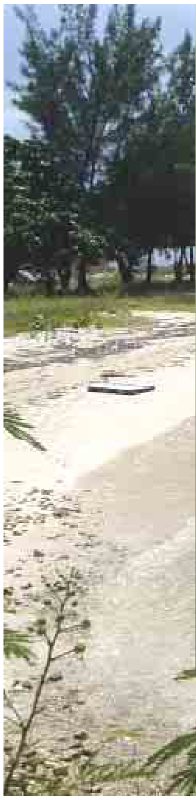

ENVIRONMENTAL IMPACT ASSESSMENT

CLUBHOTEL RIU MONTEGO BAY

MONTEGO BAY, JAMAICA

DRAFT REPORT

Submitted to

RIU HOTEL INTERNATIONAL
Hanover, Jamaica

Prepared by

CL ENVIRONMENTAL
Taking Care of You and Your Environment.

DECEMBER 2006

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LIST OF ACRONYMS

DAFOR	Dominant, Abundant, Frequent, Occasional and Rare Rating
dBA	Decibels measured on the A-scale
EIA	Environmental Impact Assessment
IGPD	Imperial Gallons Per Day
JHTA	Jamaica Hotel and Tourist Association
LPD	Litres Per Day
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
PIF	Project Information Form
TCPA	Town and Country Planning Authority
TPD	Town Planning Department
TPDCo	Tourism Product Development Company

1.0 EXECUTIVE SUMMARY

This document constitutes the Final Environmental Impact Assessment Report for the proposed Clubhotel RIU Montego Bay.

RIU International now proposes to develop their fourth resort in Jamaica, the ClubHotel RIU Montego Bay at Mahoe Bay in the parish of St. James. The proposed site is situated approximately 3 km east of the Sangster International Airport and is adjacent to Sandals Royal Caribbean Resort and Offshore Island.

It is proposed that the new hotel will have seven hundred and one (701) habitable rooms; of this 593 will be doubles, 84 triples and 24 suites. The proposed development is projected on approximately 8.3 hectares (≈ 20.6 acres) of land.

There will be six (6) 3-storey buildings for hotel rooms and one (1) 1-storey main building intended for the property. The main building will have two wings: the West Wing and the South Wing and will house the major public areas for guests including the lobby area, restaurants, shops, main kitchen and entertainment areas. Another 5 floors of hotel rooms above the restaurants are projected only in the South Wing of the main building. Adjacent to the main building, on the eastern side are two smaller buildings, one a 3- storey and the other a 1-storey. Both of these buildings are for employees and will include changing rooms, sanitary services and locker rooms. To the east of these buildings, the Administration Office and the Human Resources Office, Maintenance Room, Electrical and Emergency Power Generator, Machine Room, the Air Conditioning Chillers area, Laundry, and the Boiler Room will be situated, each in separate buildings.

The construction phase will employ 600 to 1200 skilled and unskilled labourers and completion is estimated in 18 months. The operational phase will employ approximately 450 staff at and will employ widely accepted water conservation strategies such as low volume toilets, aerated showerhead and faucets.

Jamaican environmental requirements are itemised and strongly recommended with special reference to the St. James Development Order, the NRCA Act, and the Beach Control Act.

Beach Modification

A Beach Licence Application has been submitted for the removal of stones, garbage and silt brought down by the gully located at the western boundary of the property. These works are intended to rehabilitate the foreshore and floor of the sea which has been impacted by silt, stones and garbage. It is expected that approximately 260 metres of shoreline length will be dredged by suction dredging which is a hydraulic method (using a trash pump and sedimentation basin on the beach berm). The dredge area will extend some 50 metres out from the shoreline and approximately 0.6 metres deep. Approximately 7,800 cubic metres of silt will be generated by this process.

Water Supply and Storage

The proposed development will have an estimated total daily water consumption of 199,265 Imperial Gallons per day. Water will be supplied by the National Water Commission and onsite water storage by an underground tank which can supply the development for approximately 3.2 days.

Sewage Treatment and Disposal

Taking into account the effects of irrigation and infiltration, the waste water generation rate is 149,448.8 Imperial Gallons per day (671,906.72 litres per day).

Drawings of the proposed sewerage on site indicates that the network consists of 4”and 6” pipes that will transport all untreated effluent from the visitors’ blocks and main building to the Rose Hall Waste Water Treatment Plant. Rose Hall Waste Water Treatment Plant is located approximately 9 kilometres east of the site. The treatment system there, which is scheduled to be fully operational in March of 2007, will comprise of an equalization chamber, screening, bio-reactor complete with membrane cassettes, anoxic, aerobic and membrane zone, aerobic digester and sludge treatment equipment. The treated effluent will be stored in the nursery lake to be used for the purpose of irrigation on the gardens and golf courses of various hotels in and around the Montego Bay area. The Rose Hall Utility Company Ltd. has already obtained a license to treat 9,463,530 litres per day of sewage, and discharge the treated effluent. The approved capacity of the waste water treatment plant is 9,463,530 litres per day; of this amount RIU comprises a mere 7%.

BASELINE DESCRIPTION

Data on the existing environment were collected for Climatology, Meteorology and Air Quality, Physiography, Geology and Structure, Physical Oceanography, Natural Hazards, Biological Resources, Water Quality, Noise, Historical and Cultural Resources and Socioeconomics.

Climate and Meteorology

The temperature, relative humidity and rainfall are typical of a tropical country and are similar to the National averages.

Air Quality

Respirable particulate (PM 10) levels at the proposed site were generally compliant with the Occupational Safety and Health Administration (OSHA) standard. Carbon dioxide levels at the boundaries of the proposed site ranged were within the expected range for outdoor carbon dioxide. The levels of nitrogen dioxide and sulphur dioxide were all below the measuring limits.

Physiography, Geology and Structure

The area consists of a narrow coastal plain, behind which the land rises steeply to summits of 250 to 300 m about 3.5 km south of the coastline. The back coast hills are drained by a number of steep gullies. The coastal plain along here forms a low-lying platform of variable height. A series of small pocket beaches are interspersed with the rocks of the limestone platform. The coast is protected offshore by a more or less continuous reef, sheltering a lagoon between the reef and the coast. The reef is incompletely developed opposite Mahoe Bay itself. The lower courses of the larger gullies transit and are incised into a series of gravel fans, which are evidently the result of former sediment deposition from the gullies. The most important of the local gullies is the Salt Spring Gut which exits across the coastal plain through the middle of the proposed development.

The slopes of the back coast hills expose an anticline with an east-west trending axis. The northern limb of the anticline is steep to vertical and probably associated with east-west faulting.

All along the north coast the rocks forming the limestone terrace in the coastal plain are faulted to varying degrees, indicative of seismic activity continuing to the present day (Horsfield, 1972). This terrace was formed only about 120,000 years ago, so that the region as a whole must be considered as still seismically active. The most recent large local earthquake was that of March 1, 1957, with an epicenter located near Montego Bay (Robinson *et al.* 1960).

Natural Hazards

Hurricanes

Specific to the project, the most dangerous wave heights and periods are those coming from the northwest and north direction. By and large, the site is effectively shielded from wave action from the southeast, south and southwest, due to the presence of land. It is also effectively shielded from wave action coming from the northeast, east and west, by Mahoe Bay's offshore fringing reef and the Sandals Royal restaurant cay. Nearshore Hurricane Wave Climate

Storm Surge

The storm surge analysis revealed that wave heights can encroach on the shoreline up to approximately 300 meters inland at existing ground levels. The Table below outlines the storm surge predictions for the 50 and 100 year return periods.

Table Storm Surge results of 50 and 100 year return periods

Return Period	Set-up (IBR, Tide, GSLR, Wave set-up, Wind Set-up) (m)	Wave Run up (m)	Total Storm Surge (m)	Minimum Floor Levels (plus 30%) (m)
50 yr	1.15	0.55	**1.70**	2.21
100 yr	1.30	0.75	**2.05**	2.67

Erosion Analysis

The analysis indicates that the site could experience severe erosion loss in the range of 50 to 110 m behind the shoreline. This would occur in the event of the design storm episode, and as much as 280 mm (11 inches) of ground could be lost in some instances. It can be noted that when the erosion regions are superimposed over the general hotel plan the areas of general concern arising are Block 6 in its entirety, as well as the northern portions of Block 5, the Chiringuito Restaurant and the main building.

Riverine Flooding

Elements on the proposed site could be highly vulnerable to flooding from the Salt Spring Gut, unless care is taken in the design and construction of the drainage system.

Earthquake

Mahoe Bay lies within the zone of 5 to 9 earthquakes of MM VI or greater reported per century Shepherd & Aspinall, 1980).

Biological Resources

Terrestrial Flora

A total sixty-eight (68) species of flowering plants were identified on site A1 (site for the proposed development), three (3) species are endemic, *Roystonea* sp., *Bactris jamaicana* (Prickly Pole), and *Thrinax* sp. A total of forty-six (46) species identified at Site A2 (adjacent property- previously known as Caribbean Beach park). Of this, only one species, *Roystonea princeps*, is endemic to Jamaica.

Avifauna

Eighteen (18) different species were observed, during the morning and evening counts. Overall, species diversity was so low. The most plausible explanation for the low species diversity (and individual abundance numbers) is probably the correspondingly low habitat diversity and the overall nature of the floral habitat observed at the site. Of the 18 species observed, three (3) are reported as endemic to Jamaica. These were *Turdus aurantius* (White-chinned Thrush), *Myiarchus validus* (Rufous-tailed Flycatcher) and *Myiopagis cotta* (Jamaican Elaenia).

Other Fauna

One species of crab was observed, namely *Uca pugnax* (Mud Fiddler Crab), along with dragonflies and two unidentified species of butterfly. A search of a NEPA database of recorded crocodile, turtle and manatee siting and nesting areas (around Jamaica, over the last 25 years) revealed that no crocodiles, turtles or manatee frequent the project site.

Water Quality

From the results of the water quality sampling, the marine water quality within proximity to the proposed site slightly mesothrophic, with the waters being phosphate limited. Generally the dissolved oxygen levels were below the 5mg/l acceptable standard with the nitrates and phosphate levels above established NEPA standard (0.1 mg/l) and Blue Flag (0.6 mg/l) and NEPA standard (0.01 mg/l) respectively.

The drain at the western fence line of the property is of concern as the waters are coming from freshwater source(s) external to the site which have high, nitrates, ortho-phosphates, total suspended solids fats oil and grease and the only point of non-compliant faecal coliforms. It also has extremely low dissolve oxygen. These factors results in an input loaded with nutrients, suspended solids and a high offensive odour.

Noise

Noise levels along the fence line of the proposed property are within the NEPA standard of 65 dBA. Noise at this property is influenced by noise from vehicular traffic (southern fence line) and from planes flying overhead.

Historical and Cultural Resources

There are no historical or cultural resources situated on the proposed development site.

Socioeconomics

The population of St. James in 2001 was 175,115 persons. The Social Impact Area (SIA) as demarcated as five (5km) from the proposed development site. The population in the SIA was estimated to be 53,957. Within the SIA, the 15-64 years age category accounted for 62% of the population, with the age 0-14 years (33%) and the age 65 and over category accounting for 5%. The segment of a population that is considered more vulnerable are the young (children less than five years old) and the elderly (65 years and over). In this population, approximately 11% were in the young category and 5% were in the 65 years and older category. Most of the persons within the population were females.

The carrying capacity of the beach at Mahoe Bay has not been exceeded and will not be exceeded with the addition of the proposed hotel.

Community Perception

Approximately 66% of those interviewed were aware of the proposed RIU hotel at Mahoe Bay. 77% of the respondents knew of the development through word of mouth, whilst 33% from the media. Of those interviewed, 96% were of the opinion that the site was suitable for this type of development and the remaining 4% were not and stated that setting up a park or some other development that the public could have access to would be much better for the area.

A number of interviewees believed that the construction of the hotel would not have any effect on them. Those that stated it would, listed employment opportunities as the main positive way in which the construction would affect their lives. Pollution, traffic problems and restricted access to beach were thought to be negative effects of the construction. Respondents stated that effects of the construction on the natural environment would include increased turbidity in coastal areas, loss of vegetation and sewage pollution.

Montego Bay Chamber of Commerce

From the responses garnered from Directors, the major concern is that of environmental degradation especially as it relates to waste management. More specific is the adequacy of treatment and disposal of sewage and the impact that has on the marine water quality.

Whitehouse Fishing Cooperative

The fishers were mainly concerned with soil erosion and sedimentation from the construction of the proposed hotel development citing the issues they had with sedimentation from the construction of the Ritz Carlton golf course which they have said attributed to damaging their fishing equipment and resulting in the destruction of Devils Kitchen, their main fishing ground by increased algal growth.

ENVIRONMENTAL IMPACTS

Sensitive issues have been identified and appropriate mitigative steps have been outlined. Some of these issues relate to the proposed beach works, vegetation clearance, air quality, noise pollution, stormwater runoff and drainage.

ALTERNATIVES

Alternatives to the proposed development were explored including the "No Action Alternative". Other alternatives explored were the proposed hotel located either at properties east or west of the proposed location. The proposed development at the proposed location was the preferred option.

ENVIRONMENTAL ACTION PLAN

An Environmental Action Plan, the reporting requirements and costs were outlined.

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Background

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

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

- Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytic method or technique, but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.

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

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

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

2.2 Environmental Review and Permitting Process

The Environmental Permit and License System (P&L), introduced in 1997, is a mechanism to ensure that all new developments in Jamaica meet required standards in order to minimize negative environmental impacts. The P&L System is administered by the National Environment and Planning Agency (NEPA, formerly the Natural Resources Conservation Authority, NRCA) and allows NEPA the right to issue permits for new developments and request EIA studies where necessary. Under the NRCA Act of 1991, the NRCA/NEPA is authorized to issue, suspend and revoke permits and licences if facilities are not in compliance with the environmental standards and conditions of approval stipulated.

Permits are required by persons undertaking new developments which fall within a prescribed category; 'Development Projects' require such a permit. A Project Information Form (PIF) and a Permit Application (PA) must be completed and submitted to NEPA with the required application fee. NEPA will then determine if an EIA is required and provide a Guideline Terms of Reference for carrying out the EIA.

The ClubHotel RIU Montego Bay falls within the prescribed category of 'Development Projects'. A Project Information Form and Permit Application Form were submitted to NEPA and an EIA for the project was requested. CL Environmental Co. Ltd. was contracted to undertake the EIA for this project; this document comprises the EIA report.

2.3 National Legislation - Natural Environment

2.3.1 Natural Resources Conservation Act (1991)

The Natural Resources Conservation Act (NRCA) may be considered Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation and protection of the natural resources of Jamaica. This Act was passed in the Jamaican Parliament in 1991 and subsequent to this; the Natural Resources Conservation Authority (NRCA) was established with the function of taking necessary steps to ensure the sustainable development of Jamaica through the protection and management of Jamaica's physical environment. The NRCA Act, under Sections 9 and 10 specifies that an Environmental Impact Assessment (EIA) is required from an applicant for a permit for undertaking any new construction, enterprise or development.

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

Section 9 of the NRCA Act declare the entire island and the territorial sea a 'prescribed area', in which specified activities require a permit, and for which activities an environmental impact assessment may be required. The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996) and the Permits & Licensing Regulations (Section 2.2) was passed as a result of section 9 of the NRCA Act.

The Natural Resources Conservation Authority (Air Quality) Regulations, 2002

Under section 38 of the NRCA Act, regulations pertaining to air quality in Jamaica are stipulated. The National standards, known as the National Ambient Air Quality Standards (NAAQS), are categorized into two groups. In one group, there are the primary standards, designed to protect human health and in the other, there are the secondary standards designed to protect the environment and limit property damage.

Water Quality Standards

The NRCA has primary responsibility for control of water pollution in Jamaica. National Standards for industrial and sewage discharge into rivers and streams, in addition to standards for ambient freshwater exist. For drinking water, WHO Standards are utilized and these are regulated by the National Water Commission (NWC).

2.3.2 *Wild Life Protection Act (1945)*

The Wild Life Protection Act of 1945 is mainly concerned with the protection of specified faunal species. Under this Act, the removal, sale or possession of protected animals; use of dynamite, poisons or other noxious material to kill or injure fish; and the discharge of trade effluent or industrial waste into harbours, lagoons, estuaries and streams are prohibited. In addition, this Act protects several rare and endangered faunal species including six species of sea turtle, one land mammal, one butterfly, three reptiles and a number of game birds. The establishment of Game Sanctuaries and Reserves is authorized under this Act.

2.3.3 *The Endangered Species Act (2000)*

The Endangered Species (Protection, Conservation and Regulation of Trade) Act was created in 2000 in order to ensure the codification of Jamaica's obligations under the Convention for the International Trade in Endangered Species of Wild Fauna and Flora. This Act governs international and domestic trade in endangered species in and from Jamaica. Under this act, the functions of NEPA include the grant of permits and certificates for the purpose of international trade, the determination of national quotas and the monitoring of the trade in endangered species.

Sea turtles, in addition, to yellow snakes and parrots are often traded illegal internationally and are endangered. Although no turtles were observed along the shoreline of the site during the faunal survey, turtle nesting sites have been recorded approximately 4 km east of the proposed site (NEPA). Thus, the RIU management should be aware of the existence of this endangered species in relatively close proximity to the proposed hotel site, and the potential for illegal trade. The faunal survey and research also revealed that neither crocodiles nor manatee sitings have been recorded for this area; hence these two endangered species are less likely to frequent the proposed area and be impacted by the development.

2.3.4 Water Resources Act (1995)

The Water Resources Act (1995) was promulgated in the Jamaican Parliament in September 1995 and ratified in April 1996. This Act established the Water Resources Authority (WRA), which is authorized to regulate, allocate, conserve and manage the water resources of the island. The WRA is also responsible for water quality control; as stipulated under Section 4 of the Act the WRA is responsible for providing any department or agency of Government, technical assistance for any projects, programmes or activities relating to development, conservation and the use of water resources.

Section 25 advises that a proposed user will have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, under Section 21 it states that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

2.3.5 Country Fires Act (1942)

The Country Fires Act of 1942 prohibits the setting of fire to garbage without prior notice being given to the nearest police station and the occupiers of all adjoining lands (Section 4). In addition, a space of at least 15 feet in width must be cleared around all trash to be burnt and all inflammable material removed from the area. Under section 6 of the Act, the Minister may prohibit, as may be necessary, the setting of fire to trash without a permit.

Offences against this Act include:

- Setting fire to trash between the hours of 6.00 p.m. and 6.00 a.m. (Section 5a);
- Leaving open-air fires unattended before they have been completely extinguished (Section 5b);

- Setting fires without a permit and contrary to the provisions outlined in Section 6 (Section 8);
- Negligent use or management of a fire which could result in damage to property (Section 13a);
- Smoking a pipe, cigar or cigarette on the grounds of a plantation which could result in damage to property (Section 13b).

2.3.6 Quarries Control Act (1983)

The Quarries Control Act of 1983 established the Quarries Advisory Committee, which advises the Minister on general policy relating to quarries, as well as on applications for licenses. The Act provides for the establishment of quarry zones, and controls licensing and operations of all quarries.

Under Section 5 of the Act, it is stipulated that a license is required for establishing or operating a quarry, though this requirement may be waived by the Minister if the mineral to be extracted is less than 100 cubic metres. Application procedures for this license are also outlined in this Act; one of these procedures is for the applicant to place a notice in a prominent place at the proposed site for a period of at least 21 days starting from the date on which the application was filed.

2.3.7 The Pesticides (Amendment) Act (1996)

The Pesticides (Amendment) Act of 1996 amended sections of the principal act, which came into effect in 1975 and established the Pesticides Control Authority. This Act gives the Authority the responsibility of controlling the importation, manufacture, packaging, sale, use and disposal of pesticides. Under Section 11, it is stated that the Authority is required to keep a record of all relevant information such as registered pesticides, restricted pesticides, pest control operators and persons licensed to import or manufacture pesticides. Section 16 of the Act stipulates that the Authority may also, with the approval of the Minister, make regulations which relate to areas such as:

- Aerial application of pesticides;
- Supervision required for the use of pesticides, the prescribed protective clothing to be worn and other precautionary measures;
- The permissible levels of pesticides to be used;
- The periods during which particular pesticides may or may not be used on certain agricultural crops;
- The disposal of pesticides and packages.

2.3.8 The Beach Control Act (1956)

This Act was passed in 1956 to ensure the proper management of Jamaica's coastal and marine resources by means of a licensing system. This system regulates the use of the foreshore and the floor of the sea. In addition, the Act speaks to other issues including access to the shoreline, rights related to fishing and public recreation and establishment of marine protected areas.

The Beach Control Authority (Licensing) Regulations of 1956 require a permit for any works on a beach, coastline or foreshore. Application for this permit must be made to NEPA. The requirements of the permit include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours.

2.3.9 Noise Standards

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specified equipment. This act has been said to address "some concerns but is too narrow in scope and relies on a subjective criterion" (McTavish[2]). Given this, McTavish

[2] A Review of Jamaican and International Noise Standards, Prepared for National Resources Conservation Authority, by Dr. J.L. McTavish, consultant.

conducted a study to recommend wider and more objective criteria in accordance with international trends and standards, but tailored to Jamaica's conditions and culture.

To date, apart from the Noise Abetment Act (1997), Jamaica has no other National legislation for noise.

2.4 National Legislation – Social Environment

2.4.1 Town and Country Planning Act (1958)

The Town and Country Planning Act of 1958 authorizes the Town and Country Planning Authority to prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas. The purpose of these orders is to control the development of land in the defined area. In this way, the Authority will then be able to coordinate the development of roads and public services, whilst conserving the resources in the area. The proposed development (Clubhotel RIU Montego Bay) falls within the area that is guided by the St. James Provisional Development Order (1982). This area is zoned for Resort Development.

Any person may, under Section 6 of the Act, object to any development order on the grounds that it is:

- Impractical and unnecessary;
- Against the interests of the economic welfare of the locality.

However, if the Minister is of the belief that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed development order.

Under Section 10 of the Act, it is stipulated that a development order must include:

- Clearly defined details of the area to be developed;

- Regulations regarding the development of the land in the area specified;
- Formal granting of permission for the development of land in the area.

If the provisions of section 9A of the NRCA Act apply to the development, the application can only be approved by the Planning Authority after NEPA has granted a permit for the development. The Authority may impose a "tree preservation order" under Section 25 of the Act if it considers it important to make provision for the preservation of trees and woodlands in the area of the development. This order may:

- Prohibit the cutting down, topping, lopping or willful destruction of trees;
- Secure the replanting of any section of the woodland area in which trees were felled during the forestry operations permitted under the order.

The tree preservation order is not applicable to the cutting down of trees which were already dead, dying or had become dangerous and the order can take effect only after it has been confirmed by the Minister. The Minister can, under Section 26 of the Act, make regulations to restrict and regulate the display of advertisements in any area to be developed if he considers this to be in the interest of public safety. Section 28 of the Act empowers the local authority to require the owner or occupier of land in the development area to take the steps necessary to ensure its proper maintenance.

2.4.2 The National Solid Waste Management Authority Act (2001)

The National Solid Waste Management Authority Act of 2001 is "an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto". The National Solid Waste Management Authority (NSWMA) was established in April 2002 as a result of this Act to effectively manage and regulate the collection and disposal of solid waste in Jamaica. As such, the NSWMA aims to safeguard public health and the environment by ensuring that domestic waste is collected, sorted, transported, recycled, reused or disposed of in an environmentally sound manner. In addition, public awareness and education is a part of their responsibilities.

2.4.3 Jamaica National Heritage Trust Act (1985)

The Jamaica National Heritage Trust Act established the Jamaica National Heritage Trust (JNHT). Section 4 of this 1985 Act outlines the functions of the JNHT and includes the following:

- To promote the preservation of national monuments and anything designated as protected national heritage for the benefit of the island;
- To carry out such development as it considers necessary for the preservation of any national monument or anything designated as protected national heritage;
- To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected.

Under Section 17 it is stipulated that it is considered an offence for any individual to:

- Willfully deface, damage or destroy any national monument or protected national heritage or to deface, damage, destroy, conceal or remove any mark affixed to a national monument or protected national heritage;
- Alter any national monument or mark without the written permission of the Trust;
- Remove or cause to be removed any national monument or protected national heritage to a place outside of Jamaica.

2.4.4 Land Acquisition Act (1947)

The Land Acquisition Act was passed in 1947. As stipulated under Section 3 of this Act, any officer authorized by the Minister may enter and survey land in any locality that may be needed for any public purpose. This may also involve:

- Digging or boring into the sub-soil;
- Cutting down and clearing away any standing crop, fence, bush or woodland;
- Carrying out other acts necessary to ascertain that the land is suitable for the required purpose.

The Minister is authorized to make a public declaration under his signature if land is required for a public purpose, provided that the compensation to be awarded for the land is to be paid out of the Consolidated Fund or loan funds of the Government and funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

Once the Commissioner enters into possession of any land under the provisions of this Act, the land is vested in the Commissioner of Lands and is held in trust for the Government of Jamaica in keeping with the details stated in Section 16. The Commissioner shall provide the Registrar of Titles with a copy of every notice published, as well as a plan of the land. The Commissioner will also make an application to the Registrar of Titles in order to bring the title of the land under the operation of the Registration of Titles Act.

2.4.5 Registration of Titles Act (1989)

The Registration of Titles Act of 1989 is the legal basis for land registration in Jamaica. A modified Torrens System (Centre for Property Studies, 1998) is used as the fundamental tool for this and under this system, land registration is not compulsory, although once a property is entered in the registry system the title is continued through any transfer of ownership.

2.4.6 Jamaica Hotel and Tourist Association and Tourism Product Company

The Jamaica Hotel and Tourist Association (JHTA) grants licenses for all hotels in Jamaica. Among the licensing criteria are Environmental Guidelines for various aspects of the tourism development, including Watersport and Hotel Operations. Enforcement of licensing requirements is the responsibility of the Tourism Product Development Company (TPDCo).

2.5 International Legislative and Regulatory Considerations

2.5.1 Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region) (1983)

Adopted in March 1983 in Cartagena, Colombia, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, more commonly referred to as the Cartagena Convention, is the sole legally binding environmental treaty for the Wider Caribbean. The Convention came into force in October 1996 as a legal instrument for the implementation of the Caribbean Action Plan and represents a commitment by the participating countries to protect, develop and manage their common waters individually and jointly. The Convention was ratified by twenty (20) countries and acts as a framework agreement that sets out the political and legal foundations for actions to be developed. The operational Protocols, which direct these actions, are designed to address special issues and to initiate concrete actions. The Convention is currently supported by three Protocols as follows:

- *The Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region* (The Oil Spills Protocol), which was adopted and entered into force at the same time as the Cartagena Convention;

- *The Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region* (The SPAW Protocol), which was adopted in two stages, the text in January 1990 and its Annexes in June 1991. The Protocol entered into force in 2000;

- *The Protocol Concerning Pollution from Land-based Sources and Activities in the Wider Caribbean Region* (LBS Protocol), which was adopted in October, 1999.

2.5.2 The Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promoting sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that "biological diversity is about more than plants, animals and micro organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live".

The CBD may be considered the first global, comprehensive agreement which focuses on all aspects of biodiversity, to include genetic resources, species and ecosystems. In order to achieve its main goal of sustainable development, signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica's Green Paper Number 3/01, 'Towards a National Strategy and Action Plan on Biological Diversity in Jamaica', is evidence of Jamaica's continuing commitment to its obligations as a signatory to the Convention.

2.6 EIA Process

Under Section 9 of the NRCA Act, hotels of over 12 rooms such as the proposed RIU complex will require a Permit for construction and may, under Section 10 of the Act, require an EIA. The EIA Process is described below:

- ♦ The NRCA permit and licence procedure is initiated by the submission of the Project Information Form (PIF) to the Authority. The PIF screening form is reviewed to determine whether an EIA is required and to begin determining areas of environmental significance, especially in waste discharge.

♦ Based on the review of the PIF, NEPA advised RIU that an EIA would be required for their development. The consultant then liaises with the NRCA to determine the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed by the consultant using NRCA guidelines and are approved by the NRCA. Appendix A has the approved TORs for this project.

♦ The EIA is then prepared by a multi-disciplinary team of professionals (see Appendix B for the team used in this assessment). The NRCA requires that the EIA include the following:

- A description of the present environment, i.e. physical, biological and social environment. This includes, for example, consideration of economic situations, cultural heritage and ecological preservation.
- A description of the significant impacts the environmental professionals expect the development to have on the environment, compared to the environment that would remain if there were no development. This will include indirect and cumulative impacts.
- An analysis of alternatives that were considered in order to consider means of minimising or eliminating the impacts identified above.
- An Environmental Management Plan, which includes a Monitoring & Hazard Management Plan and an Auditing schedule.

♦ The NRCA guidance on EIAs states that this process "should involve some level of stakeholder consultation in either focus groups or using structured questionnaires." A draft EIA is submitted to the developer to solicit the proponents' input into the description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply).

- Ten (10) hardcopies of the finalised draft and an electronic copy are then submitted to NEPA, two to the client, and the consultant keeps one (13 in all are produced). NEPA distributes these to various other public sector institutions who sit on the Technical Committee (e.g. WRA, ECD, JNHT etc.) for their comments. Typically this depends on the nature of the project.

- As deemed necessary by the NRCA, Public Meetings are then held, following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged.

- The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report but for incorporation into the development's design.

- The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Minister of Land and the Environment.

Public Participation in EIAs

There are usually two forms of public involvement in the environmental impact assessment (EIA) process. The first is direct involvement of the affected public or community in public consultations during EIA study. These consultations allow the developer to provide information to the public about the project and to determine what issues the public wishes to see addressed. The extent and results of these consultations are included in the documented EIA report.

The second level of involvement is at the discretion of the NRCA and takes place after the EIA report and addendum, if any, have been prepared after the applicant has provided the information needed for adequate review by NRCA and the public.

3.0 PROJECT DESCRIPTION

3.1 Project Location

The site for the proposed development, ClubHotel RIU Montego Bay, is at Mahoe Bay in the parish of St. James. It is situated approximately 3 km east of the Sangster International Airport and is adjacent to Sandals Royal Caribbean Resort and Offshore Island. To the west of the proposed development, is a site formerly known as Caribbean Beach Park (Figure 3.1).

3.2 Proposed Project

RIU International is a Spanish-owned international hotel chain with properties throughout the world, including the Caribbean and Jamaica. At present there are three (3) RIU hotels operating in Jamaica, two (2) in Negril, Hanover and another in Ocho Rios, St. Ann. RIU International now proposes to develop their fourth resort, namely *ClubHotel RIU Montego Bay* at Mahoe Bay in the parish of St. James.

It is proposed that the new hotel will have seven hundred and one (701) habitable rooms; of this 593 will be doubles, 84 triples and 24 suites. The proposed development is projected on 83,397.40 square metres (m^2) of land. The ground floor layout of the buildings utilises approximately 29.4 % of the property (24,520.38 m^2), whilst 22.42% is planned for walkways, pools, solarium, tennis courts, A/C chillers area and parking area, and the remaining 49.17% (40,174.91 m^2) for landscaping and gardening.

Six (6) 3-storey buildings for hotel rooms and one (1) 1-storey main building are intended for the property. The main building will have two wings: the West Wing and the South Wing and will house the major public areas for guests including the lobby area, restaurants, shops, main kitchen and entertainment areas. Another 5 floors of hotel rooms above the restaurants are projected only in the South Wing of the main building.

Adjacent to the main building, on the eastern side are two smaller buildings, one a 3-storey and the other a 1-storey. Both of these buildings are for employees and will include changing rooms, sanitary services and locker rooms. To the east of these buildings, the Administration Office and the Human Resources Office, Maintenance Room, Electrical and Emergency Power Generator, Machine Room, the Air-Conditioning Chillers area, Laundry, and the Boiler Room will be situated, each in separate buildings.

Floor levels for the structures on the site range from elevations of 1.93 m to 2.23 m above mean sea level. The proposed layout of the site is shown in Figure 3.2 and Table 3.1 below details the specifications of the proposed hotel.

Table 3.1 Specifications of the proposed hotel development

Total Number of Rooms	701
Site Area	83, 397.40 m^2
Ground Floor Layout (room and main buildings)	24,520.38 m^2
Landscaping and Gardening	40,174.91 m^2
Other Ground Area	18,702.11 m^2
Number of Room Blocks	6
Number of Storeys	3

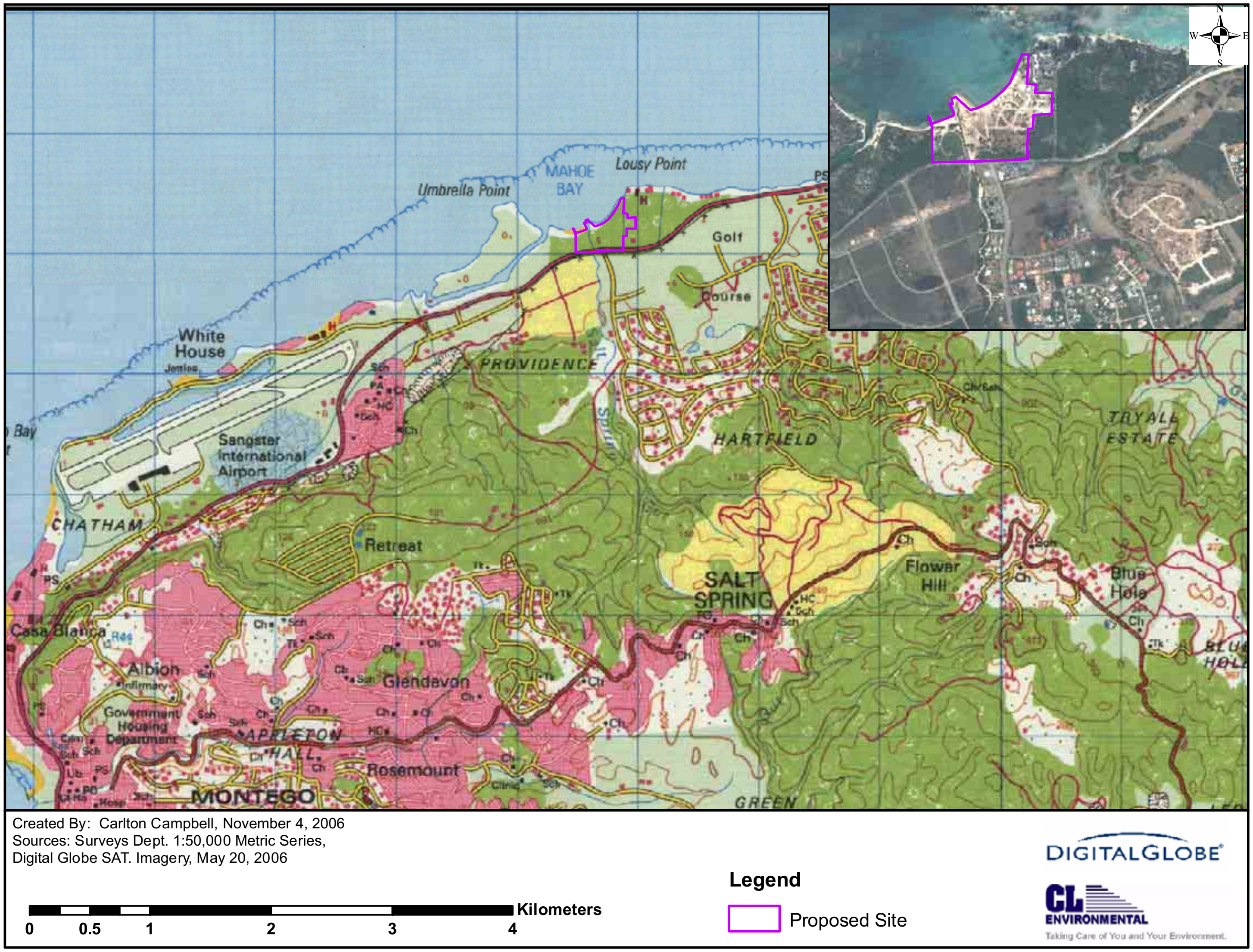

Figure 3.1 Location map of the proposed Clubhotel RIU, Montego Bay

Figure 3.2 Proposed layout of ClubHotel RIU Montego Bay development

3.3 Project Features

3.3.1 Construction

The type of construction proposed for the new RIU hotel is traditional concrete block and steel with cast floor and roof slabs.

It is proposed that the aggregate and concrete blocks for the project will be sourced and purchased from local suppliers in Montego Bay and environs. The excavated material will be stored on site and covered with tarpaulin to minimise dust pollution.

The work force for the site will be an average of 600 trade men and labourers and at peak time the number will increase to approximately 1200. To the extent practicable, RIU will utilise local skills and labour for construction and operation of the hotel. It is anticipated that construction will be completed in 18 months.

The construction waste will be collected onsite by a waste disposal company and will be transported to the Retirement dump in St. James.

3.3.2 Beach Modification

A Beach Licence Application has been submitted for the removal of stones, garbage and silt brought down by the gully located at the western boundary of the property. These works are intended to rehabilitate the foreshore and floor of the sea which has been impacted by silt, stones and garbage. It is expected that approximately 260 metres of shoreline length will be dredged by suction dredging which is a hydraulic method (using a trash pump and sedimentation basin on the beach berm). The dredge area will extend some 50 metres out from the shoreline and approximately 0.6 metres deep. Approximately 7,800 cubic metres of silt will be generated by this process.

Shoreline Stabilization

Disruption of the shoreline occurs through movement of sediments caused by changes in wave conditions due to extreme and/or non-extreme events which may be over the long or short term. Shoreline stabilization is often required to control two processes: cross-shore and long shore transport of sediment.

Cross-shore Sediment Transport

Cross-shore transport is most often stimulated by changes in the nearshore wave climate, whether short term or long term, causing a change in the beach profile due to accretion or erosion of sediments. The fall velocity ratio approximates a critical condition:

$$\frac{Ho}{w_f T} \cong 1$$

Where H_o = deepwater wave height

w_f = fall velocity and

T = wave period

If the ratio exceeds one (1), sediment moves offshore; if it is less than 1, sediment moves onshore.

This ratio revealed that the beach as it currently exists is stable in seven of the eight locations sampled. Further, for the median grain size observed on the proposed beach (0.355 mm), the existing beach can withstand wave heights up to 0.63 m and maintain a stable configuration.

The sediment samples obtained yielded the following results shown below in Table 3.2.

Table 3.2 Required wave height for stable sand environment under operational conditions

Beach Sample No.	**Grain Sizes (mm)** D50	**Wf** (m/s)	**T** (s)	**Ho** (m)	**dc** (m)
Sand Sample Location #1	**0.380**	0.108	4	0.431	0.690
	0.000	0.000	4	0.000	0.000
Sand Sample Location #2	**0.335**	0.094	4	0.375	0.601
	0.830	0.255	4	1.019	1.630
Sand Sample Location #3	**0.220**	0.059	4	0.236	0.378
	0.220	0.059	4	0.236	0.378
Sand Sample	**0.375**	0.106	4	0.425	0.680

Beach Sample No.	Grain Sizes (mm) D50	Wf (m/s)	T (s)	Ho (m)	dc (m)
Location #4	**0.480**	0.139	4	0.558	0.892
Median	**0.355**	0.156	4	**0.625**	1.0000

The dredging exercise is likely to unearth smaller sediment sizes. Therefore the existing median grain size of 0.355 mm and the corresponding tolerable wave height of 0.63 m are both likely to fall. The sediments that are likely to exist after the dredging exercise is complete will result in greater shoreline instability, and will be able to tolerate only very low wave heights.

Swell and Operational Waves

The annual swell event and daily operational model predictions for the two most critical directions of North and North West reveal that wave heights of 0.2 to 0.7 metres reach the shoreline when sea floor depths are lowered within the dredged area. These wave plots are shown in the Figure 3.4, Figure 3.5, Figure 3.6 and Figure 3.7.

These values exceed the stable wave height conditions for the average sand sizes at the beach shoreline, albeit marginally. The implications of the incident wave heights are that swell wave conditions resulting from the dredging of the area could possibly lead to erosion of the beach.

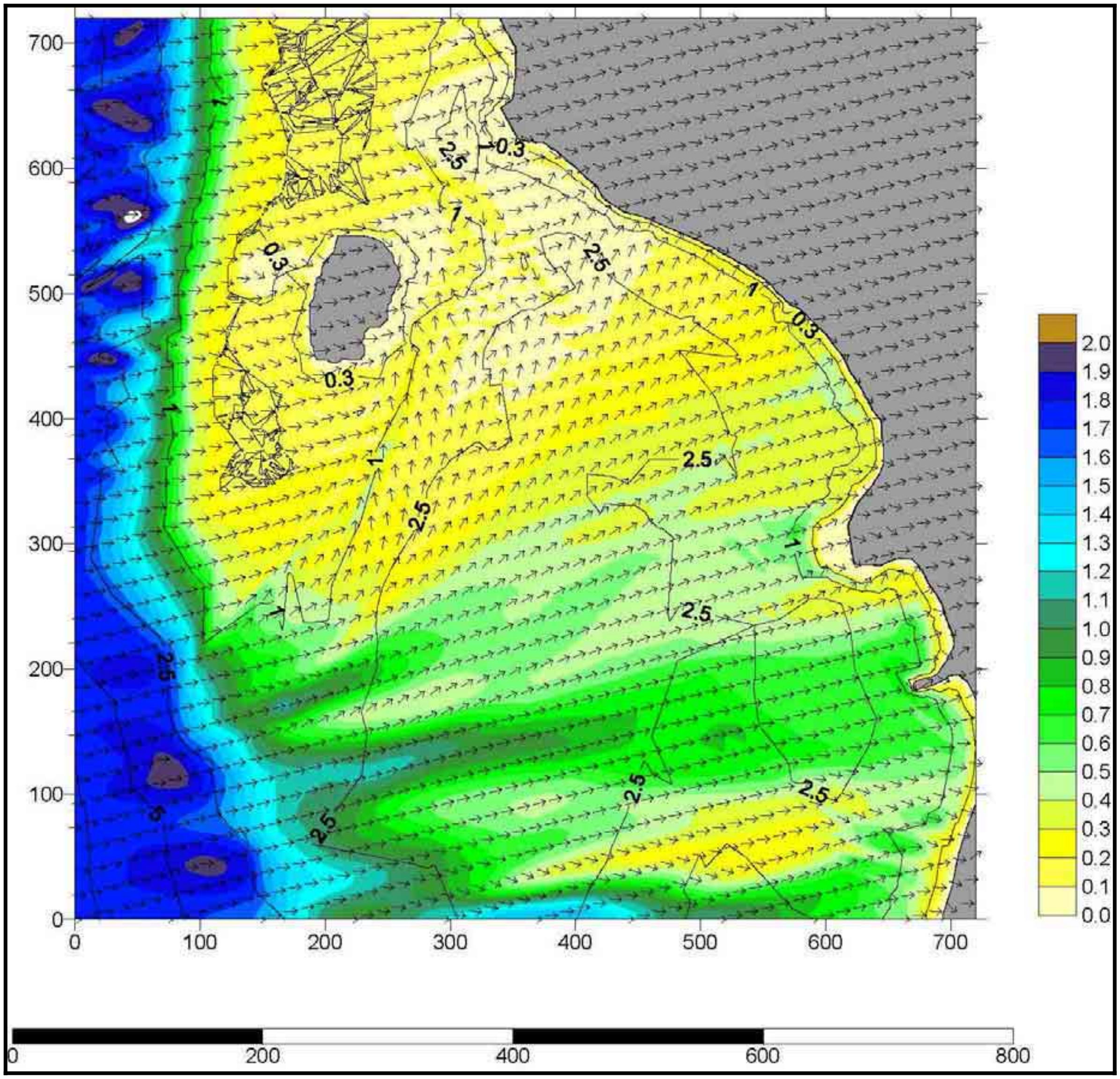

Figure 3.3 Wave plots – direction north and scenario operational

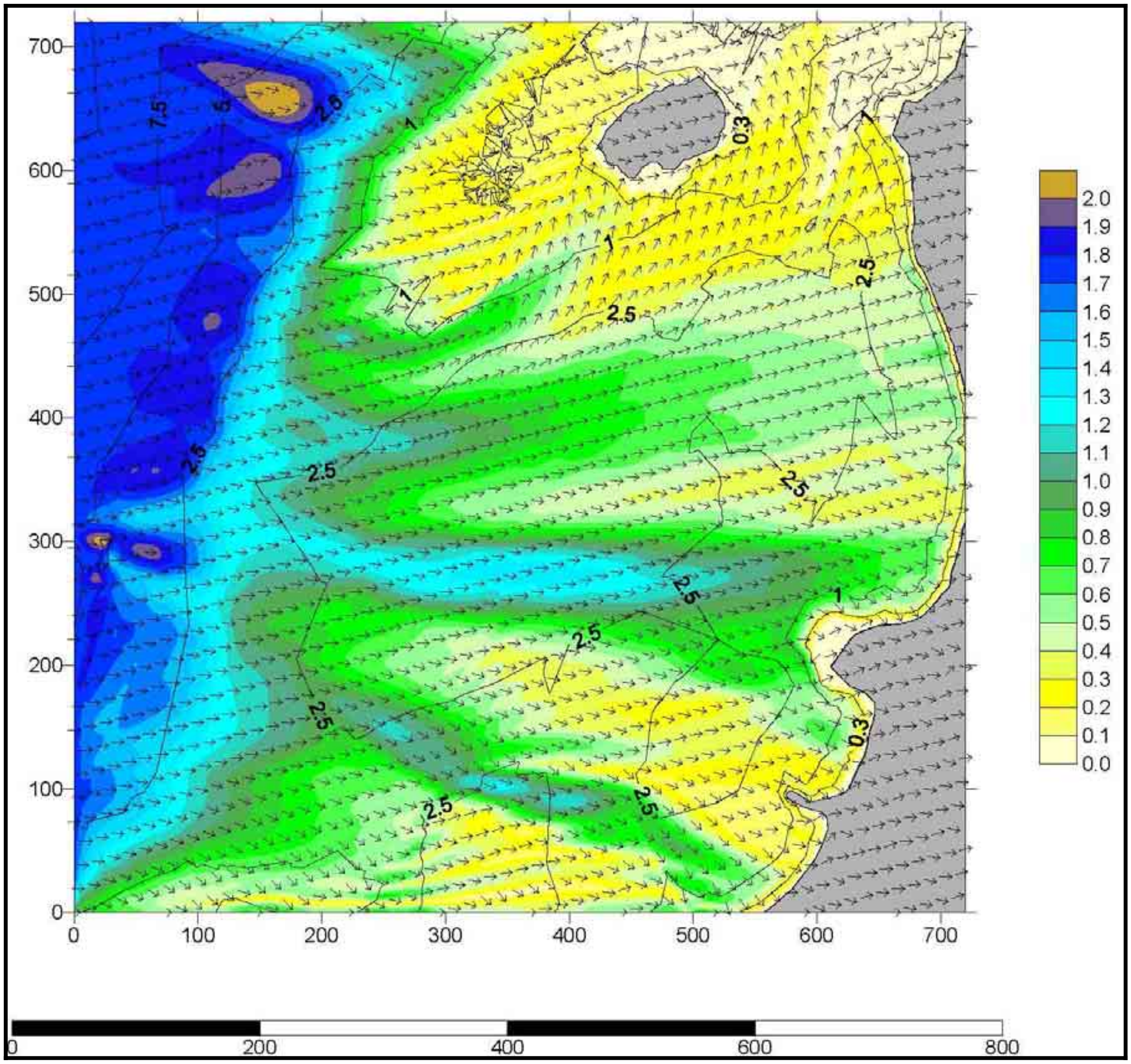

Figure 3.4 Wave plots – direction northwest and scenario operational

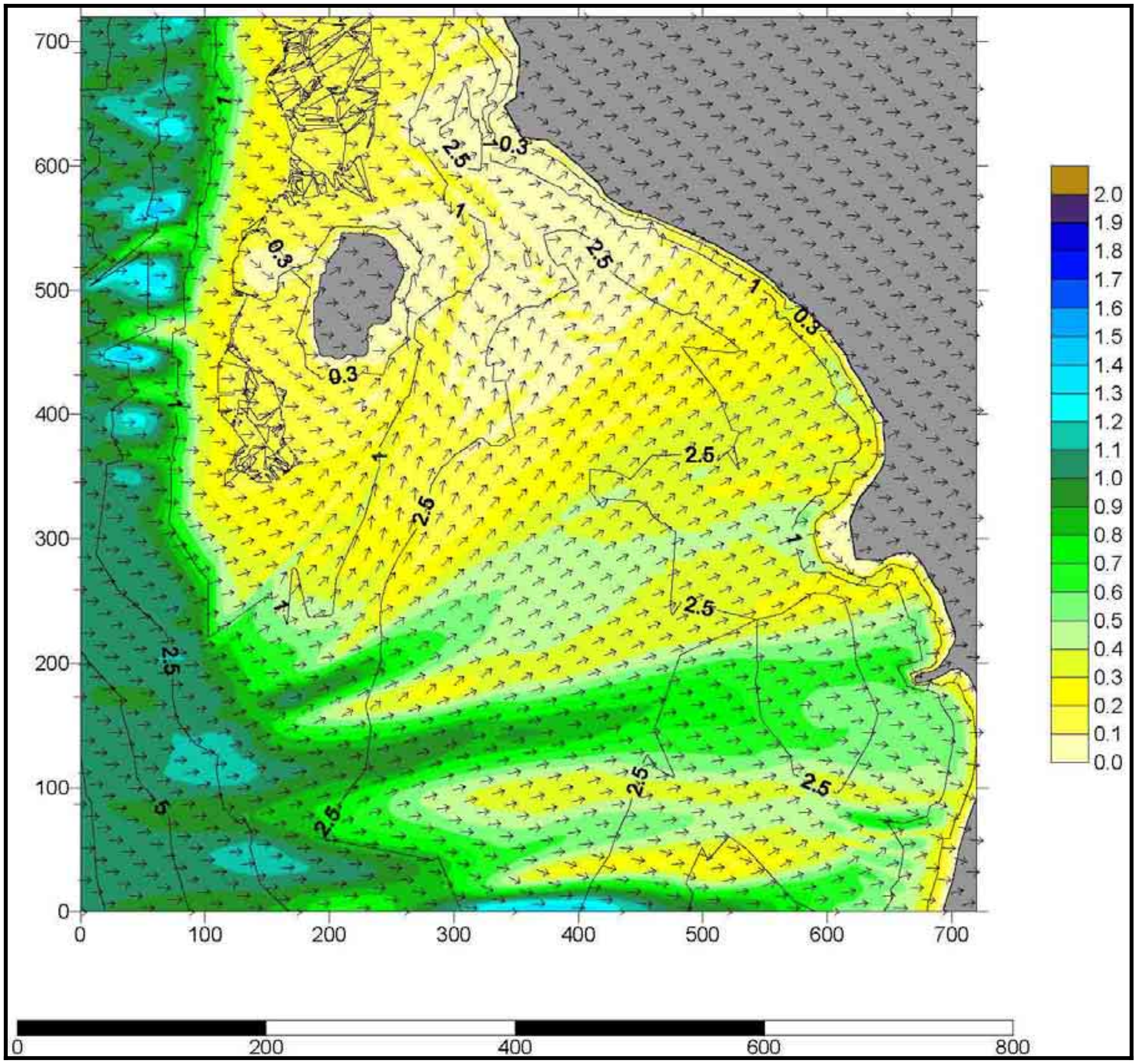

Figure 3.5 Wave plots – direction north and scenario swell

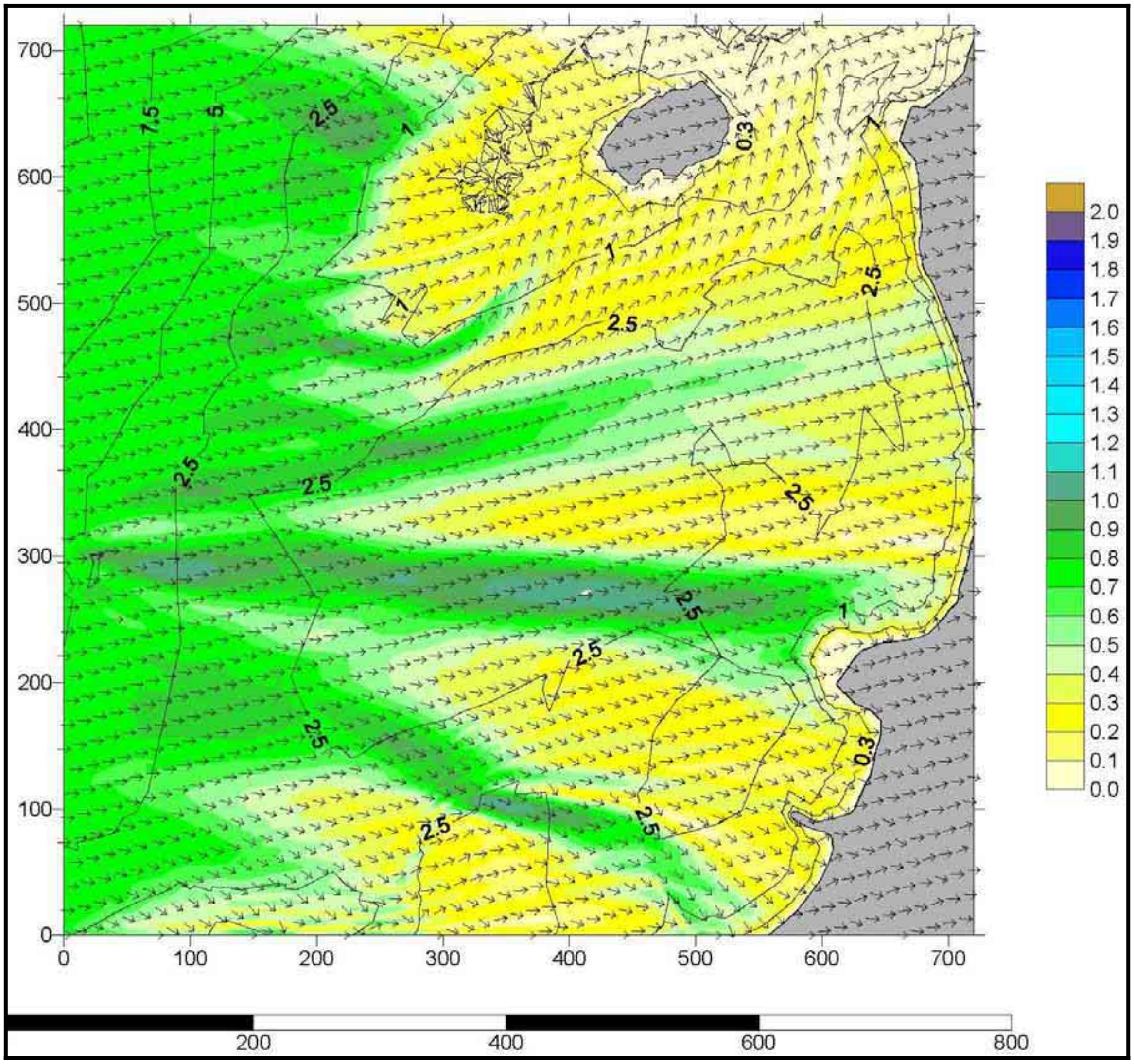

Figure 3.6 Wave plots – direction northwest and scenario swell

3.3.3 *Operation*

RIU expects to have an average of eighty percent (80%) occupancy once it is operational, assuming two guests per room that represents approximately 1,016 guests. The expected staffing for the operational phase is approximately 450 persons.

Water Supply and Storage

Water Consumption

The proposed hotel accommodates 701 guest rooms, 17 executive staff and 5 other staff residences in the main building; hence total number of rooms being 723. The analysis was performed assuming 100% occupancy of both guest rooms and employee accommodations. At this occupancy level, the total guest population arrived at was 1753 guests (Table 3.3) and 59 employees, thus a total combined population of 1812 persons. The per capita consumption was assumed to be 500 litres per day per person based on the Jamaican Institution of Engineers Guidelines as well as recommendations from the National Water Commission. The analysis resulted in a total daily water consumption of 199,265 Imperial Gallons per day (Table 3.4). This water consumption level falls within the range typically observed at hotels of this kind.

Table 3.3 Calculation of total guest population

Room Types	Block							Total Rooms by Type	Population	
	1	2	3	4	5	6	Main Bldg		Typical Occupancy/ Room	100% Occupancy
Single	36	72	24	101	24	42	120	419	2.5	1048
Double	48	-	48	12	48	18	-	174	2.5	435
Suite	-	-	-	-	12	12	-	24	2.5	60
Family	24	24	24	12	-	-	-	84	2.5	210
									Total Population	**1753**

Table 3.4 Daily flow rate at proposed hotel

Guest Population			
Occupancy level	100%		
Occupancy per room	2.5	Persons	
Guest population	**1753**	**Persons**	
Employee Live-on Population			
G1 Accommodation	25	persons	
G2 Accommodation	34	persons	
Employee population	**59**	**Persons**	
TOTAL POPULATION	**1812**	**Persons**	
Water Consumption: By Area			
Per capita consumption	500	Litres per day	
	Total	**905,750.0**	**Litres per day**
	Total Water Consumption	**199,265.0**	**Imperial Gallons per day**

Water Storage

The RIU site plans to build a tank for the purposes of water storage. The proposed location for this tank is towards the southernmost end of the site below the parking area. The proposed tank is considerably large and stretches below 60% of the total parking area. The dimensions of the tank are shown below in Table 3.5.

Table 3.5 Dimensions of proposed water tank on site

On-site Water Storage - Tank Dimensions		
Length	89.2	m
Width	16.2	m
Total Area	**1,445.0**	**m^2**
Total Depth	2.4	m
Water Depth	2.0	m
Volume	**2,890.0**	**m^3**
Capacity	**2,890,000.0**	**litres**

Using the total water consumption flowrate calculated of 199,265 Imperial Gallons per day (905,877 l/day), this tank volume has the ability to sustain a water supply to the hotel for 3.2 days in the event of a water shortage.

The tank will be connected to the National Water Commission main running along the main road. This main, which is 24" can provide up to 1100 Imperial Gallons per minute (≈ 5,000 l/min) which is equivalent to 7,201,010 litres per day. The presence of the hotel is thus not adding any significant load to the existing water supply system.

A float switch will shut off supply when the water has reached a depth of 2.0 m. Three pumps will apply the required energy to supply the hotel with water. The tank is also equipped with two manual valves which can control the flows into and out of the tank, should any need arise to do so. Provisions have also been made for an expansion tank. The schematic layout of the tank is shown below in Figure 3.8.

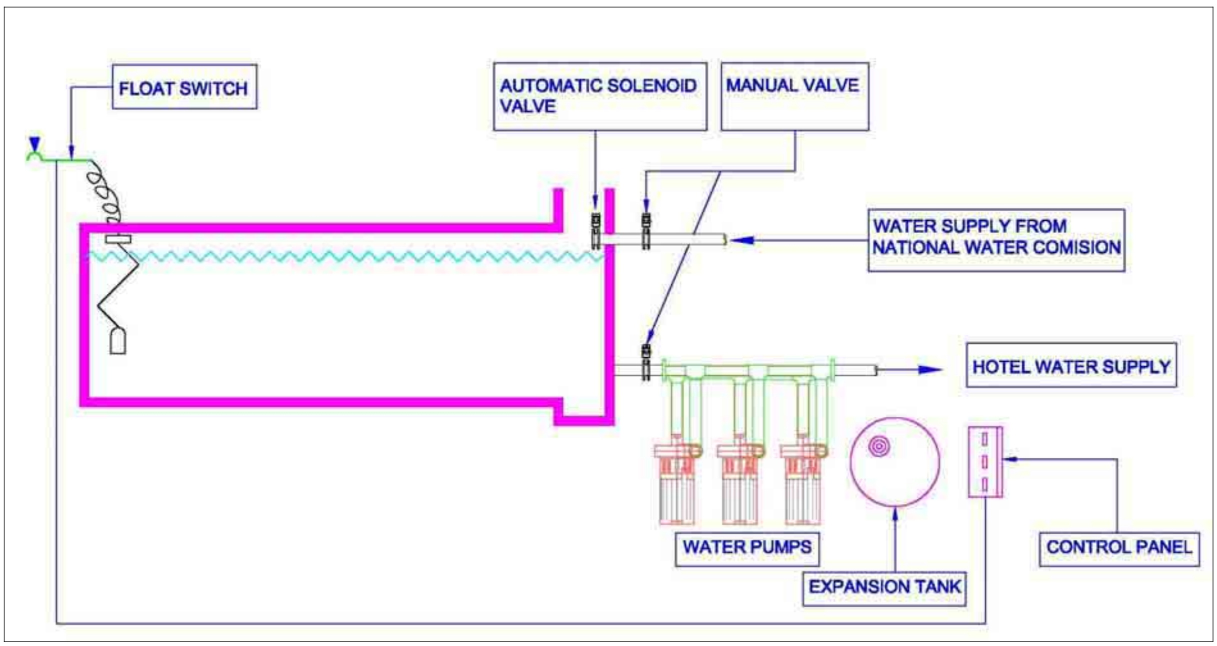

Figure 3.7 Schematic layout of proposed water storage tank

Sewage Treatment and Disposal

Waste Water Generation

The guest and employee population at the proposed RIU hotel at Mahoe Bay is expected to total 1812 persons as shown previously in Table 3.4. This population total assumes 100% occupancy at 2.5 guests per room, and 100% employee occupancy. This analysis resulted in a total water consumption of 199,265 Imperial Gallons per day. All the water consumed is eventually wasted through the piping system. Taking into account the effects of irrigation and infiltration the waste water generation rate is 149,448.8 Imperial Gallons per day (671,906.72 litres per day). This calculation is shown below in Table 3.6

Table 3.6 – Sewage generation rate calculation for proposed development

Water Consumption	199,265	Imperial Gallons per day
Less:		
Water used for Irrigation (15%)	29,890	Imperial Gallons per day
Infiltration effects (10%)	19,927	Imperial Gallons per day
Total Sewage Flow	**149,448.8**	**Imperial Gallons per day**

Sewage Treatment

Drawings of the proposed sewerage on site indicates that the network consists of 4"and 6" pipes that will transport all untreated effluent from the visitors' blocks and main building to the Rose Hall Waste Water Treatment Plant.

Rose Hall Waste Water Treatment Plant is located approximately 9 kilometres east of the site. The treatment system there, which is scheduled to be fully operational in March of 2007, will comprise of an equalization chamber, screening, bio-reactor complete with membrane cassettes, anoxic, aerobic and membrane zone, aerobic digester and sludge treatment equipment. The treated effluent will be stored in the nursery lake to be used for the purpose of irrigation on the gardens and golf courses of various hotels in and around the Montego

Bay area. The Rose Hall Utility Company Ltd. has already obtained a license to treat 9,463,530 litres per day of sewage, and discharge the treated effluent.

The Rose Hall Waste Water Treatment Plant was designed based on an assumed waste water generation rate of 500 US gallons per day (1892.706 litres/day) per room for each hotel it treats. This is an extremely conservative estimate which greatly exceeds even those waste water generation rates of luxury hotels. Based on this assumption, the expected sewage flow of the proposed RIU hotel is 1,368,426 litres per day which exceeds our estimate by 689,018.23 litres per day. It is clear that the treatment plant was designed for the absolute worst case scenario.

The approved capacity of the waste water treatment plant is 9,463,530 litres per day; of this amount RIU comprises a mere 7%. For this reason, in addition to the plans in existence for capacity upgrades and the exaggerated per room waste water generation rate; the Rose Hall Waste Water Treatment Plant that is currently under construction should ably accommodate the sewage generated by the proposed hotel.

Storm Water Collection and Disposal

Pre-Construction Drainage

The site may be considered a catchment in its entirety with a total drainage area of 77000 m^2. The Soil Conservation Service (SCS) Method was used to determine the pre and post project runoff for the 10 year return period rainfall event (Appendix C). This analysis resulted in an approximate effective runoff of 0.70 m^3/s.

Post-Construction Drainage

The culvert currently in existence along the eastern side of the property will be connected to a concrete drain to track water from the road along the boundary rather than through the site. Therefore once construction is completed there will be two drains available to handle runoff from the site. The single catchment currently existing will thus be effectively split into two catchments during post-construction, and runoff will be channelled to both sides of the property. The site catchment division is shown below in Figure 3.9.

The SCS Method of analysis which was used to determine the pre-construction runoff was once again utilized to determine post-construction runoff; these calculation steps are also shown in Appendix C. The analysis resulted in effective rational runoff for the catchments as follows:

- Western Catchment – 0.58 m^3/s
- Eastern Catchment – 0.70 m^3/s

The site will experience an increase of approximately 0.58 m^3/s in surface runoff as a result of construction. This increase is expected, as a slightly higher runoff will naturally result due to the increase in impervious land area by the construction of buildings on the site under consideration. Increased storm water runoff may therefore be considered a potential hazard to the proposed hotel.

Figure 3.8 Division of site into two catchments to facilitate stormwater runoff analysis

4.0 BASELINE DESCRIPTION

4.1 Climatology, Meteorology and Air Quality

4.1.1 Average Climate

Rainfall

The Average Climatological data based on a 50 year return period monthly mean rainfall for Montego Bay ranges from a low of 27 mm in March to a high of 166 mm in October (Figure 4.1). The rainy season is from August to December and the dry season from January to July.

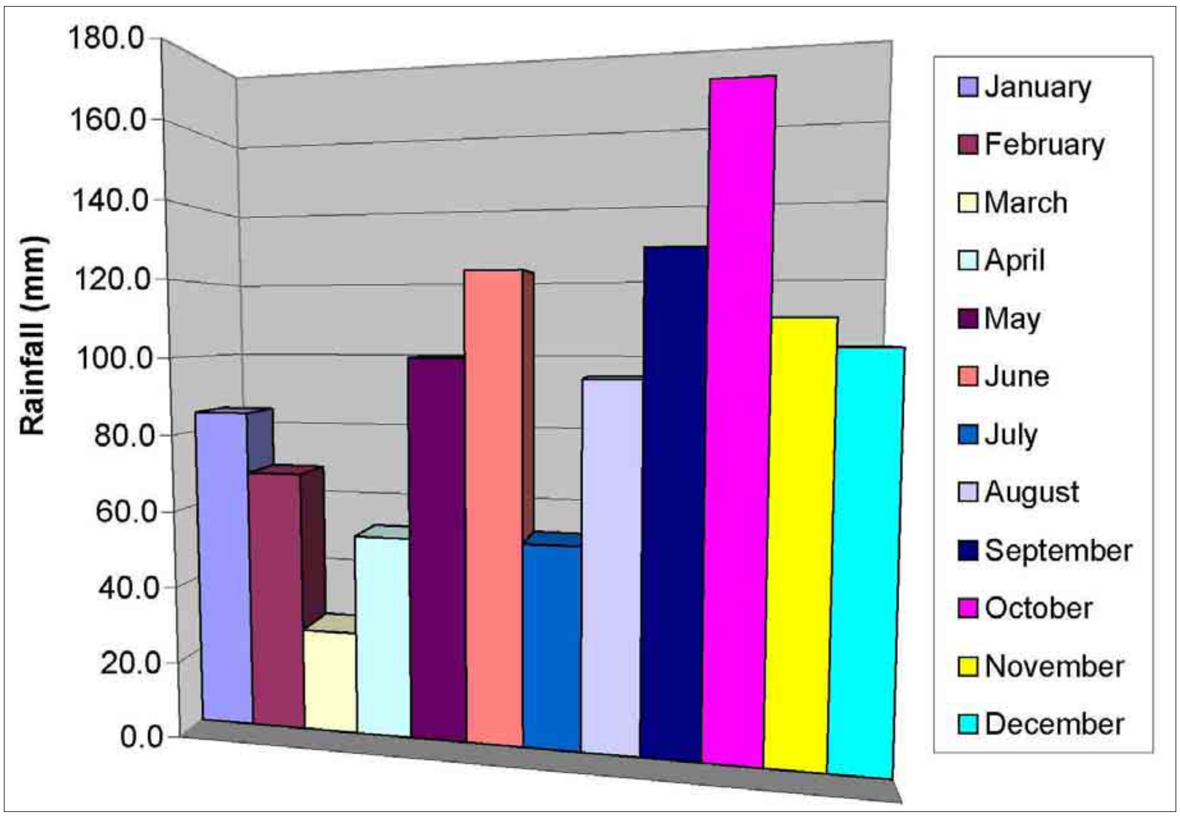

Figure 4.1 Monthly Rainfall Distribution (Sangster International Airport, Montego Bay)

The National Meteorological Service of Jamaica provides estimates of maximum 24 hour rainfall for selected return periods for 343 rain gauge locations throughout the island. The rain gauge stations closest to the proposed site are Providence and Salt Spring. The extreme rainfall data for those two locations are shown in Table 4.1 below. It should be noted here that the rainfall data for the 10 year return period was used to calculate the runoff values for the site.

Table 4.1 Maximum Rainfall for selected return periods

Return Periods	*Estimates of maximum 24 hr rainfall (mm) - Providence*	*Estimates of maximum 24 hour rainfall (mm) - Salt Spring*	*Maximum 24 hour rainfall (mm) - Average for area*
2 year	79	95	87
5 year	120	128	124
10 year	148	157	152.5
25 year	182	230	206
50 year	209	220	214.5
100 year	233	247	240

Temperature

As seen in Table.4.2, the mean monthly temperatures are lowest in January and February and highest between June and October.

Humidity

The mean monthly relative humidity ranges between 71 and 84 percent. Relative humidity is low in the afternoon and high in the evenings. Mean monthly values of daily sunshine hours range between 7.0 and 8.5 (Table.4.2).

Wind

The dominant wind direction for the city of Montego Bay is northwest. Wind speed for the Sangster International Airport, Montego Bay, ranges from 4.5 m/s in September and October to 6.0 m/s in July.

Table.4.2 Monthly Averages of Climatological Data for Montego Bay (Sangster International Airport)

Month	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)	Number of Rain days	Relative Humidity - 7am (%)	Relative Humidity - 1pm (%)	Sunshine (hrs)
January	27.9	20.7	85.0	9	85	71	7.3
February	28.2	20.4	69.0	8	85	71	7.5
March	28.8	20.9	27.0	5	83	68	8.5
April	29.5	21.9	53.0	7	82	68	7.5
May	30.2	22.6	100.0	12	83	71	8.2
June	30.9	23.1	122.0	10	84	72	7.5
July	31.3	23.5	53.0	7	82	70	8.3
August	31.4	23.6	95.0	10	82	70	7.8
September	31.1	23.1	127.0	12	84	72	7.0
October	30.4	23.1	166.0	13	86	75	7.5
November	29.7	22.8	110.0	11	84	73	7.0
December	28.4	21.9	103.0	9	89	72	7.5
Maximum	**31.4**	**23.6**	**166.0**	**13**	**89**	**75**	**8.5**
Minimum	**27.9**	**20.4**	**27.0**	**5**	**82**	**68**	**7.0**
Mean	**29.8**	**22.3**	**92.5**	**9**	**84**	**71**	**7.6**

4.1.2 *Air Quality*

Respirable particulates

Respirable particulates were measured by using Sensidyne's GilAir 5 personal samplers with cyclones and pre-weighed filters. The method followed was National Institute for Occupational Safety and Health Method 0600.

Respirable particulate levels at the proposed site were measured on November 16, 2006. These particulates are 10 μm or less. Specifically, the levels of PM10 (particles of sizes between 2.5 – 10 μm) were measured. The results are presented and compared with the Occupational Safety and Health Administration (OSHA) standard in Table 4.3 and the locations depicted in Figure 4.2.

Table 4.3 Particulate (PM 10) concentrations at Clubhotel RIU Montego Bay

LOCATION	RESULTS EXTRAPOLATED TO 8 hrs (mg/m^3)	OSHA STANDARD (mg/m^3)
1	7.07	5
2	0.73	5
3	1.65	5
4	0.82	5
5	0.95	5

With the exception of station 1 (7.07 mg/m^3) all other stations complied with the OSHA standard (5 mg/m^3) for respirable particulates (PM 10). The result at station 1 while appear to be uncharacteristically high when compared to station 2, could be as a result of vehicular traffic which has to negotiate the corner and may result in braking (creating particulates) and disturbing gravel and other particulate sources on the road surface.

Generally the PM 10 levels are within acceptable levels; however, during construction there is the potential for these levels to exceed the standard.

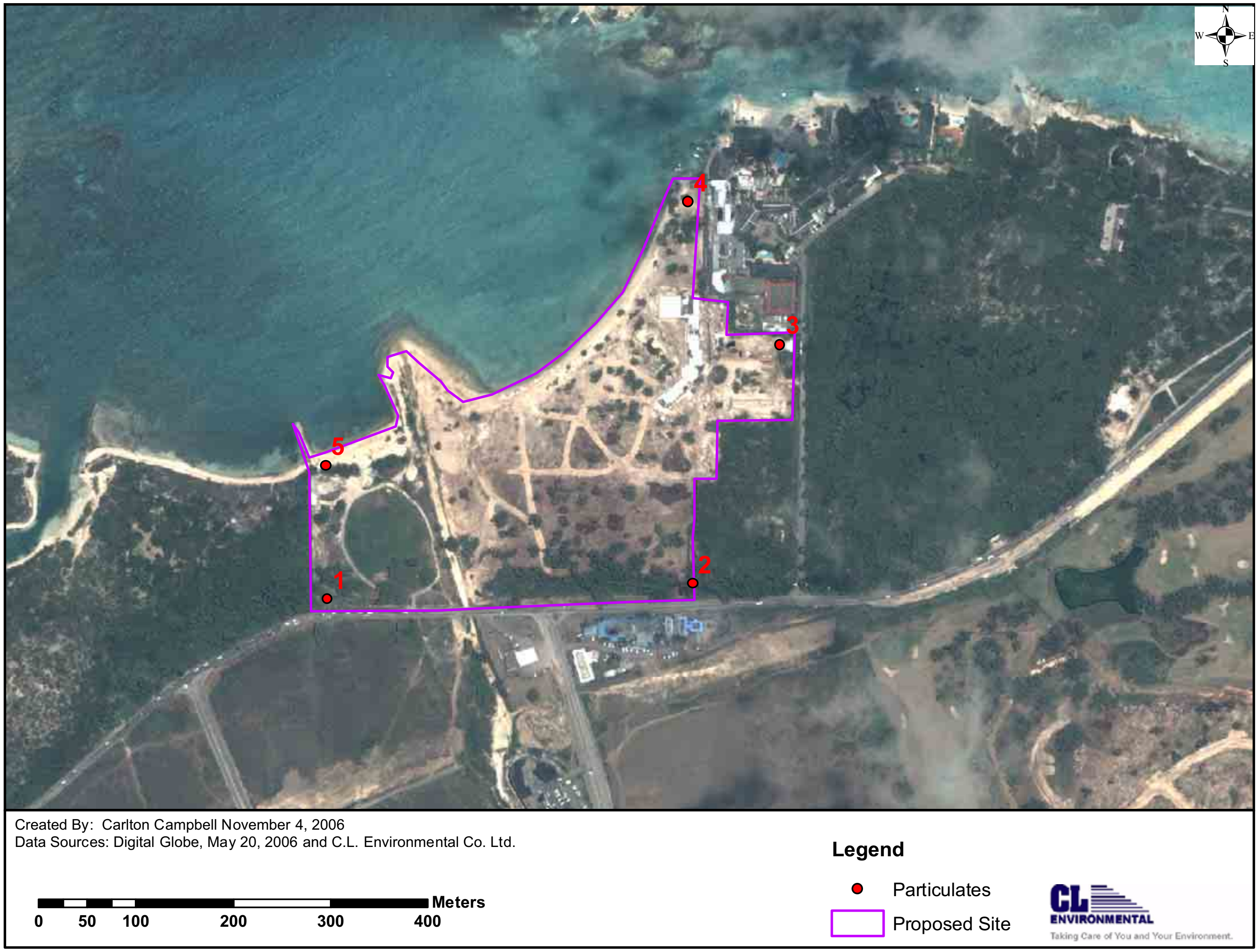

Figure 4.2 Location of particulate stations

Carbon dioxide, nitrogen dioxide and sulphur dioxide

Carbon dioxide concentrations was taken by using a Quest Technologies AQ 5000 meter and nitrogen dioxide and sulphur dioxide levels was obtained by using Sensidyne's precision gas detector tubes. The nitrogen dioxide tubes had a measuring range of 0.5 – 30 ppm and a detectable limit of 0.1 ppm. The sulphur dioxide had a measuring range of 0.25 – 10 ppm and a detection limit of 0.1 ppm.

Carbon dioxide levels at the boundaries to the proposed site ranged from 449 – 476 ppm. This is within the expected range for outdoor carbon dioxide. The levels of nitrogen dioxide and sulphur dioxide were all below the measuring limits.

4.2 Physiography, Geology and Structure

4.2.1 Physiography

The site and its environs are situated on the north coast of Jamaica in the parish of St. James. The physiography consists of a narrow coastal plain, behind which the land rises steeply to summits of 250 to 300 m about 3.5 km south of the coastline. The back coast hills are drained by a number of steep gullies. The coastal plain along here forms a low-lying platform of variable height. A series of small pocket beaches are interspersed with the rocks of the limestone platform. The coast is protected offshore by a more or less continuous reef, sheltering a lagoon between the reef and the coast. The reef is incompletely developed opposite Mahoe Bay itself. The lower courses of the larger gullies transit and are incised into a series of gravel fans, which are evidently the result of former sediment deposition from the gullies.

The proposed development is situated entirely on the coastal plain, north of the coastal highway and partly embraces one of the pocket beaches. The most important of the local gullies is the Salt Spring Gut which exits across the coastal plain through the middle of the proposed development (Figure 4.3 and Plate 4.5). Elevations over the property reach 5 m in the southwest corner but are much lower over most of the area (Figure 4.4). The highest elevations are associated with the course of the gully through the property and indicate the extension to the coastline of the gravel fan associated with Salt Spring Gut.

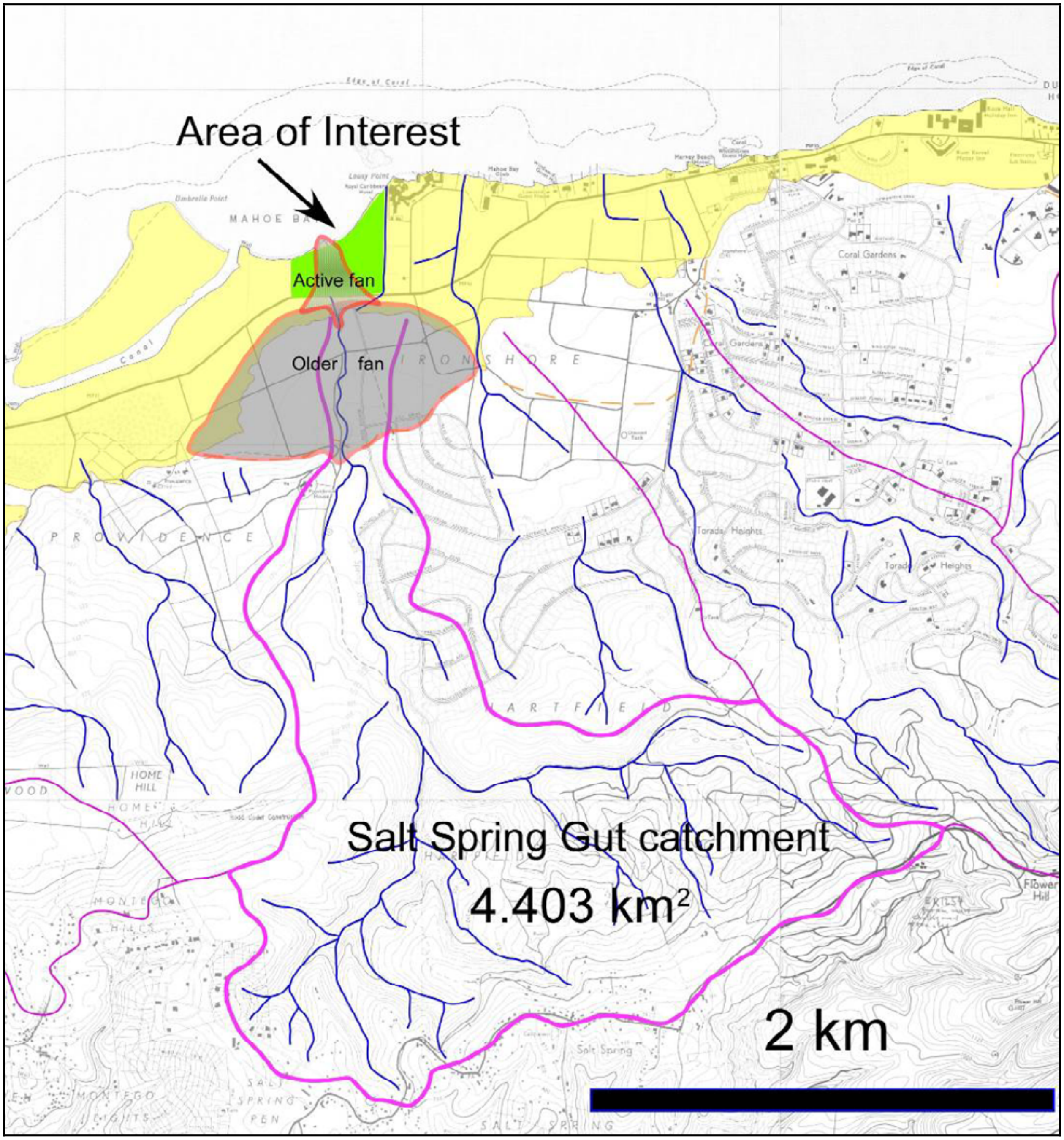

Figure 4.3 Drainage map of Mahoe Bay. RIU site green; Salt Spring Gut catchment outlined in pink; older gravel fan grey shading; active fan stippled. Pink numbers indicate contour spacing heights.

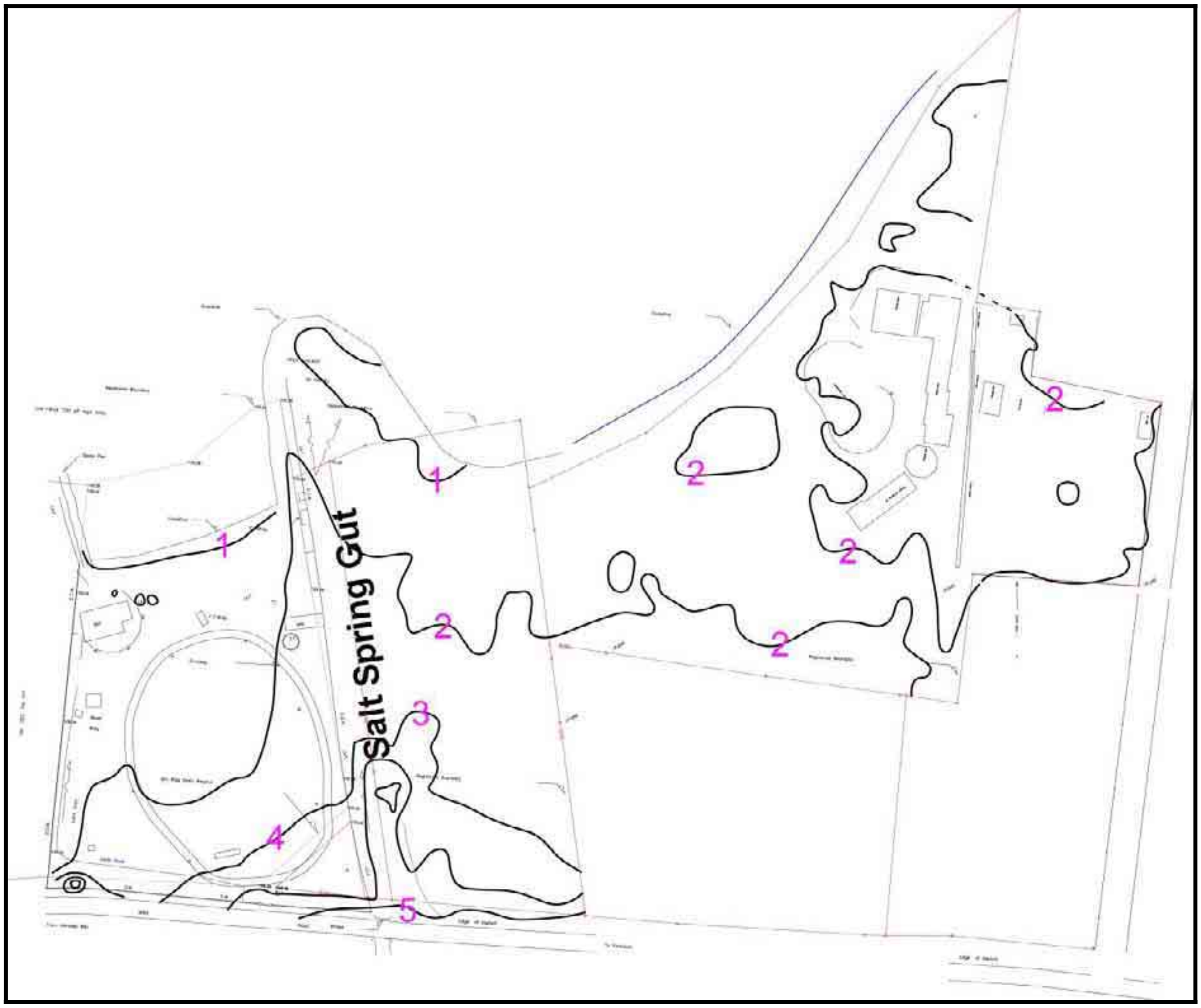

Figure 4.4 RIU site contoured at one metre intervals to indicate the relationship of Salt Spring Gut to the tip of the active fan.

Plate 4.1 Salt Spring Gut, which cuts through the property (coordinates taken at sea ward end of Salt Spring Gut - N 18.51717° W 077.88443°)

Plate 4.2 Eastern beach at Mahoe Bay site

Plate 4.3 Pebble ridge formed east of Salt Spring Gut

Plate 4.4 Western Beach (old Caribbean Beach Park) at Mahoe bay site

4.2.2 Geology

Figure 4.5 shows the geology of the area. It has been extensively modified from the published Geology Sheet 3 (1974) based on our observations of Yellow Limestone exposures on the west side of Salt Spring Gut.

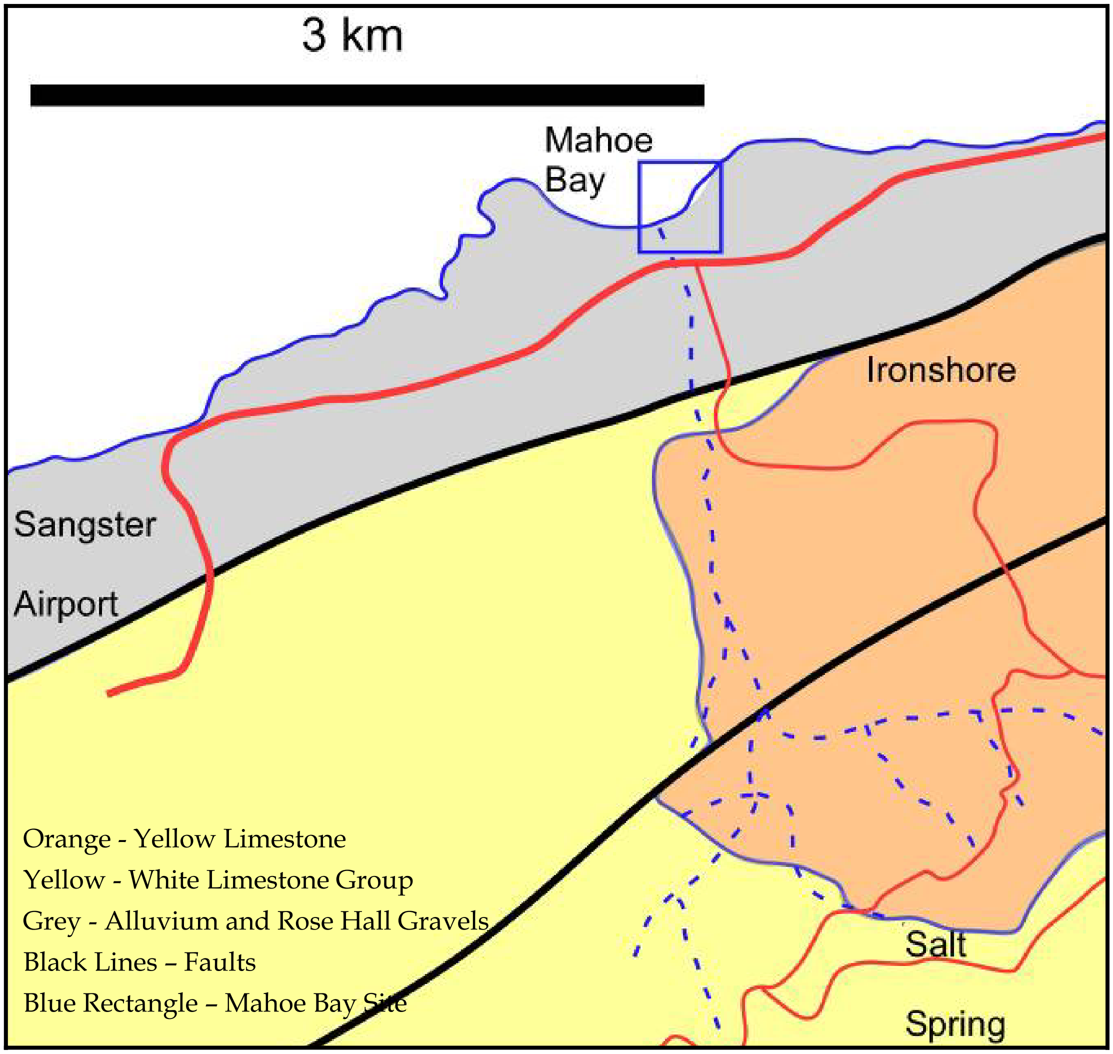

Figure 4.5 Geology of the Mahoe Bay area (Modified from published Geology Sheet 3).

Regional Stratigraphy

The stratigraphy of the area at, and adjacent to the site includes the following formations (Robinson, 1958; Geological Sheet 3):

- *Superficial deposits (at surface):* At the site these deposits are predominantly carbonate beach sand, silt and clayey silt and sand, locally with pebbles and cobbles, especially in the neighbourhood of the gully (Late Holocene).

- *Superficial deposits (buried):* At the site a mixed sequence of carbonate and non-carbonate sand and gravel as penetrated by the boreholes (Early Holocene).

- *Rose Hall Gravel Fans:* Alluvium, sand and gravel, with some clasts up to boulder size, forming the coastal plain and alluvial fans (Pleistocene to Holocene)
- *Coastal Group* (not seen by us)
- *Montpelier Formation*: White Limestone Group consisting of steeply northward dipping to vertically bedded fine grained limestone with occasional chert beds, forming the lowest part of the hill slopes behind the coastal plain (Eocene to Miocene)
- *Yellow Limestone Group*: Calcareous sandstones and shaley siltstones, forming most of the outcrops in the gully catchments, and providing most of the debris forming the gravel fans (Middle Eocene)

The beach sediment characteristics from the beach site west of Salt Spring Gut, at the formerly known Caribbean Beach Park, in addition to those at Mahoe Bay are detailed in Section 4.3.3. Typical beach profiles for the study area may be seen in Section 4.3.4.

Borehole Stratigraphy

Based on the reported fossil material from boreholes 1, 2, 4, 7, 8, 10, 13, 14, 15, 16, 17, 18, 20, 21, 22, 24 (Figure 4.6), the borehole data (as reported) indicate the following events:

1. The overall depositional environment is one dominated by gravel fan deposition, the coarser material of pebble size up, probably largely debris flow accumulations, interrupted by sporadic marine incursions.
2. There are three events that can be defined as marine incursions:
   a. Marine incursion 3, a horizon within 2 – 3.5 m depth.
   b. Marine incursion 2, a horizon within the limits 4 - 7 m depth.
   c. Marine incursion 1, a horizon between 13 – 14 m depth.

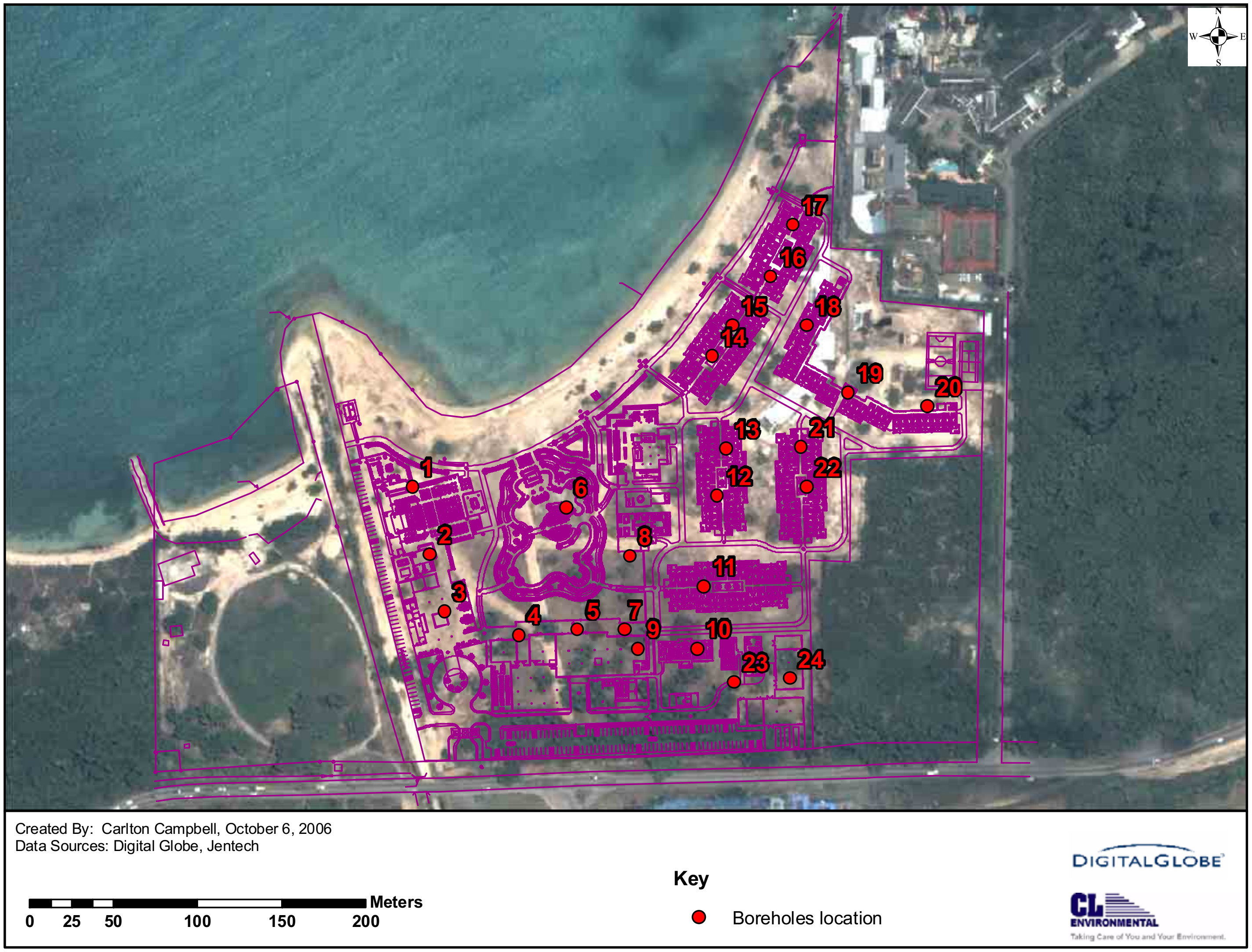

Figure 4.6 Map depicting boreholes location

3. The uppermost layer, overlying marine incursion 3 is described in several boreholes as peaty, indicating a back-beach swampy area (mangrove?) immediately preceding the present day.

4. None of the boreholes reached bedrock. The nature of the bedrock in this area is unknown, but limestone is assumed to occur at depth. The gravel fan deposits could be of considerable thickness, as the gully and fan depositional regime must have been in existence for several hundreds of thousands of years and has probably prograded over time in a seaward direction.

The further refinement of these data requires a biostratigraphic examination of material from the boreholes. Fossils from the three marine layers should also be datable by radiocarbon methods to indicate when the events occurred. Such dating is highly desirable as the incursions, if of Holocene age, could be due to very severe hurricanes and/or tsunami events. Dating would allow a preliminary assessment of possible return periods for the events.

4.2.3 Structure

The slopes of the back coast hills expose an anticline with an east-west trending axis. The northern limb of the anticline is steep to vertical and probably associated with east-west faulting, although no faults were seen by us (Figure 4.5 from Geology Sheet 5).

4.2.4 Seismicity

All along the north coast the rocks forming the limestone terrace in the coastal plain are faulted to varying degrees, indicative of seismic activity continuing to the present day (Horsfield, 1972). This terrace was formed only about 120,000 years ago, so that the region as a whole must be considered as still seismically active. Faulting affecting more recent unconsolidated or semi-consolidated sediments is difficult to identify, and is certainly not evident in the field at Mahoe Bay, but the continued occurrence of earthquakes is well documented (Shepherd & Aspinall, 1980). The most recent large local earthquake was that of March 1, 1957, with an epicenter located near Montego Bay (Robinson *et al.* 1960).

The intensity of seismic shaking depends largely on the quality and thickness of the unconsolidated or semi-consolidated sediments overlying the bedrock. Shallow (less than 50 m) thicknesses transmit short period motions to best effect. Longer period motions are transmitted best by thicknesses up to about 100 m (Aspinall & Shepherd, 1978).

4.3 Physical Oceanography

4.3.1 Bathymetry

A bathymetric survey was conducted offshore of the project site, using a boat-mounted depth sounder and Wide Area Augmentation System (WAAS) Global Positioning System. This data was augmented with existing coastline data, digitised from satellite imagery of the project site. The complete bathymetric survey/shoreline database of datum points was subsequently converted to Digital Elevation Model (DEM) grid files, by scattered data interpolation, using a Kriging method interpolation algorithm. The finite difference (FD) grids, used during the wave model runs (REF/DIF), were generated from these DEM grid files.

Figure 4.7 is a representative contour plot of the resulting bathymetric finite difference (FD) grid. It constituted a 1.41 km wide and 1.48 km long area and was comprised of a total of 20868 rectilinear, horizontal grid points, regularly spaced 10 m apart, that is dx and dy were both equal to 10 m.

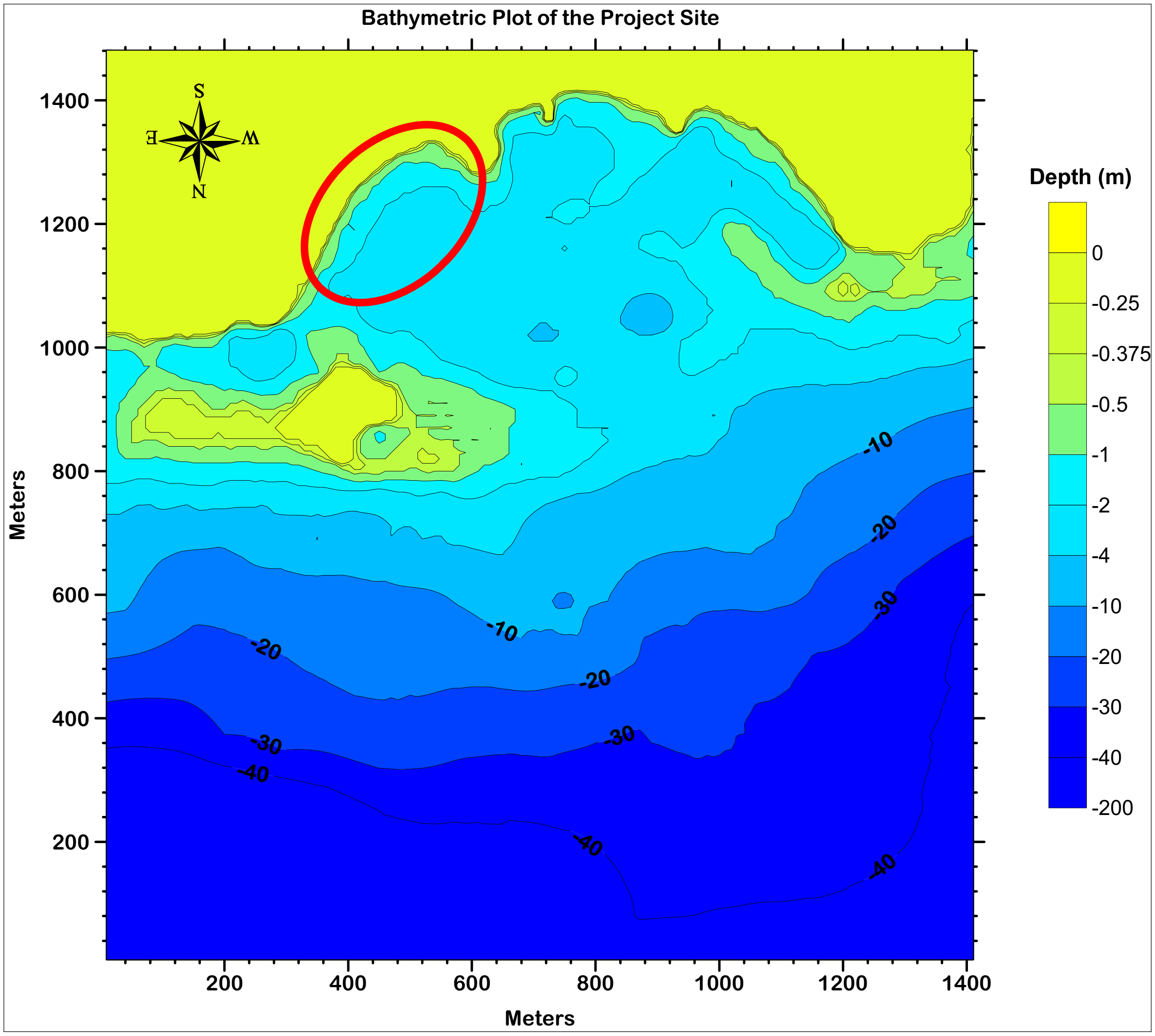

Figure 4.7 Representative contour plot of the bathymetric finite difference grid used during wave model (i.e. REF/DIF) runs. (Note: the figure is presented in a north to south orientation, with the project site located at the top of the figure, encircled in red)

4.3.2 Shoreline Sediment

Mahoe Bay

Eight (8) sediment samples were collected along the shoreline at Mahoe Bay, east of Salt Spring Gut, in order to assist in the definition of the coastal sediment properties. A sample was collected on both the beach face and on the beach berm at four (4) locations along the proposed site's shoreline (Figure 4.8). The sediments were dried in an oven and sieved from the 4.75 mm to the 0.075 mm opening size. The balance was collected in a pan below the rack of sieves.

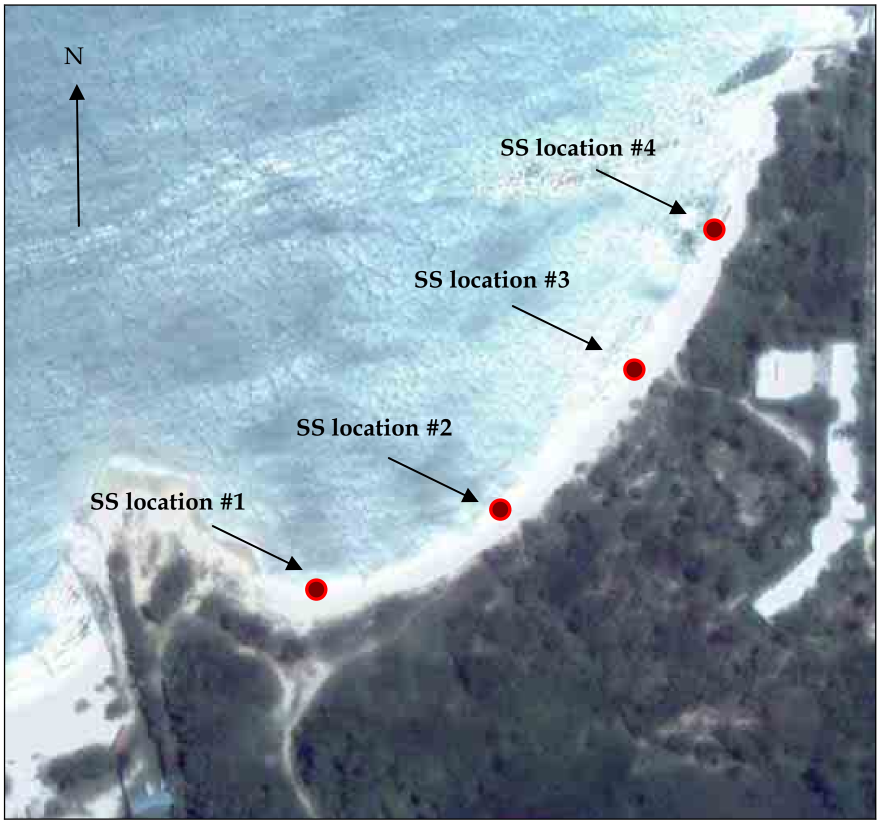

Figure 4.8 Aerial photograph showing locations of sand samples (SS)

Data from the sieve analysis was used to determine the median grain size. The results are shown in the Table 4.4 and in Figure 4.9. The grain size analysis revealed that the shoreline consisted of fine to coarse sand with the majority of the grain sizes lying between 0.2 and 0.7 mm. It must be noted that the grain sizes are better sorted in the southern half of the beach; this is as a result of the higher wave energies incident on this portion of the shoreline. The front of beach sand sample at location no. 1 appears to be an anomaly with a considerably low mean sediment size of 0.08 mm; this could be as a result of the drain that empties near that vicinity that possibly delivers terrestrial sediment to the beach face.

Table 4.4 Grain size analysis of sand samples collected at Mahoe Bay (Wentworth Classification may be seen in Table 4.5)

Beach Sample No.	Location	Mean (mm)	Standard Deviation	Skewness	Wentworth Classification of Grain Size	Sorting Classification
Sand Sample Location #1	Back of Beach	0.79	1.76	0.46	Medium Sand	Poorly Sorted
	Front of Beach	0.08	0.00	0.99	Very Fine Sand	Very well Sorted
Sand Sample Location #2	Back of Beach	1.49	0.63	-0.61	Coarse Sand	Moderately Well Sorted
	Front of Beach	0.38	1.60	0.51	Fine Sand	Poorly Sorted
Sand Sample Location #3	Back of Beach	2.11	0.90	0.37	Very Coarse Sand	Moderately Poorly Sorted
	Front of Beach	2.11	0.98	0.41	Very Coarse Sand	Moderately Poorly Sorted
Sand Sample Location #4	Back of Beach	0.94	1.46	0.24	Coarse Sand	Poorly Sorted
	Front of Beach	1.07	1.35	-0.29	Coarse Sand	Poorly Sorted

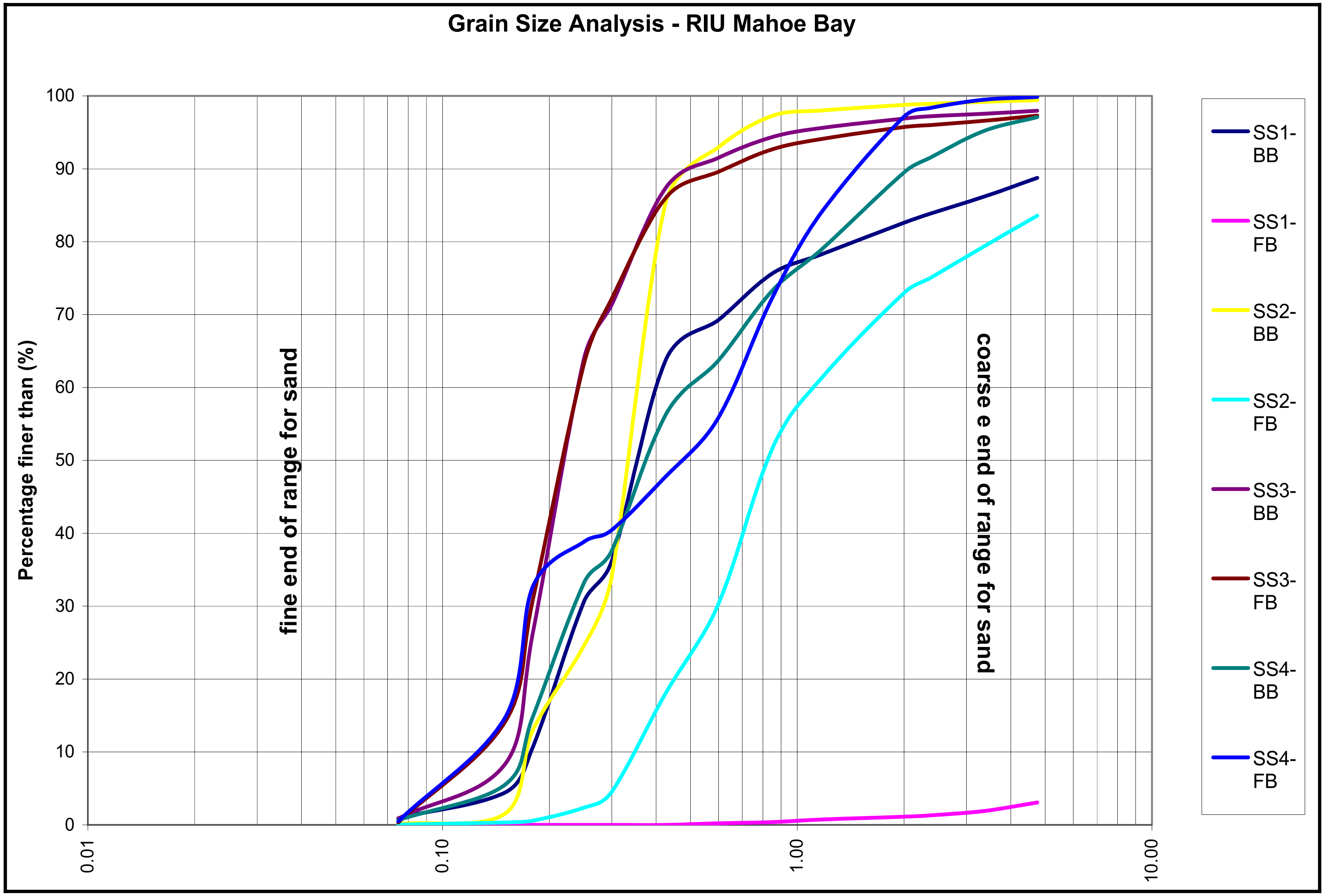

Figure 4.9 Logarithmic graph of sand grain sizes at four sampling locations, Mahoe Bay

<u>Caribbean Beach Park</u>

Composition

Composition and grain size analyses were conducted on samples collected west of Salt Spring Gut (old Caribbean Beach Park) at three (3) points across the beach profile the berm, swash and ripple zone.

Compositional analysis of the samples from this site show that they consist entirely of skeletal and non-skeletal grains; no lithoclasts were identified during petrographic analysis. The non-skeletal fraction of the sediment includes amorphous grains (21.7-53.3%), crystalline grains (10.1-31.3%) and composite grains (0.9-11.3%). Skeletal grains contribute between 14.1-56.8% of the total sample and include six primary constituents: molluscs; the green alga *Halimeda*; the coralline algae *Amphiroa*; echinoid fragments; foraminifers and worm tubes.

The most abundant bioclast contributing to the beach sediment in this area is molluscs and account on average for 40.4% of the skeletal fraction of the sediment, followed by coralline algae *Amphiroa* which accounts for 26.1%. Other contributors are foraminifera (19.4%), *Halimeda* (8.7%), echinoid fragments (4.0%) and worm tubes (1.6%).

These organisms are commonly found in quiet low velocity sheltered environments and occur at depths ranging from the inter-tidal zone to the lower limit of the photic zone. The algae contributing to the sediment commonly grow on sand or gravel and attached to rocks at depths up to 25 m and are commonly found associated with *Thalassia* beds, the lagoon-back reef-off shore area. Both have been identified as significant producers of carbonate sediment through out the Caribbean.

Grain size

The mean grain size of sediments from the site ranges from medium sand (1.6 Φ or 0.33 mm) within the foreshore to coarse sand (0.8Φ or 0.57 mm) in the inshore area; see Table 4.5 for Wentworth Classification of sand. In general the sediment is very well to moderately well sorted (0.3 to 0.7σ, standard deviation) and exhibits very negatively skewed values ranging between -0.1 and -0.3. The mean grain size of these samples range from 0.33 mm to 0.73 mm (1.6Φ - 0.5Φ).

Table 4.5 Wentworth grain size scale

Wentworth Class	**Size (mm)**	**Size (phi, Φ)**
very fine silt	0.0039 mm	8.0 phi
	0.0078 mm	7.0 phi
fine silt	0.0078 mm	7.0 phi
	0.0156 mm	6.0 phi
medium silt	0.0156 mm	6.0 phi
	0.031 mm	5.0 phi
coarse silt	0.031 mm	5.0 phi
	0.0625 mm	4.0 phi
very fine sand	0.0625 mm	4.0 phi
	0.125 mm	3.0 phi
fine sand	0.125 mm	3.0 phi
	0.250 mm	2.0 phi
medium sand	0.250 mm	2.0 phi
	0.500 mm	1.0 phi
coarse sand	0.500 mm	1.0 phi
	1.00 mm	0.0 phi
very coarse sand	1.00 mm	0.0 phi
	2.00 mm	–1.0 phi
granule	2.00 mm	–1.0 phi
	4.00 mm	–2.0 phi
pebble	4.00 mm	–2.0 phi
cobble	> 16 mm	~–6 phi
boulder	> 256 mm	–8 phi

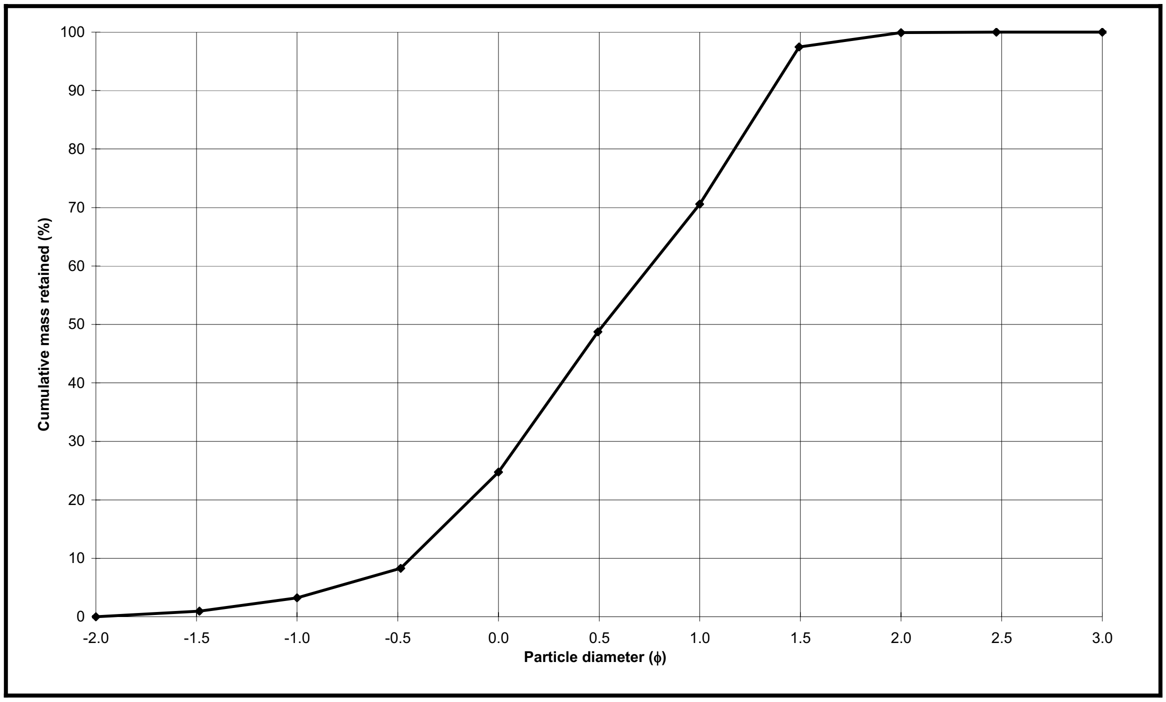

Figure 4.10 Cumulative frequency graph for berm sample at Caribbean Beach Park

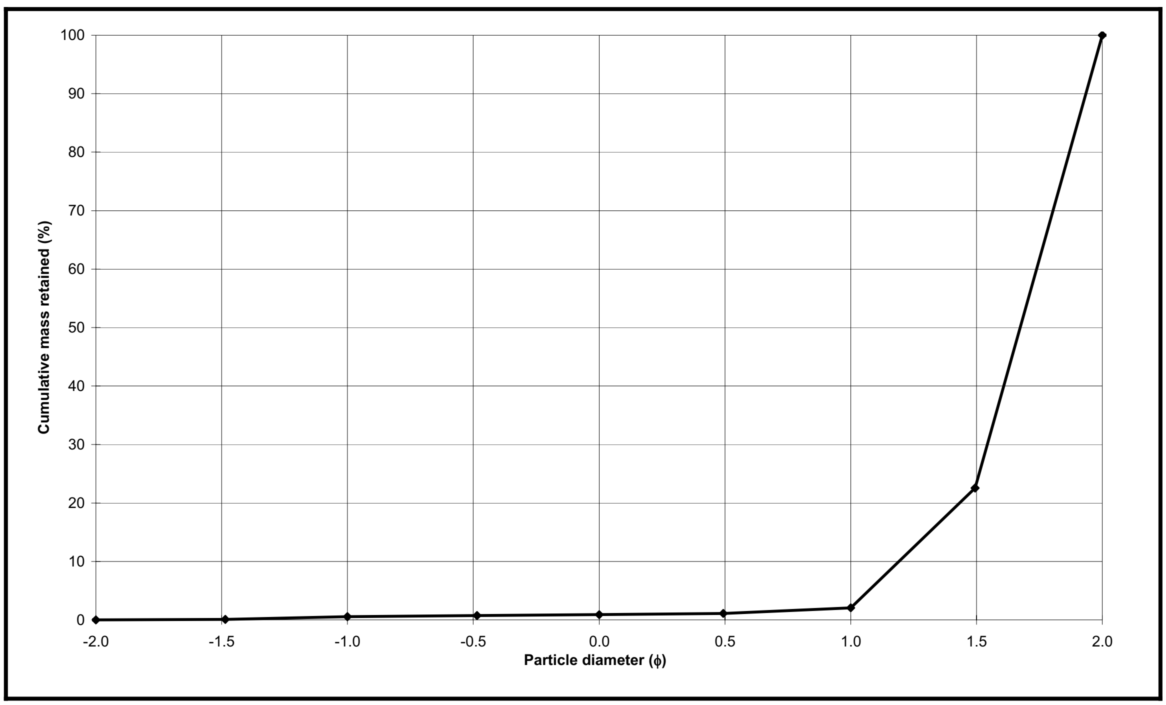

Figure 4.11 Cumulative frequency graph for swash sample at Caribbean Beach Park

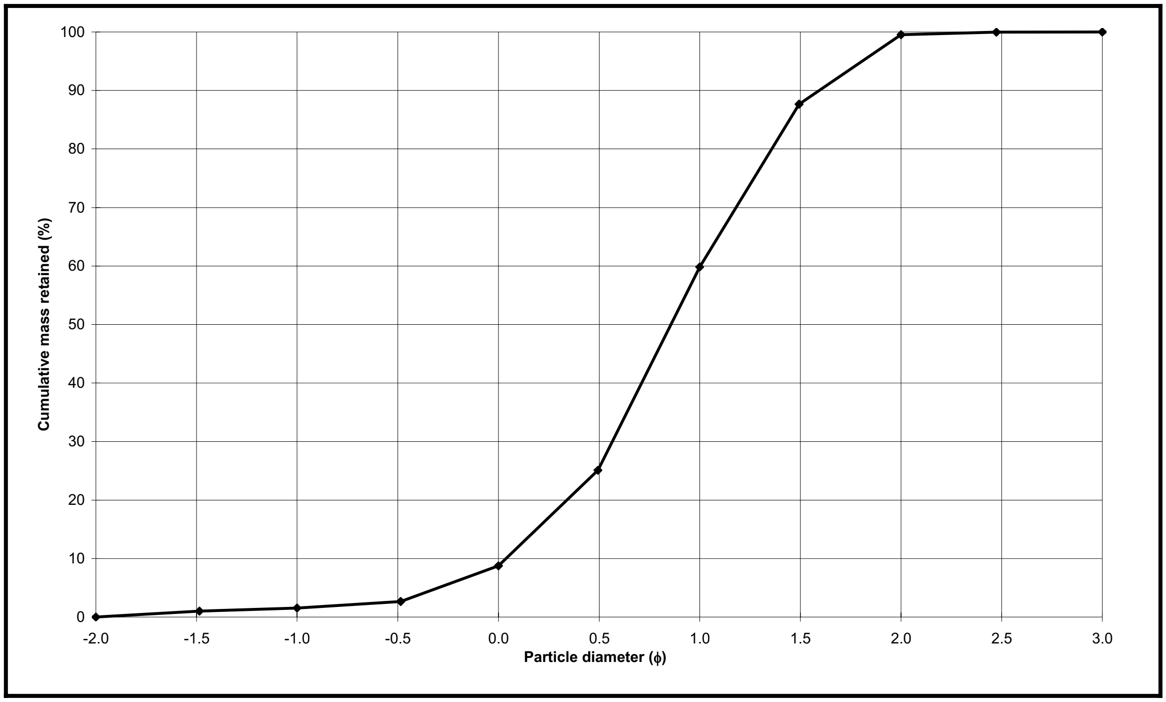

Figure 4.12 Cumulative frequency graph for ripple sample at Caribbean Beach Park

4.3.3 Beach Profile

Two profiles were established, one at the proposed hotel development, and the other at the site formerly known Caribbean Beach Park west of Salt Spring Gut. This was done in order to determine the width and elevation of the beach at each site.

Profile 1 – East of Salt Spring Gut at Proposed Hotel Development

The highest elevation measured along profile 1 (Figure 4.13) occurs at the most landward station 1.4 m behind the tree line which is 1 m above sea level (asl). The land decreases to 0.7m asl at the tree line marking the rear of the berm. The narrow berm (3.8m) is stabilized by grass and *Ipomea pes-capri* vines. The gently sloping foreshore and ripple formation in the near shore area are indicative of a low energy environment. Profiles were terminated at the edge of the seagrass beds which are present approximately 6 m from shore.

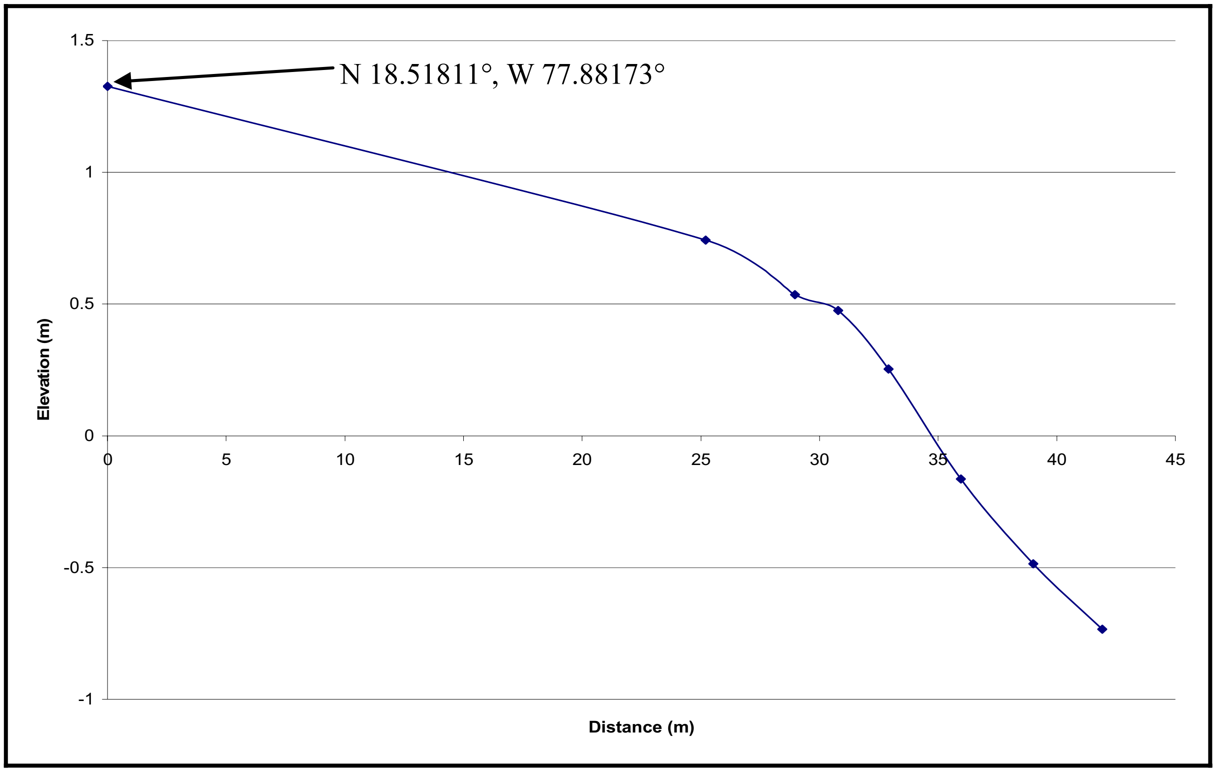

Figure 4.13 Cross section of profile 1 at proposed hotel development east of Salt Spring Gut

Profile 2 - West of Salt Spring Gut at Caribbean Beach Park

The highest elevation measured along profile 2 (Figure 4.14) occurs at the most landward station at the tree line which is 1 m asl. The berm, approximately 18m wide, is stabilized by grass and backed by pine and almond trees. The gently sloping foreshore and ripple formation in the near shore area are indicative of a low energy environment. Profiles were terminated at the edge of the seagrass beds which are present approximately 6 m from shore.

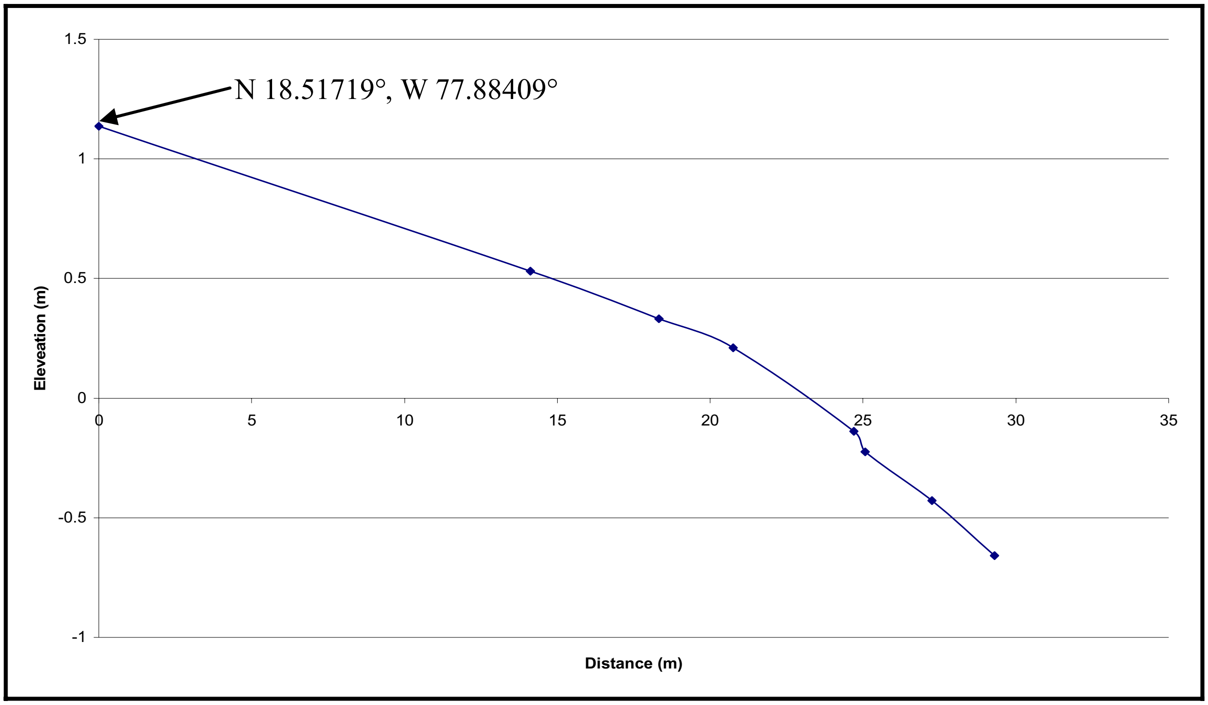

Figure 4.14 Cross section of profile 2 at the old Caribbean Beach Park west of Salt Spring Gut

4.4 Natural Hazards

4.4.1 Hurricane, Storm Surge and Beach Erosion

The last assessment of hurricane surge was carried out by C. Wilmot-Simpson (1980) following the passage of hurricane Allen. Storm surge in the neighbourhood of the site was estimated to be between 1.2 m and 3.0 m (Wilmot-Simpson, 1980). Hurricanes and tropical storms are frequently accompanied by heavy rainfall. It has also been widely suggested that the Atlantic-Caribbean region is moving, even has already moved, into a cycle of wetter and more severe tropical disturbances (IPCC, 2001). Coastal flooding, likely from a storm surge with a return period of 25 years is portrayed for the Sangster Airport and the area east as far as the western edge of Mahoe Bay (MACC, 2005).

To further define the vulnerability of the proposed site to storm surge and severe storms, storm frequency and storm surge modelling for the site was carried out.

Hurricane Deepwater Wave Extreme/Hurricane Wave Climate

Methodology

In order to develop a deep water extreme/hurricane wave climate, offshore of the project site, the National Oceanic and Atmospheric Administration (NOAA) database of tropical cyclones (found at http://www.nhc.noaa.gov/pastall.shtml) was searched and statistically analysed. This database spans the years 1851 to the present and contains over 900 tropical storms and hurricanes that have been tracked through the Caribbean. The NOAA database of storms was used to estimate the characteristics of deep water waves, offshore of the site, through use of a wave hindcasting technique based on the well-documented JONSWAP Wind-Wave Model.

A deep water location was selected approximately 1 km offshore, north of the project site (UTM coordinates: **Zone 18** 195410N 2050970E, Decimal Degree coordinates: 77.884549W, 18.527162N). Hurricanes passing within a 500 km search radius of this location were extracted from the National Hurricane Centre/NOAA database and statistically analysed to determine their paths, wind speed characteristics, central pressures and forward velocities. From these 1, 2, 5, 10, 20, 25, 50, 75, 100, 150 and 200 year, deep water hurricane waves were determined for this offshore deep water location, using the previously-mentioned JONSWAP Model. A summary of the results of the analysis is given in Table 4.6.

The analysis indicates that approximately 118 hurricane systems came within 500 kilometres of the site, from the start of the records in 1851 (Table 4.7). This speaks to the site's overall vulnerability to such systems, and the likelihood of events occurring relatively frequently.

Specific to the project, the most dangerous wave heights and periods are those coming from the northwest and north direction. By and large, the site is effectively shielded from wave action from the southeast, south and southwest, due to the presence of land. It is also effectively shielded from wave action coming from the northeast, east and west, by Mahoe Bay's offshore fringing reef and the Sandals Royal restaurant cay.

Generally waves generated on the north coast propagate most frequently from a NE to W direction. However, the most intense waves have been noted to come from the north-easterly direction. Specific to the project, north-easterly waves would be diffracted and refracted before reaching the site's shoreline thus lessening their intensity. However the north-westerly and northerly waves are directly perpendicular to the site and would therefore impact the shoreline with the greatest intensity. These waves are relatively large, with the potential for wreaking severe damage on coastal infrastructure.

Table 4.6 Offshore deep water hurricane wave predictions from the extremal analysis of hurricanes that came within 500km of the project site

Return Period	Significant Wave Heights (Hs) in meters and Wave Periods (Tp) in seconds																	
	All		NW		N		NE		E		SE		S		SW		W	
	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp
1	0.5	3.7	0.3	2.6	0.3	2.6	0.3	2.6	0.3	2.6	N/A	N/A	N/A	N/A	N/A	N/A	0.3	2.6
2	3.5	9.4	3.5	9.4	3.5	9.4	3.8	9.8	4.1	10.1	N/A	N/A	N/A	N/A	N/A	N/A	3.3	9.1
5	4.7	10.8	4.7	10.8	4.4	10.4	4.8	11.0	5.5	11.7	N/A	N/A	N/A	N/A	N/A	N/A	4.6	10.7
10	5.4	11.6	5.4	11.6	4.8	10.9	5.3	11.5	6.3	12.5	N/A	N/A	N/A	N/A	N/A	N/A	5.3	11.5
20	6.0	12.1	5.9	12.1	5.1	11.3	5.8	12.0	6.9	13.1	N/A	N/A	N/A	N/A	N/A	N/A	5.9	12.1
25	6.1	12.3	6.1	12.3	5.2	11.4	5.9	12.1	7.1	13.2	N/A	N/A	N/A	N/A	N/A	N/A	6.0	12.2
50	6.6	12.8	6.5	12.7	5.5	11.7	6.2	12.4	7.6	13.7	N/A	N/A	N/A	N/A	N/A	N/A	6.5	12.7
75	6.8	13.0	6.8	12.9	5.7	11.9	6.4	12.6	7.9	13.9	N/A	N/A	N/A	N/A	N/A	N/A	6.8	12.9
100	**7.0**	**13.1**	7.0	13.1	5.8	12.0	6.5	12.7	8.1	14.1	N/A	N/A	N/A	N/A	N/A	N/A	7.0	13.1
150	7.2	13.4	7.2	13.3	5.9	12.1	6.7	12.8	8.3	14.3	N/A	N/A	N/A	N/A	N/A	N/A	7.2	13.3
200	7.4	13.5	7.3	13.4	6.0	12.2	6.8	12.9	8.5	14.4	N/A	N/A	N/A	N/A	N/A	N/A	7.4	13.5

Table 4.7 Names and years for storms that came within 500 km of site since 1851

	Storm No.	Name	Date	Max. SS Category	
1	10	NOTNAMED	1852	2-	MODERATE
2	38	NOTNAMED	1857	2-	MODERATE
3	50	NOTNAMED	1859	3-	EXTENSIVE
4	83	NOTNAMED	1864	1-	WEAK
5	89	NOTNAMED	1865	3-	EXTENSIVE
6	94	NOTNAMED	1866	3-	EXTENSIVE
7	127	NOTNAMED	1870	2-	MODERATE
8	150	NOTNAMED	1873	3-	EXTENSIVE
9	157	NOTNAMED	1874	2-	MODERATE
10	160	NOTNAMED	1875	3-	EXTENSIVE
11	172	NOTNAMED	1877	3-	EXTENSIVE
12	178	NOTNAMED	1878	1-	WEAK
13	183	NOTNAMED	1878	4-	EXTREME
14	188	NOTNAMED	1878	1-	WEAK
15	194	NOTNAMED	1879	1-	WEAK
16	198	NOTNAMED	1880	4-	EXTREME
17	199	NOTNAMED	1880	1-	WEAK
18	227	NOTNAMED	1884	2-	MODERATE
19	240	NOTNAMED	1886	2-	MODERATE
20	241	NOTNAMED	1886	2-	MODERATE
21	242	NOTNAMED	1886	3-	EXTENSIVE
22	247	NOTNAMED	1887	2-	MODERATE
23	248	NOTNAMED	1887	1-	WEAK
24	252	NOTNAMED	1887	2-	MODERATE
25	277	NOTNAMED	1889	2-	MODERATE
26	321	NOTNAMED	1895	2-	MODERATE
27	324	NOTNAMED	1895	3-	EXTENSIVE
28	329	NOTNAMED	1896	3-	EXTENSIVE
29	344	NOTNAMED	1898	1-	WEAK
30	345	NOTNAMED	1898	1-	WEAK
31	348	NOTNAMED	1899	3-	EXTENSIVE
32	360	NOTNAMED	1901	1-	WEAK
33	375	NOTNAMED	1903	3-	EXTENSIVE
34	383	NOTNAMED	1904	1-	WEAK
35	391	NOTNAMED	1905	2-	MODERATE
36	400	NOTNAMED	1906	4-	EXTREME
37	403	NOTNAMED	1906	1-	WEAK
38	418	NOTNAMED	1909	4-	EXTREME
39	419	NOTNAMED	1909	1-	WEAK
40	420	NOTNAMED	1909	3-	EXTENSIVE
41	422	NOTNAMED	1909	4-	EXTREME
42	424	NOTNAMED	1909	3-	EXTENSIVE
43	425	NOTNAMED	1909	1-	WEAK
44	426	NOTNAMED	1910	1-	WEAK
45	427	NOTNAMED	1910	3-	EXTENSIVE
46	432	NOTNAMED	1911	2-	MODERATE
47	433	NOTNAMED	1911	1-	WEAK
48	439	NOTNAMED	1912	4-	EXTREME
49	446	NOTNAMED	1915	4-	EXTREME
50	448	NOTNAMED	1915	2-	MODERATE
51	449	NOTNAMED	1915	4-	EXTREME
52	453	NOTNAMED	1916	3-	EXTENSIVE
53	455	NOTNAMED	1916	3-	EXTENSIVE
54	462	NOTNAMED	1916	3-	EXTENSIVE
55	466	NOTNAMED	1917	3-	EXTENSIVE
56	467	NOTNAMED	1918	2-	MODERATE
57	468	NOTNAMED	1918	2-	MODERATE
58	503	NOTNAMED	1924	2-	MODERATE
59	525	NOTNAMED	1928	1-	WEAK
60	526	NOTNAMED	1928	1-	WEAK
61	537	NOTNAMED	1931	1-	WEAK
62	539	NOTNAMED	1931	3-	EXTENSIVE
63	540	NOTNAMED	1931	2-	MODERATE
64	550	NOTNAMED	1932	3-	EXTENSIVE
65	553	NOTNAMED	1932	4-	EXTREME
66	556	NOTNAMED	1933	2-	MODERATE
67	557	NOTNAMED	1933	1-	WEAK
68	560	NOTNAMED	1933	1-	WEAK
69	569	NOTNAMED	1933	2-	MODERATE
70	570	NOTNAMED	1933	1-	WEAK
71	572	NOTNAMED	1933	4-	EXTREME
72	573	NOTNAMED	1933	2-	MODERATE
73	585	NOTNAMED	1934	1-	WEAK
74	590	NOTNAMED	1935	3-	EXTENSIVE
75	591	NOTNAMED	1935	1-	WEAK
76	619	NOTNAMED	1938	2-	MODERATE
77	620	NOTNAMED	1938	2-	MODERATE
78	642	NOTNAMED	1941	3-	EXTENSIVE
79	646	NOTNAMED	1942	3-	EXTENSIVE
80	648	NOTNAMED	1942	1-	WEAK
81	666	NOTNAMED	1944	1-	WEAK
82	668	NOTNAMED	1944	3-	EXTENSIVE
83	685	NOTNAMED	1945	2-	MODERATE
84	702	NOTNAMED	1948	1-	WEAK
85	739	CHARLIE	1951	4-	EXTREME
86	740	DOG	1951	3-	EXTENSIVE
87	761	FLORENCE	1953	3-	EXTENSIVE
88	776	HAZEL	1954	4-	EXTREME
89	788	JANET	1955	5-	CATASTROPHIC
90	790	KATIE	1955	3-	EXTENSIVE
91	811	ELLA	1958	3-	EXTENSIVE
92	829	ABBY	1960	2-	MODERATE
93	835	ANNA	1961	3-	EXTENSIVE
94	857	FLORA	1963	4-	EXTREME
95	864	CLEO	1964	4-	EXTREME
96	886	INEZ	1966	4-	EXTREME
97	890	BEULAH	1967	5-	CATASTROPHIC
98	910	FRANCELIA	1969	3-	EXTENSIVE
99	936	CHLOE	1971	1-	WEAK
100	938	EDITH	1971	5-	CATASTROPHIC
101	966	CARMEN	1974	4-	EXTREME
102	969	FIFI	1974	2-	MODERATE
103	1004	GRETA	1978	4-	EXTREME
104	1018	ALLEN	1980	5-	CATASTROPHIC
105	1025	HERMINE	1980	1-	WEAK
106	1078	DANIELLE	1986	1-	WEAK
107	1095	GILBERT	1988	5-	CATASTROPHIC
108	1099	KEITH	1988	2-	MODERATE
109	1111	ARTHUR	1990	1-	WEAK
110	1186	MARCO	1996	1-	WEAK
111	1207	MITCH	1998	5-	CATASTROPHIC
112	1220	LENNY	1999	4-	EXTREME
113	1228	HELENE	2000	1-	WEAK
114	1238	CHANTAL	2001	1-	WEAK
115	1244	IRIS	2001	4-	EXTREME
116	1259	ISIDORE	2002	3-	EXTENSIVE
117	1262	LILI	2002	4-	EXTREME
118	1263	IVAN	2004	5-	CATASTROPHIC

Table 4.8 – Extremal Analysis table of wave climate for Mahoe Bay site. Please note that there were no records for waves originating from the east, southeast and south

Return Period	Wave Height (m)														
	All		SW		W		NW		N		NE		E	SE	S
	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp	Hs	Tp			
1	1.8	6.8			1.0	5.1	1.0	5.1	1.0	5.1	1.0	5.1			
2	3.6	9.5			3.6	9.5	3.6	9.6	3.4	9.3	3.5	9.4			
5	4.6	10.8			4.6	10.7	4.7	10.8	4.3	10.4	4.3	10.4			
10	5.3	11.5			5.2	11.3	5.2	11.4	4.8	10.9	4.7	10.8			
20	5.8	12.0			5.6	11.8	5.7	11.9	5.2	11.3	5.0	11.2			
25	6.0	12.2			5.8	12.0	5.8	12.0	5.3	11.4	5.1	11.3			
50	6.5	12.7			6.2	12.3	6.2	12.4	5.6	11.8	5.4	11.5			
75	6.8	12.9			6.4	12.5	6.4	12.6	5.8	11.9	5.5	11.7			
100	7.0	13.1			6.5	12.7	6.5	12.7	5.9	12.1	5.6	11.8			
150	7.2	13.3			6.7	12.9	6.7	12.9	6.0	12.2	5.7	11.9			
200	7.4	13.5			6.8	13.0	6.9	13.0	6.1	12.3	5.8	12.0			

Nearshore Hurricane Wave Climate

A refraction/diffraction wave model was set up to investigate the spatial transformation changes that occur as waves travel from deep water, inshore towards the project site. For this analysis, extreme (i.e. hurricane) deep water, incident waves, for a 50 and a 100 year return period hurricane, were used. These 50 and 100 year return period, incident, deep water, wave characteristics were developed during the Offshore Deep Water Extreme/Hurricane Wave Climate analysis, discussed in the preceding section and summarized in Table 4.5.

For the 50 year return period, deep water to inshore, wave transformation runs, a significant wave height (Hs) of 6.5 m and a wave period (Tp) of 12.7 seconds was used, for waves from the northwest. Concurrently, for the 50 year return period, deep water to inshore, wave transformations from the north, a significant wave height (Hs) of 5.5 m and a wave period (Tp) of 11.7 seconds was used.

For all the 100 year return period, deep water to inshore, wave transformation runs, it was decided that, (i) a significant wave height (Hs) of 7.0 m and a wave period (Tp) of 13.1 seconds would be used, and (ii) a third, deep water to inshore, spatial transformation run would be included, i.e. for waves from the northeast.

A significant wave height (Hs) of 7.0 m and a wave period (Tp) of 13.1 seconds was selected based on the fact that it represented wave predictions in "all" directions. In addition, it was the highest significant wave height prediction for the proposed northwest, north and northeast model runs and, therefore represented the most extreme predicted wave height discretization for waves that could impact the project shoreline during a 100 year return period. A significant wave height (Hs) of 7.0 m and a wave period (Tp) of 13.1 seconds, in effect, represented the "worst of a worse-case 100 year scenario".

The third, deep water to inshore, spatial transformation run was included (for waves from the northeast) for the sake of completeness and to demonstrate that, even for a 100 return period hurricane, the project shoreline is effectively shielded from wave action coming from the northeast (i.e. by Mahoe Bay's offshore fringing reef and the Sandals Royal restaurant cay), as discussed above in the preceding section on Offshore Deep Water Extreme/Hurricane Wave Climate.

Finally, the wave model used for all the deep water to nearshore spatial wave transformation changes was a combined refraction/diffraction wave model called REF/DIF (Kirby and Dalrymple, 1994). During the model runs, the grids were oriented in directions required for facilitating the conducted northwest, north and northeast runs. As previously mentioned, a finite difference grid size of 10 m by 10 m was used, to properly represent the waveform in shallow water and also to allow for the physics of the transformation process, in the nearshore area, to be properly represented and modelled.

The results of the 50 and 100 year (i.e. return period) REF/DIF model runs are shown in Figure 4.15, Figure 4.16, Figure 4.17, Figure 4.18 and Figure 4.19, respectively for their NW, N and NE incident hurricane waves. What can be seen very clearly is that the system of offshore reefs offers substantial protection to the project site.

On close examination of the latter figures, it is apparent that waves between 0.5 and 2.0 m in height propagate along the entrance channel, west of the Sandals Royal Caribbean offshore island, i.e. into Mahoe Bay. Inspection of the nearshore hurricane wave climate conditions for the existing shoreline configuration reveals that wave heights ranging from 1.5 to 2.0 metres can be expected to reach the western end of the main beach, while lower values ranging from 0.3 to 1.0 meter are incident on the eastern end. In both the northwest and north model runs, incoming wave energy is focused on the point area to the west of the beach. Although most beach developments on the north coast tend to experience beach growth in a westerly direction, this will likely not be the case in this proposed development, due to the high energy that is incident there. The incident waves are relatively large in comparison to the incident deepwater wave heights and can be expected to result in significant erosion (as in previous hurricanes).

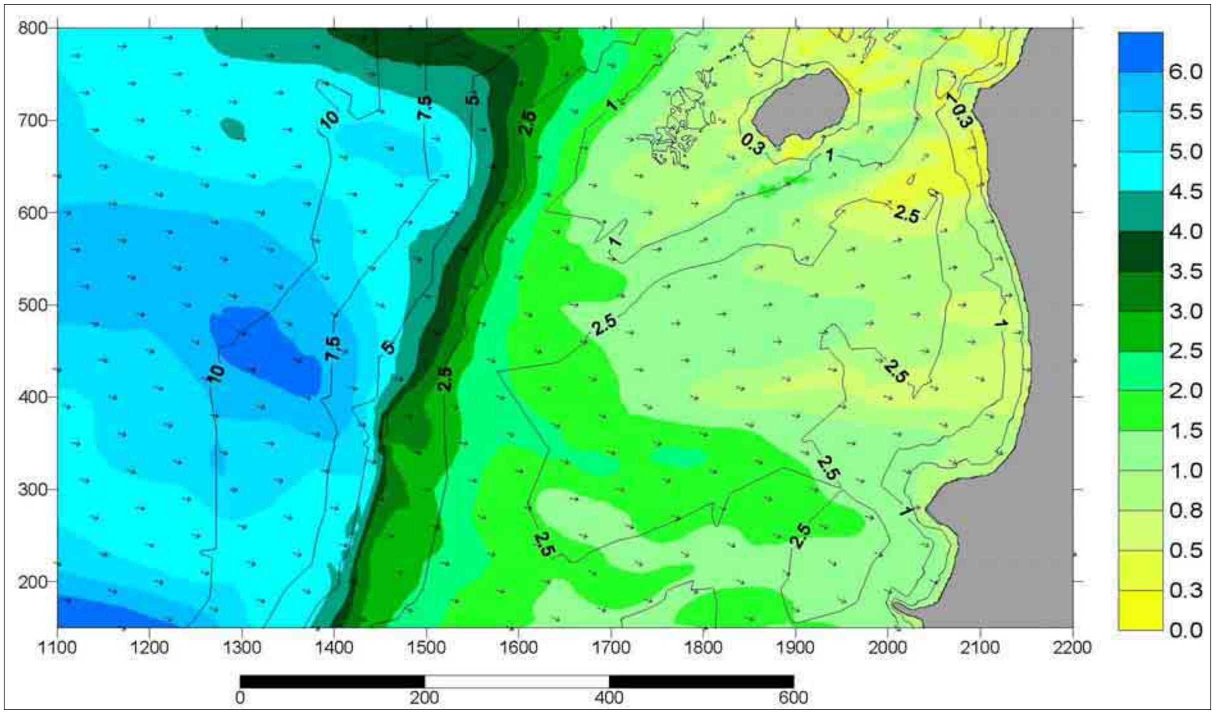

Figure 4.15 Hurricane nearshore wave climate for north-westerly waves for a 50 yr event

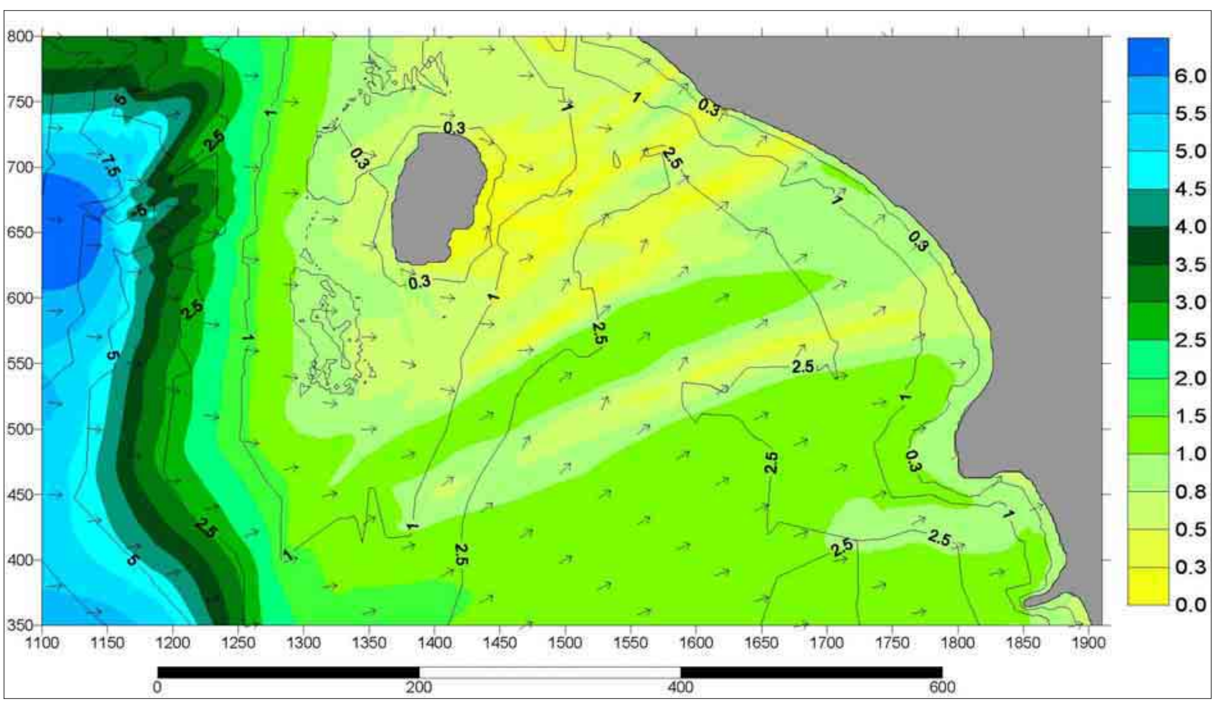

Figure 4.16 Hurricane nearshore wave climate for northerly waves for a 50 yr event

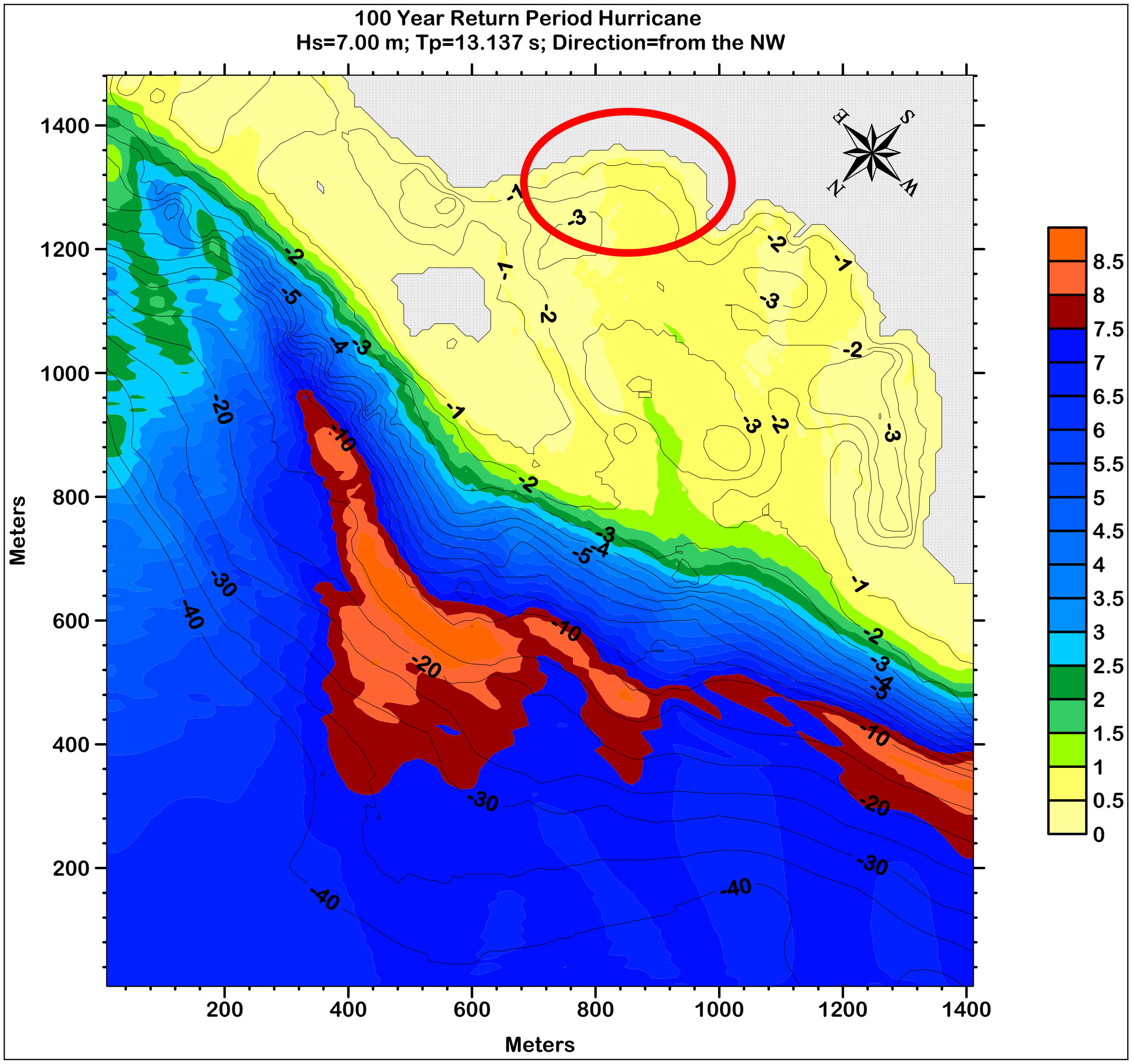

Figure 4.17 100 year return period wave heights at the project site (in red circle), for NW incident hurricane waves

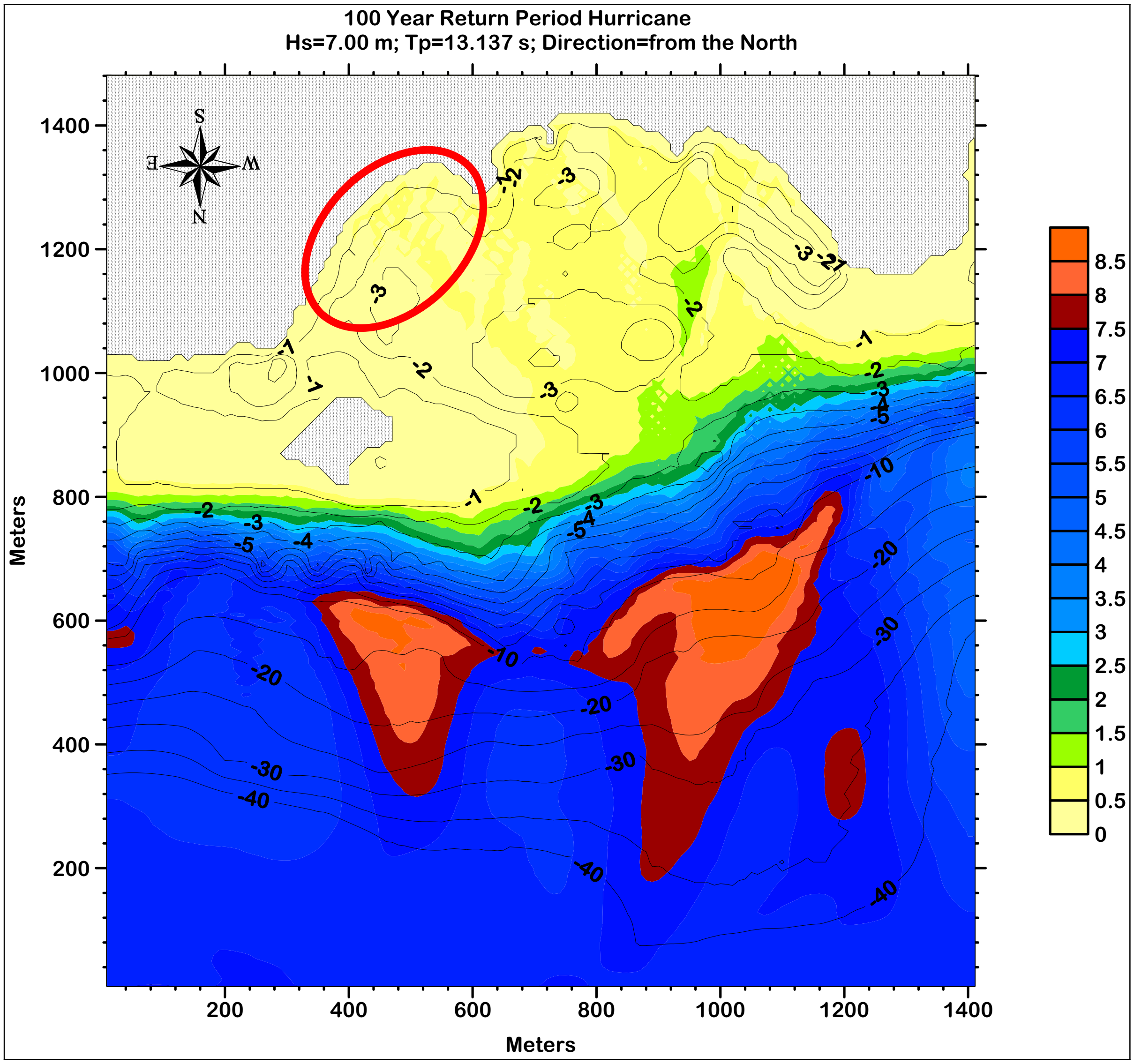

Figure 4.18 100 year return period wave heights at the project site (in red circle), for N incident hurricane waves

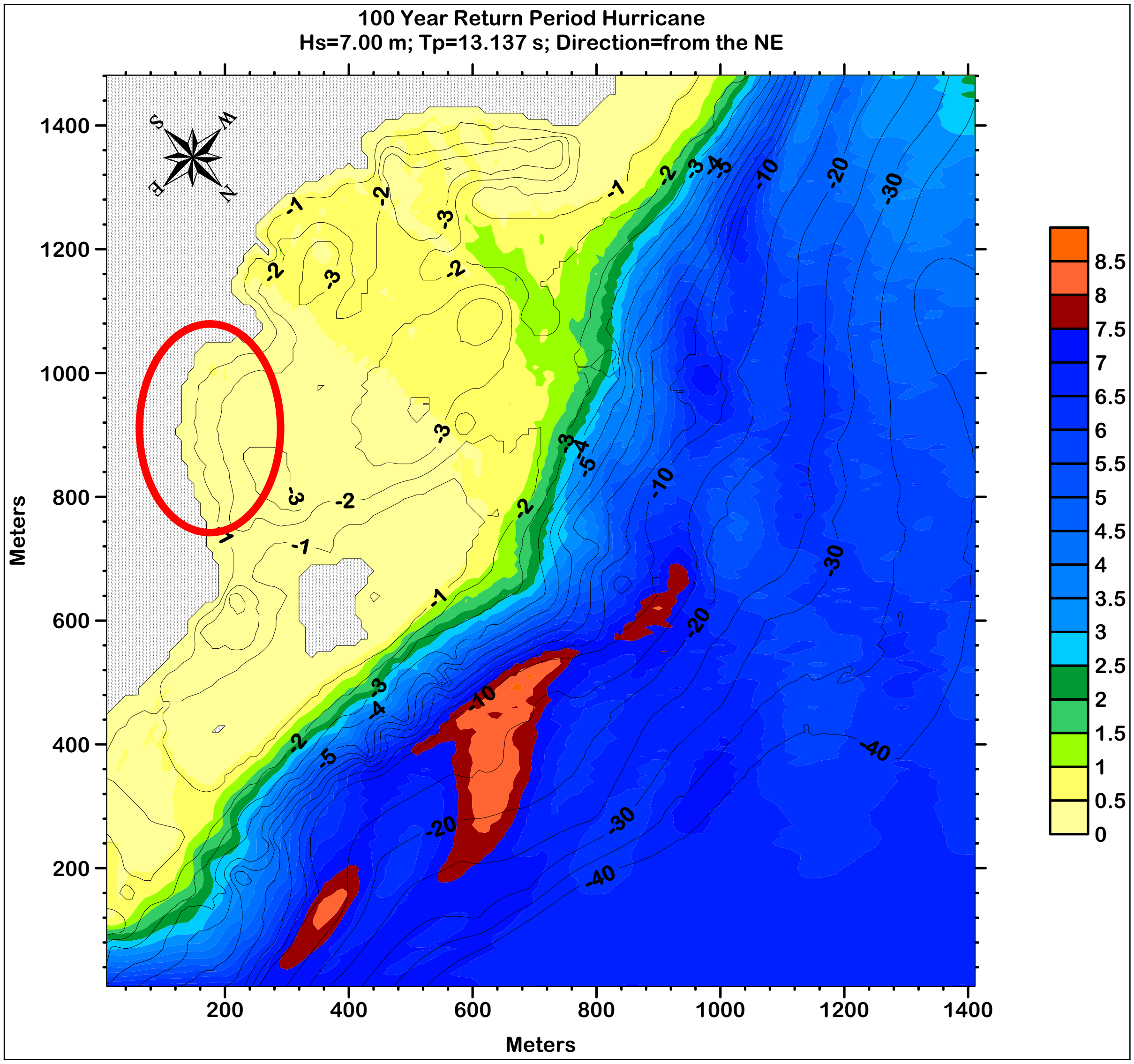

Figure 4.19 100 year return period wave heights at the project site (in red circle), for NE incident hurricane waves.

Storm Surge

The Extremal analysis conducted allowed for predictions to be made regarding the storm surge that would impact the site. The value for storm surge was derived from the combination of 'set up', as obtained from the extremal analysis in addition to the 'wave run up', obtained from the Cresswin numerical model. The north-westerly direction was assumed in the analysis and both 50 and 100 year return periods were analysed. The results of the analysis conducted are summarized in Table 4.9 below. The storm surge analysis revealed that wave heights can encroach on the shoreline up to approximately 300 meters inland at existing ground levels. This is shown in Figure 4.20 below.

Table 4.9 – Storm Surge results of 50 and 100 year return periods

Return Period	Set-up (IBR, Tide, GSLR, Wave set-up, Wind Set-up) (m)	Wave Run up (m)	Total Storm Surge (m)	Minimum Floor Levels (plus 30%) (m)
50 yr	1.15	0.55	**1.70**	2.21
100 yr	1.30	0.75	**2.05**	2.67

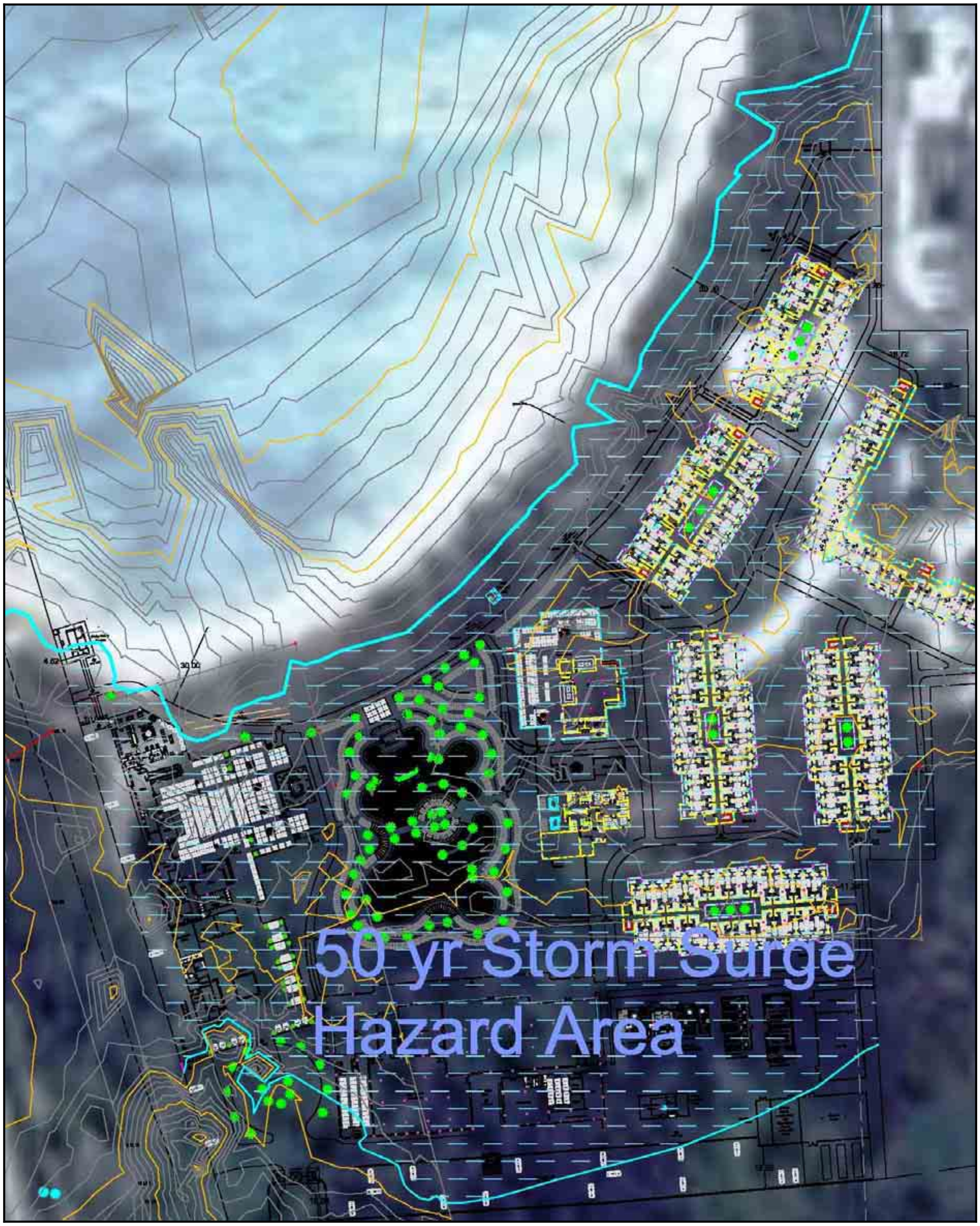

Figure 4.20 Site plan showing 50 yr storm surge hazard area on the existing ground levels

Erosion Analysis

Owing to the close proximity of the shoreline to the site, as well as the site location within an area of high wind speeds and wave energy as discussed previously, the site will be susceptible to erosion resulting from the encroachment of high energy waves on the site. Erosion, as defined in this analysis is not simply the superficial progressive destruction of the surface but rather the loss of any and all ground material as a result of the action of water on the site. As determined previously, the northerly and north-westerly directions were considered to be the most detrimental. Three (3) profile lines were drawn in each of these directions resulting in six (6) profiles along which the effects of wave energy on erosion were analysed. The location of these profile lines and the resulting erosion hazard zones are shown in Figure 4.21.

Graphs detailing the erosion results from SBEACH (Storm Induced Beach Change Model) for 50 year and 100 year storm events from the northerly and north-westerly directions along each profile line may be seen in Figure 4.22 to Figure 4.27.

The analysis indicates that the site could experience severe erosion loss in the range of 50 to 110 m behind the shoreline. This would occur in the event of the design storm episode, and as much as 280 mm (11 inches) of ground could be lost in some instances. It can be noted from Figure 4.21 that when the erosion regions are superimposed over the general hotel plan the areas of general concern arising are Block 6 in its entirety, as well as the northern portions of Block 5, the Chiringuito Restaurant and the main building.

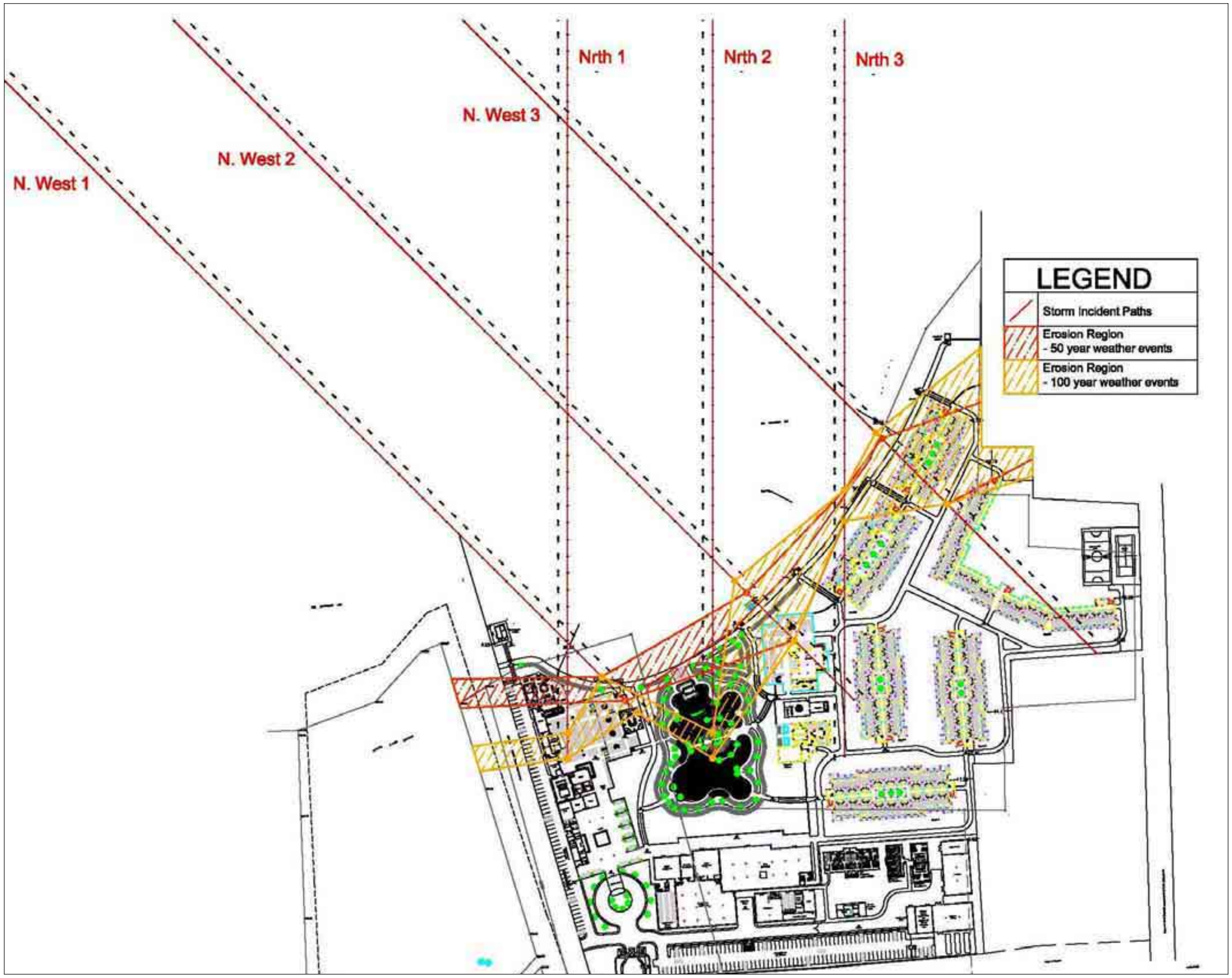

Figure 4.21 Proposed hotel site showing storm incident paths analysed, as well as resulting erosion hazard zones

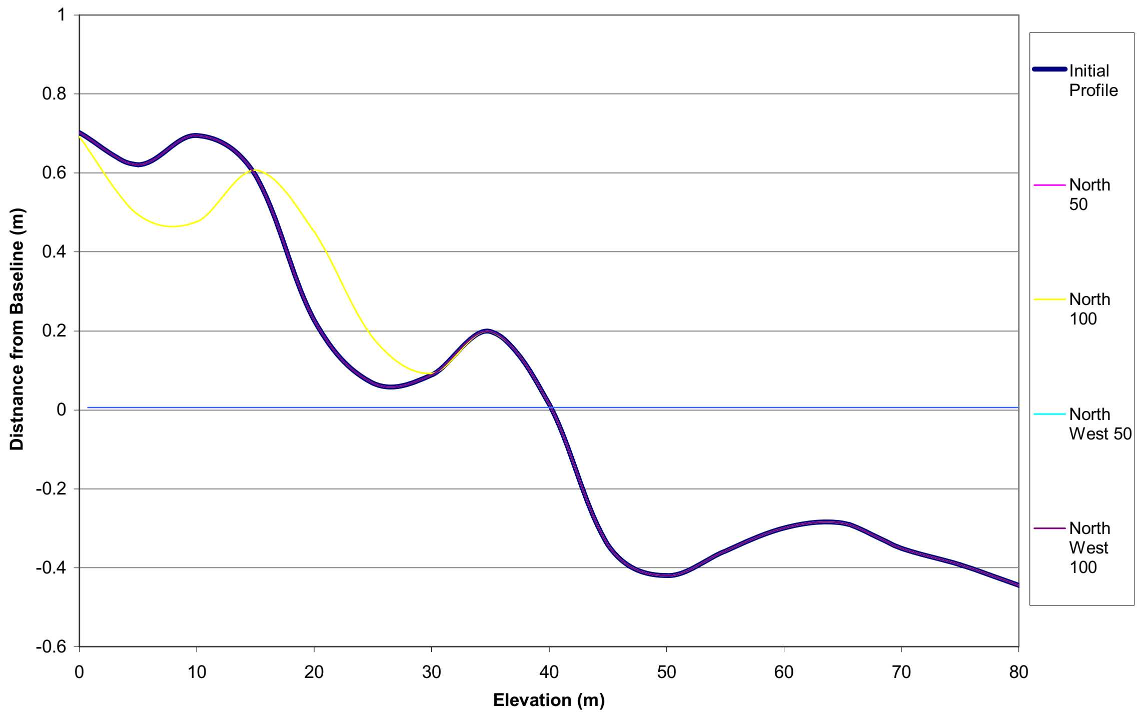

Figure 4.22 SBEACH erosion profile changes for Profile 1, northerly wave

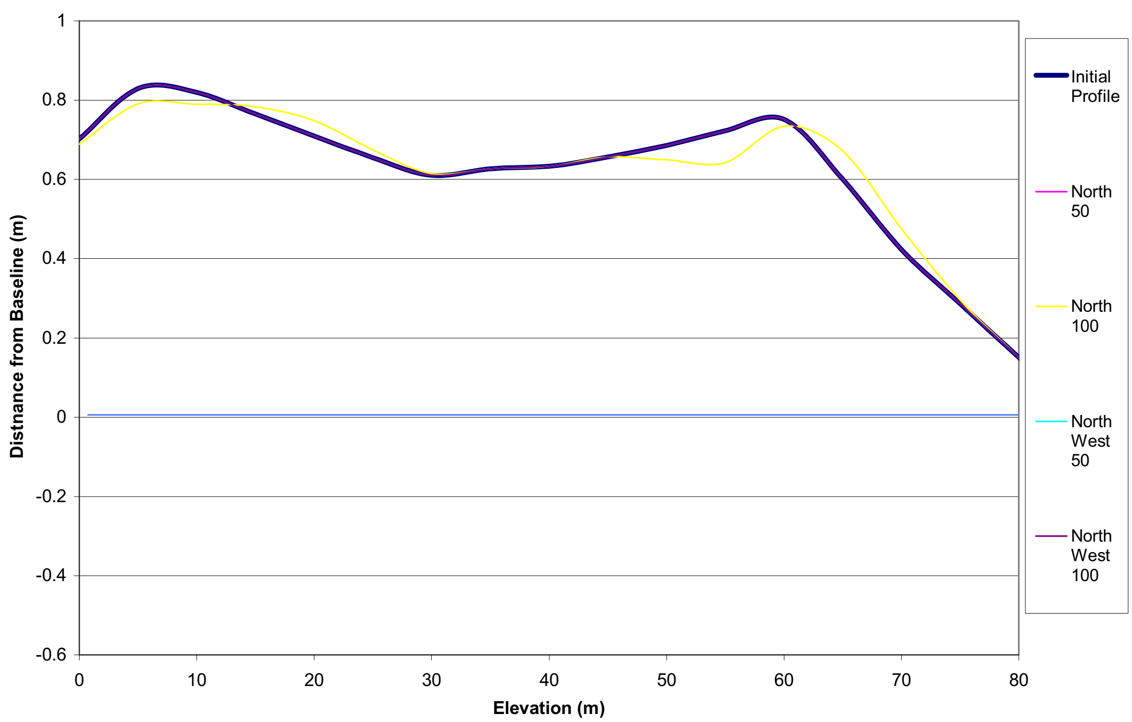

Figure 4.23 SBEACH erosion profile changes for Profile 2, northerly wave

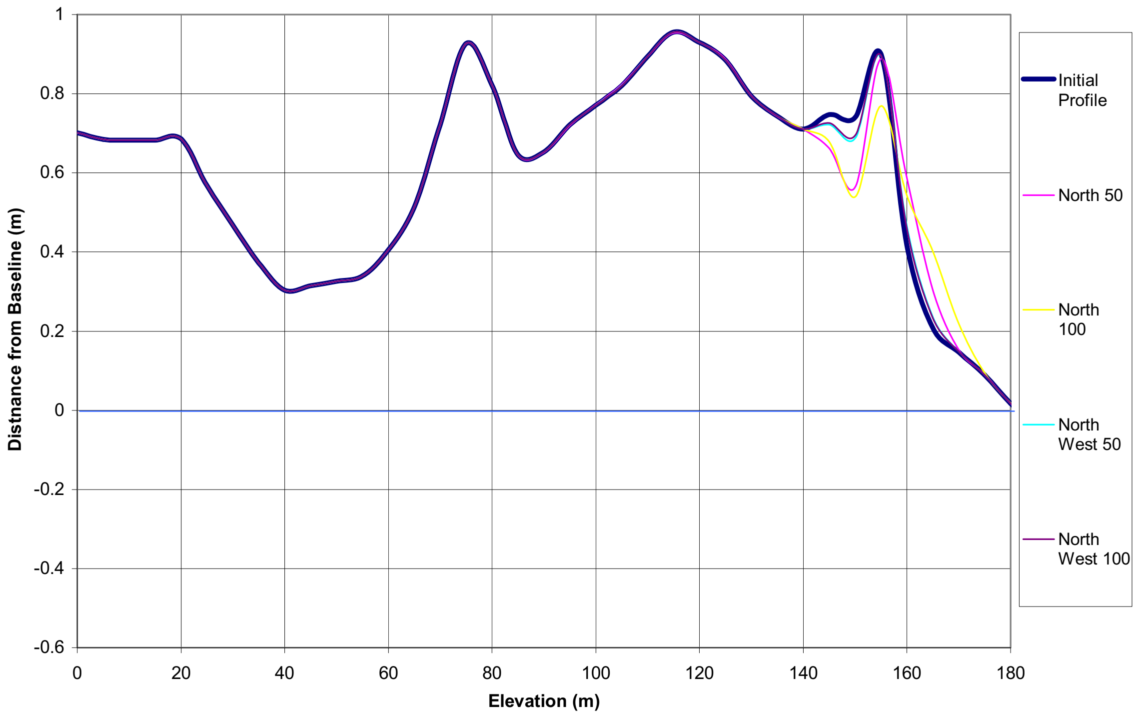

Figure 4.24 SBEACH erosion profile changes for Profile 3, northerly wave

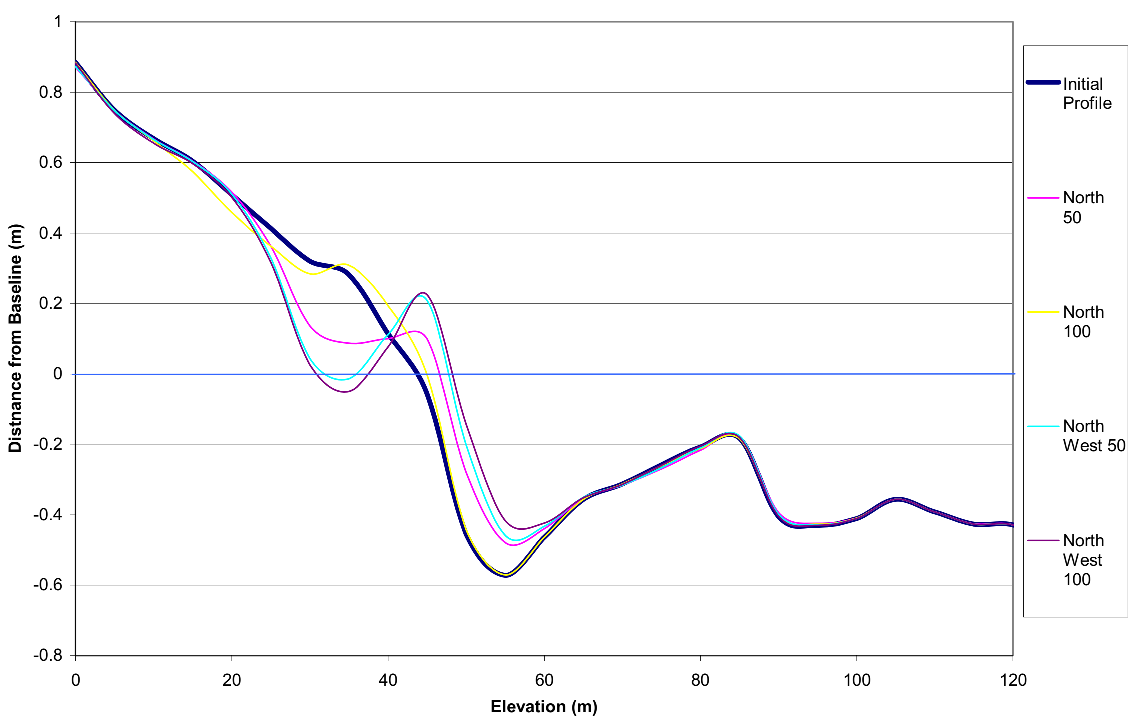

Figure 4.25 SBEACH erosion profile changes for Profile 1, north-westerly wave

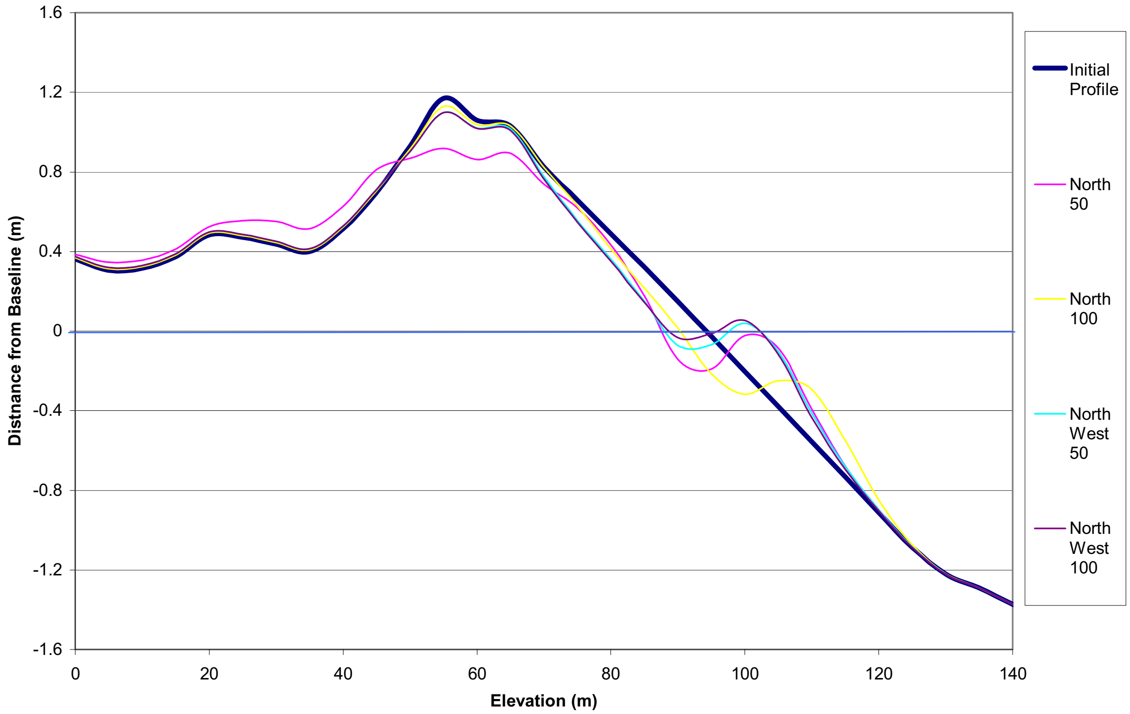

Figure 4.26 SBEACH erosion profile changes for Profile 2, north-westerly wave

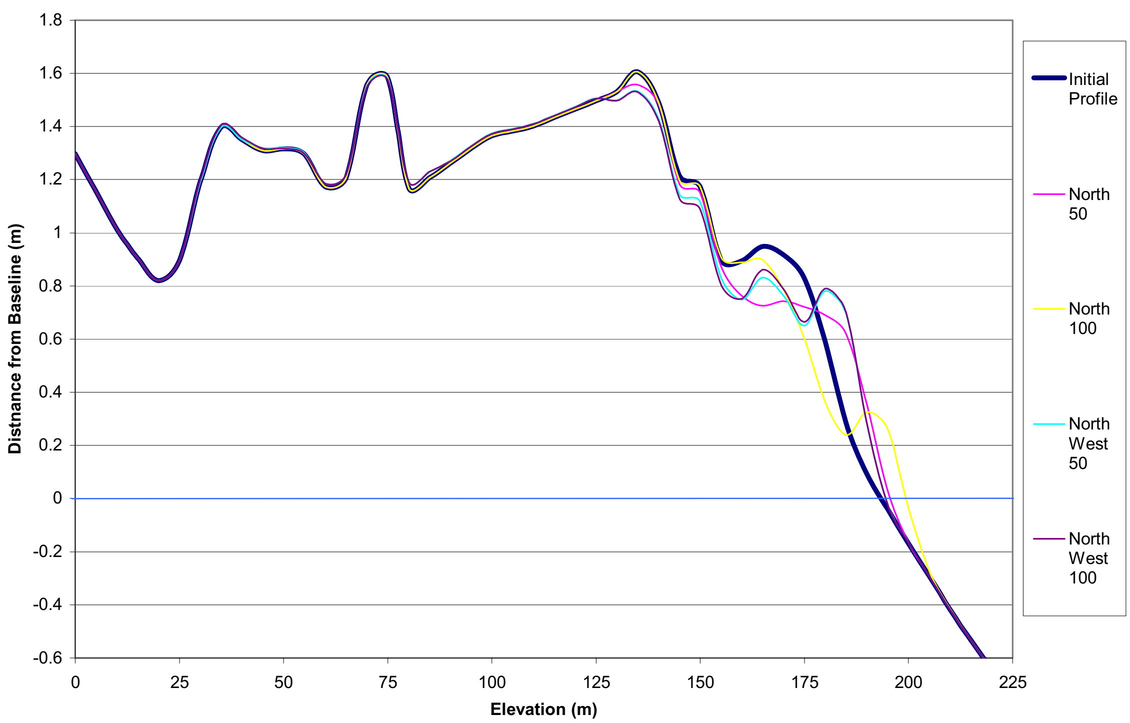

Figure 4.27 SBEACH erosion profile changes for Profile 3, north-westerly wave

4.4.2 *Riverine Flooding*

Elements on the proposed site could be highly vulnerable to flooding from the Salt Spring Gut, unless care is taken in the design and construction of the drainage system. The following features of the geology and geomorphology of the gully's catchment area are pertinent:

a) The existence of the alluvial fan over which the gully course runs is evidence of a regime of relatively frequent flooding at least over the past 12,000 years, intense enough to produce debris flows and fan building.

b) The present gully has cut down through the main fan deposits and is now depositing sediment closer to and within the area of the development site.

c) The sedimentary rocks of the catchment (Yellow Limestone sandstones and shaly siltstones) are highly erodible and form the main components of the gravels seen on the site.

d) The meteorological conditions over Jamaica are such that very intense rainfall events of short to medium duration are a common feature (Ahmad, 2003). A rainfall event of this kind precipitated the debris flow that caused flooding and debris accumulation at Rose Hall in April of 2005 (see www.mona.uwi.edu/cardin/virtual_library/docs/1131). Ahmad (2003) suggested that for rainfall of short (about 1 h) duration, intensities of > 36 mm/h are required to trigger landslides, while intensities of about 3 mm/h appear to be sufficient to cause land sliding as storm duration approaches 100 h.

Bearing the above features in mind, and the potential for increased storm water runoff owing to the development, flooding has the potential to be very hazardous to the proposed hotel.

4.4.3 *Earthquake*

Modified Mercalli Intensities for the 1957 earthquake reached VII to VIII in the Montego Bay area. At Ironshore, southeast of Mahoe Bay intensity VI was recorded. An intensity of V was reported for Salt Spring. Figure 4.28 reproduces the intensity map from Robinson et al. 1960. Although there are no first-hand accounts of the earthquake at Mahoe Bay, note that the location is more or less on the boundary of those areas where intensities of VI and VII were reported. Mahoe Bay lies within the zone of 5 to 9 earthquakes of MM VI or greater reported per century Shepherd & Aspinall, 1980).

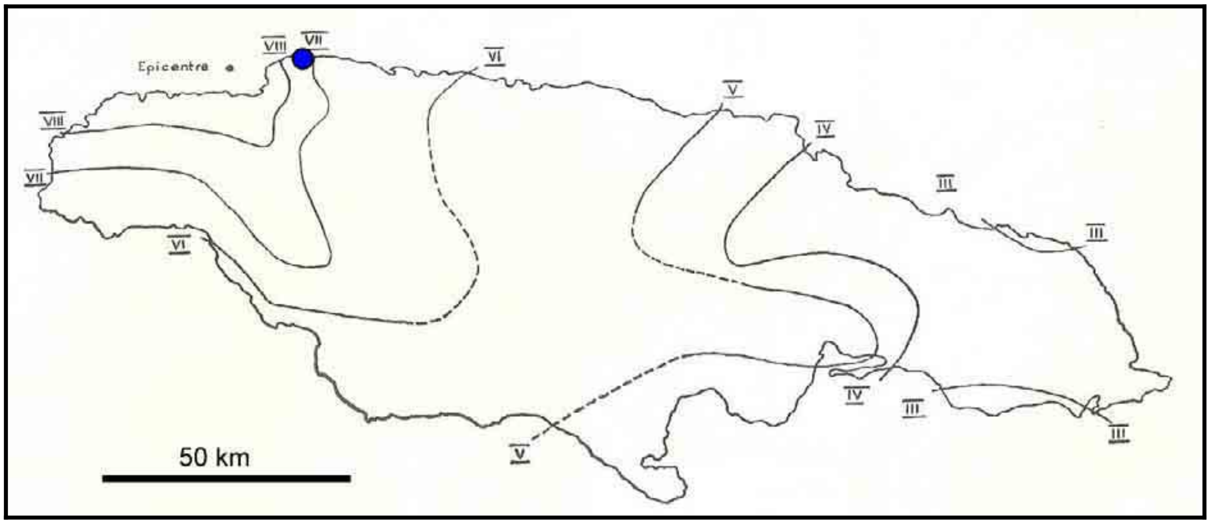

Figure 4.28 Modified Mercalli intensity map of Jamaica. The spot indicates the position of Mahoe Bay. Contour values are intensities (see Appendix D for intensity indicators).

4.4.4 *Tsunami*

Although tsunami (seismic sea waves) are rare for Jamaica, there are a number of records of their occurrence along the coast (Taber, 1920). The most recent of these was the event that accompanied the 1907 earthquake. Relatively detailed records of this event are available for the north coast between Port Antonio and St. Ann's Bay. At Annotto Bay, on the northeast coast, the maximum wave height may have reached as much as 8 metres (Tomblin & Robson, 1977). If this occurred at Mahoe Bay it would be sufficient to produce an inundation 300 to 500 m in from the coastline. Lead times for tsunami warnings are likely to be very short;

perhaps 10 minutes at most, as the sources of previous tsunami are to be found within the tectonically active Cayman Trench. In 1907 the tsunami arrived at the coast between three and nine minutes after the quake that generated it.

4.4.5 Long-term Sea Level Rise

Data from the Arctic Climate Impact Assessment report, released in mid-November, 2004, indicates the strong probability that more than half of the Arctic sea ice and a significant part of the Greenland ice cap will melt over the next hundred years (http://news.nationalgeographic.com). This could raise sea levels by up to 80 centimetres by the end of the century, and perhaps as much as 30 cm over the next 50 years (IPCC, 2001). This rise will be gradual, but the consequences of such a rise must be taken into consideration in construction.

4.4.6 Drainage Assessment

Preliminary hydrological studies have indicated the potential for the existing drain dividing the property to overtop its channel. Additionally, this drain impacts the aesthetics of the beach on the proposed property as during intense rainfall it carries silt, stones and garbage from the hinterland and deposits them along the beach area. The deposits of these have a direct impact on the water quality of the beach.

A detailed hydrological and flood plain study will be done.

4.5 Biological Resources

4.5.1 Terrestrial Flora

The coastline of Jamaica consists for the most part, of limestone rock or low-fringing coral shelves, which forms beaches, spits, cays and mud banks. These coastal communities exhibit three types of substratum, sand, limestone and coral rock and mud. The vegetation associated with each substratum, which provides a habitat for a diverse group of species, both terrestrial and marine, allows coastal communities to be classified into strand-beach, strand-dune, strand-scrub and stand-woodland associations (Asprey and Robbins, 1953).

Site A1

The site for the development of the ClubHotel RIU Montego Bay, which consisted of two lots (referred to as A1), was significantly cleared. The vegetation observed were mainly trees, with diameter at breast height (DBH) less than, equal to or greater than 18cm (Plate 4.5). Majority of the cleared areas and rarely, the under-storey (ground cover), was occupied by herbs and shrubs (Plate 4.6).

Plate 4.5 An example of the trees that dominated Site A1

Plate 4.6 Herbs and shrubs (indicated by arrow) observed in cleared areas

The substratum of A1 was mainly sand with rare occurrences of mud in water-logged areas. *Ipomoea pes-caprae* (Beach Morning Glory) and *Sporobolus virginicus*, pioneer species, as well as *Sesuvium portulacastrum* and *Heliotropium curassavicum*, were occasionally observed and are examples of the plants found in the strand-beach association. Representatives of the strand-dune association observed included, *Caesalpinia bonduc* (Grey Nickal), *Acacia tortuosa* (Wild Poponax) and *Spilanthes urens* (Pigeon Coop). *Morinda citrifolia* (Noni) and *Colubrina asiatica* (Hoop Withe) are examples of plants found in the strand-scrub association. The succession of the vegetation associations was not evident due to the prior clearance of the site.

The strand-woodland association, which was dominant, can be observed on many beaches around the island. *Coccoloba uvifera* (Sea Grape) and *Thespesia populnea* (Seaside Mahoe), examples of plants in this association were observed abundantly in conjunction with *Conocarpus erectus* (Button Mangrove) and *Dalbergia ecastaphyllum*. Other dominant trees observed were *Avicennia germinans* (Black Mangrove), *Laguncularia racemosa* (White Mangrove), *Leucaena leucocephala* (Lead Tree) and *Terminalia catappa* (West Indian Almond). West Indian Almond trees were observed in clumps and scattered throughout the site and on occasion, would form shade trees in association with others. Trees belonging to the family Palmaceae, such as *Roystonea* sp., *Bactris jamaicana* (Prickly Pole) Plate 4.7) and *Thrinax* sp. were rarely observed on-site.

Plate 4.7 *Bactris jamaicensis* (Prickly Pole) indicated by arrow

Herbs observed included *Heliotropium indicum* (Scorpion Weed), *Bidens pilosa* (Spanish Needle), *Momordica balsamina* (Cerasee) and *Cassia occidentalis* (Dandelion) to name a few.

A full listing of all flora observed at the proposed development site (Site A1) may be seen in Table 4.10 below. Of the total sixty-eight (68) species of flowering plants identified at this site, three (3) species are endemic, *Roystonea* sp., *Bactris jamaicana* (Prickly Pole), and *Thrinax* sp.

Table 4.10 Listing of floral species observed at the proposed development site (Site A1)

Scientific Name	Common Name	Status
Acacia tortuosa	Wild Poponax	
Achyranthes indica	Devil's Horse-Whip	
Ammannia sp.		
Asystasia gangetica		
Avicennia germinans	Black Mangrove	
?Bactris jamaicana	Prickly Pole	Endemic
Bambusa vulgaris	Bamboo	
Bidens pilosa	Spanish Needle	
Bidens pilosa var. *radiata*		
Borreria verticillata	Wild Scabious	
Caesalpinia bonduc	Grey Nickal, Nicker	
Capraria biflora	Goatweed	
Cassia occidentalis	Dandelion, Piss-a-bed, Stinking Weed, Wild Coffee	
Casuarina equisetifolia	Willow, Casuarina, Whistling Pine	
Cecropia peltata	Trumpet Tree	
Cenchrus ?echinatus		
Centrosema sp.		
Cleome viscose	Wild Caia	
Coccoloba uvifera	Sea Grape	
Colubrina asiatica	Hoop Withe	
Conocarpus erectus	Button Mangrove	
Crotalaria retusa	Rattleweed	
C. verrucosa	Blue Rattleweed	
Cyperus oxylepis		
Cyperus sp.		
Dalbergia ecastaphyllum		
Delonix regia	Poinciana, Flamboyant	
Euphorbia hirta		
E. hyssopifolia		
Guazuma ulmifolia	Bastard Cedar, Ba'ceda	

Scientific Name	Common Name	Status
Haematoxylum campecianum	Logwood	
Heliotropium curassavicum		
H. indicum	Scorpion Weed, Wild Clary	
Ipomoea pes-caprae	Beach Morning Glory	
Jatropha gossipiifolia		
Laguncularia racemosa	White Mangrove	
Lantana camara	White Sage, Wild Sage	
Leonotis nepetifolia	Christmas Candlestick	
Leucaena leucocephala	Lead Tree	
Ludwigia octovalvis		
Melicoccus bijugatus	Guinep	
Momordica balsamina	Cerasee	
M. charantia	Wild Cerasee	
Morinda citrifolia	Hog Apple, Noni	
Passiflora maliformis	Sweet Cup	
Passiflora sp.		
Physalis angulata	Winter Cherry, Wild Gouma	
P. cordata		
Pisonia aculeata	Cockspur	
Pluchea carolinensis	Wild Tobacco	
Portulaca oleracea	Pussley	
Ricinus communis	Oil Nut	
Roystonea sp.		Endemic
Samanea saman	Guango	
Sesuvium portulacastrum	Seaside Purslane	
Sida acuta	Broomweed	
Sida sp.		
Solanum torvum	Susumber, Gully Bean, Turkey Berry	
Sorghum halepense		
Spathodea campanulata	Flame-of-the-Forest, African Tulip Tree	
Spilanthes urens	Pigeon Coop	
Terminalia catappa	West Indian Almond	

Scientific Name	Common Name	Status
Thespesia populnea	Seaside Mahoe	
Thrinax sp.		Endemic
Vernonia cinerea		
Vigna sp.		
Waltheria indica	Raichie	
?*Zinnia* sp.		
Unknown		
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4		

Despite the prior clearance of Site A1, trees with a DBH equal to or greater than 18cm have been flagged for preservation and use in landscaping. These were:

- 86 West Indian Almond
- 28 Black Mangrove
- 28 Button Mangrove
- 25 *Guazuma ulmifolia* (Bastard Cedar)
- 16 *Haematoxylum campechianum* (Logwood)
- 14 *Samanea saman* (Guango)
- 13 Seaside Mahoe
- 6 Sea Grape
- 3 Wild Poponax
- 3 White Mangrove
- 2 *Casuarina equisetifolia* (Willow)
- 2 *Roystonea* sp.
- 1 *Thrinax* sp.

- 1 *Spathodea campanulata* (African Tulip Tree)
- 1 Species 2
- **Total = 229**

In addition to the trees equal to or greater than 18cm, other trees were marked to add to the aesthetics of the property. These trees were less than 18cm and included:

- 21 Button Mangrove
- 4 Black Mangrove
- 4 Palm seedlings (species unknown)
- 1 Seaside Mahoe
- **Total = 30**

Site A2

The adjacent property (referred to as A2) was also cleared (Plate 4.8). This site was formerly known as Caribbean Beach Park and the present state of the property is remnant of its previous use. The site also exhibited trees equal to or greater than 18cm, however, the numbers were less than those observed on Site A1. The cleared areas were mainly of the grasses *Cynodon dactylon* (Bermuda Grass) and *Panicum maximum* (Guinea Grass) intermixed with herbs and shrubs, which represented the under-storey (Plate 4.9).

Plate 4.8 Cleared areas observed on Site A2

Plate 4.9 Grass intermixed with herbs and shrubs (indicated by arrow)

The vegetation observed was similar to that observed on Site A1 except for the presence of agricultural crops, such as *Musa sapientum* (Banana), *Citrus sinensis* (Sweet Orange), *Annona muricata* (Sour Sop) and *Persea americana* (Avocado Pear). Traditional landscaping species of *Bougainvillea peruviana*, *Codiaeum variegatum* (Garden Croton) and *Nerium oleander* (Oleander) were also observed. The trees *Ficus aurea*, *Ficus* sp., *Spondias mombin* (Hog Plum) and the endemic, *Roystonea princeps* (Royal Palm, Swamp Cabbage) was also rarely observed on-site (Plate 4.10)

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Plate 4.10 Trees of *Roystonea princeps* observed on Site A2

Table 4.11 lists the forty-six (46) species identified at Site A2 (adjacent property). Of this, only one species, *Roystonea princeps*, is endemic to Jamaica.

Table 4.11 Listing of floral species observed at Site A2, Mahoe Bay

Scientific Name	Common Name	Status
Achyranthes indica	Devil's Horse-Whip	
Annona muricata	Sour Sop	
A. reticulata	Custard Apple	
Bambusa vulgaris	Bamboo	
Bidens pilosa	Spanish Needle	
Bougainvillea peruviana		
Cassia sp.		
Casuarina equisetifolia	Willow, Casuarina, Whistling Pine	
Catharanthus roseus	Periwinkle	
Centrosema sp.		
Citrus sinensis	Sweet Orange	
Codiaeum variegatum	Garden Croton	
Conocarpus erectus	Button Mangrove	
Cynodon dactylon	Bermuda Grass	
Cyperus sp.		
Emelia javanica	Cupid's Shaving Brush	
Eupatorium odoratum	Christmas Bush	
Ficus aurea		
Ipomoea pes-caprae	Beach Morning Glory	
Ipomoea sp.		
Laguncularia racemosa	White Mangrove	
Lantana camara	White Sage, Wild Sage	
Leucaena leucocephala	Lead Tree	
Musa sp.	Banana	
Nerium oleander	Oleander	
Panicum maximum	Guinea Grass	
Persea americana	Avocado Pear	
Phaseolus sp.		
Pluchea carolinensis	Wild Tobacco	
Rhynchelytrum repens	Natal Grass	
Roystonea princeps	Royal Palm, Swamp Cabbage	Endemic

Scientific Name	Common Name	Status
Ruella tuberosa	Duppy Gun	
Sesuvium portulacastrum	Seaside Purslane	
Sida sp.		
Sida urens		
Spondias mombin	Hog Plum	
Sporobolus indicus		
Sporobolus sp.		
Stachytarpheta jamaicensis	Vervine	
Stylosanthes hamata	Cheesy Toes	
Terminalia catappa	West Indian Almond	
Thespesia populnea	Seaside Mahoe	
Tridax procumbens		
Urechites lutea	Nightshade	
Urena lobata	Ballard Bush	
Waltheria indica	Raichie	
Unknown		
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4	Family - Lamiaceae	
Unknown 5		
Unknown 6		
Unknown 7		

The trees with a DBH equal to or greater than 18cm were flagged for preservation and use in landscaping;

- 9 Willow
- 9 *Ficus aurea*
- 4 West Indian Almond
- 4 Species 2

- 3 Royal Palm
- 2 *Ficus* sp.
- 2 Button Mangrove
- 2 Seaside Mahoe
- 1 Species 1
- 1 *Cassia* sp.
- 1 Avocado Pear
- 1 Hog Plum
- **Total = 39**

4.5.2 *Terrestrial Fauna*

Methodology

Sampling of avifauna was carried out between the hours of 7:00 & 9:00 am, on September 28, 2006, and 4:30 & 5:30 pm, on November 16, 2006. A point count sampling method was adopted to list the bird species seen or heard. Species not immediately identifiable, based on actual sightings and bird calls, were noted and field guides (Bond, 1990; Downer *et al*, 1990) were used to verify their identity. Given the relatively small extent of the project site, it was possible to walk through the entire proposed site and the survey was therefore conducted throughout the extent of the latter.

"Other fauna" was also surveyed and qualitatively recorded. In regards to crocodiles and turtles, special attention was paid to the beach (specifically for evidence of site use by the latter). A NEPA database of recorded crocodile, turtle and manatee siting and nesting areas (around Jamaica, over the last 25 years) was also consulted.

Avifauna

Eighteen (18) different species were observed, during the morning and evening counts (Table 4.12). A total of fifty-nine (59) individuals were observed, during both surveys.

Table 4.12 Avifauna observed at proposed site, Mahoe Bay

			NUMBERS		
FAMILY	**SPECIES NAME**	**COMMON NAME**	**28th Sept '06 7:00-9:00 am**	**16th Nov'06 4:30-5:30 pm**	**STATUS***
Ardeidae	*Bubulcus ibis*	Cattle Egret	6	-	VCR
Ardeidae	*Egretta thula*	Snowy Egret	3	2	CR
Charadriidae	*Charadrius wilsonia*	Wilson's Plover	1	4	CR
Columbidae	*Columbina passerina*	Common Ground Dove	3	-	VCWR
Columbidae	*Zenaida macroura*	Mourning Dove	4	1	CR
Cuculidae	*Crotophaga ani*	Smooth-billed Ani	5	1	CR
Emberizidae	*Dendroica palmarum*	Palm Warbler	-	1	CWV
Emberizidae	*Setophaga ruticilla*	American Redstart	-	1	CWV
Emberizidae	*Tiaris bicolor*	Black-faced Grassquit	2	-	CR
Emberizidae	*Quiscalus niger*	Greater Antillean Grackle	3	-	VCR
Fregatidae	*Egretta tricolor*	Tricoloured Heron	1	-	CR
Laridae	*Sterna maxima*	Royal Tern	-	3	CR
Muscicapidae	*Turdus aurantius***	White-chinned Thrush	1	-	VCR
Recurvirostridae	*Himantopus mexicanus*	Black-necked Stilt	-	4	CR
Tyrannidae	*Myiarchus stolidus*	Stolid Flycatcher	2	-	CR
Tyrannidae	*Myiarchus validus***	Rufous-tailed Flycatcher	4	-	UCR
Tyrannidae	*Myiopagis cotta***	Jamaican Elaenia	2	-	CR
Tyrannidae	*Tyrannus caudifasciatus*	Loggerhead Kingbird	2	3	CWR
TOTAL			**39**	**20**	

KEY:

CR	Common Resident	VCWR	Very Common Widespread Resident
CWR	Common Widespread Resident	UCR	Uncommon Resident
CWV	Common Winter Visitor		
VCR	Very Common Resident		

* Based on Downer & Sutton, 1990 ; ** Endemic species

Overall, species diversity was so low (i.e. only 18 different species of observed birds). The most plausible explanation for the low species diversity (and individual abundance numbers) is probably the correspondingly low habitat diversity and the overall nature of the floral habitat observed at the site. The proposed site is relatively disturbed and there are, therefore, few available habitats for concealment, foraging and nesting, other than within the tree canopy itself. As a result, the proposed site is considered less than ideal for supporting large and diverse bird populations. The marine/coastal species *Charadrius wilsonia* (Wilson's Plover), *Egretta tricolor* (Tricoloured Heron) and *Himantopus mexicanus* (Black-necked Stilt) were observed in the onsite gully. *Sterna maxima* (Royal Tern) was observed in flight.

Of the 18 different species observed, three (3) are reported as endemic to Jamaica. These were *Turdus aurantius* (White-chinned Thrush), *Myiarchus validus* (Rufous-tailed Flycatcher) and *Myiopagis cotta* (Jamaican Elaenia); and are discussed and described in greater detail in the remaining paragraphs that follow.

Endemic *Turdus aurantius* (White-chinned Thrush) is widespread and common throughout the island. It forages primarily on the ground for a wide range of prey including slugs, lizards, insects, berries, frogs, mice and even small birds. Its primary habitats are forests, woodlands, road edges, cultivated areas and gardens in mountains at mid and high elevations. It is regularly observed in lowlands and appears to be somewhat tolerant of disturbed vegetation, although it is less frequently observed at these elevations. (*T. aurantius* tends to be found at lower elevations during its non-breeding season which occurs most of the year.) This species breeds from May to July and typically builds its nest in a shrub, tree or at the base of a palm frond. Given the flight range of *T. aurantius*, and it's preferred mid to high elevation habitat, it is unlikely that the White-chinned Jamaican Thrush actually breeds and nests on the proposed hotel site. The site is most likely used primarily as a hunting and foraging ground for this species.

Myiarchus validus (Rufous-tailed Flycatcher) is a fairly common endemic tyrant flycatcher that is common to various forest types but primarily frequents moist forests and, to a lesser extent dry scrub and secondary forests. *M. validus* often perches beneath the forest canopy, among dense vegetation, from which it sallies for prey. This species feeds on fruit and insects, including cicadas, moths and butterflies. It breeds from April to July and typically builds a nest of grass and leaves in a shallow tree or stump cavity. Having said this, it is believed that *M. validus* primarily visits the project site for the purpose of hunting and foraging, rather than breeding and nesting.

Myiopagis cotta (Jamaican Elaenia) is also an endemic tyrant flycatcher that is uncommon, yet widespread, from lowlands to high mountains. It is most frequently found in wet forests at moderate elevations, but is also found in open woodlands, scrublands, shade coffee plantations and dry forests. It forages for insects, primarily by sallying out and picking them off nearby vegetation (while in flight). This species breeds from March to June and typically builds a well-concealed, cupped nest of plant materials. It is believed that *M. cotta* primarily visits the project site for the purpose of hunting and foraging, rather than breeding and nesting.

Other Fauna

In addition to avifauna, one species of crab was observed, namely *Uca pugnax* (Mud Fiddler Crab), along with dragonflies and two unidentified species of butterfly.

A search of a NEPA database of recorded crocodile, turtle and manatee siting and nesting areas (around Jamaica, over the last 25 years) revealed that no crocodiles, turtles or manatee frequent the project site. No turtles, turtle tracks or turtle nests were observed along the shoreline, or on the beach, of the site (during the site visit). The latter NEPA database of recorded turtle siting and nesting areas revealed that the closest (recorded) turtle nesting site is at Spring Bay (Falmouth), approximately 4 km east of the proposed hotel site. The closest (recorded) turtle siting (i.e. in the NEPA database) was in 1982, 0.8 km offshore of Success Beach (St. James), approximately 3 km northeast of the site. The species most commonly observed species was *Chelonia mydas* (Green Turtle).

4.5.3 Marine Community

Methodology

On September 27, 2006, nearshore and seagrass bed areas immediately offshore of the proposed Clubhotel RIU Montego Bay (Mahoe Bay) hotel site were assessed by means of a combination of underwater videography, fish counts and grab sampling. Figure 4.29 shows, (i) the location of the surveyed area, (ii) the layout/locations of the underwater video transect lines, and (iii) the location of the fish count/grab sample stations. Table 4.14 lists the locations of fish count/grab samples and Table 4.14 the start and end points of the video transects.

Ten (10) minute fish counts were conducted at the three (3) fish count/grab sample stations shown in Figure 4.29. Two grab samples per station were also collected at the latter. These were used to determine substrate type, and assist in the determination and identification of benthic biota, within the area of interest.

For the underwater video transect exercise, four (4) 50 m long video transects were filmed; three (3) at Beach 1 and one (1) at Beach 2 (see Figure 4.29). To facilitate the assessment, the transect rope was flagged every 10 meters (with duct tape) and the resulting video footage was used to determine the location and extent of the observed marine floral/faunal communities. The still photographic plates, included within this EIA report, were video captures along their respective video transect lines.

Finally, the coral reef and seagrass bed of the offshore fringing reef ecosystem of the Sandals Royal restaurant cay, was also assessed and photographed on November 16, 2006 by a combination of exploratory SCUBA diving, snorkelling, towed-diver transects and boat patrolling.

Table 4.13 Fish counts/grab samples location coordinates in JAD 2001

Fish Counts and Grab Stations #	JAD2001 GPS Coordinates (WGS84)	
	Easting	Northing
FC&G1	656912.366	707694.518
FC&G2	656836.838	707602.374
FC&G3	656635.933	707520.804

Table 4.14 The start and end points of the video transects coordinates in JAD 2001

Video Transects	JAD2001 GPS Coordinates (WGS84)	
	Start	End
VT1	656803.80 E 707618.59 N	656772.45 E 707588.87 N
VT2	656892.97 E 707618.59 N	656856.76 E 707650.48 N
VT3	656956.20 E 707721.81 N	656909.72 E 707741.27 N
VT4	656646.53 E 707487.81 N	656627.07 E 707535.90 N

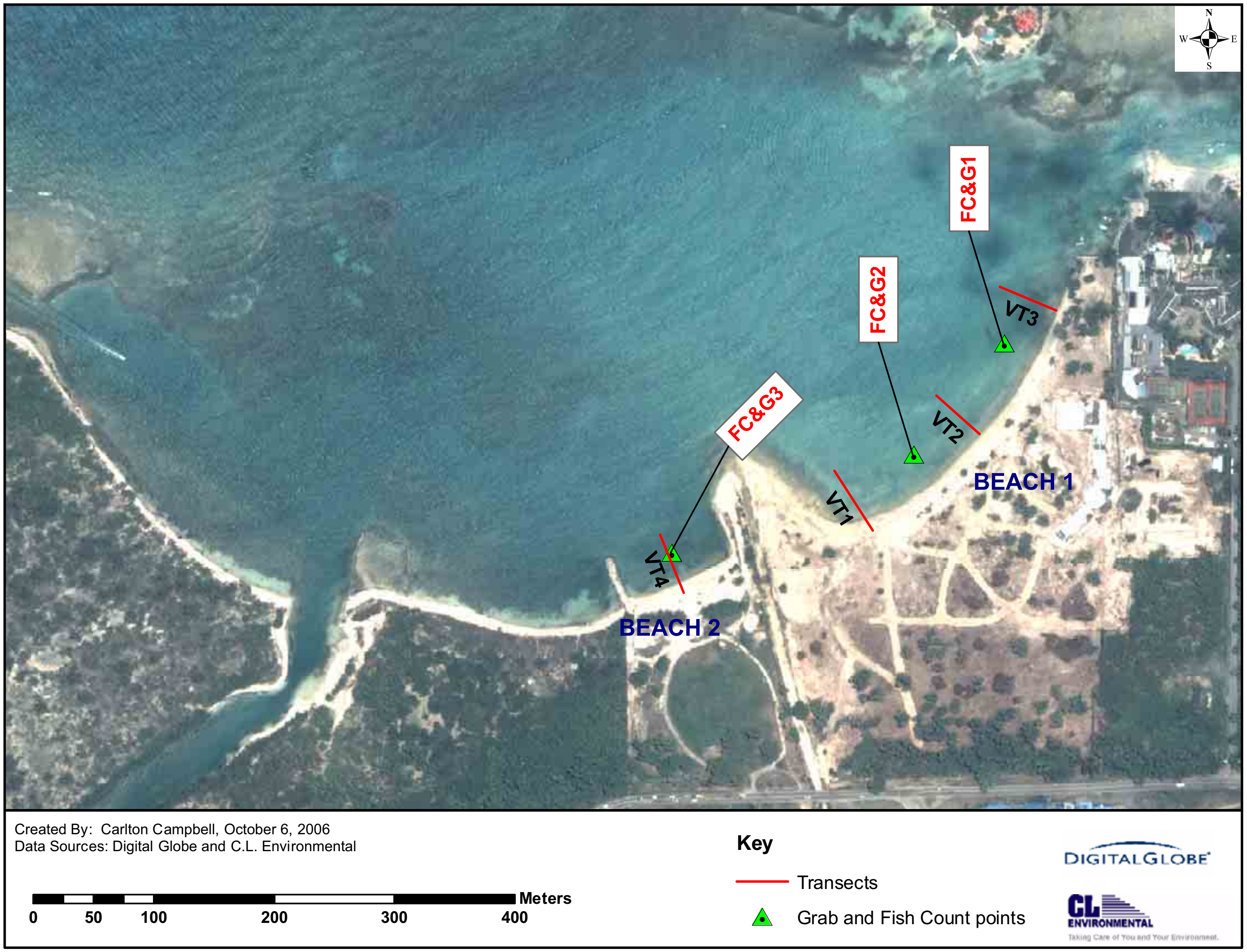


Figure 4.29 Map showing video transects, grab and fish count locations at Clubhotel RIU Montego Bay, Mahoe Bay, St. James

Seagrass/Nearshore Environment Immediately Offshore of the Proposed Site

Beach 1 Nearshore Environment - Summary

The first 0 m - 15 m segment of Beach 1 was comprised of either (i) bare sand, overlain by a relatively thin layer of silt/mud (Plate 4.11), OR (ii) bare sand/silty substrate, colonised by the occasional green and brown algae (Plate 4.12)

Beyond 15 m, the benthic environment gradually gave way to a seafloor environment colonised by either, (i) *Syringodium filiforme* beds (with a percentage coverage ranging between 30 % to 100 %; Plate 4.13 and Plate 4.14), or (ii) *S. filiforme* beds, colonised by algae and sparse *Thalassia testudinum*.

The only really evident *T. testudinum* bed was located in the northeastern section of Beach 1, along Transect 3 (Plate 4.15). Even so, it was only found at 28 m - 50 m offshore, growing on poor silt/mud substrate.

Plate 4.11 Beach 1 (Video Transect 1: 0 m - 15 m segment) – Bare sand substrate

Plate 4.12 Beach 1 (Video Transect 2: 0 m - 15 m segment) – Bare sand/silty substrate, colonised by insignificant green and brown algae

Plate 4.13 Beach 1 (Video Transect 1: 15 m - 27 m segment) – 70 % to 100 % cover *S. filiforme* seagrass substrate

Plate 4.14 Beach 1 (Video Transect 2: 20 m - 30 m segment) – 70 % to 80 % cover *S. filiforme* seagrass substrate

Plate 4.15 Beach 1 (Video Transect 3: 28 m - 50 m segment) – 80 % to 90 % cover *T. testudinum* seagrass substrate

This *T. testudinum* "bed" appeared to be under stress and it is considered impractical to attempt to remove and relocate it. Water clarity (i.e. underwater visibility), offshore of Beach 1, was extremely poor, and is probably contributing, to the reduced health of the observed nearshore seagrass.

The grab samples (i.e. G1 and G2), at Beach 1, supported the observations made during the video transect exercise; namely that the substrate, immediately offshore of Beach 1, is comprised of biogenic sand (i.e. *Halimeda sp.* fragments) and silt/mud. *T. testudinum* seagrass rhizomes, and an assortment of shells, were present in the G1 samples. In contrast, the G2 samples were comprised mainly of silt with only small amounts of biogenic sand. Seagrass leaf blades and rhizomes were notably absent within the samples.

No adult or juvenile fish were observed during the two (2) 10 minute fish counts at Beach 1 (see Figure 4.30). This suggests that the immediate offshore marine environment of the Beach 1 site (i.e. the *S. filiforme* and *T. testudinum* seagrass beds) play little or no role/function as a nursery (and does not contribute significantly to the ecology of the Mahoe Bay nearshore environment; i.e. in terms of feeding, habitat and a general nursery/safe-haven for juvenile fish).

Sand dollars (*Meoma ventricosa)* were occasionally observed within the seagrass beds (Plate 4.16).

Plate 4.16 Beach 1 (Video Transect 2) - Buried sand dollars (*Meoma ventricosa*)

Beach 2 Nearshore Environment - Summary

The first 0 m - 5 m segment of Transect 4 was typified by bare sand/silty substrate, colonised by the occasional green and brown algae (Plate 4.17). This type of benthic environment gradually gave way to a seafloor environment colonised by *S. filiforme* seagrass (from 5 m - 10 m). Percentage coverage of the *S. filiforme* seagrass sections of segment 5 m - 10 m was approximately 70 % to 80 % (Plate 4.18). Segment 10 m - 20 m was pretty much a continuation of the *S. filiforme* seagrass bed described for segment 5 m - 10 m. *S. filiforme* percentage coverage here was in the range of 70 % to 80 % (Plate 4.19). The occasional "blowout" was observed along this segment (Plate 4.20).

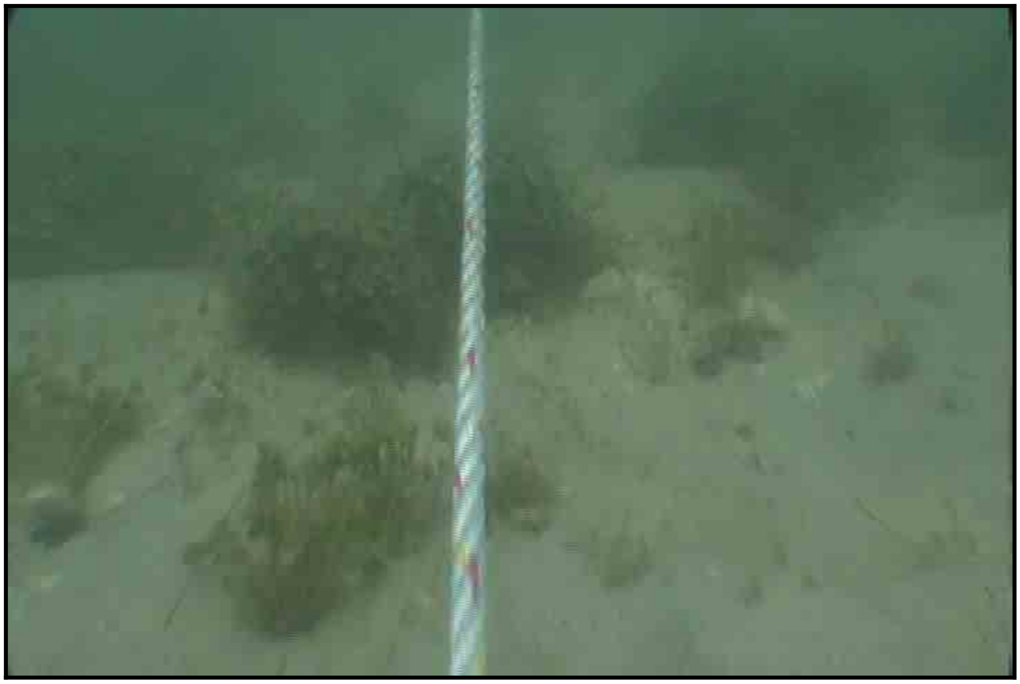


Plate 4.17 Beach 2 (Video Transect 4: 0 m - 5 m segment) – Bare sand/silty substrate, colonised by insignificant green and brown algae

Plate 4.18 **B**each 2 (Video Transect 4: 5 m - 10 m segment) – 70 % to 80 % cover *S. filiforme* seagrass substrate

Plate 4.19 Beach 2 (Video Transect 4: 10 m - 20 m segment) – 70 % to 80 % cover *S. filiforme* seagrass substrate

Plate 4.20 Beach 2 - The occasional "blowout" along the 10 m – 20 m segment of Video Transect Line 4

Segment 20 m - 30 m was a continuation of the *S. filiforme* seagrass bed described for segment 10 m - 20 m (Plate 4.21). From approximately 28 m, *T. testudinum* seagrass begins to intersperse the *S. filiforme* bed (Plate 4.22) until, at around the 30 m mark, *T. testudinum* begins to dominate, forming what might be considered a bed of *T. testudinum* which continues to the 50 m mark. Percentage coverage of the latter 30 m - 50 m *T. testudinum* seagrass was approximately 90 % to 100 % (Plate 4.23 and Plate 4.24). Water depth along the 30 m - 50 m *T. testudinum* seagrass segment was approximately 2 m – 3 m and the seagrass comprising the bed appears to be very healthy.

The grab samples at Beach 2 (i.e. G3) were comprised mainly of anoxic silt/mud with only trace amounts of biogenic sand (i.e. *Halimeda sp*. fragments). *T. testudinum* seagrass rhizomes were prevalent within the samples, indicative of a healthy, established, *T. testudinum* seagrass bed at the G3 grab station.

A number of juvenile fish were observed during the 10 minute fish count at this beach. Seven (7) different species, and a total of 31 individuals, were observed during the 10 minute count. Most of these (22 out of 31) were juveniles. Haemulidae (grunts) and Lutjanidae (snapper) dominated the species list (see Table 4.15).

Table 4.15 List of the fish species observed during the 10 minute fish count in the *T. testudinum* bed at Beach 2

FAMILY	SCIENTIFIC NAME	COMMON NAME	JUVENILES	ADULTS	TOTAL
Acanthuridae	*Acanthurus coeruleus*	Blue Tang	3	-	3
Chaetodontidae	*Chaetodon ocellatus*	Spotfin Butterflyfish	1	-	1
Haemulidae	*Haemulon aurolineatum*	Tomtate	7	2	9
Haemulidae	*Haemulon striatum*	Striped Grunt	6	4	10
Lutjanidae	*Lutjanus apodus*	Schoolmaster	3	-	3
Lutjanidae	*Lutjanus griseus*	Gray Snapper	1	3	4
Lutjanidae	*Ocyurus chrysurus*	Yellowtail Snapper	1	-	1
	TOTALS		**22**	**9**	**31**

Plate 4.21 Beach 2 (Video Transect 4: 20 m - 28 m segment) – 70 % to 80 % cover *S. filiforme* seagrass substrate

Plate 4.22 Beach 2 (Video Transect 4: 28 m - 30 m segment) – Interspersed *T. testudinum* and *S. filiforme* seagrass substrate

Plate 4.23 Beach 2 (Video Transect 4: 30 m - 40 m segment) – 90 % to 100 % cover *T. testudinum* seagrass bed

Plate 4.24 Beach 2 (Video Transect 4: 40 m - 50 m segment) – 90 % to 100 % cover *T. testudinum* seagrass bed

Water clarity (i.e. underwater visibility) was relatively good, compared with Beach 1. Sand dollars (*M. ventricosa)* were occasionally observed, within the *S. filiforme* and *T. testudinum* beds.

<u>The Fringing Reef Ecosystem at Mahoe Bay</u>

A shallow protective fringing reef with a back reef lagoon is located approximately 500 m north of the proposed RIU hotel site, in the vicinity of the Sandals Royal restaurant cay. This fringing reef is the closest defined coral reef to the project site.

The fringing reef is approximately 700 m long with maximum water depths of 13 m, 0.25 m and 0.5 m respectively on the fore reef, the reef crest and within the back reef lagoon. Substrate composition on the fore reef, reef crest and within its back reef lagoon is summarised within Table 4.16, and algal species observed during the SCUBA survey are listed in

Table 4.17. Lists of the coral, fish and invertebrate species, observed on the fore reef and within the back reef lagoon, are presented in Table 4.18, Table 4.19 and Table 4.20.

Table 4.16 Summary of substrate composition, on the Mahoe Bay fringing reef

Substrate Type*	**% Composition**		
	Deep Fore Reef	**Immediate Fore Reef/Reef Crest**	**Back Reef Lagoon**
SEAGRASS	0	0	90
ALGAE	10	60	5
CORAL (LIVING)	35	5	0
MACRO FAUNA	3	1	0
SPONGE	7	0	0
BASE SUBSTRATE	45	34	5

SUBSTRATE TYPE CODE*:

SEAGRASS	-	species or climax communities
ALGAE	-	turf or macrophytic
CORAL	-	branching, boulder or encrusting
MACRO FAUNA	-	other cnidarians; e.g. gorgonians, anemones or zoanthids
SPONGE	-	fleshy, boring or encrusting
BASE SUBSTRATE	-	bare rock, rubble, sand or mud

Table 4.17 Marine algal species observed on the Mahoe Bay fringing reef

Classification	Species	Deep Fore Reef	Immediate Fore Reef/Reef Crest	Back Reef Lagoon
Green Algae (Chlorophyta)	*Caulerpa racemosa*	X	X	
	Caulerpa cupressoides			X
	Ventricaria ventricosa			X
	*Dictyosphaeria cavernosa**			X
	Penicillus pyriformis	X		X
	Halimeda goreaui	X	X	
	Halimeda copiosa	X	X	
	Halimeda incrassate			X
	Halimeda opuntia		X	
Brown Algae (Phaeophyta)	*Dictyota cervicornis*	X	X	X
	Padina gymnospora			X
	Sargassum hystrix	X		
	Sargassum polyceratium	X	X	X
	Turbinaria turbinata		X	
Red Algae (Rhodophyta)	*Acanthophora spicifera**			X
	Gracilaria tikvahiae			X
	Galaxaura oblongata			X

Species marked by * are high nutrient indicating species.

Species marked by ** are reef building, red encrusting algal species.

The seaward (deep) fore reef of the Mahoe Bay fringing reef starts in approximately 13 m of water. It is typified by living and dead stony coral with negligible algal growth (Plate 4.25 and Plate 4.26). Boulder Star Coral (*Montastrea annularis*) and Sheet/Lettuce Coral (*Agaricia sp.*) were the dominant stony coral species on this section of the reef. Several species of sponge were also observed during the survey (see Table 4.20) and a number of sand channels were observed during the “offshore to inshore” SCUBA transect swim-thru (Plate 4.27 and Plate 4.28).

Table 4.18 List of the stony and soft coral species observed on Mahoe Bay fringing reef

Scientific Name	Common Name	Deep Fore Reef	Immediate Fore Reef/Reef Crest	Back Reef Lagoon
Stony Coral				
Acropora palmata	Elkhorn Coral	-	F	-
Porites porites	Finger Coral	O	-	-
Dendrogyra cylindrus	Pillar Coral	O	-	-
Madracis mirabilis	Yellow Pencil Coral	O	-	-
Montastrea annularis	Boulder Star Coral	D	A	-
Montastrea faveolata	Mountainous Star Coral	O	-	-
Montastraea cavernosa	Great Star Coral	F	R	-
Porites astreoides	Mustard Hill Coral	O	O	-
Siderastrea siderea	Massive Starlet Coral	O	O	-
Diploria strigosa	Symmetrical Brain Coral	F	D	-
Diploria clivosa	Knobby Brain Coral	-	O	-
Diploria labyrinthiformis	Grooved Brain Coral	R	-	-
Meandrina meandrites	Maze Coral	O	-	-
Agaricia lamarcki	Lamarck's Sheet Coral	A	-	-
Agaricia undata	Scroll Coral	A	R	-
Agaricia agaricites	Lettuce Coral	A	-	-
Isophyllastrea rigida	Rough Star Coral	R	-	-
Eusmilia fastigiata forma flabellate	Elongate Smooth Flower Coral	R	-	-
Fire Corals – Hydrocorals				
Millepora alcicornis	Branching Fire Coral	O	-	-
Millepora complanata	Blade Fire Coral	-	F	-
Gorgonians – Octocorals				
Erythropodium caribaeorum	Encrusting Gorgonian	R	-	-
Pseudoplexaura sp.	Porous Sea Rod	O	-	-
Eunicea succinea	Shelf-knob Sea Rod	O	-	-

Plexaurella sp.	Slit-pore Sea Rod	O	-	-
Pseudopterogorgia sp.	Sea Plume	F	R	-
Gorgonia ventalina	Common Sea Fan	F	F	-
Total Species = 26				

ABUNDANCE CODE:

D	-	Dominant	-	Numbers dominate the site
A	-	Abundant	-	Many individuals observed
F	-	Frequent	-	Individuals observed frequently
O	-	Occasional	-	Individuals observed a few times
R	-	Rare	-	Individuals observed once or twice

Plate 4.25 Seaward deep fore reef of the Mahoe Bay fringing reef

Plate 4.26 Seaward deep fore reef of the Mahoe Bay fringing reef

Plate 4.27 Typical sand channel within the deep fore reef of the Mahoe Bay fringing reef

Plate 4.28 Typical sand channel within the deep fore reef of the Mahoe Bay fringing reef

Table 4.19 List of the fish species observed on the Mahoe Bay fringing reef

Scientific Name	Common Name	Deep Fore Reef	Immediate Fore Reef/Reef Crest	Back Reef Lagoon
Chaetodon striatus	Banded Butterflyfish	F	-	-
Acanthurus coeruleus	Blue Tang	F	F	-
Haemulon parra	Sailors Choice	F	S	-
Ocyurus chrysurus	Yellowtail Snapper	S	-	-
Pomacentrus diencaeus	Longfin Damselfish	F	-	-
Pomacentrus planifrons	Threespot Damselfish	-	F	-
Abudefduf saxatilis	Sergeant Major	-	F	-
Chromis cyanea	Blue Chromis	F	-	-
Halichoeres garnoti	Yellowhead Wrasse	S	S	-
Thalassoma bifasciatum	Bluehead Wrasse	F	F	-
Holocentrus adscensionis	Squirrelfish	O	-	-
Holocentrus marianus	Longjaw Squirrelfish	-	-	-
Myripristis jacobus	Blackbar Soldierfish	O	-	-
Diodon holocanthus	Balloonfish	S	-	-
Total Species = 14				

ABUNDANCE CODE:

S	-	Single	-	One (1) sighting
F	-	Few	-	Two (2) to ten (10) sightings
M	-	Many	-	Eleven (11) to one hundred (100) sightings
A	-	Abundant	-	Over one hundred (100) sightings

Closer inshore, the deep fore reef begins to rise to a water depth of approximately 5 m and, in the transition zone from deep to shallow fore reef, Mustard Hill Coral (*Porites astreoides*) and Sheet/Lettuce Coral (*Agaricia sp.*) become the dominant stony coral species on "near vertical" shallow reef walls (Plate 4.29and Plate 4.30). Elkhorn coral (*Acropora palmata*) (Plate 4.31 and Plate 4.32) and the Fire Corals, *Millepora alcicornis* and *Millepora complanata,* begin to appear, and were observed periodically, within the immediate fore reef environment. Symmetrical Brain Coral (*Diploria strigosa*) was the dominant stony coral in the immediate fore reef area. Algal coverage was noticeably higher and dominant within this section of the reef, and on the reef crest (Plate 4.33 and Plate 4.34).

Plate 4.29 Near vertical shallow reef wall, dominated by Mustard Hill Coral (*Porites astreoides*) and Sheet/Lettuce Coral (*Agaricia sp.*)

Plate 4.30 Near vertical shallow reef wall, dominated by Mustard Hill Coral (*Porites astreoides*) and Sheet/Lettuce Coral (*Agaricia sp.*)

Plate 4.31 Elkhorn coral (*A. palmata*) on the immediate fore reef of the Mahoe Bay fringing reef

Plate 4.32 Elkhorn coral (*A. palmata*) on the immediate fore reef of the Mahoe Bay fringing reef

Plate 4.33 Immediate fore reef and reef crest of the Mahoe Bay fringing reef

Plate 4.34 Immediate fore reef and reef crest of the Mahoe Bay fringing reef

Table 4.20 List of the invertebrate species on the Mahoe Bay fringing reef

Scientific Name	Common Name	Deep Fore Reef	Immediate Fore Reef/Reef Crest	Back Reef Lagoon
Anemones				
Stichodactyla helianthus	Sun Anemone	-	S	-
Cnidarians				
Gymnangium longicauda	Feather Hydroid	F	-	-
Palythoa caribaeorum	White Encrusting Zoanthid	-	S	-
Ctenophores – Tentaculata				
Ocyropsis maculata	Spot-winged Comb Jelly	-	S	-
Echinoderms – Echinoidea				
Diadema antillarum	Long-spined Urchin	F	F	-
Echinometra viridis	Reef Urchin	F	F	-
Echinoderms-Holothuroidea				
Holothuria mexicana	Donkey Dung Sea Cucumber	-	-	S
Porifera- Demospongiae				
Aplysina lacunosa	Convoluted Barrel Sponge	F	-	-
Agelas conifera	Brown Tube Sponge	F	-	-
Niphates digitalis	Pink Vase Sponge	F	-	-
Xestospongia muta	Giant Barrel Sponge	F	-	-
Ircinia strobilina	Black-ball Sponge	F	-	-
Iotrochota birotulata	Green Finger Sponge	F	-	-
Agelas clathrodes	Orange Elephant Ear Sponge	F	-	-
Anthosigmella varians	Brown Variable Sponge	F	-	-
Siphonodictyon coralliphagum	Variable Boring Sponge	S	-	-
Total Species = 16				

ABUNDANCE CODE:

S	-	Single	-	One (1) sighting
F	-	Few	-	Two (2) to ten (10) sightings
M	-	Many	-	Eleven (11) to one hundred (100) sightings
A	-	Abundant	-	Over one hundred (100) sightings

Behind the reef crest, within the back reef lagoon, *T. testudinum* was the dominant marine species, accounting for 70 % - 100 % of benthic cover (Plate 4.35 and Plate 4.36).

Plate 4.35 Back reef lagoon of the Mahoe Bay fringing reef

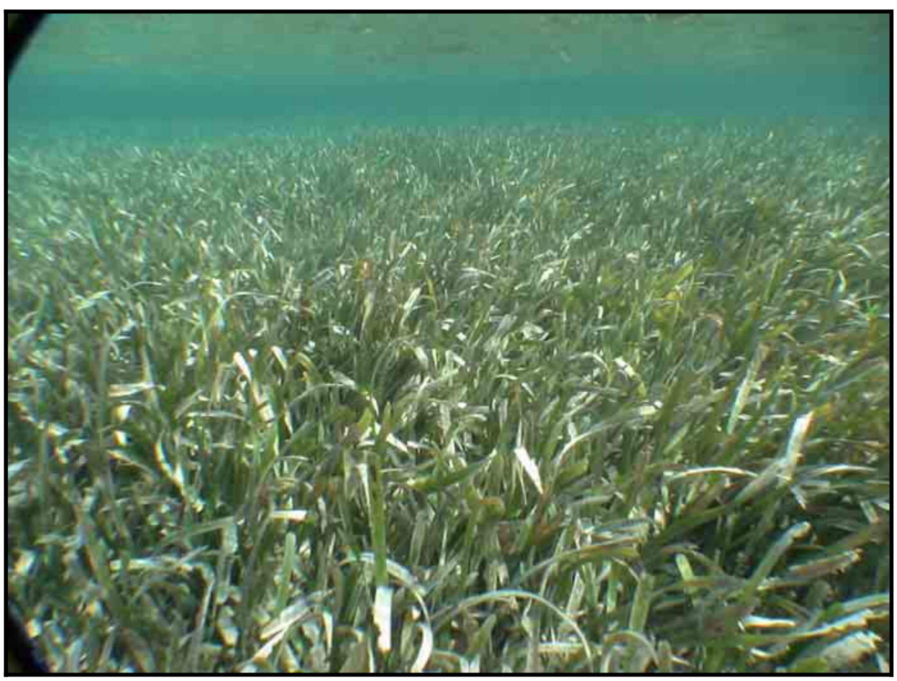


Plate 4.36 Back reef lagoon of the Mahoe Bay fringing reef

The back reef lagoon, itself, was approximately 100 m wide and protected from high wave energy by the fringing reef's reef crest. No sponges or corals were observed within it.

Overall, two (2) high nutrient indicating algal species were observed during the survey. These were the green algae *Dictyosphaeria cavernosa* and the red algae *Acanthophora spicifera*. The observed genus *Caulerpa* is also considered to be a low to moderate nutrient indicator species, by some authors. (Two different species of *Caulerpa* were observed on the fore reef, during the survey.) No sea turtles or sea lobsters were observed during the survey. However, a Sharptail Eel (*Myrichthys breviceps*) was seen and photographed on the deep fore reef (Plate 4.37).

Plate 4.37 Sharptail Eel (*Myrichthys breviceps*) observed and photographed on the deep fore reef

4.6 Water Quality

4.6.1 Marine Water Quality

Marine water quality monitoring exercise was conducted at seven (7) stations in the first instance and was increased to eight (8) stations in the other two sampling runs. The parameters monitored are listed in Table 4.21 and their locations in JAD2001 are listed in

Table 4.22 and depicted in Figure 4.30. Water quality samplings were conducted on September 27th, October 26th and November 16th, 2006.

Temperature, salinity, dissolved oxygen and pH were collected in situ using a Yellow Springs Instruments (YSI) model 556 multi probe meter. Whole water samples were collected at a depth of approximately 0.5 m; this was facilitated with the use of a boat. Samples were collected in pre-cleaned 1L plastic bottles. Bacterial samples were collected in sterilised 100 ml bottles at abovementioned depth. Fats Oil and Grease samples were collected in glass bottles. The samples were stored on ice in a cooler and transported to Environmental Technical and Analytical Services for laboratory analyses.

Table 4.21 Water quality parameters monitored

Temperature (^{o}C)	Ortho-phosphates (mg/l)
Salinity (ppt)	Total Suspended Solids (mg/l)
Dissolved Oxygen (mg/l)	Fats Oil and Grease (FOG) (mg/l)
pH	Faecal Coliforms (MPN/100ml)
Nitrates (mg/l)	

Table 4.22 Water quality stations coordinates in JAD 2001

Water Quality Stations	JAD2001 GPS Coordinates (WGS84)	
	Easting	Northing
WQ 1	656996.234	707805.745
WQ 2	656855.570	707667.549
WQ 3	656680.357	707633.000
WQ 4	656631.001	707524.418
WQ 5	656344.738	707524.418
WQ 6	656579.178	707786.003
WQ 7	656186.800	708380.246
WQ 8	656985.383	707335.678

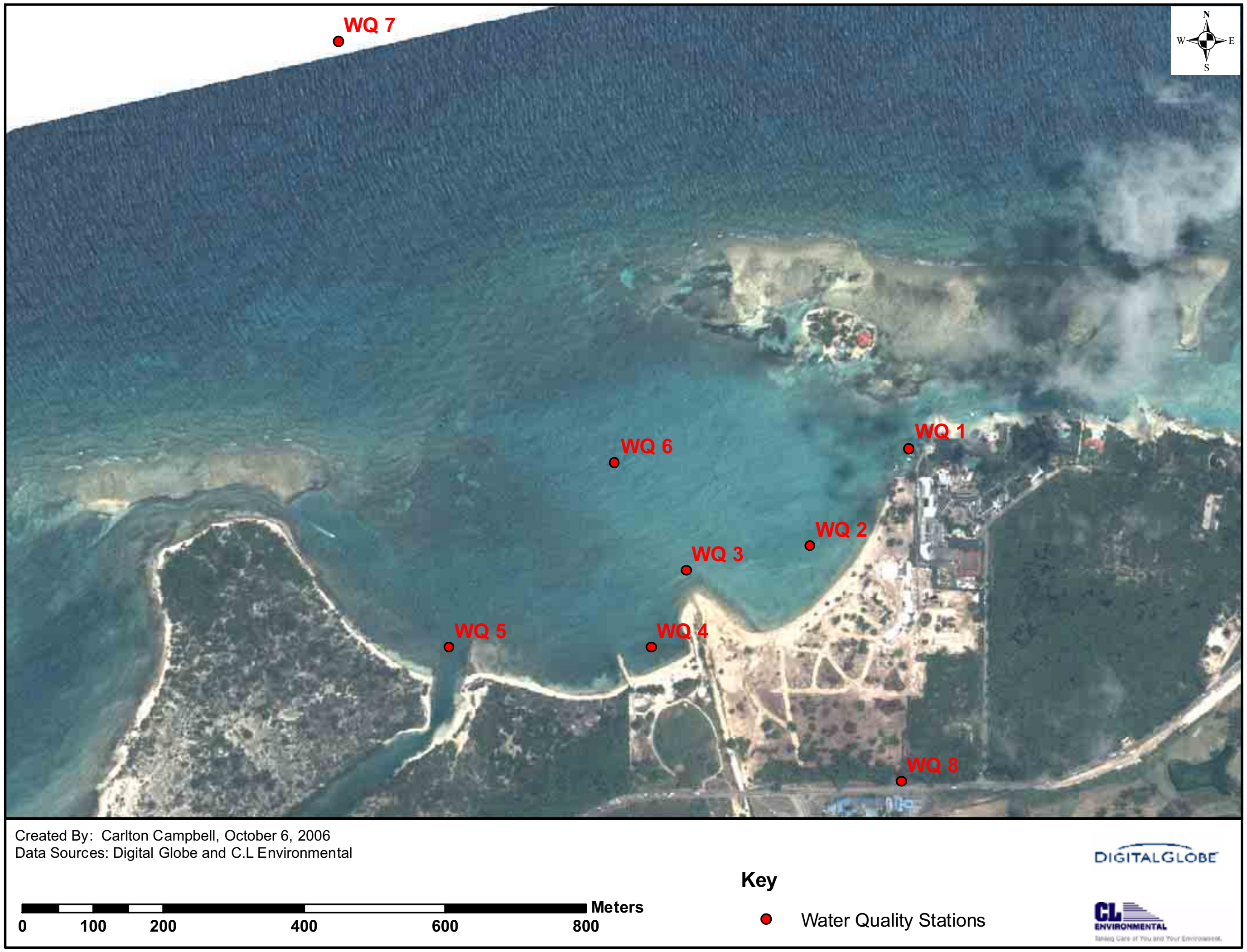


Figure 4.30 Map depicting the water quality stations at Clubhotel RIU Montego Bay, Mahoe Bay, St. James

Average temperature ranged from a low of 26.30 °C (station WQ 8) to a high of 29.95 °C (station WQ 3). The average temperatures, except for the temperature at station WQ 8 (a drain) are considered normal for tropical marine waters influenced by the Trade Winds. The average temperature at station WQ 8 (26.30 °C) is indicative of the temperatures of freshwater.

The average salinity levels were generally within acceptable levels for marine waters. The marine stations had a low salinity of 34.98 ppt (station WQ 1) to a high of 35.31 ppt (station WQ 7). At station WQ 8, the average salinity was 0.54 ppt indicating freshwater.

The average dissolved oxygen levels at the marine stations were generally below acceptable levels (5 mg/l) except for station WQ 7 (5.68 mg/l). These levels are however above the critical level of 3 mg/l when fish and other marine life would become extremely stressed. The levels at the marine stations ranged from 4.32 mg/l (station WQ 5) to 5.68 mg/l (station WQ 7). Station WQ 8 (0.92 mg/l) had extremely low average dissolved oxygen levels.

The average pH levels at all the stations were all within acceptable levels, complying with the NEPA and Blue Flag standards of a lower limit of 6.5 and an upper value of 8.5. As was expected station WQ 8 (the drain) had the lowest pH of 7.23 (almost neutral) and station WQ 7 (8.26) had the highest.

All stations exceeded the NEPA (0.1 mg/l) and Blue Flag (0.6 mg/l) standards for nitrate, with station WQ 1 having the lowest average nitrate concentration of 0.88 mg/l and station WQ 8 (the drain) the highest of 16.28 mg/l, exceeding the standards by at least twenty sevenfold. It should be noted that some of the samples were below the detection limit (< 0.76 mg/l).

Average phosphate values were all above the NEPA standard (0.01 mg/l) for all stations. With the exception of stations WQ 1 (0.14 mg/l) and WQ2 (0.16 mg/l) (close to the Blue Flag standard) and WQ 8 (9.83 mg/l), all other stations complied with the Blue Flag standard. The lowest average concentration was found at station WQ 5 (0.03 mg/l) and the highest at station WQ 8 (9.83 mg/l). It should be noted that some of the samples were below the detection limit (< 0.02 mg/l).

The Massachusetts Department of Environment (MDE) 2002 Integrated List of Water Standards recommends maximum suspended solids concentration of 25 mg/l to prevent damage to aquatic life. Four stations had average TSS values that were not compliant with this standard (25 mg/l). These were stations WQ 1 (74.2 mg/l), WQ 3 (95.9 mg/l), WQ 4 (73.2 mg/l) and WQ 8 (818.5 mg/l). The lowest average concentration was at station WQ 5 (10.3 mg/l) and the highest station WQ 8 (818.5 mg/l).

The fats, oil and grease level ranged from a low of 1.9 mg/l (station WQ 6) and a high of 3.4 mg/l at station WQ 5. The stations with the two highest levels were stations WQ 5 (3.4 mg/l) and WQ 8 (3.2 mg/l). These recorded for all stations except stations were all within what is considered an acceptable level <2 mg/l.

Average faecal coliform levels at all stations were all compliant with the NEPA standard (100 MPN/100 ml) except for station WQ 8 (≥ 2,400 MPN/100 ml).

From the results of the water quality sampling, the marine water quality within proximity to the proposed site is slightly mesothrophic, with the waters being phosphate limited.

Station WQ 8 is of concern as the waters are coming from freshwater source(s) external to the site which have high, nitrates, ortho-phosphates, total suspended solids fats oil and grease and the only point of non-compliant faecal coliforms. It also has extremely low dissolved oxygen. These factors results in an input loaded with nutrients, suspended solids and a high offensive odour.

Plate 4.38 Collage showing views of the drain (WQ 8) on Clubhotel RIU Montego Bay, St. James

Plate 4.39 View of the drain just south of the Clubhotel RIU property before entering the property

Table 4.23 Summary data of the water quality sampling regime at Clubhotel RIU, Montego Bay, St. James

STNS	TEMP (°C)			SAL (ppt)			DO (mg/l)			pH			NO_3 (mg/l)			PO_4 (mg/l)			TSS (mg/l)			FOG (mg/l)			F. Coli. (MPN/100ml)		
	S	O	N	S	O	N	S	O	N	S	O	N	S	O	N	S	O	N	S	O	N	S	O	N	S	O	N
1	29.82	30.38	28.23	35.17	34.95	34.82	4.75	5.59	4.58	8.1	8.23	8.20	0.88	< 0.76	0.88	<0.02	0.14	0.05	181.66	35	6	3.07	2.2	2.0	<3	3	9
2	29.91	30.37	28.96	35.31	35.15	34.91	3.76	4.38	4.90	8.08	8.18	8.20	1.32	< 0.76	2.20	0.34	0.05	0.08	12.16	13	14	2.93	3.8	0.80	<3	<3	<3
3	30.25	30.47	29.13	35.32	35.16	34.95	4.85	4.59	5.20	8.1	8.18	8.23	1.32	0.88	0.88	0.12	0.06	<0.02	259.61	18	10	4.8	1.6	1.10	<3	<3	<3
4	30.1	30.53	29.04	35.29	35.06	34.90	4.69	4.41	4.90	8.07	8.16	8.18	1.32	1.76	0.88	0.03	< 0.02	0.17	201.6	6	12	2.53	2.4	1.20	<3	9	<3
5	29.99	30.31	29.17	35.34	35.07	35.06	3.6	4.51	4.86	8.03	8.13	8.19	0.88	< 0.76	1.32	0.02	0.05	0.03	11.86	10	9	4.0	4.2	1.88	<3	<3	<3
6	29.94	30.22	28.97	35.34	35.16	34.95	4.14	4.58	4.86	8.09	8.19	8.24	1.32	< 0.76	2.20	<0.02	< 0.02	0.04	17.89	11	9	1.87	2.2	1.60	<3	<3	<3
7	30.23	29.94	29.45	35.39	35.38	35.16	5.44	5.54	6.07	8.21	8.27	8.31	1.32	1.32	0.88	<0.02	0.04	<0.02	15.67	12	5	3.69	3.0	1.40	<3	<3	<3
8	ND	28.15	24.44	ND	0.38	0.69	ND	1.56	0.27	ND	7.62	6.84	ND	5.72	26.84	ND	7.10	12.55	ND	762	875	ND	3.8	2.53	ND	≥ 2400	≥ 2400

TEMP. = Temperature **DO = Dissolved oxygen** **NO_3 = Nitrates** **TSS = Total suspended solids** **F. Coli. = Faecal coliforms**

SAL = Salinity **pH = pH** **PO_4 = Ortho- phosphates** **FOG = Fats, oils and grease**

NB: S = September 27th, O = October 26th and N = November 16th, 2006

4.6.2 *Ground Water*

There are no springs within 5 km of the proposed site. There are however twelve (12) licensed wells within this area. These are listed in Table 4.24 below and depicted in Figure 4.31.

Table 4.24 Wells within 5 km of the proposed site

LOCATION	EASTINGS	NORTHINGS	DEPTH OF WELL (m)	RESTING WATER DEPTH (m)	PRINCIPAL SUBSTRATE
Rose Hall 2	660352.210	706802.793	45.72	-	Clay
Rose Hall 3	661785.214	706924.788	50.29	-	Clay
Rose Hall 5 (Deep well 2)	661663.210	706284.790	115.82	-	-
Riverhead West	661683.213	705589.789	109.73	-	Limestone
Salt Spring CH	659011.205	704851.785	91.44	16.76	Yellow Limestone
Ironshore Estate	657289.201	706939.790	28.96	18.90	Limestone
Green Pond CH	657426.199	702840.779	33.53	22.56	Montpelier Limestone
Ironshore Estates No. 1	658326.205	707366.793	35.05	24.99	Limestone
Ironshore Estate	658249.202	707275.790	48.46	24.99	Limestone
Glendevon CH	655537.197	703465.784	39.62	30.18	Limestone
Rose Hall 1	659987.208	707229.791	38.10	31.70	Limestone
Rose Hall 4	659987.205	707107.789	51.82	39.01	Limestone

Historical water quality data for the Ironshore well (1) indicated that the groundwater was non compliant with the NEPA ambient water quality standards in seven of the thirteen parameters measured (Table 4.25). The levels of chlorine, nitrates, potassium, sodium, conductivity and total dissolved solids were the non-compliant parameters. The data shows some indication of saline intrusion. It also is phosphate limited.

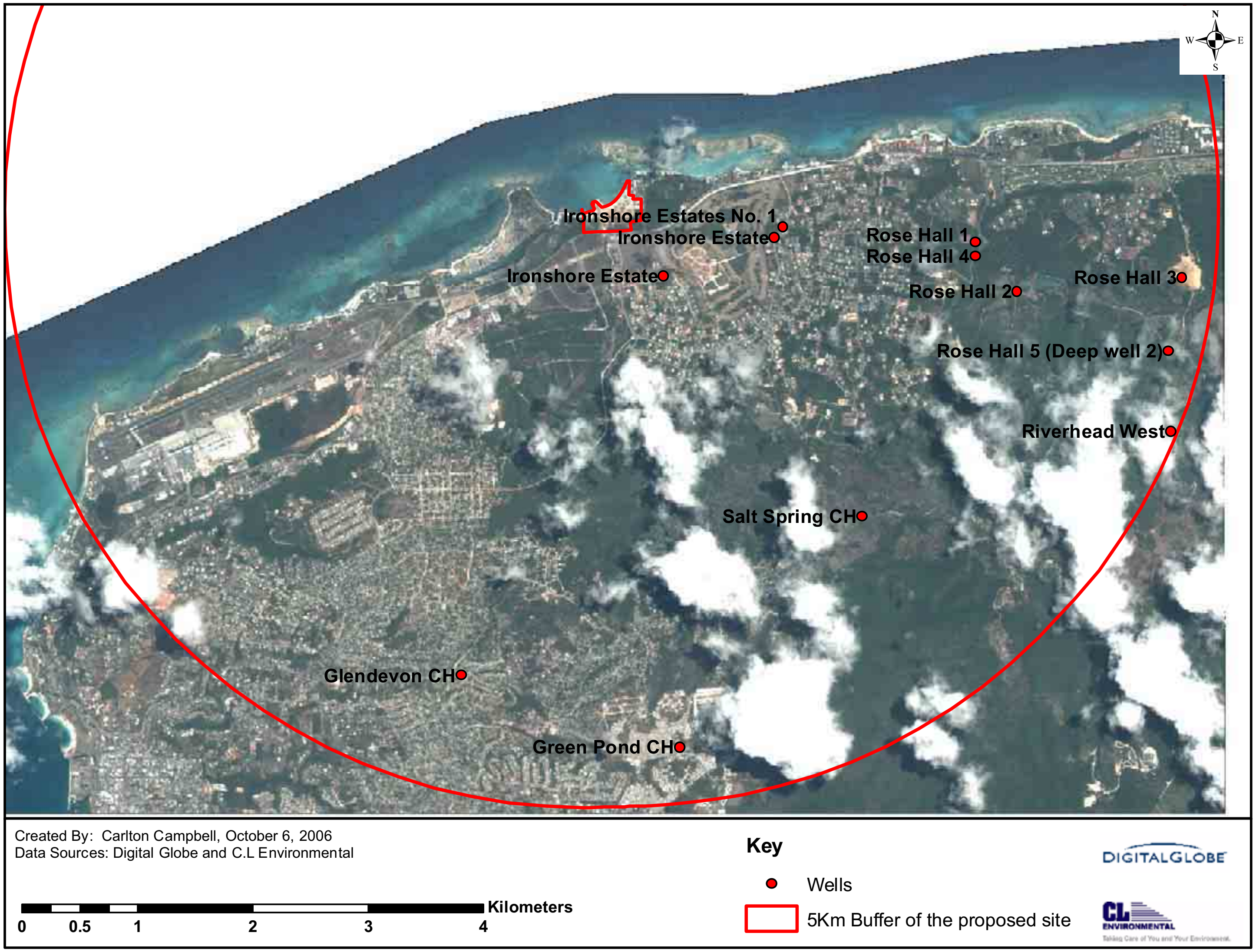


Figure 4.31 Map depicting the wells within 5 km of the proposed Clubhotel RIU Montego Bay

Table 4.25 Data from Ironshore well #1

PARAMETER	DATA	NEPA STANDARD	COMPLIANCE
Calcium	79.5	40.00-101.0 (mg/l)	√
Chloride	205.8	5.00- 20.0 (mg/l)	X
Magnesium	24	3.60- 27.0 (mg/l)	√
Nitrate	11.1	0.10- 7.5 (mg/l)	X
Phosphate	0.33	0.01 - 0.8 (mg/l)	√
pH	8.1	7.00- 8.4	√
Potassium	78.5	0.74- 5.0 (mg/l)	X
Silica	20.6	5.00- 39.0 (mg/l)	√
Sodium	79	4.50- 12.0 (mg/l)	X
Sulfate	56.7	3.00- 10.0 (mg/l)	X
Hardness	301.4	127.00-381.0 (mg/L (as$CaC0_3$)	√
Conductivity	1395	150.00-600 (ΦS/cm)	X
Total Dissolved Solids	627	120.00-300 (mg/l)	X

4.7 Land Use

4.7.1 Previous Land Use

Previously, Site 1 was cleared and attempts to set up another business enterprise. This is evidenced by the structures that were present on the site. These included old buildings and old swimming pools. Also sections of the site were being used as an informal dump for both commercial and domestic waste.

Site 2 was used for the Caribbean Beach Park. This facility provided family fun, with beach activities a restaurant, bar and ice cream parlour. Some fishers from the White House fishing beach use this section for beaching their boats before heading to the gas station across the road for fuel and oil for their boats.

4.7.2 Exiting Land Use

The St. James Development Order of 1983 has developed the Montego Bay Development Area Land Use Zoning map (Figure 4.32). Within the SIA, it outlines the following uses:

1. Transport;
2. Residential;
3. Open Space;
4. Resort;
5. Resort Residential;
6. Bathing Beach;
7. Recreational Beach (Public)
8. Bathing & Fishing Beach;
9. Fishing Beach;
10. Conservation;
11. Agricultural;

12. Commercial & Office;
13. Institutional;
14. Light Industry;
15. Marine Park; and
16. Areas of no collection and disturbance of coral reef.

Existing land use in the study area is tourism, commercial, residential, recreational and conservation area. The built environment dominates the existing land use of the study area. It accounts for approximately 51% of the land use of the SIA.

There are approximately 7 active registered hotels located within the study area and numerous villas. There are six hotels within the SIA with bathing beaches. These are Sandals Montego Bay, Sandals Royal Caribbean, Holiday Inn Sunspree Resort, Coyaba Beach, Half Moon Beach Club, Ritz Carlton Rose Hall and Cariblue Beach Hotel.

Commercial the study area has restaurants, craft shops, gas stations and an International Airport (Sangster International). There is only one (1) fishing beach located in the SIA. This is the Whitehouse fishing beach located approximately 3km southwest of the proposed hotel development site. The Blue Diamond Plaza is located approximately 200m to the south of the proposed development site, Holiday Village which is approximately 2.4 km to the east, is situated in front of Holiday Inn hotel. It is the largest shopping centre in Montego Bay, with an extensive selection of in-bond stores, souvenir and craft stores, all within easy walking distance. It also boasts an art gallery and the Half Moon Shopping Village, which is a shopping area, attached to the Half Moon Hotel. Additionally, the Half Moon Shopping Village has a fully functioning private hospital and health care facilities called MoBay Hope.

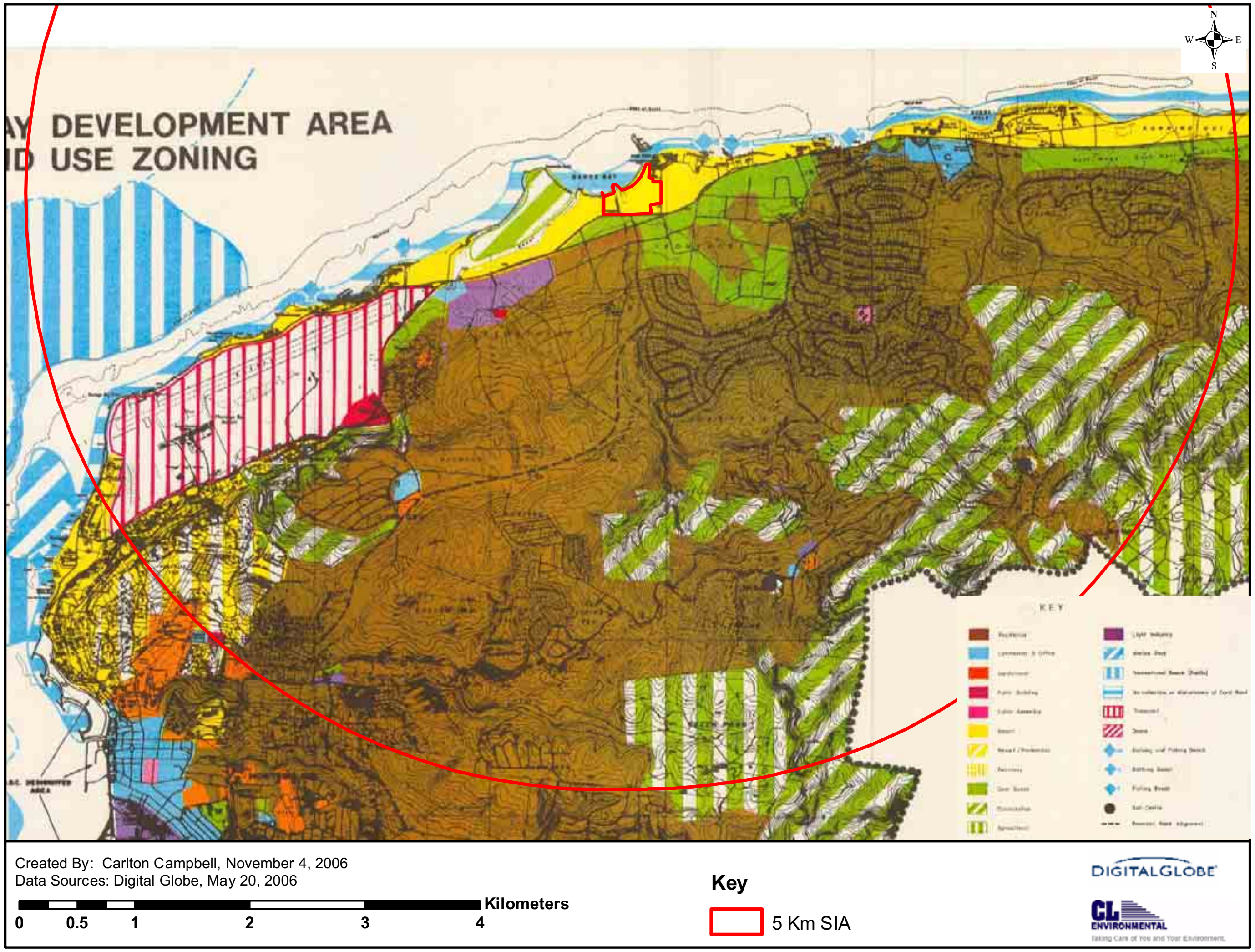


Figure 4.32 Section of the Montego Bay Development Area land use zoning falling within the SIA (Adapted St. James Development Order 1983 – Town and Country Planning Authority)

Residentially there are housing developments located at Coral Gardens, Ironshore, Providence, Hartfield, Flower Hill, Green Pond, Salt Spring, Glendevon, Rosemount, Albion, Retreat and Flankers.

Recreationally, there is a football field located at Whitehouse, golf courses at Half Moon and Ironshore and beaches. There are four (4) bathing beaches located in the SIA. These are located at Providence Pen (public), Mahoe Bay (commercial bathing), Ironshore (commercial bathing) and Coral Gardens (public).

There are also conservation areas, with the closest area being approximately 400m west of the proposed site. There are areas approximately 2.3 km south of the proposed site and a section of the Montego Bay Marine Park which falls approximately 4 km south west of the proposed hotel site (Figure 4.33).

The proposed development has the potential to have a positive impact in that there will be a reduction of the use of the area as a dump for waste, creating new employment opportunities and contributing positively to the national economy.

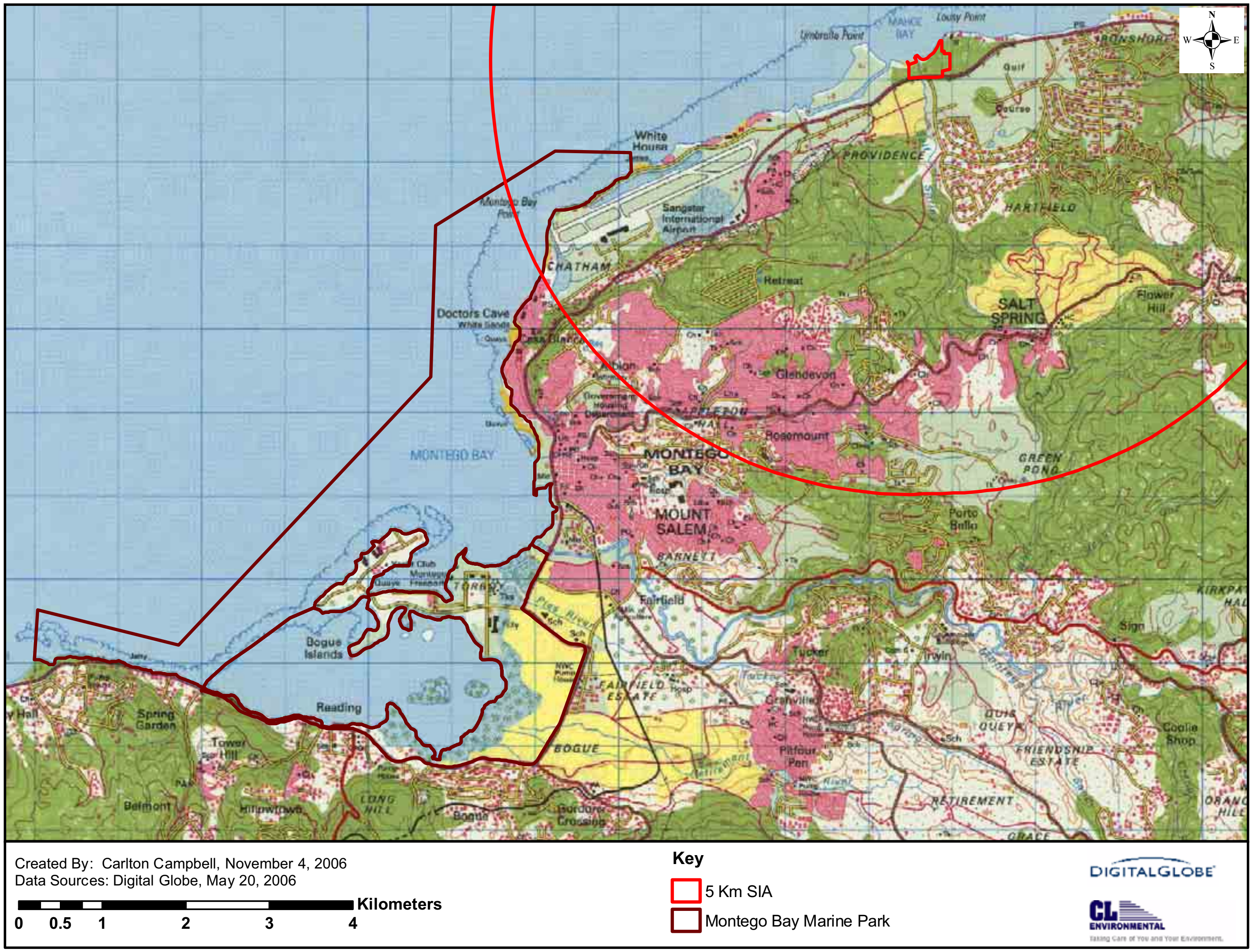


Figure 4.33 Map depicting the Montego Bay Marine Park

4.7.3 *Future Land Use*

The North Coast Highway Improvement Project (NCHIP) is currently implementing Phase 2A, which involves the realignment of the Montego Bay to Falmouth Main road. In the vicinity of the site, the road alignment will be changed so that it will be run between the Blue Diamond shopping centre and the Esso Gas station. This will effectively move the main road between 78m (closest point) to approximately 190m (farthest point) south of the proposed site.

The Palmyra Resort and Spa, will be developed on 16 hectares of land situated approximately 5.5km east of the proposed site. This project will involve the following the construction of; three eleven floor buildings, two 16-floor buildings, 500 units (1- and 2-bedrooms; 3 bedroom penthouse in each building), a spa, restaurant and bars, resort infrastructure and beach enhancements (ESL, May 2005).

The Ironshore Village Centre and Shoppes of Rose Hall located east of Palmyra Resort and Spa are two future developments. The Ironshore Village Centre is approximately 500m southeast of the proposed site.

4.8 Noise

4.8.1 *Proposed Site*

Methodology

Noise level readings were taken by using a Quest Technologies DLX 1 – 1/3 Sound Level Meter (Acoustics Standards: EN/IEC61672, ANSI S1.4-1983, EN/IEC61260, ANSI S1.11-2004 & ANSI S1.43-1997 (Also fulfills all requirements of earlier standards IEC 60651 and IEC 60804)) in the data logging mode. In this mode noise levels were stored every second over a period of between two (2) and five (5) minutes for each location. Average noise levels over five minute time period for each location were calculated. The readings were taken three times per day on one (1) day and averaged. The averaged noise levels were then compared to the National Environment and Planning Agency's (NEPA) noise guidelines.

In addition to measuring noise levels (dBA scale), octave band analysis (dBZ scale) was also conducted at all the locations. Frequency readings were taken in the low, medium and high frequency bands. Octave band analysis was conducted which provide thirty three (33) octave bands from 12.5 Hz to 20.0 kHz. The calibration certificate is found in Appendix E.

Baseline noise measurement was taken at seven (7) locations between 8:38 and 9:47 am, 12:34 – 1:16 pm and 5:13 – 5:52 pm using a Quest SoundPro DLX sound level meter. These locations are listed in Table 4.26 (coordinates are in Jamaica Grid 2001) and Figure 4.34 depicts the locations of the stations. The sound level meter was calibrated with a Quest QC - 10 sound calibrator and a windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone.

Table 4.26 Locations of the noise stations

Noise Station #	JAD2001 GPS Coordinates (WGS84)	
	Easting	**Northing**
N1	656615.343	707332.631
N2	656992.530	707348.681
N3	657082.413	707597.464
N4	656987.715	707743.524
N5	656613.738	707469.060
N6	656865.731	707571.783
N7	656824.000	707337.446
N8	656615.343	707332.631

The impact from airplane noise was determined by using data for the month of August 2005 as a worst case scenario, as during this period the airport was busiest for the year. The data was supplied by the MBJ Airport Limited. From this data the Day- Night Average Sound Level (DNL) was calculated using INM 6.2 model. DNL (Day-Night Sound Level) is based on sound levels measured in relative intensity of sound, or decibels (dB), on the "A" weighted scale (dBA). This scale most closely approximates the response characteristics of the human ear to sound. DNL represents noise exposure events over a 24-hour period. To account for human sensitivity to noise between the hours of 10:00 pm and 7:00 am, noise events occurring during these hours receive a "penalty" when the DNL is calculated. Each event is measured as if ten events occurred.

Figure 4.34 Map depicting noise stations at ClubHotel RIU Montego Bay, Mahoe Bay, St. James

Results

Station 1

Average noise at this station was 59.1 dBA and ranged between a low of 51.8 dBA to a high of 73.0 dBA (Figure 4.35). Fifty percent (50%) of the noise experienced at this station was above 58 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 50 Hz.

During the midday, average noise at this station was 54.7 dBA and ranged between a low of 49.8 dBA to a high of 58.5 dBA. Fifty percent (50%) of the noise experienced at this station was above 54 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz.

In the afternoon, average noise at this station was 57.8 dBA and ranged between a low of 50.3 dBA to a high of 70.4 dBA. Fifty percent (50%) of the noise experienced at this station was above 54.5 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz (Figure 4.36).

Generally, the noise at station 1 ranges from a low of 49.8 – 73.0 dBA throughout the day. Noise at this station was influenced by sound from traffic on the Montego Bay to Falmouth main road as evidenced by the fluctuating pattern of the graphs (Figure 4.35). These graphs show that the station was influenced by the road traffic during the morning and afternoon periods most likely occurring during the increased traffic due to work commute (to work in the morning and leaving work at evening). The average noise levels are within the NEPA guideline of 65 dBA.

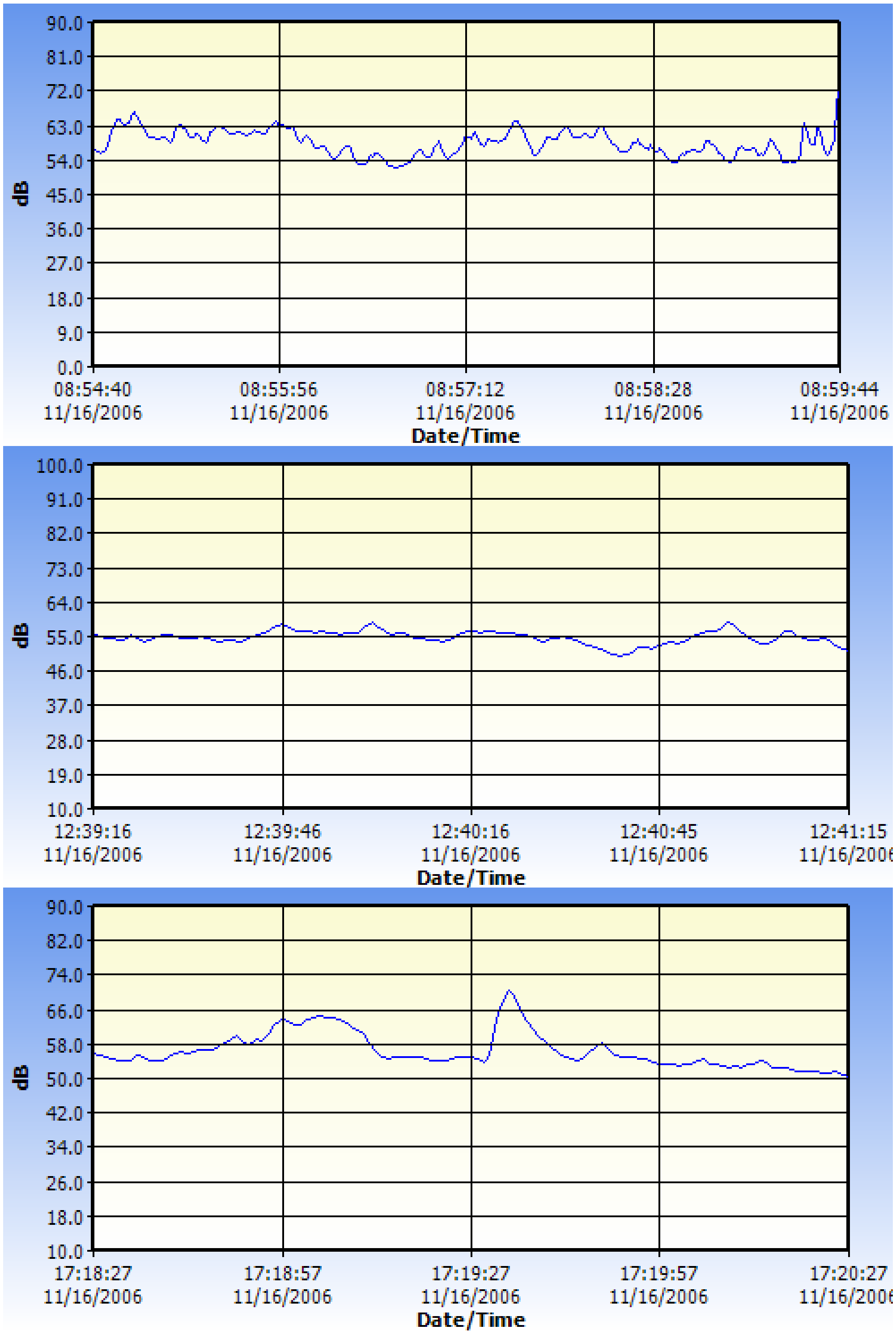


Figure 4.35 Noise levels at Station 1 at various times of day

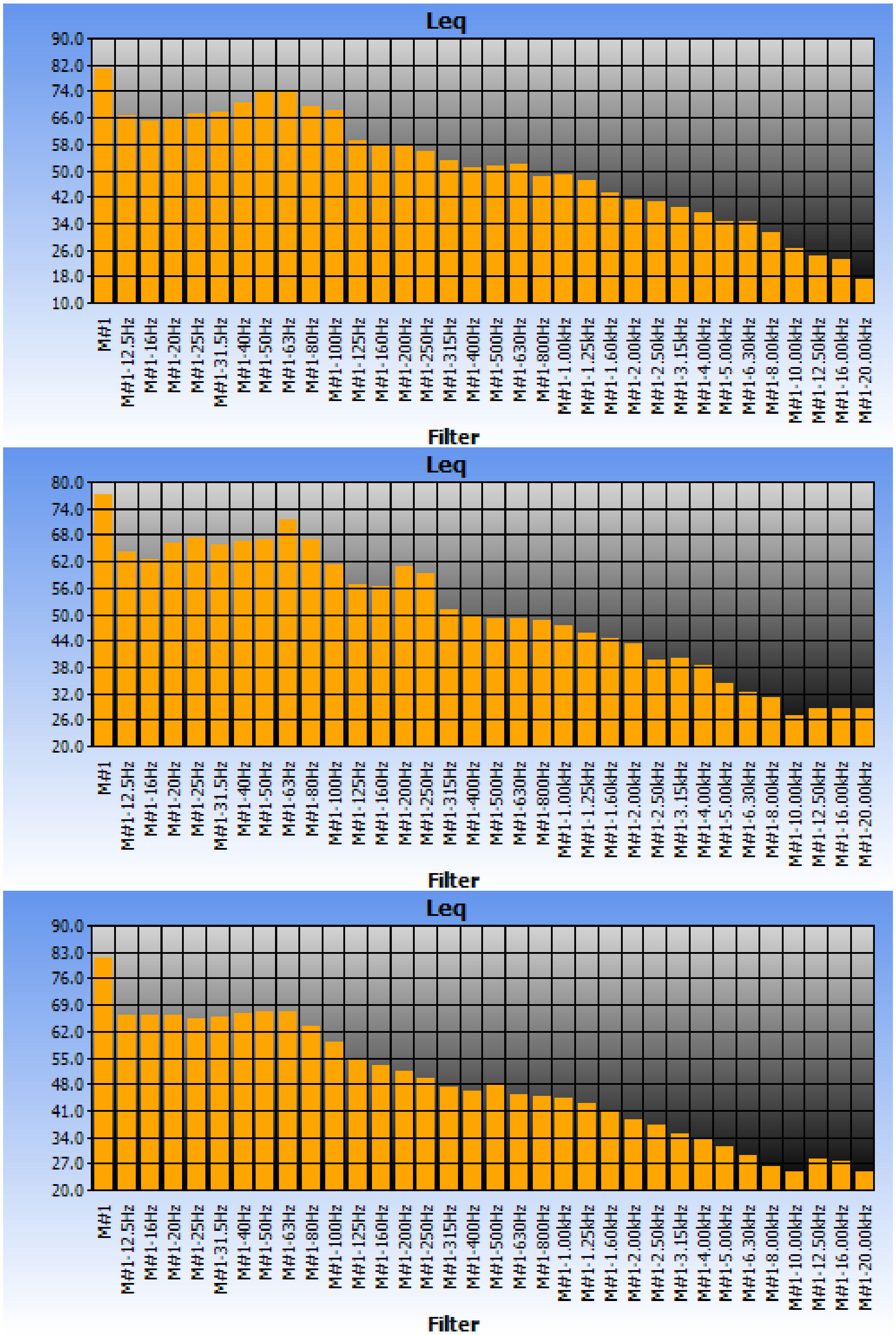


Figure 4.36 Octave band spectrum for Station 1

Station 2

Average noise at this station was 64.8 dBA and ranged between a low of 53.2 dBA to a high of 76.8 dBA (Figure 4.37). Fifty percent (50%) of the noise experienced at this station was above 62 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 40 Hz.

During the midday, average noise at this station was 61.2 dBA and ranged between a low of 54.4 dBA to a high of 64.6 dBA. Fifty percent (50%) of the noise experienced at this station was above 61 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz (Figure 4.38).

In the afternoon, average noise at this station was 61.8 dBA and ranged between a low of 51.7 dBA to a high of 74.2 dBA. Fifty percent (50%) of the noise experienced at this station was above 60.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz.

Generally, the noise at station 2 ranges from a low of 51.7 – 76.8 dBA throughout the day. Noise at this station was influenced by traffic on the Montego Bay to Falmouth main road as evidenced by the fluctuating pattern of the graphs (Figure 4.37). The average noise levels are within the NEPA guideline of 65 dBA.

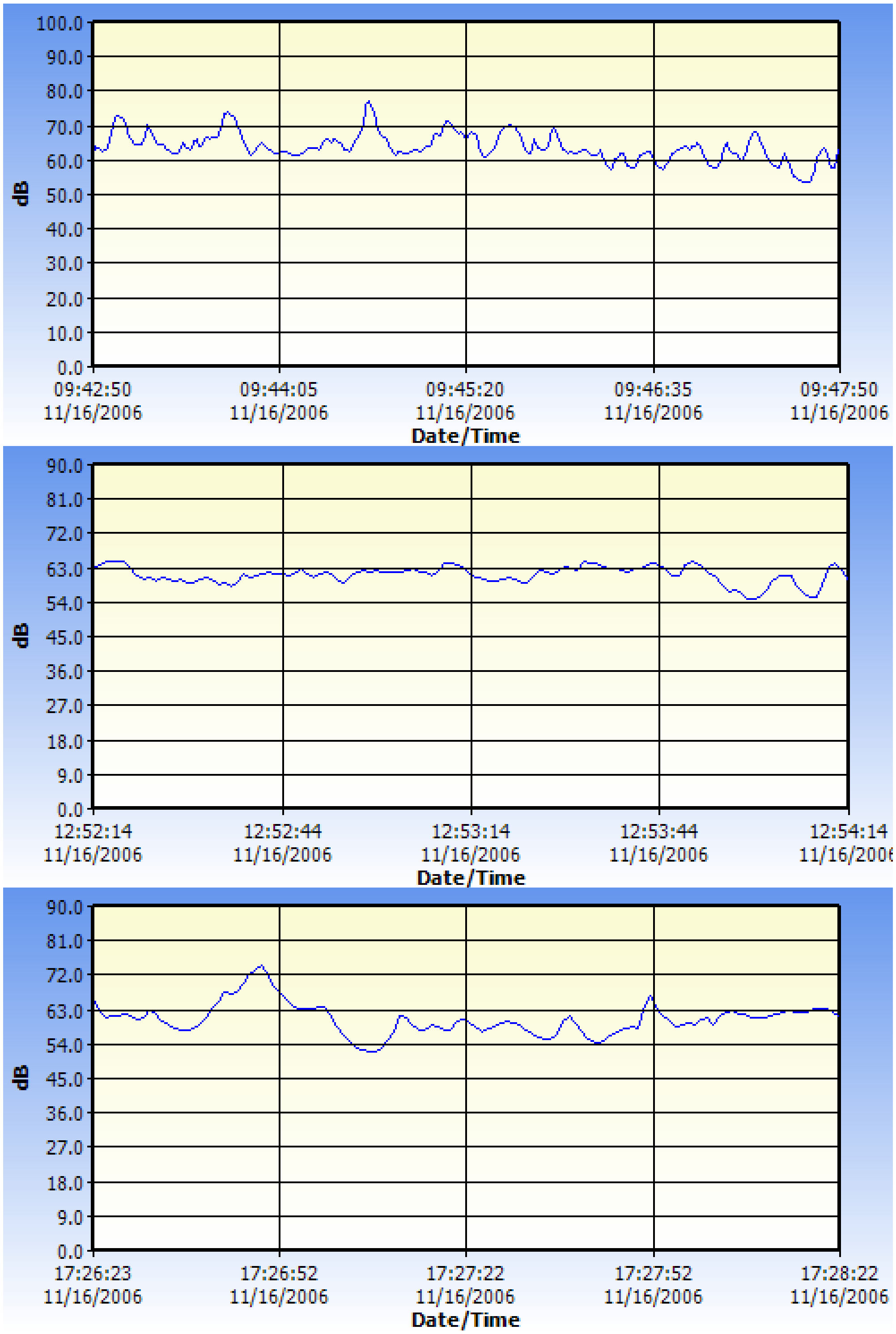


Figure 4.37 Noise levels at Station 2 at various times of day

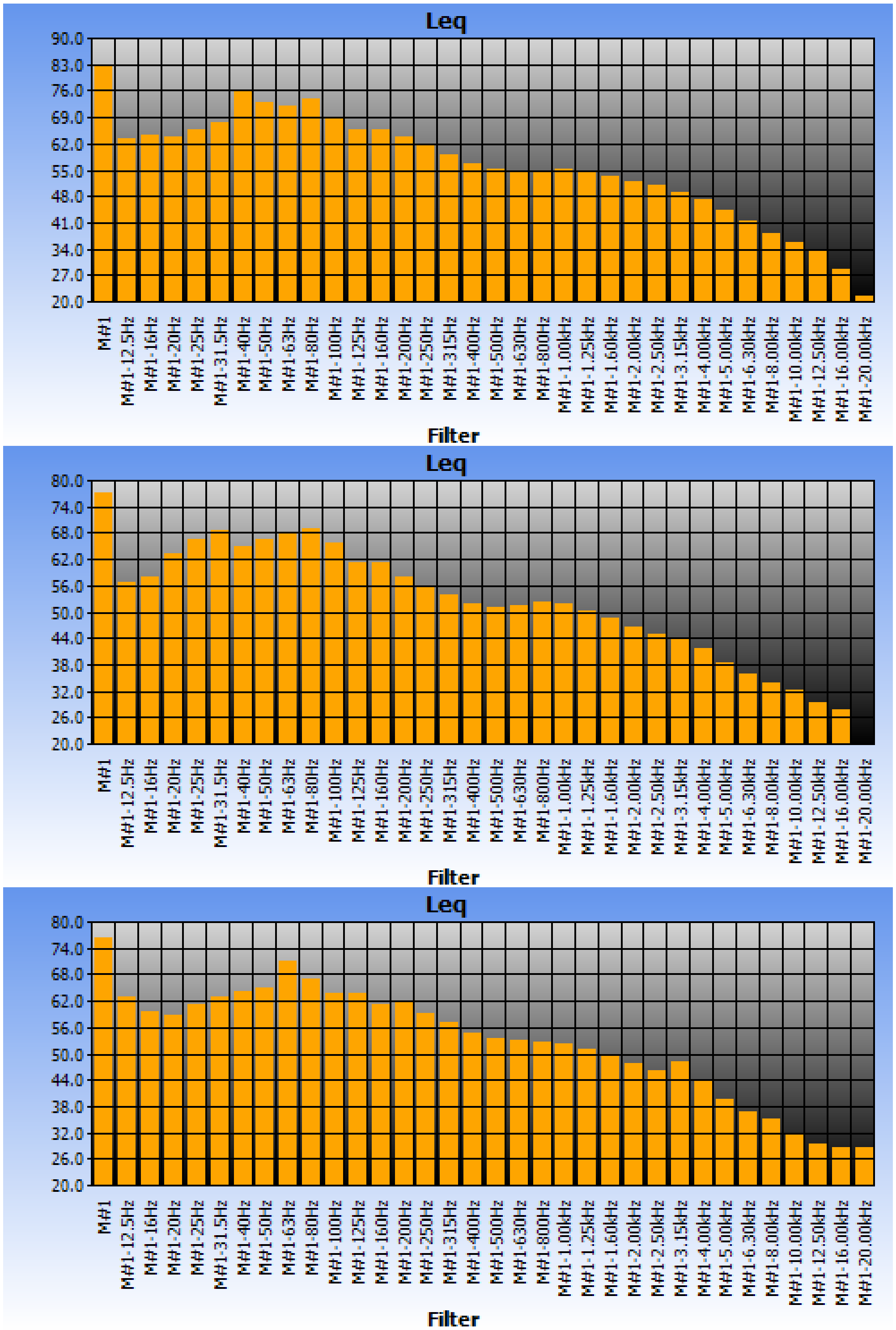


Figure 4.38 Octave band spectrum for Station 2

Station 3

Average noise at this station was 64.3 dBA and ranged between a low of 53.4 dBA to a high of 73.9 dBA (Figure 4.39). Fifty percent (50%) of the noise experienced at this station was above 62 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz (Figure 4.40).

During the midday, average noise at this station was 62.2 dBA and ranged between a low of 51.3 dBA to a high of 71.8 dBA. Fifty percent (50%) of the noise experienced at this station was above 61 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz.

During the afternoon, average noise at this station was 62.8 dBA and ranged between a low of 58.1 dBA to a high of 71.4 dBA. Fifty percent (50%) of the noise experienced at this station was above 61.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 31.5 Hz.

Generally, the noise at station 3 ranges from a low of 51.3 – 73.9 dBA throughout the day. This station was also influenced by traffic on the Montego Bay to Falmouth main road as evidenced by the fluctuating pattern of the graphs (Figure 4.39). The average noise levels are within the NEPA guideline of 65 dBA.

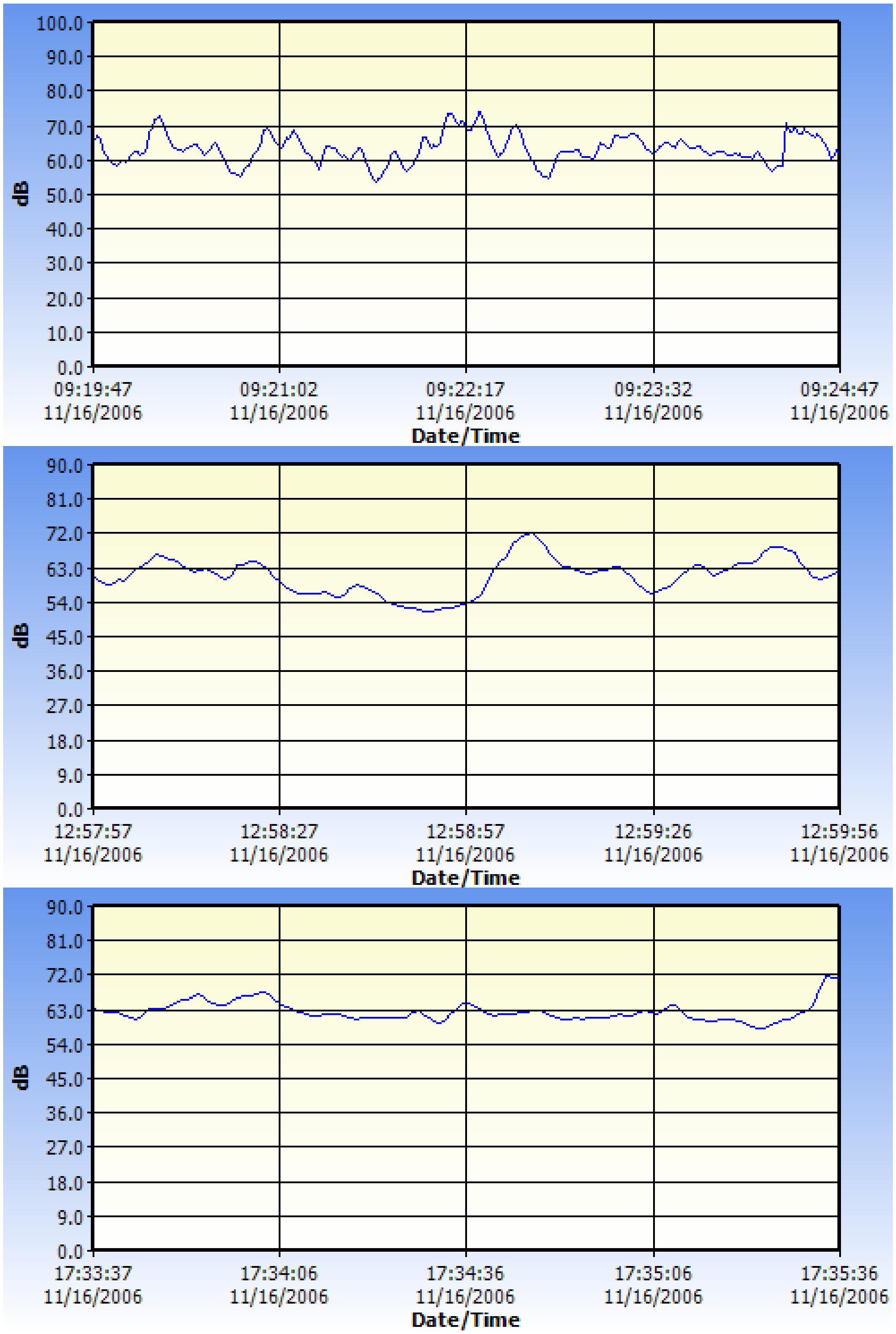


Figure 4.39 Noise levels at Station 3 at various times of day

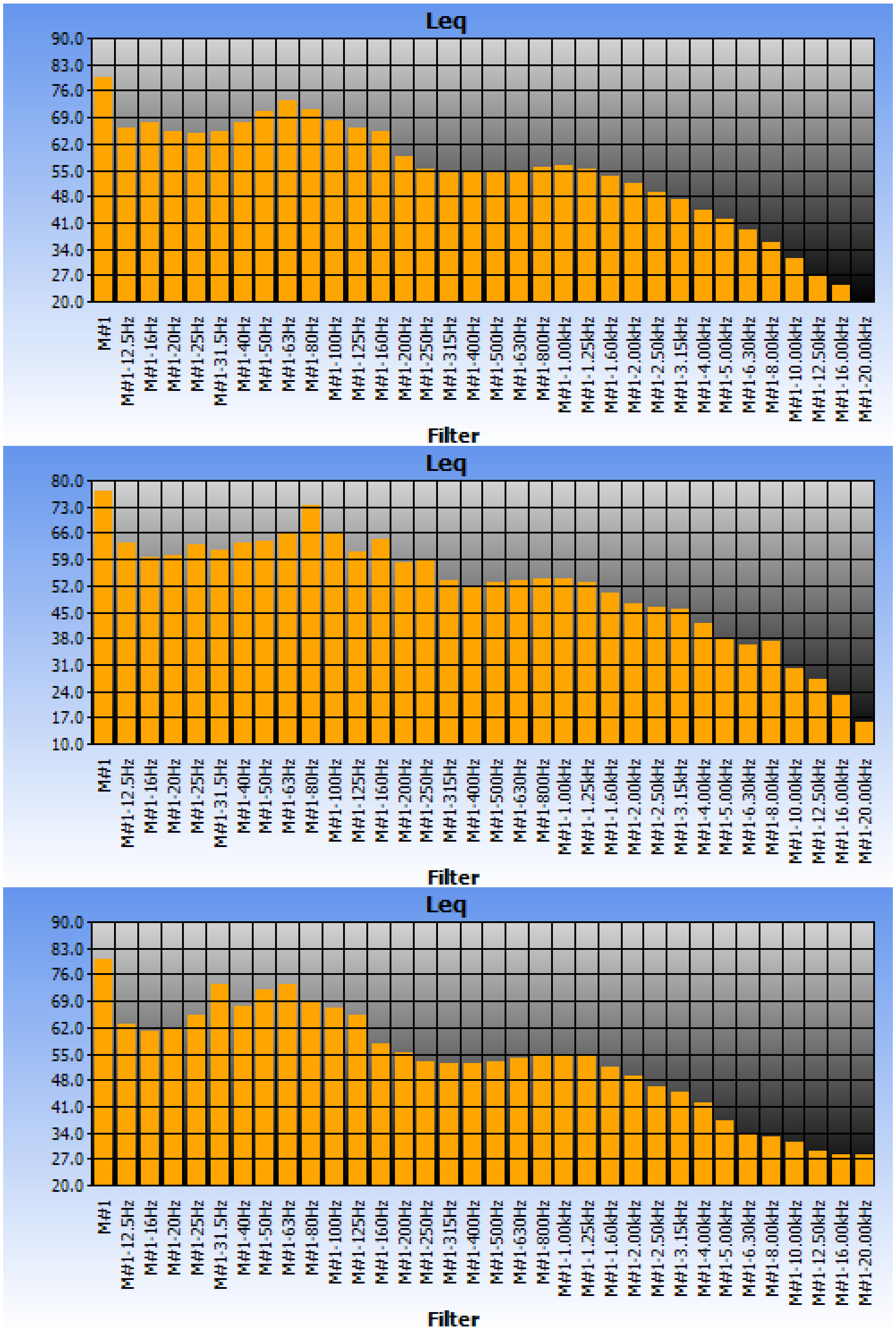


Figure 4.40 Octave band spectrum for Station 3

Station 4

Average noise at this station was 55.6 dBA and ranged between a low of 54.3 dBA to a high of 58.5 dBA (Figure 4.41). Fifty percent (50%) of the noise experienced at this station was above 55 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz (Figure 4.42).

During the midday, average noise at this station was 55.6 dBA and ranged between a low of 54.0 dBA to a high of 59.4 dBA. Fifty percent (50%) of the noise experienced at this station was above 55 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz.

During the afternoon, average noise at this station was 59.2 dBA and ranged between a low of 58.1 dBA to a high of 65.5 dBA. Fifty percent (50%) of the noise experienced at this station was above 59.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz.

Generally, the noise at station 4 ranges from a low of 54.0 – 65.5 dBA throughout the day. Noise at this station was influenced by sound from the Sandals sewage plant and from time to time from chatter from employees of Sandals near the fence. The average noise levels are within the NEPA guideline of 65 dBA.

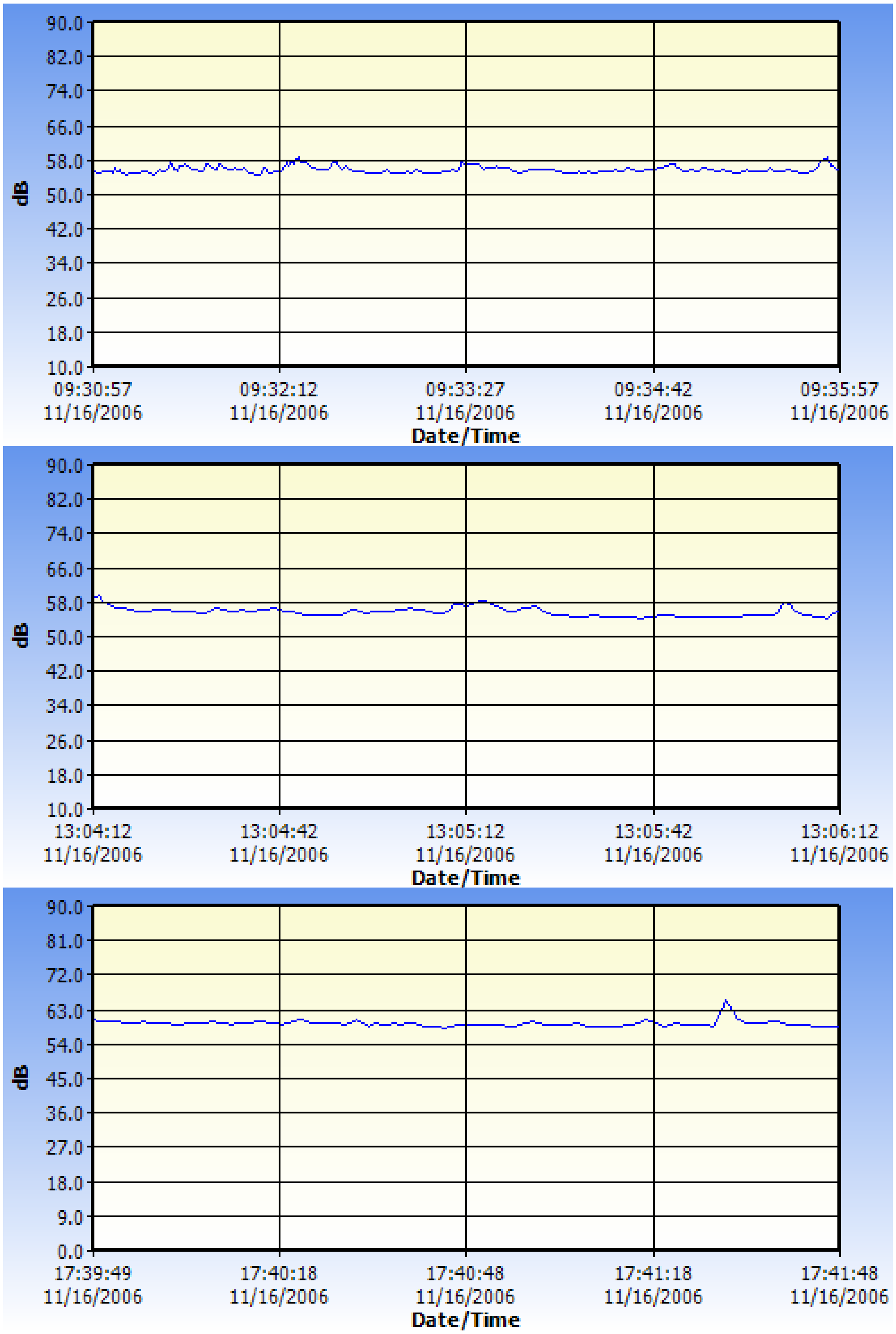


Figure 4.41 Noise levels at Station 4 at various times of day

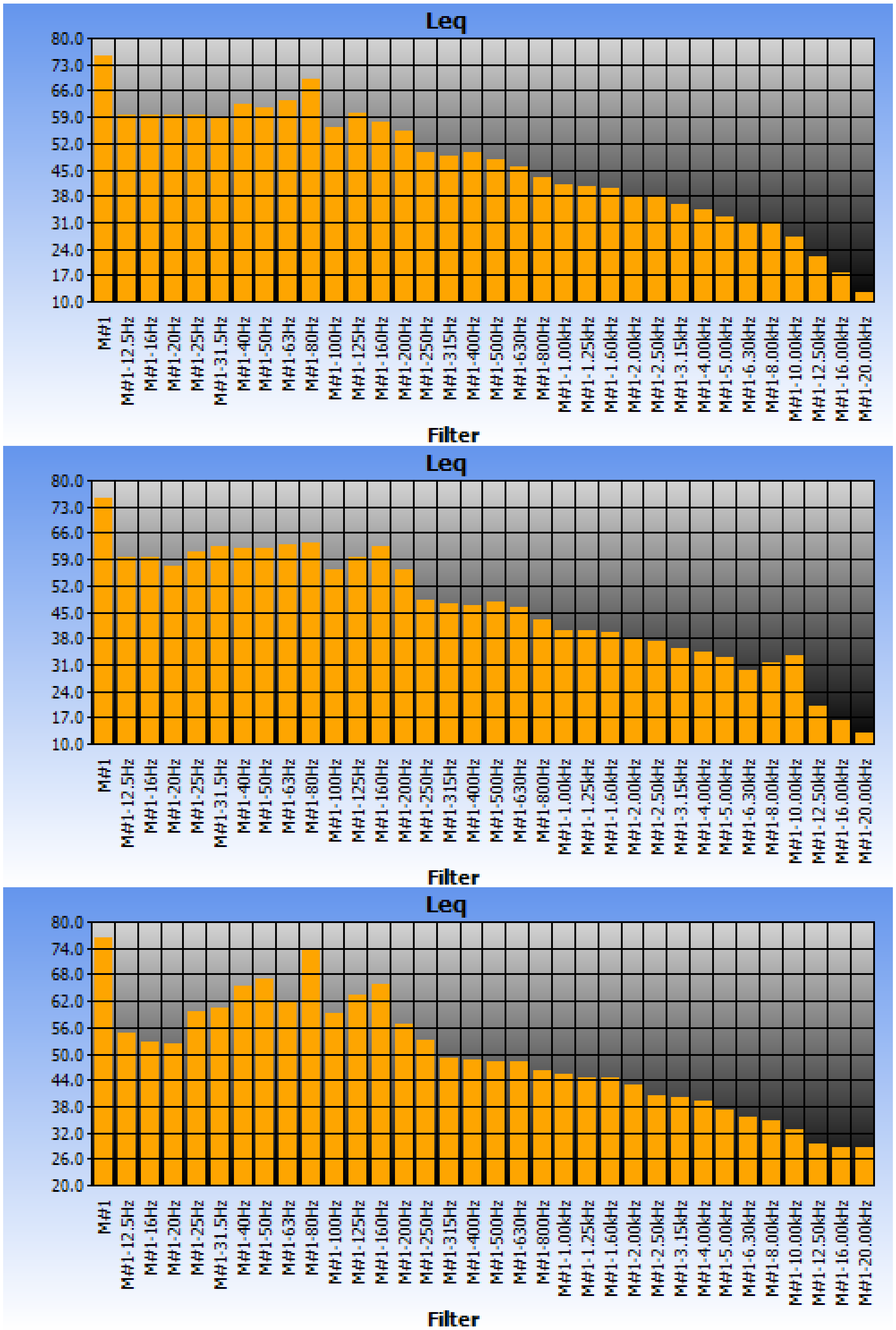


Figure 4.42 Octave band spectrum for Station 4

Station 5

Average noise at this station was 53.8 dBA and ranged between a low of 52.1 dBA to a high of 63.0 dBA (Figure 4.43). Fifty percent (50%) of the noise experienced at this station was above 55 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz (Figure 4.44).

During the midday, average noise at this station was 57.8 dBA and ranged between a low of 47.9 dBA to a high of 71.8 dBA. Fifty percent (50%) of the noise experienced at this station was above 51 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 100 Hz.

During the afternoon, average noise at this station was 56.8 dBA and ranged between a low of 53.4 dBA to a high of 64.5 dBA. Fifty percent (50%) of the noise experienced at this station was above 54.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz.

Generally, the noise at station 5 ranges from a low of 47.9 – 71.8 dBA throughout the day. Noise at this station was influenced by the cooler fans and the rattling of glass from Sandals. The average noise levels are within the NEPA guideline of 65 dBA.

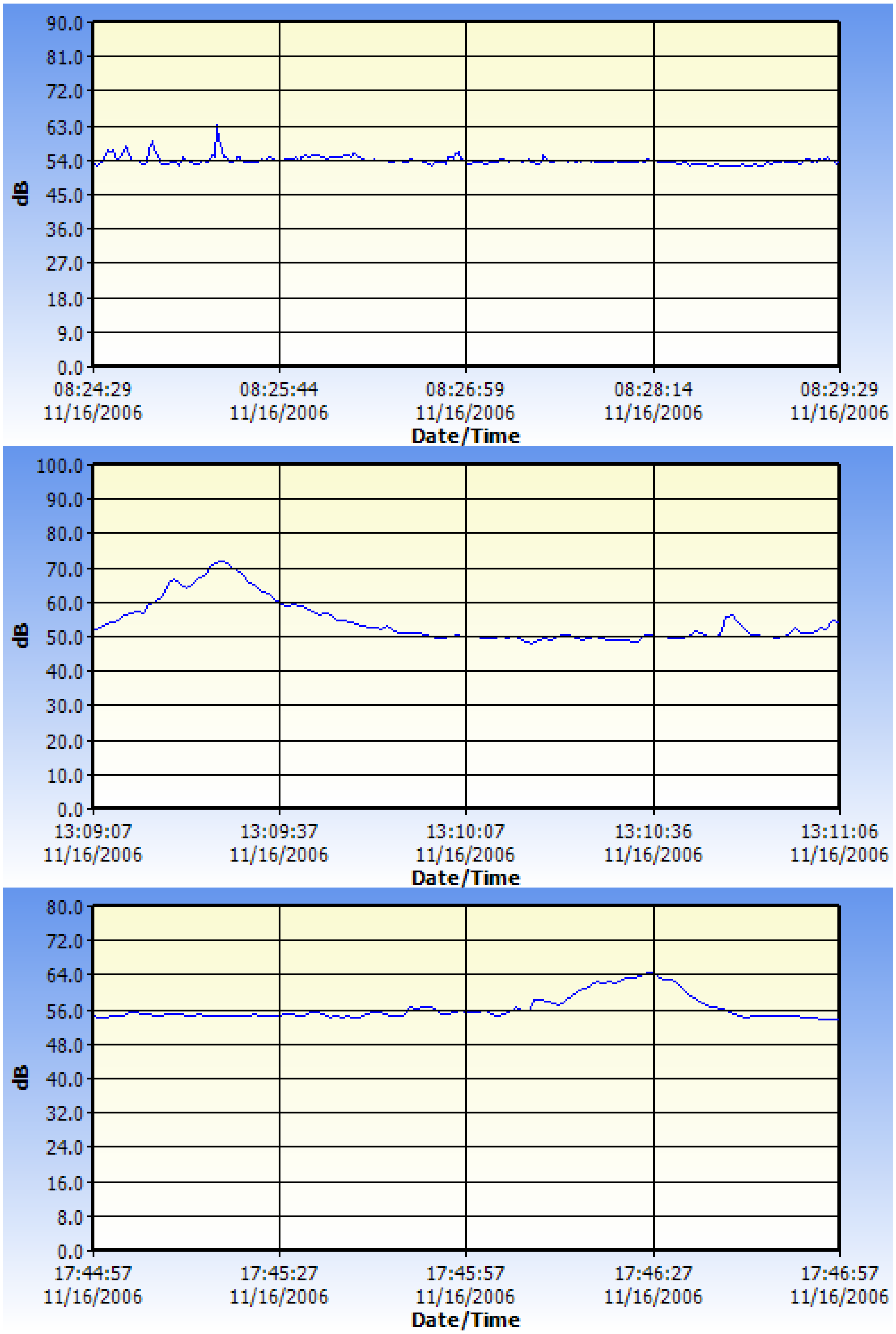


Figure 4.43 Noise levels at Station 5 at various times of day

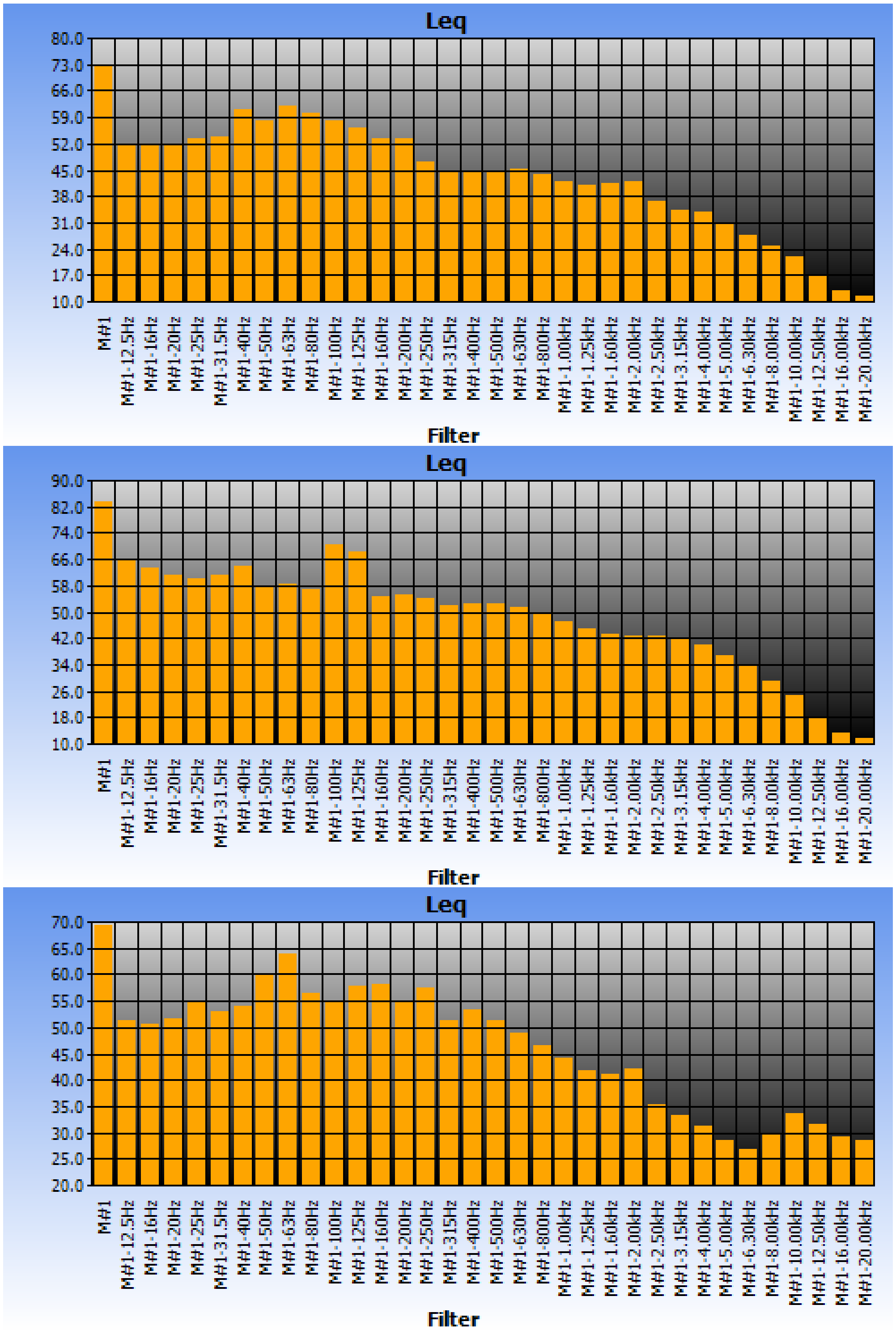


Figure 4.44 Octave band spectrum for Station 5

Station 6

Average noise at this station was 48.4 dBA and ranged between a low of 44.6 dBA to a high of 55.6 dBA (Figure 4.45). Fifty percent (50%) of the noise experienced at this station was above 47 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz (Figure 4.46).

During the midday, average noise at this station was 65.1 dBA and ranged between a low of 45.6 dBA to a high of 79.5 dBA. Fifty percent (50%) of the noise experienced at this station was above 49 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 125 Hz.

During the afternoon, average noise at this station was 52.9 dBA and ranged between a low of 49.7 dBA to a high of 57.1 dBA. Fifty percent (50%) of the noise experienced at this station was above 52.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 40 and 63 Hz.

Generally, the noise at station 6 ranges from a low of 44.6 – 79.5 dBA throughout the day. Noise at this station was influenced by sound from planes flying overhead. This is evidenced by the midday graph (Figure 4.45) in which the first thirty seconds showed a peak corresponding to a plane flying overhead. The impact from the plane is also seen in the change in the octave band analysis where there is an increase in the frequency ranges in the mi and high octave bands. The average noise levels are generally within the NEPA guideline of 65 dBA.

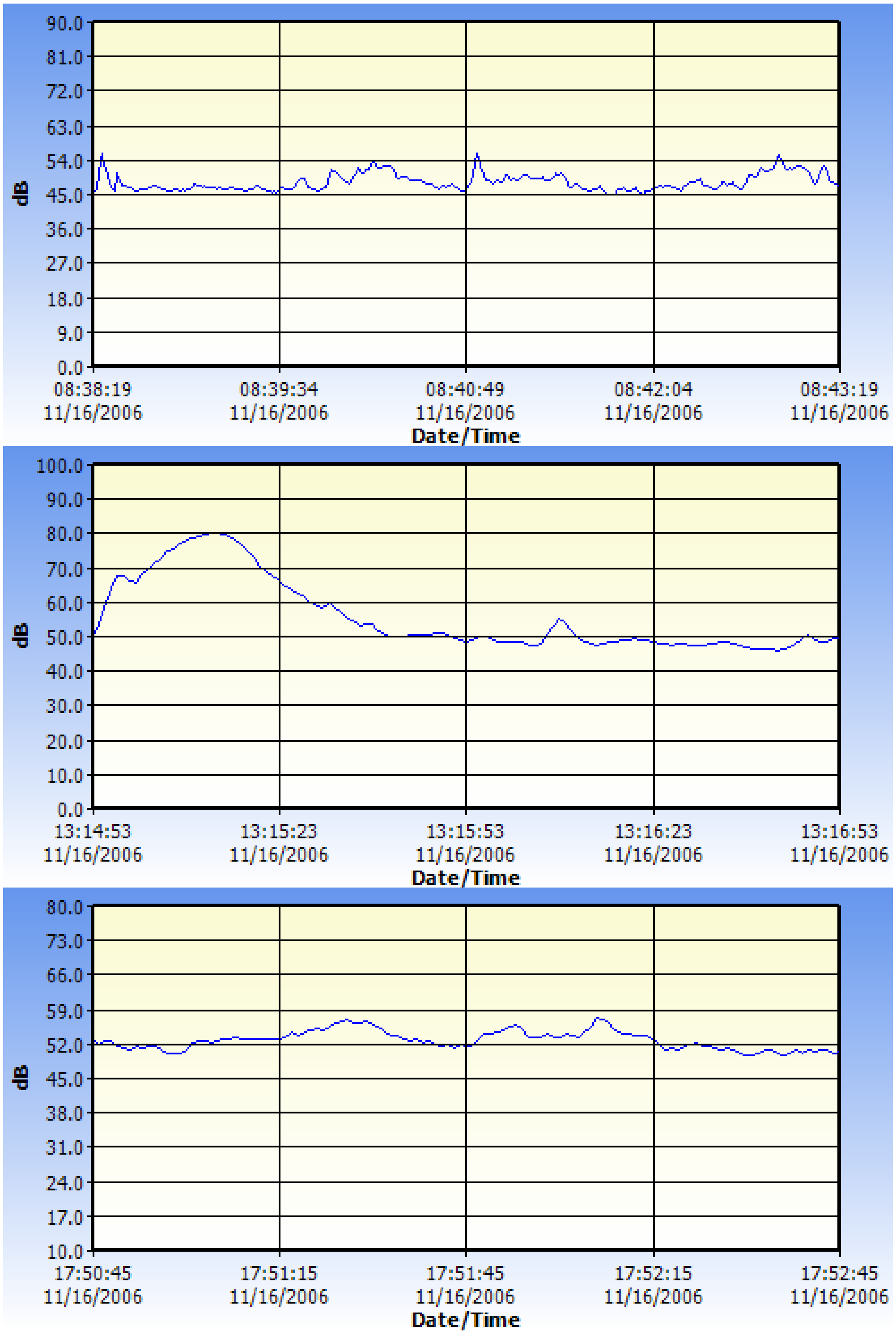


Figure 4.45 Noise levels at Station 6 at various times of day

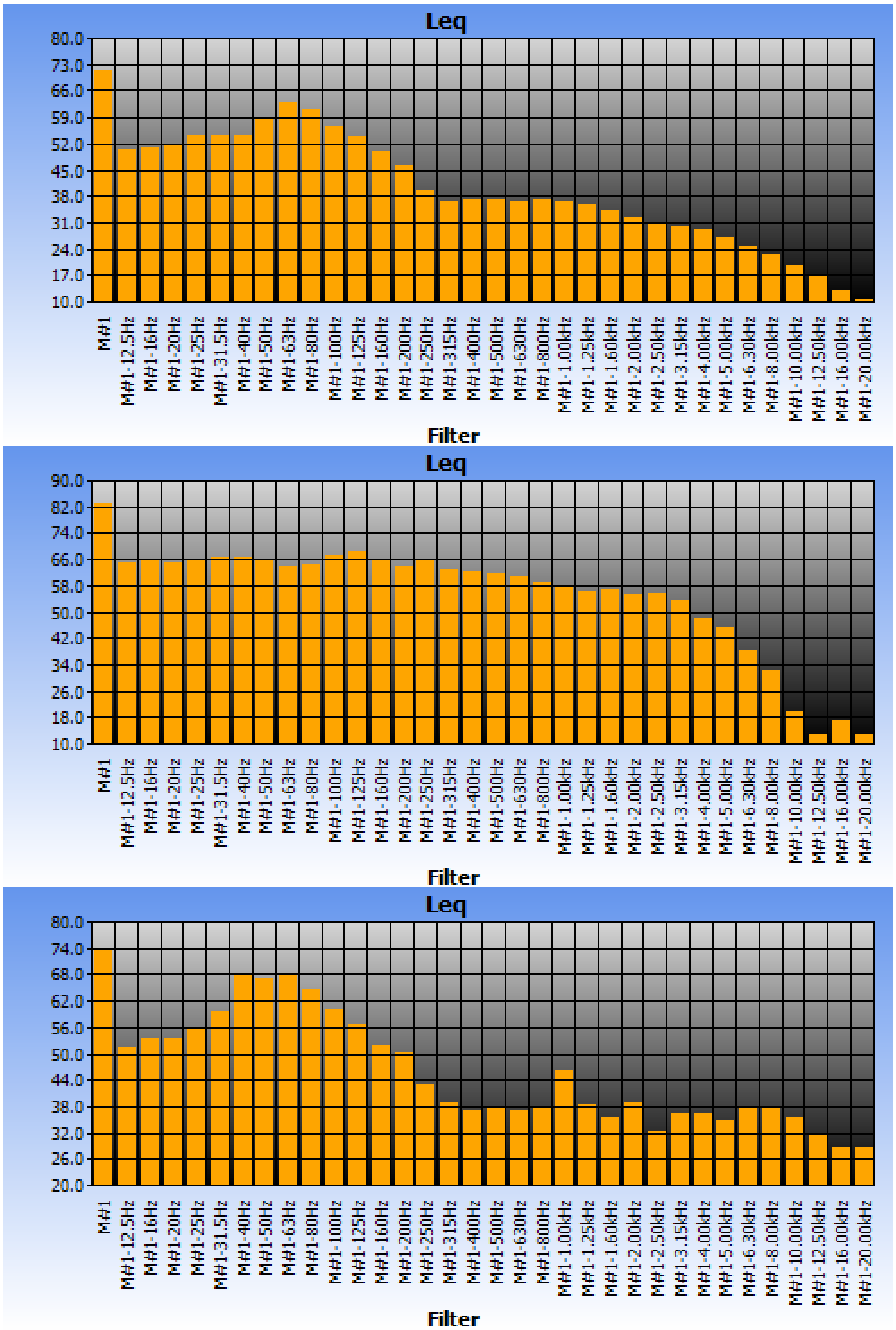


Figure 4.46 Octave band spectrum for Station 6

Station 7

Average noise at this station was 51.9 dBA and ranged between a low of 46.5 dBA to a high of 59.6 dBA (Figure 4.47). Fifty percent (50%) of the noise experienced at this station was above 50 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz (Figure 4.48).

During the midday, average noise at this station was 55.0 dBA and ranged between a low of 49.6 dBA to a high of 64.0 dBA. Fifty percent (50%) of the noise experienced at this station was above 52 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 80 Hz.

During the afternoon, average noise at this station was 49.0 dBA and ranged between a low of 46.1 dBA to a high of 53.4 dBA. Fifty percent (50%) of the noise experienced at this station was above 48.0 dBA. Octave band analysis shows that the noise at this station was in the low frequency band centred around the geometric mean frequency of 63 Hz.

Generally, the noise at station 7 ranges from a low of 46.1 – 64.0 dBA throughout the day. Noise at this station was influenced by sound from the traffic on the Montego Bay to Falmouth main road. The noise levels are within the NEPA guideline of 65 dBA.

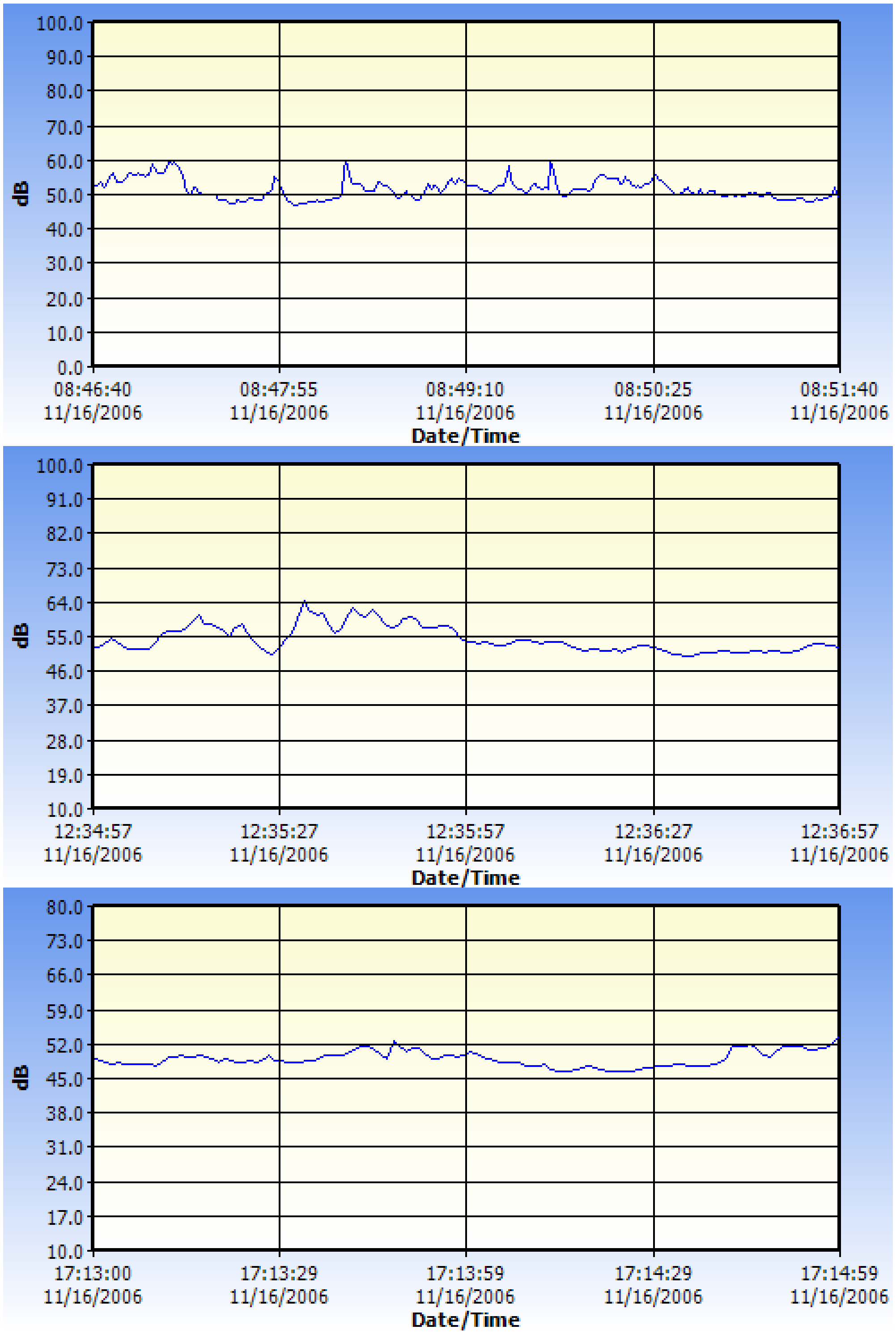


Figure 4.47 Noise levels at Station 7 at various times of day

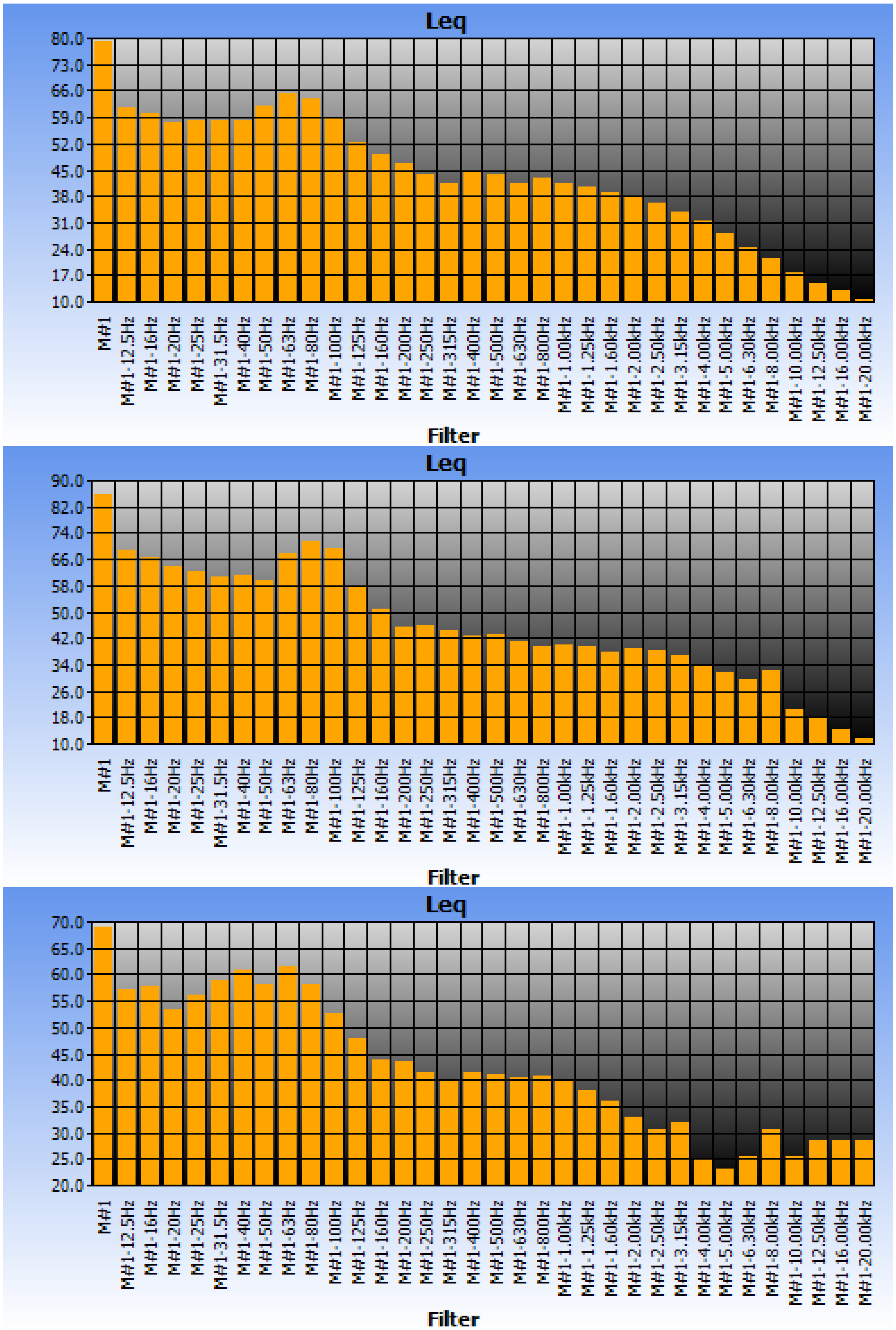


Figure 4.48 Octave band spectrum for Station 7

Summary

Table 4.27, Table 4.28, Table 4.29, Table 4.30, Table 4.31, Table 4.32 and Table 4.33 summarizes the noise data.

Table 4.27 Summary noise data for Station 1

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	73.0	51.8	59.1	50	45 - 56
Midday	58.5	49.8	54.7	63	56 - 71
Afternoon	70.4	50.3	57.8	63	56 - 71

Table 4.28 Summary noise data for Station 2

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	76.8	53.2	64.8	40	36 -45
Midday	64.6	54.4	61.2	80	71 - 90
Afternoon	74.2	51.7	61.8	63	56 - 71

Table 4.29 Summary noise data for Station 3

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	73.9	53.4	64.3	63	56 - 71
Midday	71.8	51.3	62.2	80	71 - 90
Afternoon	71.4	58.1	62.8	31.5	28 - 35

Table 4.30 Summary noise data for Station

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	58.5	54.3	55.6	80	71 - 90
Midday	59.4	54.0	55.6	80	71 - 90
Afternoon	65.5	58.1	59.2	80	71 - 90

Table 4.31 Summary noise data for Station 5

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	63.0	52.1	53.8	63	56 - 71
Midday	71.8	47.9	57.8	100	89 - 112
Afternoon	64.5	53.4	56.8	63	56 - 71

Table 4.32 Summary noise data for Station 6

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	55.6	44.6	48.4	63	56 - 71
Midday	79.5	45.6	65.1	125	111 - 140
Afternoon	57.1	49.7	52.9	40 & 63	36 -45 & 56 - 71

Table 4.33 Summary noise data for Station 7

SESSION	HIGH (dBA)	LOW (dBA)	AVG (dBA)	GEOMETRIC MEAN FREQUENCY (Hz)	OCTAVE FREQUENCY RANGE (Hz)
Morning	59.6	46.5	51.9	63	56 - 71
Midday	64.0	49.6	55.0	80	71 - 90
Afternoon	53.4	46.1	49.0	63	56 - 71

The baseline noise data for all stations are depicted in Figure 4.49.

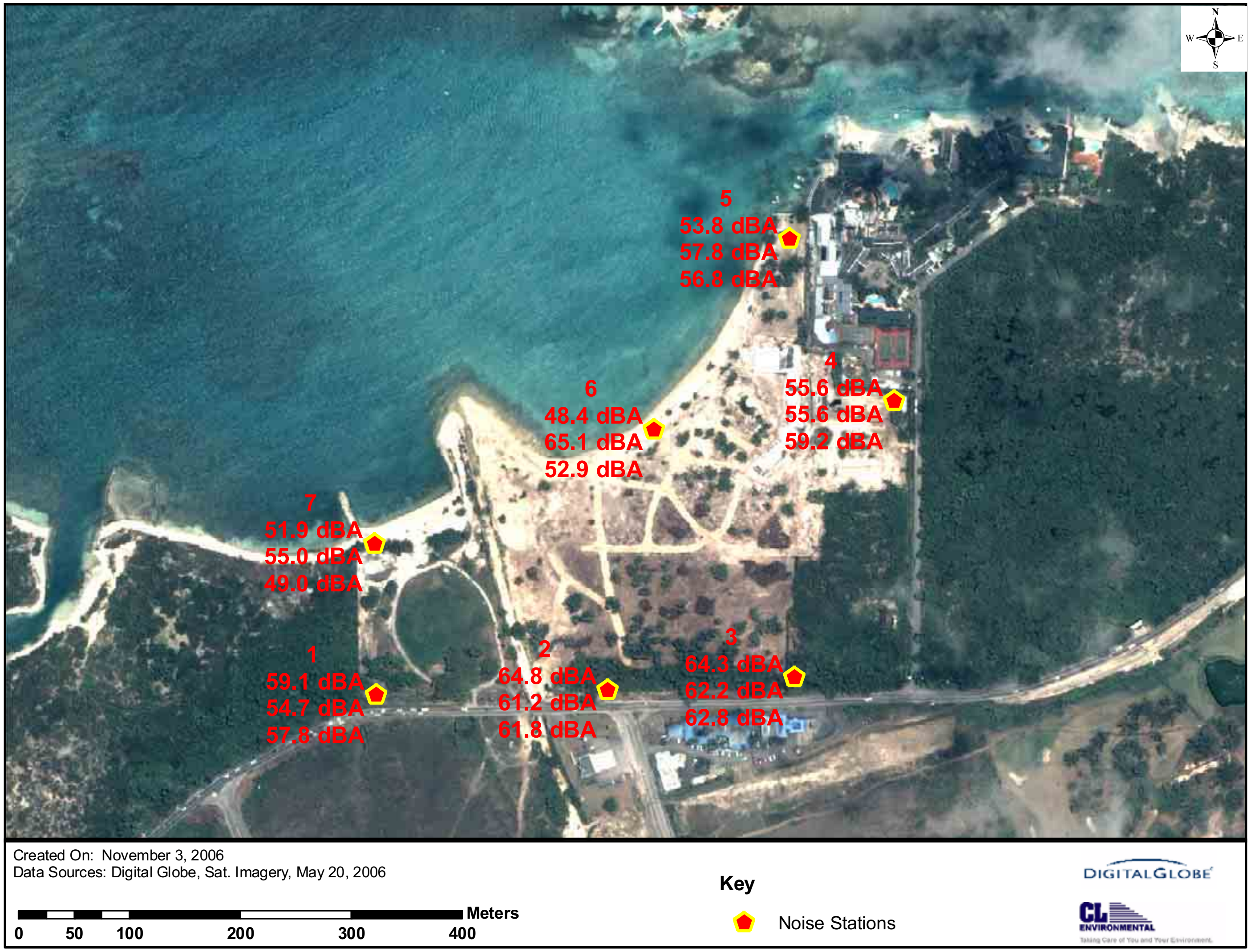


Figure 4.49 Baseline noise data in the morning, midday and afternoon for the proposed Clubhotel RIU, Montego Bay

4.8.2 *Airport Noises*

In addition to the regular anthropogenic and traffic noise, the proposed site is influenced by intermittent airplanes flying overhead. The proposed property falls within the flight path of the Sangster International Airport which is situated approximately 1.8 kilometres southwest of the property.

From the baseline noise measurements, a single flyover results in a noise level under its path on the property of 79.5 dBA. The FAA has developed land use guidelines that relate the compatibility of aircraft activity to areas surrounding airports. In the guidelines, residential land use is considered compatible with DNL below 65. From the model, the DNL for the property ranges from 55 to 60, thus within the FAA guideline (Figure 4.50).

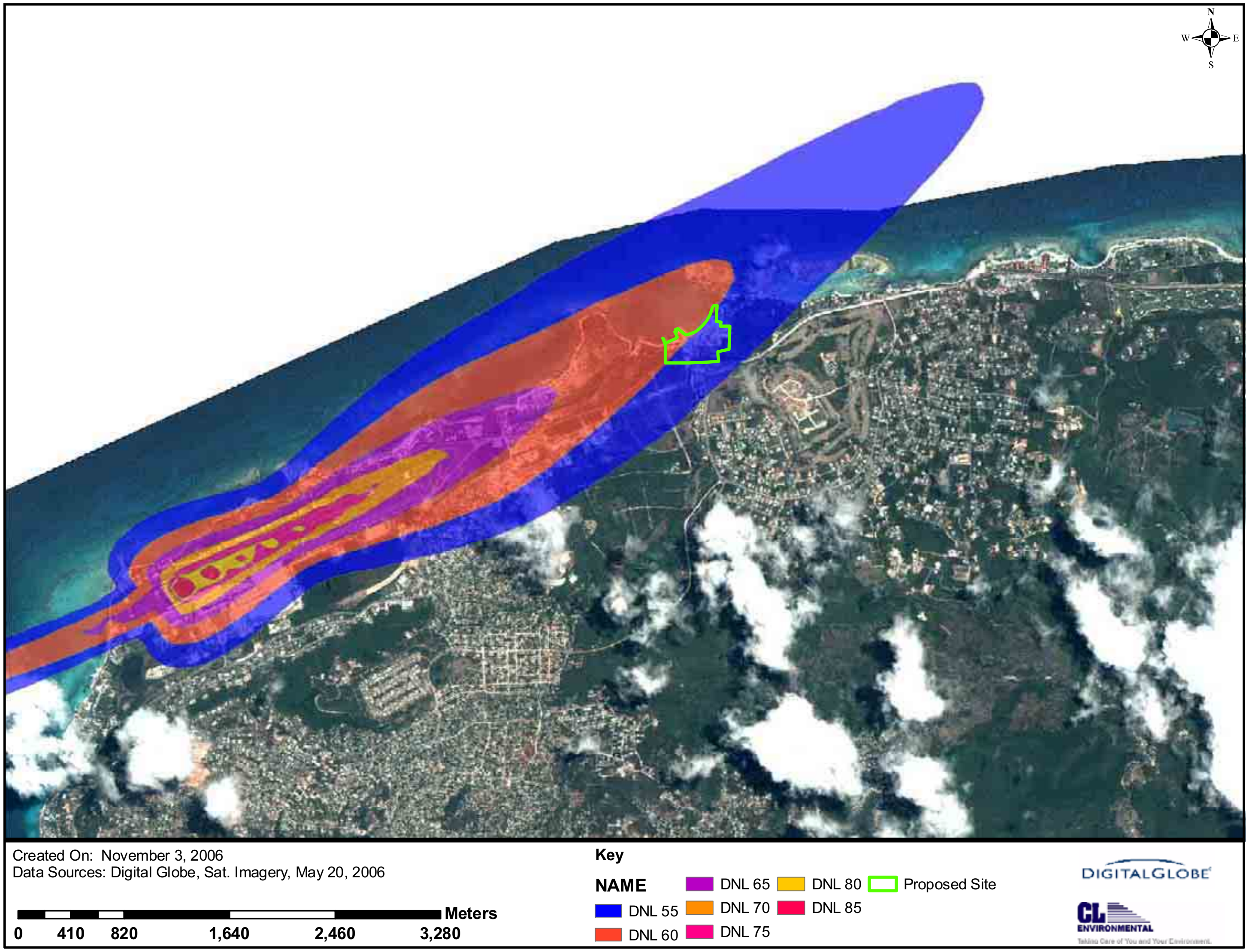


Figure 4.50 Map depicting the modelled DNL values

4.9 Historical and Cultural Resources

There are historical and cultural sites of interest both within, and outside of the social impact area (SIA) worth mentioning. Firstly, the Rose Hall Great House, situated on the hills of the former Rose Hall Sugar Estate is approximately 8km east of the proposed development and falls within the SIA. Built in the 19th century, this Great House is known for its former owner, Annie Palmer and her cruelty to her slaves. It is now a very popular visitor attraction with a guided tour of the Great House and the tomb of Annie Palmer. The Rose Hall Estate and environs therefore have a rich archaeological and cultural heritage which can be described as being a part of the tourism product for the Montego Bay area.

Similarly, Greenwood Great House may also be considered a rich archaeological and cultural heritage as it is an excellent example of late eighteenth century Great House construction in Jamaica. It is located in St. James outside the SIA for this project, however still worth mentioning as this Great House now functions as a museum and promises to become an important attraction to this project owing to its close proximity.

Mount Zion, found approximately 9km east of the proposed project, was once a free village with its imposing Church and graveyard established in the year of emancipation. In fact, the church bell is inscribed with the text preached on Emancipation Day and therefore adds to the cultural significance of this town.

Other estate related, archaeological & cultural heritage elements exist within, and in close proximity to the SIA. These elements add to the general attractiveness of the area and are capable of becoming visitor attractions. Surveying and preserving these elements through assistance from the National Heritage Trust should be of high priority, especially for the inclusion of the surrounding communities in the benefits of the proposed project.

4.10 Socioeconomics

Social The Social Impact Area (SIA) for this study was demarcated as five (5) kilometres from the proposed development area. This is outlined in the map below (Figure 4.52).

4.10.1 Introduction

Methodology

Informal interviews were conducted with residents within the communities in the study area. Other questionnaires were also administered to beach goers, vendors and shop keepers (Appendix F) and informal interviews with fishers and other stakeholders. In addition, windscreen surveys were conducted in the communities to verify and update the information on the maps. Historical socio-economic data was obtained from the 2001 population census.

Population was calculated using the formula [$i_2 = i_1 (1 + p)^x$]; where i_1 = initial population, i_2 = final population, p + actual growth rate and x = number of years. Water consumption was calculated based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption. Domestic garbage generation was calculated at 0.75 kg/capita/day and garbage generate by the proposed development at 2.3 kg/capita/day (National Solid Waste Management Authority).

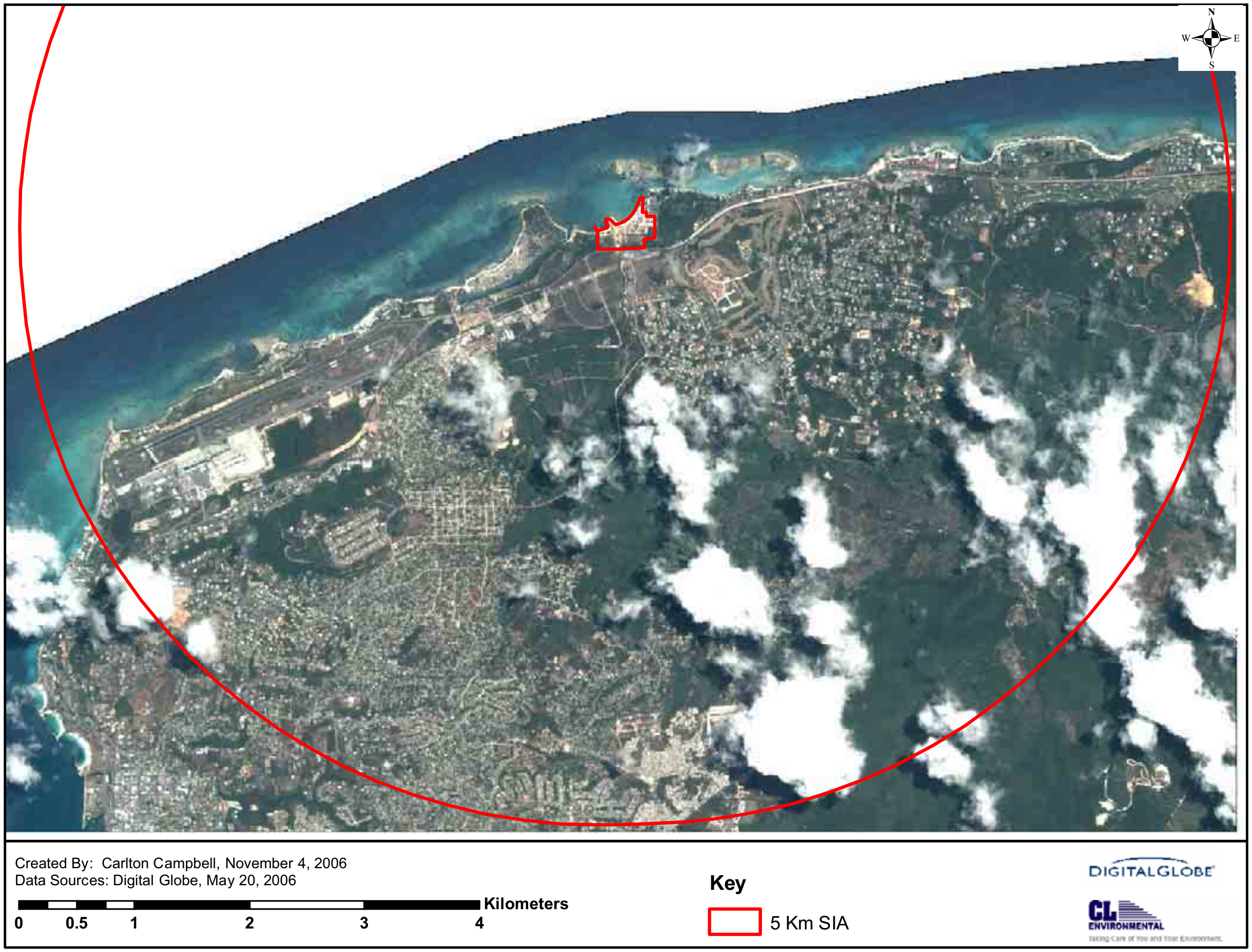


Figure 4.51 Social Impact Area demarcated

Demography

Regionally the population of St. James was 175,115 persons. During the last intercensal period (1991 –2001), St. James had an annual growth rate of 1.28%. The estimated population for St. James at the time the study was conducted was 186,613 persons. It is anticipated that the population for St. James will reach 256,469 persons over the next 25 years if the annual growth rate remains the same.

The study area (SIA) had a population of approximately 53,957 persons in 2001. At the time the study was conducted, the estimated population was 57,500 persons, calculated at an annual growth rate of 1.28 % (1991-2001 intercensal period). It is expected that the population will grow to 79,024 persons over the next 25 years if the current population growth rate is maintained.

Within the SIA in 2001, the 15-64 years age category accounted for 62% of the population, with the age 0-14 years (33%) and the age 65 and over category accounting for 5%. The segment of a population that is considered more vulnerable are the young (children less than five years old) and the elderly (65 years and over). In this population, approximately 11% were in the young category and 5% were in the 65 years and older category (Table 4.34).

Table 4.34 shows the percentage composition of each age category to the population. This is compared on a national, regional and local level. The data shows that the percentage contribution to the population for each category was generally similar except for the 15-64 and 65 & over years categories in the national context. Nationally the working population (15-64 years) and the 0-14 years were lower while the elderly category (65 & over) was slightly higher than the regional and local figures.

Table 4.34 Age categories as a percentage of the population

AGE CATEGORIES	JAMAICA (%)	ST. JAMES (%)	SIA (%)
0-14	32	33	33
15 - 64	60	61	62
65 & Over	8	6	5

(Source: STATIN Population Census 2001)

The sex ratio (males per one hundred females) in the SIA in 2001 was 92.3, which indicates that a higher percentage of the population in the SIA were females. Only the 0-14 years category had more males than females. This sex ratio was greater than both the national (Jamaica) (96.9) and regional (St. James) (96.4) ratios indicating that the SIA had a higher level of females then both the national and regional populations.

The child dependency ratios for St. James in 2001 was 551 per 1000 persons of labour force age, old age dependency ratios stood at 104 per 1000 persons of labour force age respectively and societal dependency ratios were 655.

The child dependency ratio for the SIA in 2001 was 535 per 1000 persons of labour force age; old age dependency ratio stood at 80 per 1000 persons of labour force age; and societal dependency ratio of 615 per 1000 persons of labour force. This indicates that the youth (child dependency) is more dependent on the labour force for support when compared with the elderly.

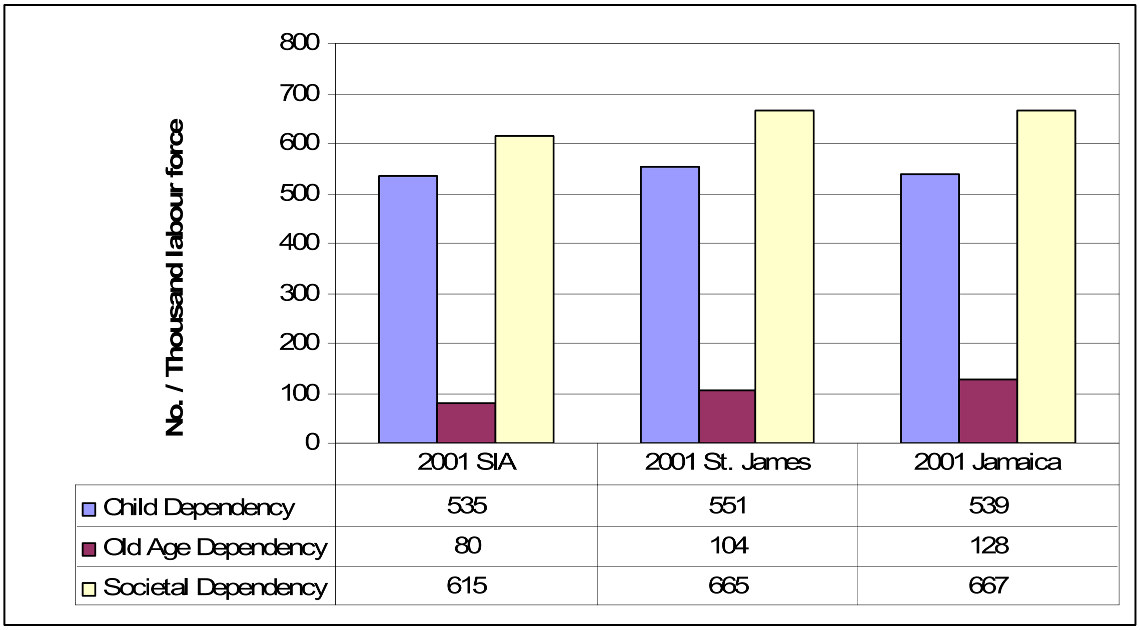


Figure 4.52 Dependency Ratios

A comparison of the dependency ratios revealed that there was a higher dependency on working population in the parish of St. James and the population of the Nation in 2001 for child, old age and societal support when compared to the SIA.

Population Densities

The land area within the SIA was calculated to be approximately 40,823,122.33 m^2 (40.8 km^2). With a population of approximately 53,957 persons the overall population density was calculated to be ≈ 1,322 person / km^2. This population density is higher than both the regional (Parish) level, which is at approximately 296 persons/km^2 and National figure (238 persons/ km^2) by at least fourfold. The population density of the SIA is considered high, however, this average density should be taken with the background that there are areas of really high densities within the SIA which has skewed the numbers for example Providence Housing Scheme, Glendevon and Rosemount. Figure 4.53 shows that the areas with the high densities are found southwest of the proposed hotel site.

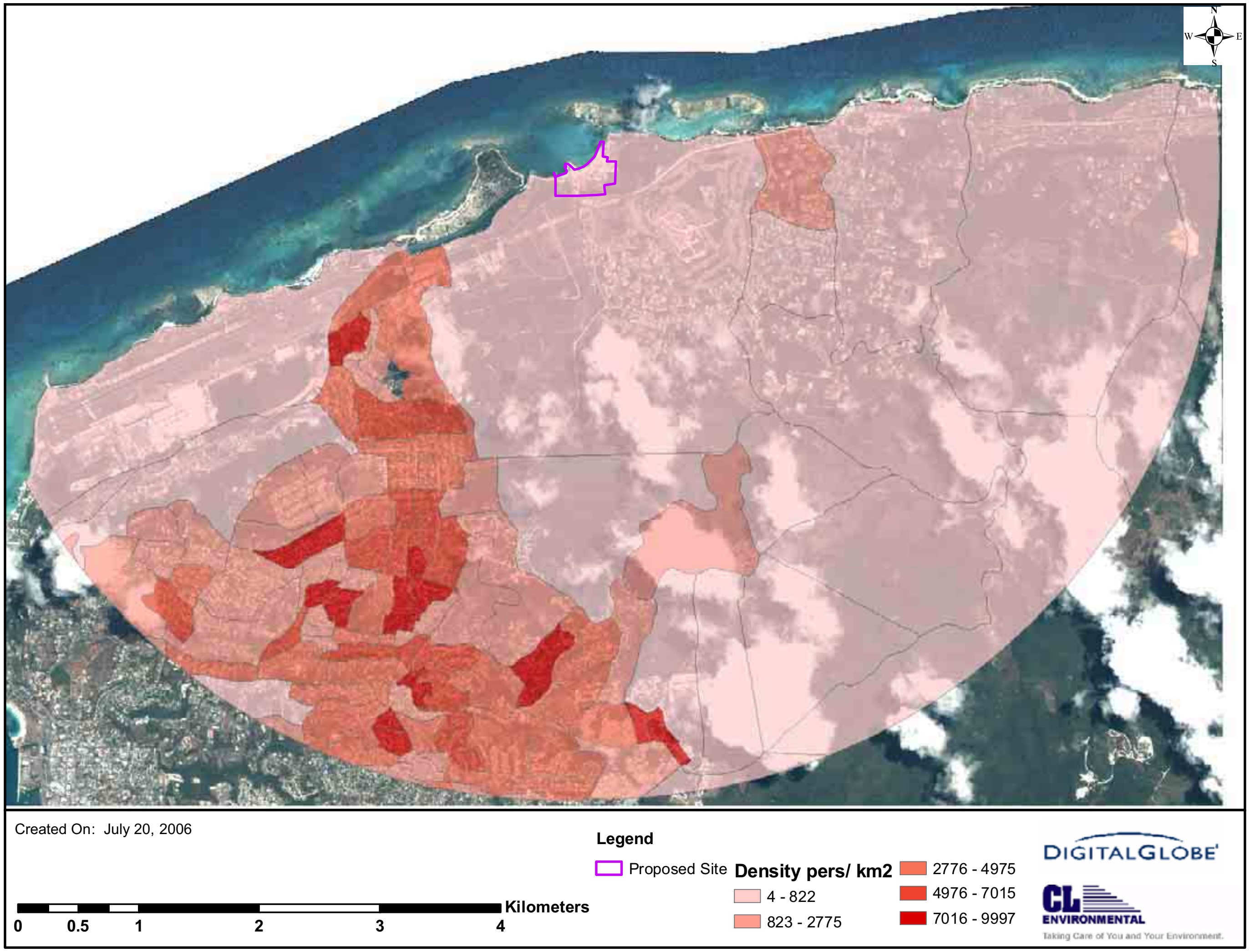


Figure 4.53 Population density map

4.10.2 *Employment and Income*

The categories of the workforce within the SIA ranged from professional, skilled and semi-skilled, casual labour and artisan.

The types were Business Persons, Bankers, Accountants, Lawyers, Waiters, Store Clerk, Computer Technicians, Fishers, Mechanics, Chefs, Masons, Electricians, Taxi Drivers Carpenters, Domestic Helpers, Butchers, Dressmakers, Security Guards and persons involved in Hospitality to name a few.

The stated incomes were as varied as the status of employment. Approximately twenty three percent (23%) of the persons interviewed were unemployed. Within the ranks of the employed, 44% were full time employees, 23% were self employed and 5% part time workers. None were employed seasonally. Five percent (5%) of those interviewed were retirees.

The stated incomes of those interviewed ranged from approximately J$501.00- over J$7,000.00 per week (US$7.59- >106.06/week @ US$1.00 to J$66.00). The majority (50%) of the respondents stated that they earned over J$7,000.00 (>US$106.06) per week. Approximately twenty percent 20% in the J$4,001.00-5,000.00 category and 10% each for those with stated earnings were in the J$3,001.00 -4,000.00, J$5,001-6,000.00 and J$6,001-7,000.00 categories.

Approximately sixty two percent (62%) of the households within the SIA had an average weekly income in excess of J$7,000. The percentage of households within the SIA earning an average weekly income of between J$4,001 – 5,000 was 10.3%, 8.6% earned J$5,001 -6,000, 6.9% earned J$3,001 – 4,000, 3.4% each for J$501- 1000 and J$6,001 – 7,000 and 1.7% each for those earning between J$1,001 -1,500, J$1,501- 2,000 and J$2,001 – 3,000 respectively. No household had an average weekly income below J$501.

There are approximately two hundred and fifty (250) licence fishers operating out of the Whitehouse fishing beach region of which approximately one hundred (100) are a part of the Old Harbour Bay Fishing Co-op. They earn on average J$3,000 - J4,000 per day.

Direct Employment in the Accommodation Sector

The number of persons employed directly in the accommodation sub-sector increased from 30,999 in 2004 to 31,227 in 2005. The main resorts of Montego Bay, Ocho Rios and Negril accounted for 26,987 persons or approximately 86% of the total number of persons employed directly in the sub-sector. Montego Bay with 9,667 direct jobs represented 31% of those employed, Ocho Rios with 8,794 direct jobs, accounted for 28%, and Negril with 8,526, was responsible for 27% (JTB, 2005). The average number of employees per room in 2005 was estimated at 1.19.

The proposed project is expected to employ approximately 600 trade men and labourers and at peak construction period, this number will increase to approximately 1200 persons and approximately 450 persons during the operation phase of the proposed development.

It is estimate that for every job created in the tourism sector in Jamaica, approximately 2 indirect jobs are created. The primary beneficiaries of these jobs are in the agriculture, transport, storage and communication and the construction and distribution sectors (Machel McCatty & Prudence Serju, Sept. 2006). The operation of the proposed hotel has the potential to generate some 900 indirect jobs.

Visitor Expenditure

Gross visitor expenditure in 2005 was estimated at US$1,545 million. This represents an increase of 7.5% against the US$1,437 million earned in 2004. Total expenditure of Foreign Nationals amounted to US$1,404 million. Cruise passenger expenditure totaled US$96 million while US$45 million was estimated as the contribution of Non-Resident Jamaicans. Foreign Nationals spent on the average US$103.51 per person per night while cruise passengers spent an average of US$85.21 per person (JTB, 2005).

Based on the JTB estimates and an average length of stay of 9.8 nights, it can be estimated that Montego Bay earned some US$424,804,522.50 from stop over visitors and US$27,860,602.44 from cruise ship passengers in 2005.

The proposed project has the potential to generate some US$33,141,397 per year based on the JTB average length of stay, average expenditure per stopover visitor per night and a 63% occupancy level.

This proposed project has the potential to create a positive impact on the labour force within the study area and by extension regionally and nationally and also the local and national economy.

4.10.3 Education

The educational attainment of persons four years and older in 2001 are represented in Table 4.35. Most persons within the SIA attained a secondary school education followed by those attaining a primary education. The educational statistics of the SIA were similar to the National and parish data, however, there were a noticeably higher percentage of those attaining a tertiary education and a lower percentage without any formal education. This maybe due to the fact that the area is close to a City and has numerous commercial and tourism related businesses.

Table 4.35 Educational attainment as a percentage of the population for persons 4 years and older

CATEGORY	JAMAICA	ST. JAMES	SIA
Pre-Primary	4.7	4.7	4.7
Primary	31.2	31.2	29.2
Secondary	49.7	49.8	49.8
University	3.1	2.1	2.4
Other Tertiary	5.9	6.9	7.8
Other	2.8	2.8	3.8
Not Stated	1.7	1.8	1.7
None	0.9	0.8	0.6

(Source: STATIN Population Census 2001)

Persons living within the study area attend approximately thirty two (32) schools and travel distances of up to approximately 60 km (≈ 37miles) to attend school.

The high percentage of the population attaining a secondary education suggests that the population within the parish and the study area should be easier to be trained to perform their job duties and functions within the tourism sector.

4.10.4 Land Tenure

In 2001, 39.4% of the households in the SIA owned the land on which they lived. Approximately, 17.2% rented the land on which they were, 14.8%, lived rent free, 14.5% did not report the type of ownership arrangements they had, probably due to informal arrangements ("squatting"), to which they did not want to admit to, 7.8% "squatted" and 2.1% had other arrangements (Table 4.36).

The higher percentage of households in the SIA owning, leasing or renting the land they are living on coupled with the fact that there was a lower percentage living rent free, squatting and having other ownership arrangements indicates that there were a higher percentage of households in the SIA compared to the national and regional setting with formalized living arrangements.

Table 4.36 Percentage household tenure nationally, parish and SIA

CATEGORY	JAMAICA (%)	ST. JAMES (%)	SIA (%)
Owned	37.5	38.2	39.4
Leased	5.0	5.8	4.2
Rented	14.8	15.7	17.2
Rent free	17.0	16.5	14.8
Squatted	2.9	6.6	7.8
Other	0.9	1.8	2.1
Not Reported	21.9	15.5	14.5

(Source: STATIN Population Census 2001)

4.10.5 Housing

For the purposes of this study the definition of housing unit, dwelling and household are those used in the conduct of the population census conducted by the Statistical Institute of Jamaica. This definition states that a "housing unit is a building or buildings used for living purposes at the time of the census. A dwelling is any building or separate and independent part of a building in which a person or group of persons lived at the time of the census". The essential features of a dwelling unit are both "separateness and independence". Occupiers of a dwelling unit must have free access to the street by their own separate and independent entrance(s) without having to pass through the living quarters of another household. Private dwellings are those in which private households reside. Examples are single houses, flats, apartments and part of commercial buildings and boarding houses catering for less than six boarders.

In 2001, there were approximately 41,625 housing units, 48,341 private dwellings and 49,741 households in St. James. The average number of dwelling in each housing unit was 1.2 and the average household to each dwelling was 1.02. The parish had an average household size of 3.52 persons/household.

Approximately ninety one percent (91.4 %) of the housing units in 2001 in St. James were of the separate detached type, 6.7 % attached type, 0.8 % part of commercial building and 0.1 % improvised housing, 0.2 other and 0.7 not stated.

In 2001, nearly seventy percent (69.2 %) of the households in St. James occupied between 1 and 3 rooms, 25.2 % between 4 and 6 rooms, 3.1 % occupied 7 and over rooms and 2.1% did not state how many rooms they occupied (Table 4.37). Most of the households in St. James occupied (25.5 %) one (1) room. Table 4.38 depicts the number of rooms that households used for sleeping within the parish (St. James) in 2001. Most of the households (87.9%) used between 1 and 3 rooms for sleeping, with the one bedroom being the most popular (37%).

Table 4.37 Percentage households by rooms occupied

NUMBER OF ROOMS OCCUPIED	% HOUSEHOLDS – ST. JAMES	% HOUSEHOLDS SIA
1	25.5	26.7
2	22.5	22.0
3	21.2	20.8
4	13.0	12.1
5	8.3	8.1
6	3.9	4.0
7	1.7	2.2
8	1.0	1.1
9	0.4	0.3
10 & OVER	0.4	0.5
NOT REPORTED	2.1	2.2

(Source: STATIN Population Census 2001)

Table 4.38 Percentage households by rooms slept in

NUMBER OF ROOMS SLEPT IN	% HOUSEHOLDS – ST. JAMES	% HOUSEHOLDS SIA
1	37.0	37.6
2	34.7	34.2
3	16.2	14.6
4	6.8	6.7
5 & OVER	4.1	4.7
NOT REPORTED	1.2	2.2

(Source: STATIN Population Census 2001)

In 2001, there were approximately 12,273 housing units, 14,813 private dwellings and 15,113 households the study area. The average dwelling in each housing unit was 1.2 and the average household to each dwelling was 1.02. The average household size was 3.57 persons/household.

A comparison of the SIA and national and regional ratios indicate that they were generally similar except for the higher national households/dwelling ratio and the higher local (SIA) average household size (Table 4.39).

Table 4.39 Comparison of national, regional and local housing ratios

	JAMAICA	ST. JAMES	SIA
Dwelling/Housing Unit	1.2	1.2	1.2
Households/Dwelling	1.03	1.02	1.02
Average Household Size	3.48	3.52	3.57

Separate housing accounted for 92.9 % of the housing units in the SIA in 2001. Approximately six percent (6.1%) was attached housing and 0.5 % part of a commercial building, 0.1% other, 0.4% did not state the type of housing unit and there were no improvished housing.

With the exception of the detached category which was higher in the SIA, the other categories were either similar or lower to what obtained in the parish.

In 2001, approximately sixty nine percent (69.5 %) of the households in the SIA occupied between 1 and 3 rooms, 24.2 % between 4 and 6 rooms, 4.1 % occupied seven or over rooms and 2.2% did not state how many rooms they occupied (Table 4.37). Table 4.38 depicts the number of rooms that households used for sleeping within the SIA in 2001. Most of the households (86.4%) used between 1 and 3 rooms for sleeping, with the one bedroom being the most popular (37.6%).

The average household size in the SIA was higher than both that of the parish and the nation. The fact that the majority of households occupied one room for sleeping suggests that there was some level of overcrowding occurring in the households. Based on the population growth and maintaining the existing average household size, then it is estimated that approximately 5,723 new housing units will be needed over the next 25 years (2001 – 2026) or approximately 229 housing units per year for the next 25 years.

4.10.6 Infrastructure

Electricity

Approximately 88.7 % of the households in the parish of St. James in 2001 used electricity. The use of kerosene (9.3%) was the next major source of lighting in households in this parish. Those households not reporting the type of lighting they used were 1.6% and those households with other means of lighting accounted for 0.4%.

In the study area in 2001, approximately 93.2 % and 5.2 % of the households used electricity and kerosene respectively. Those not reporting what type of lighting they used were 1.3% and those using other means for providing lighting to their households accounted for 0.3%.

There was a greater percentage of households within the study area using electricity was greater than in the parish (St. James). The percentage of households using kerosene in the study area was lower when compared with the parishes.

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

Telephone/Telecommunications

The parish of St. James is served with land lines provided by Cable and Wireless Jamaica Limited. Wireless communication (cellular) is provided by Cable and Wireless, Digicel Jamaica Limited and MiPhone for the parish.

In addition to telephones, there are numerous Internet service providers (ISPs) in Jamaica. The area is not an exception, with Internet cafes located in the town of Montego Bay. In addition, private homes and hotels have access to the World Wide Web.

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

Water Supply

Approximately 93.2 % of the households in the study area in 2001 received water from the National Water Commission, 2.7 % received water from private means, 2.4% had other means, 1.5% did not report what means they received their water and 0.2 % from spring/rivers.

Table 4.40 contains the estimated water consumption in the parishes of St. James and within the SIA in 2001 and 2006. It also estimates the future consumption in the year 2031.

Table 4.40 Estimated Water Consumption (in Litres per Day)

Location	2001	2006	2031
St. James	39,772,119	42,383,545	58,249,239
Study Area	12,254,714	13,059,400	17,947,931

Based on these estimates, the expected demand for water supply by the proposed development is not expected to have any potential negative impact on water supply for the area.

Water supply and storage for the proposed development was discussed previously. It is not anticipated that there will be any problems as it relates to the supply of water to the proposed development (Appendix H).

Wastewater Treatment

Past, current and future estimation of sewage generation are outlined in Table 4.41.

Table 4.41 Estimated Sewage Generation (in Litres per Day)

Location	2001	2006	2031
St. James	31,817,695	33,906,836	46,599,391
Study Area	9,803,771	10,447,520	14,358,345

In 2001, approximately 71.2% of the households within the study area disposed of their sewage by an inappropriate and inadequate manner (See Table 4.42).

Table 4.42 Comparison between the parish and the study area by sewage disposal methods as a percentage of the households

METHOD OF DISPOSAL	LOCATION	
	ST. JAMES (%)	STUDY AREA (%)
Water Closet	57.5	71.2
Pit Latrine	38.4	25.8
No established means	3.0	2.4
Not Reported	1.2	0.6

(Source: STATIN Population Census 2001)

A higher percentage of households in the study area compared to those within the parish use water closets to dispose of their sewage. There was a lower percentage of households in the study area using pit latrines, having no established means of disposing of their sewage or did not report their means of sewage disposal when compared to the parish statistics.

The building of the proposed hotel development is not expected to have a negative impact as the development will be linked to the Rose Hall sewerage system. A copy of the agreement between to provide sewage treatment is found in Appendix I.

Solid Waste Generation and Disposal

The Western Parks and Markets Waste Management Limited do solid waste collection. This service is provided free for the households within the area. The waste is transported to the Retirement dump in St. James which is located approximately 14.5 km (≈ 9 miles) from the proposed hotel site.

Private contractors do collection of solid waste from the hotels. This service is provided to the hoteliers for a fee, which is dependent on the frequency of collection. This waste is also transported to the Retirement dump. The collection of domestic waste appears to be inefficient as informal dump areas were seen throughout the study area and in particular on the projected project site.

It is estimated that households in the study area generated approximately 40.5 tonnes of solid waste in 2001. Based on the growth of the population it has been estimated that at the time of this study approximately 43.4 tonnes of solid waste was being generated and it is expected that within the next twenty five years if the population growth rate remains the same to be approximately 79 tonnes.

The 2001 census data indicated that approximately 44.5% of the households in the parish of St. James had their garbage collected by public means (Western Parks and Markets Waste Management Limited), with a higher percentage (64.4%) in the SIA. It also showed that the next preferred method of disposal in the SIA was by burning (Table 4.43). All the other categories of garbage disposal in the SIA were higher than or equivalent to the National and regional figures except the categories of private collections and burying. The fact that approximately a quarter (25%) of the households in the SIA burn their garbage as a means of disposal has the potential to impact on ambient air quality by creating air pollution. The areas with the high percentage of households burning the garbage are sufficiently far from the proposed site that they should not impact the airshed of the proposed hotel (Figure 4.54)

Table 4.43 Percentage households by method of garbage disposal

DISPOSAL METHOD	JAMAICA (%)	ST. JAMES (%)	SIA (%)
Public Collection	47.7	44.5	64.4
Private Collection	0.5	0.4	0.3
Burn	43.0	44.0	25.0
Bury	1.2	1.1	0.2
Dump	6.0	8.2	7.0
Other Method	0.3	0.2	0.3
Not reported	1.3	1.5	3.0

(Source: STATIN Population Census 2001)

Assuming that the hotel has an occupancy of three (3) persons per room, it is estimated that the proposed development is anticipated to generate approximately 4,837kg (≈4.8 tonnes) of waste per day. This is a conservative estimate. The operation of the hotel is not expected to have a negative impact on the collection and disposal of solid waste within the SIA.

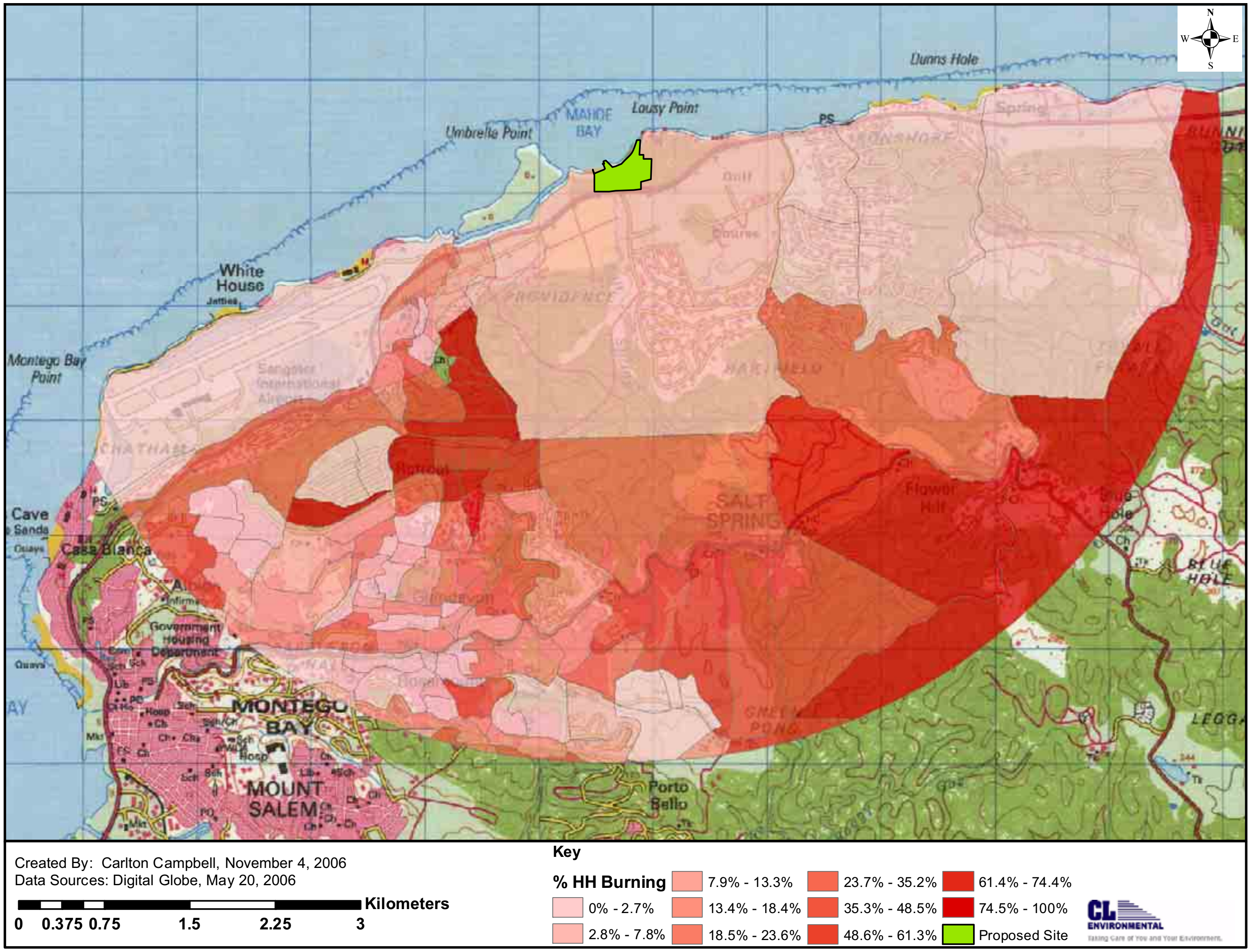


Figure 4.54 Percentage households in the SIA burning garbage

Roads and Transportation

The Montego Bay to Falmouth main road runs through the study area. It parallels the southern boundary of the proposed hotel development (Figure 4.55). The road surface is in a poor state of repair. This is compounded by the works being conducted on the NCHIP Phase 2A (Montego Bay to Greenside). This scope of works involves the dualization of the portion of road between Montego Bay and Rose Hall. Phase 2A is expected to be completed by September 2007.

Access from the site to the proposed Phase 2A of the NCHIP will be along the existing road to Blue Diamond shopping centre. Here it will join to Phase 2A and traffic flow to and from the new highway will be regulated by traffic signals. This will alleviate any potential issues as it would relate to traffic accessing and entering the site from the highway

Transportation within the study area is provided by a fleet of route taxis and "robot taxis" (unlicensed). There are also rent-a-cars, bikes and motorbikes companies in proximity to he proposed site. Montego Bay has a transportation centre located behind Court's on Barnett Street and the St. James parish Council have plans to build another transportation centre near the clock tower on Barnett Street. There are taxi stands located at the Life of Jamaica Shopping Centre Roundabout, William Street, Corner of Orange & Market Streets, Bay West Shopping Centre and Shell Station at Union & St. James Streets at which travellers can go to get taxis for travel within the SIA.

Workers to the proposed hotel will need to take these taxis and buses to go to work. In addition, transportation to and from hotels and the airport is also provided by tour companies and Jamaica Union of Travellers Association (JUTA) buses and cars.

It is anticipate that some local taxis and buses will have contracts to provide ground transportation to guests when the proposed new hotel is constructed.

Air Transport

The Sangster International airport is situated approximately 4 km (≈2.5 mile) southwest of the proposed project site. It provides air transport to international destination and other sections of the island. The "hub" of Air Jamaica is located at the Sangster International airport. Domestic air service is provided to Kingston (Tinson Pen), Port Antonio (Ken Jones) and Ocho Rios (Boscobel). Four (4) domestic air carriers serve the Sangster airport. These are TimAir and International Air Link. In addition, AirPak Express and TARA provide air courier service.

There are approximately thirty two international airlines operating out of the Sangster International airport. In addition, there are charters that operate to the airport. Recently, additional airlift has been added to the destination from; Spirit Airlines out of Ft. Lauderdale and Orlando, Florida Delta Airlines out of Cincinnati, Ohio, United Airlines out of Dulles, Washington DC, American Airlines out of Dallas, Texas Chartered service from Canjet, Sunwing and Westjet out of Toronto, Halifax and Ottawa, Canada. First Choice began an additional service from London Gatwick and Virgin Atlantic will begin a twice weekly service from London in July 2006.

Figure 4.55 Map depicting a section of the North Coast Highway Improvement Programme (NCHIP) – Phase 2A

Health Care

In addition to the private doctors that work in the SIA, there are seven locations where persons within the study area obtain their health care. These are, Cornwall Regional Hospital, MoBay Hope Hospital, Barrett Town Clinic - Type I, Flankers Clinic - Type I, Glendevon Clinic Type I, Green Pond - Type I and Salt Spring Type II.

The closest hospital to the proposed site is MoBay Hope which is approximately 4.6 km (≈3 miles) from the proposed site. It provides 24 hours emergency care and medical diagnostic services seven days per week. It offers General Practice, Radiology Services, Woman Wellness Services, Obstetrics & Gynaecology and Laboratory Services (http://www.mobayhope.org/).

The Cornwall Regional hospital which is the largest in the Caribbean is located approximately 9 km (≈ 5.5 miles) southwest of the proposed site. This hospital is a Type A. Type A Hospitals are multi-disciplinary and are the final referral points for secondary and tertiary services.

The construction and operation of the proposed hotel development is not expected to have a negative impact on the health delivery system.

Shopping

The City of Montego Bay is the main commercial centre for the study area. However, persons travel as far as Savanna-la-mar, Lucea, Negril and Falmouth for their shopping needs. Within the SIA there are numerous supermarkets and shops which persons in the SIA can go to for their shopping needs. There is the Blue Diamond shopping centre and Parkway Plaza to name a few.

4.10.7 Other Services

Financial Services

There are two commercial banks (Bank of Nova Scotia (cashless) and National Commercial Bank) that are situated in the SIA. They are located in Golden Triangle Mall and the Half

Moon shopping village (NCB). There are cambios and Bill Express and Paymaster located in Montego Bay and the SIA. In addition, most hotels provide Bureau de Exchange, where guest can convert their currencies to Jamaican dollars.

Fire Station

There is one fire station within the SIA. It is located at Ironshore approximately 1 km (≈ 0.6 miles) southwest of the proposed development site however there is one located in the City of Montego Bay, some 9 km (≈ 6 miles). Currently, this station has one fire truck and if required backup is received from the headquarters in Montego Bay which has three trucks. This truck has a capacity of 5,000 litres (≈ 1,100 imp. gals.). In addition, there are fire hydrants located at the Blue Diamond Shopping centre and surroundings.

The proposed development has its own designed fire control system (Figure 4.56) with a series of fire hydrants, fire extinguishers, fire houses and smoke detectors and alarms and a Programmable Logic Centre (PLC) (Plate 4.40). It is not anticipated that there will be any problems as it relates to a fire event.

Police Station

The Coral Gardens police station is responsible for policing the Mahoe Bay area. The incidence of major crimes are low. The main crimes committed in the SIA area are break-ins, aggravated assault, shootings and car theft. The incidents of these occurring are viewed as low by the security forces. They however, felt that the most volatile community in their jurisdiction was Flankers (approx. 3km) southwest of the proposed site with major incidents mainly domestic disputes.

Crime is not expected to be a major problem impacting on the proposed development.

Figure 4.56 Schematics showing fire control systems for the proposed hotel

Plate 4.40 Examples of the proposed fire prevention and response systems

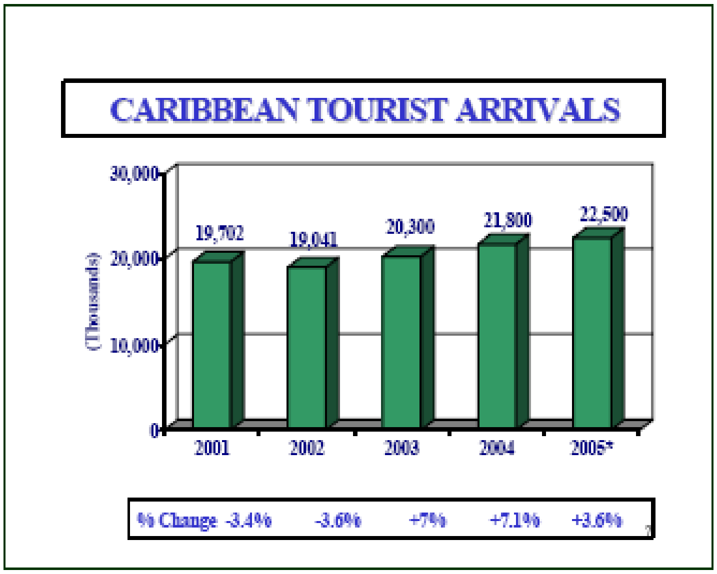
Post Office

The study area is served by three (3) post offices. These are Half Moon, Little River and Montego Bay 1 Post offices. It is anticipated that there will not be any potential negative impact on the post office operations due to the proposed construction and operation of Clubhotel RIU hotel in Mahoe Bay.

4.10.8 Tourism and Beach Use

Preliminary figures from the World Tourism Organization (WTO) indicate that international tourist arrivals are expected to exceed 800 million for 2005 with a growth of 5.5%.

The Caribbean tourist industry performance in 2005 was again affected by an active hurricane season. Despite the effects of these hurricanes, the Caribbean Tourism Organization (CTO) estimates that tourist arrivals to the region increased by some 3.6% to reach 22.5 million in 2005. In terms of major markets, it is estimated that tourist arrivals to the Caribbean from the United States increased by 2%, Europe increased by 7% and Canada increased by some 6%. The main factors influencing this performance during last year include the after effects of a very active hurricane season in 2005, the rising cost of fuel with its impact on airline costs, and resurgence of competing destinations after the Gulf War and SARS have been distinct constraining factors (Jamaica Tourist Board).



(Source Jamaica Tourist Board – Annual Travel Statistics 2005)

Figure 4.57 Five year trend of Caribbean tourist arrivals

In 2005, Jamaica's total stopover arrivals increased by 4.5% to 1,478,663, with Foreign Nationals increasing by 4.5% (1,386,996) and Non-resident Jamaicans by 4.3% (91,667). Jamaica ranked seventh out of thirteen selected Caribbean destinations in terms of growth in stopover arrivals from 2004 to 2005 (Table 4.44).

Table 4.44 Ranking of thirteen selected Caribbean destination in growth of stopover arrivals from 2004 - 2005

RANKING	COUNTRY	PERCENTAGE CHANGE 2004 - 2005
1	Anguilla	+15
2	Cuba	+13.4
3	British Virgin Islands	+9.9
4	Dominican Republic	+7.2
5	St. Lucia	+6.5
6	US Virgin Islands	+5.8
7	Jamaica	+4.5
8	The Bahamas	+4.4
9	Aruba	+0.6
10	Curacao	-0.6
11	Barbados	-0.7

RANKING	COUNTRY	PERCENTAGE CHANGE 2004 - 2005
12	Bonaire	-1.0
13	Antigua & Barbuda	-2.8

(Source JTB – Travel Statistics 2005)

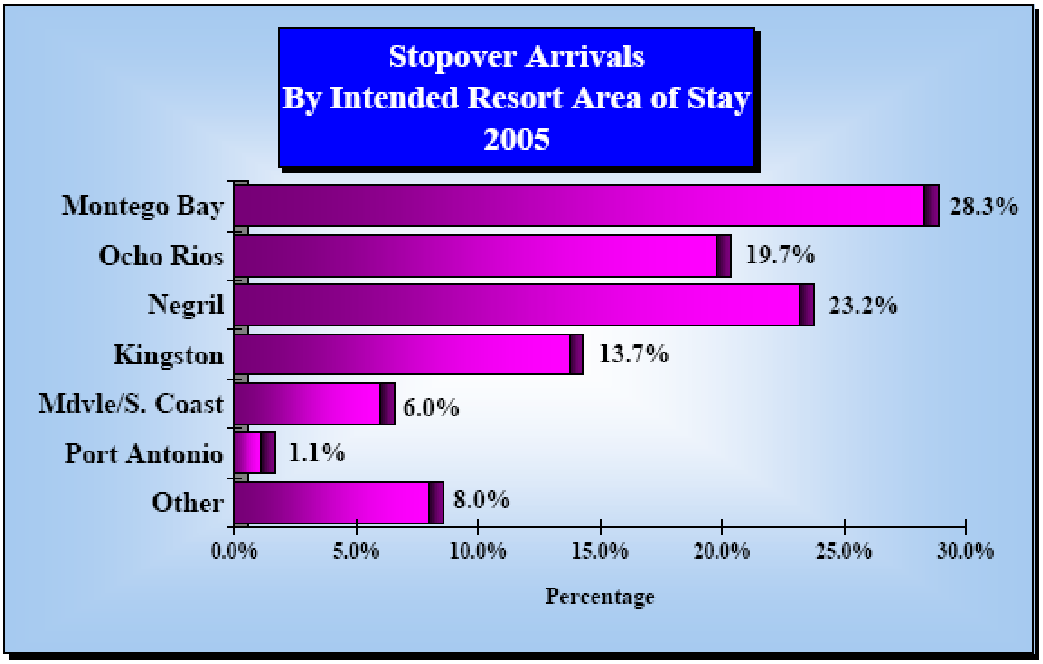
There was an increase in arrivals in Jamaica during the last quarter of 2005 which can be attributed to the diversion of some traffic from Cancun following the after effects of hurricane, Wilma on Cancun, the opening of the new 850-room RIU hotel in Ocho Rios in November, and the increase in air seats and new airline service out of Jamaica's main marketing regions (Jamaica Tourist Board).

The overall average intended length of stay for foreign nationals in 2005 was 9.8 nights, a marginal decline over the 9.9 nights recorded for 2004. The average length of stay of foreign nationals staying in hotels was 6.9 nights compared to 6.5 nights in 2004. This showed a marginal increase. Those who stayed in non-hotel accommodations were here for an average of 16.4 nights down from 17.8 nights in 2004.

American visitors, on the average, stayed 8.5 nights slightly up from the 8.3 nights in 2004, Canadians stayed an average of 11.8 nights as against 12.9 nights in 2004 and visitors across from the United Kingdom recorded an average length of stay of 16.6 nights, which was down from the 17.2 nights recorded in 2004. The average length of stay of visitors for continental Europe was up from 2004 (11.2 nights) to 11.5 nights in 2005.

Arrivals from Caribbean territories to Jamaica declined by 2.5% with 50,239 visitors in 2005. The Cayman Islands, with 15,822 stopovers, Trinidad and Tobago with 7,520, Barbados with 5,320, and the Bahamas with 2,801, continued to be the main providers of visitors to Jamaica from the Caribbean. These countries combined contributed 63% of stopovers visitors of the total Caribbean arrivals (Jamaica Tourist Board).

Montego Bay was the most favoured resort area in 2005 accounting for 28.3% of the stopover arrivals (Figure 4.58).



(Source JTB – Travel Statistics 2005)

Figure 4.58 Stopover arrivals by intended resort area

Cruise

The number of cruise arrivals to the Caribbean in 2005 was estimated at 19.8 million. Table 4.48 represents the end-of-year results from eleven selected destinations. Jamaica ranked fifth in the number of cruise passenger arrivals of eleven (11) selected Caribbean islands and was one of only three markets to record a growth in these arrivals in 2005 (Table 4.45). The growth in cruise passengers to Jamaica is expected to increase as there are plans to improve the port facilities which include increased berthing space and depths at Montego Bay and Ocho Rios. This will result in mega cruise liners which are not currently being able to dock to call on these ports thereby carrying more passengers.

Table 4.45 Cruise passenger arrivals for eleven selected Caribbean Islands for 2005

ISLAND	NUMBER OF PASSENGERS	% CHANGE OVER 2004
Bahamas	3,349,998	-0.3
Cayman Islands	1,798,999	6.2
US Virgin Islands	1,912,539	-2.7
St Maarten	1,488,461	10.4

ISLAND	NUMBER OF PASSENGERS	% CHANGE OVER 2004
Jamaica	1,135,843	3.3
Belize	800,331	-6
Barbados	559,765	-22.4
Aruba	552,819	-4.1
Antigua	466,851	-10.7
British Virgin Islands	449,152	-3.7
St. Lucia	394,364	-18.1

(Adapted from JTB – Annual Travel Statistics 2005)

Hotel Room Occupancy

During 2005 the average rate of hotel room occupancy increased by less than 1 percentage point to 61.9% when compared to 61.4% in 2004. This is the second time since 1995 that the hotel room occupancy level has reached in the 60's. The number of stopovers that intended to stay in hotel accommodations in 2005 was 961,590, an increase of 3.6%, compared to 2004. Total room nights sold of 3,253,149 increased by 3.8% from 3,133,963 in 2004. The increase in arrivals did not have the same positive impact on hotel room occupancy due to the parallel increase in hotel room capacity.

In the resort region of Montego Bay, the annual hotel room occupancy rate was 63%, which was down less than 1 percentage point from the 63.5% recorded in 2004. The total number of room nights sold decreased by less than 1% moving from 1,101,273 in 2004 to 1,095,700 in 2005. This could be attributed to the temporary closure of some hotels because of a freak storm in late April, which affected the rooms available during May and June as well as several hotels took the opportunity of a slow September to embarked upon a refurbishing programme in anticipation of the 2005/2006 winter tourist season.

The resort area of Negril recorded increases in stopover arrivals, hotel room capacity and room nights sold. An average hotel room occupancy rate of 65.3% was achieved in comparison to the rate of 63.1% in 2004. The number of hotel room nights sold in this resort area increased by 4.6%, recording 943,355 room nights sold compared to 902,229 sold in 2004.

Hotels with over 100 rooms contributed 76.8% of the room nights sold during 2005; this category of hotel represents 15.6% of the total number of hotels in Negril.

The average hotel room occupancy for Ocho Rios was 60.3%, which was 2.7 percentage points lower than the 63% rate recorded in 2004. The total number of hotel room nights sold decreased by less than 1% moving from 802,102 in 2004 to 797,542 in 2005. The fall off in hotel room nights sold is directly related to the fact that the 730 room Sunset Jamaica Grande was closed for refurbishment for a substantial part of the year.

In the Mandeville/Southcoast resort area average hotel room occupancy rate moved from 33.9% in 2004 to 57.4% in 2005, an increase of approximately 24 percentage points. Room nights sold increased from 44,955 in 2004 to 138,107 being sold in 2005. This increase in room nights sold and room occupancy rate resulted from the growth in room inventory in the region.

Kingston & St. Andrew, achieved a hotel occupancy level of 58.8%, which was more than the 55.8% recorded in 2004. The number of room nights sold in Kingston & St. Andrew decreased slightly by less than 1%, moving from 272,033 in 2004 to 271,908 in 2005.

Hotel room occupancy for the resort area of Port Antonio was 15.4%, which was 7.8 percentage points lower that the level of 23.2% recorded in 2004.

Overall, the all-inclusive hotel room occupancy rate was 70.1%, which was approximately 2 percentage points lower than the 71.9% recorded in 2004. Non all-inclusive room occupancy rate moved from 39.1% in 2004 to 42.4% in 2005 an improvement of 3.3 percentage points.

Hotel room occupancy rate varied with the size of the hotel. Hotels with less than 50 rooms, recorded a rate of 34.8%. Hotels with 50 – 100 rooms, achieved a rate of 47.4%. Hotels in the size range of 101 – 200 rooms recorded a 66.9%, and hotels with over 200 rooms achieved a room occupancy rate of 71.3%.

Table 4.46 provides the breakdown of the number of units and rooms for tourist accommodations in Montego Bay.

Table 4.46 Tourist Accommodations in Montego Bay by Number of Units and Rooms available (2001 – 2005)

	UNITS					ROOMS				
	2001	**2002**	**2003**	**2004**	**2005**	**2001**	**2002**	**2003**	**2004**	**2005**
Hotels ≤ 50 rooms	29	29	28	28	28	784	788	752	752	751
Hotels 51-100 rooms	9	9	10	10	10	696	696	756	756	756
Hotels 101-200 rooms	7	7	7	7	7	995	995	995	995	994
Hotels > 200 rooms	9	9	9	9	9	3,374	3,374	3,374	3,374	3,373
Guest Houses	74	74	76	75	77	530	530	543	532	554
Resort Villas	385	385	387	378	380	1,359	1,359	1,376	1,312	1,299
Apartments	14	14	14	14	14	223	223	223	223	223
TOTAL	**527**	**527**	**531**	**521**	**525**	**7,961**	**7,965**	**8,019**	**7,944**	**7,950**

(Adapted from the 2000 Annual Travel Statistics)

There was an increase in the number of Guest Houses. The number of hotels generally remained stable over the last three years (2003 – 2005) and the number of apartments remained stable from 2001 – 2005 (Table 4.46). The number of Resort Villas showed fluctuating fortunes over the last three years (2003 – 2005).

The total number of rooms for tourist accommodation showed an increase from 2001 – 2003, declined in 2004 and showed a incremental increase in 2005 (Table 4.46).

The development of the proposed Clubhotel RIU Mahoe Bay will increase the hotel rooms in Montego Bay to above the 2001 figure. It will also inject much needed foreign exchange earnings to the Jamaican economy.

There were two major new hotel developments completed in 2005. These were the 360-room Sandals Whitehouse hotel at Parkers Bay in Westmoreland opened in March 2005 and the 850-room RIU III in Mammee Bay, St. Ann opened in November 2005. Additionally, there is construction on the Ibero Star properties at Rose Hall, Montego Bay which is schedule to be opened in March 2007 with 950 rooms, the 1,000 rooms Bahia Principe at Pear Tree in St. Ann is expected to open in November 2006, Palmyra Resorts and Spa – 556 in phase I and projected total to be over 1,600 rooms (Rosehall, St. James), Fiesta Grand Palladium Hotels &

Resorts - 1,000 and projected to be approximately 2,000 rooms (Hanover), Fuerte Hoteles - , Oyster Bay - 470 rooms in phase I and projected total to be over 2,000 rooms, Amatera – 2,000 rooms and 2,200 villa lots and Harmony Cove located at Duncans, Trelawny. All these development are slated to be developed along Jamaica's north coast.

Beach Use

"Going to the beach is a traditional recreational experience for many Jamaicans. With an increasing population, there is now greater demand for the use of beaches. This situation becomes more acute against the background of increased tourism development along the coastal strip demarcated for exclusive use. Thus, fewer beaches are available for the use of the public, many of which are of poor quality and/or lacking of facilities. In addition, there is on going competition from fishermen who encroach on designated bathing beaches in order to carry out their livelihood."

Two hotels are using a section of Mahoe Bay. These are the 186 rooms Sandals Royal Caribbean Resort (located at Lousy point) and the 50 rooms Coyaba Beach Resort & Club. Each hotel has its own licensed beach.

The public used the Caribbean Beach Park which was a commercial beach.

Prescriptive Rights

"In development of land adjoining the foreshore, no building or other structure may be placed within a strip of land immediately adjoining the foreshore of a minimum width of ≈ 8m (25 ft) and up to ≈ 30m (100ft) wide under certain circumstances to allow public access to the foreshore and to adjoining land. Buildings should be set back a further distance to maintain privacy where this is desired or where required by planning authority" (St. James Development Order).

It goes on to state, that the stretch between Rose Hall Lotholders beach (pass Holiday Inn) to the Trelawny border, there are a number of small natural beaches to which the public has prescriptive rights by reason of their immediate access from the main road along the coast.

Carrying Capacity

There are three types of carrying capacities which are an integral part to Sustainable Tourism Development and which forms an integral part of alternative tourism and eco-tourism (Attzs, 1999). These are,

- **Ecological Carrying Capacity** - the level of visitation beyond which unacceptable ecological impacts will occur, either from the tourists or the amenities they require.
- **Tourist Social Carrying Capacity** - the level beyond which visitor satisfaction drops unacceptably from overcrowding.
- **Host Carrying Capacity** - the level beyond which unacceptable change will be detrimental to the host community.

Manning (1996) suggested that sample indicators that may be used to illustrate the carrying capacity for coastal zones include:

- Degradation (% of beach degraded, eroded);
- Use intensity (persons per meter of accessible beach);
- Shore/marina fauna (number of key species sightings);
- Water Quality (faecal coliform and heavy metal counts).

It is normally considered by experts that a beach saturation point varies from 6-8 persons per square metre for the average type of beach, to a maximum of 10 persons per square metre for the best quality beach" (Vassiliou 1995, 51).

The consultant suggests that these figures should be revised to 1 person for every $8m^2$ of beach area. Table 4.47 outlines the length and area of the two beach areas.

Table 4.47 Beach Lengths and Areas

LOCATION	LENGTH (m)	AREA (m^2)
Site 1 – Western boundary close to the Salt Spring Gully (drain) to the eastern boundary near Sandals Royal Caribbean	290	17,226
Site 2 – Western boundary close to groyne to the eastern boundary close to the Salt Spring Gully (drain)	90	3,304

Assuming the beach for Site 1 extends 50 metres seaward and 10 metres landwards from the water line, then the useable beach area is approximately 17,226 m^2 and for Site 2 extends 30 metres seaward and 10 metres landwards from the water line, then the useable beach area is approximately 3,304 m^2. Therefore the total usable beach area is 20,530 m^2. There are no hotels using this section of Mahoe Bay.

If the proposed hotel guests and workers estimated to be 2,203 were to use the beach all at the same time (not likely), then the beach area needed would be 17,624 m^2. This is outside the carrying capacity the beach on Site 1 alone. However, with the addition of Site 2, the carrying capacity of the beach (beach saturation point) will not be exceeded.

Using the sample indicators suggested by Manning, it can be said that the carrying capacity within Mahoe Bay has not been exceeded and will not be exceeded with the addition of the proposed hotel.

4.10.9 Community Consultation and Perception

Approximately 66% of those interviewed were aware of the proposed RIU hotel at Mahoe Bay. 77% of the respondents knew of the development through word of mouth, whilst 33% from the media.

Of those interviewed, 96% were of the opinion that the site was suitable for this type of development and the remaining 4% were not and stated that setting up a park or some other development that the public could have access to would be much better for the area.

A number of interviewees believed that the construction of the hotel would not have any effect on them. Those that stated it would; listed employment opportunities as the main positive way in which the construction would affect their lives. Pollution, traffic problems and restricted access to beach were thought to be negative effects of the construction. Respondents stated that effects of the construction on the natural environment would include increased turbidity in coastal areas, loss of vegetation and sewage pollution.

Additional concerns of the respondents that are worth mentioning include:

- Roads in area need fixing
- Crime needs to be addressed
- More employment opportunities needed
- Community upliftment – community/ training centre

Special Interest Groups

From the responses garnered from Directors, the major concern is that of environmental degradation especially as it relates to waste management. More specific is the adequacy of treatment and disposal of sewage and the impact that has on the marine water quality.

A director opined that "the marine life which supports our tourism is just about dead around Montego Bay, along with the water quality. When our coast is no longer safe to swim, is when we will really feel the impact of this pollution. We cannot continue to kill our natural environment, it will come back to haunt us all when people stop coming to vacation with us."

Another was concerned if the proposed density will be in keeping with zoning stipulations.

Whitehouse Fishing Cooperative

The fishers were mainly concerned with soil erosion and sedimentation from the construction of the proposed hotel development citing the issues they had with sedimentation from the construction of the Ritz Carlton golf course which they have said attributed to damaging their fishing equipment and resulting in the destruction of Devils

Kitchen, their main fishing ground by increased algal growth. This they said it began in 1999.

Investigation into the claims in 2001 by NRCA now NEPA cleared the Ritz Carlton stating that they could not reasonably conclude that the volume of sedimentation occurring at Devils Kitchen originated from the area under development by the Rose Hall Development for the Ritz Carlton Golf Course.

4.10.10 Aesthetics

The area where the proposed Clubhotel RIU, Montego Bay is located in an area that was vegetated and zone for resort development. The proposed hotel has the potential to improve the aesthetics of the area.

5.0 ENVIRONMENTAL IMPACTS

An environmental impact is defined as any change to an existing condition of the environment. The nature of the impacts may be categorised in terms of:

- Direction - positive or negative
- Duration - long or short term
- Location - direct or indirect
- Magnitude - large or small
- Extent - wide or local
- Significance - large or small

To systematically identify the impacts associated with the proposed hotel development, an impact matrix was constructed which arrayed the main project activities against the relevant environmental factors. This matrix is shown in Table 5.1 and Table 5.2.

Table 5.1 Impact Matrix for Site Preparation and Construction

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. **Site Preparation**												
Retain Vegetation	x		x		x		x		x		x	
Vegetation Removal		x	x		x		x			x		x
Habitat Removal		x		x		x		x		x		x
Increased infiltration/runoff		x		x		x		x		x		x
Increased flood potential		x		x	x			x		x		x
Increased soil erosion		x		x		x		x		x		x
Noise		x		x	x			x		x		x
2. **Cut, Fill & Levelling**												
Generated solid waste		x		x	x		x			x		x
Dust		x		x	x		x			x		x
3. Material Transport												
Dusting & spillage		x		x	x			x	x			x
Traffic congestion, road wear		x		x	x			x	x			x
Routing along the Montego Bay – Falmouth main road		x		x	x			x		x		x
4. Improper Material Storage												
Dusting		x		x	x		x			x		x
Suspended solid runoff		x		x	x			x		x		x
5. Construction Works												
Noise		x		x	x			x		x		x
Dust		x		x	x			x	x			x
Beach enhancement/ damage/modification		x	x		x	x	x			x	x	
Mangrove/seagrass removal		x	x		x		x		x		x	
Visual intrusion		x	x		x		x			x		x
Refuelling of vehicles and fuel storage onsite		x		x	x			x		x		x
Repair of vehicles onsite		x		x	x			x		x		x
6. Construction Crew												
Sewage generation		x		x	x			x		x		x
Solid waste generation		x		x	x			x		x		x
Emergency response		x		x	x			x		x		x
Vending stalls		x		x	x		x			x	x	
Food Hygiene		x		x		x		x		x		x
7. Landscape & Replanting												
Vegetation/habitat reintroduction	x		x		x		x		x		x	
8. Employment												
Job creation	x			x	x		x			x	x	

Table 5.2 Impact Matrix for Operational Phase

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. **Water supply/Consumption**												
Sustainable supply	x		x			x		x	x			x
Water conservation methods	x		x		x		x			x	x	
2. **Wastewater generation/Disposal**												
Sewage		x	x			x	x			x		x
Laundry		x	x			x		x		x		x
3. Transportation/Traffic												
Traffic congestion		x	x			x		x		x		x
4. Beach Use/Carrying Capacity												
Water Pollution		x	x		x			x		x		x
Erosion		x	x		x			x		x		x
Overcrowding		x	x		x			x		x		x
Access		x	x		x		x			x	x	
Solid waste generation & disposal		x	x		x			x		x		x
Water sports		x	x		x		x			x		x
5. Emergency Response												
Emergency response		x	x		x			x		x		x
6. Landscaping												
Vegetation/habitat removal		x	x		x			x		x		x
Local vegetation/habitat intro.	x		x		x			x	x		x	
Retain Vegetation	x		x		x		x		x		x	
Improved aesthetics	x		x		x		x		x		x	
7. Site Access Road												
Increased surface runoff		x	x		x			x		x		x
8. Security Lights												
Disturbance of nocturnal fauna		x	x			x		x		x		x
Visual intrusion		x	x		x		x			x		x
9. Housing												
Demand for accommodation		x	x			x		x		x		x
10. Employment												
Job creation	x		x		x		x			x	x	

5.1 Site Preparation and Construction

5.1.1 Beach Works and Modification

Impacts

Excavating the sea floor is likely to generate higher wave heights which will propagate onto the shoreline. These incoming waves marginally exceed the wave heights that can be tolerated by the current sediments. However, as the median sediment size present will be lowered should the area be dredged, the wave height tolerable for beach stability will also be lowered. The resulting fall velocity ratio will then exceed one and sediment will move offshore. The proposed dredging exercise is thus likely to result in shoreline erosion.

Suction dredging of the intended area will result in a relative small plume at the point of suction. Discharge into a sedimentation pond that is properly sized on-site will result in the efficient removal of both silts (in the first basin) and sand (in the second chamber). The silt will be buried in the first basin or excavated and carried to the Retirement dump for disposal.

The discharge from the last basin if properly sized can be reduced to a minimum or none at all if the basin is allows for full percolation of the dredge discharge. The impacts under the no discharge scenario which is the intended operation of the dredging activities is therefore expected to be negligible.

The proposed dredging is expected to occur in an area of low biodiversity, low density and poor health. The impacts on the biota are therefore not expected to be adverse.

Mitigation

(i) The presence of the mitigating offshore reef structure and

(ii) Possibly the construction of submerged nearshore breakwater should mitigate against any increase in operation or swell wave climate next to the shoreline.

(iii) Enclosed the dredging area with silt screens so as to localize any potential plumes from the activities.

(iv) Ensure that any overflow from the sedimentation ponds do not go directly to the marine environment.

5.1.2 Drainage

Impacts

The main gully that divides the property has the potential for the channel being overtopped. The site is proposed to be filled to 3m above mean sea level. This will minimize the risk of flooding of the site.

Mitigation

(i) Ensure that the site is filled to the desired elevation.

(ii) A berm should be constructed a long the embankment.

(iii) The measures implemented should be designed to the 50 years return period rainfall event.

(iv) Install silt fences during construction so as to prevent the potential impacts from silting.

5.1.3 Site Preparation and Vegetation Clearance

Impacts

Site clearance and construction, associated with the proposed development, will inevitably mean the removal of existing vegetation. The removal of vegetation will open up the canopy, remove ground cover and expose soil. Runoff during heavy rainfall may carry sediments, bits of vegetation and particulates with it into surface gullies and the nearshore marine waters of the project site. However, due to the generally flat topography of the project site, the negative impact of sediment loaded storm water runoff may not be substantial or significant, provided the mitigation measures recommended below are adhered to. Any soil erosion taking place is expected to be localized and contained.

Impacts of indiscriminate site clearance practices generally negatively impact existing vegetation/trees, i.e. through their removal. With respect to the proposed project site (and with intention of mitigating against the latter negative impact), a detailed tree survey and mapping exercise was conducted, during the EIA. Floral species of importance (and those worth retaining) were concurrently flagged with tape, during the tree survey exercise. These marked trees/vegetation will be retained and any potential negative impacts of indiscriminate/selective removal of trees and vegetation is expected to be insignificant and satisfactorily mitigated.

As previously discussed, onsite avifauna species diversity was low, habitat diversity was low and the proposed site is relatively disturbed, with few available habitats for concealment, foraging and nesting (other than within the tree canopy itself). As a result the proposed site is considered less than ideal for supporting large and diverse bird populations. Existing trees (more specifically those of ecological significance) will be retained and, as such, potential negative impacts of construction work, on avifauna frequenting the site, are expected to be short-term and minor.

Birds presently using the project site will primarily be impacted by noise generated by construction activities. It is expected, however, that they will retreat to adjacent surrounding vegetation communities and will return once construction activities have ceased (and the hotel is operational).

Mitigation

(i) Exposed areas should be replanted and grassed as soon as possible after construction to reduce soil erosion, sediment and organic runoff.

(ii) To reduce the amount of organic waste, and deter its inappropriate and unsightly disposal, softer vegetation should be composted on site and used for soil amendment during landscaping, whilst harder trunks and branches should be chipped (using a wood chipper) or made available to local charcoal burners or dumped at an approved location. The burning of the waste vegetation must not be allowed to take place.

5.1.4 *Effect on Ecosystems and Tree Conservation*

Impact

Vegetation clearance and construction associated with the proposed development, will inevitably mean the removal of some of the existing vegetation at the hotel site. The issue, therefore, is which species can be removed, how many individuals would be lost and which sections of the sites they would be removed from. The environmental NGOs and NEPA are specifically interested and concerned about the impacts that this vegetation removal would have on the existing environment and its corresponding terrestrial fauna.

Several flora and fauna species were identified during the 4 - 5 days of terrestrial surveys, conducted at the proposed site (see Section 4.5.1 and 4.5.2). These include avifauna (birds), crabs, amphibians, reptiles and insects, which are not only independent entities and classes but together make up a complex ecosystem. This system is dependent on the interactions, food chains, food webs and relationships that exist between the various floral and faunal classes found on the project site. Therefore, changes made to the diversity or abundance of any given organism, has a potential impact (either positive or negative) on other seemingly non-related organisms residing on and frequenting the project sites. The proposed alterations to the existing environment at the proposed site should therefore be carefully considered before implementation.

Critical ecosystem (and habitat preservation) species include onsite vegetation, the amphibians, the reptiles, and the insect populations identified under Section 4.2.4. Avifauna rely directly and indirectly on the existence, diversity and the numbers of amphibians, reptiles and insects present at the site. These amphibians, reptiles and insects in turn rely on the diverse floral habitat and species found at the site. Any large-scale removal and clearance of vegetation, from the proposed hotel site, is unacceptable. Mitigation methods are discussed below.

Mitigation

The main issue and goal in this development is to retain and maintain adequately-sized, representative sections of the main onsite terrestrial floral and faunal habitats. These habitats are required for the retention of the amphibian, reptile and insect species at the site which themselves support the crab and avifauna populations residing and utilising the site as a living and foraging habitat. In this regard, the implementation of the following mitigation measures are suggested:

(i) **Minimal removal of trees throughout all phases of the project life cycle** (i.e. site preparation and the construction and operational phases of the project). The proposed final landscape plan should seek to incorporate tree species and individuals already present on the site, as much as is practicable. This will also enhance the aesthetic quality of the hotel.

(ii) **No conversion of existing onsite habitat in favour of a lower density monoculture** of coconut/other introduced ornamental species; and/or reduction in the species and number of floral individuals at the site, in favour of extensive wide open, cleared, bare or grassed spaces unless absolutely necessary.

(iii) A **Tree Preservation Plan** is recommended before construction work begins. RIU's design architect should submit a plan for a final layout for the hotel that best suits the interests of the developer, yet seeks to retain as many of the onsite trees.

The plan should address the following recommendations:

- Trees/vegetation that fall within the building footprints of the approved layout plan should be preserved.
- Trees and vegetation stands throughout the remainder of the site that have a Diameter at Breast Height (DBH) of 18 cm should be retained.

The selected trees should be physically and clearly marked for protection. Trees were already marked prior to the fieldwork for this study (Section 4.5.1). Selected trees should be incorporated into RIU's final layout and "existing vegetation" topographic (CAD) drawings. These drawings must be subsequently passed on to the building contractor, with specific instructions with regards to implementing and adhering to the vegetation preservation plans and drawings.

The Consultant recommends that selected vegetation, earmarked for removal, be removed with their root systems intact. They should then be kept alive in a temporary designated onsite nursery area and replanted onsite during landscaping and the operational phase of the project.

In addition, legally binding "stop order" caveats must be written into the building contractor's work contract, with regards to any violation of the tree retention and preservation agreements, made under (iii) above. Evidence of violation or unauthorised deviation from the NEPA-agreed tree preservation and final hotel layout plans, must result in the "stop order" caveats being invoked by onsite monitoring representatives, pending a detailed review of onsite site clearance/construction practices and more regular, stricter and stringent policing of these practices.

(iv) During site preparation, site clearance and site construction, tree preservation, retention and removal must be **closely monitored and policed by RIU/a representative of RIU/NEPA's local personnel**.

(v) *Coccoloba uvifera* (Sea Grape) and mangroves should not be cut and should be incorporated in the hotel's landscape plan where possible. If falling in the footprints of buildings, every effort should be made to relocate such trees.

5.1.5 Preservation of Endemic Species

Impacts

As reported in Section 4.5.1, *Roystonea sp.*, *Roystonea princeps*, Prickly Pole and *Thrinax sp.* were observed throughout the site. These will also be considered in the Tree Preservation Plan, but also need to be highlighted as the preservation of these plants is not only of local importance, but national significance.

Mitigation

i. *Roystonea sp.*, *Roystonea princeps*, Prickly Pole and *Thrinax sp.* may be relocated and preserved if they fall within the footprints of the proposed buildings.

ii. If the latter trees cannot be relocated successfully, then adequate and suitable replacements (i.e. of identical species) should be replanted.

5.1.6 Noise Pollution

The proposed hotel construction will involve clearing of the land, earthwork, building construction and landscaping. It is anticipated that construction activities will take place seven (7) days per week.

Excavation of the foundation will be the first step. Bulldozers and front-end loaders will excavate the soil and load it onto trucks for transport to an approved landfill for disposal or redistribute on-site. It is anticipated that approximately two to four truckloads of debris will be removed per hour. The proposed construction site is in close proximity of the coast and it is anticipated that excavation areas will have to be dewatered. This will involve the use of pumps to remove the water.

After the excavation works have been completed, concrete trucks will arrive at the site with pre-mixed concrete and pump it into the site to form the foundations and building walls. Foundation work will use equipment such as excavators, bulldozers, loaders, pumps to remove water (both storm and groundwater), backhoes, tractors, hammers, motorized concrete buggies, concrete pumps, jack hammers, pneumatic compressors, a variety of small (mostly hand-held) tools and concrete trucks. It is estimated that foundations and below-grade construction of the proposed buildings will last for approximately 3 to 4 months.

Construction of the exterior enclosure or "shell" (superstructure) of the buildings will include construction of the framework (installation of beams and columns), floor decks, facade (exterior walls and cladding) and roof construction. These activities will require the use of equipment such as tower cranes, derricks, compressors, front-end loaders, concrete pumps, on-site bending jigs, welding machines and a variety of hand-held tools, in addition to delivery trucks bringing construction materials to, and waste from, the site.

Interior construction and finishing of the building will include the construction of interior walls, installation of lighting fixtures, and interior finishes (flooring, painting, etc.), as well as mechanical and electrical work. Mechanical and other interior work would last another 14 months. Equipment used during interior construction would likely include exterior hoists, pneumatic equipment, delivery trucks, and a variety of small hand-held tools.

The general construction phase is expected to last 18 months.

Table 5.3 lists noise emissions from typical construction equipment. The data from this will be used to estimate the potential noise impact from the construction of the proposed hotel.

Table 5.3 Typical noise emission levels for construction equipment

Equipment	Noise Level at 15m (dBA)
Air Compressor	81
Asphalt Spreader (paver)	89
Asphalt Truck	88
Backhoe	85
Bulldozer	87
Compactor	80
Concrete Spreader	89
Concrete Mixer	85
Concrete Vibrator	76
Crane (derrick)	88

Equipment	Noise Level at 15m (dBA)
Delivery Truck	88
Diamond Saw	90
Dump Truck	88
Front End Loader	84
Hoist	76
Motor Crane	83
Jackhammer	88
Pump	76
Roller	80
Shovel	82
Truck	88

Sources: Patterson, W.N., R.A. Ely, and S.M. Swanson, "Regulation of Construction Activity Noise," Bolt Beranek and Newman, Inc., Report 2887, for the Environmental Protection Agency, Washington, D.C.,

November 1974 and New York State Department of Environmental Conservation, "Construction

Noise Survey," Report No. NC-P2, Albany, NY, April 1974.

The types of noises emitted from the equipment are considered intermittent noise with the exception of noise from pumps, which is considered continuous noise.

The proposed construction activity will general generate intermittent noise within an estimated 85 dBA.

A conservative estimate of noise level at the boundaries from the construction activity at the northern, southern, western and eastern (close to Sandals) boundaries are 76.6, 76.0, 65.8 and 85 dBA respectively. This assumes the worst case scenario that multiple equipment listed in Table 5.3 above are being operated simultaneously and continuously. This will not be the case and as stated above, the type of noise generated by most of the equipment used in the construction will emit intermittent noise.

Although the estimated noise levels at the northern, southern and a section of the eastern boundaries are not in compliance with the NEPA standard of 75 dBA at the fence line. The fact that there are no neighbours at the northern and southern boundaries, makes the potential negative impact from noise pollution low. At the section of the eastern boundary, a combination of the fencing and the buildings on the Sandals property close to the fence will act as a noise buffer, therefore attenuating the noise and therefore reducing the potential negative impacts to the Sandal's guests and workers.

Mitigation

i. Use equipment that has low noise emissions as stated by the manufacturers.

ii. Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) so as to reduce the potential of creating a noise nuisance during the night.

iii. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

iv. Maintain pneumatic tools in optimum condition and keep air lines leaking

v. Fit silencers or mufflers

vi. Keep power saw blades sharp

vii. Use vibration damped blades

viii. Clamp material to be cut

ix. Use partial acoustic enclosures, which can easily be moved around the site.

x. Fit efficient silencers or exhausts fitted on jack hammers, excavators, back hoes, dumpers etc. In extreme noise sensitive areas so called 'critical residential type mufflers' can be fitted as a replacement of existing exhausts. Noise reduction of about 15dB(A) can be achieved this way.

xi. Hire compressors with acoustical grade casings.

xii. Keep enclosure panels on compressors closed.

5.1.7 *Air Quality*

Impacts

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

Mitigation

i. Site roads should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.

ii. Minimize cleared areas to those that are needed to be used.

iii. Cover or wet construction materials such as marl to prevent a dust nuisance.

iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

5.1.8 *Employment*

Impacts

During this phase, an average of six hundred (600) trade men and labourers will be utilized and at peak construction an estimated 1200 will be needed. This represents a significant level of employment within the study area. This has the potential to be a significant positive impact.

Mitigation

Not required

5.1.9 *Solid Waste Generation*

Impacts

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

i. From the construction campsite.

ii. From construction activities such as site clearance and excavation.

Mitigation

i. Skips and bins should be strategically placed within the campsite and construction site.

ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.

iii. The skips and bins at the construction site should be adequately covered to prevent a dust nuisance.

iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.

v. Disposal of the contents of the skips and bins should be done at an approved disposal site. The Retirement dump in St. James is recommended. Appropriate permission should be sought.

5.1.10 *Wastewater Generation and Disposal*

Impacts

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

Mitigation

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

ii. Connect to the Rose Hall Waste Water sewer main.

5.1.11 *Storage of Raw Material and Equipment*

Impacts

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

Mitigation

i. Raw materials that generate dust should be covered or wet frequently to prevent them from becoming air or waterborne.

ii. Raw material should be placed on hardstands (surrounded by berms) and away from drainage channels (e.g. Salt Spring Gut).

iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.

iv. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by berms to contain the volume being stored in case of accidental spillage.

5.1.12 Transportation of Raw Material and Equipment

Impacts

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along the existing Montego Bay-Falmouth main road. The entrance to the construction site will prove challenging as it enters the Montego Bay-Falmouth main road, immediately across from the Ironshore access road.

Mitigation

i. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example reduced speed near the construction site access road. This should be done in conjunction with the Ministry of Transport and Works.

ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.

iii. Trucks transporting raw materials should be made to enter the proposed site through one access point and leave through another. The trucks should be parked on the proposed site until they are off loaded. This will prevent the build up of trucks along the Montego Bay-Falmouth main road.

iv. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.

v. The use of flagmen should be employed to regulate when trucks have to enter and exit the construction site.

5.1.13 Aesthetics

Impacts

The proposed development will have some visual impact on the aesthetics of the location due to the fact that the proposed development will be taking place in a vegetated area which will be replaced by a built environment. There will however, be the potential impact of blocking the vista to the (bay) sea especially on Site 1. However, the blocking of the vista was done previously by vegetation on the proposed site.

Mitigation

i. Ensure that the proposed development has a landscape plan that incorporates as much of the existing vegetation;

ii. Plants to be introduced should be where possible native to Jamaica.

5.1.14 Vending

Impacts

With the expected 600 to 1,200 construction workers at the proposed hotel development site, one can reasonably expect that there will be the potential for "cook shops" to be set up in immediate vicinity to the development so as to provide food for these workers.

The Jamaican experience is that there are numerous vending stalls erected on any vacant lands whether it is on the road verges or private property. These stalls are erected in no organized fashion, covered with the unsightly blue tarp and there are usually no proper waste collection and storage facilities resulting in the area suffering from indiscriminate dumping of garbage. This has the potential to cause traffic congestion, traffic safety issues (vehicular/pedestrian interface) and impact on the aesthetics of the area.

Mitigation

i. An area designated for the establishment of these vending stalls should be demarcated before the initiation of the project.

ii. The vendors should be regularized and the persons and numbers established and policed by the Parish Council.

iii. Guidelines on the design and look of these vending stalls should be established and enforced by the Parish council.

iv. Proper waste collection, storage and disposal mechanisms should be established to deal with the expected solid waste issues.

5.1.15 Food Hygiene

Impacts

The establishment of a construction campsite will cause a proliferation of "cook shops" (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu likes symptoms such as nausea, vomiting, diarrhoea or fever.

Mitigation

i. Provision of adequate supply of potable water.

ii. The monitoring of the various 'cook shops" by public health authorities, and with the monitoring of the construction management team, to ensure proper hygiene is being followed.

iii. The provision of areas to adequately wash hands and utensils.

5.1.16 *Emergency Response*

Impacts

Construction of the proposed hotel will involve approximately 600-1200 construction workers. The possibility of accidental injury is high. There maybe either minor or major accidents.

Mitigation

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

ii. The RIU construction management team should have onsite first aid kits and make arrangements for the nurse and doctor at Mobay Hope to be on call for the construction site. Prior arrangements should be made with health care facilities such as Mobay Hope hospital to accommodate any eventualities.

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

5.2 Operations

5.2.1 *Earthquake Hazard*

Impact

From the catalogue of earthquakes impacting Jamaica over the past 300 years, most of the larger earthquakes recorded/reported were offshore. The earthquakes occurring on land tend to be of low magnitude. From a historical seismic perspective, the site is no more prone than any other area on the island.

Modified Mercalli Intensities for the 1957 earthquake reached VII to VIII in the Montego Bay area. At Ironshore, southeast of Mahoe Bay intensity VI was recorded. An intensity of V was reported for Salt Spring (Robinson et al. 1960). Although there are no first-hand accounts of the earthquake at Mahoe Bay, the location is more or less on the boundary of those areas where intensities of VI and VII were reported. Mahoe Bay lies within the zone of 5 to 9 earthquakes of MM VI or greater reported per century (Shepherd & Aspinall, 1980).

The major earthquake source zone on land is the Wagwater Belt in the western Blue Mountain area. The proposed site is more than two hundred kilometres (200km) from this source zone and therefore earthquakes in this area are not expected to cause significant damage at the proposed site. Given the distance of the proposed development from this source zone, the impact relating to earthquakes can be considered as moderate to low.

Mitigation

i. Proposed structures to be constructed at the site are low-rise and this implies a moderate to low earthquake hazard with respect to life and property.

iii. To minimize earthquake impact it is recommend that the buildings at the site be designed and constructed to withstand moderate to large earthquakes.

iv. An emergency response plan, to address natural and man-made disaster and possible evacuation, is required by NEPA and should be developed in close consultation with the Office of Disaster Preparedness and Emergency Management (ODPEM).

5.2.2 *Storm Surge Hazard*

Impact

Storm surges on the proposed development can have several negative results on the property. The destruction of landscaping, structural foundations etc. is most notable as sudden barrages of salt water can be very corrosive. Objects as well as people can be drawn out to sea depending on the intensity of the surge.

Storm Surge analysis combined with the Nearshore Wave Climate modelling results for the site indicate that water level increases of 1.56 to 2.25 m can be expected to occur for storms with Return Periods between 10 to 50 Years. These levels are well above the 0.6 m contour on the existing topographic survey which marks the property development boundary, as well as most other existing ground levels. The floor levels of the residential blocks tend to fall between 3.0 m and 3.3 m according to the surveyors datum, which is equivalent to a range of 1.93 m to 2.23 m heights when adjusted to mean sea level. As all analysis was based on a datum of mean sea level, these heights will be assumed as the planned floor heights for the residential buildings.

Mitigation

Two mitigations options can be employed for minimizing the likelihood of loss of life and damage to property from storm surge. These are as follows:

i. **No Loss and No Damage Option:** This option requires that all the buildings are elevated above the storm surge associated with the desired return period. The overall objective is to limit the amount of wetting of floor space. This option does however have its disadvantages. These include potentially excessive costs for landfilling and potential aesthetic issues with the landscape.

   As the 100 year return period storm surge could reach heights of 2.05 m above sea level, corresponding floor levels must be above 2.67 m if inundation is to be avoided. From the modelling exercises carried out for the purposes of this project, it was concluded that landfilling or elevation of the proposed buildings in the range of 0.45 m to 0.75 m will have to be carried out in order to prevent inundation of the hotel from 100-year return period storm.

ii. **Selective Elevation:** This option requires that infrastructure of critical importance (such as administration and expensive equipment) and selective infrastructure such as the 1st floor and higher on the hotel blocks are elevated above a certain critical storm surge level. The overall strategy being to safe guard the operation of the hotel and to provide potential shelter for visitors that may be resident at the hotel on higher levels. This strategy has the attractive advantages of providing for the disaster management need for shelter as well as minimizing the cost for landfilling.

iii. An off shore structure such as a breakwater, approximately 100 m in length should be considered by the developers. The inclusion of this structure would serve to stabilize the beach area by dampening the severe incoming wave energy and lowering the sediment transport along the shoreline.

iv. Minimize the risk of storm surge implementing an effective disaster and emergency management and evacuation plan for the hotel.

5.2.3 Beach Erosion Hazard

Impact

The erosion analysis indicates that the site could experience severe erosion loss in the range of 50 to 110 m behind the shoreline. This would occur in the event of the 50 and 100 year storm events from the northerly and north-westerly directions, and as much as vertical 280 mm (11 inches) of ground could be lost in some instances. The areas found to be exposed to high levels of erosion are Block 6 in its entirety as well as the northern portions of Block 5, the Chiringuito Restaurant and the main building.

Erosion can result in significant damage to property and landscaping. If any buried revetment to foundations exists, this will also be susceptible to damage. In extreme cases, the personal safety of the guests may be threatened. Erosion loss could also hinder the operations of the hotel as far as guest satisfaction is concerned, given the lack of beach space alternatives on this site.

Mitigation

Options that exist to mitigate or minimise the problem of storm induced erosion include:

i. Should the owner decide that the potential erosion losses are unacceptable, as far as operational risks are concerned, then coastal engineering options could be considered. Such options, if carefully thought out, could provide the required protection against erosion while blending with the natural surroundings. These include:

a) As mentioned previously, an offshore structure such as a submerged breakwater, approximately 100 m in length should be considered by the developers. The inclusion of this structure would serve to stabilize the beach area by dampening the severe incoming wave energy and lowering the sediment transport along the shoreline.

b) Buried revetments along the shoreline to reduce impact of high-energy waves

c) Artificial sand dune systems at the back of the beach to guard structures from high, powerful waves

ii. Should beach nourishment be desirable, then similar sized or coarser sand should be used for beach nourishment.

iii. The enhancement of the structural plans to feature deep pad or pile foundations. This is especially important for the buildings that fall within the high erosion zones defined above, such as Blocks 5 & 6 as well as the northern areas of the main building.

iv. Minimizing the risk of storm surge relates primarily to instituting an effective disaster and emergency management and evacuation plan for the hotel.

It should be noted that further detailed engineering studies and design conditions will be required to employ any of the aforementioned options.

5.2.4 Flooding Hazard

Impact

Flooding impacts relates to both flooding of the site by adjacent properties, and flooding of adjacent property by the proposed development at the site.

The construction of the proposed hotel at the site will result in increased storm water runoff from the site. This is primarily due to the construction of buildings and paving of the green areas. The pre and post development storm water effective rational runoff values from the site are 0.70 m^3/s and 1.28 m^3/s respectively. However this increase of 0.58 m^3/s in runoff will be accompanied by an increase in drainage capacity with the construction of new drains and the enhancement and expansion of existing drains. Consequently, the increased stormwater runoff from the site should not impact negatively on the site elements on the site itself, nor on adjacent properties.

Mitigation

Although flooding or excessive runoff is not a major concern, there are some steps that can be taken to mitigate any negative impacts. These recommendations are as follows:

i. Detention basins should be included in the stormwater system to provide some treatment of the stormwater before discharge to the shoreline. A minimum capacity of 5 mm rainfall depth should be provided for this purpose.

ii. A small berm should be constructed along the main entrance way into the property in order to direct any water running along the road to the drain.

iii. In filling the site with the proper soil, it should be ensured that the land is slightly peaked along the centreline of the site to allow for easterly and westerly sloping. This would ensure that all stormwater runoff that does make its way on to the site is directed to the constructed drain.

iv. The hotel should also ensure that there is adequate drainage infrastructure put in place along walkways and roadways within the site.

5.2.5 Drainage

Impact

The gully has the potential to flood the proposed site, impact the aesthetics, water quality and sedimentation of the beach area of the proposed development.

Mitigation

(i) Ensure that the berms are maintained.

(ii) In the re-design of the gully, baffles should be put in place to reduce the flows and encourage sedimentation and the removal of rocks and boulders.

(iii) Ensure that the baffles, channel and the mouth of the gully kept clear of debris. This should be done by scheduled maintenance using mechanical and labour methods.

5.2.6 *Employment*

Impact

During this phase, an average of four hundred and fifty (450) staff will be needed for the proper operation of the hotel. This represents an increase in the level of employment within the study area. This has the potential to be a significant positive impact.

Persons engaged in this phase will require training, which will result in an increase of persons with training in the hospitality sector.

Mitigation

Not required

5.2.7 *Beach Use and Carrying Capacity*

Impact

The addition of the proposed development in Mahoe Bay will have a potential impact on beach use and carrying capacity.

Mitigation

i. TPDCO and NEPA should conduct periodically surveys to determine if the carrying capacity is being exceeded.

5.2.8 *Solid Waste Generation and Disposal*

It is anticipated that approximately 4.8 tonnes (4,837 kg) of waste will be generated/day during the operation of the proposed development. The operation of the development has the potential of significantly increasing the solid waste at the site.

Mitigation

i. Provision of solid waste storage bins and skips.

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

iii. Monitor beach garbage.

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

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

5.2.9 *Water Supply and Consumption*

Given 100% occupancy and a per capita consumption of 500 litres per day per person, a total daily water consumption of 199,265 Imperial Gallons per day can be expected for the proposed hotel.

The proposed conservation measures are expected to have a significant beneficial impact on the reduction of the customary water consumption of such hotels. In addition, it can be reasonably concluded that the hotel is not expected to place any operational burden on the Rose Hall Waste Water Treatment Plant.

Mitigation

In addition to design and infrastructural measures for the reduction of water consumption, the hotel should also ensure operational measures are employed in order to manage the use of this resource. Summarized is a list of recommended operational strategies for the reduction of water consumption:

Departments	*Operating Procedures*
Housekeeping	• Do not leave the tap running while cleaning, using buckets for holding water instead • Make sure that all faucets do not leak and are in good repair • Report immediately any leaking or dripping faucet or toilet • Give guests the option of changing linen and towels every two or three days • Use only the minimum required amount of detergent in the laundry • Reuse rinse-water in the first cycle of washing of the next load • Separate the laundry's hot-water system from the guest room hotel-water system if possible • Hotel guests can be given politely written cards as to how to conserve water in their bathrooms, for example to, shut off water during tooth brushing, shaving, and other unnecessary period • Keep utility bills to track the consumption of water • Purchase and use water-saving equipment always • Establish an effective employee training program about water conservation
Food and Beverage	• Do not leave faucets running • Wash food products in buckets, bowls or containers

Departments	*Operating Procedures*
	• Use dishwasher with sufficient loads • Make regular inspections of dishwasher pumps for water leakage • Do not use water to defrost or thaw frozen food products, defrost in refrigerator • Report immediately any leaking and dripping faucet • Install infrared-activated faucets and toilets in restaurant rest rooms • Track the consumption of water by regular monitoring utility bills • Establish an effective employee training program about water conservation
Maintenance	• Recover waste pool water for reuse • Make regular inspections of circulating pumps for water leakage • Report immediately any pool or faucet leakage • Purchase and use water-saving pool equipment • Track the consumption of water by regular monitoring utility bills • Establish an effective employee-training program about pool water conservation • Consult pool specialists about effective maintenance of swimming pool

5.2.10 *Water Storage*

Impact

Using the total water consumption flowrate calculated of 166,100 Imperial Gallons per day, the proposed tank volume has the ability to sustain a water supply to the hotel for 3.8 days in the event of a water shortage. The tank will be connected to the NWC main running along the main road. This main, which is 24", can provide up to 1100 Imperial Gallons per minute which is equivalent to 7,201,010 litres per day. The presence of the hotel would therefore not add any significant load to the existing water supply system.

However, although the tank volume can handle the estimated daily consumptive flow and store sufficient water for approximately 3.8 days in case of a water shortage, mitigation measures should still be considered in case water shortages for prolonged periods of greater than 3.8 days should occur.

Mitigation

i. Although it is not very likely that surrounding areas will be affected, pressure drops may occur when the tank is initially being filled. The National Water Commission will have to be notified in advance of extreme demands such as this, so that they may make adequate preparations.

ii. In case of prolonged periods of water shortages, supplementary tanks built solely for the purpose of storage should be installed.

5.2.11 *Wastewater Generation and Disposal*

Impacts

Wastewater Treatment

The operation of a hotel generates significant amounts of wastewater from guest water usage, and from the operation of laundry and kitchen facilities. The approved capacity of the treatment plant for the proposed hotel, that is the Rose Hall Waste Water Treatment Plant, is

9,463,530 litres per day. Of this amount, RIU comprises a mere 7% (671,906.72 litres per day). For this reason, in addition to the plans in existence for capacity upgrades and the exaggerated per room waste water generation rate, the Rose Hall Waste Water Treatment Plant should be able to accommodate the sewage generated by the proposed hotel.

Grease

There are concerns about excess grease reaching the Rose Hall Wastewater Treatment Plant. The proposed hotel has incorporated a grease trap in their design. The grease trap has a retention time of 7.26 hours, whilst the required retention time (according to NWC) is 5.0 hours. It can therefore be concluded that the design meets and exceeds the NWC guidelines and it is expected to provide sufficient treatment. Grease and its potential adverse effect on the performance of the waste stabilization ponds is therefore not expected to be an issue.

Solid Waste Compactor Effluent

Hotels very often employ a solid waste compactor for minimizing the volumetric requirements of the solid waste that is generated and the required pick up interval. The solid waste that is usually emptied in these compactors consists of all kitchen wastes, except cardboard (which is usually recycled), yard trimmings and office waste. The kitchen waste usually generates a significant effluent stream after the activation of the compaction action. The waste stream is known to have a very strong effluent with BOD in excess of 20,000 to 50,000 mg/l. Because of the relatively small flow, it is usually poorly handled and allowed to flow either into the sewers or into the landscape.

There are no designs for the handling of this compactor effluent. However, the need for proper consideration has been discussed with the project's architect (Ms. Isiaa Madden). The project architect has agreed in principle and has expressed her intention to forward this information to the project's engineers.

<u>Mitigation</u>

i. Although there are no imminent problems with the Rose Hall Waste Water Treatment Plant, technical failures can occur in any situation. Adequate reserve systems should be instituted to allow for proper treatment in the event of any unforeseeable difficulty with the plant.

ii. Should there be any reason which necessitates the use of pumps or lift stations, the specifications of this equipment implementation should be discussed with the relevant authorities. The piping system leading to the treatment facility should be regularly monitored to ensure that any blockages, material deficiencies etc. can be noticed and rectified quickly.

iii. RIU should ensure that adequately sized grease traps are installed in the system to handle the waste from the kitchens and restaurants on site before that waste water reaches the Rose Hall Waste Water Treatment Plant.

iv. Recycle grey water (water from showers and sinks) for irrigation of the hotel grounds.

v. Ensure that the strainers within the recycling system are adequately maintained.

vi. Ensure that the proposed hotel wastewater system is linked to the Rose Hall Sewage System.

vii. Clean the grease traps periodically to maintain their effectiveness.

5.2.12 Transportation/Traffic

Impact

The operation of a hotel requires that delivery trucks and traffic generated from activities of guests is inevitable. This has the potential of directly disrupting the flow of traffic along the Montego Bay-Falmouth main road.

Mitigation

i. Design the access road so that one can see clearly in both directions along the main road on exiting the development.

ii. Negotiate with the traffic and local authorities for the appropriate access to the proposed North Coast Highway Improvement Project (Phase 2A) and create lay-bys in proximity to the proposed hotel so that workers can board and alight their taxi and/or bus in a safe manner.

iii. Add adequate and appropriate signs along the roadway in proximity to the proposed site.

iv. Limit delivery trucks to off-peak periods, to minimise traffic hindrance and delay.

5.2.13 *Emergency Response*

Impact

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

Mitigation

i. Have first aid kits located in various sections of the hotel.

ii. Make prior arrangements with health care facilities such as Mobay Hope hospital to accommodate any eventualities.

iii. Arrange with other health practitioners to be on call or have an in house physician/nurse.

iv. Design and implement an emergency response plan.

v. Staff should be trained in CPR.

vi. Coordinate with mutual aid organisations/agencies such as with the local fire brigade.

5.2.14 *Water Pollution*

Impact

The groundwater below the site is saline and cannot be used in its present state without treatment. There will be no subsurface disposal of effluent at the site and therefore the risk of groundwater contamination is negligible. The disposal of storm water, into absorption pits, could pose a threat to groundwater. Given that the groundwater below the site is of marginal quality, the risk is moderate to low.

Mitigation

i. There should be no direct disposal of effluent or storm water into the sea from the site and therefore the risk of coastal pollution from effluent disposal is negligible.

6.0 CUMULATIVE IMPACTS

6.1 Water Supply

6.1.1 Impact

Although it is not very likely that surrounding areas will be affected. Pressure drops may occur when the storage tank at the proposed development is initially being filled.

6.1.2 Mitigation

i. The National Water Commission will have to be notified in advance of extreme demands such as this so that they may make adequate preparations.

6.2 Noise

6.2.1 Impact

The cumulative noise impact takes into account all the existing background noise sources. Noise from the new noise source (the proposed hotel) is then added to the existing noise levels to determine what if any impact this new development would have on the surrounding community.

Assuming that the noise from the activities of the hotel averaged 60 dBA was placed at each noise measurement station (worst case scenario) then the resultant cumulative noise levels that would be arrived at is listed in Table 6.1 and Figure 6.1. This assumption is overly conservative as the noise source (proposed hotel) will be at varying distances to these stations which would result in the attenuation of the noise.

Table 6.1 Comparison of cumulative noise (if the hotel was located at the individual stations) and the NEPA guidelines

STATION		NOISE				
NO	TYPE	BASELINE (dBA)	ESTIMATED (dBA)	DIFFERENCE (dBA)	CUMULATIVE (dBA)	NEPA STD (dBA)
1	Commercial	59.1	60	0.9	62.5	65
2	Commercial	64.8	60	4.8	65.8	65
3	Commercial	64.3	60	4.3	65.3	65
4	Commercial	59.2	60	0.8	62.5	65
5	Commercial	57.8	60	2.2	62.0	65
6	Commercial	65.1	60	5.1	66.1	65
7	Commercial	55.0	60	5.0	61.0	65

All stations complied with the NEPA guideline except stations 2 and 3, which are influenced most by noise from vehicular traffic on the Montego Bay to Falmouth main road and station 6 which was influenced by planes flying overhead. The noise levels for stations 1 through to 3 will most likely be lower in the future when Segment 2Aof the North Coast highway is completed. This would move vehicular traffic approximately 211m, 136m and 92m south of stations 1, 2 and 3 respectively. In addition, the areas of the hotel that would most likely generate the most noise are located to the western end of the proposed project and away from potential receptors and the residential blocks would also act as noise buffers thereby further reducing any noise reaching the eastern and southern boundaries.

6.2.2 *Mitigation*

Noise caused by operation of the proposed Clubhotel RIU, Montego Bay and traffic noise induced by the operation would contribute to changes in the overall noise environment in the area of the selected site. The project contributions would not individually be expected to cause substantial noise increases. No other projects are anticipated to cause substantial noise increases that would affect nearby land uses in the project area. Therefore, project noise impacts would not be cumulatively considerable, and cumulative impacts would not be considered significant.

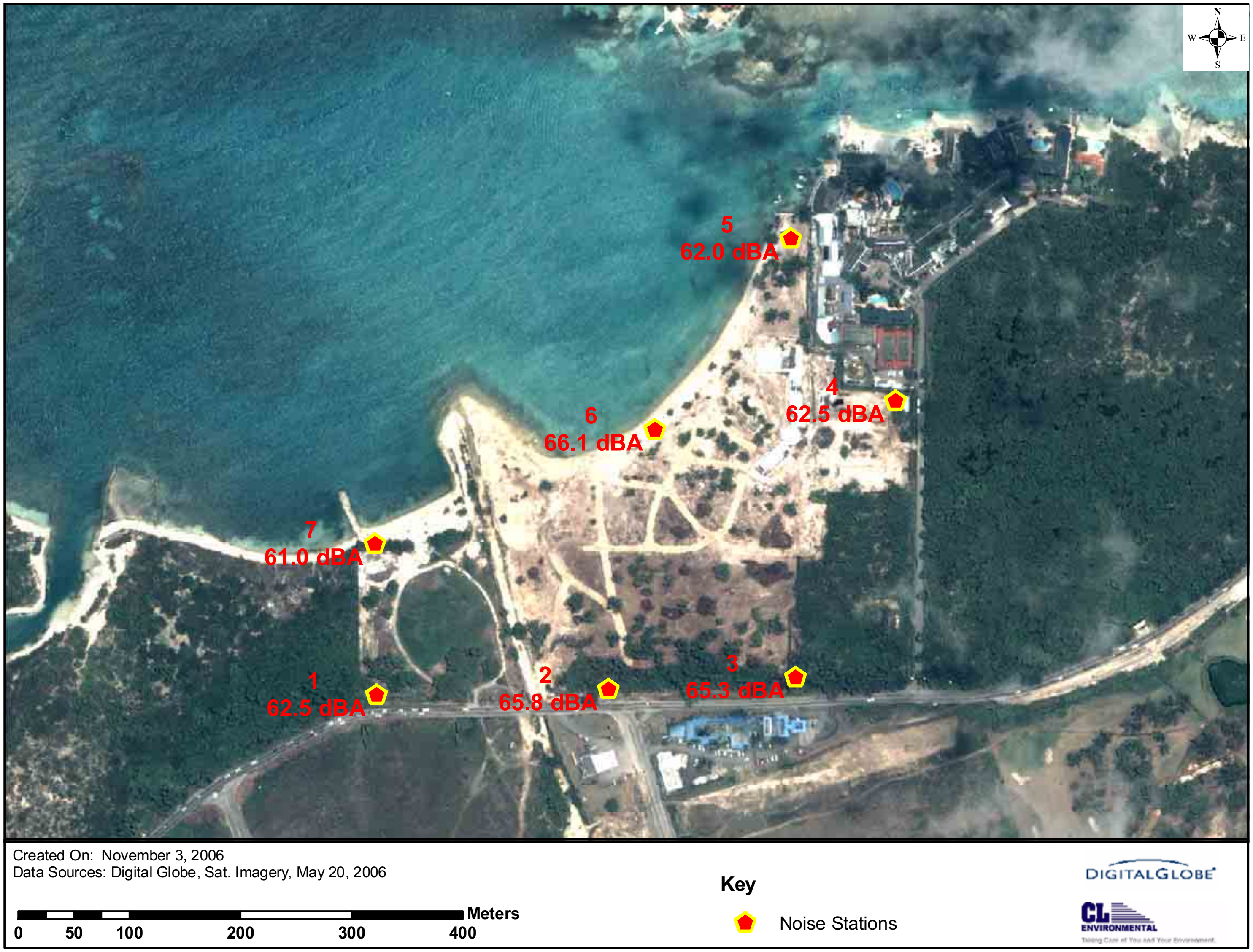


Figure 6.1 Cumulative noise data for the proposed site Clubhotel RIU, Montego Bay

7.0 ANALYSIS OF ALTERNATIVES

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

This report has identified the major environmental impacts noted by scientific experts. The RIU project team and the consulting scientists worked together, utilising findings of these impacts to analyse possible options for the final development.

The following alternatives have been identified and have been discussed with RIU as means of reducing environmental effects. They are discussed in further detail below:

- The "No-Action" Alternative
- The proposed Development as described in the EIA
- The proposed Development as described in the EIA but at another location east or west of the proposed site

7.1 The "No-Action" Alternative

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

The development will have a minimal effect on the physical environment. The only major effect identified was drainage and storm surge issues. Mitigation measures and solutions have been identified to address these issues.

The no-action alternative **should** minimize the effects on flora and fauna identified, this is not, however, a guarantee.

In terms of the social environment, the "no-action" alternative would eliminate the job opportunities and the local economic inflow as estimated in the discussions above.

7.2 The Proposed Development as described in the EIA

The impacts and mitigation measures for this alternative are discussed in detail throughout this report. The positive impacts have been identified in social and economic opportunities for the local area, as well as a positive impact on the national economy.

This alternative will have minimal impact on the physical environment and has considered the necessary measures to almost eliminate the identified issues of drainage, storm water runoff and storm surge.

7.3 The Proposed Development as described in the EIA at another location east or west of the proposed site

A survey of the areas zoned for resort development in the St. James Development Order (1982), indicated that all the other areas that would be suitable for this type and size development was either taken already or would present higher ecological risks e.g. wetland areas. These areas are located to the east and west of the proposed site. The areas to the west are too small (acreage) and those to the east are occupied by other hotels such as Sandals Royal Caribbean, Coyaba Beach Resort & Club, Holiday Inn Sunspree Resort, Halfmoon Rose Hall, Ritz Carlton , Palmyra Resort and Spa, Wyndam Rose Hall Resort and Country Club and Iberostar hotel.

7.4 Overview of Alternative Analysis

Based on the above, the most environmentally sound alternative is the development as proposed in the EIA.

8.0 ENVIRONMENTAL ACTION PLAN

8.1 Monitoring

8.1.1 Monitoring during Site Preparation of the Proposed Hotel

- Inspections should be conducted to ensure that the endemic trees of *Roystonea* sp., *Roystonea princeps*, *Bactris jamaicana* (Prickly Pole), and *Thrinax* sp. are not wantonly removed or sustain any damage. In addition, *Conocarpus erectus* (Button Mangrove), *Avicennia germinans* (Black Mangrove) and *Laguncularia racemosa* (White Mangrove) should be preserved.

  This should be done by a qualified person. NEPA should conduct spot inspections.

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

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

  RIU's project engineer / construction site supervisor should monitor the construction work hours. A Contracted Third Party should conduct the noise survey. NEPA should conduct spot checks to ensure that the hours are being followed.

  The noise survey should be conducted by C.L Environmental Co. Ltd. or any other suitable qualified company or individual. The noise survey is estimated to cost approximately **J$46,000**.

- Daily monitoring to ensure that the cleared areas and access roads creating a dust nuisance.

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

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

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

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Persons selling food to the construction workers should be in designated areas and the construction and the style of stalls should be in the nature of that predefined.

  The Parish Council and person(s) appointed by RIU may perform this exercise. It is recommended that this exercise be conducted at least weekly.

  No additional cost is anticipated for this exercise.

8.1.2 Monitoring During the Construction Phase of the Proposed Hotel

- Biweekly checks for the first three months and monthly thereafter until completion of construction should be conducted on marked trees and other vegetation to ensure that they are not damaged and are responding to relocation and reinstatement.

  This should be done by a qualified person. NEPA and should conduct these inspections.

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

- Daily inspection of site clearance activities to ensure that they are following the proposed building plan and to ensure that site drainage and wastewater system are being constructed as planned. Check and balance should be provided by NEPA and the St. James Parish Council.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Contract a Third Party with the capability to conduct monitoring of the listed parameters to perform this exercise. The report should be given to NEPA at the end of each monitoring exercise.

  This is estimated to cost approximately **J$ 68,000** per monitoring exercise.

- Persons selling food to the construction workers should prepare and serve the food in a hygienic manner so as not to cause potential health problems. Each person selling food should provide a valid **Food Handlers Permit** and the pots and utensils used in the preparation of the food should be properly sanitized.

Person(s) appointed by RIU may perform this exercise. It is recommended that this exercise be conducted at least once per month. In addition assistance maybe sought from the Public Health Inspector for the area.

No additional cost is anticipated for this exercise.

- Persons selling food to the construction workers should be in designated areas and the construction and the style of stalls should be in the nature of that predefined.

  The Parish Council and person(s) appointed by RIU may perform this exercise. It is recommended that this exercise be conducted at least weekly.

  No additional cost is anticipated for this exercise.

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

  RIU's project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. The noise survey should be conducted by C.L Environmental Co. Ltd. or any other suitable qualified company or individual.

  The monitoring of the construction work hours is not expected to incur any costs. The noise survey is estimated to cost approximately **J$46,000**.

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

  RIU's project engineer / construction site supervisor should monitor the construction area and routes that the trucks are taking. NEPA should conduct spot checks to ensure that this stipulation is being followed. In addition, the public within the area can be used to provide additional surveillance. Additionally, a Contracted Third Party should conduct monthly particulate measurements to ascertain if the levels are complying with standards.

It is anticipated that the particulate measurements will incur an estimated cost of approximately **J$67,500**.

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

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that trucks carrying raw materials and heavy equipment are parked at the designated area on the proposed site so as to prevent traffic congestion along Montego Bay to Falmouth main road.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that flagmen are in place and that adequate signs are posted along the roadway. This is to ensure that traffic along the Montego Bay to Falmouth main road have adequate warnings and direction.

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

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by RIU may perform this exercise.

No additional cost is anticipated for this exercise.

- Weekly assessment to determine that there are adequate numbers of portable toilets (approximately one per twenty five workers) and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment. The Montego Bay Chamber of Commerce could be used as the watchdog to ensure that this is achieved.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

8.1.3 Monitoring During the Operational Phase of the Proposed Hotel

- Weekly checks for approximately six (6) months should be conducted on trees that have been replanted for landscaping to ensure that they are responding to relocation and reinstatement.

  This should be done by a qualified person. NEPA could conduct these inspections.

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

- Undertake monthly inspection of drainage and wastewater systems to ensure that they are in proper working order to negate potential detrimental environmental impacts from malfunctioning infrastructure example grease traps.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

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

  Contract a Third Party with the capability to conduct monitoring of the listed parameters to perform this exercise. The report should be given to NEPA at the end of each monitoring exercise.

  This is estimated to cost approximately **J$ 70,000** per monitoring exercise.

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

  Person(s) appointed by RIU may perform this exercise.

No additional cost is anticipated for this exercise.

- Undertake weekly assessment of the beach area to see if there is any damage. If so, there should be a reduction in beach use.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Assess that the water conservation fixtures and methods that were proposed are installed and implemented.

  The Tourism Product Development Company Limited (TPDCO) may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, employees for the operation of the hotel should be sourced from within the study area. This will ensure that the local community will benefit from the investment. The Montego Bay Chamber of Commerce could be used as the watchdog to ensure that this is achieved.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Quarterly checks should be undertaken with Rosehall personnel on the proposed wastewater treatment plant to ensure that the plant is performing up to specification.

  Person(s) appointed by RIU may perform this exercise.

  No additional cost is anticipated for this exercise.

- Quarterly beach profile monitoring should be undertaken on the beach associated with and just adjacent to the hotel to determine the seasonal and long-term behaviour of the beach's plan form. This profiling should be undertaken at least six locations (100 m intervals) along the beach. Either permanent Bench marks or fixed infrastructure points should be employed to assure that profiles are consistently taken at the same location. The profiles should extend to the 1.5m water depth from fixed point on the back of beach.

Person(s) appointed by RIU may perform this exercise or NEPA may wish to extend their monitoring programme to this area.

No additional cost is anticipated for this exercise.

Environmental Management Plan

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

It operates on the following principles;

1. **REDUCE YOUR COSTS** - All companies can reduce their energy water and waste related costs. A company that has recently implemented an energy management system can expect to **reduce energy costs by at least 25%**. Similar cost reductions can be achieved by employing the Green Globe 21 system to water consumption and waste production.

2. **REDUCE YOUR IMPACT ON THE ENVIRONMENT-** Reduced environmental impacts means reduced costs and a better product with broader market appeal. The Green Globe 21 system helps your company conform with environmental legislation and provides a good foundation for building your company's future business.

3. **WIDEN YOUR MARKET APPEAL** - Green tourists make up one of the fastest growing segments of the market. By joining Green Globe 21 your business is promoted on our website and you are able to use the Green Globe 21 logos on

your marketing and publicity material to demonstrate your commitment and performance with respect to environmental issues. This can widen your current market appeal, reduce seasonality and attract more environmentally sensitive customers.

4. **IMPROVE YOUR QUALITY** - The Green Globe 21 System can improve the quality of the customer experience by putting into place a culture that embraces sustainability (economically, environmentally and socio-culturally). All members of staff are brought into the environmental policy and management system. The system also provides mechanisms for letting your customers know about your approach to environmental issues.

Adapted from Green Globe 21 www.greenglobe21.com

8.2 Reporting Requirements

8.2.1 Vegetation

A monthly report will outline the observations of the tree preservation plan at the proposed development until the completion of construction of the proposed project.

This report shall include the following data:

i. Dates of observations.

ii. A defined map showing each location clearly outlined where the demarcated trees are located.

iii. Any other relevant information (such as weather).

A. The reports shall be submitted to RIU's Project Manager or his designate and NEPA.

B. In the event that emissions do not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken.

C. Reports will be maintained on file for a minimum of three years.

8.2.2 Noise Assessment

A monthly report shall be prepared a Contracted Party. This report shall include the following data:

i. Dates, times and places of test.

ii. Test Method used.

iii. Copies of instrument calibration certificates.

iv. Noise level measurements in decibels measured on the A scale (dBA) and wind direction.

v. Noise levels measured in low, mid and high frequency bands (dBL)

vi. A defined map showing each location clearly outlined where noise measurements are taken.

vii. Any other relevant information (such as unusual local noise source).

viii. Evaluation of data, discussions and statement giving a professional opinion of the noise impact.

A. The reports shall be submitted to RIU's Project Manager or his designate and NEPA.

B. In the event that emissions do not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken.

C. Reports will be maintained on file for a minimum of three years.

8.2.3 Particulates

A monthly report will summarize the results of PM_{10} concentrations monitoring at the boundaries of the proposed development until the completion of construction of the proposed project.

This report shall include the following data:

i. Dates, times and places of test.

ii. Test Method used.

iii. Copies of instrument calibration certificates.

iv. A defined map showing each location clearly outlined where the particulate measurements are taken.

v. Any other relevant information (such as wind direction and speed).

vi. Evaluation of data, discussions and statement giving a professional opinion of the particulate impact.

A. The reports shall be submitted to RIU's Project Manager or his designate and NEPA.

B. In the event that emissions do not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken.

C. Reports will be maintained on file for a minimum of three years.

8.2.4 Water Quality

A monthly report will summarize the results of water quality monitoring at the proposed development until the completion of construction of the proposed project.

This report shall include the following data:

i. Dates, times and places of test.

ii. Test Methods used.

iii. Copies of instrument calibration certificates.

iv. A defined map showing each location clearly outlined where the water samples are taken.

v. Any other relevant information (such as weather).

vi. Evaluation of data, discussions and statement giving a professional opinion of the water quality results.

A. The reports shall be submitted to RIU's Project Manager or his designate and NEPA.

B. In the event that emissions do not meet the required criteria, investigations shall be carried out and corrective actions were necessary taken.

C. Reports will be maintained on file for a minimum of three years.

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APPENDICES

Appendix A The Approved Terms of Reference

Terms of Reference

The Environmental Impact Assessment should include but not be limited to the following:

1) Objectives

2) Complete description of the existing site proposed for development.

3) Significant environmental issues of concern through the presentation of baseline data which should include social, cultural and heritage considerations. Assess public perception of the proposed development.

4) Policies, Legislation and Regulations relevant to the project.

5) Likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and their relative importance to the design of the development's facilities.

6) Mitigation action to be taken to minimise predicted adverse impacts and quantify associated costs.

7) Monitoring Plan which should ensure that the mitigation plan is adhered to.

8) Alternatives to the project that could be considered at that site or at any other location.

9) Conclusions

TO ENSURE THAT A THOROUGH ENVIRONMENTAL IMPACT ASSESSMENT IS CARRIED OUT, IT IS EXPECTED THAT THE FOLLOWING TASKS BE UNDERTAKEN:

Task #1. Description of the Proposed Project

Provide a comprehensive description of the project, noting areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment. This should involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, ancillary buildings, as well as pre-construction, construction, and post construction plans.

For projects to be done on a phased basis it is expected that all phases be clearly defined, the relevant time schedules provided and phase maps, diagrams and appropriate visual aids be included.

The plans for providing utilities, waste disposal and other services, sewage treatment system and treated effluent disposal, storm water collection and disposal should also be outlined.

Building architectural design and integration with the character of the area should be addressed.

Task #2. Description of the Environment

Baseline studies, data collection and interpretation

This task involves the generation of baseline data which is used to describe the study area as follows:

i) physical environment

ii) biological environment

iii) Marine Environment

iv) socio-economic and cultural constraints.

It is expected that methodologies employed to obtain baseline and other data be clearly detailed.

Baseline data should include:

(A) Physical

i) A **detailed description** of the existing soil and geology, landscape, aesthetic appeal and hydrology**.** Special emphasis should be placed on storm water run-off, drainage patterns, effect on groundwater and availability of potable water. Any slope stability issues that could arise should be thoroughly explored.

ii) **Water quality** of any existing wells, rivers, ponds, streams or coastal waters in the vicinity of the development. Water quality information should be substantiated by data, where possible. Indicators should include but not be limited to nitrates, phosphates, faecal coliform, and suspended solids.

iii) **Climatic conditions and air quality** in the area of influence including particulate emissions from stationary or mobile sources, NO_x, SO_x, wind speed and direction, precipitation, relative humidity and ambient temperatures,

iv) **Noise levels** of undeveloped site and the ambient noise in the area of influence.

v) Obvious sources of pollution existing and extent of contamination.

vi) Availability of solid waste management facilities.

(B) Biological

Present a detailed description of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, protected or endangered species, sensitive habitats, including mangroves. Migratory species and wild food crop plants should also be considered. There may be need to include micro-organisms to obtain an accurate baseline assessment. Generally, species dependence, habitats/niche specificity, community structure and diversity ought to be considered.

(C) Marine Environment

Marine ecosystem, including but not limited to any seagrass and coral community, with indication of its function and value in the project area.

(D) Socio-economic & cultural

Present and projected population; present and proposed land use; planned development activities, issues relating to squatting and relocation, housing demand and supply) community structure, economic base/employment, distribution of income, goods and services; utilities; recreation; public health and safety; cultural peculiarities, aspirations and attitudes should be explored. The historical importance of the area should also be examined. While this analysis is being conducted, it is expected that an assessment of public perception of the proposed development be conducted. This assessment may vary with community structure and may take multiple forms such as public meetings or questionnaires.

Task #3 – Beach Modification

Outline of proposed works on the foreshore and the floor of the sea, including but not limited to any dredging, beach nourishment, shoreline structure construction, seagrass, mangrove or coral removal and replanting.

Prescriptive rights of the public to the access and use beach areas should be identified and addressed.

Task #4 - Legislative and Regulatory Considerations

Outline the pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation should include at minimum, legislation such as the NRCA Act, the Housing Act, the Town and Country Planning Act, Building Codes and Standards, Development Orders and Plans and the appropriate international convention/protocol/treaty where applicable.

Task #5 – Identification and Assessment of Potential Impacts

Identify and analyse the major environmental and public health issues of concern and indicate their relative importance.

Identify and analyse potential impacts, and cumulative as they relate to, (but are not restricted by) the following:

- change in drainage pattern
- flooding potential
- landscape impacts of excavation and construction
- loss of natural features, habitats and species by construction and operation
- pollution of potable, coastal, surface and ground water
- Air pollution
- capacity and design parameters of proposed sewage treatment facility.
- socio-economic and cultural impacts.
- risk assessment
- noise
- solid waste
- the carrying capacity of the proposed site
- visual impacts, including view of sea and coastline from the main road.

Potential impacts should cover both the terrestrial and marine environment.

The **impacts that have occurred and those impacts which could still occur** as a consequence of the clearing works that were conducted on the site prior to the preparation of the TORs should also be identified and analysed.

Distinguish between significant positive and negative impacts, reversible or irreversible direct and indirect, long term and immediate impacts. Identify avoidable as well as irreversible impacts.

Characterize the extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should be represented in matrix form with separate matrices for pre and post mitigation scenarios.

Task #6 – Storm Surge Analysis

Conduct storm surge analysis to inform coastal setbacks of buildings and other impact mitigation measures.

Task #7 – Drainage Assessment

An assessment of Storm Water Drainage should be conducted. The

EIA Report should cover, but not limited to:

i. Drainage for the site during construction, to include mitigation for sedimentation to the marine environment
ii. Drainage for the site during operation, to include mitigation for sedimentation to the marine environment
iii. Drainage control for the gully dividing the property, to include impacts that this drain will have on the aesthetics, water quality and sedimentation of the beach area, etc.

Task #8 Impact Mitigation

Prepare guidelines for avoiding, as far as possible, any adverse impacts due to proposed usage of the site and utilising of existing environmental attributes for optimum development. Quantify and assign financial and economic values to mitigating methods.

Task #9 – Environmental Management and Monitoring

Design a plan to monitor implementation of mitigatory or compensatory measures and project impacts during construction and occupation/operation of the units/facility. An

Environmental Management Plan for the long term operations of the site should also be prepared.

An **outline monitoring programme should be included in the EIA**, and a detailed version submitted to NEPA for approval after the granting of the permit and prior to the commencement of the development.

At the minimum the monitoring programme and report should include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit/license(s) granted.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.
- Frequency of reporting to NEPA
- Raw data collected. Tables and graphs are to be used where appropriate
- Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
- Recommendations
- Appendices of data and photographs if necessary.

Task #10 - Project Alternatives

Examine alternatives to the project including the no-action alternative. This examination of project alternatives should incorporate the use history of the overall area in which the site is located and previous uses of the site itself.

Appendix B The EIA Team

Carlton Campbell (MPhil.) – Socioeconomics, Noise Survey, Water Quality and Air Quality Sampling

David Narinesingh (PhD pending) – Marine Survey and Faunal Survey

Hugh Small (MPhil. pending) - Marine Survey

Philip Rose (MPhil.) – Floral Survey

Prof Edward Robinson - The Marine Geology Unit, University of the West Indies - Geology

Debbie Rowe - The Marine Geology Unit, University of the West Indies - Geology

Shakira Khan - The Marine Geology Unit, University of the West Indies - Geology

Christopher Burgess – CEAC Solutions Ltd. - Infrastructural (water supply, sewerage & drainage) and Coastal Assessment (storm surge, coastal erosion etc)

Danielle Dowding – CEAC Solutions Ltd. - Infrastructural (water supply, sewerage & drainage) and Coastal Assessment (storm surge, coastal erosion etc)

Carlenenus Johnson - CEAC Solutions Ltd. - Infrastructural (water supply, sewerage & drainage) and Coastal Assessment (storm surge, coastal erosion etc)

Technical Assistants - Karen McIntyre (Bsc.), Janette Manning (M. Phil. Pending), Najwa Barnes (M. Phil. Pending), Nadia Ferguson (M. Phil.) and Alexcia Gray (BSc.)

Appendix C SCS Drainage and Runoff Calculations

Analysis for runoff from site during pre-construction stage

Input Parameters	Total Catchment	Units
Area	77000	m2
Main stream length, L	277	m
Secondary length (from top of main drain to catchment boundary), L	40	m
Distance from outlet to centroid, Lc	138.5	m
Lower elevation	0.00	m
Upper elevation	0.80	m
Slope	0.289%	
Ct	1.50	
Cp	0.17	
Runoff Coefficient, C	7.0%	
Curve Number, CN	65	
Box Channel		
Length of main channel	277	m
Slope	0.002888087	
Mannings Coefficient	0.013	
Width	**6.50**	m
Depth	**0.40**	m
Depth + freeboard	0.57	m
R	0.4	m
P	7.3	m
A	2.6	m2
Velocity	2.1	m/s
Flow	5.40	m3/sec
Tt	0.01	hours
Hydrology		
Time of concentration		

Time entry	0.075	hours
Overland/shallow flow, Tt (NCCS revised)	0.028	hours
User switch (Box = 1, V = 2, Trapezoidal =3; Pipe = 4)	5	
Time of travel in main channel	0.000	hours
Tc	0.10	hours
Rainfall-24 hours (1 in 10 year return period)	145	mm/24hours
Runoff		
Maximum potential retention, S	136.8	mm
Rainfall intensity for tc	12.54	mm/24hours
Time of Concentration		
Tc-Australian	0.3	
Tc-FAA	0.8	
Effective Runoff (SCS) - Peak/Tt	**0.70**	**m3/s**

Analysis for runoff from eastern catchment during post-construction stage

Input Parameters	Eastern Catchment	Units
Area	39883	m2
Main stream length, L	606	m
Secondary length (from top of main drain to catchment boundary), L	40	m
Distance from outlet to centroid, Lc	303	m
Lower elevation	0.00	m
Upper elevation	1.95	m
Slope	0.322%	
Ct	1.50	
Cp	0.17	
Runoff Coefficient, C	10.0%	
Curve Number, CN	80	
Box Channel		
Length of main channel	606	m
Slope	0.00322	
Mannings Coefficient	0.015	
Width	**1.60**	m
Depth	**0.20**	m
Depth + freeboard	0.29	m
R	0.2	m
P	2	m
A	0.32	m2
Velocity	1.1	m/s
Flow	0.36	m3/sec
Tt	0.47	hours
Hydrology		
Time of concentration		
Time entry	0.083	hours
Overland/shallow flow, Tt (NCCS revised)	0.048	hours

User switch (Box = 1, V = 2, Trapezoidal =3; Pipe = 4)	1	
Time of travel in main channel	0.555	hours
Tc	0.69	hours
Rainfall-24 hours (1 in 10 year return period)	145	mm/24hours
Runoff		
Maximum potential retention, S	63.5	mm
Rainfall intensity for tc	6.80	mm/24hours
Time of Concentration		
Tc-Australian	0.2	
Tc-FAA	0.8	
Effective Runoff (SCS) - Peak/Tt	**0.70**	**m3/s**

Analysis for runoff from western catchment during post-construction stage

Input Parameters	**Western Catchment**	**Units**
Area	33508	m2
Main stream length, L	214.47	m
Secondary length (from top of main drain to catchment boundary), L	40	m
Distance from outlet to centroid, Lc	107.235	m
Lower elevation	2.28	m
Upper elevation	5.71	m
Slope	1.599%	
Ct	1.50	
Cp	0.17	
Runoff Coefficient, C	10.0%	
Curve Number, CN	80	
Box Channel		
Length of main channel	214.47	m
Slope	0.015992913	
Mannings Coefficient	0.013	
Width	**6.26**	m
Depth	**3.43**	m
Depth + freeboard	4.90	m
R	1.6	m
P	13.12	m
A	21.4718	m2
Velocity	13.5	m/s
Flow	290.08	m3/sec
Tt	0.00	hours
Hydrology		
Time of concentration		
Time entry	0.083	hours
Overland/shallow flow, Tt (NCCS revised)	0.012	hours

User switch (Box = 1, V = 2, Trapezoidal =3; Pipe = 4)	1	
Time of travel in main channel	0.084	hours
Tc	0.18	hours
Rainfall-24 hours (1 in 10 year return period)	145	mm/24hours
Runoff		
Maximum potential retention, S	63.5	mm
Rainfall intensity for tc	11.00	mm/24hours
Time of Concentration		
Tc-Australian	0.2	
Tc-FAA	0.8	
Effective Runoff (SCS) - Peak/Tt	**0.58**	**m3/s**

Appendix D Modified Mercalli Intensity Scale for Earthquakes

Intensity	Description
I	Not felt.
II	Felt by persons at rest on upper floors.
III	Felt indoors—hanging objects swing. Vibration like passing of light trucks.
IV	Vibration like passing of heavy trucks. Standing automobiles rock. Windows, dishes, and doors rattle; wooden walls or frame may creak.
V	Felt outdoors. Sleepers wakened. Liquids disturbed, some spilled; small objects may be moved or upset; doors swing; shutters and pictures move.
VI	Felt by all; many frightened. People walk unsteadily; windows and dishes broken; objects knocked off shelves, pictures off walls. Furniture moved or overturned; weak plaster cracked. Small bells ring. Trees and bushes shaken.
VII	Difficult to stand. Furniture broken. Damage to weak materials, such as adobe; some cracking of ordinary masonry. Fall of plaster, loose bricks, and tile. Waves on ponds; water muddy; small slides along sand or gravel banks. Large bells ring.
VIII	Steering of automobiles affected. Damage to and partial collapse of ordinary masonry. Fall of chimneys, towers. Frame houses moved on foundations if not bolted down. Changes in flow of springs and wells.
IX	General panic. Frame structures shifted off foundations if not bolted down; frames cracked. Serious damage even to partially reinforced masonry. Underground pipes broken; reservoirs damaged. Conspicuous cracks in ground.
X	Most masonry and frame structures destroyed with their foundations. Serious damage to dams and dikes; large landslides. Rails bent slightly.
XI	Rails bent greatly. Underground pipelines out of service.
XII	Damage nearly total. Large rock masses shifted; objects thrown into the air.

Modified from Montgomery, 1995.

Appendix E Noise Calibration Certificate

Certificate of Calibration

Model:	SoundPro DLX-1-1/3	**Date of Calibration:**	6 Mar 2006
Serial Number:	RTF020004	**Due Date:**	6 Mar 2007

Quest Technologies does hereby certify that the above listed product

meets or exceeds the requirements of the following standard(s):

EN/IEC 61672, ANSI S1.4-1983, EN/IEC 61260
ANSI S1.11-2004, ANSI S1.43-1997
IEC 60651, IEC 60804

Test Conditions:

Temperature:	18-25 °C	
Humidity:	20-80 %R.H.	
Barometric Pressure:	950-1050 mBar	

Subassemblies:

B&K4936 251064

Calibrated Per Procedure: S053-958

Reference Standard(s):

Device:	Due Date:
B & K Ensemble	6 Oct 2006

Measurement Uncertainty:

Uncertainty estimated at 95% Confidence Level (k=2)

+/- 3.4% Acoustic (0.3dB)

Calibrated and Reviewed By: Linda Osterndorf

Linda Osterndorf Electronic Assembler

This report certifies that all calibration equipment used in the test is traceable to NIST, and applies only to the unit identified above. This report must not be reproduced except in its entirety without the written approval of Quest Technologies.

Quest recommends annual calibration for this product.

QUEST
TECHNOLOGIES, INC.

058-387 Rev. C

1060 Corporate Center Drive • Oconomowoc, Wisconsin 53066-4828
800-245-0779 • 262-567-9157 • Fax 262-567-4047 • Internet Address: www.questtechnologies.com

Appendix F Questionnaires

CLUBHOTEL RIU – MAHOE BAY

COMMUNITY QUESTIONNAIRE

DATE:__________________ **INTERVIEWER:**______________

LOCATION:__________________

EMPLOYMENT & INCOME

1 How many persons in the household are presently employed? ___________________

2 Are you currently employed: (i) part time, (ii) seasonal, (iii) full time
(iv) unemployed (v) retired (vi) self employed (v)other __________

3 If employed, what do you do? ____
(i) casual labour (ii) semi - skilled (iii) skilled (iv) artisan (v) professional

4 Where do you work? ________________________

5 How far is your work from home? (i) less than a km, (ii) 1- 5km, (iii) 6- 15km (iv) >15km.

6 What is the main employment status of household head? (If the interviewee is not the head of the household).
(i) part time, (ii) seasonal, (iii) full time, (iv) unemployed (v) retired
(vi) self employed (v)other __________

7 What is the trade of the household head? __________________________________

8 What is the trade of the partner? ____

** **Use Table 2 to answer questions 9 - 11.**

1. Below $500	6. $3001 - $4000
2. $ 501 - $1000	7. $4001 - $5000
3. $1001 - $1500	8. $5001 - $6000
4. $1501 - $2000	9. $6001 - $7000
5. $2001 - $3000	10.Over $7000

9 What is the average weekly income of the household head?
____

10 What is the average weekly income of the partner?

____

11 What is the average weekly income of the household? (All sources) ___________________________________

12 Do you depend on the proposed development site for business or recreation?

____

EDUCATION

1. If applicable, how many members of your household attend;

Basic [ ] Primary [ ] All Age [ ] Junior High [ ] New Secondary [ ] Secondary High [ ] Comprehensive High [ ] Technical High [ ] Vocational Agricultural [ ] Community College [ ] Teachers College [ ] University [ ] HEART [ ] Other [ ] ____

NAME / TYPE OF SCHOOL	DISTANCE FROM HOME (Km)

HOUSING & SOCIAL AMENITIES

1 Approximately how old is the house you are living in? _________ yrs.

2 Do you own the house you are living in? (i) Yes (ii) No (iii) Rent (iv) Squat (v) Other ____________________

3 Number of bedrooms? __________

4 Do you have telephone? (i) Yes (ii) No

5 If yes, what kind? (i) Landline (ii) Cellular phone (iii) Cables are being laid

NATURAL HAZARDS

1 Are there problems with frequent flooding? (i) Yes (ii) No

CL Environmental Co. Ltd.
clenviro@cwjamaica.com

2 How frequently does flooding occur? ___________________________________

3 Where are the affected areas?____

4 Do you know if flooding occurs at the proposed development site in Mahoe Bay? (i) Yes (ii) No

5 How high does the water level rise? ____________________________________

6 Are there problems with frequent earthquakes? (i) Yes (ii) No

7 Are there problems with land slippage? (i) Yes (ii) No

8 If yes, where? ____

9 Are there problems with frequent fires?

10 If yes, where? ____

<u>SERVICES, COMMUNITY COHESIVENESS & DEVELOPMENT</u>

1 How do you travel? (i) Bus (ii) Personal vehicle (iii) Taxi (iv) Other _________________

2 Where do you normally shop for the household? ____________________________

3 Where do you go to market? ____

4 Where do you go for health care when you are sick? __________________________

5 Over the past twelve months did you or any member of your household have frequent: (i) Bouts of diarrhoea (ii) coughing (iii) suffocating feelings (iv) congestion (v) chest pains?

6 Do you or any member of your household suffer from (i) Asthma (ii) hypertension (iii) diabetes (iv) sinusitis (v) other? ____

7 Are there any church groups in your area? (i) Yes ______________________(ii) No

8 Are there any environmental groups in your area? (i) Yes _____________ (ii) No

9 Are there any other organizations in your area? (i) Yes _____________________ (ii) No

10 How active are these organizations? ____________________________________

11 Are you actively involved in any of these groups? (i) Yes (ii) No (iii) Used to be ____

RECREATION & CONSERVATION

1 Are there any recreational facilities nearby? (i) Yes (ii) No

2 If yes, name and location of facility ___________________________________

3 Are you aware of any historic or cultural areas / sites in your community or nearby?
(i) Yes _______________________________________ (ii) No

4 If yes, what do you know about the site? __________________________________

5 Are you aware of any environmentally sensitive areas nearby?
____

PERCEPTION

1 Are you aware that the RIU intends to construct a 700 room hotel at Mahoe Bay?
(i) Yes (ii) No

2 If yes, how were you informed?
____

3 Do you think this type of development is suitable for the area?
____

4 If no, what kind of development would you like to see happen?
____

5 How will the construction of the hotel affect you?
____

6 How do you believe the construction of this hotel will affect the natural environment?
____

____

7 How does the existence of other hotels affected you? ______________________

____

8 Do you believe RIU will have similar effects? ____________________________

____

9 Is there anything in particular about your area that you would like to tell us?

____

____

10 What else would you like to see done in your area?

____

____

11 Any other comments:

CLUBHOTEL RIU – MAHOE BAY

SHOP OWNERS QUESTIONNAIRE

DATE:__________________ **INTERVIEWER:** _______________

LOCATION: ___________________

1 What type of items do you sell?____

2 Where do you obtain the items that you sell?
____

3 How do you transport the items that you sell in your shop? __________________

4 How many persons are employed at the shop/stall? __________________________

5 What time do you open for business _________ close for the day ___________?

6 About how many customers do you get per day? ____________________________

7 About how much do you earn (make) per day? ______________________________

1. Below $500	6. $3001 - $4000
2. $ 501 - $1000	7. $4001 - $5000
3. $1001 - $1500	8. $5001 - $6000
4. $1501 - $2000	9. $6001 - $7000
5. $2001 - $3000	10.Over $7000

8 Who are your regular customers? ____

9 RIU is planning to construct a 700 room hotel at Mahoe Bay. How do you think it will affect you?

____

____

10 Are there any other concerns?

Signature: ....
Interviewer

CLUBHOTEL RIU – MAHOE BAY

BEACH USERS QUESTIONNAIRE

DATE:__________________ **INTERVIEWER:**______________

LOCATION: __________________

1 Where are you from? ____

2 How often do you come to the beach? ___________________________

3 Why do you come to the beach? (i) Recreation (ii) work (iii) other
____
____

4 What do you like about the beach? __________________________________

5 Do you think the beach is over crowded? (i) Yes (ii) No

If yes, why do you say so? _______________________________________
____

6 What is it like going to the beach during major holidays such as Independence weekend?
____
____

9 RIU is planning to develop a 700 room hotel at Mahoe Bay. How do you think this will affect you and other beach users?
____
____

10 Are there any other concerns?

Signature: ....
Interviewer

Appendix G Jamaica Public Service Company Limited Letter

JPS
Jamaica Public Service Company Limited
CHANGING LIVES WITH OUR ENERGY

6 Knutsford Boulevard, Kingston Jamaica, W.I.
Telephone: (876) 926-3190-9
Fax: (876) 511-2167
Website: www.jpsco.com

Francine Bromby
Rui Jamaicotel Ltd.
Rose Hall
Half Moon P.O
St. James

App. #: ***0606-H14490***

Dear Madamn:

Re: 500 KVA, 425/240 V Supply Project - Mahoe Bay
Private Property, Rate 40/50 Customer

We make reference to your application dated June 8, 2006 requesting electricity supply, pertaining to a demand of 25 kilovolt-amperes (kVA) or more. Our Engineers visited the location, and have determined that it will be necessary to modify our distribution network, and or effect voltage transformation along a private roadway/along a private property, which is in excess of 30 meters of our existing distribution lines, to provide the requested service to you.

The company will undertake the extension in accordance with our operating License and applicable Rate schedule, at a cost to you. The two service options are:

(1) Rate Schedule: Schedule III, Rate 40 (LV) – Power Service Low Voltage.
(2) Rate Schedule: Schedule IV, Rate 50 (MV) – Power Service Medium Voltage.

Rate Schedule: Schedule III, Rate 40 (LV) – Power Service Low Voltage.

JPS will be responsible for providing and owning the pole(s), cabling, transformer(s) and labour for the project. You will be responsible for procuring any easement rights in the form of a Way-leave Agreement annexed. You will also be responsible for civil works related to the construction of plinth, fencing for pad-mounted transformer, grounding, cable trenching, backfilling and ducting **if required**. Civil works shall be carried out in accordance with the Government Electrical Inspectors (GEI) requirements.

You will be required to make a payment of [redacted] which may be refundable, and represents the total estimated cost of construction excluding metering equipment and metering labour cost. Your entitlement to a refund under this option will be determined by the non- fuel revenue generated by customers connected to the energized line extension within three (3) years. If you are granted a refund, it shall not exceed the refundable payment made, and shall not attract any interest. JPSCo will use best efforts to advise whether you are entitled to a refund and to effect the refund, if any, within six months after the termination of the three year period.

Rate Schedule: Schedule IV, Rate 50 (MV) – Power Service Medium Voltage.

JPS will be responsible for providing and owning the pole(s), cabling and labour for the project up to the metering point, with the exception of option 1B below where JPS will provide the transformer. You will be required to procure any easement rights, which may be necessary to facilitate the construction of the line in the form of the Way-leave Agreement annexed. You will also be required to install and own all lines and associated equipment (inclusive of the power transformer) on the customer side of the meter.

There are two (2) payment options available to you, payment options 1A & 1B.

Under payment **option 1A**, you are required to provide your own transformer and will be required to make a non-refundable contribution of [redacted], towards construction, excluding transformer, metering equipment and metering labour cost.

Under payment **option 1B**, JPS will provide one of its standard transformer and you will be required to make a non-refundable contribution of [redacted], towards construction, excluding metering equipment and metering labour cost.

We kindly request, that you indicate your payment option of preference and forward the required amount, to facilitate the finalization of the outstanding preliminaries and commencement of the works. Payment can be made by cash or manager's cheque. This quotation is valid for a period of three (3) months from the date of this letter.

We will contact you upon completion of the works, and thereafter you will be required to call or visit any one of our offices to establish a contract for a supply of service, including the payment of a security deposit.

It is our pleasure to serve you and we look forward to working with you on this project. Should you have any question please, do not hesitate to visit us at our local commercial office or contact us by phone at 954 2443.

Yours sincerely
Jamaica Public Service Company Limited

Sane Facey
Customer Service Manager
For the Parish of St. James

Appendix H National Water Commission Letter

P.O. Box 65, Kingston 5
Tel: (876) 929-5430-5
Fax: (876) 926-1329

Kingston 5
Tel: (876) 926-5825-7
Fax: (876) 926-7121

Kingston 5
Tel: (876) 929-4840-4
Fax: (876) 960-0582

Kingston 5
Tel: (876) 929-3540
Fax: (876) 968-8247

NATIONAL WATER COMMISSION
Water is Life

231A Old Hope Road
Kingston 6
Tel: (876) 977-4998-9
977-5000
Fax: (876) 927-1870

28-30 Church Street
Kingston
Tel: (876) 922-8110-9
Fax: (876) 967-1499

December 05, 2006

Port Marly Limited
Bloody Bay, Negril
Westmoreland

Attention: Mr. Jose Maria Chanchez
Project Director

Dear Sir:

RE: PROPOSED RIU HOTEL DEVELOPMENT –
MAHOE BAY, MONTEGO BAY, ST. JAMES

The National Water Commission (NWC) hereby acknowledges your correspondence dated June 27, 2006 (which correspondence only came to hand at the NWC, Montego Bay on October 31, 2006) requesting a 100mm (4") nominal diameter bulk metered permanent water supply connection at your proposed development plot boundary to supply some 600,000 liters per day (132,000 imperial gallons per day) of potable water.

Be informed that the NWC will be in a position to provide RIU with the above requested permanent connection, albeit, at a "one-off" development cost; the details of which will be communicated to your goodselves at earliest.

On the matter of sewage conveyance and treatment from the captioned proposed development, we hereby confirm that the NWC has available treatment capacity at its Bogue Sewage Treatment Plant, Montego Bay, to handle your anticipated sewage flow with the nearest point for connection into our Montego Bay sewerage system being at the traffic lights at the intersection of Queens Drive and Leader Avenue some five (5) km from your development.

Page 2
Proposed Riu Hotel Development

The cost of this proposed pumped conveyance system would be to your account. Notwithstanding, the NWC is not averse to having further discussions with your good selves concerning this matter.

Yours truly,
NATIONAL WATER COMMISSION

E. G. Hunter
President

C: Mr. Franklin T. Williams, Chief Engineer (SVP) - NWC
Mr. Ajaykumar Vijayan, Technical Services Manager (Western) – NWC
Mr. Mark Barnett, Area Manager (St. James/Trelawny) – NWC

Appendix I Sewerage Agreement Letter

DEC-19-2006 01:46P FROM:ROSE HALL UTILITIES 8769538437 TO:19788760 P.1/1

ROSE HALL
JAMAICA

December 19, 2006

Mr. Carl Dehany
RIU Hotel
Bloody Bay
Negril

Dear Mr. Dehany,

<u>Rose Hall Wastewater Reclamation Facility</u>

This is to confirm that Rose Hall Utilities Limited has entered into a binding agreement with RIU Resorts for the collection and treatment of wastewater from the proposed RIU Montego Bay Resort. RIU is in compliance with all material terms of the wastewater treatment agreement and Rose Hall Utilities Limited expects to begin accepting and treating wastewater from the RIU Montego Bay Resort from the date of completion of the property which is expected to be in February 2008.

If further information is needed, please do not hesitate to contact the undersigned. We look forward to serving you as a customer connected to Rose Hall Development's Wastewater facilities.

Yours Sincerely,
ROSE HALL UTILITIES LIMITED

Cynthia Scott
Operations Manager – Wastewater Reclamation Facility

Cc: Peter Williams – Rose Hall Developments

ROSE HALL DEVELOPMENTS LTD., ROSE HALL P.O. 1, (ST. JAMES) JAMAICA, W.I.
PHONE: (876) 953-2341 / 953-9969 / 953-3855 / 953-8215 / 953-2456 FAX: (876) 953-2160
E-mail: rosehall@rosehall.com • Website: www.rosehall.com