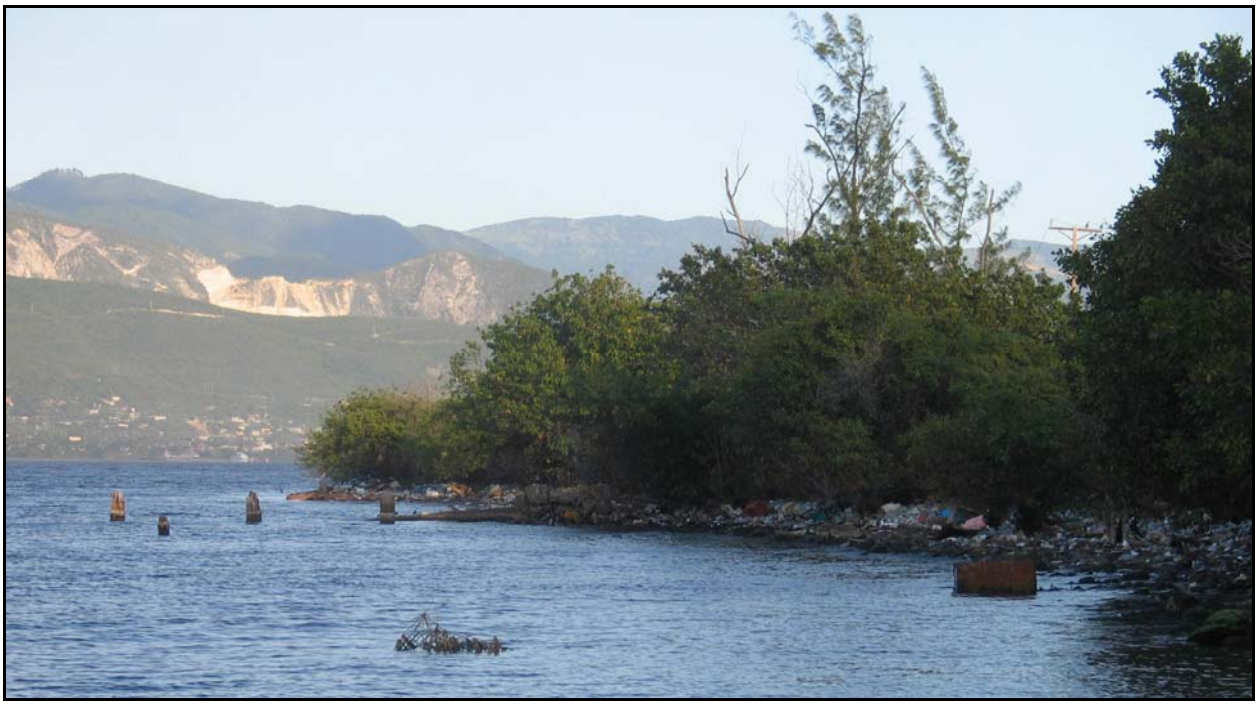


Figure 30 Narrow Beach

To conduct the benthic survey, three 100 m transects running perpendicular to the shore-line were assessed to determine the health and composition of the benthos. Transect positions (Table 16) were selected after an examination of the footprint of the proposed development; the starting points were marked using GPS co-ordinates.

Table 16 Location of start points of transects

	Northing	Easting	Latitude	Longitude
Transect 1	006-43-858	007-75-341	17° 56.66 N	76° 45.65 W
Transect 2	006-43-867	007-75-249	17° 56.67 N	76° 45.70 W
Transect 3	006-43-876	007-75-205	17° 56.67 N	76° 45.72 W

A 1 m^2 quadrat was used to estimate the abundance and percentage cover of the substrate types present every 10 m along each 100 m transect. The 1 m^2 quadrat was strung with 10 vertical and horizontal strings resulting in a grid of 100 squares with each 10 cm^2 representing 1% of the quadrat. Data from the transects were used to calculate the average percentage cover of the major substrate types as well as derive values for species diversity and richness.

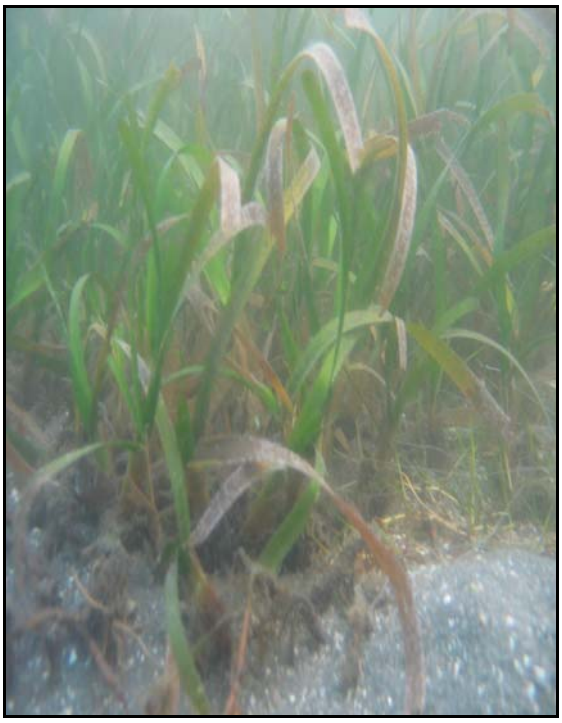
The average percentage cover on each of the substrates are given in Table 17, and described below (detailed transect data are given as Appendix 4)

Table 17 Average substrate percentage cover along transects

	Sand	Rock	Rubble	Sea grass	Algae	Coral
Transect 1	78.1	0.0	0.0	21.5	0.4	0.0
Transect 2	89.4	0.2	1.4	8.7	0.3	0.0
Transect 3	100.0	0.0	0.0	0.0	0.0	0.0
Average	**89.2**	**0.1**	**0.5**	**10.1**	**0.4**	**0.0**

Sea Grasses: Information gleaned from a review of available literature suggests that the project site lies outside the major sea grass areas of Kingston Harbour. A reconnaissance of the site revealed that the substrate composition was predominantly sand with small relatively healthy sea grass beds. Large expanses of bare sand comprised the predominant substrate along transect two and extends beyond the old boardwalk and to the west of the current beach facility. The sea grass beds were concentrated in the eastern section of the site close to the shoreline in depths of approximately 0.1 m to 0.3 m. Two types of seagrass were noted (Figure 31), turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*). Epibiota were minimal on the Thalassia blades. Numerous juvenile fish were also noted in the area mainly over the sand patches.

Figure 31 Sea grass bed showing turtle grass and manatee grass



Coral: There was a marked absence of coral except for one colony of the knobby star coral (*Solenastrea hyades*) located on one of the columns of the old pier. This finding is consistent with the findings of the 1999 benthic survey (ESL, 1999).

Algae: Several species of algae occurred in very low percentages including *Padina jamaicensis*, *Dictyota* sp., *Gracilaria* sp. and *Acetubularia* sp. Algal species indicative of nutrient loading was not observed.

Sand: Overall sand recorded the highest percentage cover along all transects assessed as percentages ranged from 78.1 % on transect one to 100% on transect three; transect two recorded 89.4 % (Figure 32 and Table 17).

Figure 32 Substrate typical of the site

3.3.4 Marine Fauna

A census of the major taxonomic groups of animals (mammals, reptiles, fish) was conducted during the marine survey in a 5 m belt along the 100 m transect line (Table 18). Organisms encountered were identified and their numbers recorded. T1 (with 22% sea grass cover) hosted the most diverse species composition and species assemblage. A total of 136 organisms grouped into four invertebrate species and four fish species were identified. Of this number approximately 66 % was juvenile fish.

The oyster *Isognomon* sp. was observed attached to rocks at the shoreline/intertidal zone. T3 had the highest composition of sand and hosted the least diverse assemblage of species.

Table 18 Census of major Taxonomic Groups with DAFOR rating

A*	B**	Class / Family	Scientific name	Common Names	Census
T1	A			Juvenile fish	90
T1	O	Asteroidea	*Oreaster reticulatus*	Cushion starfish	3
T1	F	Bivalvia	Isognomon *sp.*	Oyster	8
T1	R	Chaetodontidae	*Chaetodon* sp.	Butterflyfish	1
T1	R	Echinoidea	*Tripneustes ventricosus*	West Indian sea egg	1
T1	F	Haemulidae		Grunt (juvenile)	30
T1	R	Holothuroidea	*Holothuria mexicana*	Donkey dung sea cucumber	1
T1	R	Scaridae		Parrotfish	1
T1	R	Tetraodontidae	*Sphoeroides testudineus*	Checkered Puffer	1
T2	F			Juvenile fish	34
T2	F	Asteroidea	*Oreaster reticulatus*	Cushion starfish	10
T2	F	Haemulidae		Grunt	22
T2	O	Portunidae	*Callinectes* sp.	Blue crab	2
T3	F			Juvenile fish	20
T3	O	Asteroidea	*Oreaster reticulatus*	Cushion starfish	3

**Column A indicates the transect on which the census was done (T1, T2, and T3)*

**Column B indicates abundance on the DAFOR scale: D – dominant, A – abundant, F – frequent, O – occasional, R – rare*

The Shannon-Weiner diversity index (H_s) is a measure of species diversity that takes uncertainty into consideration. When H_s is large and an organism is picked at random from a community, we are less certain about which kind of organism it is going to be. This implies that as species are added to a community H_s will tend to increase without limit. From the diversity indices calculated it can be inferred that both transect one and two have approximately the same H_s value. They therefore have the same species diversity despite their different abundance distributions.

Indices (Table 19) calculated for Margalef's Species Richness (D_m) and Pielou's Evenness (J) further concludes that transect one displayed the better species richness while on transect two species were more well distributed. Overall, the low values calculated for H_s indicate that the number of species present at the site is low and not very diverse.

Table 19 Species Diversity on Transects

Transect	Margalef's Species Richness $D_m = s\text{-}1/\ln(N)$	Pielou's Evenness $J = H/H(max)$	Shannon-Wiener Diversity Index $H_s = -\sum [pi \ln(pi)]$
1	1.4249	0.3678	0.7648
2	0.4740	0.6833	0.7507
3	0.000	0.000	0.2657

3.3.5 Macro Benthic Invertebrate Fauna

To determine the macro-faunal assemblage three benthic grab samples were taken; two north of the existing beach facility at a depth of approximately 2 m and the third at the edge of the small lagoon. Three replicates were recovered from each station (Table 20) using a modified 0.1 m^2 Ponar grab sampler. Samples were then washed through a 1.0 mm sieve. Organisms retained were preserved in a stain solution consisting of 0.1 g Rose Bengal powder dissolved in 2 litres of formalin. All samples were grossly sorted into two groups; marine worms (Phylum Annelida) and all others.

All organisms collected were counted and identified using the relevant taxonomic literature. Damaged or juvenile individuals that were unidentifiable were taken to the lowest possible identification level (lpil). The information obtained was used to calculate values for Margalef's Species Richness, Pielou's Evenness and Shannon-Weiner Diversity Index.

Table 20 Location of Benthic Sample Stations

Stations	Northing	Easting	Latitude	Longitude
1. Middle of Bay (GBE)	006-43-928	007-75-270	17° 56.70 N	76° 45.69 W
2. Out of Bay (GBW)	006-43-972	007-75-361	17° 56.72 N	76° 45.64 W
3. Mangrove Pond (GBPO)	006-43-896	007-74-917	17° 56.78 N	76° 45.89 W

The samples retrieved from the study site were unconsolidated material which consisted mainly of crushed shells, sand and stones. Polychaete worms were the most abundant taxa followed by molluscs (gastropods and bivalves) and crustaceans (Table 21). These three taxa often dominate marine macro-benthic assemblages.

Table 21 Benthic Census according to class

Sample	Polycheata	Gastropoda	Bivalvia	Crustacea	Total No.
GBE 01	3	3	0	0	6
GBE 02	0	2	0	1	3
GBE 03	23	13	11	0	47
GBW 01	6	4	1	0	11
GBW 02	19	11	6	0	36
GBW 03	4	6	5	0	15
GBPO 01	0	1	0	0	1
GBPO 02	0	13	9	0	22
GBPO 03	0	3	1	0	4

Results show a general paucity of macro fauna in benthic samples. This is consistent with the findings of earlier investigators (Goodbody 2003, Wade *et al.* 1972) who discovered the development of an abiotic zone in the Upper Basin. The literature suggests that this paucity was likely the result of organic pollution (mainly by sewage).

The benthic macrofaunal composition consisted of few individuals which were not evenly distributed across the major taxonomic groups/families. Table 22 shows the calculated Shannon-Weiner diversity indices. High abundances and low diversity/species richness (number of species) indicate more eutrophic areas, while low abundances and high diversities point to more pristine areas.

Table 22 Benthic Species Diversity

Sample	Margalef's Species Richness	Pielou's Evenness	Shannon-Wiener Diversity Index
GBE 01	0.5581	1.0000	0.6931
GBE 02	0.9102	0.9183	0.6365
GBE 03	0.5195	0.9513	1.0451
GBW 01	0.8341	0.8342	0.9165
GBW 02	0.5581	0.9086	0.9982
GBW 03	0.7385	0.9878	1.0852
GBPO 01	0.0000	0.0000	0.0000
GBPO 02	0.2597	0.9760	0.6765
GBPO 03	0.7213	0.8113	0.5623

The findings in the project site are similar to a study conducted in San Diego Bay where species richness was typically low in regions of the Bay that have well-documented histories of anthropogenic impact. The macro-benthic assemblage in that bay was characterized by few taxa and low abundance distribution was also thought to be affected by tidal flushing (City of San Diego, 2003).

Dunbar and Webber (2003) also found limited zooplankton distribution in the Upper Basin area. These scientists theorize that low species diversity may be due to circulation patterns and a lack of mixing rather than extreme levels of enrichment. Webber *et al* (2003) determined that circulation in the Upper Basin is dominated by wind driven currents that are strong but short-lived. These produce gyres of circulation which enhances mixing within the upper basin but little net current motion between inner harbour and upper basin.

3.4 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

Data to support the socio-economic environment baseline were collected through three principal means, analysis of existing document, interviews and a community survey conducted within the defined Social Impact Area- Port Royal, Harbour View and along the Palisadoes

Primary data was obtained by site reconnaissance, interviews/survey, telephone interviews and traffic surveys. Secondary sources included National Population 1991 and 2001 Census Data and the National Environment and Planning Agency (NEPA), Ministry of Education, the Jamaica Tourist Board and the Social Development Commission

3.4.1 Demographics

3.4.1.1 Population Trends

In 2001, the enumerated population of Kingston & St. Andrew (KSA) was 651,900 compared to 639,642 in 1991 (STATIN, 2002). Of these figures, the urban population stood at approximately 565,876 (86.80%). Data sets for KSA revealed an annual decline in Kingston's population of –0.38 percent from 1991 to 2001, falling from 99,762 in 1991 to 96,052 in 2001(Table 24). This was in contrast to the population of St. Andrew that experienced annual growth of 0.29 percent, with 539,880 persons in 1991 and 555,827 in 2001.

Table 23 Population change in Jamaica and Kingston & St. Andrew, 2001-2005

	2001	2002	2003	2004	2005
Jamaica	2,607,600	2,621,500	2,635,700	2,648,200	2,660,700
Kingston & St. Andrew	651,900	652,900	653,400	656,100	658,800
% of Total Population	25.0	24.9	24.8	24.8	24.8

Source: Economic & Social Survey Jamaica, 2005

During this period the population of Port Royal was 1,261 & 1,740 respectively, an increase of 479 over the 10-year period, while the population of Harbour View stood at 2,008 and 8,386 respectively an increase of 6,378. The Statistical Institute of Jamaica estimated a population of 658,800 for Kingston and St. Andrew at the end of 2005; this was 24.8% of the island's population of 2,660,700 (Table 24).

For the period 1991 to 2001 the annual rates of growth for Port Royal and Harbour View were 2.8% and 7.6% respectively (Table 25). These are relatively high compared to annual rate of growth for Kingston over the same period which was -0.38, and for St. Andrew, which was 0.29%.

Table 24 Population Change

Location	1991	2001	Annual Growth Rate %
Parish, Kingston & St. Andrew	639,642	651,900	0.19
New Kingston	1,761	1,754	-0.039
Port Royal	1,261	1,740	2.8
Harbour View	2,008	8,386	7.6

According to data from the Statistical Institute of Jamaica (STATIN), if it is assumed that an annual growth rate of -0.40 and 0.26 for the period 1991 to 2001 is maintained for Kingston and St. Andrew respectively, by 2020 the population of Kingston and St. Andrew would be approximately 89,000.and 582,000 (See Table 26)

Table 25 Population Projection for KSA 2001-2020

Parish	Census 2001	2005	2010	2015	2020
Kingston	95,810	94,287	92,360	90,444	88,528
St. Andrew	554,241	560,005	567,210	574,415	581,620
Total	650,051	654,282	659,570	664,859	670,148

Source: Statistical Institute of Jamaica

3.4.1.2 Population Density

While densities within the KSA vary overall, the variation would be greatest between the urban and areas of urban and rural St. Andrew. Based on the 2001 Population Census, the population density within Kingston stood at 4,326.54 per sq. km. The Palisadoes Strip, with no formal residential development would be one the areas of lowest density in the Kingston and Port Rocyal areas.

3.4.1.3 Housing (Port Royal and Harbour View)

The 2001 Population Census revealed a total of 28,200 households in Kingston while the parish had a total of 27,203 dwelling units. On the other hand, St. Andrew had a total of 164,513 & 156,137 respectively. This resulted in Kingston and St. Andrew (KSAC) having a total of 192,173 households and 183,340 dwelling units. In 2001, there were 310 households and a population of approximately 1,740 persons in Port Royal. The average number of persons per household was 5.6. In 2006, however, Social Development Commission (SDC) reports an estimated 473 households with the average number of persons per household being 4 (STATIN 2001& SDC 2006). The Harbour View area, in 2001 had 3,991 households and population of 8,386, that is, an average of 2.1 persons per household.

The 2001 national survey revealed four main types of outer wall materials in Kingston: - (i) concrete and block (64 %), (ii) wood and concrete (15 %), (iii) wood (11 %), and (iv) stone and brick (4 %), the roofing materials were found to be predominantly metal sheeting (85 %). On the other hand the main outer wall materials for St. Andrew were: (i) concrete and block (77%), (ii) wood (12%) and (iii) wood and concrete (7%), while the main roofing material was also metal sheeting (73%).

Surveys conducted by the Social Development Commission indicated that the four main types of outer wall materials in Port Royal are: (i) concrete (60%), (ii) board and concrete (25%), (iii) brick (3%) and board (5%), with sixty percent (60%) of the houses in the area being in very good condition and 25% in good condition. The main outer wall materials for the Harbour View area are: (i) block (92%), (ii) concrete (5%) and (iii) board (3%), with eighty percent (80%) of the houses being in very good conditions and ten percent (10%) being in good condition.

3.4.1.4 Employment and Income

In 2001 the average unemployment rate for Kingston and St. Andrew was 6.37% and 12.22 % respectively. At the end of October 2005, the national unemployment rate averaged 10.9 %; there was a slight decrease of 0.2 % during the period January to April 2006 (PIOJ 2006) as shown in Table 27. Based on survey, the unemployment rate stood at approximately 32% with the Harbour View area having an unemployment rate of 8% and Port Royal 24%.

Table 26 Total labour force employed and unemployed

Location	Total	Employed	Unemployed	% Unemployed
Kingston (October 2001)	45,500	42,600	2,900	6.37
St. Andrew (October 2001)	261,800	229,800	32,000	12.22
Jamaica (October 2005)	1,225,000	1,091,700	133,300	10.9
Jamaica (April 2006)	1,251,300	1,117,7000	133,600	10.7
Survey	100	65	32	32

Source: Statistical Institute of Jamaica & PIOJ

The labour force of the area consists mainly of Craft & Related Workers and Professionals, which includes Nurses, Craft Vendors, Mechanics and Teachers.

In 2001, the dependency ratio for St. Andrew (the economically active - adult age-group (15-64) over infants and adolescents (ages 0-15) and the elderly (age 65+) was 58.25 while Kingston's ratio was 62.18 this is compared to the national average of 66.67. Of these figures, the dependency ratio among youths stood at 53.19 and 47.12 respectively for Kingston and St. Andrew as compared to the national level 53.92.

3.4.2 Economic Activities

The dominant economic activities for the parishes of Kingston and St. Andrew are mining, fishing, manufacturing, tourism and services. As the principal City, the Kingston Metropolitan Area (KMA) may be considered the Central Business District of Jamaica with the service sector being the hub of economic activities. However, within the immediate vicinity of the proposed development, the primary economic activities are described below.

3.4.2.1 Fishing

Fishing plays an important role in economy of Kingston, it is said to sustain approximately 3,386 fishermen who operate from seven (7) fishing villages around Kingston Harbour, whose catch is approximately 1100 tons of fish per annum[7]. The economic value of fishing within the Harbour impacts not only Kingston but also St. Catherine as "Kingston's" fishing villages are Port Royal, Harbour Head, Rae Town, Greenwich Farm, Hunts Bay, Hellshire and Port Henderson.

[7] http://www.nrca.org/kingstonharbour/html/index.html

3.4.2.2 Manufacturing

Several major manufacturing industries are found along the Kingston Harbour, these include Caribbean Cement Company, and petroleum companies, such as, Petrojam, Cool Oasis and Texaco. The manufacturing sector's contribution to Jamaica's economy over the years has been in decline. Based on the Planning Institute of Jamaica (PIOJ) quarterly report (*Review of Economic Performance, July to September 2006*,) Real GDP of the manufacturing sector declined by an estimated 2.6%" this is compared to a growth of 3.8% for the same period in 2005. Within the manufacturing sector, chemical and chemical products saw a decline of 4.8%.

3.4.2.3 Tourism

Unlike the North Coast where visitors are drawn to the "sand and sea", tourism within Kingston and St. Andrew takes on a totally different appearance where the tourism product is influenced by business tourism. At the end of 2005, Kingston & St. Andrew had a total of approximately 1,300 hotel rooms and 2,319 beds, an occupancy rate of 58.8 % and an average house count of 998.3 (Tables 28 and 29). At end of July 2006 there were only five (5) licensed or recommended hotels in the KSA based on the Tourism Product Development Company (TPDCo) standards (JTB). These are the Altamont Court Hotel, Iris Inn, Knutsford Court Hotel, Bath Fountain Hotel & Spa Bath and Starlight Chalet & Health Spa. The Morgan's Harbour Hotel, the closest hotel to the study area has a total of sixty-one (61) rooms; this is in addition to the cottages located at the Royal Jamaican Yacht Club.

Table 27 Hotels within Kingston & St. Andrew

Name Of Hotel	Address	# Of Rooms
Altamont Court Hotel	1-3 Altamont Terrace	55
Courtleigh Hotel	85 Knutsford Boulevard	125
Hilton Hotel.	77 Knutsford Blvd.	303
Hotel Four Seasons	18 Ruthven Rd.	76
Indies Hotel	5 Holborn Rd.	15
Jamaica Pegasus	81 Knutsford Blvd.	350
Knutsford Court Hotel	16 Chelsea Avenue	180
Mayfair Hotel	4 West Kings House. Cir.	32
Medallion Hall	53 Hope Rd.	21
Morgan's Harbour	Port Royal	61
Sandhurst Hotel	70 Sandhurst Cres.	35
Strawberry Hill	Irish Town	12
Terra Nova Hotel	17 Waterloo Rd.	35
		1300

Source: Tourism Product Development Company & Jamaica Tourist Board

Most business tourists stay in Kingston & St. Andrew (JTB). For the period January to September 2006, there were a total of 1,294,204 visitors of which Kingston accounted for 166,121 (12.8%) while Montego Bay and Ocho Rios accounted for 27.3 & 24.0 % respectively. Of the 1,294,204 visitors that arrived during the period January to September, 4.2 % visited for business purposes, while 1.7% visited for conventions or meeting. This is in comparison to 73.5% that visited for a vacation. During this period most visitors were in the 25 to 34 and 35 to 49 age group.

The role of KSA as a cruise ship destination is insignificant (Table 28). Kingston accounted for just over 400 cruise passengers for the January to September period, the result of one call made at the port in January

Table 28 Tourism: January to September, 2006

Location	Tourist Arrivals/ Stop Over Visitors		Cruise Ship Passengers	
	Number	Percent	Number	Percent
Montego Bay	353,689	27.3	325,465	34.25
Ocho Rios	310,070	24.0	616,865	64.91
Negril	272,478	21.1	-	
Kingston	**166,121**	**12.8**	**412**	**0.04**
Mandeville/ South Coast	79,014	6.1	-	
Port Antonio	14,418	1.1	7,587	0.80
Jamaica	1,294,204	100	950,329	100

Source: Jamaica Tourist Board

The Planning Institute of Jamaica's (PIOJ) has indicated that "*Total visitor arrivals increased by 23.3% to 193,454 in October 2006"* of this "*Stopover arrivals increased by 7.9% to 94,351*" while "*Cruise passengers increased by 42.7% to 99,103*"[8].

The economic contributions of visitors or visitor expenditure over the past five (5) years rose from US$ 1,333 million in 2000 to US$ 1,545 million in 2005. As it relates to the expenditure of visitors to our shores, it was indicated that a stopover visitor spends an average of US$ 104.14 more during the winter season (US$104.34) when compared to the summer season (US$ 101.59) and during other periods of the year (US$ 103.51). According to information provided by the Jamaica Tourist Board (JTB), more than fifty percent (50%) of all stopover visitors' expenditure is spent on accommodation in all instances; followed by shopping and then entertainment (See Table 29).

[8] *Review of Economic Performance, July to September 2006*, (November 15, 2006)

Table 29 Distribution of Expenditure of Stopover Visitors for 2005

	Winter %	Summer %	YEAR %
Accommodation (Including Food & Beverage)	59.2	56.7	57.5
Food & Beverage	5.8	5.6	5.6
Entertainment	10.3	10.7	10.6
Transportation	5.2	5.4	5.4
Shopping	9.9	11.8	11.2
Miscellaneous	9.6	9.8	9.7
TOTAL	**100.0**	**100.0**	**100.0**
Average Expenditure per person per night	US$ 104.34	US$101.59	US$103.51

Source: Jamaica Tourist Board

3.4.2.4 Transport Shipping & Air Freight Travel

Kingston Harbour and the NMIA are primary air and sea transportation hubs on the Island. In 2005, of a total of 1,478,663 stopover visitors, 1,262,176 arrived on scheduled flights while 216,487 arrived on chartered flights. Most scheduled flight stopover visitors arrived from the North East and Western region of the United States of America (USA) and include areas such as Connecticut, Washington D. C., Alaska and California. Europe accounted for most chartered flights stopover visitors, with most arriving from Northern Europe and specifically the United Kingdom (UK). With regards to stopover visitors by port of arrival, a total of 1,097,952 arrived at the Sangster International Airport (SIA) in Montego Bay while 380,711 arrived at the Norman Manley International Airport in Kingston.

The strategic location of the Kingston Harbour's in the western hemisphere, together with investment in the development of port facilities, has made Kingston the third largest port in the Caribbean and Latin America. As an important trans-shipment port, the income generated by the Kingston Harbour has been estimated to be US$510.31 million per annum, its main economic sources being industry, commerce, shipping, fishing and recreation[9]. Based on figures released by PIOJ for July to September 2006 real GDP in Transport, Storage & Communication grew by 6.5% and was mainly influenced by higher levels of activities at the island's sea and airports.

[9] Source: www.nepa.gov.jm

3.4.3 Health Services

The South East Regional Health Authority (SERHA) is responsible for public health surveillance and enforcement and delivery within Kingston & St. Andrew, St. Thomas and St. Catherine and serves a combined population of approximately 1,244, 500.

Hospital services are provided nationally through general and specialist facilities, administered through the boards of four Regional Health Authorities-South East, Southern, North East and Western. Additionally, hospitals are classified as A, B or C according to the level of service and the size of the population served. Within the South East Regional Health Authority (SERHA) there are fifteen (15) hospitals (public& private) with the Kingston Public Hospital (KPH), the Victoria Jubilee and the St. Joseph's Hospitals being in closet proximity to the Gunboat area (Table 31).

KPH is a Type A hospital: Type A hospitals are multi-disciplinary and are the final referral points for secondary and tertiary services. The hospital provides in-patient and out-patient services in areas such general surgery, internal medicine, obstetrics and gynaecology and paediatrics. Their medical staff compliment includes Medical Officers, Interns and Consultants. The hospital provides the following services:

- Internal Medicine
- Orthopaedics
- Psychiatric
- Physiotherapy
- 24hr X-ray
- Paediatrics Surgery
- Obstetrics & Gynaecology
- Anaesthetics
- 24hr Emergency Room and Outpatient
- 24hr Lab & Blood banking

The St. Joseph's Hospital is a private hospital that offers specialist services in areas, such as, general surgery, internal medicine, obstetrics and gynaecology, cosmetic surgery, neurology and paediatrics. The hospital has a medical staff complement of approximately one hundred & five (105), which includes forty five (45) nurses and approximately sixty (60) privileged doctors. The 60 privileged doctors include on-staff doctors, doctors with offices within the facility and private doctors to whom patients are referred.

Kingston and St. Andrew has a total of forty-eight (48) Health Centres ranging from Type I to Type V inclusive of six (6) satellite locations. Two health centres are located within close proximity to the area these are the Harbour View and the Port Royal Health Centres. The Harbour View Health Centre is a Type III Health Centre while that at Port Royal is Type II.

At Harbour View HC the services provided include:

- Child health (Paediatric services)
- Child guidance counselling
- Public Health (food handling etc.)
- Mental Health
- Family planning
- Social Services
- Pre-natal health
- Sexually Transmitted Infection Service
- Curative
- Dental
- Dressing

The staff complement of the Harbour View Health Centre includes a doctor, 2-3 nurses and a social worker. At the Port Royal Health Centre the services offered include curative, maternal and child health care counselling, family planning and dental care. The facility has a doctor on staff along with a nurse, this in addition to having special days when specialist doctors visit the area due to its location. The services offered include: Child health (Paediatric services), Pre-natal health, Sexually Transmitted Infection Service, Curative, Family planning, and Dressing.

3.4.4 Emergency Services

3.4.4.1 Ambulance Services

Several ambulance services are available within Kingston and St. Andrew these include Ambucare, Deluxe and St. Johns. The St. Johns Ambulance falls under auspices of the Salvation Army and offers its services voluntarily, while Deluxe and Ambucare are privately owned corporate entities. Currently, Ambucare has a fleet of ten (10) ambulances that operate within Kingston and St. Andrew, with each accommodating two medical personnel on board to respond to each call. With regards to emergency response capabilities their average response time to a call is two (2) minutes, however, for an area, such as, the Port Royal/ Palisadoes this varies and is dependent on: response of motorists to the siren, the time of day and amount of congestion.

The St. Johns Ambulance is not a commercial entity and in light of this their services are offered on a "smaller" scale with only two (2) ambulances. The impact of having only two (2) ambulances on the reliability and effectiveness of their service is shown in their average response to an emergency, as personnel indicated that this "*depends on when you are able to move and not when to get to the location*". However, when questioned about an average response time to an emergency along the Palisadoes or in Port Royal, twenty (20) minutes was given. Like Ambucare, each ambulance travels two medical personnel on board while responding to calls.

3.4.4.2 Fire Services

The study area is served by two (2) Jamaica Fire Brigade stations; these are the Port Royal and Rollington Town Fire Brigade Station. Based on information received from an officer at the Port Royal Fire Brigade Station, the station is adequately staffed with eight (8) persons on each shift. The station has one (1) fire engine which adequately serves the Port Royal community. Equipment and tools that are needed in fire fighting and emergency response are insufficiently available. An officer noted that if there should be a major accident that requires persons to be "cut from a vehicle" they are unable to do so due to lack of the required equipment known as Jaws of Life. They are also not fully equipped to adequately respond to accident including oil spillages, nevertheless, support is garnered from other stations in such situations (personal communication-Green, 2006).

At the Rollington Town Station, the District Officer indicated that the station is adequately staffed with thirty-six (36) Officers working on four (4) shifts (9 persons per shift). The station was a recipient of one (1) of the new units that were acquired by the government earlier this year, and is equipped with the required tools such as the "Jaws of Life to respond major accidents and the necessary equipment and tools for oil spills. In addition, to the Harbour View area, the station serves communities, such as, Rollington Town, Bull Bay, Windward Road, Rockfort, Franklyn Town and Vineyard Town, this is in addition to offering assistance in other jurisdictions.

An officer at the Rollington Town Fire Station indicated that they receive approximately one thousand (1,000) calls per year, with an average of fifty (50) per month, most of which are false alarms. Most calls are reportedly received from the communities of Rockfort, Bull Bay and Harbour View (personal communication-Gordon, 2006).

3.4.5 Municipal Services

3.4.5.1 Police

Among the main social facilities of all urban areas are Police Stations; the Harbour View Police Station serves communities such as Harbour View, Bay Shore Park and Shooters Hill. Information received from an officer at the Station indicated that most crimes occur in the "hot spots" of Millbrook Farm, St. Benedict's Height, Shooters Hill and Bay Shore Park, the communities that are located in the hinterlands and at the urban fringe. Crimes committed include shootings, robbery and domestic violence. Most accidents occur on the Sir Florizel Glasspole Highway and the Bull Bay Main Road.

There are fifteen (15) officers on staff at the Harbour View Police Station comprising an Inspector, a Corporal, four (4) District Constables, six (6) Constables and three (3) Sergeants. The station is manned over the twenty–four hour period as officers are rotated on shifts. One patrol unit car is also assigned for patrol. With the station a bit understaffed and inadequately equipped assistance is granted by Elleston Road Police Station (personal communication-Adamson & Smith, 2006).

3.4.5.2 Post Office

The Post Mistress at the Harbour View Post Office indicated that the post office offers the basic services of general mail delivery, receiving mail and the selling of stamps. This is in addition house-to-house delivery of mail and bill payment service. There are eleven (11) members on staff and there opening hours are Mondays to Fridays from 8am to 5pm. There are two (2) members on staff at the Port Royal Post Office, and the post office offers the basic services of mail delivery, receiving and the selling of stamps. Both Post Mistresses at the Port Royal and Harbour View Offices confirmed that neither currently serves the Gunboat area, however, service should be provided by the Norman Manley International Postal Agency. This information, however, could not be confirmed with personnel from the postal agency.

3.4.5.3 Schools

Few schools are in proximity to the Palisadoes. The public schools within the area are the Port Royal All Age & Infant School (ages 3-15), Harbour and St. Benedict's Primary Schools (ages 6-12), and the Donald Quarry High School (ages 12-17). During the 2003-2004 school year, all schools except for the Port Royal All Age & Infant school exceeded the pupil/teacher ratio standard of 30:1 set by the Ministry of Education. There are several private kindergarten schools within the Harbour View/ Port Royal area: Mary's Bond, Sea View, Sun Rise, St. Marks, Neptune and Happy Venture. The Caribbean Maritime Institute which lies west of the property is a tertiary institution that it is both privately and public owned.

3.4.5.4 Recreation and Entertainment

Within Kingston open spaces and recreational areas limited with respect to the population size, with the main recreation spots being Emancipation Park, Devon House, Hope Gardens and the Waterfront; these are in addition to areas, such as Mandela Park and the Sir William Grant Park. Other recreational spots include the Bob Marley Museum, Putt and Play Mini Golf Park and several football fields and lawn tennis courts. Outside the KSA are other popular spots, such as Nature's Habitat and Serenity Wild Life Park, located in St. Catherine.

Within Port Royal open spaces include Port Royal Community Centre, Sir Henry Morgan Park, Buccaneer Park, Port Royal All Age playing field and Port Royal playing field, most of which are in good condition. Within the general Harbour View area, recreational facilities include Aqua Park, Independent Park, Look Out Park, Rock Park, Rock Park playing field and the Harbour View Mini Stadium. However, residents within both communities would like to see improvement to what exists, as sixty five percent (65%) of those surveyed stated that recreation facilities are inadequate.

The night entertainment scene within KSA is quite vibrant with several entertainment, these include Night Clubs such as the Quad and Asylum and Sports Bars, such as, Cuddy's and Jamrock. Entertainment within Kingston also includes Karaoke nights at several hotels, various

food festivals throughout the year, along with session/shows, such as, Good Times and others held at locations such as Mass Camp. Entertainment spots in recent years have generally centralized within New Kingston, as this Business District is also the entertainment core of KSA.

There has been a gradual increase in Casino Type Entertainment Facilities within Jamaica, specifically in both cities and along the North Coast. The Betting Gaming and Lotteries Commission (BGLC) monitor all gaming and betting actives island wide under the Betting Gaming and Lotteries Act, 1965 (amended in 2005). Under the BGLC Act a license is required for both the machines and premises before operation can commence. Sections 43-46 of the Act, under sub heading Amusement Machines highlight the procedures to follow to ascertain such licenses and the relevant cost. Based on information received from the BGLC, there are approximately five (5) gaming lounges in Kingston and St. Andrew in addition to games rooms and numerous bars. New facilities are not allowed more than nineteen (19) machines.

Entertainment within the Study area is limited; however, there are events, such as, festivals such as the recent Port Royal Sea Food Festival. The need for additional entertainment was confirmed by the survey sample in the communities surveyed where, 47 % (33 respondents) of those surveyed in Port Royal and 53 % (16 respondents) in Harbour View noted that there is a need for entertainment facilities.

As it relates to the age of those surveyed, 46 respondents (47 %) were within the age cohort 18 to 35, of which, 58% (27 respondents) indicated that there is a need for entertainment facilities. This is in comparison to 43 % (22 respondents) who were 36 and older who indicated that there is a need for entertainment facilities.

3.4.6 Utilities Supply

3.4.6.1 Electricity

Electricity to the area is provided from the JPSCo plant located at Rockfort, through a 24 kV line. At present there is power supply on site through a connection along the Palisadoes; however, supply to the site/within the area is significantly affected at times by the demand of the airport, which causes voltage fluctuations in the area.

3.4.6.2 Telecommunication

Cable and Wireless supplies land line and Cellular services to area, cellular service is also available through Mossel (Jamaica) Limited and Oceanic Centennial Digital Jamaica Limited. The area is also provided with access to the World Wide Web (Internet) through Broadband and Dial-up services and Video Conferencing by the providers, such as, Cable and Wireless. Most households within the sphere of influence of the proposed development have access to cable through at least two providers. Within the Port Royal area more than 95% of all households have access to cable service as the area served as a pilot project for the Island's latest telecommunication company, Flow.

3.4.6.3 Potable Water Supply

The main sources of water for the Harbour View/Port Royal area are the Mona Reservoir, Rennock Lodge Wells. Currently, water supply to the site is via a direct connection to the National Water Commission's transmission line. The area experiences low water pressure frequently, especially when demand at the airport peaks.

3.4.7 Transportation

The Norman Manley Highway is a double lane highway: the sealed carriageway width at the intersection with the proposed development site is approximately 7.6 meters (25 feet). There are few signs along the route and a number of billboards. There are two access roads on the property from which entrance is gained to the CMI and the RJYC. The width of these arterial roads is narrow in some areas due to the overgrowth of vegetation. Sections of the road network are also partially the remnants of the former Palisadoes Park, which along with the Buccaneer and Gun Boat Beaches, were an important recreational area in the city up to the 1980's.

Traffic count data for the Airport Round-a-about (NWA) provide an indicator of current traffic volumes along the Norman Manley Highway (Table 30). Given the limited levels of activities along the route, traffic counts are accurate and indicative of actual traffic flow classification of the composition of vehicles along the highway. As the main thoroughfare to the NMIA, heavy commercial traffic is confined primarily to those hauling freight but private motor vehicles predominate, not only due to the heavy transport of airport passengers but for visitors to the popular dining-out (fish) facilities at Port Royal.

Table 30 Traffic count between the Airport Round–a-bout, 2003

		North bound	South bound	Total
Monday	12H	8133	4357	12,490
	24H	11522	5738	17,260
Tuesday	12H	5176	3740	8,916
	24H	7548	5234	12,782
Wednesday	12H	5253	4761	10,014
	24H	6919	6110	13,029
Thursday	12H	4658	4603	9,261
	24H	6745	6307	13,052
Friday	12H	4720	3795	8,515
	24H	7645	5251	12,896
Saturday	12H	4720	2469	7,189
	24H	6968	3677	10,645

Source: National Works Agency

Of a total of 49, 064 vehicles over the period, 29,987 (61 %) were Class 1 vehicles (cars, sport utility vehicles (SUV) etc.) compared to 2,143 Class 3 vehicles (two axle truck or bus) .Except for Friday, westbound traffic (towards NMIA and Port Royal) exceeded those travelling eastbound (towards Harbour View) on each day of the traffic count.

There was little variation between morning and afternoon peak hours (where applicable) for both directions. For the weekend, morning peak hour was between 11:00 and 12:00 noon while on Monday it was between 8:00 am and 9:00 am for westbound and between 9:00 am and 10:00 am for east bound traffic. The maximum morning peak hour traffic (east & west bound) was 471 on Monday (west bound) and 257 on Sunday (east bound). Afternoon peak for the weekend was between 1:00 and 2:00pm on Saturday and 7:00 and 8:00 pm on Sunday. The highest afternoon peak hour traffic was for Friday eastbound, which saw a total of 558 vehicles; this was followed by Sunday eastbound with 549.

Round– a-bouts at the Harbour View and near the NMIA filter traffic travelling to the airport. The continuing strategic roles of the intersections are assumed given their important functions. Traffic volumes at the Harbour View round-a-bout are significant.

3.4.7.1 Ports and Marinas

The Kingston Harbour is the primary maritime transportation route on the island. The harbour is accessible by one route/ channel; however entrance is possible from a westerly or easterly direction. Information received from the Pilots Office indicates that between one hundred & twenty (120) and one hundred & fifty (150) vessel access on a monthly basis, or approximately one thousand five hundred (1,500) per year.

Ports are developments for larger deep draft ships requiring basin and channel depths of 10m and more while marinas are shore-side facilities for mooring recreational boats, including water-based, as well as, land-based facilities for boats and boat users. Both give access to the sea allowing increased economic values, subsistence and recreational activities, thus, acting as catalysts for future development. The Port Authority of Jamaica facilities in Kingston are the Kingston Free Zone and the Kingston Terminal Operators while other facilities exist in Montego Bay, Ocho Rios and Port Antonio. From its headquarters on Duke Street, the PAJ is linked to its operations at the Pilotage Department, the Port Consumer Services, Gordon Cay, Kingston Terminal Operations and the Kingston Free Zone both by Fibre Optic Cable and Radio.

Marinas/Yacht Club: fourteen (14) marinas are located Island wide, with most (8) located on the North Coast. There are two Marinas and a Yacht Club within close proximity to the development site these are the Morgan's Harbour Marina and Royal Jamaican Yacht Club (RJYC). The RJYC has over three hundred (300) members.

3.4.8 Waste Disposal

3.4.8.1 Solid Waste

Solid waste in the KMA is the responsibility of the National Solid Waste Management Authority (NSWMA). In the absence of residential development in the immediate vicinity of the site, the solid waste disposal at the adjacent marina and institution is by a private contractor. On the other hand, solid waste at the communities of Harbour View and Port Royal is collected by the NSWMA on Wednesday & Saturday and Tuesday & Friday respectively.

Improper solid waste disposal within Kingston and St. Andrew which eventually reaches the Kingston Harbour poses a potential problem as waste is washed onto the shoreline of the project site. Additionally, illegal dumping at impromptu dumpsites is common, particularly in the western section of the site (closer to the airport). In addition to general trash & garbage left behind by users of the site majority of the dumpsites comprise mainly of construction material and large household appliances, such as, stoves.

3.4.8.2 Sewerage

The area lies outside of the sewerage lines of the central sewage system, therefore, sewage disposal at the adjacent facilities is by individual private wastewater treatment plants. The main method of disposal in Harbour View is a Contact stabilization wastewater treatment system while that in Port Royal is a Sand Filter.

3.4.9 Cultural and Historical Heritage

Located at the end of the Palisadoes, Port Royal "was the first town created" during the British colonial period"[10] . Once a parish of its own (including sections of Kingston and St. Andrew) and referred to as the "Wickedest City on Earth" Port Royal was one of the largest towns in the English colonies during the late 17th Century and a haven for privateers and pirates, such as, the world renowned Sir Henry Morgan. This was due to its geographic location in the core of the Caribbean. The area's rich heritage also entails being once the home of the buccaneers and a major trading port in the seventeenth century and later, Britain's major naval station in the Caribbean. However after becoming the mercantile centre of the Caribbean, this was short lived as a massive earthquake on the June 7th 1692 shook the "sandy" foundation of the city and submerging much of the city and killing approximately 2000. Still standing are Fort Charles and the Naval Hospital. The historic and cultural values of Port Royal are, therefore, very high as the site includes forts on the dunes and, what is, in fact, only a part of the City of Port Royal, as the rest sank in an earthquake in 1692 making the town a unique archaeological treasure.

[10] Kingston Jamaica , Urban Development & Social Change 1692-2002,Colin G. Clarke

The Gun Boat and Buccaneer Beaches along with the Palisadoes Park represented the primary recreational spots in the City for several years prior to the early 1980's when the beach was closed by the Government because of the pollution of the marine environment in the Kingston Harbour.

3.4.10 Land Use

3.4.10.1 Site

This area originally consisted of marshy salt flats with scattered mangrove trees. A Fleet Air Army Station was constructed during World War II, and resulted in the destruction of the natural vegetation at that time. In 1959 the Gunboat beach was landscaped to be a municipal recreational beach, complete with changing facilities and gardens. Gunboat Beach is reported to have been one of the most frequented recreational beach and entertainment facilities in Jamaica until the mid 1980's. The area was popular for water skiing, swimming, picnicking and boating. However, with increased pollution of the harbour, the area lost its appeal. Despite the poor water quality and lack of facilities that exist on site, it is still reported that there can be an excess of 200 patrons using the facility on public holidays. However, on Sunday, December 3, 2006, between 1.00 pm and 2.00 pm, only about ten (10) swimmers were observed.

With regard to infrastructure (assets) present on the property there is an old restaurant, a paved terrace, a section of the old entertainment area that doubles as a groceries and cook shop and changing rooms some of which are now occupied by transients. Illegal sand mining is said to occur on site periodically.

3.4.10.2 Surrounding Land Use

Within the vicinity of the proposed development there are industrial, commercial, recreational and institutional/ educational land uses. There is no residential land use immediately adjacent to the site. The nearest residential land use is at Bournemouth Garden, which is located ~3 km north of the site, across the harbour. Harbour View is located ~4 km to the east of the site, and Port Royal is located ~8 km to the west of the site along the Palisadoes main road.

The non-residential land uses found within a 2 km radius of the site are described below:

Recreational (Marine): Immediately west of the site is Royal Jamaican Yacht Club (RJYC). There are over one hundred (100) recreational sail and motor boats docked permanently at the club and at Morgan's Harbour. The RJYC has a capacity of 130 berths and is presently the largest marina on the island. It offers small cottages for rent and hosts one major fishing tournament annually.

Institutional: The Caribbean Maritime Institute (CMI) and the University of West Indies Marine Laboratory are located approximately one hundred meters (100m) from the site. The CMI was established in 1980 and currently has approximately two hundred & ninety two (292) students enrolled with approximately fifty (50) utilizing the campus' boarding facilities -both on campus and in Port Royal and Harbour View.

Airport: West of the site (less than 1km) is the Norman Manley International Airport. The presence of the airport and associated airport traffic (both road and air) dominate the area.

The wider area (Phase 2) includes vegetated lands and wetlands, which are included in the Palisadoes/Port Royal Ramsar Site.

4 STAKEHOLDER CONSULTATION PROCESS

4.1 SECTION OVERVIEW (TOR)

This section aims to summarize the key environmental concerns arising during the stakeholder consultations done prior to submission of the EIA. At a minimum, this section should

- Document the public participation programme for the project.
- Describe the public participation methods, timing, type of information to be provided to the public, and stakeholder target groups.
- Summarize the issues identified during the public participation process
- Discuss public input that has been incorporated into the proposed project design; and environmental management systems

The degree of public concern with specific issues (and general acceptability of the impact given proposed mitigation) is a key criterion used in determining of the relative significance of environmental impacts.

4.2 STAKEHOLDER CONSULTATIONS

The EIA process will only be considered valid if there are meaningful and valid opportunities for public scrutiny of the environmental effects of the project as proposed, including:

1. During the course of preparation of the EIA Report, direct written communication from the EIA preparer to relevant public agencies, NGOs and adjacent land owners/occupiers advising them of the project, and seeking their concerns about it as they relate to potential environmental impacts. Sixty-eight stakeholders (Appendix 5) were sent letters. Only one replied (Appendix 6).
2. Survey of the communities (Appendix 7) within proximity to the site in respect of:
    a. General acceptability of the proposed project, with consideration of the community-based stakeholders' willingness to make trade-offs, given the potential benefits of the project to the local and national economies.
    b. Fears and expectations about the specific project, including any anticipated social conflict and crime.
    c. Perceptions and attitudes of present community-based resource users, e.g., fishermen, squatters, recreational beach users.
    d. General health, safety and environmental concerns related to the project.

    The Quota Sampling method was used to arrive at the one hundred (100) individuals, eighteen and over who were surveyed. This included ascertaining the Enumeration District (EDs) in which the proposed development falls and also neighbouring EDs

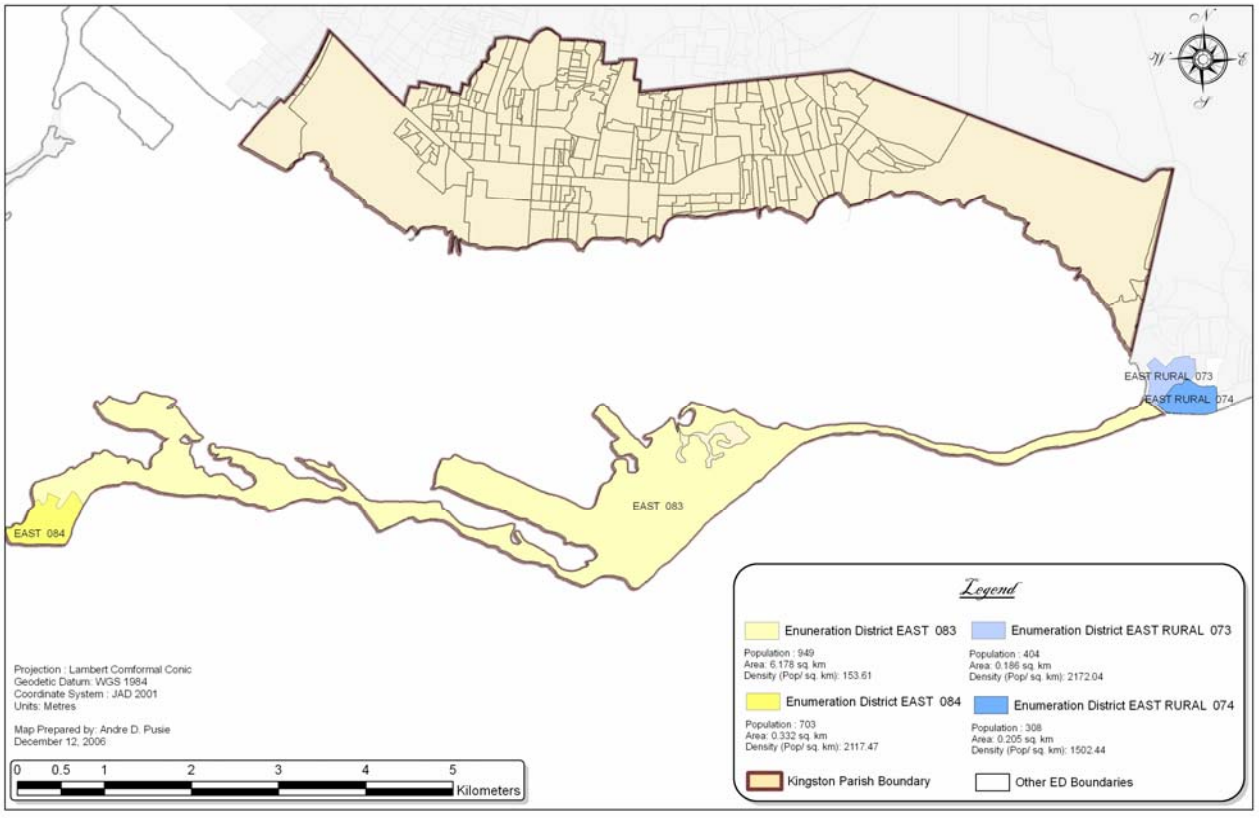
(Figure 33). A total of four (4) EDs were chosen, with a total population of 2,364, broken down as shown in (Table 31).

Table 31 Population Distribution in the EDs

ED	Location	Population	Percentage
East 83	Palisadoes to Port Royal	949	40
East 84	Port Royal	703	30
East Rural 73	Harbour View	404	17
East Rural 74	Harbour View	308	13
		2364	**100**

One hundred questionnaires were administered in this study area. The percentage distribution of population in the EDs was used to determine the number of questionnaires to administer to allow for a representative stratified sample of the four EDs.

Figure 33 Enumeration Districts



3. Availability of all EIA documents for public review, inclusive of: (1) these Terms of Reference (2) the EIA inclusive of all supporting technical appendices (3) the Public Meeting Report (containing presentations, summary, verbatim report of question and answer session and the register of attendance) and (4) Addendum Report (i.e. written response to EIA review comments).
4. Public Meeting to be held in Port Royal three weeks after the EIA is made available for review. This meeting should include presentations outlining the project, its environmental impacts, and proposed mitigations.

4.3 OPPORTUNITIES FOR STAKEHOLDER INVOLVEMENT

The EIA process for the proposed 7th Harbour Development at Gunboat Beach is proceeding according to the schedule outlined in Table 32 below.

Table 32 Project Development Schedule

Benchmark	Date
Draft TORs submitted to NEPA	November 14th 2006
Mobilization of EIA consultants	November 26th 2006
Revised TORs submitted to NEPA further to comments	January 9th 2007
Draft TORs accepted by NEPA (revised)	January 22nd 2007
EIA is submitted to NEPA for technical review	May 22nd 2007
Public Meeting (*date to be confirmed*)	June 12th 2007
Verbatim Report Available (*date to be confirmed*)	June 19th 2007
End of Public Review Period (*date to be confirmed*)	July 18th 2007
Review of application by the NRCA Board *(estimated)*	August 8th 2007

4.4 ISSUES RAISED

4.4.1 Attitudes & Perceptions

4.4.1.1 Profile of the Surveyed Population

- The average age of the respondents was 40 years.
- As many women as men chose to participate in the survey (50:50).
- Most of the respondents (84%) had lived in the area for more than 10 years.
- Approximately a third of the respondents owned their house. Most (56%) rented.
- All respondents had been to school, and had some level of literacy. Seventy-one percent had completed either secondary or tertiary education.
- Two thirds of the respondents indicated that they were employed.

- Only 63% chose to answer the question about average weekly income. Most people earned above the minimum wage ($2400 per week) and 82% reported earning above $4000 per week.

4.4.1.2 Community Complaints

- Two-thirds of the respondents were dissatisfied with the water supply (66%), garbage collection (68%) and the availability of recreational facilities (64%). Half of the respondents felt there is a need for entertainment and recreational facilities in Kingston.
- Approximately half were dissatisfied with transportation services (54%), fire services (58%), electricity supply (55%), police services (49%), health services (57%).
- Approximately a third of the respondents were dissatisfied with the telephone services.

4.4.1.3 Community Values

- All respondents indicated that they liked living in the area, with the majority (93%) explaining that this was because of their perception of the area as crime free, quiet and peaceful.
- A surprising 45% of the respondents indicated that Gunboat Beach was not important to them. Only 12% indicated that it was very important.

4.4.2 Issues Raised by Stakeholders

4.4.2.1 Perceived Impacts of the Project on the Area (Survey)

- Many indicated it may increase conflict or competition (40%) or result in increased crime (50%).
- A quarter of the respondents felt it may result in a loss of income.
- Forty-five percent (45%) indicated their belief that it would result in a loss of biodiversity.
- Most (61%) did not feel that that the project would cause increased hurricane flooding.
- Most (60%) felt that the project would result in increased traffic.
- Only a third (36%) indicated their belief that it would result in their exclusion from the beach.

- The majority (88%) believe the project will create jobs in the area, and will result in improved utility services (71%), security (73%), and living standards (76%).

4.4.2.2 Perceived Impacts of the Project on the Area (Interviews)

Stakeholders raised concerns about the following:

- Vulnerability of the proposed marina to hurricanes.
- Monitoring of the (effluent) of the STP.
- Consumption of energy.
- Proper disposal of garbage (public health issues).
- The location of the site within the Palisadoes-Port Royal Protected Area, and the designated Ramsar area.
- Effects on the mangroves and their function as a habitat and wind break.
- The effect of dune and vegetation removal on the stability of the Palisadoes and the shoreline.
- Adequacy of parking facilities.
- Potential for traffic congestion on the airport road.
- Increase in vessel traffic (from the reported baseline of 1500 per year).
- Inadequacy of nearby fire response capabilities.

In addition, there is the hope that the following positive impacts may occur:

- Public health and safety are assured by effectively preventing bathing in contaminated waters.
- Helps in the protection of the Kingston Harbour from pollution.
- Takes advantage of the uniqueness of the site: climate, geography, history, and culture.
- Improve recreational infrastructure and improve tourism

These matters, in addition to the issues identified in the Terms of Reference (Appendix 1) have been addressed in Section 5 of this report.

5 ASSESSMENT OF IMPACTS

5.1 SECTION OVERVIEW

The purpose of this task is to identify the major environmental and public health issues of concern and indicate their relative importance to the design of the project and the intended activities. The main objective is to determine whether there are any environmental considerations that need to be taken into account in reviewing the applications for environmental permits, and whether there is any environmental reason why the project should not proceed as proposed.

5.2 METHODOLOGIES

5.2.1 Impact Identification

Both positive and negative project impacts were identified using the following methods:

1. Stakeholder consultation.
2. Technical inputs from environmental specialists on the EIA team.
3. Review of the possible impact-causing aspects of the project.
4. Review of impact assessments done for similar projects.
5. Regulatory criteria governing aspects of the environment likely to be impacted.
6. The sensitivity of valued environmental components (VECs) likely to be impacted.
7. Review of the risks arising from the project and the range of environmental consequences that could arise under upset conditions.

5.2.2 Impact Assessment

1. Each identified impact is classified according to the assessed effect level (no impact, minor, moderate or major). Each identified impact shall be assessed using the following criteria:
2. Scale: this refers to the magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action. This allows higher assessment of impacts with a wider sphere of influence.
3. Affected Numbers: this considers the numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted. This parameter can refer to indicator species or general receptor populations.
4. Secondary Effects: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component, latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.
5. Resilience: This criterion examines ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) shall be considered. Resilience/sensitivity can be determined by eco-

toxicological response, dose/response relationships and exposure of the population given effect pathways.

6. Persistence: This addresses the frequency and duration of effects in the environment. In general, chronic (persistent) or acute (short-term but severe) effects are regarded as more significant.
7. Reversibility. This criterion evaluates the extent to which an affected receptor can be returned to its pre-project state.
8. Baseline change: This relates to any model or prediction of the extent of change that can be expected. This shall compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
9. Extent to which the impact can be mitigated: This addresses the feasibility (ease of implementation and cost-effectiveness) of measures to prevent or reduce environmental costs. It shall also consider the benefits or moderating circumstances given these environmental costs.
10. Uncertainty: This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
11. Acceptability to stakeholders: This examines the willingness to make trade-offs and the degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

The criteria given above are used in a simple rating scale, which further defines each of the criteria, according to the four basic effect levels commonly used in EIA practice (No Impact, Minor, Moderate and Significant). These are defined in Tables 33 and 34 and are consistently applied to each of the impacts identified.

Each impact is evaluated against each of the set criteria, with the assignment of a score (based as far as possible on the available scientific data presented in the EIA), and given a score between 0 and 5. The scores ranged from less than 1 (no impact to negligible), 1 to 1.9 (minor), 2 to 3.9 (low to high moderate), and more than 4 (low to high significant). Total score is averaged out of the scores in respect of the criteria to determine the overall averaged effect level for the impact. Where a criterion is not relevant, no score is assigned, and the average calculated only on the number of relevant and scored criteria.

Table 33 Negative Impact Assessment Criteria

	0	0.1 1.9	2 3.9	4 4.9
CRITERIA	**No impact**	**Minor**	**Moderate**	**Significant**
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.	Widespread: offsite regional effects
Affected Numbers:	None	<1% population or habitat area is directly exposed.	1% to 10% population or habitat directly exposed.	> 10% population or habitat area is directly exposed.
Secondary Effects	None	Few indirect effects.	Many indirect negative affects. One trophic level within one generation affected.	Many indirect negative affects. > 1 generation affected. Several trophic levels involved.
Resilience:	Receptors are resilient. Nuisance but no real loss of revenue or amenity. Impact does not occur at a time when receptors are vulnerable		Morbidity or health concern. Temporary loss of revenue or amenity. Impact occurs at the start or end of a period when receptor is particularly vulnerable	Receptors unable to cope. Mortality or trauma in populations. Loss of revenue or amenity is sustained after remedial action is taken. Impact occurs at the peak time when receptor is vulnerable.
Persistence:	Lasting less than a few months before recovery occurs with no observable residual effects. Related to duration of event.		Lasting from a few months to two years before signs of recovery	Impact persistent after 2 years. Impacts on a biological population over a number of recruitment cycles.
Reversibility:	Can be returned to original state completely with removal of structural elements.		Can be returned to a productive state with removal or change of use of structural elements.	Cannot be easily or cost-effectively returned to previous state or be re-used for any other productive purpose.
Baseline change:	None	Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.	Moderate deviation from baseline conditions. Within 2 standard deviation of the mean.	Major deviation from baseline conditions: > 2 standard deviations of the mean.
Manageability:	None	Very easily and cost-effectively mitigated. Significant opportunities for environmental enhancement or benefits in the short to medium term (arising within a few months).	Cost-effectively mitigated. Long term environmental benefit as a result of the short-term negative impact associated with project (arising within 2 years)	Cannot be easily mitigated or requires major design change to causative activities. No mitigation possible. No opportunity for environmental enhancement or no perceptible environmental benefit.
Scientific Uncertainties	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set.	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied.
Acceptability:		Impacts are acceptable to affected community. Complies with legal thresholds and /or best practice or wise use of resource, physical plans and land use policies.	Acceptable with mitigation. Affected stakeholders willing to make trade off. Approaches legal limits or criteria or maximum allowable levels.	Public outcry. Prohibitive legislation, plans or policies. Exceeds legal thresholds, limits or criteria or maximum allowable levels.

Table 34 Positive Impact Assessment Criteria

	0	0.1 1.9	2 3.9	4 4.9
CRITERIA	**No impact**	**Minor**	**Moderate**	**Significant**
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.	Widespread: offsite regional effects
Affected Numbers:		Less than 1% population or habitat affected.	1-10% population or habitat affected.	More than 10% population or habitat affected
Secondary Effects		Few indirect positive effects.	Many indirect positive affects. One trophic level within one generation affected.	Many indirect positive affects. > 1 generation affected. Several trophic levels involved.
Resilience:	Receptors are not able to take full benefit or benefit indirectly. Minor advantage but no real increase in revenue or amenity. Impact does not occur at a time when receptors are receptive.		Medium term increase of revenue or amenity. Impact occurs at the start or end of a period when receptor is able to benefit.	Receptors benefit directly. Revenue or amenity is sustained in the long term. Benefits are accessible at best time for receptor.
Persistence:	Lasting less than a few months before recovery occurs with no observable residual effects.		Lasting from a few months to two years before signs of recovery.	Impact persistent after 2 years. Impacts on a biological population over several recruitment cycles.
Baseline change:	Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.		Moderate deviation: 1-2 standard deviations	Major deviation: >2 standard deviations
Scientific Uncertainties	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied. Numerous conditions that are likely to occur that would affect impact of benefits.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set. A number of conditions that could off-set benefits.	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable. Few conditions that could off-set benefits.

5.3 ENVIRONMENTAL IMPACTS

5.3.1 Physical Environment

5.3.1.1 Change to Air Quality

During the construction phase air quality is expected to be affected mainly by diesel emissions from equipment like the excavator, dredger, haulage trucks etc. If concentrated, diesel and exhaust fumes have the potential to pose a health risk. Diesel emissions contain numerous toxic components such as carbon monoxide, nitrogen oxide (NO_x), sulphur dioxide (SO_2) and hydrocarbon particulates. SO_2 and NOx can be transformed into secondary pollutants such as sulphuric acid, ammonium nitrate and nitric acid, which can be transported over very long distances, and may be rained out as acid rain (pH below 5.6) or be deposited dry on surfaces. The very minor contributions of emissions from small construction sites are cumulative with other sources in the urban area.

Air quality will also be locally affected by fugitive dust (respirable particulates) associated with bare soils and earthworks, stockpiles, demolition activities and vehicular traffic on unpaved surfaces. The activities during the operational phase are not expected to impact on air quality.

CRITERIA	ASSESSMENT	Score
Scale:	Emissions are expected to disperse rapidly offsite because of the prevailing winds from the east and north-east. Although moving off site, concentrations are expected to approach ambient levels within proximity to site boundaries.	3
Affected Numbers:	Workers at the construction site will be exposed to the emissions and dust, but are expected to be protected. Vegetation (mainly to in the wetlands to the west of the site) may be receptors.	3
Secondary Effects	If workers are not protected from fumes at source there could be health risks. Very minor contribution to urban air quality and potential for smog and acid rain (cumulative effect). Dustiness at the site can reduce visibility on the road if conditions are very windy.	2
Resilience	The major receptors (construction workers) are resilient as they should be equipped with masks.	1
Persistence:	Construction is expected to last for ~12 months	2
Reversibility:	Completely	0
Baseline change	Moderate deviation	2
Manageability	• Ensuring that contractors maintain the vehicles properly. • Smoky vehicles should not be allowed to operate. • Provision of workers with dust masks. • Wetting of stockpiles and unpaved access roads. • Covering of haulage vehicles, onsite stockpiles. • Phasing of vegetation clearance and earthworks. • Early re-establishment of ground cover (landscaping). • Minimizing periods of work stoppage during earth works.	1
Uncertainty	Uncertainties about quantities of diesel that will be used and therefore emissions, exact timing of earthworks and weather conditions during these periods. However, there is a greater certainty that there will be few receptors downwind of the construction site.	3
Acceptability:	Emissions associated with the construction site will be a level that is normally acceptable for these types of operations, given the implementation of the proposed mitigation measures.	1
Classification:	**Minor**	1.8

5.3.1.2 Change to Micro-Climate

Development of the site will involve substantive change in land cover from vegetation (with some pavement) to a significant amount of pavement. This will involve a change in green cover from an estimated 76% (9 acres) to ~47% (5.5 acres) of the 11.8 acre site after development. The major environmental effect of the change in land cover will be a change in micro-climate. No clearance or physical encroachment into the wetland area is planned. Although much of the vegetation present at the site was scrub and grass, a number of tree species (Table 13) that are typical of dry coastal areas that have been heavily disturbed were documented. Vegetation affects micro-climates in a number of ways including interception of solar radiation

(temperature) and dust, circulation of air, effects on ambient humidity, as well as the production of oxygen and consumption of atmospheric carbon dioxide.

On the other side, creation of pavement can trap heat in the day time, and slowly release it in the night.

CRITERIA	ASSESSMENT	Score
Scale:	By definition, micro-climate changes are limited to the site, and localized areas such as building surfaces and air conditioning vents	1
Affected Numbers:	The effects of increased heat and humidity at the site may not be apparent to many because of the location at a coastal site and constant breezes.	1
Secondary Effects	Offices and indoor spaces will require air conditioning. This will result in increased fuel consumption. Minor contribution to urban heat island effect.	2
Resilience	Receptors are able to cope, particularly as the larger numbers of people will be on site at night when it is cooler anyway. Persons there in the day time will be either in open breezy areas or in air-conditioned rooms.	1
Persistence:	Life time of the project (50 years)	4
Reversibility:	Can be altered with removal of the pavement and restoration of the original vegetation cover.	2
Baseline change	Approximately 30% of the site now under vegetative cover will be altered. This is considered to be a moderate deviation from the baseline.	3
Manageability	Landscaping and retention of vegetation cover as much as possible. Surfaces that do not retain heat should be integrated into the design.	2
Uncertainty	Actual change in micro-climate is unknown.	2
Acceptability:	This change normally occurs with any development.	1
Classification:	**Minor**	1.9

5.3.1.3 Improvement of Visual Aesthetic at the Site

Based on this present visual aesthetic of the site this is interpreted as a positive impact. The developers are proposing to modify aspects of the site in the manner summarized in Table 35 below.

Table 35 Visual Changes

Visual Aspect	Project Elements
Shoreline & Foreshore	Removal of solid waste from the shoreline. Routine collection of garbage accumulating at the shoreline from other sources around the harbour.
	Removal of the derelict offshore concrete structure.
	Creation of a visually pleasing shore front (promenade) and marina.
Back beach and other areas	Demolition of derelict buildings and old pavements.
	Construction of architecturally designed buildings for recreational use. Removal of bulky wastes (old wrecks, fridges etc) likely to be found in the dune areas.
Vegetation	Removal of scrub and grasses.
	Landscaping with indigenous ornamental trees and preservation of trees on site wherever possible. Continuous grounds maintenance.

Entrances and access roads	New alignments, widening and pavement with appropriate landscaping.

CRITERIA	ASSESSMENT	Score
Scale:	The improvements to the shoreline will be visible from downtown Kingston.	4
Affected Numbers:	More than 10% of the site will be improved.	4
Secondary Effects	Improved water quality in the marine area. Improved safety for visitors by removal hazardous derelict buildings.	2
Resilience	Improvements will be sustained and are accessible.	4
Persistence:	Benefits will last through the project life (50 years)	4
Baseline change	Major divergence from existing visual aesthetic at the site	3
Uncertainty	Confident of improvement	4
Classification:	**Significant**	4.2

5.3.1.4 Dredging

Preliminary screening of the sediments indicated elevated levels of copper and lead in the sediments that are expected to be dredged. Approximately 13,000 m^3 of dredge spoil (silty sand) will be dredged from the marina area. It is unlikely that much of this material will be suitable for land fill behind the proposed revetment. Therefore, this material will have to be disposed of either on land or at sea at an approved dump site. The main benefit of this is that the area subject to dredging will have improved sediment quality.

CRITERIA	ASSESSMENT	Score
Scale:	Although dredging is limited to marina area, disposal will be off-site	4
Affected Numbers:	It can be assumed that all organisms in the disposal site footprint and dredging will be affected.	4
Secondary Effects	Improvement of sediment quality at the site. Creation of a sediment plume which can settle elsewhere in the harbour. Temporary increase in turbidity at the site. Alteration of bathymetry, which may result in changes to the benthic community, circulation patterns, availability of oxygen. Dredging is unlikely to affect shoreline stability as the revetment and proposed land reclamation works will counter the effects of deepening the foreshore. Marine disposal can result in smothering of benthic organisms in mound footprint. Potential change in substrate at the disposal site. Land disposal will require controlled land fill operations for contaminated sediments to prevent leachates.	3
Resilience	Not likely to be high.	4
Persistence:	The effects of dredging are expected to be persistent for years.	4
Reversibility:	Cannot be reversed.	4
Baseline change	Measurable: change in depth, presence of contaminants, effects on benthic organisms, possible	3

Manageability	Options for beneficial reuse are limited because of the potential for contamination. Similarly, ocean disposal is not recommended. Disposal at a controlled landfill is recommended, pending further testing of the sediments to ascertain contaminant levels.	3
Uncertainty	Only screening tests were performed in respect of a few heavy metals. More data is required to properly characterise the dredge spoil.	3
Acceptability:	There has been dredging in the Kingston Harbour before, although it is not certain whether there has been any done in proximity to the Palisadoes. The main concern in this case is disposal of potentially contaminated sediments, which can be effectively managed.	2
Classification:	**Moderate**	3.4

5.3.1.5 Stabilization of the Shoreline

The project proposes to undertake a significant modification of the shoreline at Gunboat Beach, replacing the beach area behind the proposed marina (Figure 34) with a boulder revetment, which will be backfilled and covered by a concrete promenade deck at 1.5 m above sea level. The proposed modifications are interpreted as a positive environmental effect because of the major secondary effects that are expected.

CRITERIA	ASSESSMENT	Score
Scale:	Proximity to borders.	3
Affected Numbers:	All users of the site and the Palisadoes main road.	4
Secondary Effects	▪ Raising the elevation of the land will protect the site from storm surge associated with low pressure cyclones. ▪ Placement of the promenade and revetment will discourage recreational bathing that is currently practised at this site because of its public accessibility in spite of the MOH warning that the water is not suitable for contact. ▪ The revetment and promenade will stabilize this section of the Palisadoes and protect against potential slumping arising from earthquakes. ▪ The overall modification will be improve the visual aesthetic of the area and will represent the most productive use of the beach, given its present recreational use constraints.	5
Resilience	*Not applicable (n/a)*	
Persistence:	Long term	4
Baseline change	Major change is proposed.	4
Uncertainty	Relatively high confidence in predicted storm surge levels and other predicted effects.	4
Classification:	**Significant**	4.1

Figure 34 Gunboat Beach as it is today

5.3.1.6 Removal of the Dunes

The site plan places a major parking lot in the area that is presently occupied by vegetated dunes (Figure 35). These dunes are also located on the leeward side of the Palisadoes and therefore cannot protect the ocean shoreline from high winds. Although they represent a major storage box for sand, these dunes have been assessed as relict features no longer contributing to active process on the south side (open ocean) of the Palisadoes main road. Therefore, the sands in the dune are not available to shoreline processes and do not contribute to the stability of the Palisadoes.

It is recommended that the sand now contained in the dune be made available for proposed dune reconstruction on the vulnerable strip of the Palisadoes east of the site. This material would be ideal for dune reconstruction as it was once part of that system before the road was constructed.

Figure 35 Vegetated Dune at the Site

CRITERIA	ASSESSMENT	Score
Scale:	On site.	2
Affected Numbers:	n/a	
Secondary Effects	Lowering of the elevation here would result in greater visibility of the site from the road. Loss of habitat to birds living in the scrub vegetation associated with the dunes. Removal of a wind barrier to the mangrove area in its lee.	3
Resilience	The stability of the site or the Palisadoes is not expected to be modified by the removal of the dunes	1
Persistence:	Long term	4
Reversibility:	Not easily reversed after parking lots are constructed, and sand removed	3
Baseline change	Significant lowering of the topography is expected. However, the dunes appear to be impacted by natural weathering (from storms) and possible illegal sand mining.	4
Manageability	None necessary.	1
Uncertainty	Uncertainty in respect the degree of protection offered by the dunes to the mangrove area during hurricanes.	3
Acceptability:	Concerns have been raised previously about the effect of removal of these dunes. Geologists with specific expertise in dune sedimentology are of the opinion that the removal of the dunes on site will not affect the stability of the Palisadoes. The negative effects should be weighed against the following potential benefits: ▪ Beneficial reuse of the dune sand for reconstruction of dunes in the active foreshore on the south side of the Palisadoes would contribute to the stability of the Palisadoes, and be aligned with plans for protection of the Palisadoes that have been proposed. ▪ Placement of the parking lot here would increase the productive use of these lands. The adequacy of parking is critical to the success of the entertainment centre and avoidance of traffic congestion issues.	3
Classification:	**Moderate**	2.7

5.3.1.7 Drainage Modification

The proposed site modifications will alter the drainage in the following ways:

- Increased impervious surfaces (parking lot and buildings).
- Altered topography that will require engineered drains and culverts as given in the drainage plan.

However, it is expected to retain the following features of the natural system:

- A similar quantity of surface run off is expected, as the natural infiltration ability of the land is very limited as it is low lying with a water table affected by tidal fluctuations.
- The major outfalls of natural drainage will be maintained, so that the pond will continue to receive surface run-off from the dune area, which is now proposed to be the parking lot area. Some run-off will also flow directly to the marine environment as before in the central and eastern parts of the site.
- The major receiving body is in hydraulic continuity with the sea, and is therefore not expected to exceed capacity and produce flooding in adjacent lands.

CRITERIA	ASSESSMENT	Score
Scale:	Drainage modification is only proposed for the site, although there will be outfall to the pond on the western side.	2
Affected Numbers:	No flooding or loss of freshwater inflow is predicted at any adjacent site because of the site's location.	0
Secondary Effects	None	0
Resilience	n/a	
Persistence:	Long term	4
Reversibility:	Can be returned to its natural state with removal of structural elements and reshaping of the land.	3
Baseline change	On the surface the change will appear to be major, but the net effects will not represent a major divergence from the present situation off site. There is no system in place to accommodate major storm flows. However, due to the very small catchment size, these flows are expected to be manageable by the proposed design,	3
Manageability	Drainage pathways must be kept clear of debris and sediment.	2
Uncertainty	Actual storm events that will impact the area in the next 50 years	2
Acceptability:	The proposed drainage plan must be evaluated and approved by the NWA.	1
Classification:	**Minor**	1.8

5.3.1.8 Decline in Coastal Water Quality

During the construction phase of the project, the major effect on coastal water quality is expected to be an increase in the concentration of total suspended solids (TSS) which was found to be very low in both wet and dry seasons at the two marine stations (see Table 7). Dredging, reclamation, boulder placement and run-offs from the construction site are all expected to contribute to the TSS load in the marine area immediately offshore of these activities. There might also be some minor loadings from construction workers (not using portable lavatories) which would contribute to the BOD, faecal coliform, and nutrient load, all of which are already relative high particularly in the dry season. Oil and grease levels may also be increased during the construction period due to the use of heavy equipment and vehicles on site.

In the operational phase, the amount of TSS is expected to be significantly reduced when compared to the construction phase. It is expected that the run-off from the main parking areas may have a loading of oil and grease associated with cars, which would outfall to the pond, which had mean levels of 4.2 to 6.4 mg/l, and was considered to be already contaminated in this respect. Minor accidental spillage of hydrocarbons in the marina may increase oil and grease loading in those waters (accidental spillage is considered elsewhere).

The other major effluent outfall associated with the project is the sewage effluent from the STP. Grey water will also be routed to the sewage treatment system, but will pass through grease traps before entering it.

The outfall will be compliant with the NRCA requirements for tertiary wastewater effluent discharges, and irrigation standards if this is the purpose for which it is to be used. It is recommended that treated effluent from the wastewater plant meet irrigation standards so that it can be beneficially reused for landscaping, and for discharge to the mangrove pond to the west of the parking lot. The mangrove area would then function to further remove suspended solids and nutrients before final outflow to the harbour.

CRITERIA	ASSESSMENT	Score
Scale:	Outfalls to the marine environment.	3
Affected Numbers:	n/a	
Secondary Effects	Marine eco-system will be impacted by increased TSS loading in the construction phase and by other pollutants in the operational phase. Decline in visual aesthetic with turbidity plumes.	1
Resilience	Marine eco-systems in the harbour are expected to be very resilient to poor water quality.	2
Persistence:	Construction phase impacts will not persist for more than a year. However, operational phase impacts will last the duration of the project.	4
Reversibility:	Completely with the removal or cessation of operations.	3
Baseline change	The marine water quality is already very poor. It is expected that any negative effects of the project on water quality will be off-set by the positive effects of removal of solid wastes that could be leaching harmful pollutants in the water. The marina will not be offering any sanding or painting services which would are usually the major sources of pollution associated with marinas. In addition, there will be the added benefit of pump out services which would greatly discourage discharge of sea.	2
Manageability	The most serious concern in terms of water quality is the potential for TSS loading in the construction phase. This can be managed in the following ways: ▪ Use of turbidity barriers during dredging. ▪ Bunding of stockpiles. ▪ Minimizing bare soils and early landscaping. ▪ Phasing earthworks. ▪ Use of portable lavatories during construction. ▪ Monitoring of the wastewater effluent. ▪ Use of the mangrove system to remove nutrients and sediments from site effluents.	2

Uncertainty	Actual loads to the marine environment from operations and construction are unknown.	4
Acceptability:	The wastewater effluents will have to be compliant with NRCA standards for wastewater at the end of pipe, and with irrigation standards if to be discharged to landscaped areas or pond.	2
Classification:	**Moderate**	2.5

5.3.2 Biological Receptors and Habitats

5.3.2.1 Increased Lighting near Coastal Habitats

Lighting in coastal areas, particularly near protected habitats or turtle nesting beaches can be a cause for concern. Although, Gunboat Beach has not been identified as a turtle nesting site, the adjacent wetlands may serve as habitat for shorebirds and possibly the American crocodile. Aside from roosting activities of the shorebirds nesting in the area, predatory activities of nocturnal birds are likely to be affected to night time lighting. During the construction phase night time lighting in this area may be very limited to security purposes only. However, during the operational phase night time lighting is expected to increase significantly, with contributions from the fence perimeter, parking areas, built areas (including entertainment complex and restaurant), promenade, and marina.

CRITERIA	ASSESSMENT	Score
Scale:	Extends beyond immediate perimeter of the site.	4
Affected Numbers:	Although the bird population in the adjacent wetland is likely to be affected, it is unlikely that this will represent more than 10% the total population on the Palisadoes. Existing sources of light pollution such as the air port are likely to have resulted in emigration of sensitive populations out of the wet land between the airport and the development site already.	3
Secondary Effects	Over time the avi-faunal population in the wetland area may decline due to out migration. Increased demand for night time lighting will also serve to increase the fuel consumption rates, which cannot be easily met by alternative sources.	4
Resilience	Receptors are expected to demonstrate typical avoidance behaviour and to seek refuge in less disturbed areas on the western side of the Palisadoes. No mortality is expected.	2
Persistence:	Expected to persist over the life time of the project (50 years)	4
Reversibility:	Completely with removal of lighting.	0
Baseline change	Moderate as there are existing sources of light pollution such as the air port and the ambient night time light levels of the city of Kingston itself. The change will be locally more significant.	2
Manageability	No mitigation possible. A mitigating circumstance that can be considered is the availability of suitable refuge sites within close proximity to this area, and that the existing wetland vegetation will be unaltered and will serve as a buffer to light.	3
Uncertainty	Exact population of birds in the area. Effects on reptiles that might be ranging in the area.	4

Acceptability:	There is no regulation of urban light pollution in Jamaica. The site properly falls within an urban area, and night time lighting is an acceptable and necessary aspect of night time recreational activities. Increased lighting is necessary for security purposes as well.	2
Classification:	**Moderate**	2.8

5.3.2.2 Nuisance Noise

During the construction phase typical construction noise emissions are to be expected. These will include noise associated with activities such as demolition, pile driving, dredging and the operation of heavy equipment and vehicles. These noise emissions will be limited to normal working hours during the work week.

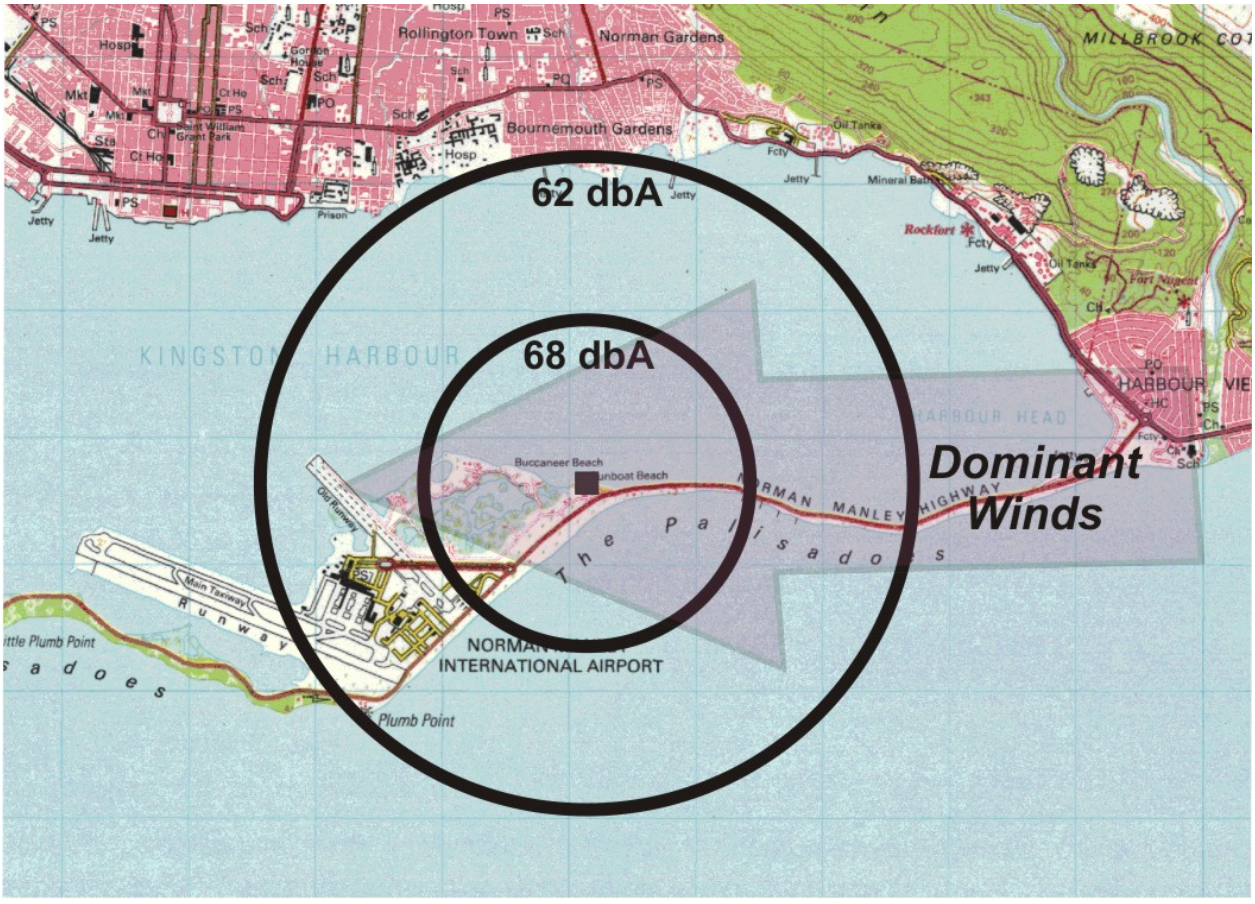
During the operational phase day time noise will be negligible on site, and is likely to be within acceptable parameters for music in the marina and restaurant area.

Night time noise associated with concerts in the open air entertainment centre is expected to be at a maximum level of 110 dB at the perimeter of the amphitheatre (loudspeakers at the perimeter will be directed inward). Using the rule that sound is reduced by 6 dB with every doubling of distance; this is calculated to fall off to the 68 dB by 1,280 m of the source. Figure 36 is a schematic diagram showing the distance decay that can be expected to occur during a concert event in relation to the dominant wind direction. Events at the entertainment centre are expected to be scheduled for either day (9 am to 7 pm) or night time (9 pm to 4 am) over an estimated 30 days per year.

CRITERIA	**ASSESSMENT**	**Score**
Scale:	Off-site but not regional.	4
Affected Numbers:	All sensitive biological receptors (birds etc.) within the wetland areas will be impacted. With the exception of the Royal Jamaica Yacht Club and Caribbean Maritime Institute (CMI), there are no noise sensitive social receptors such as communities or hospitals within the projected elevated noise zones.	4
Secondary Effects		0
Resilience	Vegetation on the western perimeter will remain in its present condition and is expected to provide an effective barrier to the noise, thus insulating bird communities within the wetlands. The CMI is expected to be more noise sensitive during normal working hours.	2
Persistence:	Each session can last several hours.	1
Reversibility:	Completely.	0
Baseline change	Jet take off noise associated with the airport will normally cease by 9 pm. This means that between the hours of 9 pm and 4 pm (proposed times for the session) the area is normally not affected by airport noise. Elevated night time noise level within a radius of 1.28 km of the amphitheatre is expected to be a measurable and major deviation from baseline conditions in this zone.	4

Manageability	The walls of the amphitheatre should be designed to act as buffer for sound within. There should be no scheduling of day time events during normal working hours to avoid disturbance of the CMI's activities. Speakers should be pointed toward the centre of the amphitheatre. There should be no speakers outside the amphitheatre.		3
Uncertainty			0
Acceptability:	Section 4 of the Noise Abatement Act stipulates that loudspeakers cannot be operated between 2 am and 6 am on a Saturday or Sunday, and between 12 pm and 6 am on Sunday, Monday, Tuesday, Wednesday or Thursday. The developers have indicated a desire to apply for some form of exemption as there are no adjacent residences in the area that would be impacted by elevated noise levels. This is shown in Figure 35 below.		4
Classification:	**Moderate**		2.2

Figure 36 Noise Distance Decay Associated with the Entertainment Complex



(assumes 110 dBA at source)

5.3.2.3 Effects on the Macro-Benthic Community

The project proposes to place a number of structures on the foreshore including jetty piles, the revetment and the groyne. The combined footprint of these structures is estimated to be of the order of 3500 m^2 of the foreshore. In addition the proposed dredging works will result in disturbance of most of the remainder of the marina area.

CRITERIA	ASSESSMENT	Score
Scale:	Within project boundaries.	2
Affected Numbers:	Almost all of the marina area of the site will be affected.	5
Secondary Effects	Crushing or removal of benthic organisms unable to flee from within the footprint. Change of substrate from a silty-muddy bottom in the area of the encroachment to a hard substrate. The indirect effect of this is a change in the structure of the marine community which is now dominated by polychaetes, which typically prefer muddy bottoms. It is expected that the rocky substrates of the groyne and revetment would create niches for encrusting organisms and fish. Any solid waste from the east would be prevented from entering the site and accumulating on the shoreline by the presence of the groyne. The solid waste would be likely to accumulate on the eastern side of the groyne and will have to be routinely removed. Dredging will also change the muddy silty bottom, replacing it in the short term with a possibly sandy substrate. Over time, this is expected to revert to a muddy bottom, which will be recolonized by a similar macrobenthos to what exists today. Operation of the marina itself may result in the introduction of foreign species which have attached themselves to vessels. Phase 1 of the marina is not expected to alter pollution levels (and thus indirectly affect the macro benthic community) as no painting or sanding is proposed, and the facility will be equipped with pump-out.	4
Resilience	The macro-benthic community at the site will be unable to cope with the changes. However, the community at the site is likely to be representative of adjacent areas, and it is expected that once dredging is completed the communities will begin to re-establish themselves.	4
Persistence:	Long term at the rocky substrate sites. Medium term at dredge site.	4
Reversibility:	Can be reversed with removal of all structural elements but this would be very costly.	3
Baseline change	The macro benthic community is presently characterised very poor with low biodiversity. This is probably related to poor water and sediment quality that was found. It is not expected that the presence of the marina will make a measurable difference to this baseline.	1
Manageability	No mitigation necessary. Monitoring of macro-benthic community biodiversity every five years is recommended.	1
Uncertainty	Actual change to macro fauna is uncertain, but data is reliable.	2
Acceptability:	No protected, rare or endangered organisms were identified. Creation of the groyne and revetment are necessary to protect project elements. Dredging is necessary to allow for sufficient draft for vessels.	1
Classification:	**Moderate**	2.7

5.3.2.4 Potential Conflict with Protected Area Designations

The site is located within the Palisadoes-Port Royal Protected Area (established September 1998) and the Palisadoes-Port Royal Ramsar Site (established April 2005). According to the NRCA Protected area plan this site falls within Zone 2, in which it was recommended in the plan that development be allowed because of the severely disturbed nature of this particular area, particularly where such development would enable restoration of recreational use of the area. In respect of the Ramsar designation, the original documentation suggested that areas classified as urban on the tombolo are not specifically intended for inclusion in the protected area. The area around the airport, yacht club, CMI and Gunboat would be considered an urban land use.

CRITERIA	ASSESSMENT	Score
Scale:	Activities, resource use and waste streams associated with the development are not predicted to negatively impact on the more sensitive areas of the protected area.	2
Affected Numbers:	The main concern of any development in this area in respect of ecological resources would be the mangrove eco-system occurring between the airport and Phase 1 of the 7th Harbour Master Plan site. Most of this eco-system has already been severely impacted by the surrounding land uses, and informal dumping in the wetlands. Phase 1 of the project is not specifically proposing to encroach on these disturbed wetlands (<% habitat is affected). The effect of tertiary effluent outfall to the adjacent pond on the western side of the property is expected to benefit the wetland, and prevent further pollution in the harbour, as will maintenance of storm flows to the wetland. *Removal of the dunes has been dealt with elsewhere as a separate impact*.	1
Secondary Effects	Development around the periphery of the disturbed wetland may ultimately encroachment into it, and could lead to its further demise, unless there is a plan for the restoration and rehabilitation of this particular area located in the midst of mainly urban land uses.	2
Resilience	The system was previously disturbed and no further encroachment is being proposed at this time.	1
Persistence:	Despite the protected area designation, no real conflict has been determined, and therefore is not predicted to be persistent.	1
Reversibility:	n/a	
Baseline change	The Gunboat and Buccaneer beach areas were previously developed as recreational sites, with hundreds of bathers reported at times. Present land use within the adjacent wetland is in conflict with its protection as it involves illegal dumping and cutting of trees. The proposed development will serve to restrict some of these activities.	1

Manageability	It recommended that the proponents of the 7th Harbour Development produce a plan to restore and rehabilitate the wetlands in this area, in a way that is integrated and consistent with recreational and tourism development being proposed by the Master Plan, instead of simply assuming that the system is degraded and has no value or can be easily lost.		3
Uncertainty	Specific interpretations of decision makers in respect of the protect area status of this area in the context of the wider protected areas, and the allowable types of land use.		4
Acceptability:	Prevention of further degradation of mangroves with illegal dumping of bulky waste. If the site remains as it is, it is likely that the wetlands will continue to become degraded. The Phase 1 development proposal does not seek permission to encroach on any protected eco-systems.		2
Classification:	**Minor**		1.7

The site is also protected by the JNHT as a historic site because of the historic Gunboat found there (Figure 37). This historic feature is not well maintained, and appears to have been concreted over. The proposed development will retain this feature as an iconic element, and will restore it, given its historic importance to the site.

Figure 37 The Gunboat

5.3.2.5 Impacts on Protected Species and Biodiversity

Although there will be some loss of vegetative cover including removal of dune vegetation (dealt with elsewhere), the project activities are not expected to impact on regional biodiversity. The vegetation at the site is representative of a highly disturbed environment, and species found there are commonly found elsewhere in coastal areas of the KMA. There shall be no encroachment into the wetlands at this time.

CRITERIA	ASSESSMENT	Score
Scale:	Protected species (crocodiles) could potentially enter the site from adjacent wetlands.	3
Affected Numbers:	With the exception of the American Crocodile, no protected species are known to range in the area. The wetlands are expected to be a habitat for the crocodile, and no evidence of their presence was found by this study, so the numbers are not likely to be very large. It is expected that less than 1% the total population of crocodiles on the Palisadoes may inhabit the adjacent wetland.	1
Secondary Effects	Safety hazard to human visitors from crocodiles. Possible attack or killing of crocodile entering the built area.	3
Resilience	This species is generally very resilient. The main concern is degradation of or intrusion into its habitat, which is not being proposed by this project.	1
Persistence:	The project is expected to co-exist with the wetlands for a very long time (more than 50 years)	4
Reversibility:	No direct loss of protected species is expected. Therefore, this parameter is not of concern.	0
Baseline change	No change to the baseline population or habitat area is predicted to arise from project's implementation.	0
Manageability	It is strongly recommended that environmental management plan make provision for the provision for their potential occurrence. This study supports the view expressed in the TOR (Appendix 1) that mitigation measures to protect the animals and users of the facility should be implemented by the developers. These measures shall include: ▪ Fencing (chain-link) of the western perimeter of the property. ▪ No recreational bathing in the marina or surrounding waters. ▪ Survey of the wider wetlands to determine whether there are any crocodiles there. ▪ Grates with a suitable mesh size should be installed in any culverts or drains that outfall to the pond or sea. ▪ Staff should be trained to deal with this contingency in such a way that a crocodile found on property can be handled without a casualty.	2
Uncertainty	Actual population of crocodiles in the wetlands if any.	2
Acceptability:	With the mitigation measures in place there should be no problem.	2
Classification:	**Minor**	1.8

5.3.2.6 Ecological Barriers

It is important to introduce fencing and landscaping to the site if the project is to be implemented. Birds, rodents and other small animals will not be affected by the chain-link fence. Fencing creates a barrier to terrestrial faunal species that do not fly or burrow. This would include crocodiles, which tend not to prefer the wetland area, the natural barrier of which will be demarcated by the fence-line. No habitat fragmentation is expected.

The marina and groyne may represent a barrier to pelagic species but the area is not completely closed off, so these elements do not represent effective ecological barriers. These features are not located in any known migratory pathway.

CRITERIA	ASSESSMENT	Score
Scale:	Regional effect	4
Affected Numbers:	Expected to impact less than 10% of the terrestrial fauna on the Palisadoes.	3
Secondary Effects	No range restriction is expected because the wetland habitat is not being fragmented by the fence line. The marina does not represent a barrier to marine species.	1
Resilience	Affected species are resilient.	1
Persistence:	Effect is long term (50 years)	4
Reversibility:	Removal of the barrier is easily done.	2
Baseline change	The natural shift between eco-systems (wetland, coastal dune) is already a barrier to species that are niche dependent. The fence line will only demarcate this natural boundary.	1
Manageability	None necessary.	0
Uncertainty	-	0
Acceptability:	Placement of the fence is necessary to restrict possible movement of crocodiles.	0
Classification:	**Minor**	1.6

5.3.2.7 Introduction of Pests, Invasive or Alien Species

Activities proposed by the project that have the potential to result in the introduction of pests, alien or invasive species include:

- Foreign vessels docking at the marina – encrusting species such as mussels.
- Storage of kitchen and restaurant wastes – flies, rodents and roaches.
- Storage of food for the restaurant - –flies, rodents and roaches.
- Feral cats or dogs may be encouraged by improper waste disposal.
- Landscaping activities – ornamental plants.
- Creation of drainage system – mosquitoes in that may become ponded in the drains.
- The presence of the marina substructures may have a reef effect, and encourage pelicans into the area. These are not considered an alien species or pest.
- The presence of the marina may encourage gregarious birds such as the grackle. These can become pests.

CRITERIA	ASSESSMENT	Score
Scale:	Isolated occurrences onsite	1
Affected Numbers:	Humans and existing eco-systems are expected to be the main receptors. It is unlikely that more than 10% of the population can be impacted.	3
Secondary Effects	Spread of disease in the case of vectors such as rodents, flies, mosquitoes and roaches. Changes to the eco-system in the case of imported marine species. Loss of biodiversity in the case of introduction of imported ornamental vegetation. Birds can be nuisances and predators to other species in the eco-system. Presence of feral cats and dogs can be a safety hazard, as well as have a negative effect on containment of solid waste.	2
Resilience	Existing eco-systems have been severely impacted and are generally resilient.	2
Persistence:	Impact will be long term	4
Reversibility:	Largely reversible with change of practice. Only marine invasive species difficult to control, but these are likely to have already been introduced into the harbour area.	2
Baseline change	The extent of disturbance of the area, previous use and present of another marina nearby suggest that the level of change will not be significant.	2
Manageability	With the possible exception of marine invasive species, all of these can be effectively managed. Proposed mitigation measures include: ▪ Implementation of proper food and garbage storage practices. ▪ Control of any feral species by removal of food wastes from restaurants and no feeding policies for birds, cats and dogs. ▪ Drains and ponds should be sprayed for mosquito larvae.	2
Uncertainty	-	0
Acceptability:	Generally acceptable if mitigation measures are put in place. The implementation of the project is expected to result in removal of significant amounts of garbage that now occurs on site, and attracts pests.	1
Classification:	**Minor**	1.9

5.3.3 Socio-Economic Environment

5.3.3.1 Demand for Municipal Services and Utilities

The presence of a major new recreational facility will place demands on the following municipal services: water supply, emergency services (police, fire, health) customs and immigration clearance at the marina and solid waste collection. There is a reasonably good source of water via the mains (from Yallahs). Other services are more constrained, and may require a level of self sufficiency on the part of the developer.

CRITERIA	ASSESSMENT	Score
Scale:	Regional	4
Affected Numbers:	The main receptors will be the providers of the resources. If the developer is relatively self sufficient, this impact will be limited.	2
Secondary Effects	Competes for scarce resources.	1
Resilience	If providers cannot meet growing demand, the developer will have to reduce demand by becoming self reliant.	2
Persistence:	Life of project,	4
Reversibility:	Demand ceases with project.	2
Baseline change	Presently, there are other commercial/institutional and residential consumers on the Palisadoes, including the Port Royal community, the airport complex, yacht club, marine laboratory, coast guard, CMI etc.	1
Manageability	▪ Site security should reduce the need for emergency police services and there should be additional security service during events. ▪ The developers should furnish space for customs and immigration if necessary. ▪ Fire water should be kept on hand. ▪ There should be a nurse's station during events at the entertainment centre. ▪ Public liability insurance should be maintained to cover all aspects of the development including the marina, entertainment centre and boat tour facility. ▪ A waste disposal contractor may be required to haul solid waste if the responsible agency is not able to do so.	2
Uncertainty	-	0
Acceptability:	Generally acceptable with implementation of mitigation measures.	1
Classification:	**Minor**	1.9

5.3.3.2 Fuel Consumption

The exact quantity of fuel that will be consumed during the construction phase and operational life time of the project cannot be estimated at this time. Based on the scale of operations, it is suggested that that fuel consumption may be of the order of 15000 KWH, particularly if there is night time security lighting around the perimeter, access roads and marina. The entertainment centre is only expected to be used ~30 times a year so this may not necessarily contribute heavily to the electricity bill. Operation of air conditioners in offices, shops and restaurant is expected to contribute. This is considered a direct negative impact as it involves consumption of a non-renewable natural resource (fossil fuel).

CRITERIA	ASSESSMENT	Score
Scale:	On site only	2
Affected Numbers:	n/a	0
Secondary Effects	Contributes to the national fuel import bill and urban electricity loading and carbon footprint of the project.	2
Resilience	n/a	0
Persistence:	Over the life of the project (50 years)	4
Reversibility:	Consumption of a non-renewable resource	4
Baseline change	This will be a minor contribution to a national effect (cumulative).	1

Manageability	Energy conservation measures include: ▪ Building design to allow for cool non-air conditioned in door spaces. ▪ Prevention of leakage from air conditioned spaces. ▪ Use of alternative energy such as solar or wind power. ▪ Use of energy efficient appliances and equipment.	2
Uncertainty	Actual consumption of electricity.	3
Acceptability:	Night time (off-peak) usage will be better than peak time consumption.	1
Classification:	**Minor**	1.9

5.3.3.3 Haulage

During the construction phase off-site subsidiary inputs will be sourced and imported to the site. These are expected to include timber (for the board walks and scaffolding), pre-fabricated concrete elements (pilings and promenades, paving tiles for the parking areas), and a range of other construction materials such as steel, pipes, roofing, windows, fixtures, zinc etc. The main concern with the consumption of these materials is their transportation to the site, and the effects that heavy vehicular haulage will have along the Palisadoes. This is of concern because this corridor is the only road between the city of Kingston and the Norman Manley International Airport. In addition, there is expected to be haulage of quarry products such as stones, aggregate, and fill. This includes importation of 280 m^3 of sand, 5,200 m^3 of stone, 1,900 m^3 rubble material and 15,000 m^3 of landfill. Some solid waste (demolition debris, dredged spoil, sand from the dunes, construction wastes etc.) will also require haulage from the site.

CRITERIA	ASSESSMENT	Score
Scale:	Along the main access corridor.	3
Affected Numbers:	It is likely that more than 10% of the road users will be impacted by construction traffic during the construction period, particularly if this coincides with any construction traffic associated with the protection works that are planned for the area just east of the site.	3
Secondary Effects	▪ Wear and tear on the road surface. ▪ Slowing of traffic by the movement of heavy haulage vehicles. ▪ Emissions from vehicles (discussed elsewhere). ▪ Fuel consumption. ▪ Accidents if unsafe driving or speeding is practiced.	3
Resilience	Road users are expected to be resilient to these effects.	2
Persistence:	12 months or less	2
Reversibility:	Moderate.	3
Baseline change	The increase in the number of haulage vehicles will be noticeable along the road during this period.	3
Manageability	▪ Spreading of axel load to reduce wear and tear. ▪ Haulage in off-peak hours. ▪ Signage advising of construction site. ▪ Contractors must observe road safety.	3
Uncertainty	-	0
Acceptability:	Generally acceptable if mitigation measures are implemented.	1
Classification:	**Moderate**	2.3

5.3.3.4 Traffic and Parking

Traffic impacts can arise from:

- Large numbers of vehicles on the road during peak hours which can affect commuter traffic to the airport, Port Royal, CMI, Yacht Club, Marine Lab, and the Coast Guard.
- Poorly designed site access/exits to the main road, and access to parking bays.
- Insufficient parking facilities. During its operational phase the site will have 83 employees, and can have up to 5000 patrons in the entertainment centre. Approximately 540 parking spaces are provided. If it is assumed that all of all of these spaces will be occupied by cars, and that each car will be carrying 5 passengers, then only 2700 or ~53% of the peak demand can be met. However, if it is assumed that most of the spaces will be filled during an event by 20-seater buses, then the available parking is more than adequate.

CRITERIA	ASSESSMENT	Score
Scale:	Along the main access corridor.	3
Affected Numbers:	It is likely that more than 10% of the road users will be impacted by operation traffic.	3
Secondary Effects	▪ Wear and tear on the road surface. ▪ Traffic congestion. ▪ Emissions from vehicles (discussed elsewhere). ▪ Fuel consumption. ▪ Accidents if unsafe driving or speeding is practiced.	3
Resilience	Road users are expected to be resilient to these effects.	2
Persistence:	Over the life time of the project	2
Reversibility:	Moderate.	3
Baseline change	The increase in the number of vehicles will be noticeable along the road during events (~30 times per year).	3
Manageability	▪ Scheduling of event start and end outside of peak hours. ▪ Careful design of access/exits with consultation with the NWA with appropriate lay-bys and slip streams for safe merging traffic. ▪ Maintenance of visibility. ▪ Appropriate traffic signage. ▪ Clear separation of exiting and entering flows (one-way circuit design). ▪ Creation of a pick-up/drop-off bus bay. ▪ Encouragement of patrons not to drive, particularly if alcohol will be consumed. ▪ Encouragement of car pooling for workers or provision of a shuttle service particularly during events. ▪ Encouragement of shuttle service providers, taxis and charter service company. ▪ Designation of a taxi-stand, where vehicles can rotate as needed. ▪ Employment of parking and traffic attendants during events.	3
Uncertainty	-	0
Acceptability:	Generally acceptable if mitigation measures are implemented.	1
Classification:	**Moderate**	2.3

5.3.3.5 Change of Land Use

The proposed land use will change the site from being one that is essentially regarded a public open space to a privately operated recreational facility. The most immediate effect of this is a loss of amenity to present users of the site. This includes vendors, beach bathers, and itinerants. This is interpreted as a positive change as the beach is not recommended for recreational swimming and represents a public health risk to swimmers. In addition, the present use encourages improper disposal of solid waste and marine pollution. The area also has the potential in its current isolated and derelict state to attract the criminal element, include drug traders.

CRITERIA	ASSESSMENT	Score
Scale:	On site	3
Affected Numbers:	All users of the site.	4
Secondary Effects	▪ Improvement in public health and safety. ▪ Improvement of visual aesthetic. ▪ Productive use of land for appropriate recreational use. ▪ Demolition of unsafe buildings. ▪ Prevention of crime and illegal dumping.	4
Resilience	Receptors are able to benefit directly	3
Persistence:	Over the life of the project.	4
Baseline change	Major improvement from the present condition of the site.	4
Uncertainty	-	4
Classification:	**Moderate**	3.7

5.3.3.6 Introduction of Vulnerability

During the construction phase there will be normal risks associated with construction sites. It is assumed that suitable worker safety protocols will be implemented by the contractors.

During both the operational and construction phase there will be the risk of earthquakes and hurricanes. Hurricanes allow for preparedness and warnings, so effective hurricane plans can reduce losses associated with this hazard. The revetment and land reclamation that are proposed will also reduce the potential for coastal flooding and damage to property during storms.

Earthquakes and other unpredictable upset conditions (such as vessel collisions, oil spillages, loss of containment of sewage, fires, or loss of electricity to STP) can produce major environmental impacts unless there a plans in place to prevent the accidents, optimize preparedness and response, and deal with clean-up as necessary.

CRITERIA	ASSESSMENT	Score
Scale:	On site elements, but approaches boundaries if there are no containment protocols (e.g. oil spill, fire etc.).	4
Affected Numbers:	Variable – can be every one on site if there is an earthquake (which can be thousands if there is an event) or can be isolated to a single person involved in an accident.	5

Secondary Effects	Depending on the event, there could be any or several of the following: ▪ Death or mortality can occur ▪ Destruction of property. ▪ Damage to eco-systems and habitats. ▪ Decline in water quality. ▪ Work stoppage or closure of the facility.	4
Resilience	The resilience of receptors will be a function of the magnitude of the event, and the measures that have been put in place to mitigate the effects of it. Not every hazard occurrence necessarily becomes a disaster. With the exception of a catastrophic earthquake, all of these hazards can be effectively mitigated.	3
Persistence:	Long term.	4
Reversibility:	The risk can be eliminated with the cessation of operations at the site.	3
Baseline change	The site is presently vulnerable to a similar range of hazards: hurricanes, earthquakes, storm surges, fires. The risk of oil spill, fires associated with boats, boating accidents, and sewage plant malfunction will be new risks introduced by the project.	3
Manageability	The proposed foreshore stabilization works should be implemented to reduce risk associated with storm surge. The East-West configuration of boat slips should be implemented as planned as well as the wide fairways, to reduce risk of vessel collision. In addition, all vessels should have radio clearance before berthing. An emergency management plan is required to cover the following contingencies: ▪ Earthquake ▪ Hurricane ▪ Fires ▪ Oil spillage at refuelling station, and main inland storage tank (including breaches associated with earthquakes). ▪ STP malfunction ▪ Vessel and vehicle collisions. This should make provisions for emergency resources, and training of staff. Insurance should be taken out to cover losses from these hazards.	3
Uncertainty	The occurrence of upset conditions cannot be predicted, but steps can be taken to prevent and contain them.	3
Acceptability:	With implementation of the mitigation measures this level of risk is acceptable, particularly as there will be no persons living on the site. This is a level of risk that applies to most urban businesses in the KMA.	3
Classification:	**Moderate**	3.5

5.3.3.7 Effects on Local Economies

The project is expected to have a positive economic effect. This will arise from:

- Creation of 100 temporary jobs during construction phase, and 83 permanent jobs during the operational phase.
- Transportation services for workers and employees (taxies, buses etc).
- Opportunities for vendors (local produce and souvenir items) and service contractors for solid waste disposal.
- There might be stimulation of tourism at Port Royal arising from the marina and entertainment centre being located at Gunboat Beach.

CRITERIA	ASSESSMENT	Score
Scale:	Effects are regional.	4
Affected Numbers:	Conservatively, less than 1% of the population is expected to be impacted.	1
Secondary Effects	▪ Social development to beneficiaries of earning opportunities. ▪ Increased tax payment to government. ▪ Revenues from the operation of the business (company taxes). ▪ Possible improved community resources.	3
Resilience	It is expected that receptors will be positioned to take advantage of the opportunities.	3
Persistence:	Life time of the project (>50 years)	4
Baseline change	Moderate improvement will be noticeable.	2
Uncertainty	Actual spin off effects unknown.	1
Classification:	**Moderate**	2.3

5.3.3.8 Provision of a New Social Amenity (Small Entertainment Centre)

It is expected that the operation of the entertainment centre will have a positive effect on the social environment as it will create an alternative to existing venues.

CRITERIA	ASSESSMENT	Score
Scale:	Regional importance	4
Affected Numbers:	Thousands of persons in the KMA will now have an alternative location for music concerts and large parties.	3
Secondary Effects	▪ Availability of better sound systems for musical performance. ▪ Promotion of cultural tourism associated with Jamaican music. ▪ Availability of VIP and backstage facilities for performers. ▪ Controlled concessionaires. ▪ Security. ▪ Adequate toilet facilities.	3
Resilience	Developers have conducted market research to confirm basis for development of this facility – domestic recreation market receptors are able to take advantage of the opportunity.	3
Persistence:	Life time of the project	4
Baseline change	Alternative venues in the KMA are located at Jamworld on the western side of the harbour near to the mouth of the Rio Cobre (Sting venue), and Sabina Park (which is basically a cricket oval with a 20,000 person capacity) and the National Stadium (seating capacity of 35,000).	3

	All of these venues are plagued with problems associated with under funding, vendor crowding, insufficient security, and inadequate infrastructure and amenities. In addition, these venues are located in proximity to residential land uses. This small entertainment centre is expected to create a new niche.		
Uncertainty	-		0
Classification:	**Moderate**		2.9

5.3.3.9 Development of Marine Tourism

The proposed project will introduce a second marina to the Palisadoes, and will offer a range of marina amenities such as the Harbour Mart, Restaurant, pump-out and refuelling facilities. In addition, marine tourism will also be promoted by the offering of a boat tour to other sites of interest in the area. It is hoped that increased capacity for berthing recreational vessels will attract more marine visitors to Jamaica, and stimulate tourism earnings from that sector.

CRITERIA	ASSESSMENT		Score
Scale:	Regional		4
Affected Numbers:	n/a		
Secondary Effects	▪ Increased foreign exchange earnings. ▪ Stimulation of local economies: demand for crafts, produce etc. ▪ Diversification of the tourism product of the KMA.		3
Resilience	n/a		-
Persistence:	Life of the marina.		4
Baseline change	The addition of 80 slip capacity will significantly increase Jamaica's overall capacity to accommodate recreational vessels.		4
Uncertainty	-		-
Acceptability:	Proposed marina complements adjacent land uses at the Yacht Club and CMI. Various maritime laws will have to be observed.		2
Classification:	**Moderate**		2.6

5.4 CONCLUSION

5.4.1 Summary

5.4.1.1 Minor Negative Impacts

A total of 18 negative environmental impacts were identified, with scores ranging from 1.6 (minor) to 3.5 (high moderate). Half of these (nine) were classified as minor negative impacts:

10. Creation of ecological barriers
11. Conflict with Protected Area status
12. Change to air quality
13. Drainage modification

14. Introduction of pests, invasive or alien species
15. Fuel consumption
16. Demand for municipal services and utilities
17. Impacts on protected species and biodiversity
18. Change to micro-climate

5.4.1.2 Moderate Negative Impacts

Of the nine classified as moderate negative impacts, 2 were limited to the construction phase, 5 were reversible with the removal of structural elements or cessation of causative activities, and 2 were regarded as permanent.

Construction Impacts (Short-Term effects that will not persist after the completion of construction activities): Construction haulage effects and dredging

Long to medium-term impacts that can be effectively reversed with removal of structural elements or project activities.

1. Effects of noise (disturbance of wetland birds)
2. Increased lighting near coastal habitats (disturbance of wetland birds)
3. Decline in coastal water quality
4. Traffic and parking effects
5. Increased risk (because of the presence of visitors and structures).

Long term operation impacts that result in a permanent change to the environment

1. Effects on macro-benthic community. No rare, endangered or protected species were encountered at the site.
2. Removal of the dunes (alteration of topography). The proposed modification was assessed as unlikely to affect the stability of the Palisadoes

Both of these were classified as moderate impacts that were relatively acceptable given the benefits of the project.

5.4.1.3 Moderate and Significant Positive Impacts

Six positive effects were assessed, with rated effect levels between 2.3 (moderate) and 4.2 (significant). These included:

5. Effects on local economies
6. Development of marine tourism
7. Provision of new social amenity (entertainment center).
8. Change of land use
9. Stabilization of the shoreline
10. Visual aesthetic

Stabilization of the shoreline, and the improvement to the appearance of the place (visual change) ranked as significant positive impacts arising from the project.

5.4.2 Summary of Findings of the EIA

The findings of this environmental impact assessment are that:

4. None of the negative environmental impacts identified has been assessed to be significant.
5. Negative environmental impacts can be cost effectively mitigated, and there are good opportunities for environmental enhancement of the performance of the project.
6. There are significant environmental benefits that are likely to accrue from implementation of the project as proposed.

6 ANALYSIS OF ALTERNATIVES

6.1 EIA OBJECTIVE

The purpose of this section of the EIA is to examine feasible alternatives to the project and highlight the benefits of and general rationale for the project that need to be considered against any potential environmental cost. It outlines the wider societal benefits of the development proposal that could arise if the environmental permit is granted.

6.2 ALTERNATIVE SITES IN THE KINGSTON AREA

6.2.1 Site Selection Criteria

6.2.1.1 The Marina

The location within the Kingston Harbour is considered ideal for a marina because it would preclude such developments to meet demand in other less environmentally disturbed areas. The following criteria were considered in selecting the site for the proposed use as a marina:

1. Availability of suitable marine space:
    - The physical dimensions and characteristics of the water body should be compatible with the scale of marina that is being proposed. There should be good natural flushing of the marina.
    - This is relatively sheltered location within the harbour, which would allow for protection against extreme wave conditions, and on-land space for dry docking if necessary.
    - There should be reasonable depth of water to minimize the need for dredging, and the location should be away from major sediment inputs, which would require frequent maintenance dredging. The proposed site is not expected to require maintenance dredging because of it is not located in a sediment outfall basin. If dredging is to be undertaken, the shoreline should be stabilized to prevent erosion.
2. There should be adequate space land side of the marina for the establishment of related amenities and facilities (immigration, potable water; electricity; STP; telephone; cable; fuel; food and other necessary supplies; shops and restaurants).

3. There should be proximity to an international airport, as is the case at Gunboat Beach. Adjacent land uses should be complementary. This is the case, with the Royal Jamaica Yacht Club and the CMI being in proximity to the site. The Coast Guard post and the Marine Laboratory are not located too far from the area. It is anticipated that marina patrons will visit the historic town of Port Royal and promote tourism there.
4. The presence of another marina in proximity to this site suggests that navigational routes across the harbour for pleasure crafts are well established, and there is potential for development of the market, and areas for pleasure cruising around Kingston Harbour, associated coastal areas and cays.

6.2.1.2 Entertainment Complex

The following criteria were considered in selecting the site for location of a 5000-person entertainment complex:

1. Land space for the amphitheatre and parking requirements.
2. Accessibility of site from major urban area via a major transport routes.
3. Location away from noise sensitive receptors such as residential communities and hospitals. Consistent with the adjacent airport land use.
4. Proximity to an urban market: high population density, culture that supports music sessions and willingness to pay for this kind of entertainment.
5. Suitable climate for outdoor recreational activities.

6.3 DESCRIPTIONS OF OPTIONS CONSIDERED FEASIBLE

This section examines the environmental, social and economic costs of the various feasible land use options including the proposed use and the present use. Feasible land use options are compared in terms of lowest costs and most benefits criteria: environmental impacts, social acceptability, economics (including productivity of land use) and engineering feasibility.

The following land use options are considered:

(1) Leaving the land as is (*status quo*);

(2) Industrial use;

(3) The proposed use.

Renovating the site as a public (municipal) recreational site is not considered a feasible option at this time, as recreational bathing is restricted.

6.3.1 The No-Action or *Status Quo* Alternative (SQ)

Under this alternative, the entire 12 acres (4.8 ha) of coastal land at Gunboat Beach will be left in its current state without any development. The following environmental receptors are not disturbed under the present land use: wetland birds, traffic flows to the airport, the dunes on the western side of the property and the macro-benthic invertebrate fauna in the foreshore. The following negative environmental impacts will continue:

1. Illegal use of the site because of its isolated nature: drug use etc.
2. Public safety risk due to the presence of derelict buildings and exposure to possible crocodiles from the adjacent wetlands.
3. Continued public health risk posed by recreational swimming in an areas with known harmful water and sediment quality.
4. Continued degradation of the JNHT site (Gunboat) and unproductive use a tourism resource.
5. Lack of alternative productive use for a site because of the proximity to the airport and location along the Palisadoes.
6. Illegal dumping of appliances and batteries in the wetlands that result in declining water and sediment quality in the foreshore.
7. Possible illegal harvesting of wetland trees for charcoal.
8. Possible illegal dune sand mining.
9. Poor visual aesthetic from the accumulation of plastics and other garbage on the shoreline.
10. Overall vulnerability of the shoreline and Palisadoes to storm surge and erosion due to the elevation of the site

    below 1.5 m.

6.3.2 Industrial Use (IU)

Given the nature of the current site and its surrounding land uses, it is possible that this area could be developed in part or whole for industrial purposes. This type of development is expected to produce benefits in terms supply of concrete to the KMA for construction, and employment opportunities (~ 20 persons at most with a standard portable batching plant). Although there might be some clean-up of the shoreline and possibly demolition of the derelict, the operation itself would not result in a major improvement to the visual aesthetic. Occupation of the site by this type of operation would have the effect of making the site less isolated and prone to illegal uses.

This may involve the following elements and negative impacts on environmental receptors.

Table 36 Impacts Associated with Industrial Alternative

Project Elements	Impact receptors
Foreshore modification for a pier.	Benthic macro invertebrates.
On-loading and off-loading of cement possibly by pneumatic transfer.	TSS load in coastal water if there is accidental spillage.
Transfer of batch concrete to transportation trucks	Accidental spillage of concrete: change of pH and TSS concentration of coastal waters and wetlands.
Demand for water.	Municipal supply
Increased flows of haulage vehicles (aggregate, and other subsidiary process inputs).	Traffic flows; Increase in fugitive dust (air quality).
Servicing of vehicles	Oil and grease loading and TSS concentration in coastal water and wetlands.
Noise from mixing operations and generators	Minor disturbance to wetland birds.
Site clearance	Removal of vegetation and possible derelict buildings.
General operations	Conflict with tourism development at Port Royal and the protected area status of the region. The Gunboat artifact would not be located in a tourist accessible area. Increased site vulnerability because of the presence of equipment and staff.

6.3.3 Proposed Use (PU)

This option includes the design elements described in Section 1 and the environmental impacts discussed in Section 5 of this report. Although negative impacts are likely to occur, the following benefits of the projects will accrue:

1. Increased revenue and income earning opportunities.
2. Development of marine tourism opportunity in the Kingston Harbour.
3. Provision of a new social amenity in the form of the small entertainment center.
4. Change of land use to a more productive use.
5. Stabilization of the shoreline, and the Palisadoes at this location. In addition, there is potential for the supply of sand for proposed dune reconstruction further east of the site.
6. Improvement to the visual aesthetic at the site arising from major clean-up, and creation of a visually pleasing shorefront (promenade deck and marina).

Additional positive effects of the project include:

7. Removal of the derelict offshore concrete ruins which present a hazard to public safety
8. Restriction of public recreational bathing in toxic waters.
9. Removal or prevention of dumping of bulky wastes (old wrecks, fridges etc) in the dune and wetland areas, which leach pollutants into the coastal area.

6.4 Cost Benefit Analysis

The land use options outlined above are compared in terms of potential benefits and costs using a range of factors or normative criteria. These options are compared using a simple ranking system in relation to the normative criteria. A rank of number 1 indicates that the option is best suited to satisfying the normative criterion, while a rank of 3 indicates that the option is least suited to satisfying the criterion.

The option scoring the lowest total score may be regarded as the most suited overall. Although the scores are un-weighted (assuming all to be of equal importance), ten sets of costs and ten sets of benefits were included to ensure a balance. Additionally, as it is a ranking system, each option is given a score of at least one, although two options could tie with the same rank. The best possible score would therefore be 10, and the worst would be 30.

Table 37 Most Benefits Matrix

Normative Criteria	RANK		
	SQ	IU	PU
1. Most economically productive land use or social amenity	3	2	1
2. Most earning opportunities including job creation	3	2	1
3. Most complementary with adjacent land uses	1	3	2
4. Most complementary with protected area objectives	1	3	2
5. Most socially acceptable land use (marine and cultural tourism)	2	3	1
6. Best potential for improvement of visual aesthetic (clean up)	3	2	1
7. Most potential for improved water and sediment quality	3	3	2
8. Most potential for shoreline stabilization	3	2	1
9. Most efficient site drainage	1	3	1
10. Best potential for rehabilitating the wetlands and heritage site.	2	2	1
	22	25	13

Table 38 Least Costs Matrix

Normative Criteria	RANK		
	SQ	IU	PU
1. Least impact on air quality, lighting, and micro-climates.	1	3	2
2. Least impact on ambient noise levels and disturbance of birds	1	2	3
3. Least loss of vegetative cover (urban green space).	1	3	2
4. Least disturbance of dunes.	2	2	3
5. Least impact on coastal and wetland water quality.	3	2	2
6. Least impact on macro benthic infauna	1	2	3
7. Least demand for municipal resources (land fill space, water, road works, electricity, emergency services).	1	2	3
8. Least effect on traffic flows.	1	3	2
9. Least impact contribution to the degradation of wetland.	2	3	1
10. Smallest carbon footprint (fuel and timber use).	1	2	3
	14	24	24

Based on the criteria selected, the proposed use had the highest most benefits rank (13) when compared to the present land use and the alternative option of a cement batching plant. However, using the normative criteria selected for least cost, the status quo option had the highest rank (14), followed by the industrial use (24) and the proposed option (24). Arguably, any development of the site would result in environmental impacts such as impacts on water quality, and changes to air, noise, light and micro-climates, loss of green space, traffic, and municipal resources. Also, most productive uses of the land can be expected to have a carbon footprint.

7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 ENVIRONMENTAL OBJECTIVES

Based on the fore-going impact assessment, the following environmental objectives are recommended to underpin any environmental management system (EMS) that is implemented by the proponents.

1. To establish contractual controls on contractors involved in construction, to minimize the predicted environmental impacts by timely and effective implementation of the recommended mitigation measures.
2. To reduce and manage identified waste streams predicted to occur during the operational phase of the project, particularly as these waste streams impact on water resources.
3. To effectively plan for and respond to the occurrence of hazards (hurricane, fire, accidental leaks) so as to minimize environmental consequences of such occurrences.
4. To maximize the benefits of positive environmental impacts of the project as far as possible, particularly through adherence to the best practices and principles of sustainable outdoor tourism.
5. To conserve resources: Gunboat artefact, adjacent wetlands.
6. To provide appropriate monitoring of the status of environmental resources to ensure their sustainable use.

7.2 SUMMARY OF PROPOSED MITIGATION MEASURES

7.2.1 Construction Phase

Implementation of all proposed mitigation measures outlined below for the construction phase is the responsibility of the developer. Monitoring the implementation of these measures is the responsibility of NEPA. A third party (environmental consultant or contractor) may be contracted to prepare quarterly monitoring reports to outline the implementation of these measures, and any incidents of non-conformance.

It is the developers/proponents ultimate responsibility to ensure that persons contracted on the project have access to the EIA, and fully understand the consequences of not implementing the mitigation measures.

It is assumed that these measures will be implemented as soon as possible.

7.2.1.1 Public and Worker Safety

1. Fence construction site and erect a visual barrier along main road.
2. Place appropriate construction site signage.
3. Provide workers with protective gear (dust masks and boots during demolition and earthworks, coveralls, ear muffs during pile driving etc.).
4. Provide portable lavatories.
5. Implement Emergency Response Plan for construction period.

7.2.1.2 Haulage Management

1. Haul in off-peak hours.
2. Contractually require all contractors to observe site and road safety protocols.
3. Use of a licensed waste disposal contractor.
4. Maintain the vehicles properly: do not allow smoky vehicles to operate.
5. Cover haulage vehicles.
6. Spread axle load

7.2.1.3 Material Management

1. Bund and cover stockpiles.
2. Wet stockpiles and unpaved access roads.
3. Minimize work stoppage during earth works.
4. Phase vegetation clearance and earthworks.
5. Re-establish ground cover as soon as possible
6. Use turbidity barriers during dredging.
7. Re-use concrete debris from demolition works.
8. Treat any hazardous demolition debris appropriately (e.g. if asbestos ceiling tiles or lead pipes are encountered).

7.2.2 Environmental Management Guidelines (Mitigation) For Operational Phase

Implementation of the mitigation measures recommended below is the responsibility of the developer.

7.2.2.1 Entertainment Centre Operations

General Guidelines

1. There should be adequate directional signage for patrons in both driving and pedestrian areas.
2. Events should be scheduled to start and end outside of peak hours to minimize cumulative effects on traffic.

3. Patrons should be encouraged not to drive, particularly if alcohol will be consumed.
4. During peak events, workers should be provided with a shuttle service or should be encouraged to car pool to allow additional parking capacity for patrons.
5. There should be adequate provision of parking and traffic attendants during events.
6. During peak events, the following should be encouraged: shuttle service providers, drop off and pick up by taxis and charter service organizers.
7. There should be a nurse's station during events at the entertainment centre.

Noise Abatement

1. There should be no scheduling of day time events during normal working hours to avoid disturbance of the CMI's activities.
2. Speakers should be pointed toward the centre of the amphitheatre. There should be no speakers outside the amphitheatre.
3. Contractual controls for touring bands in respect of noise: (a) sound systems should not exceed 110 dBA within the amphitheatre and (b) functions should conclude within the times set by the Noise Abatement Act, or within any relaxation of such that may be negotiated subsequently.

7.2.2.2 Grounds

1. Routine grounds maintenance built into the operational plan. There appears to be a tendency for accumulation of solid waste along the shoreline. It is unlikely that all of this emanates on the site. Therefore there will be a need to remove garbage from the marina area as well.
2. Additionally, there should be clean up exercises after all events held at the entertainment centre, which should extend to the amphitheatre, common areas and the parking lots. Solid waste generated after a "peak event" should be disposed of as soon as possible after clean-up exercises.
3. Drainage pathways must be kept clear of debris and sediment.
4. Drains and ponds should be sprayed for mosquito larvae on a routine basis to minimize the public health risk.
5. Fencing (chain-link) of the western perimeter of the property installed in the construction phase should be maintained.
6. Grates with a suitable mesh size should be installed in any culverts or drains that outfall to the pond or sea to prevent crocodiles from entering the site.
7. Given the requirement for flow metering of the sewage effluent outflow, and the range of flows between normal and peak (during a function), the wastewater pipe must be equipped with a meter cable of accurately measuring partial flow conditions in the pipe.

8. There should be monitor of the wastewater effluent as prescribed by the national wastewater standards.
9. NRCA irrigation standards should apply where wastewater effluent is being reused for landscaping or outfall to the wetlands.

7.2.2.3 Restaurants

1. There should be implementation of proper food and garbage storage practices (Section 1.3.1.3).
2. Timely removal of food wastes from restaurants.
3. No feeding policies for birds, cats and dogs.
4. Food handler's permits are required for restaurant staff involved in food preparation or handling.

7.2.2.4 Marina Operations

The following best management practices (BMPs) are adapted from Port Everett (2003) and are designed to mitigate effects on air, water and soil that can arise from boat activities. It is assumed that no maintenance activities (sanding or painting or servicing of boats will be done in the marina or boatyard). These BMPs are directed at the users of the marina"

1. Post copies of the BMPs around visible areas in the marina, and include a copy with the marina contract.
2. Sanding, removal of paint and painting is prohibited.
3. No boat bottom washing is allowed in the boatyard. In-water cleaning of underwater sections of the hull by divers or other means is prohibited.
4. Detergents used for washing boats and decks by hand above the waterline should be sparingly used, and should be biodegradable.
5. Trash should be placed in dumpsters or bins located around the marina facility. NO garbage, trash, oil, fuel, debris or other material shall be deposited in the water.
6. Waste engine oil and filters should be disposed of in the labelled receptacles throughout the marina, and should be used for waste oil disposal only.
7. Hosing down of engine areas is prohibited. Absorbent materials should be used to collect liquids and should be disposed in the receptacles provided for oily rags.
8. Discharge of sewage from the vessel lavatory is prohibited. Pump-out facilities are available at no additional charge (included in slip fee).
9. Bilge water contaminated with oil, antifreeze, solvents or similar materials should not be emptied into marina waters. Where a boat must be hauled out and bilge removed, an oil water separator must remove oils, which should be disposed of as an oily waste at an approved facility.
10. The discharge of untreated bilge water is prohibited.

11. Oil or hazardous material spills that occur despite preventive measures should be contained and reported immediately to the management.
12. Portable gas cans should be placed in an oil-absorbent drip pan when filling.
13. All vessels should have radio clearance before berthing.

Additionally, marina operators should:

1. Conduct regular inspections of the pump-out facilities and ensure that they kept clean and accessible.
2. Ensure adequate signage to advise patrons of the facility.
3. Make low nitrogen and low phosphate detergents available in shops.
4. Provide receptacles for domestic (including fish waste) waste, oily bilge, and oil rags. These should be disposed of by an approved contractor to the appropriate landfill cells.
5. Establish no wake zones, particularly around refuelling station.
6. Place signage near to the entrance of the wetlands advising that boating in these areas is prohibited.
7. Adequate insurance coverage should be taken out to cover public liability and hazards.

7.3 GUIDELINES FOR ENHANCEMENT OF ENVIRONMENTAL PERFORMANCE

The guidelines are recommended to improve the project's overall environmental performance.

7.3.1.1 Alignment within National Plans

As far as possible the project should be aligned with the following plans further to discussions with the agencies mentioned:

1. TPDCo - Port Royal Tourism Development. As far as possible, linkages should be made with the community based tourism in Port Royal. This may involve selective hiring and training of residents of Port Royal in the proposed boat tour facility, as well as bundled tours to the historic town of Port Royal.
2. National Works Agency – Palisadoes Protection Project. Any sand recovered from the modification of topography should be made available to the NWA for proposed dune reconstructed in the area of Gunboat Beach.
3. NEPA – Palisadoes-Port Royal Protected Area. Development in Zone 2 should limit further losses of wetlands.
4. Ministry of Tourism and Environmental Health Unit (Ministry of Health): development of the appropriate level of contact with the recreational waters. Tours to other area such as Hellshire or offshore cays should be done with the appropriate permits.

7.3.1.2 Considerations for Design Modifications

Refuelling station:

1. The refuelling station should be designed so that any spillage will be contained with no chance of spillage to the environment.
2. Automatic back pressure shut-off nozzles should be installed on the fuel pump discharge hoses.
3. The refuelling station should be located in a “no wake” zone.
4. An oil spill response station should be located in proximity to the refuelling station, and should contain booms of adequate size (to encircle largest vessel), mops and other spill response equipment.
5. The point of bulk delivery of fuel should be designed with adequate containment to prevent overflow of any spills to the environment. It should also be equipped with fire-control and spill response equipment.

Other Aspects

1. Provisions should be made for security posts, nurses’ station and customs and immigration.
2. The walls of the amphitheatre should be so designed to serve as noise buffer between the inside and outside of the amphitheatre.
3. There should be a clear separation of exiting and entering flows (one-way circuit design).
4. Consideration should be given to the creation of a pick-up/drop-off bus bay.
5. A taxi-stand area should be designated.
6. There should be careful design of access/exits with consultation with the NWA with appropriate lay-bys and slip streams for safe merging traffic.
7. The adjacent mangrove system should be used as an additional filter for sewage effluent.
8. Landscaping with indigenous ornamental trees and preservation of trees on site wherever possible. As much green cover as possible should be encouraged.

7.3.1.3 Waste Management

1. There should be routine clearance of any solid waste on the up-current side of the groyne and anywhere in the marina. There should be daily litter clean-ups.
2. There should be proper disposal of machine shop wastes including oil rags.
3. A concrete dumpster containment area that is large enough to be cleared by a truck should be installed near the service entrance to facilitate truck pick-up.
4. Waste paper bins should be provided through-out the park.

7.3.1.4 Energy Conservation

5. Use energy efficient appliances and equipment.
6. Limit use of air conditioners, and optimize settings for efficiency. Prevent leakage from air conditioned spaces.
7. As far as possible buildings should be designed to maximize natural ventilation and prevent heat being trapped within. Building design should allow for cool non-air conditioned indoor spaces.
8. Consider alternative energy such as solar or wind power.

7.3.2 Recommendations for Post-Permit Documentation

7.3.2.1 Dredge Spoil Disposal Proposal

A proposal for the disposal of dredged spoil should be made to NEPA. This should include additional testing of sediments in the dredge area to properly characterise the extent of contamination of these sediments. It is recommended that land fill disposal be considered over ocean disposal or re-use because of the potential contaminant level in the sediment.

7.3.2.2 Waste Management Plan

An integrated waste management plan should be developed to address waste streams from the restaurant, marina and entertainment centre. This should estimate quantities and types of wastes as well as sources of waste. The plan should identify an appropriate process flow from the source to final disposal, and should seek to minimize environmental effects.

7.3.2.3 Emergency Response Plan

An emergency management plan is required to cover the following contingencies: earthquakes, hurricane, STP malfunction, marina accidents and fires. An oil spill plan that is aligned with the National Oil Spill Plan is required. Oil spillage at refuelling station, and main inland storage tank (including breaches associated with earthquakes). The oil spill plan should include the immediate spill response actions, contact lists, inventory of spill response equipment and its location. Provisions should be made for adequate training of staff.

7.3.2.4 Wetland Status

It recommended that a plan to rehabilitate the wetlands in this area should be proposed as part of Phase 2 of the development. This should be done in a way that is integrated and consistent with recreational and tourism development being proposed by the Master Plan. This should include a survey to determine the whether there are any crocodiles in this area.

7.3.3 Outline Monitoring Plan

Table 39 outlines the main parameters for which monitoring is recommended, and the recommended monitoring regime.

Table 39 Environmental Monitoring

Environmental Aspect	Specific Parameter	Monitoring Regime
Construction impacts	Implementation of mitigation measures. This should include monitoring of TSS and TPH during the construction period.	A quarterly report should be submitted during the construction period. This should detail implementation actions taken, incidents of non-conformance and accidents.
Water Quality	Polycyclic Aromatic Hydrocarbons (PAHs) or Total Petroleum Hydrocarbons (TPH) Enterococci or Faecal Coliform. Biological Oxygen Demand	During the operational period at least 2 permanent monitoring stations should be established within the marina, and one control station to the east of the marina. There should also be a fourth station located within the adjacent receiving pond. These should be monitored quarterly, and reported to NEPA. Standard method should be used. The oil spill plan should provide for separate monitoring and reporting procedures in the event of a spill.
Wastewater Effluent	As specified in the wastewater regulations.	As specified in the wastewater regulations.
Sediment Quality	Bio-available lead and copper. Macrobenthos: species and biodiversity.	During this operational period at least 2 permanent monitoring stations should be established. These should be monitored annually for the first five years, and then once every five years. Standard methods should be used.

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