ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED MYSTIC MOUNTAIN PARK

March 7th 2006

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EXECUTIVE SUMMARY

Purpose: The National Environment and Planning Agency (NEPA) received an application for an Environmental Permit from Mystic Mountain Ltd. for the development and operation of an eco-tourism project in the parish of St. Ann. This application was made in accordance with the Natural Resources Conservation Act (1990). Based on the schedule of projects requiring the submission of Environmental Impact Assessment (EIA) prior to permission, NEPA determined that this application must be supported by an EIA. A Terms of Reference (TOR) for the preparation of this document has been approved by NEPA and is included as Appendix 1.

Project Overview: Mystic Mountain Ltd. (MML) is proposing to develop and operate the theme park on 97.3-acres comprising the lower eastern part of the Belmont Estate, south of the main road. The leased parcels include lands owned by the Urban Development Corporation (UDC) and Jamaica Bauxite Mining (JBM) Ltd. Lands have been leased for a 25-year period, with an option to renew. The estimated investment in this attraction is $4.4 million USD. It is proposed that the project will be developed in two phases, with the first phase involving the installation of the main infrastructure. Construction in the first phase is expected to commence immediately upon securing the necessary permits and approvals (expected by June 1, 2006). A tentative opening date of December 2006 is planned. A second phase (to be scheduled after implementation of Phase I) may include development of other attractions such as a Butterfly and Orchid Gardens, and an Amphitheatre. The main design elements include:

1. A main access road with parking facilities for tour buses and restrooms.
2. Three main rides: (a) a triple chair lift to the highest elevation (lookout point) (b) a canopy Zip-Ride (c) a Jamaican bobsled run (with retrieval lift). Interactive exhibits and museums/information centres will be located on the lower floor of the stations of the chair-lift.
3. Construction of a Lookout Point.
4. A nature trail “Rainforest Jungle Walking Tour”.
5. A central “Olympic Village” with visitor amenities (shopping, restrooms, restaurant, sports exhibit), reception/administration. In phase 2 of the project, this may also include development of an open-air amphitheatre, butterfly and orchid gardens.

The site plan shows an infrastructural footprint of ~6 acres, utilizing approximately 7% of the site. All other areas are regarded as conservation areas. The westernmost point on the site is located approximately 2 km from Island Village in downtown Ocho Rios. The entire site is located south of the main road roughly between Reynolds Pier and Dolphin Cove.

Environmental Baseline

Only the descriptions of the most sensitive environmental receptors are summarized below. The main report contains are more comprehensive review of general environmental parameters.

Water Quality: Average BOD ranged between 17.67 mg/l and 3.67 mg/l. The lowest value obtained was above the NRCA freshwater standard of 1.7. These high BOD levels may be indicative of decaying vegetation or other organic matter within the river and along its banks. TSS values ranged from 4.47 mg/l to 1.2 mg/l. These low values are typical of streams originating in limestone or issuing from springs. As expected, the wet day results are marginally higher for this parameter because of increased surface run-offs. The values for nitrates ranged between 7.92 mg/l and 9.83 mg/l. These baseline values already exceed the NRCA criteria of 7.5. The values for phosphates ranged between 0.01 and 0.07. These values are well below the NRCA standard of 0.8 mg/l. Fecal coliform values ranged between 9 MPN/100 ml (downstream wet day) and 29.67 MPN/100 ml (downstream dry day).

Hydrology: On much of the site surface run-off appears to be very limited. There is evidence in the limestone that underground drainage is developed at this site, and a minor spring issues out on the northern boundary of the site (on the main road). Surface flows are mainly noted over the Quaternary deposits found on the western side of the property. The only perennial stream on the property flows out on the far western side. This stream originates in the upper part of the Bogue Estate. Two springs issue from the limestone from the property.

Natural Hazards: Four major hazards are expected to affect the site: hurricanes, fire/drought, earthquakes and landslides. The site is not flood prone, and there is no anecdotal evidence of flooding in areas adjacent to the site. The potential effect of the project on flooding is discussed in Section 5. Once the land is cleared, soil erosion can be expected to occur in the calcarenites occurring on the gentler slopes occurring on western side of the property near the parking area/entrance.

Vegetation: The biophysical inventory was conducted by the Forestry Department (Ministry of Agriculture). The forest type was classified as *Modified Dry Limestone Forest* (WM), which falls into the general type *Tall open Dry Forest* in the Forest Department hierarchical classification system. There is usually no pronounced shrub layer, but tree height varies within the canopy and epiphytes are few in numbers. Typically there is an extensive distributed seedling flora, but few herbs. Vines are abundant in sections but few in species. The number of trees per hectare with diameter at breast height (dbh) => 10cm was calculated as six hundred and eighty five (685). Fifty-five (55) species (including 1 unknown) belonging to thirty-one (31) families were identified. Of these, three (3) species (*Coccoloba longifolia*, *Hernandia jamaicensis* and *Euphorbia alata*) are endemic to Jamaica. The five most common regeneration species (> 14,000 stems/ha) are *Licaria triandra (*Pepperleaf Sweetwood), *Brosimum alicastrum* (Breadnut), *Piper arboreum* (Jointer), *Calyptranthes pallens* (Mountain Bay) and Casearia guianensis (Wild Coffee). The four most common trees (> 130 stems/ha) are *Licaria triandra (*Pepperleaf Sweetwood), *Brosimum alicastrum* (Breadnut), *Bursera simaruba* (Red Birch), *Guazuma ulmifofia* (Bastard Cedar) and *Catalpa longissima* (Yoke Wood, French Oak, Mast Wood). See Table 3 of Appendix 3 for the full species list. Because of the disturbance of the forest in the past and its consequent regeneration it is in the *Early Secondary* successional stage of its development (Camirand and Evelyn, 2003). The life span of the dominant species is estimated at 10 to 25 years. To move to the next successional stage (*Late Secondary*) this forest would have to remain relatively undisturbed for at least the next 15 years. The area forms part of the 31% area of Jamaica classified as Forest (Forestry Department, 2001). The species richness index (Margalef's) is calculated at 8.27. Pielou's measure of eveness is calculated at 0.76969. This figure is comparable to what was found in Dolphin Head, Hanover (western Jamaica) (Camirand, 2002).

Fauna: Thirty-three species of birds were identified at the site. The most abundant species included turkey vultures, banana quits, and frigate birds. Eight endangered species (listed under “least concern”) were observed to be present at the site, including, the Jamaican Oriole, Yellow-shouldered Grassquit, Chestnut-bellied Cuckoo, Rufous-tailed Flycatcher, Jamaican Tody, Tom Fool, Ants Bird, and the Little Bee Hummingbird. The six protected terrestrial wildlife species have very restricted bio-geographic ranges in Jamaica and are unlikely to be found in Mystic Mountain site. It is possible that the Yellow Snake (*Epicrates subflavus*) may occur in this area as this species has a very wide range in Jamaica. However, it has not been observed or reported from this site. Seven butterfly species were noted at the site, including: *Dryas julia delila (Julia) e, Eurema leuce,.* Zebra Longwing, Cassius Blue,Cloudless Sulphur, *Phoebis trite* and the Antillean Malachite.Other fauna encountered during the study included terrestrial lizards (*Anolis* spp.) and the Indian Mongoose (*Herpestes javanicus*).

Coastal Ecology: Although there is no development proposed for the area north of the main road, it was decided to document the aquatic flora and fauna in the coastal stretch receiving run-off from the site. The rocky intertidal zone is dominated by snails (*Nerita versicolor*, *Cerithium litteratum*, *Littorina* sp., *Nodilittorina* sp.) and chitons. The nearshore area is protected by fringing reef. In the lagoon, live coral cover is very low (<1%) and consisted primarily of small (~20 cm) solitary heads of *Porites* sp. Dead coral rubble (storm deposited) encrusted with various algal species is common. There are bare areas of coarse sand, particularly in the western end of the bay where two small beaches exist. The shallow lagoon, which varied in low-tide depth down to about 1.5 m, contained a patchwork of seagrass and macroalgae. Two species of seagrass were found (*Thalassia testudinum* and *Halodule wrightii*) and various species of macroalgae. This intertidal community seems to be typical for this part of the north coast.

Adjacent Land Uses and Economic Activities: Regional land use of the surrounding areas includes disturbed forest, commercial/tourism, residential, agricultural, and industrial. The site and much of the lands to the south of it can be classified as disturbed forest. The presence of haul roads in this area has opened up the area over time informal uses such as bee-keeping, charcoal burning and possibly small market gardens. The area immediately to the southeast of the site near the right of way (ROW) for the conveyance line is impacted by these informal activities, particularly where terrain is flatter. Adjacent lands are under similar disturbed forest cover.

Environmental Impacts

In terms of construction impacts, a total of nine negative impacts were identified, most of which (7) were evaluated as minor or negligible. Construction noise and possible site run-offs from construction near the river were assessed as moderate impacts, and should be monitored. In terms of operational phase impacts, a total of 23 negative impacts were identified. Half of these assessed as moderate. The highest scoring impact was the increased fire hazard risk arising from visitors' presence in the forest. All negative impacts ranked at the moderate or lower effect level can be cost-effectively mitigated. In terms of VECs, it is noted that water resources are impacted by six negative impacts during this phase, four of which are classified as moderate impacts. All of these must be carefully managed to mitigate the impacts. Atmospheric receptors (air, climate, light, noise) are impacted by four impacts (three of which were assessed as minor), and ecology is impacted by four negative impacts (all of which were assessed as minor).

Summary of Negative Impacts During the Construction Phase of the Project

A1	Increased atmospheric dust (construction)	MINOR
A2	Increased combustion emissions (construction)	MINOR
A4	Above ambient noise during construction and airlift	MODERATE
C1	Possible decline in visual aesthetics at entrance during construction period.	NEGLIGIBLE
E4	Possible destruction of vegetation by local tourists collecting plants.	MINOR
E3	Some smothering of benthic eco-systems during the construction	MINOR
M1	Increased demand for solid waste disposal during construction	MINOR
W1	Possible increase in turbidity from construction of entrance facility	MODERATE
W3	Sewage effluents from construction staff (urine only)	MINOR

Summary of Negative Impacts During the Operational Phase of the Project

A3	Temperature and humidity	MINOR
A5	Above ambient noise ambient along attraction routes	MODERATE
A6	Noise if emergency generators are used.	MINOR
A7	Above ambient light during night time -security	MINOR
C2	Decline in visual aesthetics in built up areas of the park.	MINOR
E1	Vegetation clearance for the project footprint.	MODERATE
E2	Change to community in some areas /loss of biodiversity along ride routes.	MINOR
E5	Composting environment may also produce a habitat for insect pests and vectors.	NEGLIGIBLE
H1	Increased risk of flying objects (ride infrastructure) during hurricanes.	MODERATE
H2	Increased fire hazard arising from visitors' presence.	MODERATE
L1	Change in topography at entrance	MINOR
L2	Soil contamination	MODERATE
M2	Routine demand for solid waste disposal (operational phase).	MODERATE
M3	Energy consumption (non-renewable resource)	MODERATE
S1	Increased traffic near entrance	MODERATE
S2	Loss of amenity to charcoal burners and other informal users.	NEGLIGIBLE
S3	Haul road usage	MINOR
W2	Pesticide load arising from termite control.	MODERATE
W4	Effluents – secondary sewage effluents and grey water at Olympic Village	MODERATE
W5	Effluents – grey water from wash basins at Entrance facility	MODERATE
W6	Accidental litter.	MINOR
W7	Possible impact on the yield in the springs.	MINOR
W8	Increased storm run-offs	MODERATE

Seventeen positive impacts of the project were assessed. All of these impacts are long-term and occur during the operational phase of the project. Almost all of them were assessed as having a moderate effect level. The only significant impact determined by this assessment was the tremendous benefit of creating a preserve of more than 90 acres of secondary dry limestone forest, which will be able to progress to a more stable successional stage over the next 15 years. Numerous indirect/secondary effects on climate, aesthetics etc. can be realized from this impact. Seven of the 17 positive impacts assessed impacted on stakeholders, and an additional three impacted on culture, landscapes and heritage resources. An additional three impacted beneficially on ecological resources.

Summary of Positive Impacts of the Project

C1	Opportunities for spectacular views	MODERATE
C2	Potential to find archaeological artefacts during construction.	MODERATE
C3	Recognition and conservation of petrified wood and fossils.	MODERATE
E1	Protection of trees	SIGNIFICANT
E2	Conservation of reptiles and birds from feral pests	MODERATE
E3	Propagation of indigenous flora and flora	MODERATE
H1	Disaster planning and preparedness.	MODERATE
L1	Production of compost for fertilizer use.	MODERATE
M1	Potential for alternatively produced energy to register negative use.	MODERATE
S1	Diversification of the tourist product	MODERATE
S2	Productive use of the land resource.	MODERATE
S3	Earns foreign exchange revenues	MODERATE
S4	Provides opportunities for public awareness: environment and culture.	MODERATE
S5	Monetarizes the intrinsic value of the environment.	MODERATE
S6	Creates job opportunities during construction and operations.	MODERATE
S7	Stimulates of local economies	MODERATE
W1	Preservation of water quality through the use of the CMC toilets.	MINOR

This EIA concludes a <u>Finding Of No Significant Negative Impact</u> arising during the life cycle of the proposed project. All negative impacts (minor and moderate) assessed can be cost-effectively mitigated, and no major design modifications are required. There are significant benefits of the project and opportunities for improved or enhanced environmental performance of the proposed operations that off-set the combined effect of the negative impacts.

Guidance for environmental management inclusive of a schedule for implementation of construction mitigation measures and an environmental monitoring plan is given.

1 PROJECT DESCRIPTION

1.1 PREAMBLE

The National Environment and Planning Agency (NEPA) received an application for an Environmental Permit from Mystic Mountain Ltd. for the development and operation of an eco-tourism project in the parish of St. Ann. This application was made in accordance with the Natural Resources Conservation Act (1990). Based on the schedule of projects requiring the submission of Environmental Impact Assessment (EIA) prior to permission, NEPA determined that this application must be supported by an EIA. A Terms of Reference (TOR) for the preparation of this document has been approved by NEPA and is included as Appendix 1.

1.2 PROJECT BACKGROUND

In 2004 Jamaica received a total of 2.5 million tourists (JTB, 2005), of which cruise ship passengers accounted for almost 44%. In the same period, Ocho Rios received 768,263 or 70% of all cruise ship arrivals to the island, and had 298,320 or 21.1% of all stopover visitors to the island. The coastal area of the parish of St. Ann continues to develop as a major tourism area, with plans for redevelopment of the Reynolds Pier (a second cruise port in the Ocho Rios Bay), and increasing numbers of hotel rooms (e.g. Riu, Bahia Principe etc.).

With this increasing growth in the tourism sector in the Ocho Rios area, there is an increasing demand for a more diversified range of recreational opportunities. According to the Jamaican Tourist Board Travel Statistics, in the period 2000 to 2004, tourists below the age of 35 accounted for between 45% and 49% of all tourists. Other attraction operators in the area have long recognized that the modern demographics of tourism require more adventure or participant tourism opportunities to satisfy the younger tourists, as opposed to simple beach or shopping experiences. Examples of this type of experience-based tourism include the adventure tours offered by Chukka Blue (such as river tubing or tours on All Terrain Vehicles), Dolphin Cove, and even Dunn's River Falls.

Aware of these trends, Mystic Mountain Ltd. (MML) has realized that there is a growing need for a different type of tourism attraction in the Ocho Rios area. The proponent is therefore seeking to develop a viable tourism attraction on these lands, which will contribute to the range of recreational opportunities now available in the Ocho Rios area. Secondary objectives include the demonstration of environmental sustainable tourism in practice, and promotion of environmental awareness amongst visitors. The proposed attraction will offer thrill rides as well as opportunities to interact with nature and learn about the Jamaican environment, culture and history.

MML is proposing to develop and operate the theme park on 97.3-acres comprising the lower eastern part of the Belmont Estate, south of the main road. The leased parcels include lands owned by the Urban Development Corporation (UDC) and Jamaica Bauxite Mining (JBM) Ltd. Lands have been leased for a 25-year period, with an option to renew. The estimated investment in this attraction is $4.4 million USD.

1.3 LOCATION

The westernmost point on the site is located approximately 2 km from Island Village in downtown Ocho Rios. The entire site is located south of the main road roughly between Reynolds Pier and Dolphin Cove (Figure 1). The leased area actually abuts the main road for about 1 km going east as far as the Ocho Rios sewage treatment plant (STP) from the Dolphin Cove Phase 2 boundary. A small stream crosses the southwestern boundary of the site, and empties into the sea. The western boundary is approximately 1.5 km from the entrance to Dunn's River Falls. On the western, southern and eastern sides, the adjacent lands are generally under disturbed broadleaf forest cover. The lands on the eastern side have been impacted by conveyance systems associated with the bauxite, sugar and limestone transshipment operations. The site extends inland for about 650 m on the southeastern side.

Figure 1 Location of the Proposed Mystic Mountain Development

1.4 PROJECT SCHEDULE/PHASING

It is proposed that the project will be developed in two phases, with the first phase involving the installation of the main infrastructure described below. Construction in the first phase is expected to commence immediately upon securing the necessary permits and approvals. A tentative project schedule is given as Table 1.

Table 1 Project Schedule

Project Benchmark	J	F	M	A	M	J	J	A	S	O	N	D
Submission of the EIA		x										
Government Licenses and Approvals	x	x	x	x	x							
Installation of primary infrastructure					x	x						
Construction of park entrance						x	x	x				
Installation of the chair lift						x	x	x	x	x		
Installation of the bobsled run										x	x	
Construction of the Lookout Point						x	x	x	x			
Construction of the Olympic Village					x	x	x	x	x			
Installation of the ZipRider										x	x	
Finalization of nature trails and signage											x	x
Pre-opening operations & staff training											x	x
Grand Opening												x

A second phase (to be scheduled after implementation of Phase I) may include development of other attractions such as a Butterfly and Orchid Gardens, and an Amphitheatre.

1.5 SITE PLAN & DESIGN SPECIFICATIONS

1.5.1 Project Overview

The main design elements, described in detail below, include:

6. A main access road with parking facilities for tour buses and restrooms.
7. Three main rides: (a) a triple chair lift to the highest elevation (lookout point) (b) a canopy Zip-Ride (c) a Jamaican bobsled run (with retrieval lift). Interactive exhibits and museums/information centres will be located on the lower floor of the stations of the chair-lift.
8. Construction of a Lookout Point.
9. A nature trail “Rainforest Jungle Walking Tour”.

10. A central “Olympic Village” with visitor amenities (shopping, restrooms, restaurant, sports exhibit), reception/administration. In phase 2 of the project, this may also include development of an open-air Amphitheatre, butterfly and orchid gardens.

The site plan (Figure 2) shows the footprints of the main infrastructural elements and property boundaries. All other areas are regarded as conservation areas. No sewage treatment plant is planned as the sewage disposal will be via dry composting toilets and septic system with tile field described in Section 1.5.2.6 below.

1.5.2 Design Specifications

1.5.2.1 Main Access Road and Parking Areas

It is proposed that the main entrance to the site from the main road, and the main parking area (2 acres) will be located on the western side as shown in Figure 2. The road access and parking plans were not available at the time of preparation of this document. However, the basic ideas would be incorporated into the final design:

- A lay-by would be constructed to filter traffic from and onto the north coast highway, and to enable safe off-road drop-off and pick-up. The lay-by will be one-way, with in-coming traffic filtered from an eastern entrance (Ocho Rios side), and exiting traffic flowing out on the western exit.
- The access roadway will be 9 m wide. The entrance and exits connecting to the North Coast Highway will be wider than this.
- Parking bays will be clearly delineated (angled or parallel), and will be a standard 5 m x 2.5 m for cars. There will be a 6 m access aisle to parking areas.
- Parking capacity (shown in white on Figure 2) for 20 staff cars, 20 visitor cars, and 15 buses. The main types of vehicles expected are tour buses (20 to 30 seaters), staff vehicles (not expected to exceed 30) and the cars of local visitors to the facility. As a means of managing vehicular traffic, local visitors would be encouraged (by pricing policy) to come mainly on non-cruise ship days (such as weekends) and during off-season periods. Demand for bus parking during peak seasons will also be managed by encouraging drop-off and pick-up arrangements for guests. Parking lot attendants will be on-hand to reduce congestion problems.

Ticketing/reception will have to be done at this lower entrance, as this is essentially a park and ride arrangement using the chairlift to get to the interior of the park and the Olympic Village (described below). Visitors and tour buses will not be allowed to enter the site using the existing haul roads on the southeastern side of the property.

Four (4) Clivus Multrum Composting (CMC) toilets will be located near the bus parking bays.

The Entrance and Park Headquarters will be staffed with a Park Manager and three administrative staff workers. There will also be a security guard contingent (six to eight uniformed guards).

Figure 2 Site Plan, Mystic Mountain Development

Red line: chair lift route

White dashed line: Forest trail.

Gold line: bobsled run

Dashed gold line: retrieval route.

Blue line: zip rider cable route

Yellow broken line: site boundary.

Areas slated for construction shown in pink.

Parking areas shown in white

1.5.2.2 Rides

Chair Lift

The route of the triple-chair lift begins at the entrance area (Figure 2) and lifts passengers from the highway level at ~8 m above mean sea level (asl) to a lookout point located at 180 m asl. The route is aligned along a southeasterly direction and extends for a distance of 1350 m. It is estimated that this ride will take about 14 minutes (at an average speed of 3.6 miles per hour). The chairlift that will be used is a 1982 Borvig Triple chairlift with 162 three-person chairs. The chair lift will be operated by two loaders at each of the four terminals and will have the capacity to transport up to 800 passengers per hour.

The drive will be located at the top station rather than the bottom station. The unit was a top drive lift in its previous application. Top drive lifts are more energy efficient, because the loads are lighter. With a top drive lift, the motor pulls the cable up the hill and gravity assists on the downhill return. A bottom drive has to pull both uphill and downhill sides continuously.

Final designs for the foundation system were not yet available at the time of preparation of this report. There will be a total of 28 support towers along the lift when completed. Four stations (including the top, bottom and two intermediate ones) will have a footprint of 10 m by 10 m square in dimension. These will be constructed as two-storey towers so that the one floor could provide the support for the lift system, and the other floors could be used to house displays or disseminate information.

The preliminary engineering design is that the drive and return foundations will be 4 legs, which will either be imbedded or anchored by bolts to a spread footer foundation with a vertical column. The top station and idler will use 50 and 35 yards of concrete respectively. Foundation sizes vary with the location of the tower, which will affect static and dynamic loads; it is estimated that the footprint of the 24 support towers will be 3 m by 3 m at most. Foundations will be excavated by hand and the structural components emplaced via helicopter. Foundations will comprise spread footings with vertical columns. The spread footings will be anchored into the limestone bedrock using rebar and grout. Vegetation will be disturbed only to facilitate tower footprint. Footings shall not rest on undisturbed soil, and shall be anchored to stable bedrock of the appropriate load bearing capacity.

More detailed topographic surveys of the routes and stations sites (Figure 2) will be done, as well as a geotechnical investigation prior to finalization of the engineering design.

Detailed specifications for the proposed lift are given in Table 2.

Table 2 Chair-lift Design Specifications

Rope Speed	The lift will operate at a reduced speed of 200 fpm (feet per minute).
Gauge of Line	12’
Drive Bullwheel	12’ diameter
Idler Bullwheel	12’ diameter
Main and Auxiliary Power	Connected to JPSCo power mains originally allocated to the bauxite haulage operations.
Haul Rope	1.375”
Tension System	Counterweight: the tension system is a concrete counterweight, weighing approximately 30,000 lbs using a 1.12" cable connected to the idler bullwheel.
Backstay Cable	1.12”
Communications & Emergency Stop System	The communication system is a 50-pair communication line connected to safety switches on the uphill and downhill sides of each tower. In the event of a cable derail, the circuit is broken and the lift stops. The operators can also stop the lift manually.
Monitoring	This will be done by attendants at the top and bottom of the lift and by an operator. The attendants will assist passengers and recognize safety issues. The supplier (Mad River Lifts – MRL) will provide appropriate training for staff.
Maintenance	The suppliers will provide a detailed maintenance schedule for the individual components of the system, and provide technical expertise as necessary. Additionally, the lift will be inspected daily prior to operation.

Figure 3 Lookout Tower

The upper floor of the top station will be developed as a Lookout Point (Figure 3). This area will allow for a panoramic views to the horizon over 50 km (depending on the final elevation of the upper floor). It is unlikely it will afford a view of Cuba as Jamaica lies 150 km south of Cuba.

Figure 2 shows the concept that will be used in the design of the tower. Essentially, the top floor will be covered, column-supported viewing area with a 360^{o} balcony. Token-operated viewers (scopes, binoculars or telescopes) may be installed to enhance the experience at the Lookout Point.

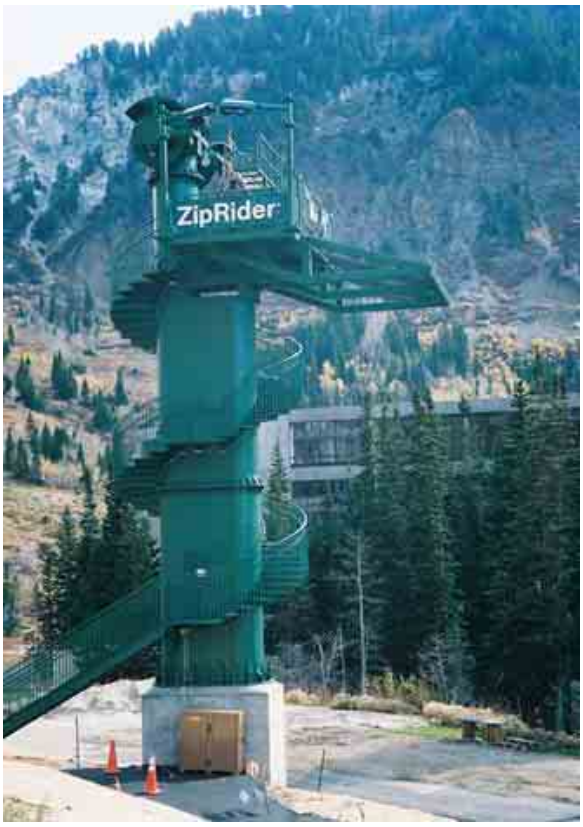
Two tour guides will be present at the Lookout Point.

ZipRider™

The ZipRider™ is a trademarked aerial "Extreme Cable Thrill Ride" product (see http://www.ziprider.com/). According to the manufacturers, the "*key to the entire ride lies in the design of the ZipRider trolley. It has a (patented) braking system that is activated but not controlled by the weight of the rider. As the rider leaves the top loading station the brake is constantly applied, limiting the runaway and uncontrollable speeds seen in a traditional zip-line. The rider hangs four feet beneath the cable and is thus too far below the cable to interfere with the trolley and its braking system. The ZipRider trolley's brake system is adjustable, making it completely adaptable to any cable length and percent grade*." The longest Zip Rider line in the USA is 700 m (Park City Mountain Resort in Utah).

Figure 4 (on the left) below shows one of the two towers that are located on either end of the cable. The photo on the right shows the cables and riders in harnesses (n.b. these photos from two North American locations are taken from the ZipRider™ website, and intended for illustration purposes only).

Figure 4 ZipRider™ tower and cables with passenger harnesses.



It is proposed that the ZipRider™ will start near to the top station of the chair lift system, and will be located at an elevation of ~ 175 m asl. The ZipRider™ cable will run a northeasterly downhill course of 440 m, terminating at an elevation of 130 m asl, near to the second station of the chair lift station, just to the east of the proposed Olympic Village (main staging area). This ride therefore involves a descent of ~ 45 m, over approximately 441 m (slope), in less than a minute.

A tower (probably lower than shown in Figure 3 above) will be located at the top. The ride will terminate at a landing pad/platform, which is about a meter above ground level. No other ground contacts occur between the launch and landing terminals. These towers have a footprint of ~30 m by 30 m. The bobsled run and ZipRider will be operated by two loaders at the start and at the finish line and can accommodate 400 and 200 riders per hour respectively. The harness/trolleys will stay on the ZipRider line and by hauled back up to the top (without riders) on a pulley system.

Bob-Sled

The project proposes to include a 1000 m bobsled run. This concept is intended to capitalize on the fame of "Cool Runnings" 1993 Disney movie, which popularized Jamaica's national bobsled team's entry into the 1988 winter Olympics. The proposed ride is actually a kind of a roller coaster ride named "*Alpine Roller Coasters*". According to the manufacturers (Wiegand), this roller coaster has a range of features (Table 3).

Table 3 Bobsled Features

Features	Advantages
A flexible module system	Allows for use on steep curves, jumps, as well as slower stretches.
Supports for the tracks are anchored to the ground with long spike nails.	No digging, earthworks or foundations are required.
Bridge arrangements with supports	Allows for easy track placement across uneven topography (including steep slopes or ravines).
Plug-in and bolt together systems	Allow for easy dismantling and assembly.
Two supporting tubes	Allow for safe guiding of the bobsleds.
Automatic turnaround (and retrieval)	Reduces the need for manual labor.
Dual-circuit braking system	Increased safety and control.
Weather-independent system	Safe operation in rain.

The roller coaster launches from an elevation of 152 m asl and travels downhill to ~50 asl. The proposed course involves two loops and six hairpin turns (see Figure 2). The retrieval lift is shown as a dashed line in Figure 2. As shown (Figure 5), appropriate safety fencing and rails will be constructed according to industry standards.

1.5.2.3 Nature Trail

The development plan identifies a "Rainforest Jungle Walking Tour" as a fourth way down the hill, the other three ways being the Bobsled Roller Coaster, ZipRider, and Chairlift. The trail will be located on the gentler slopes located on the western side of the chairlift route, and will cover a straight-line distance of ~635 m between the ZipRider landing pad and the entrance area. Persons wishing to take the nature trail will have to walk over to the Forest Station, which will be located on the ground floor of the 2nd Station of the chair lift.

Figure 5 Bobsled

	
(a) Overview of the Alpine Roller Coaster	(c) Detail of Track and Sled.

The actual length of the winding trail, when finalized, will be of the order of ~800 m. This trail will be designed to be easy walking, and will be covered with compacted river gravel or mulch to reduce vegetative re-growth along the pathway. Difficult slopes will be avoided. Where slopes or other difficult crossings cannot be avoided, boardwalks or steps will be constructed. Trees and other points of interest will be marked by signs, giving the scientific name and geographic distribution. Tour guides will be on hand to identify birds, lizards, trees etc. to visitors. Six to eight trained park rangers will be positioned at various points along the route.

1.5.2.4 Visitor Information Centres

There are four 2-storey stations supporting the chair-lift system. The ground floor of these will be used approximately 20 m by 20 m. Station 1 will be the main entrance/exit and will therefore house a reception/ticketing booth, and will possibly have a gift shop. The ground floor of the stations 2, 3 and 4 will accommodate the following visitor information centres:

1. **Forest Station/Land of Wood and Water Canopy Centre**. This will be located a short walk from the landing pad of the ZipRider at Station 2. Trained tour guides will accompany visitors wanting to do the jungle trail from this station to the entrance via the trail. This will provide guests with an opportunity to learn about the tropical forest ecosystem and Jamaica's beautiful natural resources.
2. **Sports Hall of Fame**. This will be located at the Olympic Village at Station 3. It will include displays and authentic trophies, gold medals from World and Olympic Games in honor of great Jamaican athletes.
3. **Heritage Hall.** This will be located at the top station (Station 4), and will give visitors the opportunity to walk through Jamaican history along an interactive timeline. There will be opportunities to learn about the history of Jamaica and its national heroes.

1.5.2.5 Olympic Village

The Olympic Village will represent the main staging area of the facility, and will be located at the 2-acre site shown in Figure 2 (near to the 3rd station, and start of the ZipRider and Bobsled Run). This site is located on relatively flat land at about 120 m above mean sea level. This area is presently under grass cover (see Figure 6).

Figure 6 Location of the Olympic Village

One central building will be constructed at this site. The bottom floor will house offices, giftshop, restrooms, photography department, maintenance and storage facilities for the bobsled. A restaurant (100-table capacity) and the Bobsled Team Chalet Cinema will be located on the top floor. The cinema will show footage from 1988 Winter Olympics, highlights of summer Olympic games and clips from the "*Cool Runnings*" 1993 Disney movie.

A service entrance will be located on the southeastern side, allowing access from the old bauxite haul road. A small utility/service area will be located south of the Olympic Village on the western side of the bauxite haul road. This area will house the back-up generators, and storage area for diesel, machine oils and other equipment needed for the maintenance of the rides. The detailed architectural designs and layout of the Olympic Village and associated service area have not yet been completed.

1.5.2.6 Utilities

Power: The Bobsled Roller Coaster, Chair-lift and ZipRider will all be powered by electricity. In addition, electricity will be needed for operating computers (management offices), video displays, lighting, etc. It is estimated that ~ 15,000 KWH will be needed per 37-day billing cycle (which is the billing cycle that JPSCo uses) to operate the facility. The present plan for power supply entails connecting with Jamaican Public Service electrical mains that run along the main road near to the northern boundary of the lease area, and use the existing JBM power poles and lines that run adjacent to the existing conveyor belt; JBM has agreed to allow MML to use these lines as they are in process of switching from their own power generation to JPSCo. A 500 KW transformer will be located near the southeastern boundary of the site. Emergency

generators will be kept on hand on the southwestern part of the property in the event of power failure.

Potable Water Supply: It is estimated that the maximum number of persons on property at any given time will be of the order of 600 persons. With a 30% over-design capacity, it is estimated that no more than 20 cubic meters (5,284 gallons) per day of potable water will be required during peak season. Water will be required mainly for cooking and cleaning (restaurant), flushing toilets, washing hands, and general cleaning. Water from the NWC mains along the main road should be able to meet the demand of the operations. An alternative (to water supply from the NWC mains) is a spring located at 18276268 E 2036721 N, ~250 m up a small dirt road, behind the Ocho Rios Sewage Treatment Plant. The spring is contained in a small concrete house (Figure 7a) from the base of which runs a 6" pipeline. There are also overflows at the top of the casement. The 6"-inch water line runs to the north east in the direction of the pier. At the junction shown in Figure 7/b (located about 30 m from the spring) a smaller line takes water off to the east (probably to the cement works). This infrastructure was constructed by JBM, and is of sufficient yield to allow Mystic Mountain to take some water as well (personal communication, February 2006, Mystic Mountain Ltd.).

Figure 7 Spring

7/a Concrete Housing

7/b Pipeline and valve.

Sewage Treatment: Two separate sewage disposal systems are being proposed:

1. *Composting Toilets*: at the entrance to the facility, it is proposed that four dry Clivus Multrum composting (CMC) toilets will be constructed. The CMC toilets are described by their manufacturers (http://www.clivus.com/) as:

    - Odorless,
    - Low maintenance (therefore low cost),
    - Environmentally safe (no effluent discharges),
    - Saving water,
    - Suitable for any site or climate.

    This system is ideal for locating near to the stream that is also close to the coast. Clivus Multrum is an Australian company that supplies the Australian government with systems

for a wide range of locations, including roadside amenities, recreation areas and public amenities in other remote and/or environmentally sensitive areas (http://www.virotech.com.au/composting_toilets.htm). This toilet uses the basic principle of organic decomposition. Sewage decomposes in the composting chamber, which is fitted with a controlled airflow to accelerate the process. Water from the washbasins (3 in men's and 3 in the women's) in the toilets will be discharged to the stream. However care will be taken to ensure that biodegradable low phosphate soap is provided.

2. *Septic Tank and Tile Field*: It is estimated that there could be as many as 500 persons at the Olympic Village site at any given time (~174 square feet per person for the 2-acre site). Eight additional toilets (two male toilets with 4 urinals and six female toilets)[1] will be provided at the Olympic Village (located at about 500 m from the coast at an elevation of 120 m above sea level). These toilets will be connected to a septic system and absorption tile field. Grey water from the kitchen and bathrooms will also be routed through grease traps to the septic tank. The design capacity of the septic system is 5000 gallons per day. The final design and site of the septic tank and tile field within the Olympic Village site has not yet been determined. Three wash-basins will be provided in the women's bathroom, and three will be provided in the men's.

Storm Water Drainage: The natural drainage across the site will not be altered. At the Olympic Village and the Entrance/Parking facility, drains will have to be provided to transmit storm water from the paved areas. The drainage system will be designed to convey only storm water. Storm water from the site presently drains to the northwest (discussed in Section 4). Drainage plans for these two areas will be prepared once the sites have been surveyed in more detail. These plans will be submitted for the approval of the Drainage Division of the St. Ann Parish Council.

Communications: The site presently receives good cell phone reception. In addition, the operation will require at least 6 business telephone lines, including a fax line. Cable and Wireless will provide these from the Ocho Rios exchange. Tour guides, rider operators and security guards will communicate using radios. If lines are to be run up to the Olympic Village, they will follow the chair-lift line from the bottom.

Health and Safety: In the event of an accident anywhere on the property, a first aid kit and spine board will be kept at each of the 4 stations. Fire extinguishers and smoke alarms will be installed in all buildings. A schedule of on-call emergency response resources will be available to all staff.

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[1] Reference on recommended number of toilets for a licensed restaurant facility: http://www.health.gov.je/resources/health_protection/food_matters/4666-2348.doc

1.6 IMPACT-CAUSING ASPECTS OF THE PROJECT

1.6.1 Site Preparation & Construction

Activities	Details		Resource Demands	Waste Streams or Public Nuisances
Land Clearance (15,360 square metres = 3.7 acres)	Access/Parking:	8094	10 labourers to clear lands in the area of the proposed entrance and the Olympic Village site. Solid waste collection and disposal at Hadden Dump.	Vegetative solid waste Site run-off from bare soil
	Bobsled clearance:	2000		
	Olympic Village:	0		
	Service Area	1000		
	ZipRider:	1800		
	Nature trails	1600		
	OV and FS Stations (10 x 10)	200		
	Base station (15 m x 15 m)	225		
	Top Station/Lookout Point	225		
	24 support towers (3 x 3)	216		
		15360		
Earthworks	It is expected that there would be some site leveling at the entrance will be located (2-acre). Foundations will require compaction: buildings at Olympic Village, tower bases (4 stations, 2 ZipRider towers, and the supports for the bobsled.		Heavy construction equipment Diesel fuel Labourers	Emissions from diesel combustion.
Transportation of construction materials (daytime only)	This will involve transportation of concrete blocks, steel lengths, cables, bagged cement, fine aggregate, and other construction materials to the two main staging areas (entrance and Olympic village). Materials will be transported via the highway from the source, and will be taken to the staging area using existing access roads through the site. Poured cement and tower components will be		Haulage trucks Helicopter Specially trained helicopter drivers Diesel fuel	Emissions Traffic Noise from the helicopter

Activities	Details	Resource Demands	Waste Streams or Public Nuisances
	transported to the site by helicopter		
Erection of a Temporary Construction Site	A construction camp will be erected to stockpile construction materials, and serve as a site management office.	Rental of portable toilets for workers Plywood for office and screening Tarpaulins for covering stockpiles. Security for construction materials.	Solid waste: domestic waste from workers (lunch and juice boxes, tins, bottles). Packaging materials (bags, boxing etc.) Site run-off: from stockpiles and mixing of mortars. Possible grease from equipment maintenance.
Construction of Olympic Village & Entrance area	Building foundations will be piled into the underlying limestone bedrock. Construction of buildings and facilities: walls, floors, roofs, electrical, plumbing & sewage Construction of access roads, parking area, storm water drainage. Installation of sewage disposal units – excavation of septic tank and tile field.	Concrete blocks, cement, fine aggregate (sand), lumbar for rails, construction water, steel bars, floor tiles, roofing materials, doors and other fixtures and furnishings (kitchens, restaurant, bathrooms, offices etc.) Use of concrete mixer Paint Masons, carpenters, plumbers, electricians, constructions workers. Furnishing and fixtures. Gravel filtration for tile field.	Packaging materials (solid waste) Site run-offs Earth or rock from excavated area.
Erection of stations/visitor centers & rides	Installation of tower components by helicopter.	Tower components Furnishing and fixtures. Lumber, cables etc.	Diesel emissions Solid waste
Laying Jungle trail	Creation of boardwalk, signage and visitor	Lumber; paint Carpenters	

1.6.2 Operations

Activities	Details	Resource Demands	Expected Waste Streams
Landscaping	This will be minimized, and mainly focused on the two staging areas (Entrance and Olympic Village). No non-indigenous species will be introduced to the site. Trees along trails will be trimmed where they represent a hazard: e.g. dead limbs.	Plants for landscaping Fertilizer: compost	Cuttings from pruning.
Termite Control	The Olympic Village and other areas where wooden structures may be placed will be treated for termites, as there is evidence of termites.	Pesticides	Pesticide residues
Staffing & Offices	Approximately 53 permanent staff will be employed in the operational phase of the project.	Managers, supervisors, tour guides, photographers. Utilities: Water; Electricity; Telephones; Demand for parking; use of haul road. Use of paper; Demand for staff food and beverage; training needs; Air conditioning (in offices)	Solid waste Emissions from staff vehicles Sewage. Gray water from sinks. Possible traffic congestion Restaurant wastes Air conditioner emissions
Built area	Roads and parking; buildings; footpaths and trails; footprint of rides	Storm water disposal	Storm water run-off
Visitor Presence	Once operational, the attraction is expected to have a capacity of about 500 visitors per day, and will be open everyday, with down time only expected during bad weather and maintenance periods. Various amenities and facilities will be provided.	CMC toilets; Septic tank and tile field; Utilities: Water; Electricity. Security and safety demand (including insurance); Demand for transportation; restaurants; shopping	Noise (crowds and music) Solid waste: domestic and packing Sewage & gray water. Possible traffic congestion due to slowing at entrance and buses. Restaurant wastes
Operation and maintenance of the rides		Electricity; Machine oils (lubes); Engineers (maintenance)	Oily rags
Operation of the restaurant at Olympic Village	The restaurant will have a 400-person capacity (100 4-seater tables) and will be located in the main building.	Staff; Food & beverage; storage requirements; Furnishings. Fuel (gas); cleansing chemicals (ammonia, phosphates); Dishware; tableware. Cookware. Lighting/air conditioning.	Cooking oils; solid waste (kitchen) Detergents & oils in gray water. Noise emissions Organic wastes (food cuttings, leftovers etc.)
Service area	Generators, diesel fuel storage and other subsidiary inputs required for maintenance of the rides, trails etc	Security Safety procedures and training	

2 ANALYSIS OF ALTERNATIVES

The purpose of this section of the EIA is to examine feasible alternatives to the project including the no-action alternative. With respect to scaling of the project elements, these have been designed to have the minimal footprint while achieving the maximum safety and most appropriate level of recreational experience. Although all the rides can be completed within an hour, the concept of the attraction is to have visitors linger, and enjoy the views, restaurant facilities, and interactive cultural experiences. Reducing the scale would significantly reduce the viability of the operations (for attracting visitors) and would negatively impact on the quality of the recreational experience by increasing perceptions of crowding. Increasing the scale would make the project more expensive, and would not necessarily bring additional benefits.

Opportunities for alternative scheduling of the project were severely constrained by the proponents' objective to have the attraction completed before 2007, which is the year of the Cricket World Cup.

Similarly, this location represents the optimal siting for the proposed project as:

(a) It is located within 10 minutes of the cruise ship piers in Ocho Rios, and within an hour of most of the larger hotels in St. Ann, and is on the North Coast Highway.

(b) The land available in this area has the slope gradients necessary for the proposed rides.

(c) The existing land cover (disturbed forest, rocky outcrops) can be well integrated into a Mountain theme park-type attraction. Squatters have not informally used the site.

(d) There is a supply of trained tour guides and other persons with experience in the hospitality industry in the Ocho Rios area.

(e) Required utilities can be easily supplied (water, electricity, telephone etc.) because of the use of the adjacent area for hauling limestone and bauxite to Reynolds Pier.

2.1 LAND USE DEVELOPMENT OPTIONS

Three options are considered in this analysis, including:

1. **Status Quo (SQ)**: the present land use at the site is disturbed broad-leaf forest cover with rocky outcrops. The lower areas of the site, particularly along the river banks and flatter slopes on the south-western side of the property appear to have been used for burning charcoal and as temporary sleeping areas for indigents. Although the presence of dry stonewalls within the estate suggest historic use by persons, there is no evidence of farming or historic structures on the property. The eastern side of the property is

bound by bauxite infrastructure, including the haul road itself and aerial conveyance system. Adjacent land use on the eastern side is the Rockwill company limestone haulage operations, and on the southeastern side the major land use is the Ocho Rios Sewage Treatment Plant (STP). The major land use on the northern boundary of the site is the main road. Land uses to the south and west are very similar to the land use at the site (forest cover). These areas have not been developed mainly due to the fact that the UDC and the Bauxite Company hold very large land holdings in this area. Difficult terrain and poor soil conditions discourage informal use by squatters and small farmers respectively. More details of the present land use are given in Section 4.

2. **Proposed Mystic Mountain Park (MM)**: This option includes development of park rides, visitor amenities and facilities as described in the fore-going section. Less than 5 acres (1.8 ha) or ~5% of the total available acreage will be cleared (not counting the cleared 2-acre Olympic Village Site). Therefore, much of the site will remain in its present forested condition. The infrastructural changes being implemented (i.e. the actual project footprint) are completely reversible as no significant earthworks or drainage modifications are planned, and the forest can re-establish itself in the areas impacted by the footprint. Design elements such as the rides and trails can be easily removed with no lasting environmental imprint. The most significant difference between the SQ and the proposed land use (MM) is the potential presence of as many as 500 tourists per day at the site. The impacts of this are dealt with in detail in Section 5.

3. **Feasible Alternative: Resort Development (RD)**: for the purpose of comparison and discussion, a hypothetical alternative is included. The site could also reasonably be used for resort type development, similar to Columbus Heights or Crane Ridge, which take advantage of the magnificent sea views on the limestone ridges on the south side of the North Coast Highway. These are fairly dense land use, which offers both short and long-term suite/apartment accommodation to residents and visitors alike. Such land use will involve major changes in slope, ground cover and drainage. Additionally it will have high demands for sewage disposal, roads/parking, electricity, potable water and telephones. Staffing levels will vary with the scale of the operations, but could be significant if more than 500 rooms are developed.

These three land use options are compared below in terms of potential benefits and costs, using a range of factors or normative criteria. This approach tries to represent economic, technical, environmental and social aspects. A rank of number 1 indicates that the option is best suited to satisfying the criterion, and a rank of 3 indicates that the option is least suited to satisfying the normative criterion. Therefore, the option scoring the lowest total score may be regarded as the most suited overall. Although the scores are un-weighted (assuming all to be of equal

importance), ten sets of costs and ten sets of benefits were included to ensure a balance. Additionally, as it is a ranking system, each option must be given a score of at least one, although two options could tie with the same rank. The best possible score would therefore be 20, and the worst would be 60.

In terms of benefits criteria (Table 4), the proposed project (MM) ranks first or second in most cases, and therefore has the lowest score (i.e. is best suited for achieving productive and sustainable land use). Between the proposed use and the present use (status quo), the proposed use is regarded to be a more productive use of the resource.

Table 4 Comparison of Alternative Land Uses (Most Benefits)

Normative Criteria	RANK		
	SQ	MM	RD
Value-adding to local economies: goods and services.	3	2	1
Creates employment for local persons	3	2	1
Is consistent with physical planning zonation for the area.	1	1	3
Attracting more visitors through product diversification (filter down)	3	1	3
Transmits conservation values to visitors (environment & heritage)	2	1	3
Increases (monetarizes) perception of environmental value	2	1	3
Is an opportunity to demonstrate environmental best practice for tourism	3	1	3
Creates foreign exchange revenue stream	3	2	1
Increased availability of recreational opportunities	3	1	2
Environmental monitoring and knowledge of the site	2	1	3
	25	13	23

With respect to costs (Table 5), the resort development option is the costliest in terms of economics, environment, municipal planning and social terms. Looking at the combined scores for costs and benefits, SQ (35) and MM (33) score closely, whilst the alternative examined, RD (53), scored very high indicating that it is a less suitable land use than the other two alternatives. Other feasible land uses than the proposed use and the status quo are likely to be more land intensive and could result in persistent environmental changes.

Table 5 Comparison of Alternative Land Uses (Least Costs)

Normative Criteria	RANK		
	SQ	MM	RD
Lowest Implementation/development costs	1	2	3
Least loss of habitat, biodiversity, tree cover and green space	1	2	3
Lowest level of pollutants: air emissions and effluent discharges	1	2	3
Lowest demand on municipal resources (power, water, landfill)	1	2	3
Least likely to compound other environmental problems (cumulative)	1	2	3
Lowest consumption of non-renewable resources	1	2	3
Least level of stakeholder objection/visual intrusion	1	2	3
Lowest potential to disrupt traffic on main road at access points	1	2	3
Greatest potential to revert to pre-development status	1	2	3
Lowest risk & vulnerability once developed (persons, livelihoods property).	1	2	3
	10	20	30

3 REGULATORY & INSTITUTIONAL FRAMEWORK

3.1.1 Section Overview (TOR)

The objective of this task is to provide an outline of the pertinent regulations, policies 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 Wildlife Protection Act, the Watershed Management Act, Building Codes and Standards, Development Orders and Plans and the appropriate international convention/protocol/treaty where applicable.

3.2 REGULATED ASPECTS OF THE PROJECT

3.2.1 Development Control

3.2.1.1 Tourism Development Projects Permitting

The Town Planning Authority (through the Planning Branch within the Integrated Planning and Environment Division NEPA) administers the Town Planning Act, which covers the development and use of land. All development projects within the watershed must have planning and building permission (which considers planning constraints such as zonation, parking, availability of municipal services) from the Local Planning Authority and TPA.

The National Works Agency (NWA) is responsible for reviewing the development proposal and approving any proposed road or drainage works, particularly as they tie-in to municipal roads and drainage systems. NWA administers the Flood Water Control Act 1958. Under this act, the NWA is charged with the responsibility to manage watercourses with respect to flood regulation in terms of surveys, civil works or clearance. The North Coast Highway Project management team at the NWA will have to ensure that the proposed design of the entrance and exit to the North Coast Highway is safe and integrates properly with the highway alignment.

National Water Commission (NWC) has the responsibility for providing potable water and sewage services for proposed development. The water supply and sewage disposal plans will have to be approved by the NWC. This will be done in conjunction with the **Water Resources Authority**, which has the mandate for managing ground and surface water resources (in terms of supply, flood risk, water quality), and has a representative on NEPA's Technical Review Committee (TRC), which reviews development proposals. The **Environmental Health Unit** (Ministry of Health) also reviews the application and makes comments in terms of the potential of the proposed sewage disposal to impact on human health.

NEPA has overall responsibility for controlling development of land (including public works) and natural resource conservation under the NRCA Act, which makes provision for Environmental Impact Assessments (EIAs) to be conducted for projects falling within a schedule of prescribed activities (such as eco-tourism projects), as a means of providing documentation to support an application for an environmental permit.

The Ministry of Tourism regulates the operation of tourism attractions in Jamaica in conjunction with the Tourism Product Development Corporation (TPDCo.) The Ministry provides policy and regulatory mechanisms for the tourism industry. **TPDCo.** and the **Jamaica Tourist Board (JTB)** has the responsibility for licensing tourism attractions, including heritage attractions.

3.2.1.2 Development and Operation of Rides: Standards

There are no appropriate standards in Jamaica to regulate the types of rides that are being proposed. The American National Standards Institute (ANSI) Standard B77.1-1990 is the American National Standard for Passenger Tramways (including aerial tramways and lifts). The American Society for Testing and Materials (ASTM) standards govern the design, manufacture and operation of amusement rides and devices are given in Table 6 below.

Table 6 List of ASTM Standards for Amusement Rides and Devices

F1159-94	The Design and Manufacture of Amusement Rides and Devices
F698-94	Physical Information to be Provided for Amusement Rides and Devices
F770-93	Operation Procedures for Amusement Rides and Devices
F846-92	Testing Performance of Amusement Rides and Devices
F853-93	Maintenance Procedures for Amusement Rides and Devices
F893-87	Inspection of Amusement Rides and Devices
F1193-88	An Amusement Ride and Devise Manufacturer Quality Assurance Program
F1305-94	The Classification of Amusement Ride and Device Related Injuries and Illnesses

3.2.1.3 Operation of a Restaurant

Restaurants have to be inspected by the St. Ann Health Department and have a Public Health Certificate. Persons involved in preparing food are required to have a Food Handler's Permit, issued by the Ministry of Health (Comprehensive Health Centre).

3.2.2 Environmental Protection

3.2.2.1 Air Quality and Noise Emissions

NEPA is responsible for matters related to air quality and noise emissions under its general environment and planning mandate, although no specific Jamaican regulations in connection with either exist. In the absence of local regulations for air quality, the US Environmental Protection Agency (USEPA) guidance and criteria may be used. The 1990 Federal Clean Air Act regulates air quality in the US, and identifies six major pollutants (ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, respirable particulates and lead), most of which are combustion emissions of fossil fuels.

With respect to noise, World Bank Guidelines and the World Health Organization Noise standards can be used. These standards differentiate between residential, commercial and industrial levels, with commercial and industrial limits for both day and night time being 70 dBA. The Noise Pollution Rules (NPR) of the Environmental Management Act (2000) of Trinidad and Tobago are also a useful guide. The Second Schedule of the NPR indicates three zones in which a sound may emanate: industrial, environmentally sensitive areas, and general. According to these regulations the maximum Sound Pressure Level (SPL) shall not exceed 75 dBA, 60 dBA and 65 dBA in industrial, environmentally sensitive and general areas respectively. The proposed land use can be described as commercial, whilst the land use on the eastern sides of the property can be described as industrial (STP and haulage operations). Although wooded, the western and southern side of the property cannot be described as *environmentally sensitive,* and would fall into a general category.

3.2.2.2 Watersheds and Rivers

The site is located within a sub-basin of the Turtle River Watershed, which is located immediately to the east of the Dunn's River Watershed. It is one of the five watersheds that drain into the Ocho Rios Marine Park, the other being Harbridge Gully, Little River, Dunn's River and White River.

The National Integrated Watershed Management Council (NIWMC) was established in 2000 to implement the National Integrated Watershed Management Programme (NIWMP), which seeks to "*to promote the integrated protection, conservation and development of land and water resources in the watersheds, for their sustainable use, and for the benefit of the residents of the watershed and the nation as a whole*". The NIWMC reports to Cabinet through the Land and Environment Committee and to the Minister of Land and Environment.

The Integrated Watersheds and Coastal Zone Management Branch (of NEPA) administers the Natural Resources Conservation Act, the Wildlife Act, and Watersheds Protection Act

through the Natural Resources Conservation Authority (NRCA). This branch is responsible for administering the Watershed Protection Act (1963) and developing the National Watershed Policy for Jamaica, as well as executing the NIWMP. The Watershed Protection Act was established to protect the island's watersheds and to promote water resources conservation.

The Forestry Department was named in the National Watershed Policy (Draft November 2003) as the implementing agency with overall responsibility for watershed protection and conservation, with NEPA as the main policy and monitoring body. The policy is concerned with such issues as slope stability, erosion, deforestation/forest fires etc. Under the **Country Fires Act (1942)** notice of planned trash burning must be given to adjacent land occupiers and at the nearest police station. It is an offence to leave such fires unattended.

The Water Resources Authority (WRA) administers the Water Resources Act (1995), which regulates the use of water resources in Jamaica, including any activities that impact on the quality of freshwater resources. WRA manages the water resources of Jamaica by issuing 5-year licenses for the abstraction of groundwater and surface waters. WRA also implements the Water Sector Policy Strategy/Action Plan (Ministry of Water, 1999), which addresses water resource management, urban water and sewerage, rural water and sanitation, urban drainage and irrigation.

The Pesticide Control Authority (PCA) was established by the Pesticides Control Act (1975, amended in 1996). This act regulates the use of pesticides, including permissible levels and disposal of pesticides and packaging.

3.2.2.3 Forestry, Wild Life and Biodiversity

The Conservator of Forests (and by extension, the Forestry Department) is charged with the sustainable management of forests on crown lands (including those owned by the UDC) under the Forest Act (1995). This Act provides for the establishment of forests reserves, forestry research, reforestation initiatives and a forestry management plan. The Forest Regulations (1945) are presently under revision. Amongst the considerations under the new regulations are wildlife protection and management of forest reserves for recreation. The National Forest Management and Conservation Plan (March 2001) addresses (inter alia) issues related to co-management, the role of the private sector, reclamation of mined lands, allocation of forest land, incentives, compliance and public education. The Forest Policy (2001), which is contained in this plan, updates the Forest Land Use Policy of 1996. The Forest Policy recognized the importance of involving local communities, private sector and NGOs in national forest conservation efforts. This policy stipulates that, with respect to Crown lands, no net loss would be permitted on forested lands.

Town Planning Department (and by extension the Parish Council) regulates the preservation of forests, woods, trees, shrubs, plants and flowers under Section 25 of the Town & Country Planning Act, which provides for the establishment of development orders.

The Biodiversity Branch (NEPA) has the responsibility of administering the Wildlife Protection Act (1945). The act establishes game sanctuaries, and makes provisions for regulation of bird-shooting and hunting. Of the six terrestrial protected species, (Coney, Crocodile, Iguana, Giant Swallowtail Butterfly, Yellow Snake and Jamaican Kite Swallowtail Butterfly), only the Yellow Snake (*Epicrates subflavus*) may be expected to range in this area, although it is unreported at the site. This species is threatened by predation from introduced species (dogs, cats and mongoose) and loss of habitat. There is a draft National Strategy on Biodiversity, made in compliance with the requirements of the Convention on Biodiversity.

3.2.2.4 Marine Park and Coastal Areas

The proposed development site is located in the hinterland of the Ocho Rios Marine Park, which is regulated by NEPA under the Natural Resources (Marine Parks) Regulations, 1992 (made pursuant to Section 38 of the Natural Resources Conservation Act).

3.2.2.5 Heritage Resources

The Jamaican National Heritage Trust is mandated under the Jamaica National Heritage Trust Act (1985) to conserve anything that could be designated as part of the national heritage, and to document any precious objects that need to be preserved. In the unlikely event that any archaeological artefacts are found during construction works, the JNHT will have to be notified.

3.2.3 Waste Management

3.2.3.1 Pollution Control & Public Health

NEPA is responsible for the control of groundwater contamination from discharges under Sections 15 and 16 of the Natural Resources Conservation Act. Section 12 of the Natural Resources Conservation Act stipulates that licenses are required for the discharge of sewage or any polluting matter. A licenses is not required if the discharge results from "domestic waste" from absorption or soak away pits or other prescribed waste disposal system (in accordance with provisions of this enactment or any other law in force pertaining to such disposal). However, a license is required to construct any works for the discharge of any sewage or trade effluent (such as a sewage treatment plant). Section 17 allows for the periodic performance reporting from the owner or operator of any sewage treatment plant, industrial waste treatment facility or any facility for the disposal of solid waste or any other facility for controlling pollution. This can include information pertaining to the performance of the facility; the quantity and

condition of effluent discharged and the area affected by the discharge of effluents. Regulations are being developed under the Natural Resources Conservation Act to address sources of pollution related to sewage and trade effluent discharges (Davis-Mattis, 2002).

Section 11 of the Wildlife Protection Act makes it an offence against the law to allow or cause discharge of trade effluent/industrial waste into any body of water with fish.

Table 7 summarizes available national water quality standards for freshwater, sewage and trade effluents.

Table 7 Jamaican Water Quality Standards (Key Parameters)

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

The Environmental Health Unit (EHU) of the Ministry of Health implements the Public Health Act (1974), which controls point source pollution, monitors wastewater quality and occupational health. **The Public Health Department** for St. Ann have responsibility to monitor point sources of pollution such as restaurants.

3.2.3.2 Solid Waste Disposal

The **National Solid Waste Management Authority** (NSWMA) is the public authority with responsibility for solid waste management in Jamaica, under the National Solid Waste Management Act, 2001. This includes provision for environmentally sound waste collection, transportation, re-use and re-cycling, and the establishment a licensing system for operators of solid waste management facilities and collection systems.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 SECTION OVERVIEW

The purpose of this section of the EIA is to describe valued environmental components (VECs) within an area that could be impacted should the project be implemented. It is therefore not limited to a description of the site. The level of study given to any one VEC in this baseline is commensurate with the degree of change to baseline condition that may be expected as a result of project implementation. This section is organized according to the broad classification of physical environment, biological environment and human and built environment. Methodologies and data sources with respect to each sub-section are given at the start of that sub-section.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Climate

Climatic data for Ocho Rios are available (summarized in Table 9 below) from the National Meteorological Service of Jamaica. Given its latitude (18 degrees north of the equator) it generally has a tropical climate with dry and wet seasons.

Temperatures: Between November and May mean maximum temperatures are below 30 degrees Celsius. During these cooler months, mean minimum temperatures range between 19 degrees and 21 degrees between December and March. Conversely, mean maximum temperatures are highest between June and October (with an August high)

Rainfall: The mean total annual rainfall for the Ocho Rios station is 1250 mm. The annual distribution of rainfall shows a pronounced wet season between September and January, when mean monthly rainfall ranges between 111 mm and 199 mm. A secondary rainfall peak occurs in April/May with mean monthly rainfall ranging between 87 and 99 mm. Although March is the driest month of the year (40 mm), the main “dry season” for Ocho Rios occurs in the hot summer months between June and August.

Table 8 Ocho Rios Climatic Data (1951-1980) – National Met. Service

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max. Temp. (°C)	28.5	27.9	29.1	29.5	29.6	30.8	31	31.3	30.9	30.4	29.5	28.9
Min. Temp. (°C)	19.6	19.2	20.4	21.8	22.6	22.9	23.5	23.8	23.2	22.8	22.3	20.7
Rainfall (mm)	132	86	40	87	99	67	58	65	111	118	199	189
Relative Humidity – 7 am (%)	85	84	84	83	85	82	84	84	85	86	84	85
Relative Humidity – 1 pm (%)	81	77	76	78	78	75	75	76	78	78	80	81

Humidity: Relative humidity (morning) ranges between 86% and 82% throughout the year. Relative humidity (afternoon) ranges between 75% and 78% for most of the year (February to October). In the wet winter months (November to January), afternoon humidity ranges between 80% and 81%.

Winds: The site is influenced mainly by the north-east trades, which bring winds and rain from the north-east, with an average speed of 15 knots. The location within 500 m of the coast also means that the site is strongly influenced by nighttime land breezes and daytime sea breezes. According to the National Met. Service (http://www.metservice.gov.jm/wind.asp) maximum onshore winds of 23 knots are reached in the daytime between June and July. During November to March the area is also strongly affected by winds from the north and northwest (called “Northers” or “Norwesters”).

4.2.2 Ambient Air Quality

As the project is not expected to generate major air pollution, this parameter is only described qualitatively in terms of existing sources of air pollution. The major existing source of emissions in proximity to the site is the extremely busy main road between Ocho Rios and St. Ann’s Bay, which soon to be upgraded under the North Coast Highway Project. Much of the vehicular traffic moving between Montego Bay and Kingston passes along this roadway. The main air pollutants in this area are associated with exhaust emissions and fugitive dust (from trucks and heavy construction equipment using this roadway). The cement haulage operations between the south-eastern side of the property and Reynolds Pier (upwind of the site) also contribute to the presence of fugitive dust in the area. In general dustiness in the area is related to wind and rainfall conditions, and is predicted to be at its maximum levels during the period June to August.

4.2.3 Ambient Noise Levels

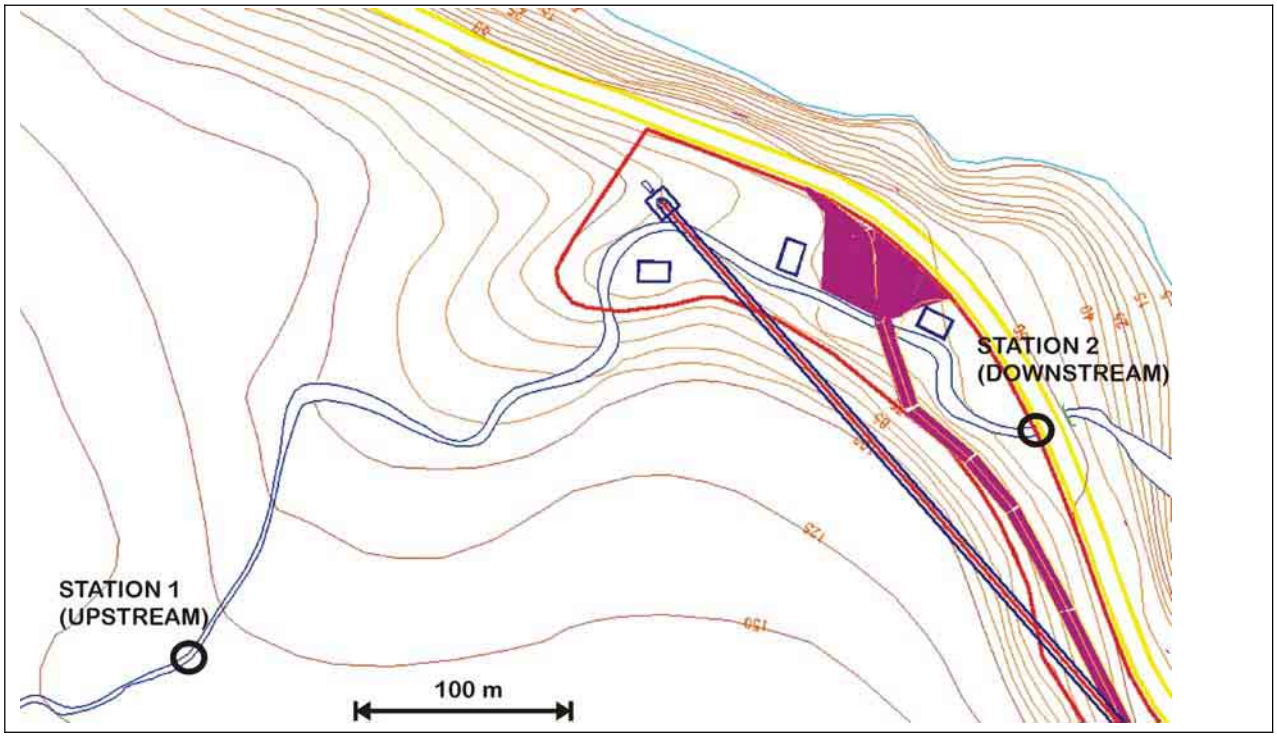
As in the case of ambient air quality, this project is not expected to result in a significant change to ambient levels of noise in the area. Consequently this parameter is only described qualitatively in terms of existing sources of noise. The sources of noise are the same as the sources of air pollution in the area, and include:

1. Vehicular traffic along the main road which forms the southern boundary of the project area
2. Cement haulage operations based on the eastern side of the property and along the haul road on the eastern boundary of the lease area.

4.2.4 Water Quality

Approximately 285 m of a small stream runs through the lease area in the vicinity of the proposed entrance/parking area on the western side of the property. Water quality was assessed using data from two stations along the stream on the western side of the property (Figure 8). The stations were selected based on a simple BACI (Before/After Control/Impact) design. These data are intended to help in the establishment of baseline and control levels for the parameters being investigated. Station 1 (18.41472 N 77.127433 E) is located 280 m southwest of the lease boundary (above the proposed parking area and first chair-lift station), and would represent a before scenario for the control station. Station 2 (18.41433 N 77.125783 E) is located at the exit of the stream from the property, near where the stream enters the culvert at the main road, and would represent a before scenario for the impact station. Three replicates were taken from each station on February 1st 2006 and then again on February 16th 2006. The days preceding the first sample event were very dry, while the three days preceding the second sample event were very rainy.

Figure 8 Locations of Water Quality Stations



Proposed project boundaries and infrastructure are also shown in Figure 8 above.

The water samples were tested[2] for Biological Oxygen Demand (BOD), Nitrates, Phosphates, Total Suspended Solids (TSS) and Fecal Coliform. The analytical methodologies used and laboratory certificates are given in Appendix 2.

[2] The laboratory conducting the tests was the Environmental Solutions Technical Services Laboratory.

The results of the two sampling events are given in Table 9 below. Each parameter is discussed in relation to the NRCA standards for freshwater.

Table 9 Water Quality Results

	mg/l				MPN/100ml
CONTROL BEFORE	**BOD**	**TSS**	**NITRATES**	**PHOSPHATES**	**FECAL COLIFORM**
1a – dry day	5	0.3	9.24	0.07	15
1b – dry day	8	2.6	8.8	0.04	23
1c – dry day	15	0.7	10.12	0.1	39
MEAN	**9.33**	**1.20**	**9.39**	**0.07**	**25.67**
1a – wet day	9	3.3	7.92	0.01	23
1b – wet day	9	2.7	8.36	0.01	4
1c – wet day	1	3.3	8.8	0.01	39
	6.33	**3.10**	**8.36**	**0.01**	**22.00**
IMPACT BEFORE					
2a – dry day	15	4.7	9.24	0.01	23
2b – dry day	25	0.7	9.68	0.01	43
2c – dry day	13	8	10.56	0.01	23
MEAN	**17.67**	**4.47**	**9.83**	**0.01**	**29.67**
2a – wet day	5	3	7.92	0. 06	9
2b - wet day	3	3.6	7.92	0.01	9
2c – wet day	3	3.3	7.92	0.01	9
	3.67	**3.30**	**7.92**	**0.03**	**9.00**
NRCA Standards	1.7	30	7.5	0.8	0

BOD is an indicator of the general level of biological contamination in the water. Average BOD ranged between 17.67 mg/l and 3.67 mg/l. The lowest value obtained was above the NRCA freshwater standard of 1.7. These high BOD levels may be indicative of decaying vegetation or other organic matter within the river and along its banks. There was no major difference between upstream and downstream locations, nor between wet and dry conditions.

TSS level in water is an indicator of the amount of suspended or fine sediment (or microscopic plants) contained in water. It is controlled by run-offs from the land, both in terms of fine sediment, and nutrient loading. TSS values ranged from 4.47 mg/l to 1.2 mg/l. These low values (compared to the NRCA standard) are typical of streams originating in limestone or issuing from springs. As expected the wet day results are marginally higher for this parameter because of increased surface run-offs. There was no major difference between upstream and downstream locations.

Nitrates: The values for nitrates ranged between 7.92 mg/l and 9.83 mg/l, showing no major difference between upstream and downstream locations, or between dry and wet days. These baseline values already exceed the NRCA criteria of 7.5.

Phosphates: The values for phosphates ranged between 0.01 and 0.07, possibly showing an increase between wet and dry days. These values are well below the NRCA standard of 0.8 mg/l.

Fecal Coliform: These values ranged between 9 MPN/100 ml (downstream wet day) and 29.67 MPN/100 ml (downstream dry day). There appears to be no difference between the wet and dry days, or between the upstream and downstream locations. This relatively low level of fecal coliform in the river water may be accounted for by the lack of dense human settlements and soak away pits in the catchment above. The presence may be due to possible indigents and other informal users of the site defecating along the river banks.

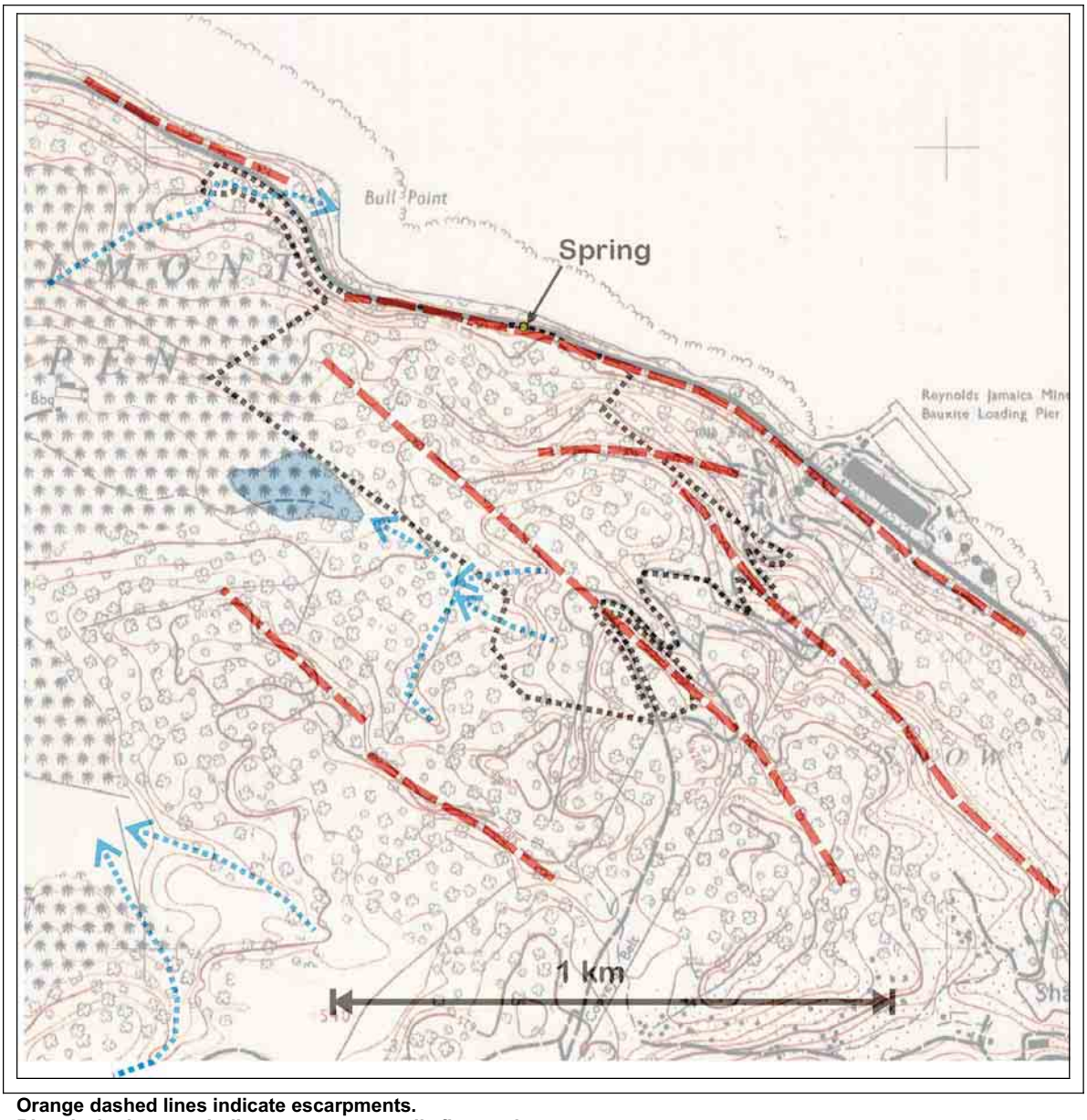
4.2.5 Landforms and Terrain

The land rises from its lowest points (along the main road) of ~35 feet above sea level to a maximum elevation of 580 feet above sea-level (at the proposed look-out site). The terrain is strongly controlled by the underlying geology. Much of the property is underlain by the Coastal Group limestone, which in this area allows for underground drainage and development of extensive karstification (including at least one minor cave and scarp slopes with dripstone features). This accounts for the lack of surface drainage on the property, and the presence of a spring, which issues near the main road as shown (also the location of the car washers). This karstified limestone is also characterized by the presence of several north-west trending fault scarps, which produce steep slopes in the limestone. Minor slumping of the limestone can occur along the escarpments, particularly if the sediment is not well indurated. Where limestone is well-cemented or case-hardened[3], the escarpments appear to be relatively stable, although there is evidence of re-cemented scree forming some lower slopes. These escarpments are not marked on the published geological map, but are inferred based on field observation and map interpretation. On the south-western side of the property, there is some evidence of possible ephemeral gullies that may channel storm flows to the north-west along the general alignment of the major fault trends in the area.

The terrain adjacent to the western boundary (and the proposed entrance area) of the site is very different, comprising a soft, poorly indurated calcarenite lithology, which typifies the Dunn's River Falls area. The slopes here tend to be much gentler and lower in elevation. Small slumps are also typical of this lithology in sloping terrain, particularly when soil conditions are wet. The terrain of the area is given in Figure 9. Dry stone walls possibly demarcating historic property boundaries were noted. Also, in places there were stone mounds, which could possibly be man-made.

[3] Encased in cemented coating caused by carbonate rich flowing water.

Figure 9 Terrain of the Mystic Mountain Area



Orange dashed lines indicate escarpments.
Blue dashed arrows indicate streams or gully flow paths.
Black stippled line indicates property boundary.

4.2.6 Geology & Soils

On the published geological map (Geological Survey Division, Sheet 4), much of the site is underlain by undifferentiated Mio-Pliocene Coastal Group (designated MP on the map), which overlies less permeable the Montpelier Formation (White Limestone Group) seen outcropping on the southern part of the map (Figure 11).

The Coastal Group is described as succession of “soft marly limestones” with a conglomeratic base, which can be observed in section along the Belmont Main Road (between Ocho Rios and Dunn’s River). These limestones contain abundant benthic fossils of Upper Miocene to Lower Pliocene age, including corals. In this area, this reefal formation is likely to be the Hopegate Formation, onto which the younger Falmouth Formation onlaps. Hydrogeologically, this unit is usually categorized as a “Coastal aquiclude”, however, field observations show that that there are areas underlain by the Coastal Group in which significant karstification (underground drainage) occurs. On the site this unit is casehardened, with solution features, and dripstones. In places a re-cemented scree lithology can be observed to be associated with escarpments.

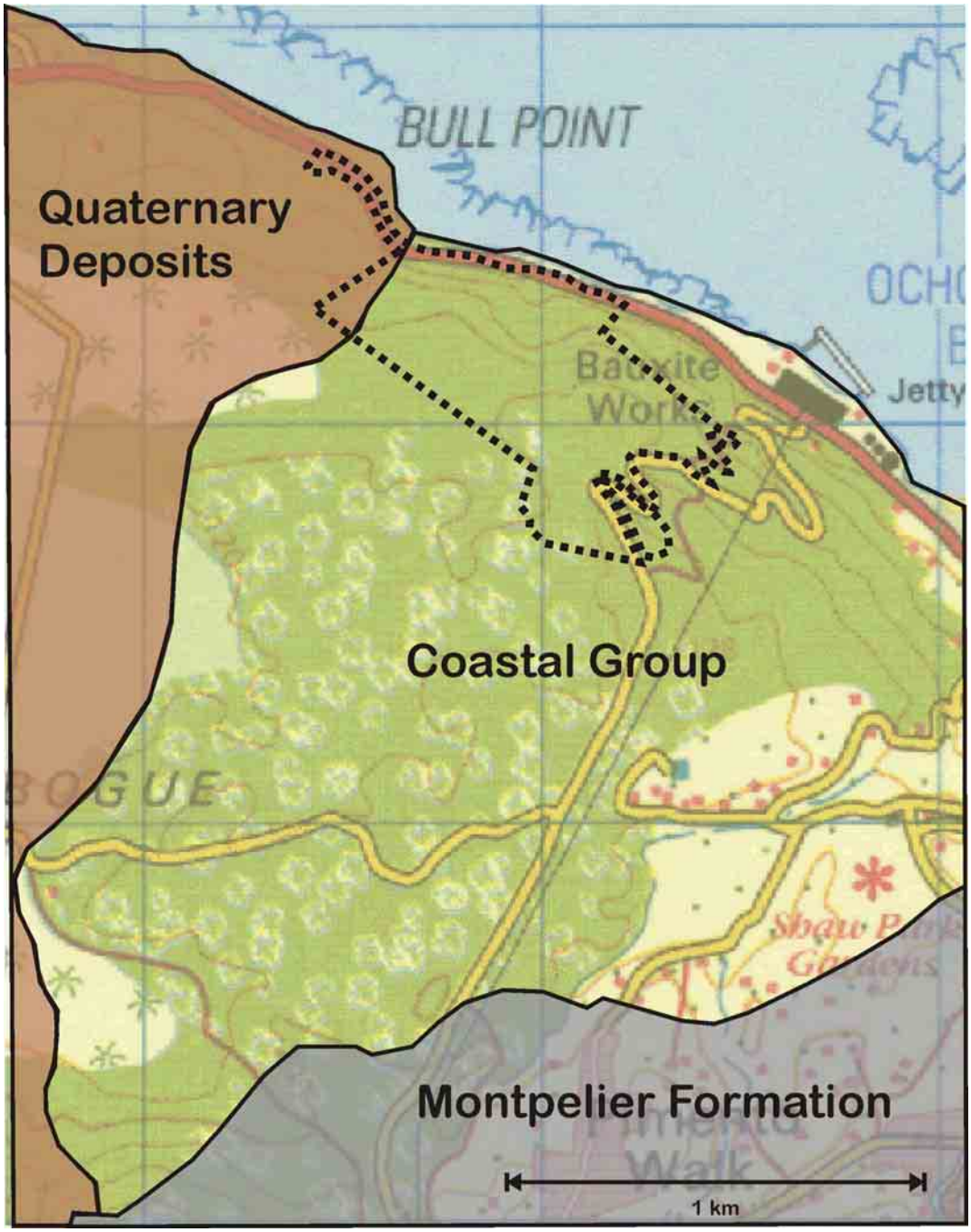
Figure 10 shows three photos of the main rock type. The left shows a well-bedded limestone exposed along the main road. The right photo shows the typical rocky outcrop on the site with surface solution features.

Figure 10 Bedrock at Mystic Mountain.

According to the published geological sheet, the western part of the site is underlain by “Qt” (Figure 11), which is not discussed as a formation on the notes for this sheet. This unit may be part of a terrace deposit, which in this area appears to largely comprise calcarenites, which may be conglomeratic in places. In the field, the lithology observed at the site comprises soft calcareous marls with abundant fossilized land snails and calcified tree trunks. At the site, it is therefore a Quaternary palaeosol developed on the terrace deposit or on calcareous marls of the Coastal Group.

The dominant soil in the area is the Killancholly Clay, which is a thin dark soil with moderate internal drainage. As this soil develops over poorly indurated (marly) limestones it is typically alkaline. In the Forestry Survey, more than half the plots had soil depths less than 20 cm. Only 15% of the survey area contained soils with greater than 1 m of soil.

Figure 11 Regional Geology (GSD, Sheet 4)

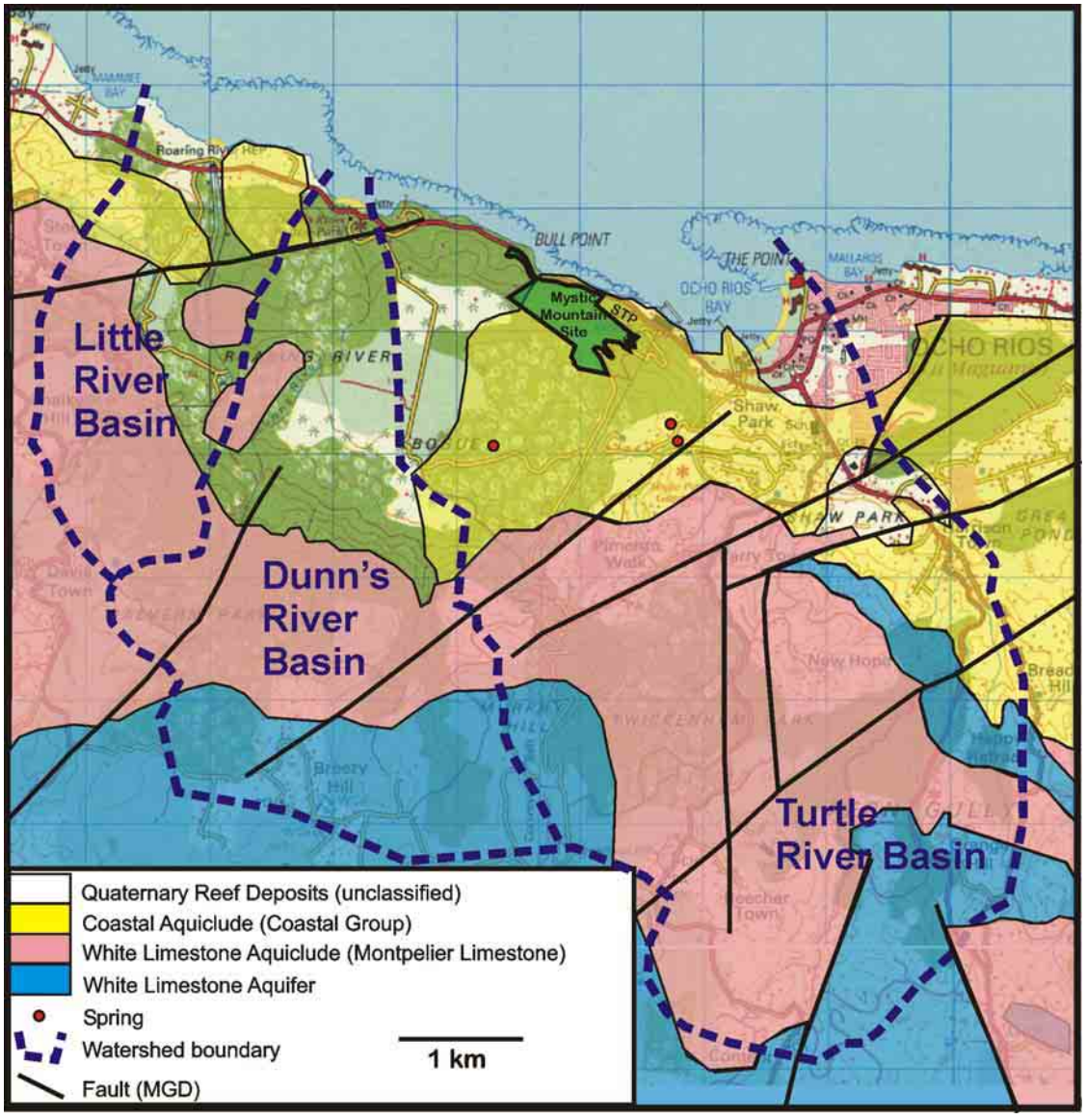


Adapted from Sheet 4, GSD, and OS Metric Sheet 4 (1:50,000) series.

4.2.7 Hydrology

The project site falls within Water Management Unit Six (Dry Harbour Mountains: Rio Bueno-White River) of the major catchments identified for the island of Jamaica by the WRA. Figure 12 below shows the broad hydrogeological zonation, geological faults, and watershed basins. Four major catchments drain into the Ocho Rios Marine Park: White River (east of the Turtle River Basin), Turtle River, Dunn's River and Little River basins. The study area (Mystic Mountain Site shown in green below) is located within the Turtle River Basin, and is located in a sensitive recharge aquifer area for water supply resources.

Figure 12 Hydrogeology and Watershed Near Mystic Mountain



(Sources: Metric Survey Sheets 4/8, Geological Sheet 4/8 –MGD, WRA – nearest springs to site). The Falmouth Formation (Quaternary reefs and gravels) outcrops in the unshaded areas.

The WRA has indicated that there are three springs that supply water in this area (n.b. the JBC spring and spring on the main road are not included in this inventory). These are all located more than 1 km away, and are topographically higher than the proposed site. These springs arise from within the Coastal Group, and are probably controlled by differences in the lithologies within the Coastal Group.

On much of the site surface run-off appears to be very limited. There is evidence in the limestone that underground drainage is developed at this site, and a minor spring issues out on the northern boundary of the site (on the main road). Surface flows are mainly noted over the Quaternary deposits found on the western side of the property. The only perennial stream on the property flows out on the far western side. This stream originates in the upper part of the Bogue Estate.

4.2.8 Natural Hazards

Four major hazards are expected to affect the site: hurricanes, fire/drought, earthquakes and landslides. The site is not flood prone, and there is no anecdotal evidence of flooding in areas adjacent to the site. The potential effect of the project on flooding is discussed in Section 5.

4.2.8.1 Hurricanes

The site is vulnerable to the hurricanes for six months of the year like the rest of Jamaica, during the main hurricane season of June to November. Atlantic hurricanes normally originate in the southern mid-Atlantic off the coast of Africa and track north-westerly towards the Florida pan-handle within a very broad zone. It would be unusual for a hurricane to approach the north coast of Jamaica from the north. The north coast of Jamaica has had a number of “close calls” in the past two decades, but has not had a direct hit.

Hurricanes pathways likely to affect the north coast of Jamaica include those that (a) track south of the island (b) make landfall on the south or east coast and travel across the length of the island (e.g. Gilbert 1988) or (c) track north of the island. Each of these scenarios represents a different level of hazard for the proposed site.

For a system tracking south of the island, maximum hurricane force winds are not usually experienced on the north coast, although considerable precipitation may occur over an extended period (e.g. Ivan, 2004; Claudette, 2003; Isadore, 2002, TS Charley, 2004; and Iris, 2001). This is the commonest type hurricane pathway, and represents the lowest level of risk to the Ocho Rios area. There is also the odd case hurricane that develops in the western part of the Caribbean like Hurricane Mitch in 1998, which brought devastation to Mexico. This type of

system can result in major rain and flooding across Jamaica. A system tracking across the island (e.g. Gilbert 1988, which tracked across southern parishes) the damage can be the most devastating because of the potential for winds close to the centre to affect the site. The third scenario envisages a hurricane passing north of Jamaica (e.g. Lilli 2002 and TS Helene, 2000). Hurricanes tend to move to the northwest, so as the hurricane passes Jamaica it normally moves further away. The extent of impact from such a hurricane will depend on the proximity to the north coast of Jamaica, the speed, intensity and the general direction. In this scenario the impacts of the hurricane are related to wind damage, flooding from rain and coastal flooding arising from storm surge. The site's lowest elevations is ~10 m asl, which would generally be out of the range of storm surge.

Because of the different risks presented by the different hurricane pathways, it is important to keep abreast of the predicted tracks[4]. The Saffir-Simpson Hurricane Scale ranks hurricanes between 1-5, based on its intensity. This ranking can be used to estimate potential damage from winds and flooding that could be expected if a hurricane makes landfall.

Table 10 Saffir-Simpson Hurricane Scale

Category	Wind Speeds km/hr	Max Storm Surge (m)	Possible Damage on the North Coast
One	119-153	1.5	Trees limbs, signs affected. Landslides and mudslides. Some flooding.
Two	154-177	2.5	Roofs, doors, window damage. Small trees and shrubs. High-tension wires and overhead cables blown down. Infrastructure associated with chairlift, bob-sled and ZipRider may be damaged by wind.
Three	178-209	3.6	Minor structural damage. Large trees. Coastal roads flooded.
Four	210-249	5.5	More extensive structural damage, doors and windows; loss of roofs. Vegetation and signs blown down. Low-lying terrain and roads flooded.
Five	>249	>5.5	Some complete building failures. All vegetation and signs blow down. Severe damage to windows doors and roofs. Hurricane Gilbert was the strongest Atlantic hurricane on record with minimum pressure of 888 mb.

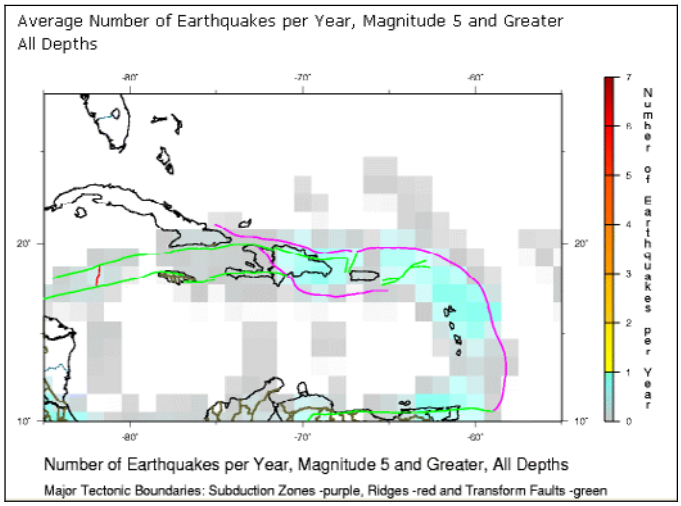
The effects of hurricanes are not limited to the physical damage to property arising from winds and rain. The tourism industry on the North Coast can be crippled by impassable roads, lack of utilities (power, water, telephones), and bad publicity which results in a general lack of visitors. It is critical to have proper insurance coverage for lost income arising from hurricanes.

[4] Regularly updated hurricane information on the region can be obtained from the following online sites: (1) http://www.wunderground.com/tropical/ (2) http://www.nhc.noaa.gov/ (3) http://www.weather.com/index.html

4.2.8.2 Earthquakes

An earthquake density map of the Caribbean (Figure 13), reproduced from the USGS website (http://earthquake.usgs.gov/regional/world/caribbean/density.php), shows that on average Jamaica experiences less than 1 earthquake of magnitude 5 and greater. The earthquake risk in northern Jamaica is affected by the presence of the major transform boundary, which is associated with the Duanvale Fault.

Figure 13 Earthquake density map for the Caribbean



There is a moderate potential for the site to experience a "felt earthquake", as described under the modified Mercalli Intensity scale (Table 11).

A major earthquake (>5 in magnitude) originating elsewhere in Jamaica could be felt in this area.

Table 11 Modified Mercalli Intensity (MMI) Scale

MMI	Magnitude	Effects
I	1-2	Felt by very few people. Barely noticeable
II	2-3	Felt by a few people, especially on upper floors.
III	3-4	Noticeable indoors, especially on upper floors but may not be recognizable as an earthquake
IV	4	Felt by many indoors, few outdoors. May feel like heavy truck passing by.
V	4-5	Felt by almost everyone, some people awakened. Small objects moved. Trees and poles may shake.
VI	5-6	Felt by everyone. Difficult to stand. Some heavy furniture moved, some plaster falls. Chimneys may be slightly damaged.
VII	6	Slight to moderate damage in well built, ordinary structures. Considerable damage to poorly built structures. Some walls may fall.
VIII	6-7	Little damage in specially built structures. Considerable damage to ordinary buildings, severe damage to poorly built structures. Some walls collapse.
IX	7	Considerable damage to specially built structures, buildings shifted off foundations. Ground cracked noticeably. Wholesale destruction. Landslides.
X	7-8	Most masonry and frame structures and their foundations destroyed. Ground badly cracked. Landslides. Wholesale destruction.
XI	8	Total damage. Few, if any, structures standing. Bridges destroyed. Wide cracks in ground. Waves seen on ground.
XII	>8	Waves seen on ground. Objects thrown up into air.

Historically there have been at least 13 damaging earthquakes affecting Jamaica, the most recent of which was the January 13th 1993 Kingston earthquake of magnitude 5.4. It is likely that many of these were "felt" in St. Ann, although the epi-centre occurred many kilometres away, as was the case in the 1993 earthquake (Wiggins-Grandison, 1996).

4.2.8.3 Bush Fires

In any wooded area in the general Ocho Rios area, bush fires are a risk during the dry hot months between June and August, when relative afternoon humidity can be below 76%. Bush fires can begin naturally or as a result of persons disposing lit cigarettes or leaving fires unattended. On the site there is also evidence of charcoal burning, which can also represent a hazard particularly during the summer months when vegetation is brittle and dry.

4.2.8.4 Landslides

Landslides occur mainly along escarpments in the softer, less indurated lithologies (as can be observed at various locations along the main road). These take the form of minor rotational slumping. Outcrops of this less indurated limestone are uncommon within the site, and are observed mainly along the main road. In general the well-indurated limestone that dominates the site is very stable at steep angles. Where this lithology is brecciated (due to faulting), rock falls can occur. Once the land is cleared, soil erosion can be expected to occur in the calcarenites occurring on the gentler slopes occurring on western side of the property near the parking area/entrance.

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Vegetation

4.3.1.1 Methodology

The biophysical inventory was conducted during the period February 15th – 18th, 2006 by trained foresters of the Forestry Department (Ministry of Agriculture). Using 1991 1:15,000 scale aerial photographs, an interpretation of the vegetation was done to determine the forest type(s) of the proposed site and surrounding areas. The land use classification system used is the hierarchical land classification system at 10 000 scale design for Jamaica by the Forestry Department (Camirand and Evelyn, 2003).

Normally, the allowable (or expected) error for a management (biophysical) inventory should be around +/- 10 % at the 95 % level of probability (α = 5%). This allowable error should be a weighted sampling error of all forest types. To achieve this for the area it would require at least 75 plots (10%) to be established (Forestry Department, 2000). This was not possible because of cost and time constraints; therefore a sampling intensity of 2% was decided on. Based on the

principles of a stratified random allocation, short transect lines from random access points were distributed in the forest type found on the site. On these transects lines 13 sample units or rectangular plots 25 m x 20 m (0.05 ha) were allocated systematically 100 m apart. Each sampling transect was defined by a compass bearing determined during the office planning. The 25 m x 20 m sample plot was established by laying out the centre line at 25 m. At the start of this centre line perpendicular offsets, 10m on either side of the line, were defined; the same was done at the other end of the 25 m centre line. The end points of these offsets define the rectangular plot. Within this large plot a sub-plot 5m x 10 m was established and within this sub-plot a further sub-sub plot 1mx 2m was laid out.

All trees greater than 9.5 cm (recorded 10 cm) diameter at breast height (DBH) whose point of germination lies within the sample plot boundaries were examined, evaluated, measured, and recorded on a tally sheets. An enumeration was done of the saplings and regeneration tree species having a point of germination within the boundaries of the sample subplot (5x10m) and a sub-sub plot (1 x 2m), respectively. Tree regeneration was defined as small trees up to 2m total height; tree saplings are greater than 2 m high but less than 9.5 cm dbh. All trees within the plot boundaries were identified, measured, evaluated and recorded on tally sheets. These trees were coded according to the Forest Department's Code of Tree Species.

4.3.1.2 Classification of Forest Type

The forest type on the site was classified as *Modified Dry Limestone Forest* (WM), which falls into the general type *Tall open Dry Forest* in the Forest Department hierarchical classification system (Figure 14). This is typically a well-developed "dry semi-evergreen forest over limestone" with a canopy height of 8-15 m with some emergent trees. There is usually no pronounced shrub layer, but tree height varies within the canopy and epiphytes are few in numbers. Typically there is an extensive distributed seedling flora, but few herbs. Vines are abundant in sections but few in species.

4.3.1.3 Abundance and Composition

The number of trees per hectare with diameter at breast height (dbh) => 10cm was calculated as six hundred and eighty five (685). Fifty-five (55) species (including 1 unknown) belonging to thirty-one (31) families were identified. Of these, three (3) species (*Coccoloba longifolia*, *Hernandia jamaicensis* and *Euphorbia alata*) are endemic to Jamaica. The weighted sampling error for the standing tree parameters is 25% which is what was expected for the sampling intensity chosen The number of species normally increase with the increasing of sample plot area or number of sample units. Therefore, it is possible that some of the tree species on the site were missed in this inventory.

The five most common regeneration species (> 14,000 stems/ha) are *Licaria triandra (*Pepperleaf Sweetwood), *Brosimum alicastrum* (Breadnut), *Piper arboreum* (Jointer), *Calyptranthes pallens* (Mountain Bay) and Casearia guianensis (Wild Coffee). See Table 2 of Appendix 3 for the full species list. The four most common trees (> 130 stems/ha) are *Licaria triandra (*Pepperleaf Sweetwood), *Brosimum alicastrum* (Breadnut), *Bursera simaruba* (Red Birch), *Guazuma ulmifofia* (Bastard Cedar) and *Catalpa longissima* (Yoke Wood, French Oak, Mast Wood). See Table 3 of Appendix 3 for the full species list.

Figure 14 Forest Cover

4.3.1.4 Successional Stage

Because of the disturbance of the forest in the past and its consequent regeneration it is in the *Early Secondary* successional stage of its development (Camirand and Evelyn, 2003). The life span of the dominant species is estimated at 10 – 25 years. To move to the next successional stage (*Late Secondary*) this forest would have to remain relatively undisturbed for at least the next 15 years. Thus the carrying capacity of any development would have to be gauged to ensure minimal disturbance to the surrounding vegetation. The area forms part of the 31% area of Jamaica classified as Forest (Forestry Department, 2001).

4.3.1.5 Biodiversity

Margalef's richness index, is calculated using the data in Table 3 of Appendix 3 and the formula given *(S-1)/* ln*(n)*, where *S* is the number of taxa, and *n* is the number of individuals. The species richness index is calculated at 8.27. Pielou's measure of eveness is calculated using the data in Table 3 of Appendix 3 and the formula given (J) = J = H / ln(S), where H = -SUM (p*ln(p)), p = (n/N), n = # of individuals by species and S = Total number of recorded species. The measure of eveness is calculated at 0.76969. This figure is comparable to what was found in Dolphin Head (Camirand, 2002).

4.3.2 Terrestrial Fauna

4.3.2.1 Avifauna

General Conservation Status: Jamaican forests contain a diverse range of habitats, which is reflected in ~280 bird species reported for the island. Notably, ~35 of these are endemics, the highest in the Caribbean (Appendix 4). The five endemic genera are: *Pseudoscops, Trochilus, Loxipasser, Euneornis* and *Nesopsar.* This avifaunal assemblage also includes many Greater Antillean and Neotropical species, as well as over 80 North American winter migrants (especially warblers and shore birds) because of Jamaica's geographical position on one of the main north-south migration routes. Smaller numbers also visit from Central America and from the south during the austral winter. There are approximately 170 recorded breeding species.

All restricted-range bird species (Table 12) in Jamaica occur primarily in rainforest (a few in forest on limestone). Most species occur in both the lowlands and mountains, but many are altitudinal migrants that breed only in higher-elevation forests (BirdLife International 2003). These priority species are increasingly threatened by habitat modification/destruction caused by agriculture, urban sprawl and industrialization.

Table 12 Threatened Bird Species (Jamaica)

Species	Status	Comment
Widespread Range		
West Indian Whistling Duck, *Dendrocygna arborea*	Vulnerable	
Piping Plover, *Charadrius melodus*	Vulnerable	Winter only
Plain Pigeon, *Columba inornata*	Endangered	
Restricted Range		
Patagioenas caribaea	Vulnerable	Hunting pressure
Siphonorhis americanus	Critical	Predation by introduced rats and mongooses.
Amazona agilis	Vulnerable	Poaching for food and trapping for the local bird trade.

Major causative factors of past extinctions during the colonial period (>100 years ago) were (i) excessive hunting (for human consumption), (ii) introduction of non-indigenous predatory species (mongoose, cats, rats, wild pigs), and (iii) trapping for the bird trade. Recently arrived brood parasites such as the Shiny Cowbird (*Molothrus bonariensis*) can also contribute to the problems faced. The Jamaican Petrel (*Pterodroma caribbaea*) is thought to be extinct because of predation by mongooses and human exploitation, but is listed as critical as it may conceivably still survive in remote parts of the island.

Occurrence at Site

Table 13 is a list of species encountered on the study site outside of census times during fieldwork in February 2006. A DAFOR (Dominant, Abundant, Frequent, Occasional or Rare) scale was used to categorize abundance.

Table 13 Species Encountered at Mystic Mountain Site

	SPECIES	COMMON NAME	ABUNDANCE
1	*Cathartes aura*	Turkey Vulture	F
2	*Coereba flaveola* **	Bananaquit	F
3	*Fregata magnificens*	Magnificent Frigatebird	F
4	*Bubulcus ibis*	Cattle Egret	O
5	*Columbina passerina*	Common Ground Dove	O
6	*Egretta caerulea*	Little Blue Heron	O
7	*Icterus leucopteryx*	Jamaican Oriole*	O
8	*Loxipasser anoxanthus*	Yellow-shouldered Grassquit*	O
9	*Pelecanus occidentalis*	Brown Pelican	O
10	*Tiaris bicolor*	Black-faced Grassquit	O
11	*Actitis macularius*	Spotted Sandpiper	R
12	*Buteo jamaicensis*	Red-tailed Hawk	R
13	*Dendroica caerulescens*	Black-throated Blue Warbler	R
14	*Egretta thula*	Snowy Egret	R
15	*Forpus passerinus*	Green-rumped Parrotlet	R
16	*Geothlypis trichas*	Common Yellowthroat	R
17	*Hyetornis pluvialis*	Chestnut-bellied Cuckoo*	R
18	*Loxigilla violacea*	Greater Antillean Bullfinch	R
19	*Melanerpes radiolatus*	Jamaican Woodpecker*	R
20	*Mimus polyglottos*	Northern Mockingbird	R
21	*Mniotilta varia* **	Black-and-white Warbler	R
22	*Myiarchus validus*	Rufous-tailed Flycatcher*	R
23	*Parula americana*	Northern Parula	R
24	*Patagioenas leucocephala*	White-crowned Pigeon	R
25	*Quiscalus niger*	Greater Antillean Grackle	R
26	*Setophaga ruticilla*	American Redstart	R
27	*Todus todus* **	Jamaican Tody*	R
28	*Tyrannus caudifasciatus*	Loggerhead Kingbird	R
29	*Vireo altiloquus*	Black-whiskered Vireo	R
30	*Zenaida aurita*	Zenaida Dove	R

* indicates Jamaican endemic species categorized as of “Least Concern”.

** indicates birds that were also identified in the Forestry Survey.

The Forestry Department also recorded birds species encountered at each of the sampling stations established for the floral survey (also done in February 2006). In addition to the species indicated above (as also identified by the Forestry Survey), the following three threatened species (of relatively low concern) were also identified:

- *Myiarchus stolidus stolidus* (Tom Fool) – Frequent (6 individuals)
- *Dendroica pharetra* (Ants Bird, Ants Picker) – Occasional (2 individuals)
- *Mellisuga minima minima* (Bee Hummingbird, Little) –Occasional (2 individuals)

4.3.3 Other Fauna

Of the 20 wild life species protected by the law, only six are terrestrial, including the Coney, Crocodile, Iguana, Giant Swallowtail Butterfly, Yellow Snake and Jamaican Kite Swallowtail Butterfly. Most of these have very restricted bio-geographic ranges in Jamaica and are unlikely to be found in Mystic Mountain site. It is possible that the Yellow Snake (*Epicrates subflavus*) may occur in this area as this species has a very wide range in Jamaica. However, it has not been observed or reported from this site. Threats to this endangered species include habitat loss and predation by introduced species (dogs, cats and mongoose).

Jamaica has 134 butterfly and moth species, 20 of which are endemic (e.g., the giant swallowtail, *Pterorous homerus*). Butterflies observed at the site included:

- *Dryas julia delila (Julia) e*
- *Eurema leuce*
- *Heliconius charithonia* simulator *(Zebra Longwing) e*
- *Leptotes cassius theonus (Cassius Blue)*
- *Phoebis sennae (Cloudless Sulphur)*
- *Phoebis trite*
- *Siproeta stelenes stelenes (Antillean Malachite)*

Other fauna encountered during the study included terrestrial lizards (*Anolis* spp.) and the Indian Mongoose (*Herpestes javanicus*).

4.3.4 Coastal Ecology

Although there is no development proposed for the area north of the main road, it was decided to document the aquatic flora and fauna in the coastal stretch shown in Figure 15 below. The small stream that runs across the western side of the property (which is the proposed entrance and parking area) empties into the sea on the western side of the bay. A qualitative nearshore

transect survey was conducted on February 24th 2006 at low tide from east to west across the length of the bay. All encountered species at walking depths were documented.

Figure 15 Location of Coastal Survey

The bay itself is part of the Ocho Rios Marine Park (ORMP), which extends from Frankfort (Tower Isle, St. Mary) to Drax Hall (St. Ann). The area between Reynolds Pier and Bull Point was included in the survey. Much of the coastal area in this location occurs within 15 to 30 m of the main road.

This lagoon is very shallow and partially exposed at low tide.

The rocky intertidal zone is dominated by snails (*Nerita versicolor*, *Cerithium litteratum*, *Littorina* sp., *Nodilittorina* sp.) and chitons. The nearshore area is lagoonal in nature, protected by fringing reef that is typical for this area. In the lagoon, live coral cover is very low (<1%) and consisted primarily of small (~20 cm) solitary heads of *Porites* sp. Dead coral rubble (storm deposited) encrusted with various algal species is common. There are bare areas of coarse sand, particularly in the western end of the bay where two small beaches exist.

The shallow lagoon, which varied in low-tide depth down to about 1.5 m, contained a patchwork of seagrass and macroalgal areas, sometimes interspersed. Two species of seagrass were found – *Thalassia testudinum* and *Halodule wrightii*, as well as various species of red (*Rhodophyta*), brown (*Phaeophyta*) and green (*Chlorophyta*) macroalgae: *Penicillus dumetosus*, *Amphiroa rigida*, *Hypnea* sp., *Caulerpa* sp., *Laurencia* sp. The sun anemone (*Stichodactyla helianthus*) was also common.

This intertidal community seems to be typical for this part of the north coast. Existing sources of environmental stress includes:

1. Run-offs associated with Reynolds Pier (where limestone aggregate is often openly stockpiled),

2. Outflows from the small stream that enters the area as a small waterfall (Figure 16 a). This is the same stream that was sampled for water quality testing.
3. Informal use of the small, secluded pocket beach by locals (Figure 16 b).
4. Run-offs from the main road, which would also include surface run-offs from the sewage treatment pond and Mystic Mountain leased area.
5. Outflows associated with the small freshwater spring located on the northern side of the road on the soft shoulder where car washing is presently done. This run-off passes under the main road by culvert.

Figure 16 Coastal Area East of Bull Point, Ocho Rios.

a/ Waterfall at western end of bay.

b/ Secluded pocket beach.

4.4 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

4.4.1 Human Population

4.4.1.1 Demographics

The demography of the parish of St. Ann is described using secondary data available from published censuses, particularly the 2001 Census. Between 1991 and 2001, the total population of St. Ann grew from 150,600 persons to 167,300 persons, registering a 10-year rate of population increase of 11.1%. Of the 14 parishes in Jamaica, this gives St. Ann the fourth fastest growing population, after Kingston/St. Andrew (11.4%), St. James (16.9%) and Manchester (19.1%). However, the relative proportion of Jamaica's population living in St. Ann in both 1991 and 2001 was roughly the same (6.4%).

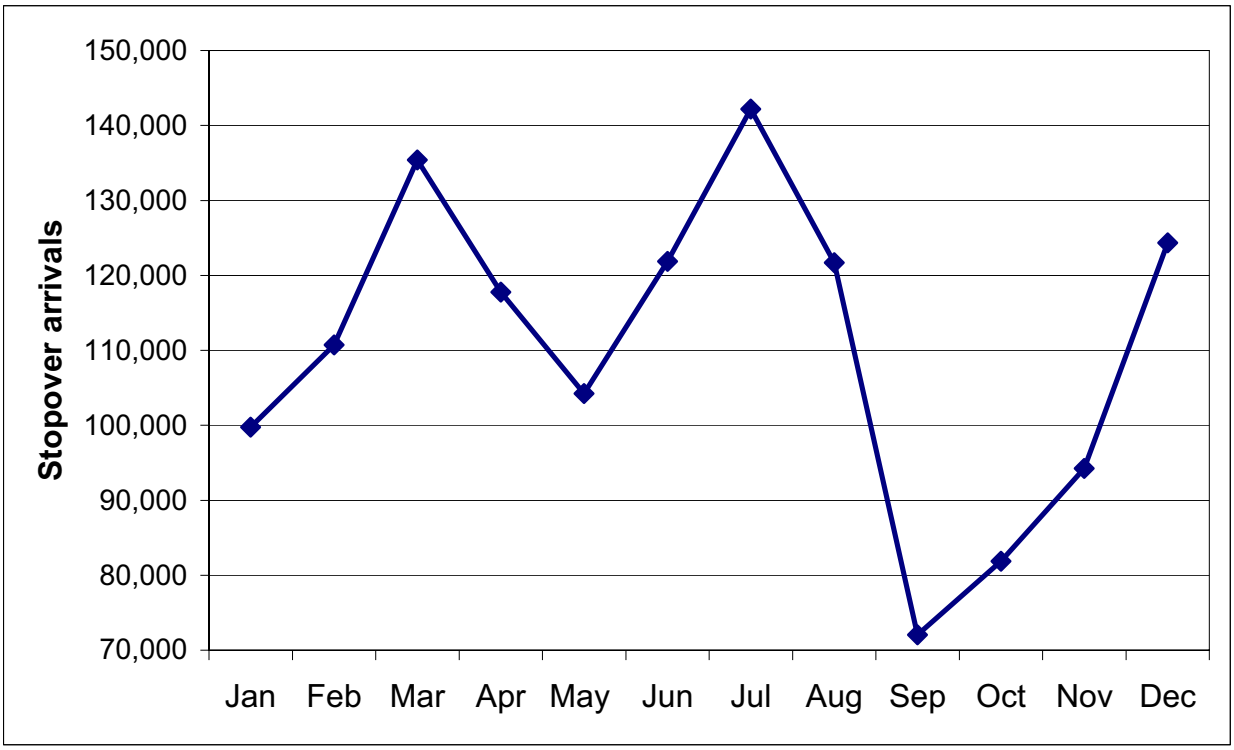
The most relevant population to the project site would fall within the Ocho Rios urban area. Twenty-two (22) EDs are listed by STATIN for the Ocho Rios urban area for the 2001 Census.

According to the 2001 Census data, there were 15,772 persons living in the Ocho Rios urban area. Of these 48.61% were male, and 51.39% female.

4.4.1.2 Tourism Trends

The overwhelming importance of tourism can be best understood by comparing the resident population of just under 16,000 persons to the annual combined total (cruise passengers and stop-over guests) of over one million visitors to the town. According to the 2004 Tourist Board Report, the busiest stop-over months are July, March and December. In general mean monthly arrivals exceed 100,000 visitors between December and August. The slowest period is September through to November (Figure 17).

Figure 17 Annual Distribution of Visitor Arrivals to Jamaica: 5-Year Monthly Averages (2000-2004)

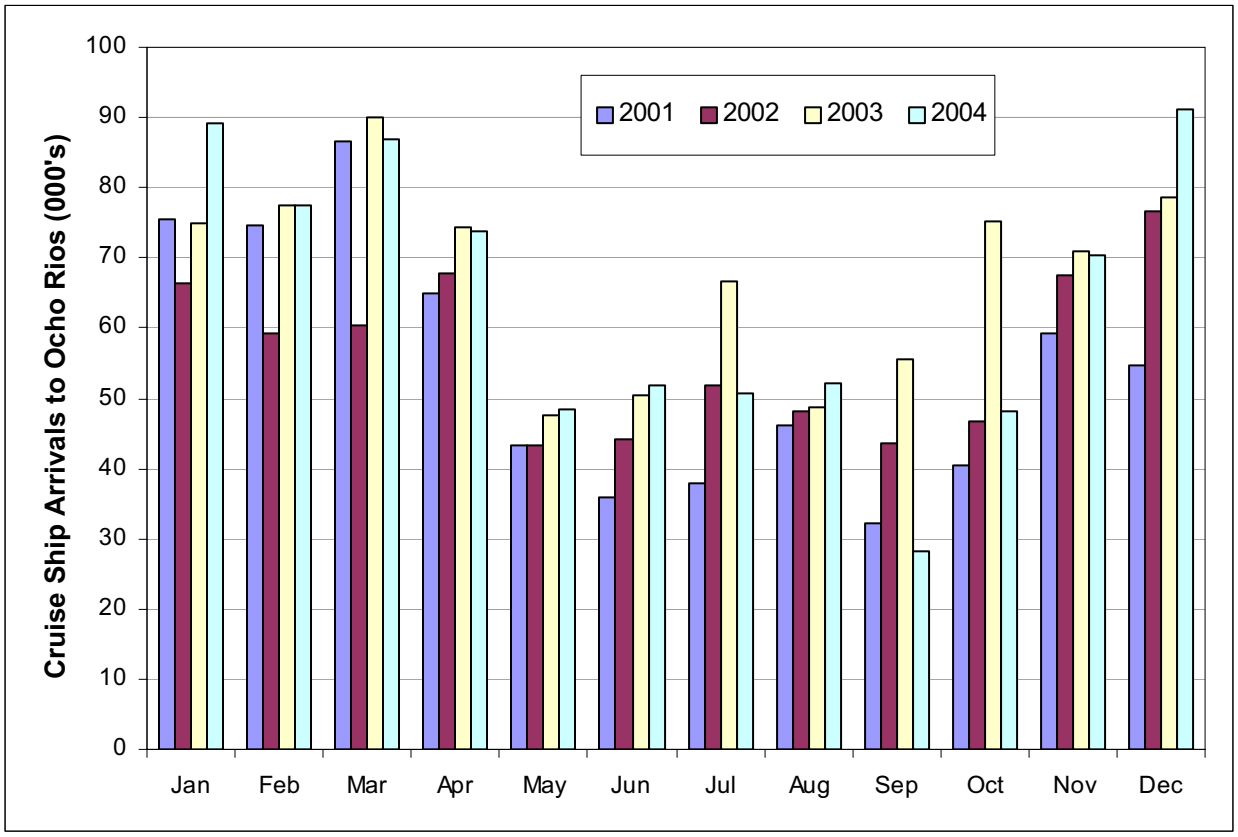


Data taken from JTB 2004

Figure 18 shows the annual distribution of cruise ship arrivals specifically to the port of Ocho Rios. This figure shows the general trends with high, sustained cruise ship arrivals between November and April. Between November 2003 and April 2004, the average number of cruise ship arrivals per month was almost 80,000 (more than 5 times the resident population of the town). For the period May to October 2004, the average number of cruise ship arrivals per month was 46,586, which is considerably lower. This period of May to October coincides with the main part of the hurricane season for Jamaica. March and July are a peak period for both

cruise ship visitors and hotel guests, and can be expected to be very busy tour seasons in Ocho Rios.

Figure 18 Cruise Ship Arrivals to Ocho Rios (2001-2004)



Data taken from JTB 2004

4.4.2 Municipal Resources

Power: JPSCo supplies electricity to the Ocho Rios area. The nearest regional office is in St. Ann's Bay.

Water supply: The municipal water supply for the Ocho Rios area comes is met by the NWC. Part of the residential area of Shaw Park is met by private water supply. Dolphin Cove takes water from an underground spring that emerges on that property. The Bogue/Pimento Walk spring located approximately 800 m south of the site supplies the communities of Pimento Walk, Parry Town, Snow Hill and Hill Top. The output of the system is 0.16 MGD and the demand is 0.12 MGD leaving a spare capacity of 0.04 MGD.

Sewage: The main sewage treatment plant (STP) for the Ocho Rios area is operated by the NWC. Many of the residential areas are not tied into the sewage mains that go to the STP.

Solid waste: The nearest landfill in the Ocho Rios area is Hadden Dump in St. Ann. The Solid Waste Management Authority collects solid waste from commercial and residential areas.

Telephone: Cable and Wireless Jamaica supplies telephone lines (land lines). Cellular service is available from Digicel as well as Cable and Wireless.

Emergency Response: There are a number of medical practitioners in the Ocho Rios area, who are available in case of medical emergency in a tourist attraction. The nearest hospital with a 24-hour accident and emergency facility is located in St. Ann's Bay. Ocho Rios has a Police Station. The nearest fire response service is located in Ocho Rios. After a major natural disaster (hurricane, flood, earthquake), the Jamaica Defence Force is expected to play a leading role in the restoration efforts.

4.4.3 Adjacent Land Uses and Economic Activities.

Figure 20 shows the regional land use of the surrounding areas (showing a wider region of ~2000 acres), sub-divided according to disturbed forest, commercial/tourism, residential, agricultural, and industrial.

Disturbed Forest: The site and much of the lands to the south of it can be classified as disturbed forest. These lands were either owned by the UDC (on the western side) or by the bauxite company (particularly along the conveyance line and haul roads). The presence of haul roads in this area has opened up the area over time informal uses such as bee-keeping, charcoal burning and possibly small market gardens. The area immediately to the southeast of the site near the right of way (ROW) for the conveyance line is impacted by these informal activities, particularly where terrain is flatter.

Commercial/Tourism: Downtown Ocho Rios and as small area to the west (Dolphin Cove) comprise mainly commercial or tourism related activities.

Residential: The main urban residential area in proximity to the site is Shaw Park, Russell Hall and Pimento Walk, which has encroached as far the ROW for the haul line. The areas of Shaw Park that offer vistas to the sea have become prime real estate in the Ocho Rios area.

Agricultural: The land to the west of the site was previously under cultivation (coconut); there is also a small area to the southeast of the site that was used for market gardening. Much of this area appears to be reverting to an uncultivated state.

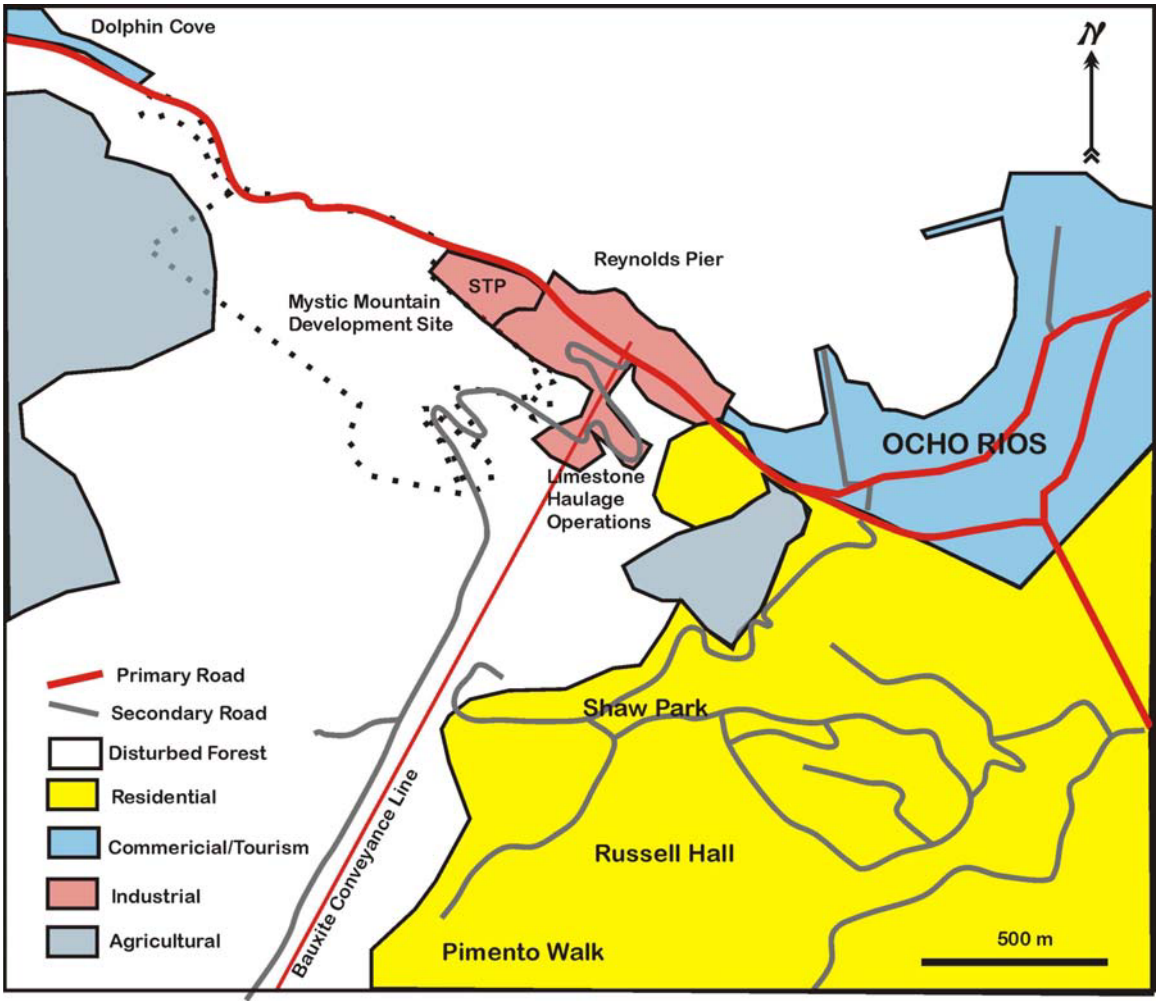
Industrial: Industrial use in this area is largely related to the limestone (and previously) bauxite haulage operations based at Reynolds Pier. Rockwill Cement Company presently uses the haul road on the eastern side of the property (see Figure 19).

Figure 19 Industrial Land Use on the Eastern Side of the Property

Reynolds Pier itself is used for both tourism and as a trans-shipment port for sugar and crushed limestone. Crushed limestone is often stockpiled near the pier.

The municipal sewage treatment plant adjacent to the site is classified as an industrial land use.

Figure 20 Land Use (Regional)



5 STAKEHOLDER CONSULTATION PROCESS

5.1 SECTION OVERVIEW (TOR)

This included the following types of consultations:

1. Town Meeting: overview of project, expected environmental changes, discussion.
2. Discussions with government agencies: Water Resources Authority, Forestry Division, NEPA, Jamaica Bauxite Institute, St. Ann Parish Council and Works and Drainage Division; Ministry of Tourism and Tourism Product Development Corporation (TPDCo.); JAMPRO.
3. Discussions with NGO's: Friends of the Sea, North Coast of Jamaica Conservation Association.
4. Discussions with occupiers of adjacent lands: UDC, Dolphin Cove, JBM; Rockwill Cement Company. These companies

Aside from the newspaper notice of the completion of the EIA, the above identified groups will receive written notices of the availability of the EIA for review and comment, as well as the scheduled time for the public meeting (week of March 20th 2006). The EIA timeline indicating opportunities for stakeholder participation is given in the Table 14 below.

Table 14 Project Development Schedule

Benchmark	Date
EIA kick-off	January 16th
Draft TORs submitted to NEPA	January 16th
Draft TORs accepted by NEPA (revised)	January 30th
Stakeholders advised of Project and EIA, and invited to submit comments	February 3rd
Notice of TORs availability posted in Monday Gleaner	February 20th
EIA is submitted to NEPA for technical review	March 6th
Copies of EIA placed for public review*	March 6th
Notice of EIA availability to be placed in Gleaner	March 8th
PUBLIC MEETING	March 24th
Verbatim Report Available (7 DAYS AFTER PUBLIC MEETING)	March 31st
End of Public Review Period (30 DAYS AFTER THE PUBLIC MEETING)	April 24th
Stakeholder Site Tour	April 27th
Proponent advised of NRCA's decision on application for environmental permit	May 27th

* Copies of the EIA will be available from NEPA (including the website nrca.org) and from the Ocho Rios Library, St. Ann Parish Council, NEPA regional office, FOTS office and NJCA office.

5.2 ISSUES RAISED

5.2.1 Eco-Tourism Designation

In a communication to the preparers of the EIA, the Ministry of Industry and Tourism (MIT) defined ecotourism as "…. *a segment of sustainable tourism that offers experiences that enable visitors to discover protected areas while preserving their integrity, and to understand, through interpretation and education, the natural and cultural sense of place. It fosters respect towards the environment, reflects sustainable business practices, created socio-economic benefits for communities/regions and for the country on a whole and recognizes and respects local indigenous cultures, traditions and values."* According to the MIT the project cannot be properly classified as an "eco-tourism project". It is however, validly classified as a nature/adventure park. The following specific issues are raised by MIT (in italics), and addressed as appropriate below.

5.2.1.1 Conservation

The proposal mentions nature conservation under "Environmental Management" as an area that will be addressed. This needs to be explicitly explained. Considering that the development is proposed for a disturbed broad leaf forest, will any attempt be made to restore/preserve the area (to be guided by research and scientific study)? What other measures will be in place to actively contribute to the preservation of the natural and cultural heritage of the area?

Aside from the specific footprint of the Olympic Village, Entrance/Parking area and the rides and Jungle Trail, much of the lease area will be conserved and protected. This amounts to more than 95 acres of forested lands that will remain under the protection of Mystic Mountain Ltd. An extensive forestry survey was done as part of the EIA to ensure that the status of the forest was scientifically documented. According to the recommendation of the Forestry Department, areas outside the immediate footprint of the park infrastructure and buildings, will be preserved so that so the forest can recover to the next successional stage (late secondary). Tree-cutting (for charcoal burning, site clearance, or craft supplies) within the forested area will not be permitted. Random hiking by visitors through the forest preserve will also not be encouraged. More details on proposed environmental management strategies are discussed in Section 7 of this report.

5.2.1.2 Education and Awareness-raising

Public education in respect of the environment, Jamaican culture and history are mentioned. However, will there be an attempt to educate visitors on local indigenous natural resources (e.g. endemic and/or endangered species) and cultural practices?

The Jungle Trail and Forest Station will be the main areas where visitors will have opportunities to learn about indigenous resources and to some extent, cultural practices. It is proposed that visitors on the Jungle Trail will be lead by trained guides who give interpretative talks, highlighting endemic and/or endangered species of birds and other wildlife on the tour. Endemic species of trees will have signs with scientific information.

It is planned that there will be an orchid patch, into which only endemic Jamaican orchids will be transplanted and grown for display purposes.

It has been recommended that the following should also be considered:

- A display of Jamaican ferns in an area on the property where there is a natural high diversity of ferns.
- A small area that displays cultivated Jamaican cultivation plants (such as cocoa, coffee, banana, yams, sugar cane) and natural herbs with known medicinal properties. All displays will be explained by the trained guides, and will also have the appropriate level of signage.

5.2.1.3 Community Development

There is no mention made of how local communities will be involved in the project. For instance, what percentage of staff will be employed from surrounding community (as guides etc.)? Are there communities in the project area? If so, how will these be incorporated into the development and operation of the park? Ideally in ecotourism projects, communities should share some ownership of the resources and be involved in its management and use.

The project is being developed on lands lease from the UDC and JBM, so that there are no communities within the site, or immediately adjacent to it. The nearest communities are those of Shaw Park, Snow Hill, Parry Town and Pimento Walk. The latter three communities have organized themselves into a group called Hills United Development Organization (HUDO). HUDO focuses on the promotion of alternative livelihoods (to practices that are environmentally deleterious) for community members. Presently they are involved in the bee-keeping project that is located in the areas along the bauxite conveyance system as well as a proposed nature trail. The HUDO nature trail has been developed in the hills between Dunn's River Falls and the Bogue Great House (Delton Walker, personal communication, February 2006). It is intended that the community members will take tourists on walking tours of this area. The proposed development will not be competing with this true "eco-tour" as it intends to appeal to a different type of tourist (adventure-thrill seeking).

The proponents have however indicated that they intend to hire from within the nearby communities, as long as the community members have the requisite skills and qualifications. They are particularly interested in having tour guides from the adjacent communities.

5.2.1.4 *Carrying Capacity*

Whilst it is understood that the facility requires a certain volume of business to be viable, eco-tourism attractions generally accommodate a small number of visitors over a period. It is necessary to calculate a suitable number of visitors per unit area ratio to ensure that the environment and the experience, that is the ecological and social carrying capacity, are not compromised. In our estimation, 500 persons per day, every day is too high to be ecotourism.

It is agreed that this project cannot be classified as an eco-tourism project. It is being developed as basically outdoor recreation (mountain adventure), with strong nature/heritage components. It must be emphasized that large numbers of tourists will not be trampling through the forests on a daily basis. The calculated footprint of the tour operations is less than 6 acres or ~5% of the leased area. Tourists will have opportunities to see the forest from the Olympic Village, the various rides and Look-out Point, but will only be able to walk through a small part of it. Tourist traffic in the footprint areas will be controlled and managed through the reservation system to avoid bottlenecks and crowding. The highest density of tourists can be expected to occur at the Olympic Village, which will be the main staging area, where tourists will expect (and probably arrive in) large groups. In this 2-acre area, it is calculated that even at peak capacity (assuming all 500 visitors are at Olympic Village at one time) the maximum density of persons will be of the order of 16 m^2 per person.

The capacity of the rides will be controlled by engineering design (which includes the throughput speed). The most sensitive area that will require strict control is the Jungle Trail. It is recommended that the maximum group size on these walks be ten persons (not including guides). Groups should also not leave the forest station (for the Jungle Tour) within 10 minutes of each other.

Another concern with carrying capacity is the potentially large numbers of vehicles (personal communication D. Blake, Ministry of Land and Environment). The main parking and drop-off area will be located in a 2-acre designated site. Traffic congestion will be controlled by various means (including shuttles, parking attendants etc.).

5.2.1.5 Compatibility

Wendy Lee of the Northern Jamaica Conservation Agency (NJCA) raised a concern (personal communication, February 2006) about the Bobsled Roller Coaster Ride in particular, indicating that this activity will be perceived as noisy (from screaming riders and movement of the cars on the rails) and will probably be incompatible with bird watching and other nature oriented activities. However, the area is large enough to accommodate both types of outdoor recreation in designated areas that are sufficiently removed from each other. The Jungle Trail will be located in the area immediately west of the chair lift route. It is also expected that trees and the separation distance will buffer noise from the Bobsled Roller Coaster Ride.

The Ministry of Industry and Tourism also had a concern with the potential for noise pollution to impact on wildlife and habitats in the area. As indicated above, bird and wildlife habitat areas (more than 95% of the lease area) will be largely off limits to tourists, who will be guided through designated areas only.

5.2.2 Other Concerns/Recommendations

The following concerns that have been raised include:

- Visual aesthetics of the built facilities: it was recommended that these should be unobtrusive.
- Environmental management: it was recommended that "*the facility should have an Environmental Management System (EMS) in place, which inter alia includes policies and strategies for Disaster and Emergency Management"* (MIT)
- Need for interpretive programmes: MIT recommended, "*An interpretative programme should be developed as part of the visitor education component to increase visitors' awareness for the natural and cultural heritage of the site".* Details of plans for interpretive tours and information centres are given in Section 1 of this report.
- Sewage disposal: MIT indicated that sewage must be tertiary treated to avoid groundwater pollution. However, discussions with persons at the Water Resources Authority indicate that secondary treatment (septic system and tile field) would be acceptable at the Olympic Village site. They also indicated that the effluent free CMC toilets would also be acceptable at the entrance.
- Storm water disposal on cleared slopes (V. Blake, NEPA). The areas to be cleared for the main facilities are located on generally flat or gentle slopes. The Olympic Village site is actually under grass cover presently, and will not require extensive clearance. An area of sensitivity is the parking lot area, and approaches to reducing construction site run-offs are discussed in Section 7.
- Disposal of organic wastes: material from kitchens and restaurants will be sorted, composted and reused as soil conditioners as recommended (V. Blake).

6 ASSESSMENT OF IMPACTS

6.1 SECTION OVERVIEW (TOR)

The goals of this section of the EIA report are to:

1. Comprehensively identify all possible and likely impacts on Valued Environmental Components (VECs) that might arise in the event the project, as proposed, is implemented. This includes all impacts that could arise during the lifecycle of the project from site preparation, through construction to the operational phase.

2. Determine as quantitatively as possible the effect level associated with each identified impact. Impacts are assessed and classified by effect level (minor, moderate, and significant). This involves a detailed, comprehensive evaluation of the identified impacts in terms of specific criteria.

3. Clearly and concisely summarize salient information needed by the NEPA to make a determination with respect to the environmental costs of the project, and whether, in the project should (a) be granted an environmental permit as proposed, or (b) granted an environmental permit, subject to recommended modifications. In both cases, it is expected that there would be licensing conditions that enforce the recommended management plan (including mitigation measures and monitoring plan).

6.2 IMPACT IDENTIFICATION

6.2.1 Methodology

Preliminary environmental scoping done by NEPA and the consultants in preparing the TOR identified some of the main impacts that would be considered in the study. This list was augmented by discussions with project stakeholders and the professional experience of the EIA preparation team. Team members conducted an exhaustive review of the possible impact-causing aspects of the project, the regulatory criteria controlling environmental aspects, and the status of valued environmental components (VECs), and created the checklist of possible impacts. Additionally, possible impacts were included based on a literature review of similar projects elsewhere, and other developments in this area.

6.2.2 Identified Impacts

Tables 15 and 16 identify environmental impacts that have the potential to occur with implementation of this project. These are categorized according to the resources or VEC being impacted. These are coded and numbered, and separated into negative and positive impacts.

Table 15 Negative Impacts

	VEC	Negative Impacts
A	Air, Light & Noise	1. Increased atmospheric dust from bare soils, stockpiles, traffic etc. 2. Increased combustion emissions from heavy vehicles and equipment. 3. Temperature and humidity 4. Above ambient noise during construction and airlift 5. Above ambient noise along attraction routes 6. Noise if emergency generators are used. 7. Above ambient light during night time -security
W	Water	1. Possible increase in turbidity from construction of entrance facility 2. Pesticide load arising from termite control. 3. Sewage effluents from construction staff (urine only) 4. Effluents – secondary sewage effluents and grey water at Olympic Village 5. Effluents – grey water from wash basins at Entrance facility 6. Litter. 7. Possible impact on the yield in the springs. 8. Increased storm run-offs
C	Culture, Landscapes & History	1. Possible decline in visual aesthetics at entrance during construction period. 2. Decline in visual aesthetics in built up areas of the park.
L	Land and soils	1. Change in topography at entrance 2. Soil contamination from accidental loss of containment of stored fuels and lubes in service area
E	Ecology	1. Vegetation clearance for the project footprint. 2. Change to community in some areas /loss of biodiversity along ride routes. 3. Some smothering of benthic eco-systems during the construction. 4. Possible destruction of vegetation by local tourists collecting plants. 5. Composting environment may produce a habitat for insect pests and vectors.
S	Stakeholder & Community	1. Increased traffic near entrance 2. Loss of amenity to charcoal burners and other informal users. 3. Haul road usage
M	Municipal Resources	1. Increased demand for solid waste disposal during construction 2. Routine demand for solid waste disposal (operational phase). 3. Energy consumption (non-renewable resource)
H	Hazards	1. Increased risk of flying objects (ride infrastructure) during hurricanes. 2. Increased fire hazard arising from visitors' presence. 3. Potential for increased flooding arising from decreased infiltration.

Table 16 Positive Impacts

	VEC	Positive Impacts
W	Water	1. Preservation of water quality through the use of the CMC toilets.
C	Culture, Landscapes & History	1. Opportunities for spectacular views 2. Potential to find archaeological artefacts during construction. 3. Recognition and conservation of petrified wood and fossils.
L	Land & Soils	1. Production of compost for fertilizer use.
E	Ecology	1. Protection of trees 2. Conservation of reptiles and birds from feral pests – rodents, mongoose etc. 3. Propagation of indigenous flora and flora
S	Stakeholder & Community	1. Diversification of the tourist product, and increasing range of recreational opportunities for both locals and tourists. 2. Productive use of the land resource. 3. Earns foreign exchange revenues 4. Provides opportunities for public awareness: environment and culture. 5. Monetarizes the intrinsic value of the environment. 6. Creates job opportunities during construction and operations. 7. Stimulates of local economies – purchase of goods and services during construction and operations.
M	Municipal Resources	1. Potential for alternatively produced energy to register negative use.
H	Hazards	1. Disaster planning and preparedness.

6.3 Assessment of Environmental Impacts

6.3.1 Methodology & Definition of Terms

6.3.1.1 Objectives

Impacts are semi-quantitatively and quantitatively assessed according to the ten criteria, which are defined below. The objectives of defining the terms and criteria for impact assessment are to enable application of a robust methodology that is:

1. Objective because the criteria are pre-set, and dependent on the fore-going sections of the EIA (project description, planning constraints/regulatory controls, stakeholder consultations and the environmental baseline). Because impact assessment is traditionally an expert-based system that uses a myriad of predictive tools that vary in technical complexity, the “scientific” basis for deciding whether an impact is significant or minor, is often a judgment call based on the actual value placed on the VEC.
2. Reproducible in that it can be tested and repeated by EIA reviewers so that they can conduct independent determinations, which are directly comparable.
3. More valid in that it allows for a comprehensive assessment of the impact, as opposed to a simplistic identification of environmental impacts likely to arise from the project.

6.3.1.2 Definitions

1. **Scale**: this refers to the magnitude of the adverse effect in terms of the geographic extent of influence arising from frequency and magnitude of the causative action. This allows higher assessment of impacts with a wider sphere of influence.
2. **Affected Numbers**: this considers the numbers of individuals (organisms, people etc.) from a valued population that stand to be impacted. This parameter can refer to indicator species or general receptor populations.
3. **Secondary Effects**: This parameter looks at the impact as a trigger mechanism for other effects, particularly those manifesting downstream of a pathway emanating from a project component. Latent effects that could occur in the future, such as bioaccumulation of heavy metals in the food chain, or effects on future generations.
4. **Resilience**: This criterion examines ecological resilience/sensitivity (ability of a population to cope with effect). Existing stresses and variability of sensitivity (spatial or seasonal) should be considered. Resilience/sensitivity can be determined by eco-toxicological response, dose/response relationships and exposure of the population given effect pathways. Degree of loss (risk) can also be factored in terms of quantifiable amounts.
5. **Persistence**: This addresses the frequency and duration of effects in the environment. In general, persistent (long-term) or frequently adverse effects are regarded as more significant.
6. **Reversibility**. This criterion evaluates the extent to which an effected receptor can be returned to its pre-project state (reversibility).
7. **Baseline change**: this relates to any model or prediction of the extent of change that can be expected. This should compare predicted levels of change with normal fluctuations as well as trends in the parameter without the effect of the project.
8. **Extent Mitigable**: This addresses the ease to which feasible measures can be implemented to prevent or reduce the environmental cost. It should consider the economic cost of implementing these measures, and whether there are any moderating circumstances or benefits that need to be considered given the environmental cost. The extent to which appropriate and cost effective measures can be implemented to mitigate the effects.
9. **Uncertainty**. This allows for disclosure of the level of scientific confidence in the predicted outcomes, and the general reliability of the data and models used to predict impacts.
10. **Acceptability to stakeholders** This examines the willingness to make trade-offs or degree of objection, given potential benefits of the project. This also includes planning constraints and scientific criteria (maximum allowable limits).

6.3.1.3 Pre-set Assessment Criteria

Table 17 (next page) outlines the pre-set assessment criteria and the associated scoring system that is used in the evaluation of impacts. Based on this system of pre-set assessment criteria (PAC), the level of impact (Effect Level) can be classified as either no impact, minor, moderate or significant. The scores assigned in each of the ten PAC are then averaged, and this mean score is used to determine the overall effect level.

In the assessment of negative impacts, the scale ranges from 0 (no impact), -1 (minor), --2 to -3 (low to high moderate), and -4 to -5 (low to high significant). Total score is averaged out of the scores in respect of the ten criteria.

In respect of positive impacts, the scores and criteria are given in Table 18. Some of the criteria used to assess negative impacts are not relevant (e.g. stakeholder acceptability, reversibility and extent mitigable). Scores are therefore averaged out of seven instead of ten criteria scores.

6.3.1.4 Approach to Cumulative Impacts

Cumulative impacts are caused by (a) activities unrelated to the proposal being evaluated but are likely to occur at the same time that the project activities are occurring and (b) several activities associated with the implementation of the project as proposed.

External activities (a), form part of the baseline condition, and are taken into account in the examination of the baseline, and expected divergence from the baseline that might arise from project implementation. In respect of internal aggregations of impacts on specific VECs that may individually be assessed as having a “minor” effect, but may collectively have a significant combined effect, the resultant cumulative effects are evaluated collectively where multiple project activities contribute to the same effect. These are treated separately when the activities are spatially separated.

Table 17 Pre-set Impact Assessment Criteria (Negative Impacts)

	0	1	2	3	4	5
CRITERIA	**No impact**	**Minor**	**Moderate**		**Significant**	
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.		Widespread: offsite regional effects	
Affected Numbers:		Less than 1% population or habitat area is directly exposed.	1% to 10% population or habitat directly exposed.		More than 10% population or habitat area is directly exposed.	
Secondary Effects		Few indirect effects.	Many indirect negative affects. One trophic level within one generation affected.		Many indirect negative affects. More than 1 generation affected. Several trophic levels involved.	
Resilience:		Receptors are resilient. Nuisance but no real loss of revenue or amenity. Impact does not occur at a time when receptors are vulnerable	Morbidity or health concern. Temporary loss of revenue or amenity. Impact occurs at the start or end of a period when receptor is particularly vulnerable.		Receptors unable to cope. Mortality or trauma in populations. Loss of revenue or amenity is sustained after remedial action is taken. Impact occurs at the peak time when receptor is vulnerable.	
Persistence:		Lasting less than a few months before recovery occurs with no observable residual effects. Related to duration of event.	Lasting from a few months to two years before signs of recovery.		Impact persistent after 2 years. Impacts on a biological population over a number of recruitment cycles.	
Reversibility:	Can be returned to original state completely with removal of structural elements.		Can be returned to a productive state with removal or change of use of structural elements.		Cannot be easily or cost-effectively returned to previous state or be re-used for any other productive purpose.	
Baseline change:		Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.	Moderate deviation from baseline conditions. Within 2 standard deviation of the mean.		Major deviation from baseline conditions: > 2 standard deviations of the mean.	
Extent Mitigable:	No mitigation necessary	Very easily and cost-effectively mitigated. Significant opportunities for environmental enhancement or benefits in the short to medium term (arising within a few months).	Cost-effectively mitigated. Long term environmental benefit as a result of the short-term negative impact associated with project (arising within 2 years)		Cannot be easily mitigated or requires major design change to causative activities. No mitigation possible. No opportunity for environmental enhancement or no perceptible environmental benefit.	
Scientific Uncertainties	>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set.		<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied.	
Acceptability:		Impacts are acceptable to affected community. Complies with legal thresholds and /or best practice or wise use of resource, physical plans and land use policies.	With mitigation is acceptable to stakeholders. Affected stakeholders willing to make trade off. Approaches legal thresholds, limits or criteria or maximum allowable levels.		Public outcry. Prohibitive legislation, plans or policies. Exceeds legal thresholds, limits or criteria or maximum allowable levels.	

Table 18 Pre-set Impact Assessment Criteria (Positive Impacts)

	0	1	2	3	4	5
CRITERIA	**No impact**	**Minor**	**Moderate**		**Significant**	
Scale:		Isolated effects within project site.	Localized area close to borders or offsite dispersion pathways.		Widespread: offsite regional effects	
Affected Numbers:		Less than 1% population or habitat affected.	1-10% population or habitat affected.		More than 10% population or habitat affected	
Secondary Effects		Few indirect positive effects.	Many indirect positive affects. One trophic level within one generation affected.		Many indirect positive affects. More than 1 generation affected. Several trophic levels involved.	
Resilience:		Receptors are not able to take full benefit or benefit indirectly. Minor advantage but no real increase in revenue or amenity. Impact does not occur at a time when receptors are able to accept.	Medium term increase of revenue or amenity. Impact occurs at the start or end of a period when receptor is able to benefit.		Receptors benefit directly. Revenue or amenity is sustained after in the long term. Benefits are accessible at best time for receptor.	
Persistence:		Lasting less than a few months before recovery occurs with no observable residual effects. Related to duration of event.	Lasting from a few months to two years before signs of recovery.		Impact persistent after 2 years. Impacts on a biological population over a number of recruitment cycles.	
Baseline change:		Effects are barely measurable against baseline conditions – within 1 standard deviation of the mean.	Moderate deviation from baseline conditions. Within 2 standard deviation of the mean.		Major deviation from baseline conditions: > 2 standard deviations of the mean.	
Scientific Uncertainties	<75% confidence in the validity of the predictions. Inadequate data available for numeric modelling. Predictions based on qualitative or anecdotal evidence. Worst-case scenarios have to be applied. Numerous conditions that are likely to occur that would affect impact of benefits.		76-99% confidence in the validity of the predictions. Numeric models extrapolate data set. A number of conditions that could off-set benefits.		>99% confidence in the validity of the prediction of the impact parameters. No data gaps or uncertainties. Data is reliable. Few conditions that could off-set benefits.	

6.3.2 Negative Impacts

6.3.2.1 Air, Light & Noise

CRITERIA	ASSESSMENT		
Expected Impact (s)	Increased atmospheric dust during the construction period.		
Causative Action:	Expected to arise as a result of clearance at the entrance mainly, and to a lesser extent from clearance along footprint of the ride, which would expose fine clayey soils. There may also be fugitive dust arising from temporary stockpiles of construction material (cement). Trucks hauling solid waste or bringing construction materials up along the haul roads may also raise dust as the road is marl.		
Scale:	Although relatively small areas will be cleared (3.7 acres), dust can affect a wide area as it is airborne or is rained out.		3
Affected Numbers:	Nearby communities are unlikely to be impacted by dust. However, traffic on the main road may be affected by dust emanating from construction activities near the entrance/parking area. Construction workers will be impacted.		3
Secondary Effects	There will be an impact on the visual aesthetic of the area.		1
Resilience	Persons in moving vehicles are not expected to have health problems from passing fugitive dust.		1
Persistence:	This impact will not persist after the area is landscaped and construction completed. Short-term effect		1
Reversibility:	Complete		0
Baseline change	The area is presently unaffected by significant dust. However, within the same time frame it is expected that there will be construction on the main road as part of the North Coast Highway Project. This will mean that the area will be considerably dustier than present conditions. This project will add to this effect, particularly between the dry summer months of June and September (when construction is planned).		3
Extent Mitigable:	Sprinkle bare soils during dry windy periods	Cover stockpiles & transported materials.	1
	Phase clearance and re-vegetation as soon as possible.	Wash haulage trucks.	
	Construction workers should wear dust masks.		
Uncertainty	Fair degree of certainty that there worst case scenario will be with night-time land breezes taking moving dust toward the main road. Dust from clearance is unavoidable.		1
Acceptability:	Dustiness not expected to reach unacceptable levels		1
Classification:	MINOR		1.2

CRITERIA	ASSESSMENT		
Expected Impact (s)	Increased combustion emissions: NOx, Sox, CO, particulates. During construction		
Causative Action:	From the use heavy vehicles and equipment, including helicopter emissions.		
Scale:	These emissions will produced in relatively small quantities, and will be dispersed in lower concentrations. They are not expected to accumulate to the point of having major secondary effects off site.		2
Affected Numbers:	Mainly night time road users and construction site workers will be affected.		3
Secondary Effects	-		0
Resilience	Persons in moving vehicles are not expected to have health problems from passing emissions.		1
Persistence:	This impact will not persist after the area is landscaped and construction completed. Short-term effect		1
Reversibility:	Complete		0
Baseline change	As in the case with dust, there will be elevated vehicular emissions from heavy equipment working on the North Coast Highway Project during the summer months. The Baseline change therefore is expected to be relatively small.		2
Extent Mitigable:	Service vehicles. Use low lead fuels.		3
Uncertainty	Emissions are unavoidable during construction. Uncertainty as to the exact quantity of fuel that will be combusted so specific quantities of pollutants cannot be calculated and modelled.		4
Acceptability:	Emissions not expected to reach unacceptable or harmful levels.		2
Classification:	MINOR		1.8

CRITERIA	ASSESSMENT		
Expected Impact (s)	Increased temperature and humidity.		
Causative Action:	Generation of heat and steam from air conditioners, and kitchen.		
Scale:	Localized around compressors and vents. Expected to dissipate to ambient close to source.		1
Affected Numbers:	Compressors and vents are likely to be located in built areas and will not affect > 1% trees and wild life.		1
Secondary Effects	-		0
Resilience	Persons who are outdoors in built areas may experience higher humidity – generally resilient.		1
Persistence:	During periods of operation of air conditioners etc.		4
Reversibility:	Completely		0
Baseline change	Not expected to be significant.		2
Extent Mitigable:	Air conditioners can be set to re-circulate rather than bring in air.		4
Uncertainty	Uncertain how many units and compressors will be used. Uncertain as to actual humidity levels.		4
Acceptability:	Not generally a problem in built up areas.		
Classification:	MINOR		1.7

CRITERIA	ASSESSMENT	
Expected Impact (s)	Above ambient noise during construction and airlift.	
Causative Action:	This will arise from the use of construction equipment at the Olympic Village, Entrance area and along the rides.	
Scale:	There is a distance decay function of noise with distance from the source of the emission. In this heavily vegetated and sloping terrain it is likely that it will be well buffered and will not reach nearby communities. The noisiest equipment is expected to be the helicopter (with a point source noise level of ~105 dBA), which is expected to be used to install the lift supports and components (to avoid clear cutting of access roads in forest). The helicopter will be expected to be low flying near the site.	1
Affected Numbers:	Birds and other wild life within close proximity to the construction sites may be disturbed. Because of the linear dimension of the rides footprint and helicopter routes, this is likely to affect more than 10% of receptors.	3
Secondary Effects	There may be temporary fleeing of noise sensitive receptors from affected areas.	3
Resilience	Birds and other wildlife will tend to return once noise is reduced to ambient again.	2
Persistence:	Not expected to last more than 5 to 6 months, and for only a few hours a day during weekdays. Helicopter operations are not expected to be more than a few weeks.	1
Reversibility:	Completely reversible.	
Baseline change	Significant at noise sources.	4
Extent Mitigable:	Ensure vehicles and equipment are operating in good order. Do not operate machinery and helicopter between 6 pm and 7 when birds may be roosting or feeding.	3
Uncertainty	There will be significant point sources of noise, and there are sensitive bird populations in the site.	4
Acceptability:	The presence of the sensitive wild life populations (birds) make this an environmentally sensitive area, so noise emissions significantly above 60 dBA are not acceptable. The alternative to the helicopter noise is clear cutting access roads through the forest, which would be more unacceptable than the helicopter noise.	4
Classification:	MODERATE	2.5

CRITERIA	ASSESSMENT		
Expected Impact (s)	Above ambient noise along attraction routes during operational periods.		
Causative Action:	Conversations between visitors and tour guides. Shrill noises from bobsled roller coaster and ZipRider. Mechanical noises from movement of bobsled, and other rides.		
Scale:	Not expected to exceed 65 dBA in close proximity to the designated routes. Noise levels away from routes will be buffered by relatively dense vegetation (40-50% tree cover on average).		1
Affected Numbers:	Noise emanating from the tour routes will most likely disturb birds in close proximity to the routes. These trails affect approximately 5% of the total acreage of the site. It is extrapolated that 5% of the habitat area will therefore be disturbed.		2
Secondary Effects	Long-term decrease in the biodiversity of birds in the disturbed area. This may result in increases in food species (insects, fruiting trees) in the area due to the lack of removal.		2
Resilience	Tours will be conducted during hours of 8 am to 5 pm, when birds are least likely to roosting.		1
Persistence:	The life of the proposed tour operations is likely to be of the order of 25 years. Noise levels will persist as long as operations.		5
Reversibility:	Can be reversed completely with no structural change needed.		0
Baseline change	Expected to be above ambient along localized areas.		3
Extent Mitigable:	Machinery and equipment must be kept in good working order to reduce noise. Environmentally sensitive zones along walking route can be identified and visitors so advised. Groups should be kept to 10 persons and less. There should be no tourism operations between 6 pm and 7 am.		3
Uncertainty	Uncertainty with respect to actual levels of noise disturbance.		3
Acceptability:	Approaches a threshold for environmentally sensitive areas.		3
Classification:	MODERATE		2.3

CRITERIA	ASSESSMENT		
Expected Impact (s)	Above ambient levels of noise near service area.		
Causative Action:	Emergency generators and service and delivery vehicles. Normal noise level of generators in the 5 kW to 200 kW range is between 77 dBA to 93 dBA at 7 m.		
Scale:	This will be localized in area within a few hundred meters of the service area.		2
Affected Numbers:	Likely to affect less than 1% of bird habitat. Staff working in close proximity may be exposed.		1
Secondary Effects	Nuisance to visitors and staff. Will frighten some birds away.		1
Resilience	Most humans will be able to tolerate this. Fauna will move away.		1
Persistence:	Will only be operated under emergency conditions e.g. during a power failure after before and after a hurricane.		1
Reversibility:	Completely reversible (no structural change)		
Baseline change	Significant close to source (ambient forest noise levels expected to be below 20 dBA).		4
Extent Mitigable:	Buffering with trees. Use of new quieter technologies.		3
Uncertainty	Uncertainty re timeframes for emergency operations. Not expected to be more than 10 to 15 days on any occasion.		2
Acceptability:	Normally acceptable under emergency conditions. Exceeds threshold for environmentally sensitive areas.		4
Classification:	MINOR		1.9

CRITERIA	ASSESSMENT	
Expected Impact (s)	Above ambient light during night time	
Causative Action:	Security lights	
Scale:	Localized: expected to affect no more than 6 acres of the total area, where there will be some infrastructural footprint.	1
Affected Numbers:	Less than 10% the total habitat area will be affected	3
Secondary Effects	Improved security and protection of investment in these lit areas. Increased numbers of insects attracted to light. Some contribution to the general urban light pollution of the Ocho Rios area. Consumption of electricity.	2
Resilience	Nocturnal animals will avoid the brightly lit areas.	1
Persistence:	Will only impact in night time hours – 6 pm to 6 am; but likely to persist for project life.	4
Reversibility:	With removal of lighting infrastructure.	1
Baseline change	Will be significantly above ambient night time levels in the forest environment.	4
Extent Mitigable:	No mitigation necessary	0
Uncertainty	Uncertainty about brightness of security lights to be used, and numbers. Uncertainty about numbers of nocturnal birds.	3
Acceptability:	No objection expected.	0
Classification:	MINOR	1.9

6.3.2.2 Water

CRITERIA	ASSESSMENT		
Expected Impact (s)	Possible increase in suspended solids/turbidity in coastal waters and river – during construction		
Causative Action:	Clearance of lands and construction of entrance area, access road and parking area		
Scale:	2 acres will be cleared. This will impact approximately ~400 m of the stream (less than 25% total length) before it exits into the bay. Upon entering the bay, it is likely that much of the suspended solids will be dispersed in a plume moving towards the northwest (depending on wind conditions).		3
Affected Numbers:	Although less than 10% of the total river will be impacted, there is potential for a significant portion of the bay receiving the river outflows to be impacted. The baseline survey indicated a thriving benthic population including sea grasses.		4
Secondary Effects	Increased suspended solids in the lower part of the river will impact on coastal turbidity, and the health of sea grasses and benthic organisms in the shallow lagoon receiving river water. However, it is only expected to impact on one generation.		3
Resilience	Sea grasses are dependent on light in the water column to live. Elevated suspended solids levels reduce this available light. Plants could experience morbidity. Other species could be negatively impacted depending on the degree of turbidity.		4
Persistence:	Increased TSS levels can be expected to persist until the sources of fine sediments are properly managed, and will also depend on oceanographic conditions during the construction period (May to September). Not expected to last more than a few months.		2
Reversibility:	Completely reversible.		0
Baseline change	Baseline TSS levels that were measures were below 5 mg/L for this area, even after rainfall. If unmanaged TSS levels could be significant due to the need for complete vegetation clearance in this area and the presence of friable clayey soils.		4
Extent Mitigable:	• Vegetation clearance should be phased as much as possible. Vegetation should be restored as early as possible. • Clearance should be avoided until after the peak rainfall in May-June. • Berms should be constructed along the banks of the river to reduce construction site run-offs to the river. • Stock piles of construction aggregate and cement should be marshalled, bunded and covered.		2
Uncertainty	The extent of site run-off will vary with rainfall which is uncertain, but expected to be less between July to September, and greater in May-June.		3
Acceptability:	TSS levels in excess of 30 mg/l in waters exiting the construction site would be unacceptable. Properly managed TSS can remain below this level.		2
Classification:	MODERATE		2.5

CRITERIA	ASSESSMENT	
Expected Impact (s)	Decline in water quality: pesticide load	
Causative Action:	The use of pesticides to control termite near buildings and rides.	
Scale:	Very localized: limited to use within the ~6 acres of built area, and to specific spots therein. Pesticides are expected to enter the karstic groundwater and not impact surface populations. Ground water will impact coastal waters.	4
Affected Numbers:	Affected numbers will depend on the amount of pesticides being used. This impact will be cumulative with other sources of pesticide load in the Ocho Rios Marine Park (ORMP).	3
Secondary Effects	There could be long-term impacts on the benthic populations.	4
Resilience	There is a health concern with respect to benthic populations.	3
Persistence:	Pesticide load in groundwater outflows to the marine environment is likely to be rapidly diluted and dispersed in the marine environment.	2
Reversibility:	There may be persistent residues in the soils.	3
Baseline change	No tests were done to establish baseline pesticide levels in the bay or soils in the forest area. There is no history of such use in this area so introduction with this project is expected to increase baseline levels above ambient.	3
Extent Mitigable:	Strict control on the type and quantity of pesticide used to ensure environmental breakdown. Frequency of use should be limited. Termite control should only be applied within 100 m of the built areas.	3
Uncertainty	Uncertainty with respect to type and quantity that will be needed. Uncertainty with respect to exposure and response of benthic populations to the type and quantity ending up in the marine environment. Uncertainty with respect to future baseline levels of pesticide in the ORMP.	4
Acceptability:	This is controlled by the Pesticides Authority. Use should not exceed recommended criteria.	2
Classification:	MODERATE	3.1

CRITERIA	ASSESSMENT	
Expected Impact (s)	Increased nitrogen loading in river and coastal waters during the construction period.	
Causative Action:	Although portable toilets will be provided, it is cultural practice for construction workers to urinate in outdoors.	
Scale:	This is likely to be localized around construction sites (entrance, routes and Olympic Village). At the entrance site it has the potential to enter the river and coastal area.	2
Affected Numbers:	The effect of increased nitrogen is likely to negatively impact on aquatic populations mainly. The numbers will vary with the extent to which there is an elevated nitrogen loading. It is not expected that more than 1% of the ORMP will be impacted.	1
Secondary Effects	Increased nitrogen increases vegetative/algal growth in aquatic communities and may result in a community shift towards more invasive species that can out compete sea grasses.	3
Resilience	The aquatic communities in this area are used to elevated levels of nitrates in the stream (between 8 and 10 mg/l were measured). However, the impact will be cumulative.	2
Persistence:	Not expected to last more than a few months.	1
Reversibility:	Complete	0
Baseline change	Relative small quantities of inputs from this source are expected.	1
Extent Mitigable:	Workers can be required to use the portable toilets.	2
Uncertainty	Uncertainty of the actual quantities involved.	3
Acceptability:	Baseline levels already exceed criteria. This practice is generally culturally accepted.	3
Classification:	MINOR	1.8

CRITERIA	ASSESSMENT	
Expected Impact (s)	Decline in groundwater quality: nutrients, fecal coliform, oil and grease	
Causative Action:	This impact may arise from the discharge of secondary sewage effluents and grey water at Olympic Village. At this site, it is proposed that a 5000 USGPD septic system with absorption tile filed will be used to treat sewage to a secondary standard. Gray water from sinks and kitchens (not storm water) will also be routed to this system. Information on the final site for the septic system is not yet available, but the likely elevation above sea level is ~120 m. The general geology of the area would suggest that there is high permeability of the limestone, and reasonably well developed underground drainage systems. Exact flow pathways from the site are unknown, but likely to be either northwest or northeast.	
Scale:	Discharge of secondary effluent (within NRCA standards) may have the greatest impact closest to the source. However, given the karstic nature of the underlying limestone, there is likely to be some transport of secondary effluent to areas offsite.	3
Affected Numbers:	The groundwater resources in this area occur very close to the coast, and therefore not upstream of any major municipal water abstraction points. JBM utilizes water from a spring issuing to the north east of the proposed Olympic Village Site; this water may be used for drinking amongst other things. A second spring located at a lower level (road level) also occurs to the north east of the site; this spring is used mainly for car washing. It is likely that the groundwater sources for both these springs come from the main property. In the event of fecal contamination of the groundwater, these springs could be impacted.	3
Secondary Effects	Poor groundwater quality would result in elevated pollutant levels in the coastal area, and a decline in coastal water. Fecal coliforms die back in saltwater so this would not be too much of a problem. There could be slightly elevated nutrient levels, which would promote algal growth in the bay. This bay is already heavily stressed from other external impacting activities (cumulative effect).	3
Resilience	Public health concerns.	2
Persistence:	Impacts would persist for the life of the park (+25 years)	3
Reversibility:	Reversible with cessation of discharge	1
Baseline change	Surface water fecal coliform levels are below 30 MPN/100 ml. Spring water and groundwater were not tested but are assumed to be purer than the surface waters. Secondary treatment (tile field) of the sewage is expected to reduce coliform levels to <12 MPN/100 ml.	2
Extent Mitigable:	A well designed and well site tile field and septic system is key.	2
Uncertainty	The final design and site is as yet unknown. The extent of conduit flow in the general location of the septic tank, and groundwater pathways are also uncertain.	5
Acceptability:	Whilst straight soak away pits are no longer acceptable for limestone occurring within 500 m of the coast, it may be more acceptable to have the septic system with tile field option. Secondary treated effluents should meet irrigation standards (oil and grease 10 mg/l; TSS 15 mg/l; BOD 15 mg/l; COD: <100 mg/l and fecal coliform of 12 MPN/100 ml	2
Classification:	MODERATE	2.6

CRITERIA	ASSESSMENT	
Expected Impact (s)	Decline in water quality: phosphates and oil and grease	
Causative Action:	It is planned that water from wash basins at the Entrance facility will be discharged to the river, as the no septic system will be put in place at the site (dry composting toilets to be used). The drains will be equipped with grease traps to reduce the amount of oil and grease (only from hand washing) entering the stream. However it is expected that there will be elevated phosphate levels from soaps in the discharged water.	
Scale:	This will impact at the river and will therefore exit the site boundaries, and enter the coastal area.	3
Affected Numbers:	Less than 1% of the ORMP is expected to impacted.	1
Secondary Effects	Phosphates affect marine benthic communities adversely. There are a number of calcareous algae and other organisms that would be affected. It may also promote succession of fleshy algae in this area (over the sea grasses).	4
Resilience	Aquatic communities are vulnerable to increased nutrient loads; this is expected to add (cumulative) to a baseline load.	3
Persistence:	This impact will persist throughout the life cycle of the operations (25 years)	4
Reversibility:	Can be reversed with cessation of discharge.	0
Baseline change	Not expected to be significant. Phosphate levels in the stream are presently very low (0.07, compared to the NRCA freshwater standard of 0.8 mg/l)	2
Extent Mitigable:	Install alternative dry handing sanitizing systems to reduce wastewater outflows. Provide low phosphate hand soap. Install grease traps	1
Uncertainty	Uncertainty as to actual phosphate loading, and impacts on aquatic communities. Uncertain wastewater throughputs.	3
Acceptability:	For proper hygiene and public health, running water must be provided to wash room facilities despite the fact that the toilets are dry.	1
Classification:	MODERATE	2.2

CRITERIA	ASSESSMENT	
Expected Impact (s)	Littering	
Causative Action:	Most outdoor recreational areas have litter as a major environmental issue. The extent of the problem depends on many factors including the cultural practices of the visitors, as well as the numbers of visitors.	
Scale:	This has the potential to impact the marine area, offsite. However, with proper management, it is not expected that a large volume of litter will end up in the marine area.	2
Affected Numbers:	Not expected to impact on more than 1% of the ORMP	1
Secondary Effects	Decline in water quality from presence of persistent floatables: marine turtles and other organisms could ingest plastics in the marine environment (harmful). Decline in visual aesthetic (park area, river, beach/marine area).	3
Resilience	Health concern for marine organisms. Nuisance for humans.	2
Persistence:	Operational lifetime	4
Reversibility:	Completely.	0
Baseline change	Presently litter is left by indigents and charcoal burners, particularly along the river and flatter slopes. Management and control of the park area by the operators should actually improve the problem.	0
Extent Mitigable:	Provide waste disposal bins for visitors. Have signs indicating that littering is unacceptable. Have attendants pick up litter at least twice a day along all trails and routes where visitors are. Do not allow vending of food, beverages or souvenirs along nature trails and routes.	1
Uncertainty	How visitors will behave.	
Acceptability:	Generally acceptable with the implementation of appropriate mitigation measures.	2
Classification:	MINOR	1.5

CRITERIA	ASSESSMENT	
Expected Impact (s)	Possible impact on the yield in the springs.	
Causative Action:	This could arise if the recharge area for the groundwater system feeding the springs is reduced, or if water is abstracted from this groundwater system. Reduction in the recharge area would arise from reduced infiltration (particularly at the Olympic Village 2-acre site). This is a very small percent of the total available acreage for recharge. The more significant impact would be if the spring or some associate groundwater flow is either abstracted or impounded for use by the park operations.	
Scale:	Onsite springs. Very minor.	1
Affected Numbers:	The users of the springs would be affected - about four or five car washers using the lower spring and the Reynolds Pier operations and possibly Rockwill Cement Company.	1
Secondary Effects	Reduced yield in the springs would (1) probably increase the bauxite company's reliance on municipal water supply, thus increasing demand from the Bogue system (2) reduce or eliminate the presence of car washers at the site, and thus indirectly reduce the quantity of pollutants entering the coastal environment from this source.	1
Resilience	Likely to be able to cope with the change. Probably worst in the dry periods.	1
Persistence:	Operational lifetime.	4
Reversibility:	Completely with cessation of causative action.	2
Baseline change	Variable with rainfall and extent of abstraction.	2
Extent Mitigable:	None necessary. However, the conceptual design for Olympic Village parking areas could include use of concrete tiles interspersed with grass to allow for better infiltration. The storm water drainage system that is designed for this area should allow for natural soak away.	2
Uncertainty	At the moment the exact water source for the operations is undecided.	3
Acceptability:	Any abstraction or impoundment of water would have to be sanctioned by WRA prior to implementation.	2
Classification:	MINOR	1.9

<table>
<tr><td>CRITERIA</td><td>ASSESSMENT</td><td></td></tr>
<tr><td>Expected Impact (s)</td><td colspan="2">Increased storm water run-offs</td></tr>
<tr><td>Causative Action:</td><td colspan="2">Built areas (buildings, parking areas etc.) at Olympic Village and entrance</td></tr>
<tr><td>Scale:</td><td>Onsite. Storm water expected to infiltrate before leaving property boundaries at Olympic Village. The entire development has a size of ~ 39 hectares, of which 1.98 hectares or 4.5% will be built up. The access/parking area with approximately 8,000 m^2 will be the largest contributor to an increased runoff. Storm run-off from the entrance will be routed to the stream, for which the North Coast Highway is providing an engineered culvert. Using the rational runoff method as described by the equation: $Q_{pk} = C \times I \times A$

Table 19 Rainfall Intensities by Return Period at the Sangster International Airport (mm/hr)
<table>
<tr><th>Return period</th><th>5 [m]</th><th>10 [m]</th><th>15 [m]</th><th>30 [m]</th><th>1 [h]</th><th>2 [h]</th><th>6 [h]</th><th>12 [h]</th><th>24 [h]</th></tr>
<tr><td>5 years</td><td>219.3</td><td>142.3</td><td>128.4</td><td>85.2</td><td>56.6</td><td>33.8</td><td>13.8</td><td>7.2</td><td>3.7</td></tr>
<tr><td>10 years</td><td>268.5</td><td>167.8</td><td>152.2</td><td>100.1</td><td>67.0</td><td>40.0</td><td>16.3</td><td>8.6</td><td>4.4</td></tr>
<tr><td>25 years</td><td>330.6</td><td>200.0</td><td>182.2</td><td>118.8</td><td>80.2</td><td>47.8</td><td>19.6</td><td>10.3</td><td>5.2</td></tr>
<tr><td>50 years</td><td>376.7</td><td>223.9</td><td>204.4</td><td>132.7</td><td>89.9</td><td>53.6</td><td>22.0</td><td>11.6</td><td>5.9</td></tr>
<tr><td>100 years</td><td>422.4</td><td>247.6</td><td>226.5</td><td>146.6</td><td>99.6</td><td>59.4</td><td>24.4</td><td>12.8</td><td>6.5</td></tr>
</table>
Using intensity-duration-frequency information from Sangster International Airport (Table 19) a peak flow of 20.6 cfs (0.58 m^3/s) was calculated for the entrance area. The following assumptions were applied:
- Time of concentration:5 min
- Rainfall intensity:13 in/hr (25 year return period)
- Runoff coefficient: 0.8
- Size of the contributing area:1.98 acres</td><td>3</td></tr>
<tr><td>Affected Numbers:</td><td>No adjacent settlements. Flooding from sheet flows on the main road could affect road users.</td><td>4</td></tr>
<tr><td>Secondary Effects</td><td>If unmanaged sheet flows could result in flooding along the North Coast Highway and traffic congestion, and damage to the road surface.</td><td>2</td></tr>
<tr><td>Resilience</td><td></td><td>0</td></tr>
</table>

CRITERIA	ASSESSMENT		
Persistence:	During heavy rains (May-June and November)		1
Reversibility:	Completely with removal of structural elements.		2
Baseline change	Minor (less than 2% total lease area is used at Olympic Village) There is no anecdotal evidence of flooding along the Ocho Rios to Dunn's River main road in the vicinity of the proposed development suggesting that rainfall readily percolates into the subsurface.		1
Extent Mitigable:	Adequate drainage is required to reduce the volume of water crossing the main road as sheet flow. It is recommended that the runoff generated from the parking area be retained to the south of the main road by constructing a swale or other detention features, and ensuring storm water is routed to the stream and culvert. No flooding hazard is expected to emanate from the change in permeability at the other areas as storm water will runoff into the adjacent disturbed broad leaf forest and percolates rapidly into the subsurface. The area is covered with disturbed broadleaf forest underlain by soils of the Killancholly clay type with moderate to rapid internal drainage capacity, and karstic limestone. Storm water at the Olympic Village should be engineered and this should optimize natural soak away.		3
Uncertainty			2
Acceptability:	With appropriate storm water design in place this should be reduced to a completely acceptable level.		2
Classification:	MODERATE		2.0

6.3.2.3 Culture, Landscapes & History

CRITERIA	ASSESSMENT		
Expected Impact (s)	Possible decline in visual aesthetics at entrance during construction period.		
Causative Action:	The presence of construction materials, heavy equipment, vegetation clearance etc. in the lower entrance area near the river is expected to reduce the visual aesthetic of the normally well-vegetated quiet area.		
Scale:	Limited to the site.		1
Affected Numbers:	Persons passing the site who may notice a change; persons visiting Dolphin Cove.		1
Secondary Effects			0
Resilience			0
Persistence:	Only a few months during the construction period.		1
Reversibility:	Once the area is landscaped, a different visual aesthetic can be established.		2
Baseline change	Expected to be different from the present unoccupied forested look. However, it is expected that there will be considerable road construction at this time.		2
Extent Mitigable:	It is recommended that zinc or plywood screens be erected to block views of the construction area. A tree line along the perimeter should be maintained as much as possible.		1
Uncertainty			0
Acceptability:	Generally acceptable aspect of construction.		1
Classification:	NEGLIGIBLE		0.9

CRITERIA	ASSESSMENT	
Expected Impact (s)	Decline in visual aesthetic in built up areas of the park	
Causative Action:	Presence of infrastructure and buildings in natural areas. The total built up area is estimated to be less than 6 acres in total, which is <7% the total acreage leased.	
Scale:	Onsite only	1
Affected Numbers:	Only staff and visitors, most of who are not expected to find the limited built up area objectionable.	1
Secondary Effects		0
Resilience		0
Persistence:	Lifetime of operations (25 years)	4
Reversibility:	With removal of structural elements.	3
Baseline change	Would be major change from present land use. The proposed site of the Olympic Village is presently under grass and used as a dump site.	2
Extent Mitigable:	Buildings can be constructed to be unobtrusive, using natural colours and woods in the facades. Bamboo is recommended for facing material. Buildings can also be occluded by strategic landscaping. The entrance to the park can also be well-landscaped.	1
Uncertainty		0
Acceptability:	No major planning objections have been raised so far.	1
Classification:	MINOR	1.3

6.3.2.4 Land and soils

CRITERIA	ASSESSMENT	
Expected Impact (s)	Change in topography at entrance	
Causative Action:	It is expected that there will be some grading and compaction at the entrance facility, to facilitate the construction of the parking areas, access road, and first station.	
Scale:	Approximately 2 acres on site will be affected.	1
Affected Numbers:	-	0
Secondary Effects	This may alter natural drainage patterns resulting in a greater propensity for sheet flow off the land. Earth that is removed as a result of the grading works will have to be disposed. Alteration of the topography will also possibly unearth archaeological artefacts and possibly fossilized wood specimens.	1
Resilience	Damage could be done to specimens if they are present, and construction team is unaware of their potential to occur at this location.	2
Persistence:	Changes and potential losses of buried resources would be permanent.	4
Reversibility:	Not very.	4
Baseline change	The natural gradients are low. There is no record of any finding of archaeological artefacts at this site. The EIA preparation team discovered fossilized wood that could be displayed.	3
Extent Mitigable:	None necessary. The removed soil could be used to create a berm along the road side prevent sheet wash to the road. Some fill could also be used to create temporary levees to block site run-offs from entering the river. Construction teams need to be apprised of the procedures to follow if archaeological artefacts are uncovered.	1
Uncertainty	Uncertain as to what lays buried. Uncertainty as to how much earth will have to be removed.	2
Acceptability:	The St. Ann Parish Council and the NWA will have to approve plans for levelling or grading the site, and any associated drainage modifications.	1
Classification:	MINOR	1.9

CRITERIA	ASSESSMENT	
Expected Impact (s)	Soil contamination from accidental loss of containment of stored fuels and lubes in service area	
Causative Action:	It is proposed that a service area (shown in Figure 2) will be located north of the proposed Olympic Village site. Lubes, diesel, machine shop (for maintenance of the rides) and the emergency generators will be located here. Where there is storage of lubes and fuel there is a potential for loss of containment.	
Scale:	If properly designed, the fuel and oil storage area will be completely enclosed and there will be very little potential for soil contamination. It is expected that this impact can be contained very locally.	1
Affected Numbers:	If not properly managed, there is a potential for oil or diesel to leak to the groundwater system, where it can eventually impact on the inter-tidal community in the bay. This community represents less than 1% the ORMP habitat.	1
Secondary Effects	Loss of containment can result in accidental ignition and fire, which could injure workers, destroy property, and spread to the forest. The extent of the damage would be related to winds, moisture conditions and the time taken to bring the fire under control. In the event it is not ignited, leaks could affect the groundwater, and possibly the springs, and coastal water.	4
Resilience	Forest, water and workers are vulnerable.	4
Persistence:	Effects on the groundwater/coastal water and forest are not expected to persist more than 2 years.	3
Reversibility:	Can be returned to the original state with time. Contaminated soils can be removed.	2
Baseline change	It is expected that there is very little hydrocarbon content in the soils and groundwater in this area.	5
Extent Mitigable:	• Ensure that diesel and lubricant oils are stored in a sealed containment area that can accommodate 110% maximum storage capacity. There should be no potential for leaking oils to contaminate soils. • Train service staff in proper handling and storage of hydrocarbons – no smoking, no topping off, etc. • Have fire-extinguishing equipment on hand. This should include a store of emergency fire water. • Maintain a fire trail 5 m wide between the service area and the rest of the forest. The road on the eastern side can serve as the fire trail on that side.	1
Uncertainty	The quantity and exact types of hydrocarbons to be stored are unknown at this time.	2
Acceptability:	This is a necessary risk that must accompany project implementation.	2
Classification:	MODERATE	2.5

6.3.2.5 Ecology

CRITERIA	ASSESSMENT	
Expected Impact (s)	Vegetation clearance within project footprint.	
Causative Action:	Approximately 3.7 acres is slated for clearance. NB The Olympic Village 2-acre site is not included as it is already clear cut.	
Scale:	This will be limited to very specific areas as shown on Figure 2.	1
Affected Numbers:	Less than 5% of the total area leased will be directly impacted.	1
Secondary Effects	This will result in reduced habitat, and fragmentation of habitat, particularly on the western side of the property. This will also mean a loss of biomass, and sequestered carbon. Erosion hazard and surface water turbidity.	5
Resilience	The main fauna in this area are birds and small reptiles. They will tend to take refuge into the unaffected parts of the forest.	2
Persistence:	This impact will be persistent for the life of the operations.	4
Reversibility:	This is completely reversible with removal of all structural elements.	3
Baseline change	This forest succession has been classified as an “early secondary”, suggesting that it has been historically disturbed. Clearance, particularly in the entrance area will not be destroying a pristine or non-renewable resource.	1
Extent Mitigable:	No mitigation necessary. Landscaping and regrassing will alleviate some of the secondary effects. Minimize footprint as much as possible.	0
Uncertainty		0
Acceptability:	Clearance is necessary to make room for the footprint.	3
Classification:	MODERATE	2.0

CRITERIA	ASSESSMENT		
Expected Impact (s)	Change to community in some areas (loss of biodiversity along ride routes and landscaped areas)		
Causative Action:	This is expected to arise as a result of “recreational trampling” especially if people go off track, and due to landscaping works (including establishment of display plots such as the orchid patch, fern plots or herb gardens).		
Scale:	Very localized		1
Affected Numbers:	Routes and trails will impact less than 3% total habitat.		2
Secondary Effects	Micro-climate changes within a few meters of the trails and routes. Changes in avifaunal occurrences.		4
Resilience	Biodiversity will be maintained in core preserved areas that are not open to recreational use.		1
Persistence:	Life time of project (25 years)		4
Reversibility:	Completely with cessation of activities.		1
Baseline change	Micro-climate along pathways and opened-up areas may be sufficiently different for different species to grow there than at present.		3
Extent Mitigable:	None necessary. Care should be taken to ensure that there are untouched core refugia/sanctuaries within the park.		0
Uncertainty			0
Acceptability:	Expected to be acceptable given the preservation of more than 80 acres of secondary forest that will be allowed to progress to more advance successions.		1
Classification:	MINOR		1.7

CRITERIA	ASSESSMENT	
Expected Impact (s)	Some smothering of benthic eco-system during the construction	
Causative Action:	Vegetation clearance, earthworks, stockpiling of construction materials etc. at the parking area site may lead to elevated TSS in river/receiving coastal areas, and possibly smothering of aquatic communities.	
Scale:	Along river course on site, and possible in coastal area.	2
Affected Numbers:	Small percentage of habitat (river and ORMP) will be impacted.	2
Secondary Effects	Mortality in benthic organisms. Change in substrate conditions (more muddy). Change in community composition and loss of biodiversity.	3
Resilience	It is expected that once the system is flushed, communities can be re-established.	1
Persistence:	Not expected to persist for more than a few weeks.	1
Reversibility:	Completely reversible run-offs from construction site are controlled.	1
Baseline change	This marine area is affected by run-off from the road (which includes landslide material), river, and pier, so it is likely that periodically there is some smothering of benthic community. It is also expected that road construction during this period will result in high levels of siltation in the bay from marls etc. used on the road.	2
Extent Mitigable:	Can be easily controlled by limited silt run-off from the construction site.	1
Uncertainty		0
Acceptability:	Acceptable once efforts are made to limit siltation effects.	0
Classification:	MINOR	1.3

CRITERIA	ASSESSMENT	
Expected Impact (s)	Possible destruction of vegetation by local tourists collecting plants.	
Causative Action:	It is expected that the park will attract local collectors of plants hunting epiphytes, ferns, orchids and houseplants. This can be regarded as a form of vandalism.	
Scale:	May be localized along established walking areas.	1
Affected Numbers:	Less than 5% of the total habitat may be impacted thus.	2
Secondary Effects	Reduction of biodiversity, habitat disturbance, thinning out of forest cover (disturbance)	3
Resilience	High	0
Persistence:	Plants are expected to re-establish once protected.	1
Reversibility:	Completely once left alone.	0
Baseline change	Minor.	1
Extent Mitigable:	• Signs should be placed indicating that removing plants or fauna from the property is not allowed. • Persons seen leaving with plants should be asked to return the plants. • Guides should be trained to discourage visitors from collecting specimens.	1
Uncertainty	Uncertain as to what ratio of visitors will be vandals.	2
Acceptability:	No formal restrictions to this cultural practice.	1
Classification:	MINOR	1.2

CRITERIA	ASSESSMENT		
Expected Impact (s)	Composting environment may produce a habitat for insect pests and vectors.		
Causative Action:	Presence of composting toilets.		
Scale:	Limited to area around the CMC toilets.		1
Affected Numbers:	There will be no food preparation area near here so numbers impacted by pests and vectors would be limited to very few.		1
Secondary Effects	Not expected to be visible to visitors. Some birds may be attracted in the night if insects come out then.		0
Resilience	Public health concern, particularly if there is any food that can be affected by vector insects.		2
Persistence:	Will be cyclic around clearance and rotting of the manures.		2
Reversibility:	Completely reversible.		0
Baseline change	Insect species that are already present will be probably found in greater densities here.		1
Extent Mitigable:	None necessary		0
Uncertainty			0
Acceptability:	Trade-off for the benefits of the CMC toilets.		2
Classification:	NEGLIGIBLE		0.9

6.3.2.6 Stakeholder & Community

CRITERIA	ASSESSMENT		
Expected Impact (s)	Increased traffic near entrance.		
Causative Action:	Arising from buses (visitors) and cars (staff and visitors) turning in and exiting from site.		
Scale:	Limited to exit/entrance area		1
Affected Numbers:	Vehicles using the North Coast Highway during peak operational periods.		4
Secondary Effects	Traffic congestion during peak periods. Noise pollution from horns and radios.		1
Resilience	High as the road is expected to be widened and straightened as part of the North Coast Highway Project.		1
Persistence:	Life time of project		4
Reversibility:	Can be reversed if entrance is relocated.		3
Baseline change	This adds to a cumulative problem, with roadside parking at Dolphin Cove. There is no problem with traffic going to Dunn's River.		2
Extent Mitigable:	With well-designed filtering lay-bys this should not be a problem. There is adequate space inside for bus and car parking to avoid and road side parking.		2
Uncertainty	Actual numbers of staff vehicles.		1
Acceptability:	Slowing traffic in tourist areas can be expected and is acceptable.		1
Classification:	MODERATE		2.0

CRITERIA	ASSESSMENT	
Expected Impact (s)	Loss of amenity to charcoal burners and other informal users (including indigents) of the land.	
Causative Action:	Area will protected from wood cutting and informal uses.	
Scale:	Limited to site	1
Affected Numbers:	Uncertain how many persons use the area for charcoal burning. At least 2 pits were noted. There was also evidence of some homeless person(s) using the area from time to time. It is expected that a very small number will be affected as the area does not appear to be commonly used by the community.	1
Secondary Effects	All secondary effects are beneficial to the area (see positive impacts).	0
Resilience	Expected that the charcoal burners will move to other wooded areas or will find alternative livelihoods.	1
Persistence:	This impact will persist throughout the life time of the project (25 years)	4
Reversibility:	If protection is removed, charcoal burners will probably return.	1
Baseline change	-	0
Extent Mitigable:	None necessary	0
Uncertainty	-	0
Acceptability:	Very acceptable trade-off because of environmental costs of charcoal burning etc.	0
Classification:	NEGLIGIBLE	0.8

CRITERIA	ASSESSMENT		
Expected Impact (s)	Haul road usage – possible interactions with other users (limestone and cement haulage).		
Causative Action:	Possible use of the haul road by staff and service personnel using the service entrance and service areas of Olympic Village, both of which are accessible from the haul road.		
Scale:	Limited to the haul road, the western side of which is the lease boundary.		1
Affected Numbers:	This road is used by the Rockwill Cement Company, persons associated with the STP. The road is wide enough that other users may not necessarily be inconvenienced.		1
Secondary Effects	Further degradation of a poorly surfaced marl road.		2
Resilience	Minor nuisance but no real loss of amenity to other parties.		1
Persistence:	Life time of the project		4
Reversibility:	With cessation of use.		1
Baseline change	Road is presently only used by cement trucks and staff cars (cement company and STP).		3
Extent Mitigable:	None necessary.		0
Uncertainty	It is uncertain as to what extent the haul road will be used by staff. It is likely that it will be used as a service entrance.		2
Acceptability:	If this road is to be used to access the site, the leasers must be in agreement with such use.		3
Classification:	MINOR		1.8

6.3.2.7 Municipal Resources

CRITERIA	ASSESSMENT	
Expected Impact (s)	Increased demand for solid waste disposal during construction phase	
Causative Action:	This will arise as a result of site preparation with wastes including earth materials (from site grading) and vegetative material. In addition there will be construction wastes such as domestic wastes from construction camp, packaging materials, etc.	
Scale:	Will impact off-site land fill area.	2
Affected Numbers:	Less than 1% of the available municipal dump will be utilized.	1
Secondary Effects	Heavy haulage vehicles on roads between site and Hadden dump (traffic, dust, safety).	1
Resilience	-	0
Persistence:	Temporary demand during construction period only.	1
Reversibility:	Not very once waste is produced.	4
Baseline change	Minor increase.	1
Extent Mitigable:	None necessary. Some waste can be recycled or re-used on site: e.g. earth materials can be used to construct berms or levees, wood can be chipped and used as mulch for landscaping or along trails to control vegetation re-growth.	0
Uncertainty	Exact quantities of solid waste and frequency of removal demand.	2
Acceptability:	Generally acceptable effect.	
Classification:	MINOR	1.2

CRITERIA	ASSESSMENT	
Expected Impact (s)	Routine demand for solid waste disposal via service entrance (operational)	
Causative Action:	Solid waste will be produced at Olympic Village. This will include kitchen wastes (organic materials, waste oils, glass jars and bottles, plastic bags, paper and boxes and tins), office wastes (mainly paper), machine shop wastes (oily cloths and plastic containers), general waste from tourists (food and beverage packaging etc.), and landscaping wastes	
Scale:	Waste generated is not expected to be more than 82 tons per year (assuming each person coming accounts for 1 lb of waste, and that 500 persons come for 365 days per year), and will impact off site landfill area.	3
Affected Numbers:	Less than 1% of available landfill space is expected to be used.	1
Secondary Effects	Waste haulage trucks operating between site and dump (traffic, safety etc.); consumption of a finite resource (landfill) Oily cloths require special sorting and disposal to prevent groundwater contamination at landfill site.	2
Resilience	-	0
Persistence:	Life time of project (25 years)	3
Reversibility:	Finite resource consumption.	4
Baseline change	Contribution to the urban waste disposal demand.	3
Extent Mitigable:	Waste reduction: composting, use of wood chippings, paper use reduction. Sorting and proper disposal of oily wastes. Sorting and recycling of glass.	2
Uncertainty		0
Acceptability:	This is a necessary trade off of the operation.	2
Classification:	MODERATE	2.0

CRITERIA	ASSESSMENT	
Expected Impact (s)	Energy consumption (non-renewable resource)	
Causative Action:	Increased demand for electricity - It is expected that operations may require as much as 15000 KWH per 37-day cycle to operate the rides, lifts, air conditioners etc.	
Scale:	This is a regional impact because it impacts on the national gas bill, and offsite impacts of fuel extraction and power generation.	4
Affected Numbers:	Expected to be significantly less than 1% national industrial demand.	1
Secondary Effects	Off site impacts of fuel extraction and power generation. Marginal impact of electricity distribution infrastructure (existing lines will be used).	2
Resilience	Jamaica does not presently produce fuels for electricity so this impacts on the national gas bill.	2
Persistence:	Demand expected to persist over the project life time (25 years)	4
Reversibility:	Fuel is a non-renewable resource. Consumption cannot be reversed.	4
Baseline change	Not expected to be significant, compared to national or regional consumption levels.	2
Extent Mitigable:	Energy conservation: limiting use of air conditioners. Alternative power generation: wind and solar power hybrid generation (being considered).	1
Uncertainty	Extent of environmental performance (reduced energy usage from JPSCo grid which uses fossil fuels)	2
Acceptability:	Expected consumption with development.	1
Classification:	MODERATE	2.3

6.3.2.8 Hazards

CRITERIA	ASSESSMENT		
Expected Impact (s)	Increased risk of flying objects (ride infrastructure) during hurricanes.		
Causative Action:	Presence of cables and rails etc. associated with chair lift, bobsled and ZipRider.		
Scale:	Could be transported off site.		2
Affected Numbers:	Unlikely to impact on communities as these are far removed from the site. The highway may be impacted, but during a hurricane no cars are expected to there.		1
Secondary Effects	Littering. Loss of property. Injury or loss of life if a person is hit by flying debris (low probability).		3
Resilience	Vulnerable receptors not expected to present during hurricane.		1
Persistence:	Risk will persist throughout project life time (25 years)		4
Reversibility:	Completely with removal of structural elements		2
Baseline change	There is not much infrastructure that is vulnerable to wind transport on site now.		3
Extent Mitigable:	Elements that are prone to wind damage can be dismantled a few hours before the storm occurs.		2
Uncertainty	How secure infrastructure will be given wind speeds between 100 km to 250 km per hour.		3
Acceptability:	This risk is acceptable with a hurricane preparedness plan in place.		2
Classification:	MODERATE		2.3

CRITERIA	ASSESSMENT	
Expected Impact (s)	Increased fire hazard arising from visitors' presence.	
Causative Action:	Visitors cultural practices: disposal of cigarettes, random use of fire (camp site or picknicking)	
Scale:	Could be regional if fire is out of control	4
Affected Numbers:	All persons on the property would be affected. 100% of the habitat could be impacted.	5
Secondary Effects	Loss of biomass and loss of regional biodiversity. Potential loss of life. Loss of productive time. Loss of ecological resources.	4
Resilience	Receptors are very vulnerable, particularly in the dry summer months.	3
Persistence:	Life time of operations (25 years)	4
Reversibility:	Damage to forest from fire can be reversed over many years (15 to 30 years).	3
Baseline change	The area has been previously impacted by clearing and charcoal burning. Generally less than 50% tree cover reported.	3
Extent Mitigable:	Signs must indicate that smoking is prohibited. No outdoor cooking must be permitted. Guides must be vigilant to advise and intervene is smoking is noted. There must be a fire response plan. There should be no burning of vegetation (from clearing or landscaping)	2
Uncertainty	Cultural practices of visitors.	2
Acceptability:	Acceptable risk provided that mitigation measures are put in place.	2
Classification:	MODERATE	3.2

6.3.3 Positive Impacts

6.3.3.1 Water

CRITERIA	ASSESSMENT		
Expected Impact (s)	Preservation of water quality in the river and coastal area.		
Causative Action:	The use of the CMC toilets		
Scale:	Offsite – bay area		2
Affected Numbers:	Less than 1% habitat of ORMP		1
Secondary effects	Prevention of elevated coliform levels and nutrients from sewage effluents if an STP was installed. Beneficial use of manure from composting.		2
Resilience	Receptors in aquatic eco-systems and beach users benefit immediately.		2
Persistence:	As long as the CMC toilets are maintained well.		4
Baseline change	-		0
Uncertainty	If people do not use the toilet facilities provided		2
Classification:	MINOR		1.9

6.3.3.2 Culture, Landscapes & History

CRITERIA	ASSESSMENT		
Expected Impact (s)	Opportunities for spectacular views		
Causative Action:	Construction of the Look-Out Point, Olympic Village, Chair Lift and ZipRider.		
Scale:	Onsite only		1
Affected Numbers:	All visitors will have the opportunities to see views of the port of Ocho Rios and surrounding areas		4
Secondary effects	Greater appreciation of the natural beauty of Jamaica; Visitor satisfaction;		2
Resilience	Immediate benefit		4
Persistence:	Operational life time (25 years)		4
Baseline change	There are presently few accessible opportunities for visitors to have elevated views of Ocho Rios, particularly from a tourist attraction, with visitor amenities in place.		4
Uncertainty	-		4
Classification:	MODERATE		3.3

CRITERIA	ASSESSMENT		
Expected Impact (s)	Potential to find archaeological artefacts during construction.		
Causative Action:	Earthworks at entrance/parking area site.		
Scale:	Could be of national importance.		4
Affected Numbers:	NOT RELEVANT		
Secondary effects	Contribution to knowledge of the history and heritage. Adds to the interest of the place.		1
Resilience	NOT RELEVANT		
Persistence:	NOT RELEVANT		
Baseline change	Such a find would be major as there are no reported artefact from this area.		3
Uncertainty	Potential for artefacts not to be recognized during earthworks. Workers would have to be advised of procedures.		2
Classification:	MODERATE		2.5

CRITERIA	ASSESSMENT		
Expected Impact (s)	Recognition and conservation of petrified wood and fossils.		
Causative Action:	Geological investigations along trails and routes; earthworks in the entrance/parking facility		
Scale:	Could be of national importance		4
Affected Numbers:	NOT RELEVANT		
Secondary effects	Contribution to the knowledge of natural history in this area. Adds to the interest of the place.		1
Resilience	NOT RELEVANT		
Persistence:	NOT RELEVANT		
Baseline change	Major as there are very few specimens of petrified wood occurring in limestone in this area.		4
Uncertainty	Potential for visitors to “collect” specimens.		1
Classification:	MODERATE		2.5

6.3.3.3 Land and soils

CRITERIA	ASSESSMENT		
Expected Impact (s)	Production of compost for fertilizer use.		
Causative Action:	Use of the CMC toilets, composting practices at Olympic Village (restaurant and kitchen wastes)		
Scale:	On site only		1
Affected Numbers:	NOT RELEVANT		
Secondary effects	Beneficial use as soil conditioner and fertilizer for plants. Reduction of solid waste. Good demonstration of environmental best practice.		3
Resilience	NOT RELEVANT		
Persistence:	NOT RELEVANT		
Baseline change	NOT RELEVANT		
Uncertainty	Few conditions could off-set benefits.		4
Classification:	MODERATE		2.3

6.3.3.4 Ecology

CRITERIA	ASSESSMENT		
Expected Impact (s)	Tree preservation		
Causative Action:	Pro-active preservation of tree cover on the lease area.		
Scale:	Beyond the boundaries of the built areas, approximately 90 acres of forestlands protected.		5
Affected Numbers:	This is expected to impact on more than 90% of the available habitat.		5
Secondary effects	Ozone production, extraction of carbon dioxide and buffering of noise from park; micro-climate benefits to plants and fauna (birds, land snails, reptiles, etc.). Protection of the trees from charcoal burners and other destructive uses.		5
Resilience	Forest cover can recover to next successional stage in 15 years.		2
Persistence:	Over life time of project (25 years)		4
Baseline change	Effects will be moderately measurable over time, particularly with growing urban encroachment in this area.		4
Uncertainty	Success could be off-set by unplanned development, fires, vandalism.		3
Classification:	SIGNIFICANT		4.0

CRITERIA	ASSESSMENT		
Expected Impact (s)	Conservation of reptiles and birds from feral pests – rodents, mongoose etc.		
Causative Action:	Policy of eradication of rodents, cats, mongoose etc. from property.		
Scale:	This is expected to impact on the entire site		5
Affected Numbers:	More than 10% of the habitats and populations of reptiles and birds will be impacted.		4
Secondary effects	Reduced predation from feral species: greater survivorship in eggs and juveniles. Healthy populations.		3
Resilience	Birds and reptiles will benefit consistently over time.		3
Persistence:	As long as feral species are discourage from the area.		3
Baseline change	Could be major as the population sizes of the imported feral species are unknown.		3
Uncertainty	Effectiveness of eradication policy.		3
Classification:	MODERATE		3.4

CRITERIA	ASSESSMENT		
Expected Impact (s)	Propagation of indigenous flora (trees ferns and orchids) and butterflies		
Causative Action:	Implementation of propagation programmes and maintenance of display areas		
Scale:	Onsite only		1
Affected Numbers:	Less than 10% total habitat		2
Secondary effects	Increased biodiversity; visual aesthetic; visitor satisfaction; opportunities to appreciate Jamaica's natural resources.		4
Resilience	NOT RELEVANT		
Persistence:	Life time of operations (25 years)		4
Baseline change	The site has a naturally high biodiversity/		2
Uncertainty	Persons could try to collect specimens.		3
Classification:	MODERATE		2.6

6.3.3.5 Stakeholder & Community

CRITERIA	ASSESSMENT		
Expected Impact (s)	Diversification of the tourist product, and increasing range of recreational opportunities for both locals and tourists.		
Causative Action:	Development of the theme park with a focus on outdoor recreation, adventure rides and nature in a location that is less than 1.5 km from the cruise ship pier and in close proximity to a large number of Ocho Rios based hotel rooms. Presently there are a number of water based experience/adventure tours (Dunn's River, White River, and Dolphin Cove). There are also a number of tours offering rides such as horseback, jitney, ATV, bicycle, open jeep. However, there are no traditional amusement park thrill rides being offered. The closest option is Chukka Blue Adventure's Canopy Tour. This tour has the comparative advantage of offering rides with views (chair lift) and 2 thrill rides (roller coaster bobsled and ZipRider). The attraction also offers traditional museum (sports, culture, etc.) tours not presently being offered in Ocho Rios. In respect of the nature tourism aspect, there are other tours with hiking or nature walks, but this tour offers the advantage of being in a genuine dry limestone forest with a high natural biodiversity and opportunities to view real wildlife in their native habitats.		
Scale:	Regional contribution		4
Affected Numbers:	Expected to attract more than 10% the cruise ship visitors (in Ocho Rios 2004 the total number of cruise ship arrivals was 768,263, and an additional number of stopovers from Montego Bay also take tours in Ocho Rios). Also expected to attract at least 10% of hotel guests to the area (total stopover in Ocho Rios was almost 300,000 in 2004). A number of local recreationalists may also be attracted.		4
Secondary effects	May appeal to different niches of visitors, who would normally not disembark.		1
Resilience	Benefits of this development will impact on the industry within the first year.		3
Persistence:	Over the lifetime of the project (25 years)		4
Baseline change	Moderate change to the range of recreational opportunities.		3
Uncertainty	There is a potential for this tour to divide the existing market as well attract new visitors		3
Classification:	MODERATE		3.1

CRITERIA	ASSESSMENT		
Expected Impact (s)	Productive use of the land resource.		
Causative Action:	Development of tour infrastructure that will earn revenue and create jobs.		
Scale:	On site only.		2
Affected Numbers:	Approximately 6 acres will be brought into productive use. The remainder will be preserve as a nature park, which has intrinsic value.		4
Secondary effects	This activity precludes informal uses for charcoal, and also precludes urban/industrial encroachment.		3
Resilience	NOT RELEVANT		
Persistence:	At least 25 years		4
Baseline change	NOT RELEVANT		
Uncertainty			4
Classification:	MODERATE		2.8

CRITERIA	ASSESSMENT		
Expected Impact (s)	Earns foreign exchange revenues		
Causative Action:	The project represents a minimum initial investment of 4.4 million USD dollars, and is expected to attract over 100 000 visitors per year, targeting mainly cruise ship arrivals. It is expected that there will significant foreign exchange revenue earnings.		
Scale:	Regional impact		4
Affected Numbers:	Less than 1% national tourism earnings		1
Secondary effects	Numerous: affects balance of payments (national), cost of living, cost and availability of foreign exchange etc.		3
Resilience	Benefits accrue within the first two years.		2
Persistence:	~25 years		4
Baseline change	Project represents a significant investment in the Ocho Rios area.		2
Uncertainty	Actual earnings unknown. Could be impacted by risks such as hurricanes & inclement weather, competition from other tours		2
Classification:	MODERATE		2.6

CRITERIA	ASSESSMENT		
Expected Impact (s)	Provides opportunities for public (tourist) awareness of Jamaica's environment and culture.		
Causative Action:	Programmatic public awareness components of the tour: interpreted tours with forest guides, signage, display plots, museum/information centres show casing Jamaican environment, sports and history.		
Scale:	National importance		4
Affected Numbers:	All visitors will have opportunities to be made aware. More than 10% visitors to Ocho Rios.		4
Secondary effects	Greater appreciation of environment and culture, development of stewardship, visitor satisfaction.		3
Resilience	Receptors will be able to benefit immediately.		4
Persistence:	Life time of project – 25 years		4
Baseline change	There are a few opportunities in Ocho Rios in terms of tours e.g. Prospect Plantation tour. This tour offers an opportunity to visit a high biodiversity area, and learn about Jamaica's high endemism of birds, butterflies, herpetofauna, and floral biodiversity (trees, ferns, orchids etc.)		3
Uncertainty			4
Classification:	MODERATE		3.7

CRITERIA	ASSESSMENT		
Expected Impact (s)	Monetarizes the intrinsic value of the environment (worth protecting because of the income earning potential of a cared resource).		
Causative Action:	Large investment and revenue stream created from protecting natural resources.		
Scale:	Regional significance		4
Affected Numbers:	NOT RELEVANT		
Secondary effects	Economic investment in natural resources increases the perception of monetary value, and promotes environmental stewardship		3
Resilience	NOT RELEVANT		
Persistence:	Long term, and cumulative		4
Baseline change	There are a few examples of tours where the environment is a major attraction and perceived as a source of income if sustainably used.		3
Uncertainty	Actual effects uncertain.		2
Classification:	MODERATE		3.2

CRITERIA	ASSESSMENT		
Expected Impact (s)	Creates job opportunities during construction and operations.		
Causative Action:	Construction and operations.		
Scale:	Regional		3
Affected Numbers:	At least 10 labourers will be employed to assist with clearance and site preparation. An additional number of construction workers will be involved in development of the stations, entrance facility and Olympic Village/Look out area. During the operational phase at least 50 persons will have to be employed permanently. This will probably less than 1% of the total unemployed in the Ocho Rios area (numbers are uncertain).		1
Secondary effects	Economic benefits for the staff.		2
Resilience	NOT RELEVANT		
Persistence:	Long term (25 years)		4
Baseline change	Expected to be minor against unemployment rates (unavailable for Ocho Rios area).		2
Uncertainty	Unemployment rates in the area are uncertain.		2
Classification:	MODERATE		2.3

CRITERIA	ASSESSMENT		
Expected Impact (s)	Stimulates of local economies – purchase of goods and services during construction and operations.		
Causative Action:	Presence of construction camp workers and later, permanent staff will increase the demand public transport, and lunch meals for staff. During operations, the restaurant will have to be supplied with fresh vegetables and meats. Advertisers, etc.		
Scale:	Regional impact		3
Affected Numbers:	Likely to be less than 1% population of the area.		1
Secondary effects	Economic benefits to service providers.		2
Resilience	Local service providers will be able to offer services as soon as project is implemented.		3
Persistence:	Long term (25 years)		4
Baseline change	Difficult to calculate. Expected to be relatively small.		1
Uncertainty	Uncertainty with respect to numbers and scale of benefits. Benefits could be off-set by high importation of produce.		2
Classification:	MODERATE		2.4

6.3.3.6 *Municipal Resources*

CRITERIA	ASSESSMENT	
Expected Impact (s)	Potential for alternatively produced energy to register negative use.	
Causative Action:	It is planned that a hybrid solar/wind alternative energy production system will be developed to power the rides and meet other demands.	
Scale:	Impact on overall demands for non-renewal resource consumption – national fuel bill.	4
Affected Numbers:	Expected to be significantly less than 1% national industrial demand.	1
Secondary effects	Sustainable tourism in practice being demonstrated to other operators. If this demonstration allows other major users to see the cost effectiveness of investing in alternative energy sources, this could have major trigger effects.	3
Resilience	NOT RELEVANT	
Persistence:	Long term, cumulative over time.	4
Baseline change	Initially expected to be relatively small	1
Uncertainty	Uncertainty when and how much energy will be produced.	2
Classification:	MODERATE	2.5

6.3.3.7 *Hazards*

CRITERIA	ASSESSMENT	
Expected Impact (s)	Disaster planning and preparedness.	
Causative Action:	Pruning trees will reduce damage during hurricane. Stabilization of any unstable slopes. Removal of hazardous rocks that could fall. Implementation of a hurricane and fire contingency plans that include staff training and preparedness components. Signage. Fire precautions and equipment.	
Scale:	On site effects. Could reduce off site effects of fire.	2
Affected Numbers:	Could benefit all visitors, staff and the overall health of the forest eco-system.	4
Secondary effects	Increased safety; reduced risk of fire, injury, property loss.	3
Resilience	Sensitive receptors are able to benefit directly.	4
Persistence:	Long term and cumulative over time (25 years)	4
Baseline change	Minor change as the project itself increased the hazard and risks.	1
Uncertainty	Cost effectiveness and success of planning and preparedness.	2
Classification:	MODERATE	2.8

6.4 SUMMARY

In terms of construction impacts (table 20), a total of nine negative impacts were identified, most of which (7) were evaluated as minor. Construction noise and possible site run-offs from construction near the river were assessed as moderate impacts, and should be monitored.

In terms of operational phase impacts (Table 21), a total of 23 negative impacts were identified. Half of these assessed as moderate (average scores between 3.2 and 2.0). The highest scoring impact was the increased fire hazard risk arising from visitors' presence in the forest. All negative impacts ranked at the moderate or lower effect level can be cost-effectively mitigated. In terms of VECs, water resources are impacted by six negative impacts during this phase, four of which are classified as moderate impacts. All of these must be carefully managed to mitigate the impacts. Atmospheric receptors (air, climate, light, noise) are impacted by four impacts (three of which were assessed as minor), and ecology is impacted by four negative impacts (all of which were assessed as minor).

Table 22 (next page) summarises the 17 positive impacts of the project that were assessed. All of these impacts are long-term and occur during the operational phase of the project. Almost all of them were assessed as having a moderate effect level. The only significant impact determined by this assessment was the tremendous benefit of creating a preserve of more than 90 acres of secondary dry limestone forest, which will be able to progress to a more stable successional stage over the next 15 years. Numerous indirect/secondary effects on climate, aesthetics etc. can be realized from this impact. Seven of the 17 positive impacts assessed impacted on stakeholders, and an additional three impacted on culture, landscapes and heritage resources. An additional three impacted beneficially on ecological resources.

Table 20 Summary of Negative Impacts During the Construction Phase of the Project

A1	Increased atmospheric dust (construction)	1.2
A2	Increased combustion emissions (construction)	1.8
A4	Above ambient noise during construction and airlift	2.5
C1	Possible decline in visual aesthetics at entrance during construction period.	0.9
E4	Possible destruction of vegetation by local tourists collecting plants.	1.2
E3	Some smothering of benthic eco-systems during the construction	1.3
M1	Increased demand for solid waste disposal during construction	1.2
W1	Possible increase in turbidity from construction of entrance facility	2.5
W3	Sewage effluents from construction staff (urine only)	1.8

Table 21 Summary of Negative Impacts During the Operational Phase of the Project

A3	Temperature and humidity	1.7
A5	Above ambient noise ambient along attraction routes	2.3
A6	Noise if emergency generators are used.	1.9
A7	Above ambient light during night time -security	1.9
C2	Decline in visual aesthetics in built up areas of the park.	1.3
E1	Vegetation clearance for the project footprint.	2.0
E2	Change to community in some areas /loss of biodiversity along ride routes.	1.7
E5	Composting environment may also produce a habitat for insect pests and vectors.	0.9
H1	Increased risk of flying objects (ride infrastructure) during hurricanes.	2.3
H2	Increased fire hazard arising from visitors' presence.	3.2
L1	Change in topography at entrance	1.9
L2	Soil contamination	2.5
M2	Routine demand for solid waste disposal (operational phase).	2.0
M3	Energy consumption (non-renewable resource)	2.3
S1	Increased traffic near entrance	2.0
S2	Loss of amenity to charcoal burners and other informal users.	0.8
S3	Haul road usage	1.8
W2	Pesticide load arising from termite control.	3.1
W4	Effluents – secondary sewage effluents and grey water at Olympic Village	2.6
W5	Effluents – grey water from wash basins at Entrance facility	2.2
W6	Accidental litter.	1.5
W7	Possible impact on the yield in the springs.	1.9
W8	Increased storm run-offs	2.0

Table 22 Summary of Positive Impacts of the Project.

C1	Opportunities for spectacular views	3.3
C2	Potential to find archaeological artefacts during construction.	2.5
C3	Recognition and conservation of petrified wood and fossils.	2.5
E1	Protection of trees	4.0
E2	Conservation of reptiles and birds from feral pests	3.4
E3	Propagation of indigenous flora and flora	2.0
H1	Disaster planning and preparedness.	2.8
L1	Production of compost for fertilizer use.	2.3
M1	Potential for alternatively produced energy to register negative use.	2.5
S1	Diversification of the tourist product	3.1
S2	Productive use of the land resource.	2.8
S3	Earns foreign exchange revenues	2.6
S4	Provides opportunities for public awareness: environment and culture.	3.7
S5	Monetarizes the intrinsic value of the environment.	3.2
S6	Creates job opportunities during construction and operations.	2.3
S7	Stimulates of local economies	2.4
W1	Preservation of water quality through the use of the CMC toilets.	1.9

6.5 CONCLUSION

This EIA concludes a Finding Of No Significant Negative Impact arising during the life cycle of the proposed project. All negative impacts (minor and moderate) assessed can be cost-effectively mitigated, and no major design modifications are required. There are significant benefits of the project and opportunities for improved or enhanced environmental performance of the proposed operations that off-set the combined effect of the negative impacts.

7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 ENVIRONMENTAL OBJECTIVES

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

1. To establish contractual controls on contractors involved in construction, to minimize the predicted environmental impacts by timely and effective implementation of the recommended mitigation measures (described in Table 23).
2. To reduce and manage identified waste streams predicted to occur during the operational phase of the project, particularly as these waste streams impact on water resources.
3. To minimize habitat disturbance associated with the project footprint (including noise along the trails, long-term loss of vegetation and changes to ecology). To avoid habitat disturbance and any form of recreational encroachment on areas of the leased property not included in the project footprint.
4. To effectively plan for and respond to the occurrence of hazards (hurricane, fire, accidental leaks) so as to minimize environmental consequences of such occurrences.
5. To maximize the benefits of positive environmental impacts of the project as far as possible, particularly through adherence to the best practices and principles of sustainable outdoor tourism.
6. To conserve natural resources: biodiversity/forest eco-systems, geological and other resources (possibly archaeological).
7. To promote environmental stewardship amongst staff, visitors, and other key stakeholders by example.
8. To provide appropriate monitoring of the status of environmental resources to ensure their sustainable use.

7.2 PROPOSED MITIGATION MEASURES

7.2.1 Pre-Operational Phase

Table 23 is a schedule of proposed mitigation measures recommended to reduce negative impacts during the project planning and development (including site preparation and construction phase). It denotes best timing, responsibilities and input requirements (which can be used to quantify costs). It is the developers/proponents ultimate responsibility to ensure that persons contracted on the project have access to the EIA, and fully understand the consequences of not implementing the mitigation measures.

Table 23 Schedule for Proposed Mitigation Measures (Project Planning and Development Phase)

PROPOSED MITIGATION MEASURES	INPUT REQUIREMENTS
DESIGN AND PLANNING MEASURES: Engineers & design team	ASIDE FROM DESIGN INPUTS
1. Berms and levees to reduce site run-offs to road and river.	Fill material; earth moving equipment
2. Swale or other detention features near parking area.	Earth moving equipment
3. Concrete tiles interspersed with grass in parking areas.	Tiles
4. Storm water drainage should allow for natural soak away.	Boulders and gravel fill
5. Route storm water to stream and culvert	Concrete for drains
6. Design and siting of the tile field and septic system at Olympic Village	Concrete; gravel, sand filters
7. Install grease traps in all drains.	Grease traps
8. Minimize footprint as much as possible.	
9. Natural (greens, browns) colours and woods (e.g. bamboo) in building facades.	
10. Strategic landscape design to hide buildings and built areas	
11. Lay-bys for accessing and exiting main entrance.	
12. Ensure that the CMC toilets are not at risk from flooding.	
CONSTRUCTION MANAGEMENT: Contractors, construction workers	
1. Sprinkle bare soils during dry windy periods	Construction water
2. Cover stockpiles & transported materials.	Tarpaulins
3. Marshall and bund construction stockpiles.	Labour
4. Wash haulage trucks.	Construction water; labour
5. Erection of zinc or plywood screens to block construction area.	Zinc or plywood
6. Construction workers should wear dust masks if airborne dust is visible.	Dust masks
7. Ensure vehicles and equipment are in operating in good order.	Mechanics
8. Do not operate machinery and helicopter between 6 pm and 7 am	Supervision
9. Workers can be required to use the portable toilets.	Portable toilets
10. Apprise contractors of procedures for archaeological finds.	Supervision
11. Phase clearance and re-vegetation as soon as possible.	Supervision
12. Clearance should be avoided until after the peak rainfall in May-June.	Supervision
13. Landscape and re-grass as soon as possible	Supervision
14. There should be no burning of vegetation (from clearing or landscaping)	Supervision

7.2.2 Environmental Management Guidelines (Mitigation) For Operational Phase

The following measures are organized to form the basis of an environmental management system for the proposed operations.

7.2.2.1 General Operational Policies

1. The operation should set a goal to become Green Globe 21 certified within 18 months of opening. This is a three level programme for companies involved in sustainable tourism (website: www.greenglobe21.com).
2. Vending of food, beverages or souvenirs along nature trails and routes should not be allowed. All vending should be done at either the entrance or the Olympic Village Site.
3. There should be no tolerance of tree felling for any reason (charcoal or other).
4. No tolerance/feeding of feral species (cats, dogs, mongooses) rodents or insect vectors.
5. Recreational bathing or other use of river should not be allowed.
6. There could be a display area for petrified wood, fossils and artefacts that may be collected on the property. This could possibly be integrated into the Heritage Hall.
7. A priority should be placed on maintaining a natural visual aesthetic.

> ***"…recreational enjoyment can often be maintained if co-existing land use activities are designed to minimize visual impacts."***
> **USDA Forest Service Gen Tech. Rep PSW-GTR-141-WWW. 1993**

8. All management, technical and guide staff should be have an inexpensive means of communication through out site in case of emergency e.g. a radio.
9. A formal protected forestry area could be designated within the site. Such designation can reduce land taxes, and can be altered with notice to the Conservator of Forests. This area is not formally protected, although it is included by the Forestry Department in its inventory of Jamaica's forest. Sections of it have very high biodiversity and should be conserved. This can fall under IUCN Management Category V (Protected Landscape/Seascape: Protected area managed mainly for landscape/seascape: conservation and recreation). The specific objectives for Category V are listed below (reproduced from Eagles et al, 2002):
    a. Primary objectives: protection of specific natural/cultural features, tourism and recreation, and maintenance of cultural/traditional attributes.
    b. Secondary objectives: scientific research, preservation of biodiversity, environmental services, education, sustainable use of resources of natural eco-systems.

7.2.2.2 Community Involvement

10. Public awareness and environmental demonstration programs (e.g. sports museum, heritage centre etc.) should cater to local schools as well as overseas visitors. Schools could also benefit from seeing solar-wind generation and composting toilets at work.
11. Forest wardens, tour guides and trail/landscape maintenance persons should be hired from within local communities (Snow Hill, Parry Town, Pimento Walk and Ocho Rios). Discussions should be held with HUDO to see what co-operation can be achieved.
12. Community folk performers can be hired to perform local songs or music in costume at Olympic Village. These performers could where historic costumes to be in line with the Heritage Hall concept. There could also be a traditional story-teller at scheduled times.
13. Low impact operations such as bee-keeping can only be done in close proximity to roads, if the developers choose to allow this.

7.2.2.3 Signage

Appropriately sized signs should indicate:

1. No littering.
2. No smoking
3. No outdoor cooking.
4. Environmentally sensitive species or area
5. Endemic or endangered species
6. No plant or butterfly collection.

7.2.2.4 Visitor Management

1. There should be no tourism operations between 6 pm and 7 am anywhere in the park.
2. Restricted unguided hikers or bird-watching groups may be done within designated areas of the site. This should be done in groups no larger than four or five, and groups should be apprised of the nature of the habitat. The difficulty of the route should be denoted. Ecologically sensitive areas should be reserved (not accessible to the public).
3. Competitive sports (races, hiking challenges etc.) should not be allowed within the park. Low impact sports like cycling can be done, provided that trails are designated.
4. It is recommended that if a cycling trail is later included, this should only be done in the area west of the chair lift. If horse-back riding is to be done (at a later date), care should be taken to (1) designate the trails properly so that it does not disturb vulnerable or sensitive habitat area (2) wastes from the horses are collected so that they do not add to coliform levels in ground water, river or coastal area.
5. Groups walking on the Jungle Trail should be kept to 10 persons and less. Groups should leave at least 10 minutes apart.
6. No outdoor cooking must be permitted. If a picnic area is to be designated, this should be in close proximity to the Olympic Village site.

7. Provide waste disposal bins to reduce littering at an interval of at 1 every 150 m along trails and in built areas.
8. The quality of the visitor experience is defined partly by environmental setting meeting expectations, but also by the quality of the tour products (rides, trails etc), availability of visitor amenities (food, shops, rest rooms, stairs, ramps, accessibility etc.) and the interactions they have with staff. Staff training, particularly in dealing with visitors is critical. Guides should be trained to:
    a. Be knowledgeable about endemic wildlife and flora, and geology (described in this report).
    b. Discourage visitors from collecting specimens.
    c. Confiscate any collected specimens.
    d. Advise visitors of environmentally sensitive zones along walking routes
    e. Advise and intervene if smoking is noted.
9. Operators should collect data on the types of visitors that are using the facility, the numbers and the general practices of visitors to (a) be better positioned in the market and (b)(better manage the visitors' use of the park. Managers should be aware that level of use (e.g. 500 persons per day) is not the only variable that can affect the park. Other variables include: visitor behaviour, group size, season, biophysical conditions.
10. Take steps to ensure economic benefits of the park's use are maximized. The text box below is reproduced from Eagles et al (2002).

Guidelines for capturing economic benefits are:

- *Increase the number of visitors*: Increasing visitation is risky unless the financial benefits from the visitors exceed their costs. It may increase other impacts, some negatively.
- *Increase the length of stay*: Increased length of stay provides more opportunity to sell local products and services.
- *Attract richer market niches*: Different marketing tactics may bring in consumers with strong abilities to spend.
- *Increase purchases per visitor*: Offering more locally-made goods for sale, available directly and indirectly to the visitor, helps increase visitor expenditure and local incomes.
- *Provide lodging*: The costs of overnight accommodation are relatively large and are paid for locally. Local lodging also increases expenditures on meals, and local goods and services.
- *Provide guides or other services*: Since much tourist activity in protected areas is information intensive, there are usually good opportunities for guide services.
- *Host events*: Artwork, crafts and festivals based on local culture can increase local economic impact.
- *Purchase local food and drink*: When visitors, park staff and tourism employees consume locally grown food and drink, they provide important income to local farmers.

7.2.2.5 Landscaping and Grounds Management

1. Only endemic Jamaican species should be used to landscape the grounds.
2. Strictly control the type, location and quantity of pesticide used to control termites.
3. There should be a pest management system implemented in connection with the composting areas.
4. Maintain trees along routes and trails as noise buffers.
5. Maintain a tree line along the perimeter (along main road)
6. Have attendants pick up litter at least twice a day along all trails and routes
7. There should be no burning of vegetation (from clearing or landscaping)
8. Maintain a fire trail 5 m wide between the service area and the rest of the forest.

7.2.2.6 Waste, Management

Develop a waste management plan that identifies strategies for waste reduction and disposal:

1. Sorting and recycling of glass, organic wastes (composting), re-use of wood chippings as mulch, paper use reduction.
2. There should be proper disposal of machine shop wastes including oil rags.
3. A concrete dumpster containment area that is large enough to be cleared by a truck should be installed near the service entrance to facilitate truck pick-up.
4. Waste paper bins should be provided through-out the park.
5. There should be daily litter clean-ups.
6. Alternative dry handing sanitizing systems to reduce wastewater outflows should be installed, and low phosphate hand soap provided in wash basins in restrooms.
7. There should be adoption of noise abatement policies such as ensuring equipment is operating in good order, and use new quieter technologies when available (upgrade and improve). Music should be restricted very low volume levels in the restaurant area.

7.2.2.7 Energy Conservation

Develop energy conservation procedures, including:

8. Limit of air conditioners, and optimize settings for efficiency.
9. As far as possible buildings should be designed to maximize natural ventilation and prevent heat being trapped within.
10. Development and implementation of the alternative power generation: wind and solar power hybrid generation (being considered by proponents).

7.2.2.8 Hazard Contingency Plan

1. **Hurricane Contingency Plan**: this should identify when and what to dismantle a before the storm occurs, and how and where it should be stored. The machine shop and any stored chemicals or fuels should also be properly secured. Offices, display units, restaurants and other facilities should be properly secured. The plan should also include post-hurricane procedures (clean-up, repair and restoration), particularly with respect routes, trails, rides and operational requirements. Resources, personnel, training requirements need to be identified. An on-site co-ordinator should be designated. There should be real time access to weather information onsite (e.g. internet access to satellite monitoring websites).
2. **Fire Plan**: establishment of procedures for preparedness and response, training of staff, fire-fighting resources, and emergency call numbers. Risk reduction measures: fire trails, no smoking, no outdoor cooking etc. An on-site co-ordinator should be designated.
3. **Oil Spill Plan**: This should also address procedures and resources for oil spill management (e.g. store diesel and lubricant oils in a sealed containment area with 110% storage capacity, and maintain a store of fire water and extinguishers etc.). Train service staff in proper handling and storage of hydrocarbons. An on-site co-ordinator should be designated.
4. **Medical Accident Plan**: In the event of any kind of medical emergency in the park, there should be a medical accident plan. This should include a list of emergency medical personnel, on site emergency resources (first aid kit, spine board etc.), evacuation procedures (as there is no vehicle access throughout most of the park) and nearest vehicle access points. The requisite insurance coverage should be maintained. Accident waiver forms should be signed by visitors using the rides. An on-site co-ordinator should be designated.

7.3 OUTLINE MONITORING PLAN

7.3.1 Reporting on Final Design

Recommendations in respect of design improvement were made to mitigate specific adverse environment impacts. These included:

- Drainage design: (1) at the park entrance: use of berms and levees, swale or other detention features, use of concrete tiles interspersed with grass in parking areas. Engineered routing of storm water to stream and culvert, and (2) At Olympic Village: storm water drainage should allow for natural soak away. Final drainage designs must be approved by the St. Ann Parish Council/Drainage Department.
- Secondary Sewage Treatment at Olympic Village: final design and siting of the tile field and septic system must be approved by the St. Ann Parish Council/WRA.

- The final design and siting of the CMC toilets at the entrance must ensure that the CMC toilets are not at risk from flooding. This must be approved by the St. Ann Parish Council/WRA.
- Parking facilities and access road design: must be approved by the St. Ann Parish Council/ National Works Agency (North Coast Highway Project). Lay-bys are recommended for accessing and exiting main entrance.
- Final architectural and site layout of Olympic Village and Entrance Area: Final designs must be have building permits from the St. Ann Parish Council (Planning Department). It is recommended that natural colours and woods be used in building facades. Strategic landscape design should be used to hide buildings and built areas.

Once these approvals are secured, it is recommended that a brief pre-construction notice be sent to NEPA to advise that the most environmentally sound designs have in fact been approved and are being used. In addition, the final decision in respect of potable water source should be indicated to NEPA after WRA has approval this use.

7.3.2 Implementation of Mitigation Measures Recommended for Construction

Construction is expected to take approximately 6 months. During this time a number of mitigation measures are expected to be implemented to reduce and control predicted environmental impacts associated with this phase of the project. It is recommended that three bi-monthly reports be submitted, the first being submitted at the end of August 2006, the second at the end of October 2006, and the last submitted at the end of December 2006. These reports should detail implementation of measures used to:

- Control dust (sprinkling soils, stockpile management, equipment maintenance, workers' gear.
- Control site run-offs (vegetation clearance and landscaping progress, swales and berms along river).
- Limit visual intrusion from outside site (construction fence at entrance only).
- Limit habitat disturbance/noise (no construction between 6 pm and 7 am).
- Reduce potential for surface water contamination (availability of portable toilets).
- Control fire hazard (no smoking or vegetation burning).
- Recognize and conserve any geological (fossils) or archaeological (artifacts) finds.

7.3.3 Monitoring of Water Quality During Construction

It is recommended that the same upstream and downstream water quality stations be monitored during the construction of the parking facilities, access roads and entrance facilities (including the first station of the chairlift) and any other visitor amenities (shops, restrooms etc.). Three replicates should be collected from each of the stations on a bi-monthly basis between initial clearance and final landscaping. Samples should be tested only for TSS at this time to ensure that stream loads are maintained at TSS levels below 30 mg/l. In the event that stream TSS loads at Station 2 (exit) exceed stream TSS loads at Station 1, or 30 mg/l, there should be an immediate report to NEPA and a review of the run-off control measures previously implemented. The method for testing TSS should be consistent with the methodology used in this study (SM-2540D).

7.3.4 Water Quality Monitoring

It is recommended that the following water quality stations be monitored:

- Station 1 (upstream of site boundary and proposed entrance facility) – established by this study.
- Station 2 (downstream of proposed entrance facility) – established by this study.
- Station 3 (spring issuing on main road) – to be established.

These stations should be tested quarterly for TSS, fecal coliform, BOD, nitrates, and phosphates. Analytical methodologies should be consistent with those indicated in Appendix 2. Three replicates should be collected from each station at each sample event. Annual reports should be made to NEPA, unless the standards given in Table 9 are exceeded.

7.3.5 Forest Status

It is recommended that the forestry survey be repeated once every five years to ensure that the forest status is progressing.

7.3.6 Aquatic Fauna

It is recommended that biennial survey of the freshwater aquatic fauna in the stream on the property be done to determine whether there are any shifts in the population or public health risks. No recreational use or modification of the stream is presently proposed so it is not expected that there would be any physical disturbance of the aquatic community other than those arising from site run-offs. Should there be any change in this position, approval from NEPA should be sought.

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