ENVIRONMENTAL IMPACT ASSESSMENT

SUBDIVISION
at
DRAGON BAY
PORTLAND, JAMAICA

Submitted to:

LOCKSTONE HOLDINGS LTD.
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Jamaica

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1. INTRODUCTION

Lockstone Holdings Ltd. intend to sub-divide 12.1 hectares (29.9 acres) of land on a high bluff at Zion Hill, Dragon Bay, into 38 lots of which 4 are dedicated to open space as shown in Figure 1.1. The development is aimed at the high end of the market and the average size of the lots is 2,900 square meters. It is planned to make the lots available primarily for sale for villa sites but some will be allocated for the construction of apartments and townhouses. It is intended to protect the wooded character of the land.

Figure 1.1: Location of subdivision site

1.1 PURPOSE AND BACKGROUND

Applications have been made the Portland Parish Council, and the National Environmental & Planning Agency (NEPA) for permission to subdivide these lands. No timetable for construction of the buildings has yet been set.

In their letter of 3 October 2003 (Ref. 2003-04017-EP00105), NEPA determined that an environmental impact assessment (EIA) of the proposed development was needed and, within the context of standard EIA requirements, identified specific matters to be addressed by that assessment. These were subsequently incorporated in the Terms of Reference for the EIA as presented in Section 1.2 below.

This document presents the EIA report.

1.2 TERMS OF REFERENCE

The following TORs for the Dragon Bay Subdivision were adapted from World Bank and NEPA guidelines and were approved by NEPA.

1. *Introduction - Describe the development project to be assessed and explain the executing arrangements for the environmental assessment*

2. *Background Information - Briefly describe the major components of the proposed project, the implementing agents, a brief history of the project and its current status.*

3. *Study Area - Specify the boundaries of the study area for assessment as well as any adjacent or remote areas that should be considered with respect to the project.*

4. *Scope of Work - The following tasks will be performed:*

   Task 1. Description of the Proposed Project - Provide a full description of the project and its existing setting, using maps at appropriate scales. This is to include: general layout (subdivision plan, road access, type/size of house, etc.); pre-construction activities (including vegetation clearance); construction methods and works; duration of construction phase; plans for providing utilities, waste disposal and other necessary service; sewage treatment system maintenance, and storm water collection and disposal.

   Task 2. Description of the Environment - Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area, including consideration of the following:

   a) *Physical environment: geology, topography, soils, climate and meteorology, surface and groundwater hydrology, and natural hazard vulnerability.*
   b) *Biological environment: flora, fauna, rare or endangered species, sensitive habitats, trees worthy of protection, species of commercial importance, and species with potential to become nuisances, vectors or dangerous. Location or distribution maps will be presented where appropriate.*
   c) *Socio-cultural environment (both present and projected): population, land use, other planned development, distribution of income, recreation, water supply public health, cultural/historical properties, and any unusual local customs.*

   Task 3. Legislative and Regulatory Considerations - Describe the pertinent regulations and standards governing siting and land use control, environmental quality, health and safety, protection of sensitive areas and endangered species.

Task 4. Determine the Potential Impacts of the Proposed Project - Distinguish between significant positive and negative impacts, and direct and indirect impacts. Identify impacts that are unavoidable, irreversible and cumulative. Special attention should be paid to:

a) *landform and topography;*
b) *vegetation clearance and habitat alteration;*
c) *geology and land drainage;*
d) *soil erosion;*
e) *sewage treatment and disposal;*
f) *coastal water quality;*
g) *physical carrying capacity of local infrastructure and public services, including water supply and roads;*
h) *location of site within boundaries of proposed Port Antonio Marine Park;*
i) *opportunities for employment; and*
j) *community perceptions and concerns as regards the proposed development.*

Task 5. Analysis of Project Alternatives – Describe the alternatives examined for the proposed project that would achieve the same objective, including the "no action" alternative. Distinguish the most environmentally friendly alternatives.

Task 6. Mitigation and Management of Negative Impacts - Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels.

Task 7. Environmental Impact Monitoring Plan - Prepare a draft plan for monitoring the implementation of mitigating measures and the impacts of the project during the construction phase.

Task 8. Assist in Inter-Agency Coordination and Public / NGO Participation - As and if required by the NEPA, assist in coordinating the review of the environmental assessment by the relevant government agencies and in obtaining the views of local NGOs and affected groups.

5. *Report - The environmental assessment report will be concise and limited to significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental assessment report will be organised according to, but not necessarily limited by, the outline below:*

- *Executive Summary*
- *Description of the Proposed Project*
- *Policy, Legal and Administrative Framework*
- *Description of the Project Environment*
- *Significant Environmental Impacts*
- *Analysis of Alternatives*
- *Mitigation Measures*

- *Impact Monitoring Plan*
- *List of References*

1.3 STUDY TEAM

Environmental Solutions Ltd carried out this EIA. The multidisciplinary team engaged to do the assessment included local expertise in environmental impact assessment, marine and coastal ecology, environmental chemistry, and socio-economics. The team members were:

Environmental Solutions Ltd.:

- Mr. Peter Reeson, M.Sc. – Team Leader and EIA Specialist
- Mr. George Campbell, M.Sc. – Socio-economist
- Mr. Aedan Earle, M.Phil. – Geologist
- Mrs. Sharonmae Shirley, M.Phil. – Environmental chemist

ESL associates:

- Ms. Andrea Lanigan, M.Phil. – Marine biologist

1.4 METHODOLOGY

1.4.1 Terrestrial Survey

A simple 'walk through' terrestrial survey of flora and fauna was conducted on 14 July 2004. Plant species were identified, the presence of any rare and endemic plants was determined, and an indication of the level of biodiversity at the site was obtained.

1.4.2 Marine Survey

Information and descriptions of the marine environment at Dragon Bay were obtained from a marine biology survey conducted on 14 July 2004.The survey covered the offshore area immediately surrounding the subdivision area including the bays on either side of the bluff. The survey involved a series of SCUBA dives, towed-diver transects, and snorkeling exercises.

The reef along the northern border of the bluff was investigated to determine the status of the marine community and to evaluate the vulnerability of the environment to any adverse impacts from the development of the area. The investigation was carried out by SCUBA diving.

A qualitative assessment of each site was conducted to provide a species list and an abundance (DAFOR) rating for each species. The DAFOR is a subjective rating which provides an indication of whether an organism is Dominant, Abundant, Frequent, Occasional or Rare in the environment.

Qualitative data was obtained on percent cover of various benthic organisms and general features of the site. Quantitative data on coral cover and size were collected along 10 m long transects. Data on algal cover and coral recruit densities were collected using 0.25 cm^2 quadrats laid along the transect lines.

1.4.3 Marine Water Quality Survey

Marine water quality data was obtained during a sampling exercise carried out in 14 July 2004. The data provide a quantitative indication of the existing water quality at the site. It should be noted that each sample was a 'one-off' grab sample. The results can therefore only be used to provide an indication of the existing water quality conditions on that sampling trip as they may not reflect the typical water quality profile for the site.

The samples were collected using a boat from a depth of 0.5m. After collection they were placed on ice and transported to the ESL Laboratory at 20 West Kings House Road, Kingston 10.

The following parameters were analysed:

- pH
- Conductivity/salinity
- Temperature
- Dissolved Oxygen
- Total Suspended Solids
- Nitrate
- Phosphate
- BOD
- Oil and grease
- Total and Faecal Coliform

Conductivity/salinity, temperature, and dissolved oxygen were measured *in situ* at the sampling stations. The analytical methods used are based on established procedures in Standard Methods for Water and Wastewater Analysis.

1.4.4 Socioeconomic Survey

Rapid rural appraisal techniques were used in the five main communities within or around Dragons Bay to identify impacts of relevance to the project. These communities were: Dolphins Bay, Drapers, San San, Fairy Hill, Boston and Port Antonio. Select sub-communities within these main communities were also targeted (for example housing schemes, or fishing or recreational beach communities). The process involved windscreen observations, in-depth structured interviews, as well as non-structured *ad hoc* discussions with individuals and groups of citizens. Both government agencies and private sector enterprises were canvassed. Demographic data was sourced from 2001 Census data (STATIN) and hydrological data from the Water Resources Authority.

2. ENVIRONMENTAL POLICY, LEGISLATION AND REGULATORY FRAMEWORK

The environmental laws and regulations of Jamaica that are relevant to the proposed subdivision, are listed and commented upon below.

2.1 LEGISLATION AND REGULATIONS

Natural Resources Conservation Authority Act (1991)
This is the main environmental legislation that relates to the proposed project. This Act establishes the Natural Resources Conservation Authority (NRCA) with primary responsibility for ensuring sustainable development through the protection and management of the country's natural resources and the control of pollution. This is partly achieved through an environmental permit and license system.

The Act gives the Authority power to:

- issue permits to the entity responsible for undertaking any enterprise, construction or development of a prescribed category in a prescribed area [Section 9]. This section, the Prescribed Area Order, designates all of Jamaica as being within the prescribed area;
- issue licences for discharge of trade or sewage effluent or for construction or modification of any works for such discharge [Section 12 (1) (a) and (b)];
- request information or documents as the Authority thinks fit [Section 10 (1) (a)];
- request an environmental impact assessment containing such information as may be prescribed [Section 10 (1) (b)];
- request information on pollution control facilities [Section 17];
- revoke or suspend permits.

The Act also incorporates the earlier Beach Control Act, Wildlife Protection Act and Watersheds Act.

Beach Control Act (1978) (currently under review)
The regulations of 1978 relate to hotels, commercial and public recreational beaches, regulated beach activities, care of beaches and rights of license. The Beach Control Act extends only to the foreshore; while it provides for the designation of protected areas, it does not address the basis for such designation, nor does it deal with the management of coastal resources landward or seaward of the foreshore. The Beach Control Law requires that an application be made for the modification of any beach/coastline and sets out requirements for the posting of public notices.

Wild Life Protection Act (1945)
Prohibits removal, sale or possession of protected animals, use of dynamite, poisons or other noxious material to kill or injure fish, prohibits discharge of trade effluent or industrial waste into harbors, lagoons, estuaries and streams. It authorizes the establishment of Game Sanctuaries and Reserves. Protected under the Wildlife Protection Act are six species of sea turtles.

Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996)
The island of Jamaica and the Territorial Sea of Jamaica has been declared as a Prescribed Area. No person can undertake any enterprise, construction or development of a prescribed description of category except under and in accordance with a permit.

Natural Resources Conservation (Permits and Licenses) Regulations (1996)
These regulations give effect to the provisions of the Prescribed Areas Order. Hotel/resort complexes of more than 12 rooms, as well as sewage treatment facilities, are included on the list of prescribed activities.

Natural Resources Conservation (Sewage Effluent) Regulations (Draft)
These regulations, when brought into effect, will cover the discharge of sewage effluent, the operations, monitoring and reporting mechanism of sewage treatment facilities.

Water Quality NRCA Act (1990)
The NRCA has primary responsibility for control of pollution in Jamaica's environment, including pollution of water. National standards exist for industrial and sewage effluent discharges to rivers and streams.

Town and Country Planning Act (1958)
Established the Town and Country Planning Authority with responsibility for Development Orders to control both rural and urban land development, ensure proper sanitary conveniences, co-ordinate building of roads and other public services. Planning approvals for the project will have to be obtained from the Town Planning Authority at NEPA.

Quarries Control Act (1983)
This Act repeals the Quarries Act of 1958 and makes provisions for quarry zones and licenses, quarry tax, enforcement and safety. The proposed project should ensure that any earth materials used for construction purposes at the subdivision are obtained only from licensed quarries.

2.2 POLICIES AND REGULATIONS

Policy for Jamaica's System of Protected Areas (1997)
The System of Protected Areas is an expression Jamaica's commitment to protect the environment and its resources through the protection of parks and protected areas. The policy lists six goals, which include, economic development, environmental conservation, sustainable use of resources, recreation and public education, public participation and financial sustainability. The proposed subdivision is located within the boundaries of the coastal area proposed for the Port Antonio Marine Park.

Coral Reef Protection and Preservation Policy and Regulation (Draft - 1996)
This document reviews the ecological and socio-economic functions of coral reefs, issues affecting coral reefs and Government's role and responsibility. Five main goals are outlined which include reduction of pollutants, reduction of over-harvesting of reef fish, reduction of physical damage from recreational activities, improving the response

capability to oil spills, and control of coastal zone developments. The proposed subdivision must ensure that its activities do not threaten or harm the coral reefs in surrounding offshore areas.

3. DESCRIPTION OF PROJECT AREA

3.1 PHYSIOGRAPHY AND DRAINAGE

The proposed subdivision site is located at the northern end of an elevated coastal area known as Fairy Hill between Salt Creek Bay (a.k.a. Dragon Bay) to the west and Fairy Hill Bay to the east Figure 3.1.1 The site is currently a wooded area adjacent to a residential area to the south known as Fairy Hill and the Dragon Bay hotel to the west. This elevated area rises from the sea as a series of cliffs and forms a bluff projecting into the sea between two prominent bays. The near vertical, bare rocky cliffs are 40 to 50 feet high.

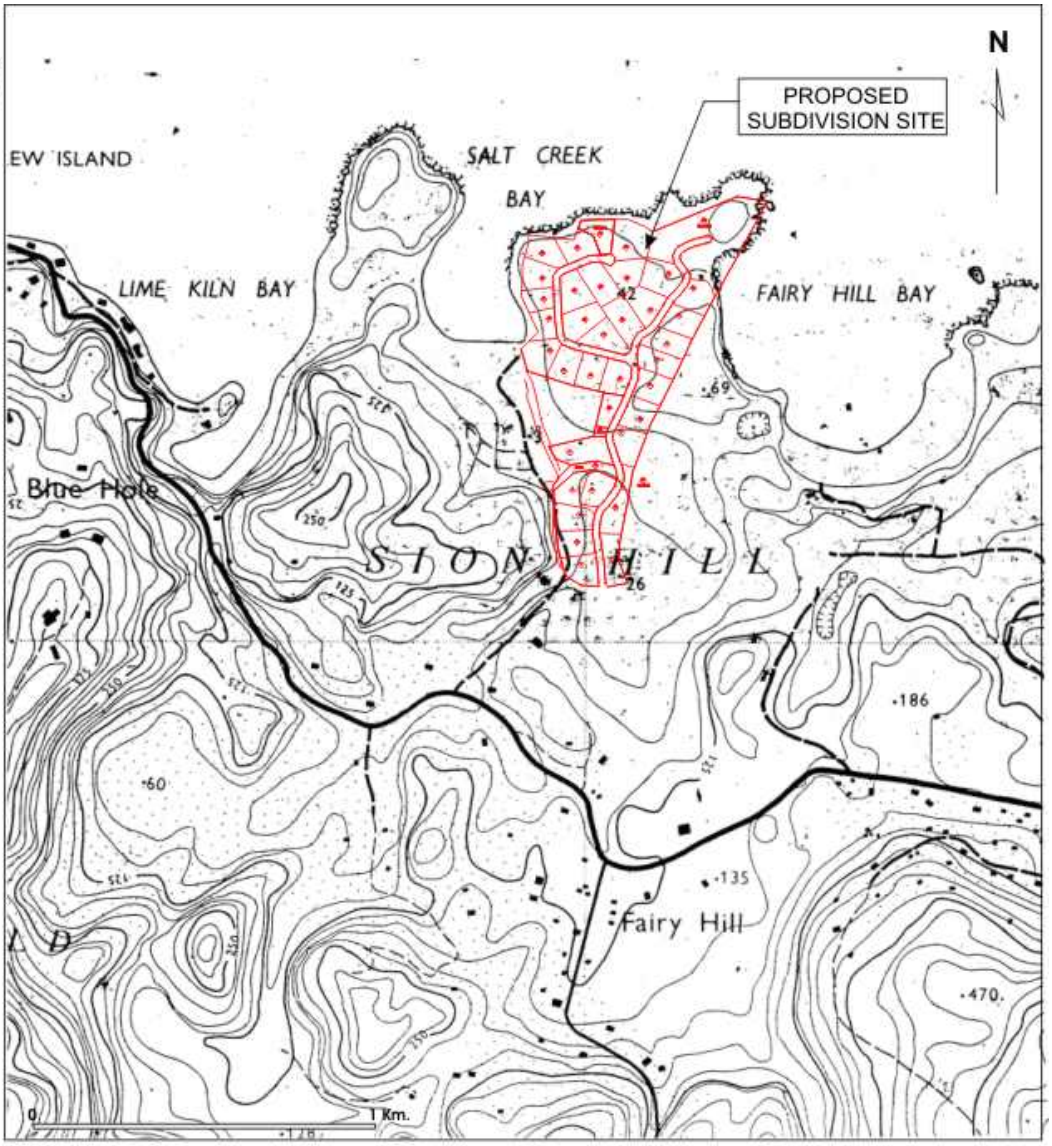

FIGURE 3.1.1: REGIONAL SETTING OF SUBDIVISION SITE.

The landform of the site consists of a relatively flat plateau that rises sharply from the sea with near vertical rocky cliffs on the northern, western and eastern sides. The maximum elevation of the plateau is in the order of 50 feet above mean sea level with localised changes in relief in the order of 15 feet, Figure 3.1.2. The surface is however made uneven where the underlying rock is exposed and the highly irregular karst landform dominates. Solution features within the bedrock form localised depressions and sinkholes which is places are as large as 20 feet in diameter.

Figure 3.1.2 Topography of the subdivision site.

There are no well-developed drainage lines on the site. A small river (stream) runs northerly towards the sea along the western border of the development site that drains the northernmost flanks of the John Crow Mountains located to the south of the site. It enters the sea at the southeastern side of Dragon Bay. Rainwater drains from the site downwards by percolation through the highly developed solution features in the underlying bedrock.

3.2 GEOLOGY

The bedrock of the study area is comprised of series of relatively pure Coastal Limestone that are part of the White Limestone Group. This rocktype forms a raised platform with high cliffs and the limestone is exposed over most of the study area. The rocks consists of well, bedded, hard highly karstified limestone that is comprised of highly fossiliferous reef rock.

Solution features are highly developed with large sinkholes the most prominent examples. A very thin layer of reddish brown, clay, soil accumulates mainly in depressions within the limestone. This soil type is a fine grained, poorly sorted clay-loam with low permeability and high erodibility on steep devegetated slopes.

3.3 METEOROLOGY

The Fairy Hill area in Portland, like the rest of the island, experiences a subtropical climate. Mean daily temperatures are lowest in March (28^{o}C) and highest in July and August (29^{o}C and 31^{o}C, respectively). Relative humidity ranges between 65% and 85%.

Portland experiences the highest rainfall in Jamaica, in the order of 3200 mm annually. Most of the rainfall occurs in May And October. Rainfall is largely the result of orographic effects that causes precipitation when moisture laden northeasterly trade winds encounter the Blue Mountain range. Extreme weather conditions usually result from cold fronts and tropical weather systems. The cold fronts migrate southwards from the North American continent from mid-October to mid-April. Tropical weather systems, namely Tropical Waves, Tropical Depressions, Tropical Storms and Hurricanes occur from April to December. The official hurricane season is from June to November

Wind conditions are largely determined by the prevailing Northeast Trades. Along the north coast the sea breeze combines with the trade winds to give an east-northeasterly wind at an average speed of 15 knots (17 miles per hour), At night, the trade winds combine with land breezes which blow offshore down the slopes of the hills near the coasts with the result that nightime winds generally have a southerly component with a mean speed of 5 knots (6 miles per hour).

3.4 TERRESTRIAL ECOLOGY

3.4.1 Flora

The forest on the site may be classified as a disturbed broadleaf forest (Evelyn & Carimand 2000). This type is a secondary forest characterised by the presence of broadleaved trees at least 5m in height. The canopy is more or less closed, and indicator species of disturbance such as Trumpet trees are present. Using alternate

classifications, this forest may also be categorized as Disturbed Closed forest (FAO, Food & Agricultural Organization) or Semi-evergreen Moist Broadleaf forest (TNC, The Nature Conservancy). It could also be classified as wet limestone forest, the term most commonly used in Jamaica.

The forest is composed of numerous large diameter trees, many exceeding 0.3m and many of the trees are quite tall, often reaching 15m or more. The tallest trees are mainly Prickly Yellow and Trumpet trees. At least twelve plant species were identified, with a number of others present that were not identified. Among these, Pimento, Bullet, Strangler Fig, Prickly Yellow, and the Sweetwoods, are known to be feeding trees for birds.

The forest floor is stony in some areas with old coral skeletons forming part of the substrate, while in other areas the substrate is soil covered in a thick layer of moist leaf litter. The canopy is closed throughout the forest creating a shaded interior. The under canopy layer is open towards the periphery of the forest, but becomes denser towards the center. Numerous vines and lianas were observed hanging from the tall trees.

Table 3.4.1. Vegetation identified on the subdivision site, Dragon Bay.

Common name	Scientific name
Pimento	*Pimenta dioica*
Trumpet	*Cecropia peltata*
Prickly Yellow	*Fagara martinicensis*
Strangler Fig	*Ficus sp.*
Almond	*Terminalia catappa*
Mango	*Mangifera indica*
Sweetwood	*Nectandra spp.*
Bullet	*Bumelia sp.*
Santa Maria	*Calophyllum calaba*
Spanish elm	
Philodendron	
Palm	
Total	**12 species**

3.4.2 Avifauna

Numerous birds were heard In the forest area, mainly in the upper canopy. Ten species of birds were identified, with a number of unidentified species also present. Of the ten species identified, five of these are found only in Jamaica. In addition, three other species are endemic to Jamaica at the subspecies level. One species, the White-crowned pigeon, is known to be threatened due to habitat destruction and hunting. The bird species identified are listed in Table 3.22. All the species listed are common residents in Jamaica.

Table 3.4.2. Bird species identified at the subdivision site, Dragon Bay.

Common name	Scientific name	Number seen	Notes
Black-billed streamertail	*Trochilus polytmus*	1	Endemic genus
Jamaican vireo	*Vireo modestus*	2	Endemic species
Jamaican mango	*Anthracothorax mango*	1	Endemic species
White-chinned thrush	*Turdus aurantius*	2	Endemic species
Jamaican woodpecker	*Melanerpes radiolatus*	1	Endemic species
Jamaican oriole	*Icterus leucopteryx*	2	Endemic subspecies
Bananaquit	*Coereba flaveola*	2	Endemic subspecies
Loggerhead kingbird	*Tyrannus caudifasciatus*	3	Endemic subspecies
Gray kingbird	*Tyrannus dominicensis*	1	
White-crowned pigeon	*Columba leucocephala*	1	Threatened
Total	**10 species**	**16**	

3.5 MARINE ECOLOGY

3.5.1 Back reef

This study site is the back reef community along the northern border of the rocky shore of the bluff. This site is just east of Salt Creek Bay, and ranges in depth from 3 to 7.5 m. The substrate slopes sharply down from the rocky shore, then transitions into more gently sloping areas and reef flats interspersed by patch reefs and large mounds of coral colonies. The substrate is mainly hard pavement covered with a very thin layer of medium to coarse-grained sand. Lists of the species comprising the back reef community are given in Table 3.5.1.

Benthic invertebrates such as scleractinian corals, gorgonians and sponges are numerous on the reef. Scleractinian (reef-building) coral cover ranged from 10 to 15% cover, with *Agaricia agaricites* being the most commonly occurring species. *Siderastrea sp.*, and *Porites sp.* Were also frequently seen. Corals were of small to medium size; with an average diameter of 15 cm. Coral recruits (colonies less than 2 cm in diameter) were frequently seen on the reef, occurring at densities of approximately $3m^{-2}$.

Soft corals or gorgonians were numerous at the site, covering approximately 10% of the substrate. At least 6 species are present, with three of these occurring frequently. Sponge cover was also high, at 8-10%. Six species of sponge were identified at the site, many of which were large in size.

The fish community was composed of at least 30 species, with a number of commercially important fish such as parrotfish, doctorfish, French grunts, hogfish, Spanish hogfish, goatfish and coneys observed. Fish were generally small to medium-sized, at an average of 20 cm long. The community is made up of approximately equal numbers of adult and juvenile fish.

Urchins, particularly *Diadema antillarum,* (which is an important reef herbivore) were numerous at the site, and were present in clumps of up to $5m^{-2}$. Other invertebrates

Table 3.5.1 Species list of organisms found on the back reef north of the bluff.

Common name	Scientific name	DAFOR
Fish		**30 species**
Blue tang	*Acanthurus coeruleus*	F
Ocean surgeonfish	*Acanthurus bahianus*	F
Doctorfish	*Acanthurus chirurgus*	O
French grunt	*Haemulon flavolineatum*	O
Stoplight parrotfish	*Sparisoma viride*	F
Princess parrotfish	*Scarus taeniopterus*	F
Redband parrotfish	*Sparisoma aurofrenatum*	O
Spanish hogfish	*Bodianus rufus*	O
Hogfish	*Lachnolaimus maximus*	O
Coney	*Cephalopholis fulvus*	R
Spotted goatfish	*Pseudupeneus maculatus*	F
Yellow goatfish	*Mulloidichthys martinicus*	F
Slippery dick	*Halichoeres bivittatus*	F
Yellowhead wrasse	*Halichoeres garnoti*	F
Bluehead	*Thalassoma bifasciatum*	F
Creole wrasse	*Clepticus parrae*	O
Squirrelfish	*Holocentrus adscensionis*	F
Fairy basslet	*Gramma loreto*	F
Dusky damselfish	*Stegastes adustus*	O
Bicolor damselfish	*Stegastes partitus*	O
Yellowtail damselfish	*Microspathodon chrysurus*	O
Beaugregory	*Stegastes leucostictus*	F
Sergeant major	*Abudefduf saxatilis*	F
Brown chromis	*Chromis multilineata*	F
Porcupinefish	*Diodon hystrix*	R
Smooth trunkfish	*Lactophrys triqueter*	R
Trumpetfish	*Aulostomus maculatus*	R
Cleaning goby	*Gobiosoma genie*	O
Rock beauty	*Holacanthus tricolor*	O
Silversides	Family Atherinidae	F
Echinoderms		**3 species**
Long-spined urchin	*Diadema antillarum*	F
Reef urchin	*Echinometra viridis*	O
Rock-boring urchin	*Echinometra lucunter*	O
Cnidarians		**2 species**
Beaded anemone	*Epicystis crucifer*	O
White encrusting zoanthid	*Palythoa caribaeorum*	O
Gorgonians		**6 species**
Common sea fan	*Gorgonia ventalina*	F
Corky sea finger	*Briareum asbestinum*	F
Sea plumes	*Pseudopterogorgia spp.*	F
Bipinnate sea plume	*Pseudopterogorgia bipinnata*	O
Black sea rod	*Plexaura homomalla*	O
Bent sea rod	*Plexaura flexuosa*	O

Table 3.5.1 (contd.) Species list of organisms found on the back reef north of the bluff.

Common name	Scientific name	DAFOR
Scleractinian corals		**13 species**
Blade fire coral	*Millepora complanata*	O
Symmetrical brain coral	*Diploria strigosa*	O
Grooved brain coral	*Diploria labyrinthiformis*	O
Finger coral	*Porites porites*	F
Mustard hill coral	*Porites astreoides*	F
Massive starlet coral	*Siderastrea siderea*	F
Lesser starlet coral	*Siderastrea radians*	F
Lettuce coral	*Agaricia agaricites*	F
Great star coral	*Montastraea cavernosa*	R
Spiny flower coral	*Mussa angulosa*	R
Maze coral	*Meandrina meandrites*	R
Pillar coral	*Dendrogyra cylindrus*	R
Elliptical star coral	*Dichocoenia stokesii*	R
Sponges		**6 species**
Branching tube sponge	*Pseudoceratina crassa*	F
Red encrusting sponge	*Monanchora barbadensis*	F
Loggerhead sponge	*Spheciospongia vesparium*	F
Variable boring sponge	*Siphonodictyon coralliphagum*	F
Scattered pore rope sponge	*Aplysina fulva*	O
Convoluted barrel sponge	*Aplysina lacunosa*	R
Algae		**18 species**
Watercress alga	*Halimeda opuntia*	F
Large leaf watercress alga	*Halimeda discoidea*	O
Sea pearl	*Ventricaria ventricosa*	O
Derbesia	*Derbesia*	O
Green clump algae	*Cladophora prolifera*	O
Paddle blade alga	*Avrainvillea longicaulis*	O
Bristle ball brush	*Penicillus dumetosus*	O
Mermaid's fans	*Udotea sp.*	O
Y branched algae	*Dictyota bartayresii*	O
Y branched algae	*Dictyota cervicornis*	A
Sargassum	*Sargassum sp.*	A
White-vein sargassum	*Sargassum hystrix*	O
Saucer leaf alga	*Turbinaria tricostata*	A
Leafy flat-blade alga	*Stypopodium zonale*	F
Tubular thicket algae	*Galaxaura oblongata*	F
Reef cement	*Porolithon pachydermum*	A
Burgundy crust algae	*Peyssonnelia sp.*	O
Schizothrix	*Schizothrix calcicola*	O
Other		**3 species**
Caribbean reef squid	*Sepioteuthis sepioidea*	O
Sea walnut	*Mnemiopsis mccradyi*	O
Yellow fan worm	*Notaulax occidentalis*	O
Total		**81 species**

present at the site include the benthic Yellow fanworm, White encrusting zoanthid and Beaded anemone, and the pelagic Sea walnut and Caribbean reef squid.

The algal community at the site is composed of large quantities of reef cement, which is important in reef formation. Crustose coralline algae (including reef cement) covered approximately 35% of the substrate (see Table 3.5.2). Brown fleshy algae are the dominant macroalgal type on the reef, comprised mainly of *Sargassum sp., Dictyota sp.* And *Turbinaria tricostata*. These algal types cover approximately 20% of the substrate, and grow to heights of 10 to 15 cm. Calcareous algae on the reef were mainly the green algae, *Halimeda spp.*, and the red alga, *Galaxaura oblongata*. Calcareous macroalgae only occupied about 2.5% of the substrate, and the plants were quite short at an average height of 3 cm.

Table 3.5.2 Percent cover of benthic organisms in the back reef area.

Quadrat	Fleshy macroalgae	Calcareous macroalgae	Crustose coralline algae	Sand	Other*
1	20	0	25	40	15
2	5	0	30	55	10
3	20	0	40	10	30
4	35	10	45	10	0
Average	**20**	**2.5**	**35**	**28.5**	**14**

*Includes all other benthic fauna types within the quadrats.

Reefs with a low ratio of macroalgae to crustose coralline algae (as seen at this site) are considered healthier than reefs with a high ratio. In addition, the large quantities of reef cement provide good conditions for settlement of coral larvae, as evidenced by the numerous recruits seen at the site. Macroalgal cover is relatively low at this site, as compared to other Jamaican reefs, which allows for coral growth to occur without being smothered by the fast-growing algae.

This site is in fairly good condition for a back reef community, as macroalgal cover is low, allowing for coral growth to occur. The large quantities of reef cement encourage coral recruit settlement, while the numerous herbivorous fish and urchins keep macroalgal cover low. The high wave action caused by the close proximity to the rocky shore also keeps algal heights relatively low.

3.5.2 Fore reef

The fore reef area just west of Winifred's Beach has been investigated and described in a previous report prepared for ESL (see Marine Report for the Northern Coastal Highway Improvement Project, March 2004). This area is composed of large reef flats and patch reefs, and is approximately 8 m deep. A total of 85 species were identified, including 9 algal species, 11 sponge species, 10 gorgonian species, 19 scleractinian coral species and 25 fish species.

Coral cover is relatively high, at 20 to 30%, with a high density of coral recruits. Macroalgal cover is approximately 47%, with fleshy brown algae being the dominant type. Crustose coralline algae occur at approximately 10% cover. The increase in macroalgal cover and decrease in crustose coralline algae cover as compared to the back reef may be attributed to less wave action at this site due to the greater depth and distance from the shore.

The dominant fish are scarids (parrotfish) and pomacentrids (damselfish), with predatory and commercially important fish also occurring in fewer numbers. Grunts, snappers and hogfish are among the species observed, and ranged in length from 15 to 30 cm.

3.5.3 Salt Creek Bay

Inside Salt Creek Bay, which lies to the west of the bluff, the community is the same as that found in the back reef area. Seagrass is generally absent, while coral heads and patch reefs occur quite frequently. The reef structure gradually gives way to bare sand towards the shore. Fish, sponges, urchins, gorgonians and hard corals, as described for the back reef site, are found throughout the seaward side of the bay.

3.6 MARINE WATER QUALITY

The water quality was examined by collecting and analyzing four (4) water samples collected at the sampling stations shown in Figure 3.6.1. The analytical results of the water quality samples collected are given in Table 3.6.1.

FIGURE 3.6.1: Water quality sample locations.

Table 3.6.1. Results of water quality survey (July 14, 2004).

PARAMETERS	STATIONS				NEPA Marine Standards
	# 1	# 2	# 3	# 4	
pH	7.8	7.7	7.7	7.2	8.0 – 8.44
Salinity (ppt)	35	35.5	34.9	16.5	-
Dissolved Oxygen (mg/L)	5.7	5.0	6.2	4.3	4.5 – 6.8
BOD (mg/L)	2	6	8	18	0.57 – 1.16
TSS (mg/L)	10.0	30.0	30.0	20.0	-
Nitrate (mg/L)	0.09	0.08	0.14	1.49	0.001 – 0.081
Phosphate (mg/L)	0.2	0.1	1.0	0.1	0.001 – 0.055
Total Coliform (MPN/100ml)	<3	<3	<3	240	48 – 256
Faecal Coliform (MPN/100ml)	<3	<3	<3	240	<2 – 13
Oil & Grease (mg/L)	1.0	1.1	1.8	1.1	-

The data show that the water quality of the three coastal stations is quite good. The water is oxygenated with low nutrient and bacterial levels. Total suspended solids are somewhat elevated at Stations 2 and 3, likely as a result of wave action. The sample taken at the mouth of the river (# 4) has high nitrate and biochemical oxygen demand levels and low dissolved oxygen levels. This suggests that there are significant levels of

oxygen demanding substances in the water probably from a nitrogen source. Total and faecal coliform levels though within the recommended guidelines are much higher at this station than at the other coastal stations. The water quality of the river should be monitored and any upstream point source identified as this has implications for the overall water quality of the bay and long-term health of the coral reef.

3.7 NATURAL HAZARD VULNERABILITY

Portland is prone to hurricane force winds, storm surges, earthquakes and flooding from storm events of varying intensities. Of particular concern to the overall project area are the hazards of storm surge and flooding from storm events. However the height of the bluff will minimize the potential effects of storm surge at the site. Storm surge consists of the anticipated sea level rise due to the passage of tropical storms and hurricanes, but must also consider the effects of normal tidal variations and any long-term sea level changes.

Long-term sea level rise should also be considered in the assessment of storm surge risk. In the absence of local, site-specific data, a value of 5mm per year has been proposed by UNEP.

Earthquakes are an ever-present risk for Jamaica. The seismic zonation map of (Periera, 1987) shown in Figure 3.7.1 indicates that for medium and high intensity earthquakes the proposed site is located in an area with a high probability of occurrence. However, the rock type on which the subdivision is sited will not have any significant amplification effects on earthquake induced ground shaking.

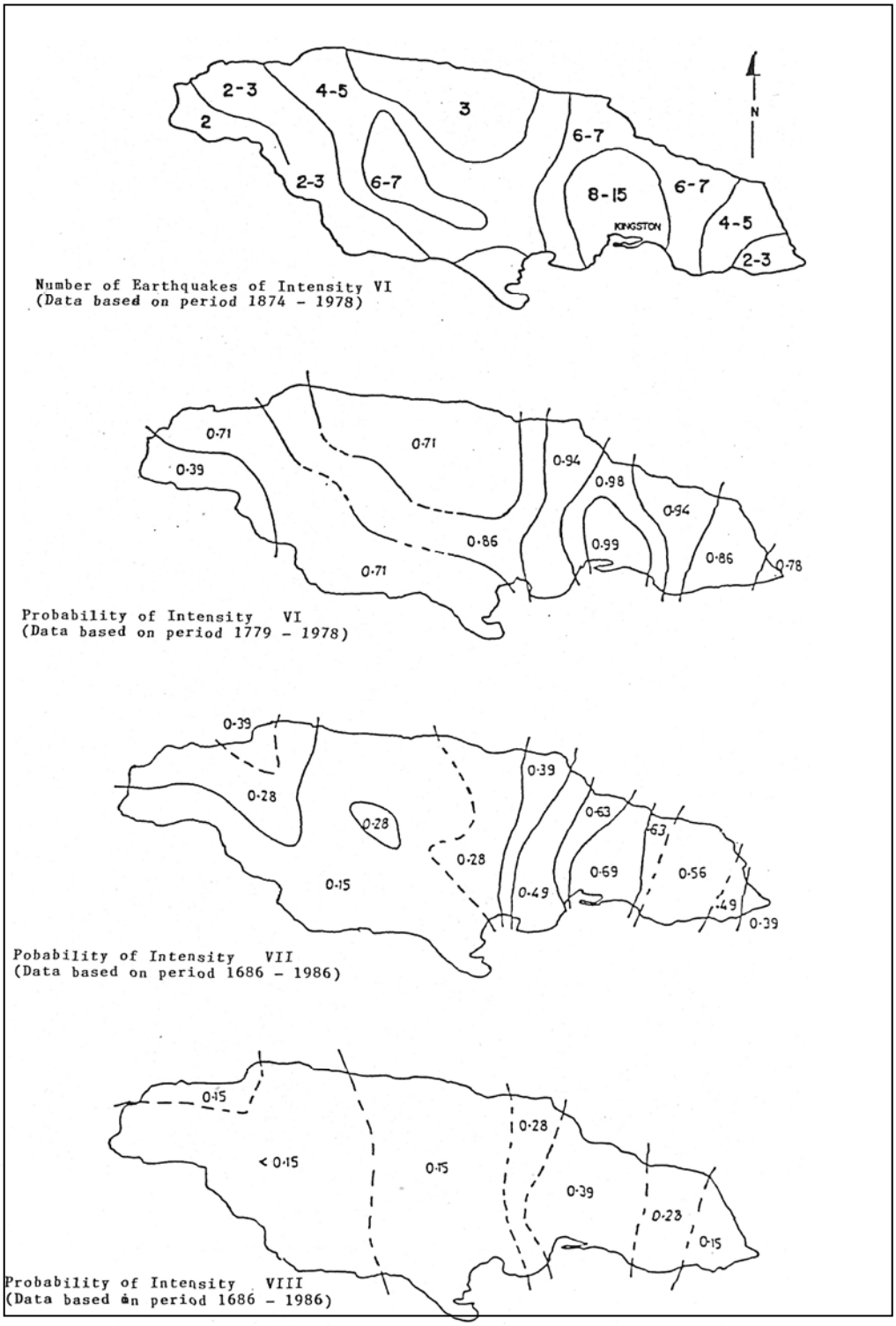

Figure 3.7.1 Seismic zonation of Jamaica (Periera et al 1987)

3.8 SOCIO-ECONOMIC ENVIRONMENT

3.8.1 Communities

Dragon Bay is situated approximately 8 kilometers (5 miles) east of Port Antonio. There are a number of coastal communities that lie along the main road between Port Antonio and Manchioneal, the next largest township. The project is a residential real estate development and can be expected to confer positive, if modest, benefits on these communities via opportunities for income generation and employment. No significant negative social impacts on the project by these communities were determined.

Of the nine communities that lie within the immediate employment sphere of influence of the project, including Port Antonio, only those likely to provide or receive discernable and direct project impacts are described. The incomes and employment effect of the project can be expected to filter to all communities over time, even if not equally. However, each of the communities included in this section present peculiar or unique opportunities for impacting or being impacted by the project. These communities, traveling east from Port Antonio are:

- **Port Antonio**. This is the parish capital and administrative center. It is also the commercial, transportation and shipping center of the parish, as well as the focal point for its social, educational and other cultural facilities. It will both benefit from and be of benefit to the project. In particular, the new Port Antonio Marina, with its luxury yacht facility, will fit in very well with the projects profile. A challenge faced by the parish capital, already appreciated in the context of the marina, is the need to clean up the town, restore the heritage elements that are rapidly disappearing (Titchfield Hill being the best example) and encourage the development of additional visitor attractions, in harmony with the type of tourism that the parish is promoting.

- **Dolphin Bay.** This area lies to the east of the town and contains some of the better-known hotels, such as Trident Hotel & Villas, The Palace, the Palace Hotel and Villa Pablo. Dolphin Bay also contains two large middle income housing schemes; Anchovy Gardens comprising about 150 units and Dolphin Bay Housing scheme, which comprises about 24 larger size properties.

- **Drapers**. This is the most densely populated, unplanned, residential community, comprising a mix of approximately 200 lower and lower middle-income housing units close to the main road, and about 40 more planned, middle income housing units as it climbs into the coastal hills (e.g. 'Drapers Heights'). Drapers could benefit from the project in that it is the largest population center proximal to the project area and could provide a pool of construction labour, domestic services and other artisan occupations. Local agricultural produce could find a market outlet in the project.

  The bathing beach at Drapers, locally called Sanku Beach, is a good example of the emerging response of the coastal populations in Portland to tourism and visitor growth. (East Harbour in Port Antonio, Winifred's Beach, and Boston Bay are other examples of this evolving product.)

- **San San.** This community currently lies at the center of Port Antonio's visitor market. The proposed subdivision is conceptually aligned closely with the hospitality and residential infrastructure of San San. San San has approximately 30 upper income estate homes and hospitality facilities that have been developed around good bathing beaches, the Blue Hole Lagoon (a national landmark) and the biodiversity found in the fringing mountains. San San is likely to derive a particular benefit from the proposed project in that the project's target market is likely to enjoy the entertainment facilities provided by the hotels, restaurants and nightlife of San San. Similarly San San will benefit the project by providing a training ground for hospitality workers at all levels required to meet the needs of the project. San San has the only police station in the wider project area.

- **Fairy Hill.** This community is adjacent to the project area. It is a sprawling, unplanned, mainly low-income settlement, although there are no squatter elements. Fairy Hill contains a 27 unit housing scheme which shares the project access road. This housing scheme is mainly owned and occupied by returning residents. The community stands to benefit from the project mainly through the employment and incomes effect, generated by construction labour, domestic services and any visitor expenditure within the community.

  The other sub-community at Fairy Hill is Winnifred's Beach. This is a popular public bathing beach, which has 20 stalls and basic bathroom (not working at time of visit) and changing room facilities available to bathers. These comprise two toilets and two showers leading into soak away pits dug into the sand. The system uses seawater for flushing. The efficiency of this arrangement needs to be established, as the current flows west across the project beach frontage and likely inside of the fringing reef past Blue Lagoon and down to San San beach. Nevertheless, Winnifred's Beach is likely to be a beneficiary of the project, since it has cultivated a 'roots' image, and is popular with visitors and locals. The beach's official status with NEPA is that it is closed due to the lack of adequate public facilities. With upgrading this beach could benefit from the project.

- **Boston.** This well-known community is included, mainly because of its association with "jerk" and its annual festival. There is also a public bathing and fishing beach (4 boats and 12 fishermen), the official status of which is under review by NEPA due to lack of adequate facilities. Boston provides perhaps, the best example of the community tourism branding referred to earlier. It can be expected to attract project patrons and in turn benefit from their patronage.

A summary of the official status of the main beaches in these communities is as follows:

Name of Beach	NEPA Status
Sanku,	A former public bathing beach now designated as "closed" because of inadequate facilities.
Winifred's	A former public bathing beach now designated as "closed" because of inadequate facilities.
Boston	A beach designated for use as a public bathing but pending a review of this status.
San San	A commercial public bathing beach.

3.8.2 Demographics

According to the 2001 Census, published by STATIN, the population of Portland grew from 38,275 in 1991 to 40,227 in 2001, or by 1,952 persons (3.04%). The corresponding figures for Port Antonio over the same period, were an absolute increase of 765 persons to a total population of 14,568 representing a growth rate of 5.54%. One measure of the comparative stagnation taking place in Portland is that the population growth in Ocho Rios during the same period increased by 51% and in Montego Bay by 13%. While the demographic composition of Portland's population will have no effect on the project given its size and nature, published data indicates that Portland has experienced negative internal migration, losing its population mainly to St Andrew and St. Catherine. Additionally, data shows that Portland has a dependency ratio of 75%, which means that the earnings of a quarter of the population supports the rest. The figures support the general perception that Portland is not a vibrant, growth oriented Parish, and continues to suffer from lack of development and infrastructure.

3.8.3 Education, Employment & Social Development

The principal secondary educational institution in Port Antonio is the Titchfield High School. It can be expected that some project employment benefits will flow to graduates of this school, since, other things being equal, employment opportunities would favour Port Antonio based residents. The College of Agriculture Science and Education (CASE) is the only tertiary institution in the parish. There are no HEART Academies in Port Antonio.

3.8.4 Public Health & Safety

The public health profile of Portland indicates that the incidence of communicable diseases are within normal national parameters and that this is thought to hold true for chronic illnesses. Port Antonio has a 95 bed hospital, which serves the entire parish, the nearest other hospitals being in St. Mary (Annotto Bay) and St. Thomas (Morant Bay). Although several health clinics exist, the one closest to the project area is in Fairy Hill.

There is one fire engine stationed in Port Antonio. This is supported by a unit in Buff Bay and one in Annotto Bay. This level of coverage is inadequate and needs to be improved as a matter of priority.

3.8.5 Water Demand & Supply

The project area receives its water supply from two main sources, the Turtle Crawl River system and the Grants Level system in the Rio Grande Valley. The National Water Commission is the main distributor of water. Those interviewed in the project area report that normally there is good water pressure when supply is available but that the supply is not totally consistent and that there is a considerable reduction in water pressure at peak demand periods during the summer months. Most community members interviewed reported that the visual appearance of piped water was unsatisfactory although the NWC claimed that water quality was supplied at acceptable levels. The region has tended to suffer from a water shortage problem because the Blue Mountain North Basin, within which Port Antonio lies, produces marginally more water than is demanded according to 1990 figures supplied by the Water Resources Authority.

Average Annual Production	30.50 mcm
Average annual total Demand	24.57 mcm
Projected demand in 2015	47.40 mcm

The NWC is of the opinion that the subdivision project will need to have water storage capacity.

3.8.6 Transportation & Traffic

Traffic along the main public road serving the project area is characterized as light to moderate by officers stationed at the San San police station. For this reason traffic counts were not considered necessary. Daily peak periods occur between 7:00am to 9:00am and again between 5:00pm to 7:00pm. The heaviest traffic flows are reported to occur on Saturdays and month end periods. Traffic congestion, when it does occur, is confined mainly to the Boston Bay area on public holiday events and during the annual jerk festival.

The entrance to the project access road is not concealed and should not present any particular hazard to road users if properly signed. Excessive speeding is not the norm in this area given the nature of the road surfaces. However, during the construction phase, careful consideration must be given to the correct handling of heavy duty haulage vehicles at the main intersection with the main road. In the post construction period it is not expected that the project will experience high levels of vehicular use.

3.8.7 Land Use

The area adjoining the subdivision site is either undeveloped or used for residential and resort purposes. As best as could be determined, based on community interviews, there are no other major projects, under construction or planned, within the immediate area that would impact negatively, one way or the other on the project.

3.8.8 Archaeological & Cultural Heritage

This section of the coast can be assumed to contain unrevealed and therefore un-recovered archaeological and heritage elements. However, as the project area is quite small and reasonably well explored, the risk is present but not high that such archaeologically valuable material will be disturbed by the project. Nevertheless, the contractors should be made aware of the possibility and instructed to report any findings to the Jamaica National Heritage Trust.

3.8.9 Perceptions of the project

Based on the interviews conducted for the socioeconomic data collection, there was very positive support for the project, although very little had been heard about it. Generally, all persons interviewed accepted that the project was a positive initiative for the region. For the communities to better engage with the project, a local public information initiative would help to address the current information gap.

4. PROJECT DESCRIPTION

Lockstone Holdings Ltd. intend to sub-divide 12.1 hectares (29.9 acres) of land on a high bluff at Zion Hill, Dragon Bay, into 38 lots for residential development that will satisfy the high end of the market. The average size of the lots will be 2900 square meters. As shown in Figure 4.1.1, twenty seven lots will be dedicated to the construction of villas, seven lots (# 24 – 30) will be dedicated to the construction of 2 & 3 story townhouses and apartments not exceeding 30 rooms/acre, and 4 lots (# 35, 36,37,38, & 39) are to be reserved for open space. The forested character of the land will be retained as far as possible.

Figure 4.1.1: Subdivision plan.

The development works of significance at the outset will be construction of the sub-division's roads followed by clearance of low vegetation to gain access to the individual lots. Road construction, given the topography of the land and the alignment of the roads, will require little cutting into slopes and thus little displacement of rock and soil. It should be possible to use most of this displaced material as fill elsewhere on the development site.

At the present time it is not possible to discuss any details of the houses and apartments that will eventually be built but it can be assumed for the purposes of the EIA that the average footprint of a villa will be 255.5 m^2 (2,750 ft^2.), and that each lot will have a pool sized at approximately 74.3 m^2 (800 ft^2 or 23,000 gal), a lawn, a driveway, and that all existing large trees on the lot will be retained. The corresponding details for the townhouses and apartments are not yet available.

Similarly, the details of construction methodology are not available but it can be assumed that the houses will be built using conventional block and steel technology after the site has been cleared of underbrush and undesired trees. The extent to which 'green architecture' will be utilized and the degree to which resource saving devices will be incorporated in the structure is not presently known but will probably depend on the interests and concerns of the individual owners and developers. It is expected that the residential units will be built over a period of ten years, which will serve to dissipate the environmental impacts related to construction works.

Water, electricity, and telephone services will be connected to each lot from the respective mains running alongside the roads. At full build out it is estimated that the total demand for potable water will be about 8,000 gallons/day. It is proposed that each individual lot would have its own sewage treatment system comprising of a septic tank and tile field. The generic design for such a system to be adopted for the subdivision has not yet been prepared but sewage treatment options should take into account the proximity of the site to the sea, the porosity of the soil, and closeness of the reef to the shore.

Figure 4.1.2 illustrates the proposed drainage plan for the site.

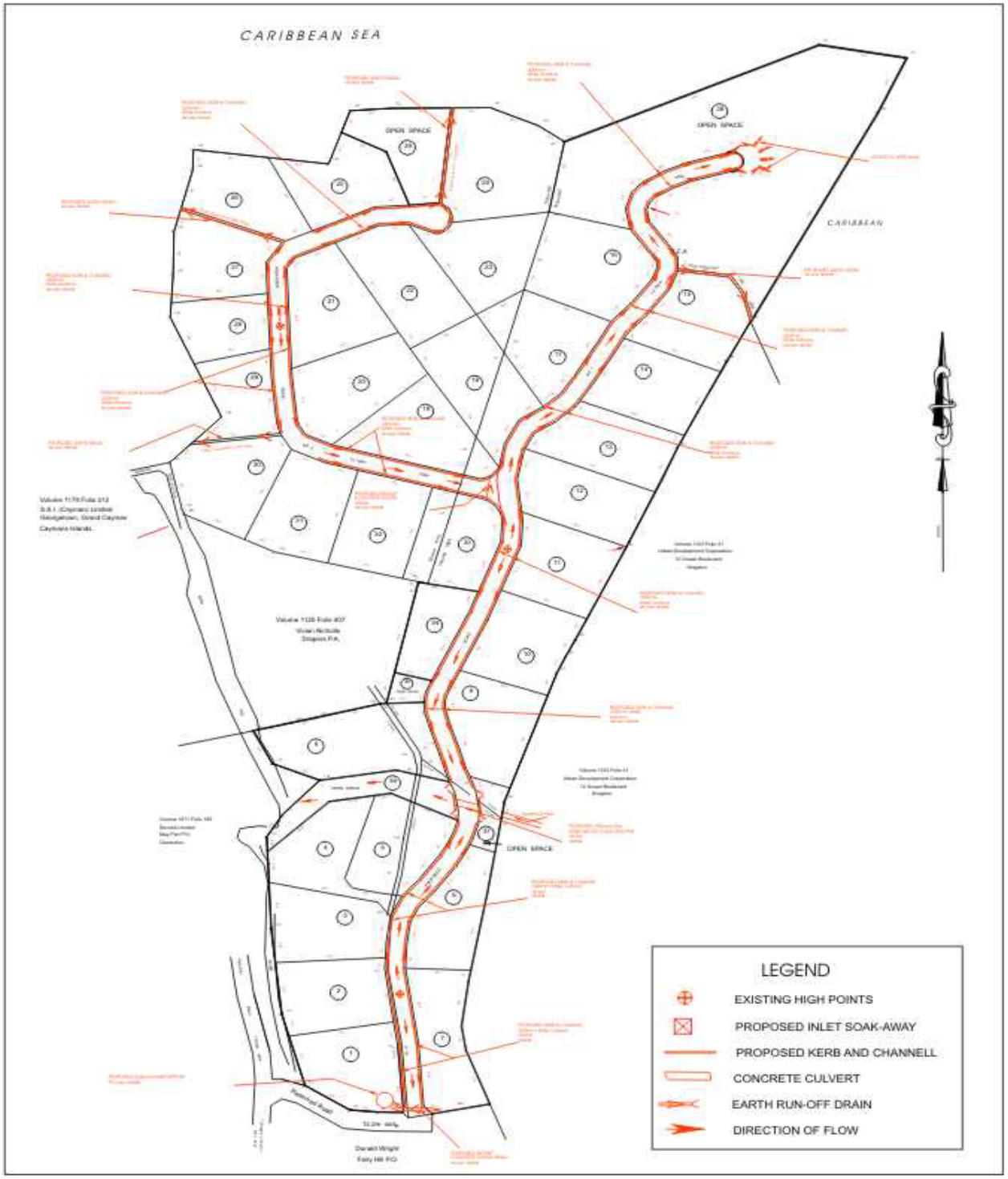

Figure 4.1.2: Proposed drainage system for subdivision site

5. ENVIRONMENTAL IMPACTS AND MITIGATION

Potential positive and adverse environmental impacts associated with the sub-division will arise first during the **site clearance and preparation** phase when the ground vegetation is cleared, the internal road is laid and the service infrastructure (water and electricity) is installed. These activities will impact the development area more or less at the same time. The second phase, **house and apartment construction**, will be protracted, its duration dependent on the rate at which the individual lots are developed and the homes are built. This phase will overlap with the third phase, **habitation**, the period over the long-term during which the homes are lived in. The environmental impacts related to the three phases are discussed below. For ease of discussion and presentation, the corresponding impact mitigation measures are presented after the discussion of each impact. A summary of the impacts is given in Table 5.1.

5.1 SITE CLEARANCE AND PREPARATION IMPACTS

5.1.1 Loss of natural habitat and biodiversity

The clearing of brush and removal of trees during road construction and the development of the individual lots will result in the loss of at least a part of the existing forest and vegetation and, as a consequence, a reduction of arboreal habitat for epiphytes, lizards, tree frogs, and birds, including endemic species. Bird feeding trees may also be lost. Noise, vibrations, and intrusive activities related to construction works will tend to scare away any animals remaining on the site after vegetation clearance. The incremental loss of natural habitat and of biodiversity is a negative consequence of the proposed development. It is also a cumulative impact in that the development results in further loss of wet limestone forest, albeit disturbed in this case, in the Dragon Bay region. These are the environmental trade offs for expansion of residential area and the tourism industry.

Mitigation:

Impact mitigation here seeks to retain and restore as much of the original and natural forested condition of the overall development site as possible and for the most part this would be would be implemented on a lot by lot basis as development of the individual lots proceeds.

- *Construction of the subdivision roads should be carried out after identifying and locating all the mature and ecologically valuable trees (using qualified personnel) and aligning the roads so as to save these trees.*
- *Finalisation of the layout plans for individual sites should be done only after superimposing the proposed villa footprint on the lot's tree survey drawing and then aligning the footprint so as to minimize tree removal and ensure protection of ecologically valuable trees. This should also take into account the scenic views and cleared space needed around the building to facilitate construction.*
- *Final site layout plan for each lot should also identify areas suitable for replanting.*

- *Trees to be protected should be clearly marked and indicated on the landscape plan prior to the commencement of construction.*
- *Where it is unavoidable that ecologically valuable trees have to be removed, they should be relocated rather than be destroyed.*
- *The building contractor should be subject to punitive penalties for any breaches of the tree protection plan*
- *The landscape plan should be prepared prior to commencement of site clearance and be subject to careful review and assessment.*
- *The landscape plan should seek to utilize low-maintenance native species tolerant of coastal conditions and attractive to birds but should not include imported and invasive species.*

5.1.2 Soil erosion

Vegetation clearance, road construction and excavation works related to construction of the houses and buildings will expose soils in the affected areas leaving them vulnerable to erosion by surface run-off and ultimately threatening adjacent coastal waters with high turbidity and sediment deposition, a negative consequence. The topography of the site and the pervious nature of the substrate would tend to reduce erosive surface flows and the threat of turbidity should exist only for the duration of construction works before landscaping and drainage works are put in place that would reduce the susceptibility to soil erosion. Gullies and streams near to the site could be affected by soil erosion and turbidity. Ultimately, it is the corals and inshore marine habitat that would be adversely affected by prolonged levels of high turbidity.

Mitigation:

- *To the greatest extent possible, phase site clearance so as to inimize the area of exposed soil at any given time.*
- *Re-cover exposed soils with grass and other appropriate species as soon as possible.*
- *Temporarily bund exposed soil and redirect flows from heavy runoff areas that threaten to erode or result in substantial surface runoff to adjacent marine waters*
- *Monitor areas of exposed soil during periods of heavy rainfall throughout the construction phase of the project*

5.1.3 Nuisance dusting

It can be anticipated that a certain amount of air borne particulate matter (dust) will be generated by earth moving activities during road construction and during off loading of marl. This situation will be worst during the dry season and during the afternoons when the winds are most prevalent. Air borne particulates may pose a hazard to residents in the vicinity or downwind of the construction site that suffer from upper respiratory tract problems. Otherwise it may only be a nuisance. The impact of dusting is short-term, lasting for the duration of the construction activity, but it may be severe if it causes significant health problems, a matter of particular concern given the nature of the hospitality industry.

Mitigation:

- *Access roads and exposed ground should be regularly wetted in a manner that effectively keeps down the dust.*

- *Stockpiles of fine materials (e.g. marl) should be wetted or covered with tarp during windy conditions.*
- *Workers on the site should be issued with dust masks during dry and windy conditions.*

5.1.4 Noise

The use of heavy equipment during site clearance and road construction works will inevitably generate noise, which may create a nuisance for nearby residents. Albeit annoying, this negative impact will be short-term (limited to the duration of the road construction works) and is not considered to be a significant threat to the health or well being of humans. Distance and the wooded nature of the site should help to ameliorate noises.

Mitigation:

- *Construction activities that will generate disturbing sounds should be restricted to normal working hours.*
- *Local residents should be given notice of intended noisy activities so as to reduce degree of annoyances.*
- *Workers operating equipment that generates noise should be equipped with noise protection gear. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs.*

5.2 CONSTRUCTION IMPACTS

5.2.1 Loss of land use options

The construction of houses and apartments will involve the erection of permanent block and concrete structures on what is a green field site. This will result in a loss of the options for alternative land use and thus represents an irreversible commitment of land resources. The loss of optional uses for the land in the future is considered to be a negative impact.

Mitigation:

N/A

5.2.2 Earth material sourcing

Earth materials needed for construction (e.g. marl, sand) are normally obtained from quarry and mining operations. Conscious or unwitting purchase of these materials from unlicensed operations indirectly supports, encourages and promotes environmental degradation at the illegal quarry sites and causes medium to long-term negative impacts at source.

Mitigation:

- *Earth materials must be obtained from officially licensed and approved quarries and copies of the relevant licenses made available for inspection at the site by the Contractor.*

5.2.3 Materials transportation

The various materials required for construction and building (e.g. steel, blocks, lumber, marl, asphalt, etc.) will be obtained from sources elsewhere and transported to the site. Transportation of these materials, typically in over-laden and sometimes uncovered trucks, usually results in undue road wear-and-tear. Special note is made here of the presently weak road surface in the Dragon Bay property which will require upgrading.

In the case of fine earth materials, dusting and spillages occur on the roadways between source and site. Dusting degrades local air quality and material spillages worsen driving conditions and increase the risk of road accidents. These occurrences represent indirect, short-term, reversible, negative impacts on public health and safety.

Of some concern are the narrow winding roads in the vicinity of Zion Hill. Heavily laden and slow moving construction vehicles, transiting to and from the project site, may cause traffic hold-ups resulting in commuter frustration and, possibly, traffic accidents.

Mitigation:

- *All fine earth materials must be enclosed during transportation to the site to prevent spillage and dusting. Trucks used for that purpose should be fitted with tailgates that close properly and with tarpaulins to cover the materials. The cleanup of spilled earth and construction material on the main roads should be the responsibility of the Contractor and should be done in a timely manner (say within 2 hours) so as not to inconvenience or endanger other road users. These requirements should be included as clauses within the contracts made with relevant sub-contractors.*
- *The transportation of lubricants and fuel to the construction site should only be done in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.*
- *As far as possible, transport of construction materials should be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.*
- *Appropriate traffic warning signs, informing road users of a construction site entrance ahead and instructing them to reduce speed, should be placed along the main road in the vicinity of the entrance to the Dragon Bay property.*
- *Flagmen should be employed to control traffic and assist construction vehicles as they attempt to enter and exit the project site.*

5.2.4 Materials storage

The improper siting of stockpiles and storage of sand, gravel, cement, etc., at the construction sites could lead to fine materials being washed away, during heavy rainfall events, into the drainage system and ultimately into the adjacent marine environment. This would not only represent a waste of materials but would also contribute to turbidity and sedimentation with consequent negative impacts on inshore marine water quality and possibly the ecology of the shallow marine environments.

Hazardous and flammable materials (e.g. paints, thinner, solvents, etc.) improperly stored and handled on the site are potential health hazards for construction workers and spilled chemicals would have the potential to contaminate soil and inhibit plant growth in localized areas. It is not anticipated that refueling or maintenance of large vehicles will

take place on the construction sites and therefore there will be no requirement to store fuel and lubricants on the sites.

Mitigation:

- *The stockpiling of construction materials should be properly managed and controlled. Fine-grained materials (sand, marl, etc.) should be stockpiled away from surface drainage channels and features.*
- *Materials should not be stockpiled on the roads where they are easily washed away.*
- *Low berms should be placed around the piles and/or tarpaulin used to cover open piles of stored materials to prevent them from being washed away during rainfall.*
- *Safe storage areas should be identified and retaining structures put in place prior to the arrival and placement of material.*
- *Hazardous chemicals (e.g. fuels) should be properly stored in appropriate containers and these should be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities.*

5.2.5 Modification of surface drainage

Assuming an average lot size of 2,875 m^2 (31,000 ft^2) and the average building footprint covering 255.5 m^2, the impervious surface created by the covered building area will be about 11% of the total development land area. Add to this the surface areas of asphalted roads and it becomes apparent that the site will generate considerable volumes of runoff during the periods of torrential rainfall typical of Portland.

The access road will carry most of the storm water runoff and therefore the controlled disposal of water from the roads will be essential to prevent localised ponding or erosion.

Mitigation:

- *The appropriate design of storm water drainage system*
- *Design of individual soakaway systems to dispose of run off from each lot*
- *Design and install sedimentation traps at exit points for road drainage*

5.2.6 Construction waste disposal

Solid waste generated during site preparation and construction work would include cut vegetation and typical construction waste (e.g. wasted concrete, steel, wooden scaffolding and forms, bags, waste earth materials, etc.). This waste would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Cleared vegetation burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. Vegetation and solid waste, if allowed to accumulate in drainage ways, could cause localised pooling and flooding. Pooling of water, in turn, would create conditions conducive to the breeding of nuisance and health-threatening pests such as mosquitoes. Poor construction waste management constitutes a short-term negative impact.

Mitigation:

- *A site waste management plan should be prepared by the contractor prior to commencement of building. This should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site*, and a system for supervision and monitoring. Preparation and implementation of the plan must be made the responsibility of the building contractor with the system being monitored independently.*
- *Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction. To reduce organic waste, softer vegetation may be composted onsite and used for soil amendment during landscaping.*
- *Vegetation and combustible waste must not be burned on the site.*
- *Reusable inorganic waste (e.g. excavated sand) should be stockpiled away from drainage features and used for in filling where necessary.*
- *Unusable construction waste, such as damaged pipes, formwork and other construction material, must be disposed of at an approved dumpsite.*

**At the present time, until the new solid waste landfill is constructed, the official dump for Portland is at Buff Bay.*

5.2.7 Sewage and litter management

Inadequate provision of toilets for use by workers can lead to ad hoc defecation in secluded areas on the site, thus creating of unsanitary conditions and sources of fly infestation. Improper disposal of food cartons and other domestic forms of construction camp garbage could lead to littering of the site and pollution of adjacent coastal waters.

Mitigation:

- *Proper solid waste receptacles and storage containers should be provided, particularly for the disposal of lunch and drink boxes so as to prevent littering of the site.*
- *Arrangements should be made for the regular collection of litter and for its disposal only at the Buff Bay dump site.*

5.2.8 Replanting and landscaping

Landscaping and replanting of trees will be needed to recreate some semblance of the original appearance and condition of the site. No details of landscaping plans or planting material are available at this stage but the plant species selected for replanting will in large part determine which types of birds, butterflies, and other fauna, if any, inhabit the site (gardens) after construction. In addition to enhancing the aesthetic appeal of the project site, landscaping provides the means for partially restoring the site's natural elements and ecological habitats. It is therefore a significant mitigation activity with a positive impact.

The landscaping plan should seek to avoid the use of non-native and potentially invasive species. It should include low-maintenance local species and the types of trees and shrubs used for feeding by local bird species. The landscape design should seek to encourage bird life, especially for the endemics, maximize shade and windbreak effect, as well as to hide the roofline of the houses.

Mitigation:

N/A

5.2.9 Employment/Income generation

It is not possible to realistically estimate the number of workers will be employed on the site at any one time during the construction phase. If one assumes six workers per villa then the construction phase of the development would provide approximately 180 jobs. These levels of short-term employment would have a positive impact on the local economy and on regional unemployment.

Mitigation:

N/A

5.3 SITE HABITATION IMPACTS

5.3.1 Employment/Income generation

Assuming two domestic helpers and a gardener for each villa then the proposed development would potentially offer employment to approximately 90 persons. This would represent a positive long-term impact.

Mitigation:

N/A

5.3.2 Water supply

As indicated earlier at Section 3.8.5 the production capacity of water supplied by the NWC is marginally greater than the demand. Based on the estimated additional demand by the proposed development the supply of water from the NWC will be inadequate. The increased demand for water is therefore expected to have a negative impact on the water supply network in the area.

Mitigation:

- *Provide adequate water storage facilities to ensure adequate supplies for the development.*

5.3.3 Depletion of water resources

If the building of villas results in a net increase in the number of foreign visitors to Jamaica it will also imply an increase in the demand on local water resources. Each villa should put the following water conservation devices or technologies in place.

Mitigation:

- *Install aerators/flow restrictors*
- *Install low flush toilets.*
- *Collect grey-water separately from sewage effluent and use for irrigation.*
- *Collect rainwater be from roofs and store for grounds irrigation.*

5.3.4 Sewage disposal

Sewage generated by each villa will be collected and treated on site. Improperly maintained systems could result in direct discharge of untreated effluent to the ground and through porous substrate to inshore marine waters.

Mitigation:

- *Adequate wastewater grease traps must be installed on the site.*
- *Grease traps must be properly maintained on a regular basis to prevent malfunction of the treatment system.*
- *Ensure proper maintenance of the tile fields and regular examination to ensure integrity of the system.*

5.3.5 Solid waste disposal

Poor garbage management at the site would lead to unsanitary conditions including vermin and fly infestation and odours as well as unsightly conditions. Although the means of solid waste collection and disposal have not been determined, it is expected that garbage management and good housekeeping will be practiced on the site and that problems arising from the improper storage of solid waste will therefore be avoided. It is also anticipated that a private waste contractor will be responsible for collection and disposal of waste from the site.

Mitigation:

- *Ensure regular collection of garbage by either public or private waste disposal service.*
- *Ensure waste is disposed of at Buff Bay dump until new facility for Port Antonio is constructed.*

5.3.6 Use of electricity

JPSCo Ltd. will supply power for the development site from the existing mains running along the Boston/Drapers main road. The incremental demand will be within the capacity of the system and this will be confirmed in writing by the utility. The expansion should therefore not cause any supply shortages to the rest of the system. However, this increased demand will commensurately increase the utility‘s use of fossil fuel to generate that electricity, and thus the project will indirectly incur negative impacts associated with greenhouse emissions.

Mitigation:

Mitigation measures relate to improving energy management and conservation practices.

- *Sub-meters and real-time energy monitoring equipment, timers, photoelectric cells, thermostats, etc. should be installed in the villas.*
- *Install translucent shades and fluorescent lighting.*
- *Pipe insulation, tank lagging (not asbestos!) and heat recovery systems should be installed wherever it is practical to do so.*

5.3.7 Sedimentation in coastal water

Solid material and sediments on the subdivision roads will tend to be washed into the sea out of overfilled sediment traps.

Mitigation:
- Regular cleaning and clearance of the sedimentation traps, especially prior to rainy season.

5.3.8 Worker housing demand

Tourism resort development in Jamaica, has not been matched by the corresponding development and construction of housing and the social infrastructure to meet the demand of resort facility workers, etc. Therefore, squatting and informal settlements despoil the resort towns and worsen social tensions. This is viewed as an indirect, cumulative, long-term, reversible negative impact. The present project may add to the unplanned settlement problem in the local region

Mitigation:
- *The developers should seek, in some appropriate manner, to alleviate the problems of housing shortage for the increased workforce induced by the subdivision development. Ideally this could be done in concert with the Dragon Bay hotel.*

Table 5.1 Environmental Impact Summary

ENVIRONMENTAL IMPACT	IMPACT TYPE								MITIGATION		
	Positive		Negative								
	Significant	Not significant	Significant	Not significant	Short Term	Long Term	Irreversible	Cumulative	No Mitigation Required	Mitigation Required	Reference to Mitigation Section
SITE CLEARANCE AND PREPARATION											
• Loss of natural habitat & biodiversity			×			×	×	×		×	5.1.1 & 5.2.8
• Soil erosion				×	×					×	5.1.2
• Nuisance dusting				×	×					×	5.1.3
• Noise				×	×					×	5.1.4
CONSTRUCTION IMPACTS											
• Loss of land use options			×			×	×	×	×		
• Earth material sourcing				×	×					×	5.2.2
• Materials transportation				×	×					×	5.2.3
• Material storage				×	×					×	5.2.4
• Modification of surface drainage				×		×	×			×	5.2.5
• Construction waste disposal				×	×					×	5.2.6
• Sewage and litter management				×	×					×	5.2.7
• Replanting and landscaping	×					×			×		
• Employment/income generation	×					×			×		
SITE HABITATION IMPACTS											
• Employment/income generation	×					×			×		
• Water supply				×		×			×		
• Depletion of water resources				×		×				×	5.3.3
• Sewage disposal				×		×				×	5.3.4
• Solid waste disposal				×		×				×	5.3.5
• Use of electricty				×		×				×	5.3.6
• Worker housing demand			×			×		×		×	5.3.7

6. OUTLINE ENVIRONMENTAL MONITORING PLAN

The plan proposed below is structured to accommodate the likely situation that after initial site preparation and installation of basic infrastructure for the subdivision the development of the individual lots and construction of the houses and apartments will not take place simultaneously. It is strongly recommended that the environmental management plans be reviewed and discussed at a meeting of the developer. project manager, contractor, and environmental monitor so that environmental performance standards are clearly understood.

6.1 DEVELOPMENT SITE PREPARATION

Prior to general site clearance and road construction activities, the developer should have prepared an environmental management plan to be provided to the contractor that would include the identification of the trees to be kept, proposed drainage works, dust control measures, activity schedule, etc. for review and approval by NEPA, the environmental monitor and the supervising engineer. The developer should present a tree survey on which the trees/vegetation earmarked for protection should be flagged and hoarded by the contractor.

6.2 INDIVIDUAL LOT DEVELOPMENT

The entity selected to carry out environmental monitoring of the construction works should then prepare a generic environmental monitoring programme based on the findings of the EIA and the requirements of the development permit. This programme would be adopted for the construction of all the villas in the subdivision.

The major elements of the environmental construction monitoring programme would include the following:

- Ensure that trees marked for protection are left untouched;
- Ensure that large areas of soil are not left exposed and uncovered for extended periods of time;
- Ensure site drainage and surface runoff controls, especially during and shortly after major rainfall events, to ensure there is no flooding, ponding and runoff of surface water to the beach;
- Ensure compliance of construction works with site management and landscape plans;
- Inspection of quarry licenses to ensure earth materials are being obtained only from licensed operators;
- Ensure earth materials are transported only in covered trucks;
- Ensure stockpiles of fine materials are placed away from drainage features;
- Ensure good solid waste management practice;
- Water quality monitoring; and
- Ensure replanting of vegetation and trees that will encourage endemic birds.

7. SUMMARY AND CONCLUSIONS

- The proposed 12 ha subdivision site is presently covered by disturbed wet limestone forest.
- Site development immediately entails selective vegetation clearance, road construction, and installation of services infrastructure, to be followed by incremental construction of villas, townhouses and apartments on 32 of the 38 lots over a period of years.
- The most significant impact will be the disturbance of a forested area harbouring eight endemic types of birds, which may cause their disappearance from the site.
- The EIA has not identified any significant negative impacts related to the subdivision of land and house construction that cannot be mitigated.
- Land subdivision will bring about a loss of natural habitat and of options for alternative land use, which are the trade offs for the opportunity of expanding housing and diversifying Jamaica's tourism product in an area suited for exclusive and low-impact tourism.
- The high rainfall in the project area and the creation of relatively large areas of paved surface will require that adequate storm water runoff control be established.
- The developers and users of the subdivision must be aware of the sensitivity of the inshore marine waters surrounding the site and ensure that activities on land cannot adversely affect these.
- The construction of homes must be undertaken with due regard for the relevant environmental issues and under the terms of appropriate and supervised environmental management plans for each lot.
- A significant positive impact related to implementation of the proposed subdivision is the creation of short- and long-term job opportunities and the generation of foreign exchange.
- A possibly significant negative impact related to the subdivision is the role it could play in inducing unplanned settlement. This is a matter to be addressed by the appropriate housing and development authorities.
- Letters verifying the satisfactory delivery of services are required from JPSCo and NWC.

The Dragon Bay subdivision, is an upscale residential project, which by its location and concept, will easily co-exist with the surrounding built environment. It is not a large project, but in terms of employment and income generation, it will have important and positive impacts on neighboring communities. These are made up mainly of lower income groups, which although free of squatter communities, present the pressing issues of social disintegration seen in other tourism centers. Several instances of community-based tourism exist and these are fully in keeping with the direction envisioned by tourism planners for Portland's emerging tourism product. Properly encouraged and managed, positive benefits will flow both ways.

8. REFERENCES

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9. PLATES

9.1 Collection of plates illustrating terrestrial ecology:

Plate 9.1.1. Numerous vines and lianas hanging from the trees.

Plate 9.1.2. Dense undercanopy in the interior of the forest.

Plate 9.1.3. Stony substrate found in the forest.

Plate 9.1.4. Note the closed canopy and tall trees.

Plate 9.1.5. Layer of moist leaf litter on the forest floor.

Plate 9.1.6. Note dense growth of shrub layer and tightly packed trees in background. In foreground is a Prickly Yellow tree.

Plate 9.1.7. Note densely packed trees in forest.

9.2 Collection of plates illustrating marine ecology:

Plate 9.2.1. Reef flats in the back reef area.

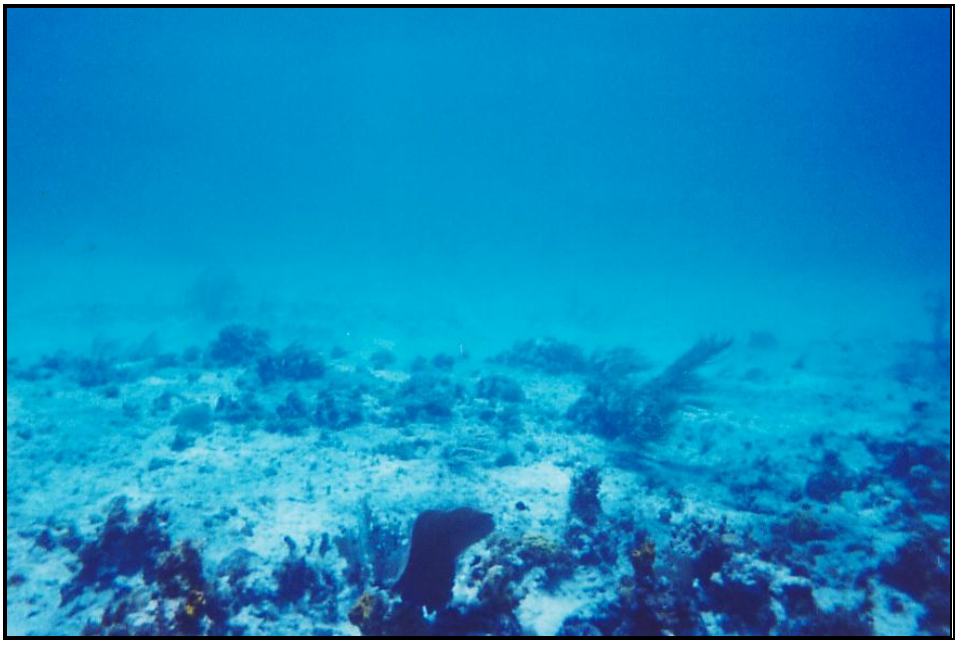

Plate 9.2.2. Patch reefs.

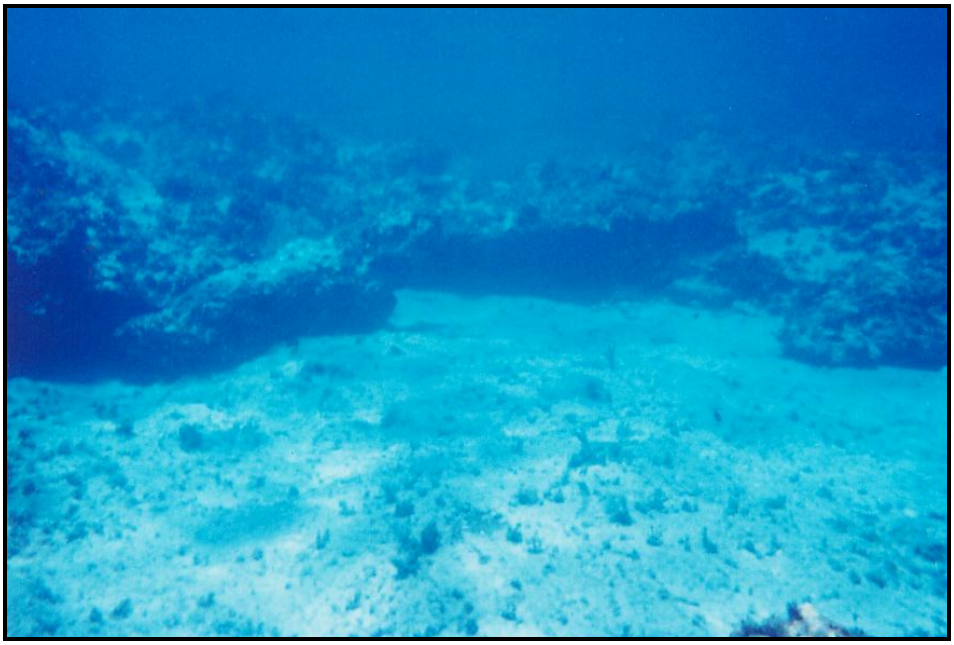

Plate 9.2.3. Large mound formed by coral colonies.

Plate 9.2.4. *Diadema sp.*, *Agaricia sp. Porites porites* (center) and *Sargassum sp*. (left).

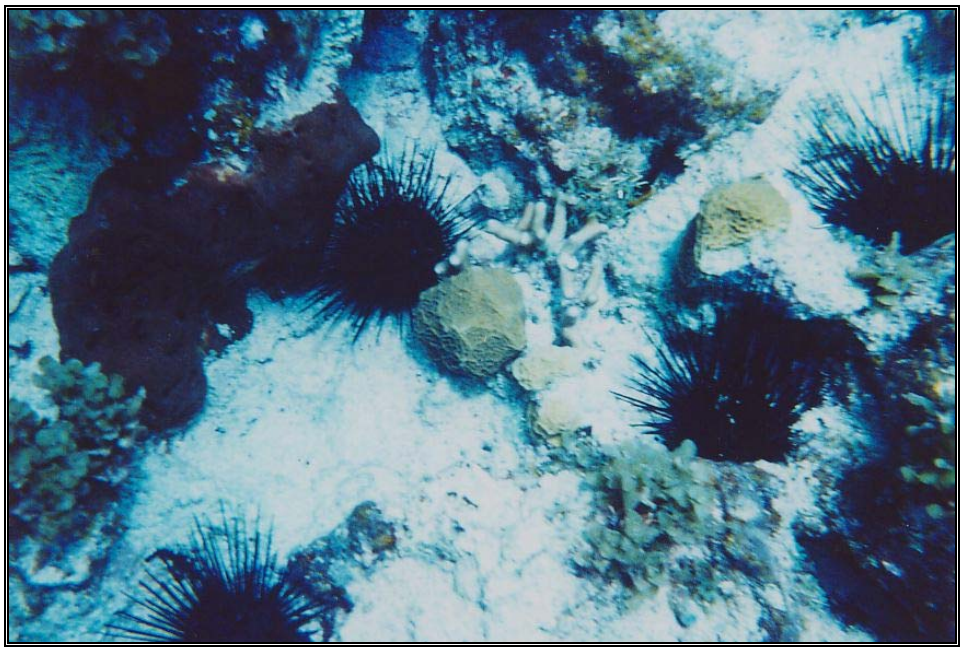

Plate 9.2.5. Rock beauty visible at center of image.
Also note urchins, sponges and gorgonians.

Plate 9.2.6. Sea fan, Brain coral and *Diadema sp*. are visible to the left of the image.

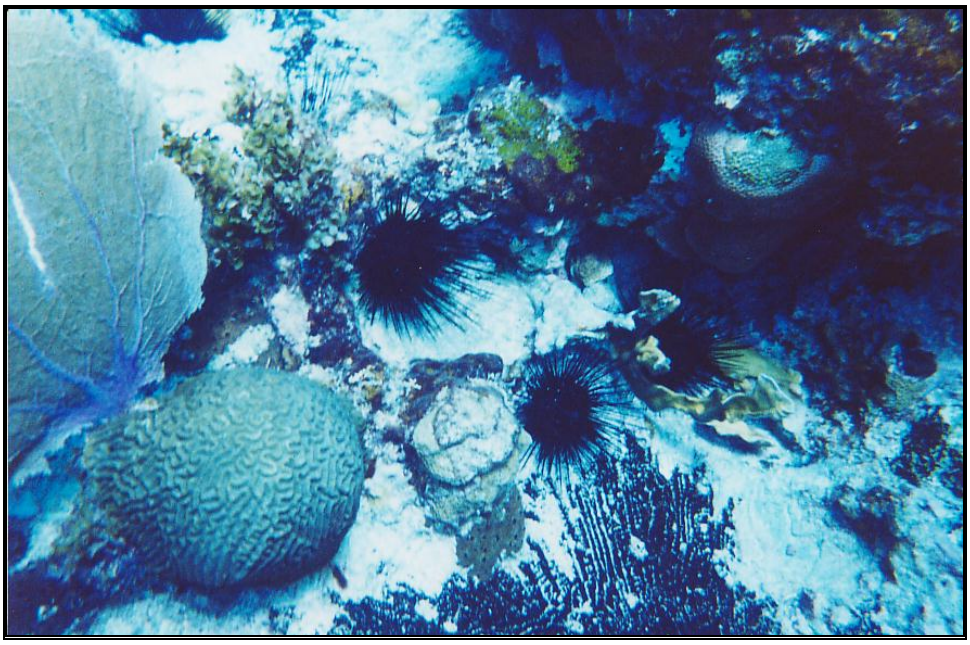

Plate 9.2.7. Note large bare areas, covered by a thin layer of sand or crustose coralline algae. Also note low macroalgal cover and presence of sponges and corals.

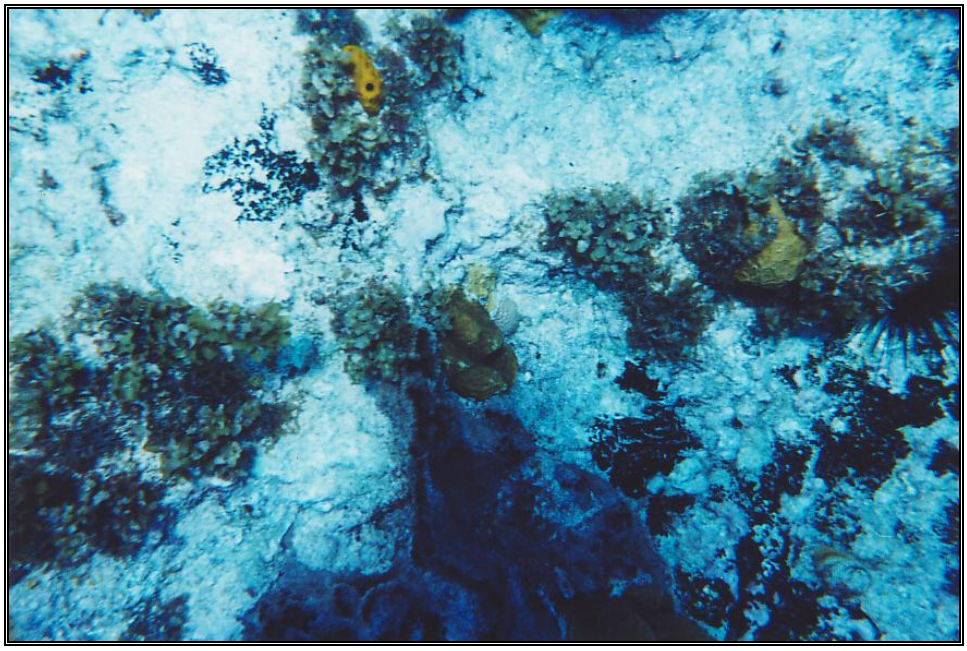

Plate 9.2.8. Photograph of transect line running next to a White encrusting zoanthid and Loggerhead sponge (center). Note low macroalgal cover and presence of urchins.

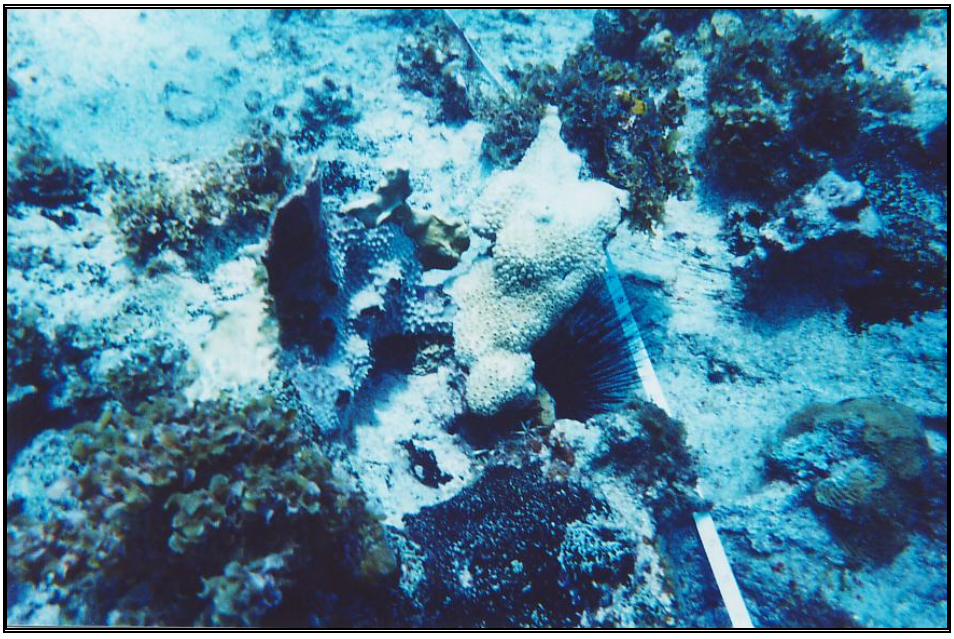

Plate 9.2.9. Large *Dendrogyra sp*. colony (center) on steep slope of the rocky shore.

Plate 9.2.10. School of Caribbean reef squid swimming over the reef.