ENVIRONMENTAL IMPACT ASSESSMENT OF PROPOSED RESIDENTIAL DEVELOPMENT, PART OF DUNDEE, TRELAWNY

FINAL DRAFT

Compiled for: BC Dundee Enterprises Limited

By:

November 2016

NEPA Reference No: 2014-07017-EP00232

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Environmental Impact Assessment (EIA) report by the Directors of BC Enterprises Limited seeks to fulfill the requirement communicated to them by the National Environment and Planning Agency (NEPA)/Natural Resource Conservation Authority (NRCA) in accordance with the relevant requirements under the Natural Resources Conservation Act and the Licences and Permits Regulations, 1991. The Company had applied to the Agency for an environmental permit to subdivide approximately 30.7 hectares (76 acres) of land at Dundee in Trelawny for a proposed housing development. The property is located in the Salt Marsh area of Trelawny, approximately 4.5 km (3 miles) west of Falmouth. The land occupies an area south of the Northern Coastal Highway (Falmouth to Montego Bay) that forms its northern boundary.

The EIA Report addresses the potential environmental impacts associated with the proposed development. NEPA is the lead Agency in the project's permit approval process. The EIA will provide information on potentially significant impacts of the Proposed Project on the environment; the manner in which those significant impacts can be avoided or significantly reduced; the significant and unavoidable adverse impacts that cannot be mitigated; and any reasonable and feasible alternatives to the Proposed Project that would eliminate any significant adverse environmental impacts or reduce the impacts' levels to insignificant.

The Proposed Project, the Hamptons at Dundee, would add approximately 266 housing solutions to the housing stock in the parish in the form of 3-bedroom bungalows, 3-bedroom two storey units on individual lots, as well as 2-bedroom apartments. In addition to the proposed residential units, the north-west corner of the development is slated for commercial development, as a feeder shopping centre not just for the development itself, but to contribute to the overall development of the community of Salt Marsh and its environs.

1.2 Physical Planning Criteria

The proposed site is located within the Falmouth Growth Centre Boundary and is an area zoned for single family residential use within the *Town and Country Planning (Trelawny Parish) Development Order 2013*. As indicated in the agreed Terms of Reference, the immediate sphere of influence of the project is a 1km radius of the site.

The development would proceed in four (4) phases. The first phase will involve the clearing and establishment of site physical infrastructure such as roads, storm water drainage structures, potable water mains and electrical conduits along with construction of 102 of the proposed 266 housing solutions. This phase will also include the establishment of the central amenity space that includes a club house, pool, gymnasium and walking trails.

1.3 Site Drainage Design

Storm water on the property presently channels into gullies that predominately discharge into the Flamingo Pond located to the east of the site and which overflows into the sea. The wetland area to the North also receives pre-development flows and this will continue with post development storm water flows. The proposed drains are designed for storm return periods as follows:

- Culverts : 25 years storm return period
- Pipe/Open drains: 25 years storm return period
- Ditches/Swale /Gullies– 10 years storm return period
- Curb and Channel – 2 years storm return period
- Detention Pond : 10 and 100 years storm return period
- Wetland flood control : 100 years storm return period

1.4 Proposed Waste Water Treatment

The progress of each phase of the waste water treatment plant will be influenced by the stages (phases) of the proposed housing development. The design parameters for the waste water treatment plant are:

- **Volume expected** = {(137*3*2*0.23)+ (72*3*2*0.23)+ (84*3*2*0.23)+ 20}+(10% increase)+(10% infiltration)=**467m3/d**
- The proposed treatment plant is designed to treat sewage from projected flows of **480m3/d**
- The Anaerobic Baffle Reactors (ABR) and reed beds will be designed as four (4) parallel models with one influent and one effluent. Each model will treat a total of **120m3**

1.5 Potable Water

The National Water Commission (NWC) is the state agency responsible for the supply of potable water. In its effort to enhance water security, the proposed development's Master Plan includes the installation of a 1,000,000 litre water tank at a high point to the south of the site that will allow water to be gravity fed to homes as the demand dictates. Rainwater harvesting is also under consideration.

1.6 Physical Environment

One of the most distinct features on the property is an ephemeral gully that runs eastward from the west south west direction forming a narrow limestone valley. Further south, beyond the limit of the property boundary, the site stretches to the top of a limestone ridge and eventually forms part of the northern facing slope of the limestone hill. A contour plan of a section of the proposed project site shows the low lying areas in the north (including the wetlands) and slopes to the south.

1.7 Wetlands

The flat, low lying wetland area is approximately 3.05m above mean sea level. Information from the 1961 aerial photographs at a scale of 1: 25,000 for the project site and surrounding areas shows the

original extent of the coastal wetlands prior to the encroachment of the Northern Coastal Highway and the urbanization of the area. The current wetland area formed a part of that larger ecosystem that has been modified by development. The wetlands now function as a point of collection for storm water.

1.8 Surface Drainage

The property features four (4) catchment areas. The most significant of these is a main ephemeral gully that crosses the southern upland limestone area and discharges into the Flamingo Pond. The limestone dry forest areas naturally direct storm water towards the gullies and into the low lying coastal mangrove areas to the north. Pre-development storm water towards the north (4.7 hectares /11.69 acres) discharges into the wetland area of the property. Some of this storm water flows to the detention pond in the east while the rest flows westerly via a NWA swale from the northern wetland area.

1.9 Percolation Test Results

The percolation rates in Test Pits 1 and 2 indicate that the absorptive property of the soil/rock is low while the percolation rate in Test Pit 3 is moderate. A higher percolation is expected in the southern section of the site leading to lower overland flow. The presence of a geological fault in close proximity to Test Pit 3 (test pit with the highest percolation rate) could be the reason for the higher percolation rate in the southern section of the site.

1.10 Geology

The site's underlying formation is the Montpelier White Limestone that is classified as Limestone Aquiclude. A fault on the property corresponds to the large dry gully which takes storm water into the Flamingo Pond to the northeast. This gully would remain in its natural state.

1.11 Project Site Baseline Air Quality

Sensitive air quality receptors in the vicinity of the proposed site are limited to local residential land use to the north and west. The EIA considers the existing effects of environmental noise on receptors adjacent to the proposed Project Site. The results of the noise sampling shows that baseline noise impact on the adjacent receptor community of Salt Marsh is insignificant but is expected to increase intermittently once development is implemented. However, it is not expected to exceed the permissible levels.

1.12 Climate Change

An estimated rise in sea level of 30-35 mm over the next 50 years raises concern for the low lying coastal areas of Jamaica According to the storm surge and sea-level rise models developed by Mona Geo-Informatics, areas with high population densities, industrial, commercial and tourism development are most at risk.. Based on the models, potentially, the greatest impact of sea level rise would be on the south coast of the island.

1.13 Erosion Potential

Once vegetation is removed for housing development, the potential for erosion will increase significantly. The wholescale clearing of land would not be allowed, but would be in stages based on the immediate demand for land as the development proceeds through its four (4) phases. The process will be managed against the proposed Erosion and Sedimentation Control Plan (Appendix 4.1).

1.14 Earthquake Hazard

The project site is located near to the St. James/Trelawny parish boundary in western Jamaica. St. James suffered the greatest impact from an earthquake in March 1957. Ground shaking similar to magnitude experienced then would result in loose rock being mobilized on the scarp slope. The International Building Code (IBC) adopted for Jamaica recommends that the Peak Spectral Site Response Acceleration for the project site and surrounding areas is 50% of gravity for 0.2s short period waves and 20% of gravity for 1.0s long period waves with a 2% probability (2,475-yr Return Period) of exceedance in a 50-yr period, which is a relatively low risk.

1.15 Flora

Vegetation on the higher slopes of the property and adjacent areas travelling in an east to west direction are classified as Disturbed Forest Patch, Extremely Disturbed Woodland Patch, Disturbed Woodland and Disturbed Dry Limestone Forest Patch. Plant species vary between domestic plants, such as, Guinep (*Melicoccus bijugatus)* and Ackee *(Blighia sapid)* and forest species, such as, Red Birch *(Bursera simarouba)* and bastard cedar *Guazuma ulmifolia*).

The wetland area is dominated[1] by White Mangrove growth, with occasional representations of Black Mangroves[2] *(Avicennia germinans)* observed along the periphery of the wetland area. Growths of *Typha domingensis*[3] vegetation were also frequently observed within the wetland area, but confined to the periphery of areas of standing water that were present within the interior of the wetland at the time of the assessment. The central to eastern section of the wetlands has the least dense wetland vegetation growth and a greater representation of exposed standing water.

1.16 Site Fauna

During the assessment, a total of 34 bird species were observed. Among them, there were 10 Endemics, 5 Residents and 2 Summer Residents. The endemic species include Jamaican Tody (*Todus todus*) and the Jamaican Woodpecker (*Melanerpes radiolatus*) while resident species included Caribbean Dove (*Leptoptila jamaicensis*) and Yellow-faced Grassquit (*Tiaris olivacea*). An example of an observed migratory species (winter resident) was the American Redstart (*Setophaga ruticilla*). The proposed open

[1] Dominant designation under the DAFOR abundance scale

[2] Occasional designation under the DAFOR abundance scale

[3] Frequent designation under the DAFOR abundance scale

space (bird sanctuary) zone would promote the environment for these bird species along with the natural vegetation of adjacent properties.

1.17 Heritage

There were no substantial historical artifacts observed on the site (JNHT, 2015).

1.18 Socio-economic Assessment

The socio-economic assessment seeks to understand the behaviors (past, present & future) of the individuals, communities, and agencies affected by the development. Falmouth is the administrative capital of the parish of Trelawny. Of the major population centres along the North Coast including Montego Bay, Ocho Rios, St. Ann's Bay and Falmouth, it was Montego Bay that experienced the highest population growth of approximately 14% over the census period 2001 to 2011.

A. Population Characteristics

According to the Statistical Institute of Jamaica (STATIN, 2012), the 2011 population of 2,697,983 for Jamaica reflects a positive population growth of 0.36% over 2001 when the population stood at 2,607,632. In 2011the population of Trelawny was 516,218 or 19.13 % of the island's population in 2011 and grew at a rate of .30% over the period. Between 2001 and 2011 Falmouth's population grew by 5.3% from 8,188 to 8,686.

B. Community and Institutional Structure

The parish of Trelawny is divided into two constituencies- Trewlawny Northern and Trewlawny Southern. Dundee/Salt Marsh is located in the Falmouth Division of the Trelawny North Constituency

C. Land use and Planning

Land use planning in Trelawny is covered under the *Town and Country Planning (Trelawny Parish) Provisional Development Order 2013*. The area of the Proposed Action falls within the Greater Falmouth Area while the *Dundee property is zoned for single family residential development*. The only area zoned for conservation, south of the highway is the Flamingo Pond to the east of the property.

D. Housing

It appears that the slower rate of growth of new dwelling units in the parish capital when compared to the entire parish is the result of residential development occurring at other locations in the parish such as Florence Hall and Coral Spring. The National Housing Trust (*2009)* identified a potential housing market of 2,344 persons in Trelawny with an average monthly income of $27,921.88. Salt Marsh was named among the top ten locations for likely future residential development.

E. Social Services and Amenities Infrastructure

Fire Protection

The Project Site is located within Area III of the four (4) administrative zones of the Jamaica Fire Brigade (JFB). The Falmouth Police Station serves the Project Area with its Local Policing, Operations and Community Safety activities.

Schools

The Salt Marsh Primary School with a capacity of 200 (based on the Ministry of Education 2012 data) is the only public school that falls within the Project Area. There are two public high schools within a 5 kilometre radius of the site. The schools are Holland High School (1,200 capacity) and William Knibb High (1,000 capacity).

Health Services

The Trelawny Health Services include the Falmouth, Duncans and Clarks Town Districts. The development area is served by the Type C Falmouth Hospital, that provides primary care services and basic secondary care services. The Type IV Health Centre is also located at the hospital. This Health Centre administers the health programme of the parish. Preventative Services include water and sanitation monitoring, family health care, dental health care and mental health care.

Water Service and Waste Water

The Project Area generally falls under the jurisdiction of the Trelawny Parish Council that manages Rural Water Supply. However, the area is served by the National Water Commission. Based on the results of the community survey, the population of Salt Marsh appears to access water that is primarily piped into their dwellings.

Wastewater disposal options in the parish include pit latrines (38%).

Income and Employment

Within the SEIA area land use is mixed, featuring residential developments alongside small commercial businesses. Except for an asphalt and aggregate company, there is limited industrial development in the area. Anecdotally, it is the opinion of one resident that Salt Marsh was the first area on the North Coast that produced carvings and offered fried fish for sale along the roadside.

Data from the community survey within the receptor communities pointed to an employment rate of 90% which is above the national average. The professions of community members include shopkeepers, teachers, engineers, barbers, masons, taxi drivers and grounds men. It is anticipated that the immediate communities will be a significant source of construction workers for the proposed development. Materials and equipment will be sourced from the adjacent areas where they are available and operate legitimately under the requisite licenses and permits.

1.19 Traffic

The traffic count data underscore the steady volume of traffic along the Trelawny stretch of the Northern Coastal Highway. Twelve-hour traffic survey data for January 15, 2015 show a total of 7,225 vehicles

travelling east-west/west-east between Falmouth and Salt Marsh. It is estimated that the proposed development would generate additional traffic of its own of approximately 2, 437 trips daily. The appropriate traffic management measures recommended by the National Works Agency (NWA) would be implemented to reduce any vehicular/pedestrian conflict in the vicinity of the proposed development.

1.20 Public Participation

Based on the 2011 national census, the 1km radius of the Project Area lies within sections of five (5) Enumeration Districts (EDs) where the population was 3,014 persons. The quantitative survey estimated that of approximately one third of the population from these EDs fall within the Project Area. The non-probability, convenience sampling method captured data from two sources - the receptor communities of Dundee/Salt Marsh and the adjacent communities of Comfort Hall, Scarlett Hall and Greenside (N=32, N=40 respectively).

Most respondents in Salt Marsh/Dundee and the adjacent communities (72% and 73% respectively) indicated an awareness of the proposed development and pointed out employment opportunities as the main outcome of the proposal. However, in Salt Marsh/Dundee there was some concerns that there might be an increase in traffic (13%). Others saw the potential for an increase in business opportunities (6%) and community improvement (6%), but there was minimal concern for an increase in crime (3%). The general sentiment was that the appropriate use for the property is housing. In addition to the findings of the survey, the development would serve to improve the economic well being of the parish by improving its property tax base.

1.21 Potential Impact of the Proposed Development

The proposed Hamptons at Dundee would positively impact the Salt Marsh community through the potential for improvement in the social and economic character of the area given the middle to upper income target market for the proposed housing solutions. The development would further add value to the communities through the fostering of economic activities resulting in economic growth. The nearby Greenside to the east is an example of a similar upscale community in the area.

1.22 Energy Use and Conservation

Energy efficiency and a green building program would deliver economic benefits through building practices that reduce operating costs and increase property values. These would serve to reduce the carbon footprint of the community, specifically, through methods of energy conservation, passive design and a reduction in the consumption of non renewable energy lighting systems.

1.23 Residual Impacts

a. Vegetation and Fauna

There will be permanent decline in the biodiversity of the Project Site with the proposed development and its requirement for the extensive removal of flora which would be replaced by dwellings.

b. Socio-Economic

Permanent changes would occur to the form/land use of the community. Positive changes would occur to the socio-economic character of the community that would include higher income levels and increased opportunities for employment.

c. Carrying Capacity

There is some potential for a negative impact on social services, such as, health and education; however, there will be lasting improvement in community infrastructure such as roads and drainage structures. The increased tax base would also help to improve and maintain these social services and infrastructure.

1.24 Development Alternatives in the Wetland Development Area

The wetlands work in sync with the Flaming Pond to the east as conduits and repositories for storm water. Two development avenues have been considered to offer various levels of mitigation against wetland impacts at the northern site. With Alternative A, the wetlands would be utilized for housing with some compensatory replanting at a nearby site, while in Alternative B, development would occur on the dryer western site and replanting and drainage compensation interventions would be conducted on the eastern side to help to maintain and enhance the viability of the remaining wetlands, as well as, to convey surplus storm water off the site. The presented option of choice is Alternative B.

Mitigation measures for project impacts of significance for specific indicators are outlined below.

Table 1.1: Geology and Soils: Specific Impacts

INDICATOR	MITIGATION
Construction/Implementation	
Geology Excavations	Rocks will be removed during excavation works and utilized as fill and construction material where appropriate – removal of geological resource. In the northern area excavation and removal of the upper 2 metres of topsoil and replace with a layer of river shingle and compacted granular fill and use a stiff raft foundation. This may require the drawdown of the water table by well pointing prior to excavation , or: Preload the site with approved backfill and consolidate the peaty clays over tine or with vertical drains (wick drains) over a significantly shorter time and use raft or ties pad footings. The spacing and size of wick drains would be designed along with the height of fill required to accomplish the consolidation in the timeframe required for construction.

Table 1.2: Hydrology/Water: Specific Impacts

INDICATOR	MITIGATION
Construction/Implementation	
Hydrology Surface water hydrology and channel morphology	Peak flows and total volume runoff estimated from the runoff models used in the design of the internal drainage system and other drains, for example, those that discharge into the Eastern Gully. • Discharge of gully areas 1 and 2 into the Detention Pond /Flaming Pond • Collection and channeling of storm water via curb and channel into swales, through culverts, pipe drains and U drains. • The flow of storm water in the north toward the Flamingo Pond in the east and the culverts that cross the Northern Coastal Highway. • Construction of a detention pond • Design of storm water management infrastructure for up to 100 year flood events
INDICATOR	**MITIGATION**
Operation/Maintenance	

Hydrology Surface water hydrology and channel morphology *Flooding*	The main gully is sufficiently large to accommodate significant volume of storm water from a 100 year event. However, it is critical the arrangements be made between Dundee and the Trelawny Parish Council with respect to the culvert along the Northern Coastal Highway so that flooding can be significantly reduced or eliminated.

NATURAL HAZARDS

Table 1.3 Hazards: Specific Impacts

INDICATOR	**MITIGATION**
Construction/Implementation	
Natural Hazards	Development should be concentrated in the upland limestone area to the north of the main gully with minimum disturbance of land within the periphery of the gully
Rock fall	In areas consisting of loose rocks where development may be contemplated and which fall outside the moderate to high rock fall potential zone, these should be removed by mechanical means and taken to safe areas offsite if there is an excess after this may be used as fill and during the construction process.
Erosion	Erosion control should be given priority, as controlling sediment load is more difficult and costly. Vegetation cover should only be removed where it is absolutely necessary and should be targeted at the construction sites only. It is assumed that the housing development will proceed on a 'design and build' basis which implies that the developer will build the houses over a short period. It also implied that the property will be stripped of vegetation to accommodate housing construction. It is recommended that construction should be done on a phased basis so that vegetation is maintained as long as possible in areas where construction is not required during site development. Sediment holding ponds may need to be constructed to assist in trapping sediments during construction as a method of sediment control During construction phase, loose material should be kept within the curtilage of the site and not allowed to be transported off the site. The use of silt fences, maintaining vegetation cover and riparian vegetation are strongly encouraged. The management of peak flows into the wetlands to be adopted as a feature of the storm water drainage design. . Vegetation on the scarp slope near the major gully should not be disturbed but remain in its natural state. In the design of storm water drainage, erosion and sediment control structures should be considered as integral to the drainage network.
Flooding	The culverts which drain storm water across the highway should be regularly maintained to prevent blockage and mitigate against flooding.
Earthquake	Loose rocks will be dislodged from the scarp slope during ground shaking from a moderate to large earthquake. To minimize the impact of rock-falls, development along the fault scarp should be strongly discouraged. The impact of dislodged boulders would be minimal if there is no residential development on the scarp slope. Typical reinforced block and steel structures tend to perform well during seismic events. The design of housing structures should be done by a qualified and experienced structural engineer and in accordance with the Adopted IBC code for Jamaica. The use of approved fill in the reclamation of the impacted area of the wetlands is essential. It should be rolled and compacted in accordance with the ASTM standard and that the fill must be further tested to determine its bearing capacity if structural loads are to be imposed on the fill.
Hurricane	Assuming non-slab roof construction for the structures, wooden roofing to the wall structure must be adequately secured. Design specification for the roof to withstand hurricane force winds should be based on the 1:50 year return period and in accordance with the current building code

	The Jamaica Application Document for the International Building Code (IBC) has a wind speed map for the Island which is recommended to be used to aid in roof designs to withstand hurricane gale force winds. *Salt Marsh Community Disaster Risk Management Plan* is a document which should be consulted for information pertaining to the location of shelters, emergency response systems in the community as well as an understanding of the community's vulnerability with respect to hurricanes and other natural hazards.
Manmade Hazards Blasting	Due to the physical nature of the limestone blasting will only be required if large deposits of the harder chert deposits are found in the path of construction activities. The appropriate management of blasting would be observed at blast sites to ensure rules of safety are observed. These would include precautionary measures, such as, appropriate safety and protective gears, warning signs and signals

2.0 INTRODUCTION

This EIA addresses the potential environmental impacts associated with the proposed development. This Report, therefore serves to inform the NEPA and NRCA decision-makers, regulatory authorities and the public-at-large of the nature and environmental effects of the Proposed Project. The EIA has been prepared in accordance with, and in fulfillment of, Section 10 of the Natural Resources Conservation Act and the Licences and Permits Regulations, 1991. NEPA is the lead Agency in the project's permitting, licencing and approval process.

2.1 ENVIRONMENTAL PROCEDURES AND SCOPE OF ENVIRONMENTAL REVIEW

An application for an environmental permit was made to the National Environment and Planning Agency (NEPA) on January 28, 2014, by the Project Proponents. They were advised in a letter dated May 27, 2014, that, after the Agency's environmental screening process it was decided that given the nature and scope of the proposed development, the existing vegetation cover, the expected loss of biodiversity and the potential negative environmental impacts an EIA was being requested pursuant to Section 10 of the Natural Resources Conservation Act, 1991. The Agency in following its framework for environmental permitting, through its environmental scoping, established guidelines for preparing the Terms of Reference (TOR). These guidelines were augmented by discussions with project stakeholders, the specialist Environmental Impact Assessment professionals, and the relevant approval granting agencies. The Terms of Reference (TOR) are attached in Appendix 14.3. It was recommended that the general outline of the EIA should include the following:

Executive Summary
Introduction
Legislation and Regulatory Consideration
Project Description
Description of the Environment
Public Participation
Impact Identification
Residual Impacts
Energy and Conservation
Residual Impact
Analysis of Alternatives
Environmental Monitoring and Management
List of References
Appendices
Activities

This EIA provides information on potentially significant impacts of the Proposed Project on the environment; the manner in which those significant impacts can be avoided or significantly reduced; the

significant and unavoidable adverse impacts that cannot be mitigated; and any reasonable and feasible alternatives to the Proposed Project that would eliminate any significant adverse environmental impacts or reduce the impacts' levels to insignificant. Once approved, the EIA will serve as the base environmental document by NEPA and will be used as a basis for decisions on implementation of the Proposed Project. Other agencies may also use this EIA in their review and approval processes.

In its December 2015 response to the September 2015 EIA, NEPA advised that there were shortcomings in the document that needed to be addressed. In addition, the project design detailed in the document was also impacted by the fact that an application for a permit for the modification of the wetlands on the property was refused by the NRCA Board in February 2015. Subsequently, in a hearing of an appeal of the NRCA Board's decision, the Minister requested that a comprise position be agreed on with the Developer. Documents supporting a proposed Alternative B were submitted to NEPA on March 8, 2016 and in a correspondence dated May 4, 2016 NEPA advised of its intention to support the proposal, pending the submission of a Technical Report which should include (a) A Hydrological Assessment (b) A Storm Water Management Plan (c) An Erosion and Sediment Control Plan. These items were delivered to the Agency on June 8 2016. In its response to these submissions on June 29 2016 the Agency indicated that it offers "no objection" in principle to the information and the recommendations contained therein but this was contingent on additional information related to the design of the proposed boardwalk, fencing for the proposed detention pond and Environmental Management Plans by each Contractor. This current document proceeds with the knowledge that the result of the appeal of the NRCA's ruling was favourable based on correspondence dated July 18, 2016.

2.2 REPORT FORMAT AND ORGANIZATION

The content and format of this EIA are designed to meet the requirements of NEPA. The report is organized into the following chapters:

Chapter 1, Executive Summary summarizes the project; it's Impacts and available Mitigation Measures.

Chapter 2, Introduction and describes the EIA process; the public review process; and, report format. Also, provides the antecedents to the project and the resulting request for an environmental impact assessment

Chapter 3, Legislation and Regulatory Consideration, considers all the relevant agencies, legislations and international agreements and conventions.

Chapter 4, Project Description, describes the Proposed Project, and its objectives

Chapter 5, Description of the Environment, describes the existing conditions and environmental setting before project implementation

Chapter 6, Public Participation, outlines the outcomes of efforts to engage the community before project implementation.

Chapters 7 and 8, Identify Potential impacts and mitigation measures respectively that would result from the Proposed Project;

Chapter 9, Energy and Conservation outlines measures to reduce the carbon footprint of the development

Chapter 10, Analysis of alternatives, assesses possible alternatives to the proposed project and, mitigation measures that would eliminate or reduce significant environmental impacts.

The EIA ends with an Environmental Management and Monitoring Plan (Chapter 12) and the List of References, the Appendices and Activities.

3.0 LEGISLATIVE AND REGULATORY CONSIDERATIONS

Chapter 3 covers the relevant regulatory authorities, legislations and regulations and some applicable international conventions and relevant guidelines and policies.

Table 3.1: Relevant Regulatory Authorities

Regulatory Authorities	Description
The National Environment and Planning Agency	Under the Natural Resources Authority Act and the Permits and Licenses Regulations of 1996, NEPA is responsible for environmental protection on the island. In discharging its responsibilities, NEPA is not only responsible for the environmental protection but also manages the nation's natural resources and enforces the environmental and development planning laws. Its functions include ensuring that developments are undertaken within its environmental guidelines by requiring Environmental Impact Assessments, reviewing proposed developments, and granting permits and licenses. Besides the NRCA Act, NEPA monitors and enforces laws and regulations such as The Beach Control Act, The Watershed Protection Act, and the Wildlife Protection Act.
The Town and Country Planning Authority	This development falls under the Town and Country Planning Act of 1958 (amended 1993 and 1999) , the Local Improvements Act of 1944 and the Building Act, 2011. These statutes control the development and subdivision of land. In such cases normal procedures for building and development applications would be pursued by being channeled through the Trelawny parish council and NEPA respectively.
The Ministry of Health	The Environmental Health Unit (EHU) of the Ministry of Health (MOH) is the agency responsible for the approval of the proposed sewage treatment and disposal system and setting the discharge limits and pollution control.
The National Works Agency	Under the Ministry of Transportation and Works, NWA is responsible for reviewing the proposed development plan and ensuring that the drainage and road design meet the required standard. In essence, this means that the NWA will have to ensure that the surface drainage/storm war runoff generated from the site is effectively intercepted and disposed of and that the road design for proposed subdivision is safe.
National Water Commission	The NWC is responsible for potable water supply and sewerage services and will review the sewage disposal and water supply plans for the project and determine whether they should be approved.
Water Resources Authority	This government Agency is responsible for monitoring and ensuring the proper use of the surface and ground water resources of the island. The WRA is usually asked to review the development proposal.
Trelawny Parish Council	The Trelawny Parish Council is the local planning authority and has responsibility for the provision, management, and regulation of certain public services including public health services, fire protection, abattoirs, housing, street cleaning, parks and play fields and markets
Office of the Prime Minister (Local Government Division)	This ministry has responsibility for coordinating the functions of the local authorities such as the Parish Councils and the NSWMA.
National Land	This government agency has the responsibility of managing all information as it relates to land (services)

Agency	and would verify land ownership by the project proponent.
Urban Development Corporation	This government agency is responsible for urbanization in rural areas and would serve to ensure that the proposed development is sustainable.
Jamaica National Heritage Trust	This agency is responsible for the preservation of monuments, art, botanical, and animal life, and anything designated as protected national heritage for the benefit of the island.
Office of Disaster Preparedness and Emergency Management	This Government agency's overarching responsibility is disaster risk reduction through its hazard preparedness and mitigation measures.

Table 3.2: Relevant Regulatory Legislations

Relevant Legislations	Description
The Natural Resources Conservation Authority (NRCA) Act, 1991	The NRCA Act (1991) is the over-riding legislation governing environmental management in Jamaica. It requires that all new developments (or expansion of existing projects) which involve the sub-division of ten (10) or more lots be subject to EIA. The regulations require that fourteen (14) copies of the EIA Report be submitted to the Authority for review. Therefore, a preliminary review period of ten (10) days is required to determine whether additional information is needed. After the initial review, the process can take up to ninety (90) days for approval. If on review and evaluation of the EIA the required criteria are met, a permit is granted. In the event that the EIA is not approved, there is provision for an appeal to be made to the Minister. Specifically, the relevant section(s) under the Act that addresses the proposed project are: Section 10: Empowers the Authority to request EIAs for the construction of any enterprise of a prescribed category. Section 12: Addresses the potential for contamination of ground water by trade effluent and sewage. Section 15: Addresses the implementation of stop orders and fines associated with the pollution of water resources. Section 16: Authorizes the government to intervene in order to prevent the contamination of ground water. Section 17: Addresses the authority of the government to request in writing, any information pertaining to the: performance of the facility quantity and condition of the effluent discharged area affected by the discharge of effluent.
Natural Resources Conservation (Permits and License) Regulation, 1996	Water treatment facilities including sewage and industrial wastewater require permits. Regulation 8 sets out the application process for obtaining a license to discharge pollutants Regulation 9 empowers the NRCA to require owners for operators of existing facilities to upgrade their facilities to the "current standards applicable to new facilities" within a specified time.

Relevant Legislations	Description
he Watershed Protection Act, 1963	This Act governs the activities operating within the island's watersheds, as well as protects these areas. The watershed designated under this Act is the Deans Valley River Watershed Management Unit.
The Public Health Act, 1974	This Act falls under the ambit of the MOH. Provisions are also made under this Act for the activities of the Environmental Health Unit (EHU), a division of the MOH. The EHU has no direct legislative jurisdiction, but works through the Public Health Act to monitor and control pollution from point sources. The Central Health Committee would administer action against any breaches of this Act. In addition, there are various sections of this legislative instrument that govern and protect the health of the public. Relevant sections under the Public Health Act of 1985 are: Section 7 - (1) A local Board may from time to time, and shall if directed by the Minister to do so, make regulations relating to nuisances and, Section 14 - (1) The Minister may make regulations generally for carrying out the provisions and purposes of this Act, and in particular, subject to Section 7 but without prejudice to the generality of the foregoing, may make regulations in relation to air, soil, and water pollution.
The National Solid Waste Management Act, 2001	The Regulatory Agency, NSWMA will be responsible for the implementation of the National Solid Waste Management Act. In Part II Section 4-1 the Authority shall – (a) Take all such steps as are necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that waste is collected, stored transported, recycled, reused or disposed of, in an environmentally sound manner and promote safety standards in relation to such waste; In Section 23 – (i) Every person who: a. Operates or propose to operate a solid waste disposal facility: b. Provides or proposes to provide solid waste collection or transfer service; or c. Otherwise manages solid waste, "Shall apply in the prescribed form and manner to the authority for the appropriate licence." Part V Section 42 – (i) 7. The Authority may provide the occupier of any premises, on his request, with receptacles to be used for: a. Compostable waste which is to be recycled b. Non - compostable waste which is to be recycled; or c. Waste which is not to be recycled Subject to subsection (4), the Authority may, in relation to a request for receptacles: a. Where possible, provide them free of charge; or

Relevant Legislations	Description
	b. Provide them at such cost, and on such terms as to payment, as may be agreed with the occupier. Part VII Section 45 - Every person who - a. Disposes of solid waste in any area or in any manner not approved by the authority; b. Operate a solid waste disposal facility, provide solid waste collection or transfer service or otherwise manages solid waste, without a valid licence or operating certificate under this Act or any regulation hereunder; commits an offence and shall be liable on summary conviction before a Resident Magistrate to a fine not exceeding one million dollars or to imprisonment for a term not exceeding nine months or to both such fine and imprisonment. The NSWMA is the public authority responsible 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 recycling, and the establishment of a licensing system for operators of solid waste management facilities and collection systems. The permit issued to the applicant stipulated that the developer had the responsibility to dispose solid waste from the facility at an NSWMA approved disposal site.
The Wild Life Protection Act, 1945 and The Wildlife Protection (Amendment) Act Order 1998	The Wild Life Protection Act and Regulations are administered by NEPA. Under the Act specific personnel are designated who are given responsibility of and the required power to ensure compliance with the legislation. For example, the Game Warden/Constable/Fishery Inspector may enter and inspect land where it is suspected that an offence took place or is about to be committed. .
Jamaica National Heritage Trust Act, 1985	The Jamaica National Heritage Trust Act of 1985 established the Jamaica National Heritage Trust (JNHT). The trust's functions include the following responsibilities: • To promote the preservation monuments and anything designated as protected national heritage for the benefit of the land; • To carry out such development, as it considers necessary for the preservation of any national monuments or anything designated as protected national heritage; • To record any precious objects or works of art to be preserved and to identify and record any species of botanical or animal life to be protected. Section 17 further states that it is an offence for any individual to: • Willfully deface, damage or destroy any national monuments or protected national heritage or to deface, damage destroy, conceal or remove any mark affixed to a national monument or protected national heritage; • Alter any national monuments or mark without the written permission of the Trust; • Remove or cause to be removed any national monument or protected national heritage to a place outside Jamaica.
Town and	Section 5 of the Town and Country Planning Act authorizes the Town and Country Planning Authority to

Relevant Legislations	Description
Country Planning Act, 1958	prepare, after consultation with any local authority, the provisional development orders required for any land in the urban or rural areas, so as to control the development of land in the prescribed area. In this manner, the Authority will be able to coordinate the development of roads and public services, conserve, and develop the resources in the area. Any person may, under Section 6 of the Act, object to any development order on the grounds that it is: • impractical and unnecessary; • against the interests of the economic welfare of the locality. However, if the Minister is satisfied that the implementation of the provisional development order is likely to be in the public interest, he may, under Section 7 (2) of the Act, confirm it with or without modification by publishing a notice in the Gazette. Section 8 of the Act also gives the Minister the authority to amend a confirmed development order. Section 10 of the Act states that a development order must include: • clearly defined details of the area to be developed; • regulations regarding the development of the land in the area specified; • formal granting of permission for the development of land in the area. If the provisions of Section 9A of the Natural Resources Conservation Authority (NRCA) Act apply to the development, the application can only be approved by the Planning Authority after the NRCA has granted a permit for the development. (Section 11 (1A). The Authority may impose a "tree preservation order" under Section 25 of the Act if it considers it important to make provision for the preservation of trees and woodlands in the area of the development.
Town and Communities Act, 1843	The Town and Communities Act of 1843 govern the code of conduct in communities.
The Local Improvements Act	The subdivision of land throughout Jamaica is regulated under this Act. The Act stipulates that all subdivision of land for building or sale throughout Jamaica requires the permission of the local planning authority of the parish in which the land is located. The Act requires that the comments of the Chief Technical Director be obtained prior to the applicant being notified of the Parish Council's decision. By virtue of an amendment in 1959, the expert advice of the Government Town Planner is also required by the local authority prior to notification of applicants.
The Clean Air Act, 1964	The Central Health Committee regulates air emissions of any noxious or offensive gases and dust from a premise. This Act lists seven categories of dust and noxious gases, including air emissions from the following works: alumina, cement, lime, sulphur from petroleum processing, gypsum, and sugar factories. With the exception of cement that will be used in the construction phase of this development, the project does not include any of these activities in its construction or operational phase.
The Noise Abatement Act, 1997	The Noise Abatement Act, 1997 is the main legislation for the control of noise in Jamaica. Section 3 of this Act prohibits persons in private or public places from operating amplification devices in such a way that could cause a nuisance to persons in the vicinity.
The Water Resources Act,	The Water Resources Authority (WRA) administers the Water Resources Act 1995, which regulates the allocation and preservation of water resources in Jamaica.

Relevant Legislations	Description
1995	
Fire Brigades Act, 1988, Amended 1990, 1992	Section 5.- (1) The act states that it shall be the duty of the brigade to protect life and property in the case of fire or other disaster and, without prejudice to the generality of the foregoing.
The Country Fires Act, 1942	This act is administered by the Ministry of Agriculture. The Act makes is illegal to set fire to crops except to get rid of vines or pests, set a fire against the condition of an order or a permit and to negligently use or manage a fire.

Table 3.3: Relevant International Agreements, Conventions & Standards

International obligations	**Description**
Agenda 21	This is an international programme developed at the United Nations Conference on the Environment and Development, which provides proposals for the work on sustainable development on all areas of society. This programme, however, is not legally binding.
Convention on Biological Diversity	This convention is concerned with the protection and sustainable use of the world's biological diversity and equitable sharing of the benefits arising from the sustainable use of heritable resources.
Rio's Forest Principles	This document promotes sustainable forest management. The Intergovernmental Forum on Forests (IFF) implements the forest principles. Similar to Agenda 21, this document is not legally binding.
United Nations Convention to Combating Desertification (UNCCD)	United Nations Convention to Combat Desertification (UNCCD) was adopted in Paris on June 17, 1994 and was entered into force on December 26, 1996, ninety days after the fiftieth ratification was received. Presently, UNCCD membership stands at 194. The UNCCD is the only internationally recognized legally binding instrument that addresses the problem of land degradation in dry land rural area. UNCCD is a direct result of the United Nations Conference on Environment and Development (UNCED),which took place in Rio in 1992, sometimes known as the earth summit and it one of efforts at securing sustainable development.
Ramsar Convention	The Convention uses a broad definition of wetlands. It includes all lakes and rivers, underground aquifers, swamps and marshes, wet grasslands, peatlands, oases, estuaries, deltas and tidal flats, mangroves and other coastal areas, coral reefs, and all human-made sites such as fish ponds, rice paddies, reservoirs and salt pans. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under the "three pillars" of the Convention, the Contracting Parties commit to: 1. Work towards the wise use of all their wetlands; 2. Designate suitable wetlands for the List of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; 3. Cooperate internationally on transboundary wetlands, shared wetland systems and shared species.

Other relevant policies and guidelines include:

1. *The Town and Country Planning (Trelawny Parish) Provisional Development Order 2013* – zoning and guidelines for the physical development of the parish of Trelawny
2. *The Manual for Development* – produced by the former Town Planning Department / Town and Country Planning Authority offers guidance to Architects, Planners, Engineers, Land Surveyors, Developers, other Consultants and the public in general so that they can contribute to good environmental planning and project design.
3. Vision 2030 Jamaica National Development Plan by the Planning Institute of Jamaica

4.0 PROJECT DESCRIPTION

4.1 HISTORY AND BACKGROUND

This EIA report by the Directors of BC Enterprises Limited fulfils the requirement communicated to them by the National Environment and Planning Agency (NEPA)/Natural Resource Conservation Authority (NRCA). An application by the company's Directors, to the Agency for an environmental permit to subdivide approximately 30.7 hectares (76 acres) of land at Dundee in Trelawny for a proposed housing development is the antecedent of this document. An application was also submitted for the modification of the wetlands on the property. The Developers subsequently appealed the decision and are now awaiting the resolution of the appeal in order to proceed with a revised design that is presented in this report.

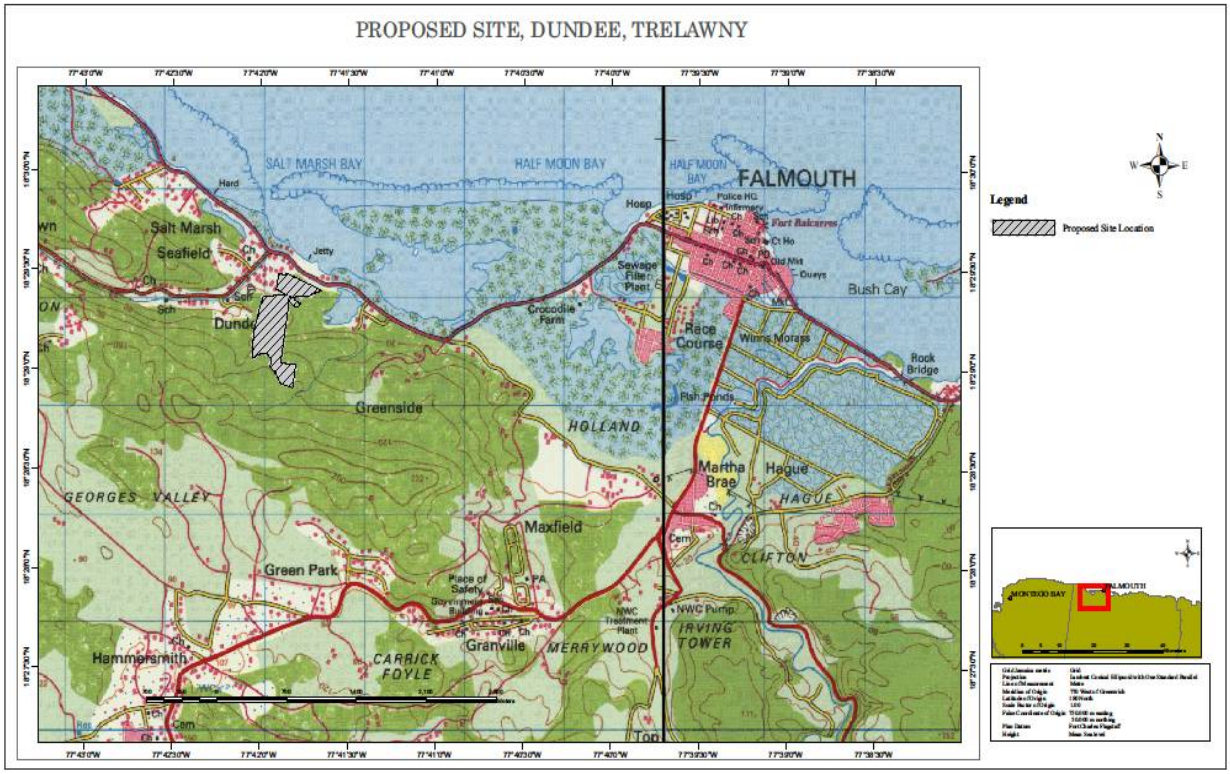

Figure 4. 1: Location map of the proposed Dundee site in Trelawny

The property is located in the Salt Marsh area of Trelawny approximately 4.5 km (3 miles) west of Falmouth. The land/property stretches southwards from the Falmouth to Montego Bay Highway, into the upland area (Figure 4.1 and Figure 4.2). The Falmouth to Montego Bay leg of the Northern Coastal Highway borders the northern boundary of the property. Access to the site can be gained from the Highway and a parochial road which traverse through the limestone uplands.

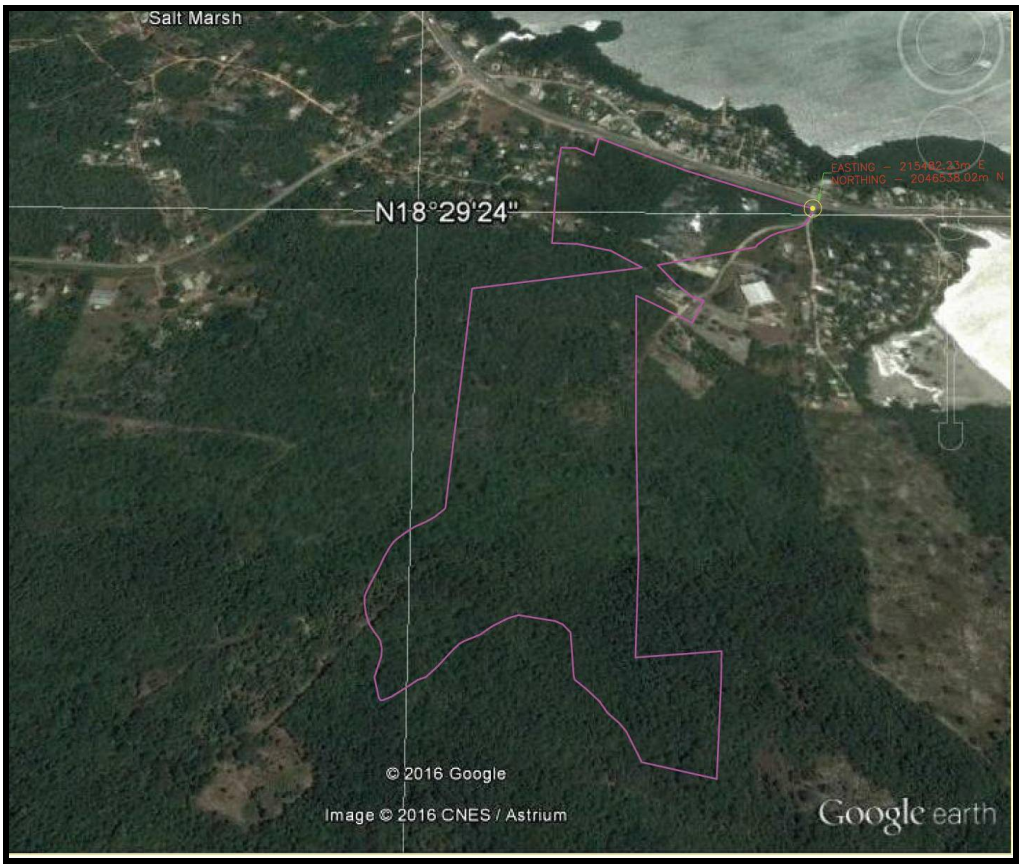

Figure 4. 2: Google earth image showing outline of the proposed development project, Dundee, Trelawny

4.2 PHYSICAL PLANNING CRITERIA

4.2.1 Land use and Planning

Land use planning in Trelawny is covered under the *Town and Country Planning (Trelawny Parish) Provisional Development Order 2013*. Land use planning in Trelawny is covered under the *Town and Country Planning (Trelawny Parish) Provisional Development Order 2013* (Figure 4.3). The area of the Proposed Action falls within the Greater Falmouth Area while the *Dundee property is zoned for single family residential development*. The only area south of the highway that is zoned for conservation, is the Flamingo Pond which is located in the eastern portion of the property (Figure 4.4). The development of this area requires both planning approval and building approvals under the Town and Country Act and Building Act respectively, from the Trelawny Parish Council. The zoning requirement for the area allows for thirty (30) habitable rooms per acre.

The land use is typical of most areas along the North Coast where ribbon development occurs along the coastal road network, where the social, economic and administrative activities of the population centres serve the hinterland communities to the south. Most of the developments at Dundee/Salt Marsh fringe the Northern Coastal Highway, while the areas to the south are the predominantly disturbed natural vegetation, such as, Limestone Forest.

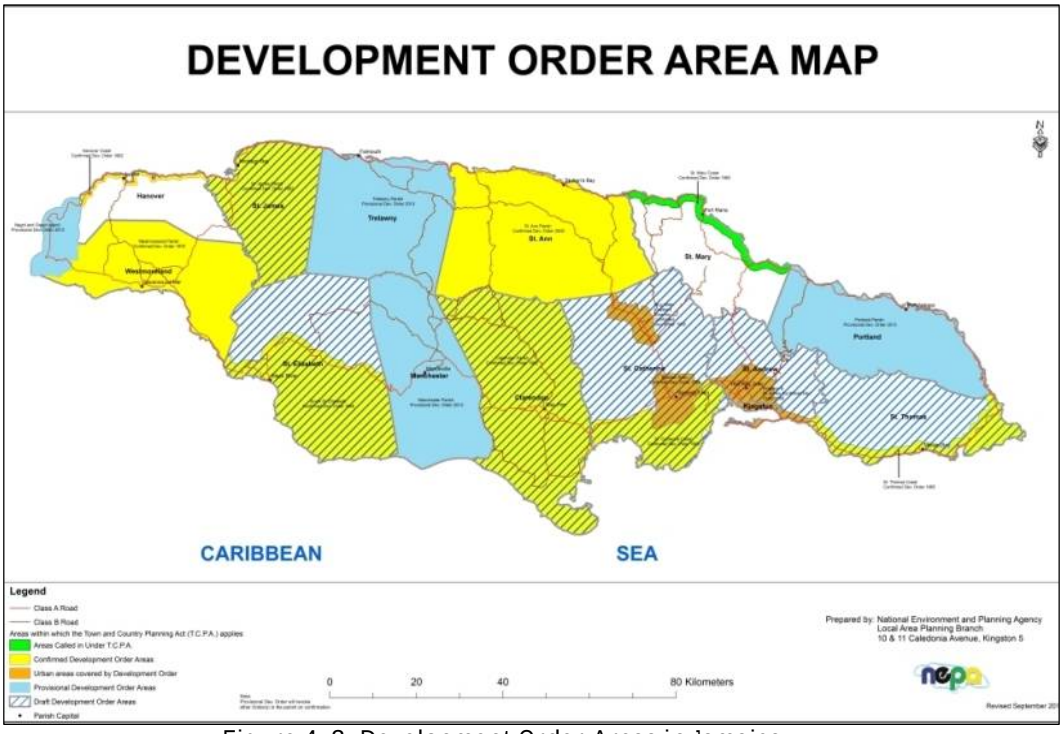

Figure 4. 3: Development Order Areas in Jamaica

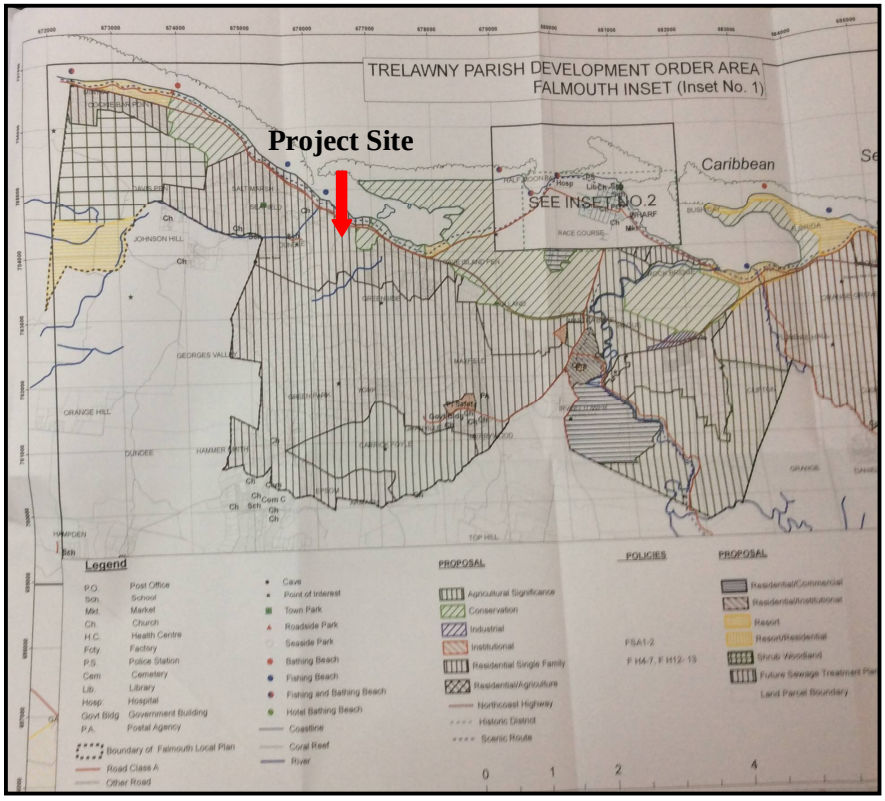

Figure 4. 4: The Proposed Site on a section of the Falmouth inset from the Town and Country Planning (Trelawny Parish) Provisional Development Order, 2013

The wet area to the north east was found to be unsustainable in its present condition since instead of being a thriving ecosystem along the coastline, it is stagnated due to unregulated development nearby and uncontrolled water runoff. The intention was to zone this area for residential use and manage the storm water flows through appropriate engineering methods.

The development would also seek to adopt sustainability principles such as those outlined in the Leadership for in Energy and Environmental Design (LEED) programme administered by the US Green Building Council (a private, non-profit organization). The LEED programme evaluates and certifies green buildings in the United States of America. In this context, LEED for Neighbourhood Development (LEED-ND) would be introduced. LEED-ND speaks to:

- Smart Locations and Linkage (SLL) - where to build
- Neighbourhood Pattern and Design (NPD) – what to build
- Green Infrastructure and Buildings (GIB) – how to manage environmental impacts

LEED-ND elements to be incorporated in the development include:

- Connected streets
- A discernible centre
- Playgrounds within easy reach of all dwellings
- A variety of dwelling types
- Narrow shaded streets conducive to pedestrians and cyclists
- Buildings close to the street at a pedestrian scale
- A community decision process for maintenance, security and community development

4.2.2 Proposed Land Use and Zoning

The Proposed Project, a housing development at Dundee, Salt Marsh would add approximately 268 housing solutions in the form of 3-bedroom bungalows, 3-bedroom two storey units on individual lots, as well as 2- bedroom apartments, as shown in Figure 4.5 and Table 4.1. In addition, there will be social amenities such as a waste water treatment plant, a centralized amenity (recreational) area (Club House) and other open spaces and a commercial area. Over 2.43 hectares (6 acres) is to remain in its near original state to create nature trails and provide a green area as an oasis/bird sanctuary within the scheme.

The proposal for the property at Dundee is shown below in Table 4.1: To the north, the New Proposed area for development of 8.41 Acres includes a commercial area, a new Sewage area and a road while the New Proposed Wet area will retain 4.34 Acres. The Proposed Sewage Lot stands at 5.83 Acres (not all need be used for sewage) while the commercial area is as previously at 1.55 Acres

Figure 4. 5: Site Plan/Landscape Plan for the proposed housing development at Dundee

Table 4. 1: Land use budget of the proposed housing development at Dundee, Trelawny

LAND USE	QUANTITY	Description
Residential		
3-bedroom bungalows	130	Lot size: 557 sq. metres. Unit Area: 155 sq. metres
3-bedroom 2-storey units (super lots)	52	Lot size: 471 sq. metres. Unit area: 162 sq. metres
2-bedroom apartments	84	Unit area: 104.7 sq. metres
Social Amenities		
Centralized amenity space	2.43 hectares (6 acres)	With club house, pool, gymnasium and walking trails
Additional amenity, open space and parks	0.405 hectares (1 acre)	Strategically placed for easy access
Sewage Treatment Plant	1.62 hectares (5.83 acres – including grey water soak away .66 hectares (1.64 acres)	Septic tank/chlorination chamber system
Commercial space	.628 hectares (1.55 acres)	To locate shops /offices/daycare etc.
Water tank	1,000,000 litres)	Reserve storage

4.3 EXISTING SITE CHARACTERISTICS AND PROPOSED IMPROVEMENTS

4.3.1 Existing Site Characteristics

The general site characteristic is uphill slopes, but the property is divided into two sections; the flat, low lying area of approximately 5..61 hectares (12.75 acres) .in size (averaging 3.05 metres (10 feet) above mean sea level (amsl)) consisting of mainly mangrove vegetation and the larger upland area of 25.09 hectares (63.25 acres) approximately consisting of dense disturbed vegetation (rising to approximately 85 metres /278.89 feet amsl). One of the most distinct features on the property is an ephemeral gully that runs eastward from the west south west direction forming a narrow limestone valley.

The wet area to the north east was considered unsustainable since instead of being a thriving ecosystem, as is typical along the northern coastline, it appeared stagnated due to nearby unregulated development and uncontrolled water runoff. The intention is to change this to residential homes and redirect the water flow to drain properly across the site into the culvert that crosses road. There are no current site improvements and the site is generally undeveloped except for the informal residences to the north west.

The lowland property covers an approximate area of 5.61 hectares (12.75 acres) and is flat with elevations varying from 0.3 metres (1.0 feet) to 2.36 metres (7.74 feet). This section of the property generally consists of 1.2 metres (4 feet) to 2 metres (6.7 feet) depth combined clay/peat layer overlaying stable marly limestone outcrop. Above the 1.0 metres (3.3 feet) elevation was found to be consistently dry. This dry lowland area covers approximately 1.72 hectares (4.25 acres). Below the 0.85 metres (3 feet) elevation was found to be consistently wet.

4.3.2 Construction and Phasing

The development would proceed in four (4) phases (Figure 4.6). The construction of the 268 apartments and houses will be distributed throughout the phases. The north and most of the central areas will be

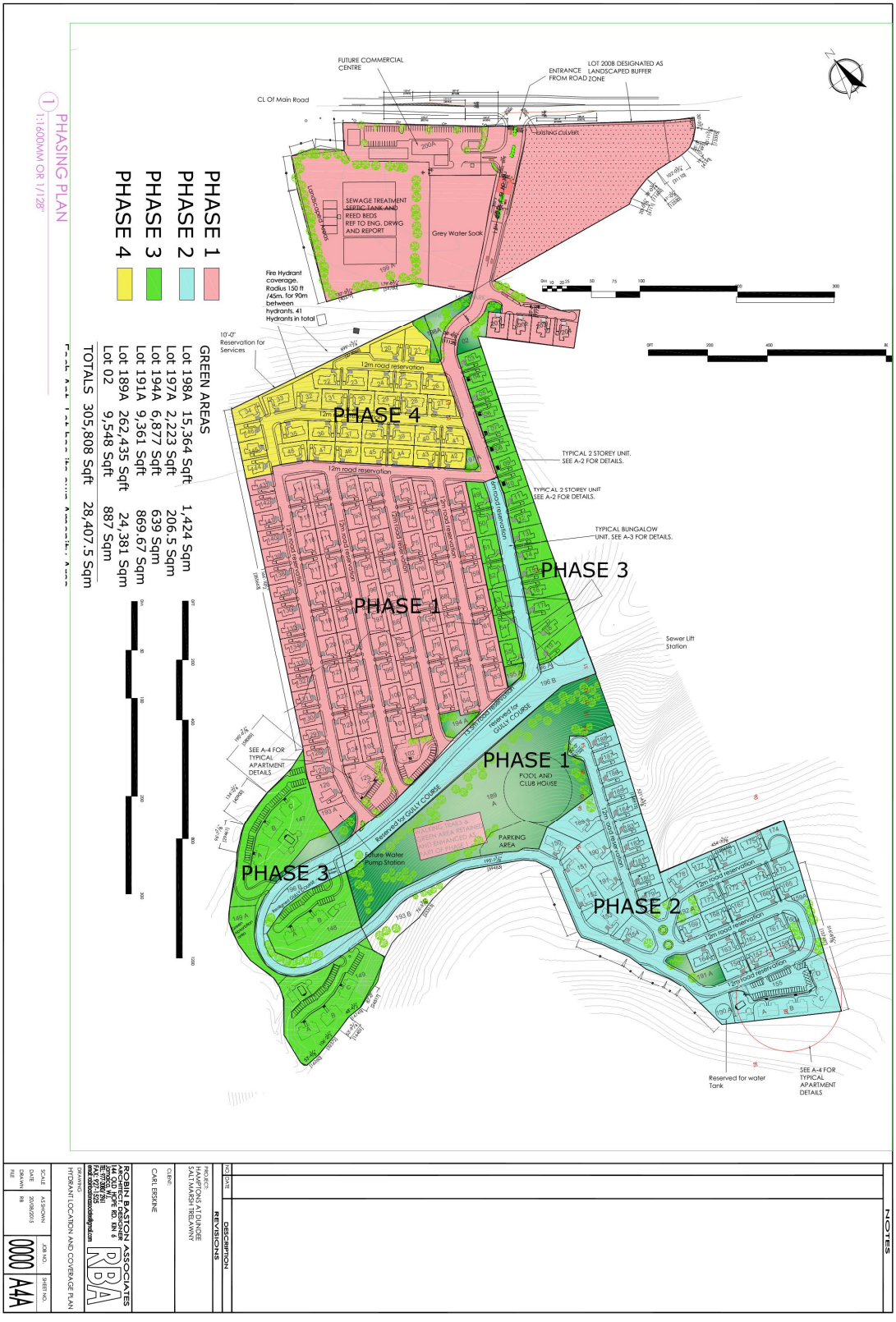

Figure 4. 6; The phasing and landscape proposal for Hampton at Dundee

developed in Phase 1. This phase will comprise a total of 102 dwellings- 90 single family residential units and 12 apartments. The commercial area, the main amenity area and the initial module of the waste water treatment plant are also included in this phase. In general, project implementation will commence with the clearing and the establishment of site physical infrastructure such as roads, storm water drainage structures, potable water mains and electrical conduits within the first phase. Phase 2 will involve the development of a total of 50 dwellings to the north- 38 single family residential units and 12 apartments. In Phase 3, development will proceed towards the south west and the east with 48 2-bedroom apartments and 24 – single family units. The project will end with Phase 4 and the construction of 32 single family units in the north western section of the property The total amenity required is 16,088 m^2 but 28,407.5 m^2 have been provided.

4.4 MODIFICATION OF LIMESTONE TERRAIN FOR HOUSING

One of the objectives of the Dundee Project Proponent is to maintain or recreate as much vegetation as possible. Therefore, in grading the site, consideration will be given to ensuring that the steepest sections of the site in the south are left undisturbed, in natural vegetation. The natural gradients will be maintained, as far as possible, during site excavation to facilitate the laying of foundations. Limestone covers approximately 80 percent of the Project Site, most of which would be used in the construction process. Where the bedrock is close to the surface, the limestone may be excavated using heavy duty equipment such as a hammer to remove the limestone rocks. The only areas that may require controlled blasting to attain the required depth for construction would be where chert outcrops occur in the limestone.

There are sections of the property where terracing will be required in order to stabilize the slopes. This can be done where the terrain has a gentle to moderate slope. The area will be excavated and terraces properly designed in order to facilitate access to residential units. Where slopes are above 18 – 25 degrees or 32- 48 %[4], for instance, the dry gully in the south, they will be left in their natural state.

4.4.1 Proposed Buildings / Facilities

Therefore, it is proposed that the housing lots be created on a series of terraces, with several small green spaces dotted around the site within easy walking distance to the various areas of the site. These green areas would be kept as natural as possible. The large, main green area, along with the walking trails, will afford not only a "breather" within the development, but also afford spectacular views while at the same time preserving avian fauna (bird sanctuary) on the property. A small area (approximately 1,500 Sq. metres) of this green space would be dedicated to a Club House consisting of a gym, swimming pool, and patio areas.

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4 http://www.mgd.gov.jm/services/products/guide-to-quarry-licence.html?view=category&id=5 Retrieved September 15, 2015

4.4.2 Proposed Roads and Parking

Access to the property would be by way of a dual carriageway - the main access/egress road with a round-a-about to be created for traffic control. It will also enhance the security of both vehicular traffic and pedestrians as it reduces vehicle speeds through an intersection, and as a result improve safety for all road users — pedestrians, cyclists and motorists. The overall design of the development is a rectilinear grid which is a more efficient subdivision design.

Road designs would follow the National Works Agency (NWA) guidelines for multi-family residential developments and will include a main estate road with a minimum width of 15 metres and minor estate roads with a minimum width of 14 metres. The stipulated parking assignment for single family units with two (2) or more bedrooms is two spaces per unit. Whereas, for the apartments there should be a minimum 1.25 spaces for each individual unit. Spaces for the less able are also required and would be provided. Parking for the commercial area would be at least 1 space for each 20 square metres of floor area.

4.4.3 Proposed Landscaping

The proposed development project would apply the usual irrigated and manicured lawns for the community open spaces, including the central recreation area at the clubhouse. Existing mature trees would be preserved as far as possible in areas to be maintained as green spaces. These trees would be marked for preservation before the commencement of construction. As indicated above, 19 to 25 degree slopes would remain in their state.

4.4.4 Drainage Assessment

4.4.4.1 Site Drains

Methodology

The rate of storm water runoff for the property was derived in accordance with the Jamaica Institute of Engineers, *Guidelines for Design and Construction of Housing Infrastructure, Vol. 1 – 1984 – Storm Water Drainage*, the *National Works Agency Guidelines for Drainage Review of Subdivisions and Development Application,* the topographical plan of the site, the 1:12,500 map of the region and the *Norman Manley Airport rainfall Intensity Duration Frequency (IDF) Curves*. The time of concentration for each catchment was computed as follows:

$$\frac{1.32 \times (n \times L)^{0.6}}{(C \times A)^{0.4} \times S^{0.3}} = \frac{T_i - T_g}{(T_i \times B)^{0.4}}$$

C – run- off coefficient for the Catchment

N – Roughness coefficient for the Catchment

L – Average Overland flow length (ft)

S – Average Ground slope (ft/ft)

A & B – Design parameter for the storm depending on the storm return period

T_g – the gutter flow time (minutes)

T_i – time of concentration (minutes)

The rate of storm water runoff from each catchment was computed using the rational formula below while the results are shown in Table 4.2.

Rational Equation:

$Q=C \times I \times A$

Q - the peak flow from the catchment (ft^3/s)
Q - Peak discharge, cfs
A - the area of catchment (acres)
I - Runoff intensity, inch/hour

Four (4) waterways drain the southern slopes. Of these, a major gully traverses the centre of the upland limestone area that comprises 18.90 hectares (46.69 acres) which, together with Gully #2 drains into the 7.1 hectare (17.5 acres) Flamingo Pond adjacent to the Northern Coastal Highway. This pond overflows into the existing NWA culverts that across the highway towards the sea via the wetlands along the coast, north of the highway. Existing pre-development storm water from the remaining 4.7 hectares /11.69 acres of the property and runoff from lowland and external catchment areas discharges into the wetland area of the property (Gully #4). Some of this storm water flows to the detention pond to the east (Gully #3) while the rest flows westerly via a NWA swale from the northern wetland area (Figure 4.8). Storm water flowing westward in the NWA swale is collected by (2) two 600 mm (2ft) drainage culverts which deposit storm water into the sea. Analysis of the pre-development storm water and run-off from the catchments for different return periods are summarized in Table 4.2 and Figure 4.7 and Appendix 4.1.

Table 4. 2: Results of the catchment analysis

CATCHMENT PROPERTIES							
Catchment	Area (acres)	Co (pre)	Co (post)	No(pre)	No(post)	Lo (ft)	So
1	33.11	0.3	0.42	0.03	0.027	1414	0.1061
1A	19.98	0.3	0.3	0.03	0.03		
1B	13.13	0.3	0.6	0.03	0.022		
2	132.02	0.3	0.38	0.03	0.028	3763	0.161
2A	98.46	0.3	0.3	0.03	0.03		
2B	33.56	0.3	0.6	0.03	0.022		
3A	25.5	0.22	0.46	0.038	0.032	2493	0.0562
3A-1	15.56	0.3	0.6	0.03	0.022		
3A-2	7.77	0.1	0.1	0.05	0.05		
3A-3	2.17	0.1	0.75	0.05	0.04		
3B	9.01	0.6	0.6	0.022	0.022	1460	0.045
4	7.21	0.183	0.35	0.039	0.047	873	0.021
4A-1	3	0.3	0.2	0.024	0.05		
4A-2	2.21	0.1	0.2	0.05	0.05		
4A-3	2	0.1	0.75	0.05	0.04		

4.4.4.2 Design for Management of Storm Water (Post-Development)

Methodology

The proposed drains are designed for storm return periods as follows:

1. Culverts: 25 years storm return period
2. Pipe/Open drains: 25 years storm return period
3. Swale/Gullies – 10 year storm return period
4. Curb and Channel – 2 year storm return period
5. Detention Pond: 10 and 100 years storm return period
6. Wetland flood control: 100 years storm return period

The Manning's Formula was used to design hydraulic structures, such as, culverts, swales and open channels while the Jamaican Institute of Engineers (JIE) Guidelines were followed in the design of the capacities of the curb and channel /inlets along the streets. A minimum of 25% freeboard was incorporated in the design.

The project design incorporates a detention pond to facilitate the management of storm water in addition to the wetlands that perform a similar function.

Using the Modified Rational Method the calculation is as follow:

Q_{10} Pre-development flow from catchment 1 & 2 =176.85cfs.

Q_{10} Post –dev. flow from catchment 1 & 2 =252.45cfs (T_c = 32.6 mins)

From analysis of varied storm duration vs storage , the optimum storm duration =32.6 mins; Q post =252.45cfs;

Post-dev. volume$_{10}$ =494,100cu.ft.

Pre -dev. volume $_{10}$=449,660cu.ft.

Minimum Detention $_{10}$ = 44,440 cu.ft. (1258 cu.m.)

The estimated detention effect of the wetland using the Modified Rational Method is as follows:

Q_{25} Pre-development flow from catchment 4 =19.46cfs.

Q_{100} Post -development flow from catchment 3 & 4=114cfs (T_c = 28.2 mins)

From analysis of varied storm duration vs storage , the optimum storm duration =79 mins; Q post =62.12cfs;

Post-dev. volume$_{100}$ =294,469cu.ft.

Pre -dev. volume $_{25}$=114,853cu.ft.

Minimum Detention $_{100}$ = 179,616 cu.ft.

Undeveloped wetland area = 3.1 acres (135,036 sq.ft.)

Average flood depth = 1.33ft (0.41m)

Flood Water avg. elevation = o.85m +0.41m =1.26m Say 1.3m (4.27ft)

Post-development storm water from 18.90 hectares (46.69 acres) of the highland property, together with those from external catchments will be channeled along the roadways via curb and channel to low points, where it will be collected and discharged via systems of swale (ditch), culverts, pipe drains and U drains to the nearby existing Gully #2. From here it is to be detained in a proposed pond on the property. Pre-development flow will continue from the proposed pond to the existing 7.1 hectares (17.5 acres) pond adjacent to the North Coast Highway. Post-development storm water from the remaining 4.73 hectares (11.69 acres) of the Highland property, together with those from the undeveloped area of the Lowland property and external catchments will flow into the remaining wetland area of this property and wetland on adjacent properties to the east. The wetland will provide a detention effect and release post-development (restricted) flows to the existing 7.1 hectares detention pond in the east.

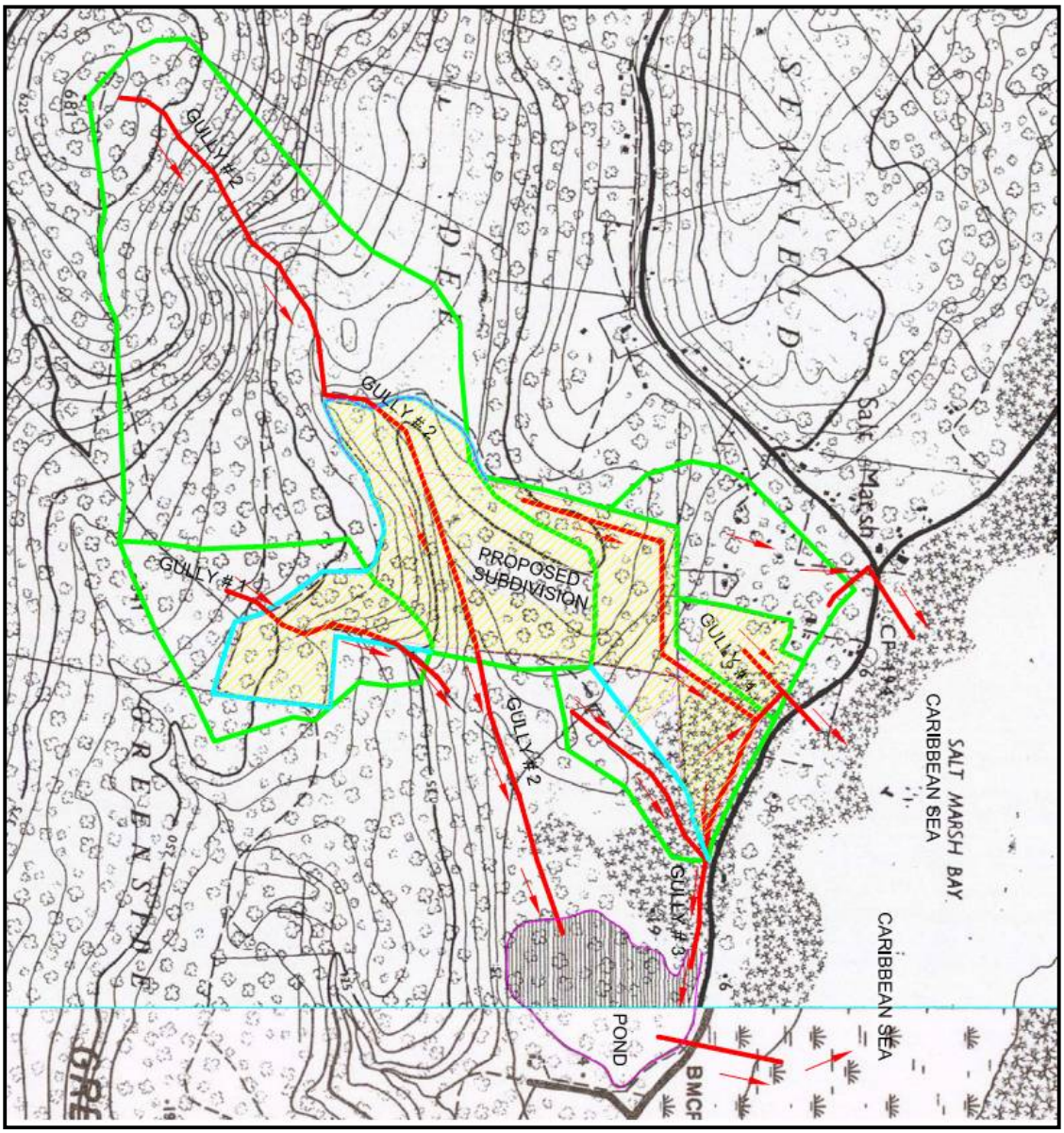


Figure 4. 7: Catchment layout and outfall to the sea at the proposed Dundee development

The maximum expected 100 year flood elevation of the wetland is 1.3 metres at pre-development outflow. The preliminary fill level for the developed section of the lowland site is 2.00 metres and the final level will be in the order of 2.3 metres. The existing 525mm (21") diameter culvert under the existing access road to the east of the lowland property is partially submerged with invert estimated at 0.56 m (1.87ft). This culvert does not have the capacity for the estimated 25 year pre-development flow and a new culvert is proposed. Post-development storm water from the developed area of the lowland property (excluding the entrance road) will flow into the existing NWA roadside ditch and into the two (2) existing 600mm diameter culverts north of the property and across the Northern Coastal Highway. Existing earth ditches will discharge the water to the sea.

It is proposed that storm water run-off from the development be channelled along roadways via curb and channel to low points (Figure 4.7) where it would be collected and discharged by way of swales, pipe drains and u drains to nearby gullies and culverts.

4.4.4.3 Wastewater Treatment

Methodology

The preferred option for waste water treatment is anaerobic baffle reactor to a reed bed followed by a chlorination chamber system (Figure 4.8 and Appendix 14.1).

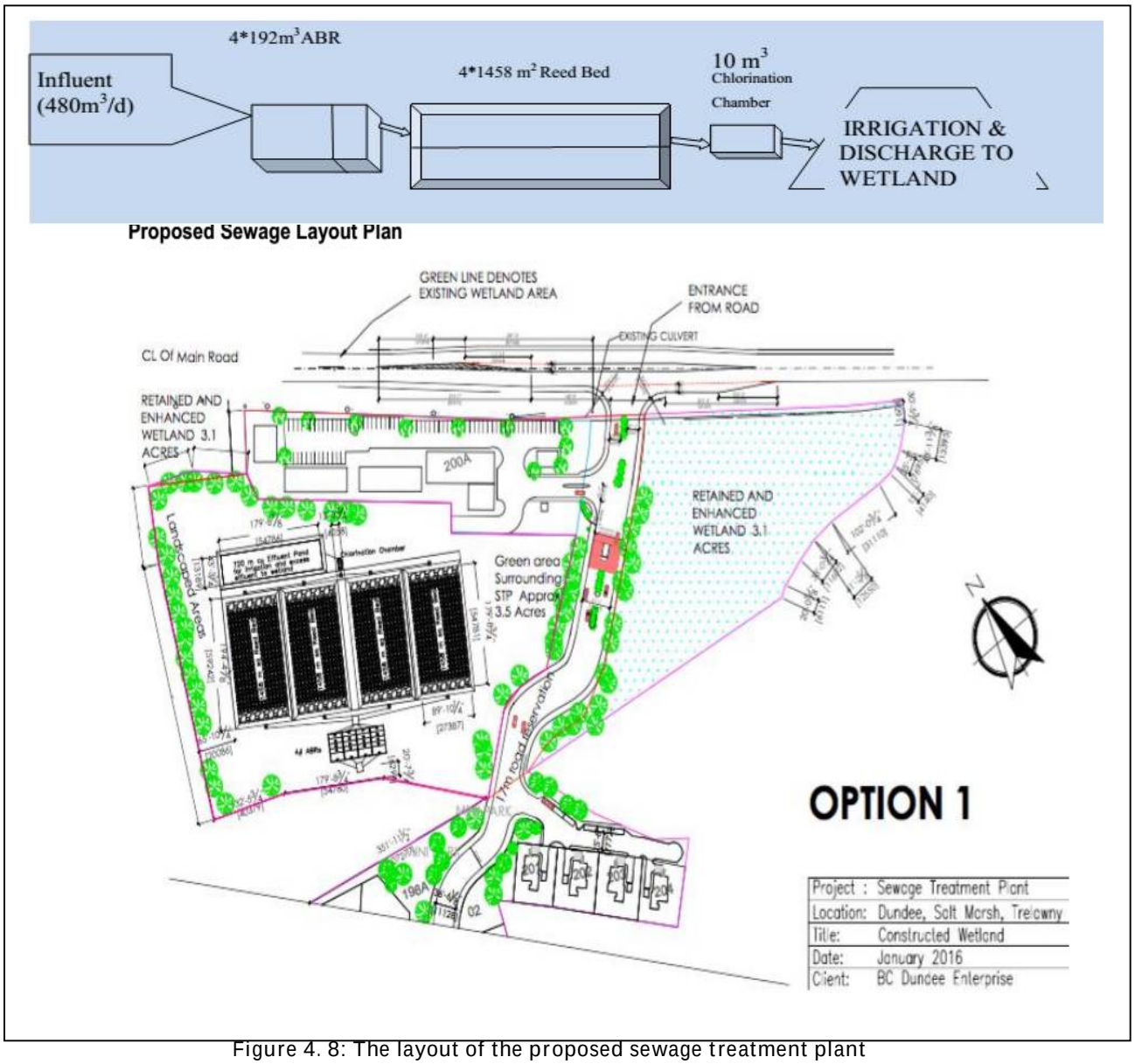


Figure 4. 8: The layout of the proposed sewage treatment plant

The design parameters are:

1. **Volume expected** = {(137*3*2*0.23)+ (72*3*2*0.23)+ (84*3*2*0.23)+ 20}+(10% increase)+(10% infiltration)=**467m3/d**

2. The proposed treatment plant is designed to treat sewage from projected flows of **480m3/d**

3. The Anaerobic Baffle Reactors (ABR) and reed beds will be designed as four (4) parallel models with one influent and one effluent. Each model will treat a total of **120m3**

The disposal of the final treated effluent will be by means of irrigation with the excess directed to the wetland. Construction of the wastewater treatment plant will be undertaken in four (4) phases and in sync with the development phases. For example, phase 1 will be completed to serve up to 25% of the total number of units, phase 2 will serve up to 50%, phase 3 will serve up 75% and phase 4 will serve the entire development.

4.4.6 Proposed Utility Services

Electricity - The Jamaica Public Service Company Limited (JPSCo) will supply electricity to the development from its 20 kV line that travels via its utility poles along the highway. Residents will also be given the opportunity to have solar power systems installed in their dwellings. Solar power would be utilized for the water heater to be installed in every housing unit, and all external lighting, for example, in the club house and the street lighting.

Potable Water Supply - The NWC is the state agency responsible for the supply of potable water. The project proponents have included in their plans a 1,000,000 litre steel tank to be installed at a high point in the south which will allow water to be gravity fed to homes (Appendix 14.2). In addition, each unit will be built with an underground water storage tank.

Telephone, Cable, Internet - The population would be expected to use the telephone, cable and internet services provided by existing providers such as FLOW and Digicel.

4.4.7 Waste Management

The main types of waste streams expected are solid, organic and construction waste. While there could be some hazardous waste, this would be minimal.

- The amount of waste material to be generated from blast excavation would not be a concern as most of it would be reused during the construction process for fill and the infilling of low levels in road profiles during road construction.

- Vegetation cleared from the property would be made available to persons who are coal burners. The options for the excess is the production of mulch and disposal at the community waste management facility.

- Waste from the construction processes such as crates, bags, buckets and tins will be recycled as far as possible by the developers, workers and other community members. These will be assigned a specific storage area under the management of a site supervisor.

A detailed Waste Management Plan is located in Appendix 14.1.

4.4.8 Construction Management

The development would be managed from a fixed location within Phase 1 of the proposed development. All the administrative activities, storage and equipment facilities will be located within the same area. Some administrative functions will be removed to the model house once it becomes available.

a. Equipment

Construction equipment will include backhoes, cranes, wheel loaders, graders, forklifts, bulldozers, mechanical excavators like D9 with the assistance of a hydraulic or pneumatic hammer drill mounted on the ripper

A residential development on rocky terrain requires the right tools along with equipment that are up to the task because stony ground poses a number of unique challenges. The problems encountered can vary, but generally they include the following issues:

Damage to equipment: Grading in rocky soil can easily cause chipping and breaking of smaller tractor blades, which can lead to costly repair bills and require the contractor to resort to hand-digging, creating an expensive labor charge due to how time-consuming nature of this method.

Need for the correct equipment: Excavation, for example, is an essential part of laying pipe, digging post holes, and a number of other construction projects that will save time during construction of houses

Rock relocation: One of the biggest issues involved with rocky soil is what to do with the stones that are unearthed. Sometimes they can be very large and small utility trucks cannot remove them.

Once the project has been given the approval, a Project Manager and Contractor will be engaged to provide a detailed list of the required equipment for the project, sourcing, budget and schedules.

b. Staff

The construction will occur over a period of at least 5 years commencing with Phase 1. The Project Team will include the Project Manager, Contractor, Project Engineer, Land Surveyor, Architect and the Landscape Architect. Construction workers to be engaged would include builders, steel workers, masons, carpenters, roofers and tillers. The manpower demand for the project would be determined by the Project Manager based on the time schedule and the availability of staff.

4.4.9 Project Need

According to the NHT (2009) Salt Marsh was one of the top ten locations in Trelawny for likely future residential development. The project proponents have, therefore, viewed this proposal as an opportunity

to tap into the demand for residential units on the northern coast of the island which is noted for its vibrant tourism product.

4.4.9.1 Target Market

The northern coast of the island is a favourite location for returning residents. This, coupled with the attractive project concept would seek to lure local and overseas purchasers/investors. Locally, the parishes to be targeted in its marketing campaign include Kingston and St. Andrew, Trelawny, St. James and St. Ann, while overseas markets include Canada, the United States of America (USA) and the United Kingdom (UK).

According to the Planning Institute of Jamaica (2012), there has been a decline in the number of returning residents with a 2011 arrival figure of 1,068, a 5.8 %reduction relative to 2010 when 1,134 persons returned. The Planning Institute of Jamaica (2012) also indicated that the majority of returning residents, (522, or 51.7 %) originated in the USA, followed by the UK (208 or 19.5 %). During the period, there was a decline in the number of returning residents from all countries except Canada.[5] Attracting returning residents will, therefore, require an aggressive Marketing Plan for the overseas market.

4.4.10 Project Objective

The proposed Dundee project would :

- Make a significant contribution to the housing stock in Trelawny and provide residential options for residents of the parish capital, Falmouth, along with the other markets being targeted.
- Boost the island's foreign direct investment.
- Provide employment opportunities for residents in the receptor community.
- Meet the social needs of the public and the economic needs of the entity in its offering of middle income type housing solutions.

[5] http://www.jamaicaobserver.com/news/Decline-in-deportees_11551412 Accessed May 4, 2015

5.0 DESCRIPTION OF THE ENVIRONMENT

The multidisciplinary project team conducted an exhaustive review of the possible impact-causing aspects of the project, the regulatory criteria controlling environmental aspects (development controls), and the status of valued environmental components (physical resource base of the project site and environs). Additionally, literature reviews on assessments of a similar nature within the vicinity of the proposed development, environmental data and other findings were used to strengthen the baseline data collected. Data and information were also obtained from agencies such as The National Water Commission (NWC), Water Resources Authority (WRA), The National Works Agency (NWA), the Statistical Institute of Jamaica (STATIN), Jamaica National Heritage Trust (JNHT) and the Mines and Geology Division (MGD). The production of maps and diagrams was facilitated though the use of Geographic Information Systems (GIS) software.

Baseline conditions at the proposed site were recorded and assessed following site visits, literature reviews, interviews and consultations, measuring, testing and sampling within the boundaries of the site and its contiguous areas:

METHODOLOGY

A. PHYSICAL ENVIRONMENT

- Description of topography, soils, climate, drainage, geology (including, but not limited to seismicity and faults), geomorphology of the site and hazard vulnerability including impacts on current landscape, aesthetic appeal and hydrology examined.

- Special emphasis placed on storm water runoff, drainage patterns. Percolation conducted within the proposed study area.

- Water quality for surface water feature in the vicinity of the development. Quality –indicators include Nitrate, Phosphate, Faecal Coliform, Salinity and Total Suspended Solids.

- Climatic conditions and air quality in the area of influence including particulates - Particulate monitoring over a 24- hour period

- Noise levels of undeveloped site and the ambient noise in the area of influence. – data collected over two (2) periods

- Availability of solid waste management facilities identified

B. CARRYING CAPACITY

The ecological carrying capacity assessed based on features of the site ecosystem

C. NATURAL HAZARDS

- A risk assessment of the development in relation to:

- Hurricanes, earthquakes, flooding potential, rockfall and land subsidence

- Natural hazard risk assessment taking into account climate change projections.

D. BIOLOGICAL ENVIRONMENT

Description made of terrestrial habitats, existing vegetation, flora and fauna surveys, inclusive of a species list, commentary on the ecological health, function and value in the project area, threats and conservation significance:

This includes:

- A detailed qualitative and quantitative assessment of terrestrial habitats in and around the proposed project site and the areas of impact.

- Special emphasis was placed on rare, endemic, threatened, protected or endangered species. Migratory species were also considered.

- Generally, species' dependence, habitats/niche specificity, community structure and diversity were considered.

The field data collected include:

- Vegetation profile
- Benthic features of the proposed development areas as well as the areas of potential impact
- Species provided for each community
- A habitat map of the area

i. Limestone Hills

Avifaunal Census

Fixed Radius Point Count Census Method

This Point Count method is based on the principle of counting birds at a defined point or spot and determining the distance of each bird censured. A point is selected and then all bird contacts (seen and heard) are recorded, with a determination of distance given (< 25m or >25m) for each contact. This is done for a - time, usually 10 minutes, before moving to another point at a specified distance away (Bibby et al. 1998). Points for this survey were at most 40m apart.

Advantages of this method include:

1. Greater concentration on the birds and habitats without having to watch where you walk.
2. More time available to identify contacts
3. Greater opportunity to identify cryptic and skulking species)
4. Easier to relate bird occurrence to habitat features (Bibby et. al.1998).

Technique Limitations

As with all survey techniques, there are limitations, which influence overall results. Below are factors which affect both census techniques used.

1. Time of Day Constraint – the best time for conducting a census is in the morning from sunrise until about 10 am in the lowlands. It is recognized that as the day continues it gets hotter and the ability to detect birds decreases due to lack of movement (Wunderle 1994). The surveys were conducted from sunrise to 10 am.
2. Time of Year – the change in behaviour of birds during the breeding and non-breeding seasons affect detection. For this report, the assessment was done at the end of the non-breeding season, when birds are less vocal, and when winter migrants are present in Jamaica. (Wunderle 1994).
3. Weather – things such as wind, rain, fog or if the day is too hot, affect conducting a census given the potential effects of these conditions on species count (Wunderle 1994). The day of survey was sunny with minimal wind.
4. Summer Counts versus Winter Counts – the counts were conducted within the early spring period, therefore incorporating both residents, early arriving summer residents and departing winter migrants.

Other Faunal Surveys

Other faunal surveys were done, through basic, direct observation of species within a randomly selected area. The incidence of burrows, nests and tracks were also included to ensure a complete assessment of all the fauna.

Vegetation Assessment

For tree and plant assessment, a vegetation description was done for the survey site. A species list of trees and plant species, inclusive of all plant life forms, endemics and native plants, was generated.

Survey Dates
The survey was conducted March 13 and 14, 2015. A prior survey was conducted in October 2012.

ii. Wetlands Area

Literature related to the expected forest types to be found within the project area were examined in order to establish a general description of the various types of flora and fauna that could be found at the site. Camirand and Evelyn (2004[6]) and Forestry Department[7],[8] references were valuable in examining the forest types peripheral to the wetland area and also helped to give an understanding of animal life (particularly avi-fauna) which may be observed interacting between the boundary of the two vegetation

[6] **Roland Camirand and Owen B. Evelyn –** National Forest Inventory Report 2003 Volume 1 of 2 – Main Report and Appendices I-V 2004.

[7] Forestry Department Min of Agriculture Photo Interpretation Manual – June 2002

[8] Forestry Department - Forest Inventories in Natural Forests [UNDP/FAO, 1972; Swedforest Consulting, 1981; FIDCO, 1982-83; TFT Project, 1998-99

types. The Biodiversity of Jamaican Mangrove Areas -Volume 7, written by Dr. M. Weber served as a reference for the types of mangrove vegetation that could be observed within the study area and provided identification keys for any land, aquatic or tree-based fauna that might be observed within the area.

Aerial Imagery Assessments -Flora:

Google Earth images of the location dated 2003 and 2013[9] were georeferenced to the JAD 2001 coordinate system using Geographical Information System software[10]. After georeferencing, the Google Earth images were then used to determine the estimates of spatial floral coverage on the site.

Floral Assessments –Ground Truthing

A line intercept method[11] was employed along orientations running peripheral to the wetland to examine the various types of flora existing on the proposed development site. In this method, features existing along the lines traversed around floral aggregations were assessed, with observations being made along a vertical arc extending from the ground towards any forest canopy existing along the transect line.

The line intercept method was chosen because navigation within stands of wetland vegetation on the site was anticipated to be difficult, considering the density of the vegetation and the presence of standing water and underlying peaty substrates that could prevent walking. Both the North Coast Highway and an interior roadway provided peripheral access to the wetland area and served as the survey lines.

Assessment lines typically followed the alignment of walking trails traversing the site and an indication of prevalence was given, as defined using the DAFOR scale system[12] defined below:

D - **Dominant**
A - **Abundant**
F - **Frequent**
O - **Occasional**
R - **Rare**

In this case, the DAFOR **scale was based on percentage cover with** D**ominant** = >75%, A**bundant** = 75 – 51%, F**requent** = 50 – 26%, O**ccasional** = 25 – 11%, R**are** 10 – 1 %

E. HERITAGE

An archaeological and cultural assessments by the Jamaica National Heritage Trust as follows:

[9] Representing the most recent imagery available

[10] www.mapmaker.com

[11] www.wikipedia.org – Line Intercept method

[12] http://www.surreyflora.org.uk/newnotes.php Retrieved 2015 May 20

- Desk-Based Assessment – (a) Research relevant historical documentations: maps, plans, estate accounts, correspondence, titles, and deeds; (b) Research published and unpublished narratives, studies and data sets of the study area, adjoining areas and associated projects; (c) Analysis of satellite images and aerial photographs.

- Site Survey – Conduct archaeological field walk, artifacts sample collection and analysis, cultural heritage contexts interpretation and analysis and recording significant cultural assets to be affected.

- Description of the Proposed Project – Provide a full description of the project and its existing setting and location, using plans, maps and photograph.

- Description of the Project Area – Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area, including physical environment: geology, topography, soils and drainage system;

- Biological environment: flora and fauna that has cultural implications.

  Determination of Potential Impacts – present major issues of archaeological and socio-economic concerns and indicates their relative importance. This included an assessment of the cultural environment in its historical context. This led to the determination of the historical and cultural value of the location.

F. SOCIO-ECONOMIC ENVIRONMENT

This included data gathering, analysis and description of demography, the regional setting, locational assessment and current and potential land-use patterns (of neighbouring properties); existing infrastructure such as transportation, electricity, water and telecommunications, and public health safety; cultural peculiarities, aspirations and attitudes and social and political structure

Public consultation included interviews and a community survey using the non-probability convenience sampling method to determine public perception of the project (both negative and positive) and potential impacts on social, aesthetic and historical/ cultural values. The survey was conducted within the Project Area on March 18, 2015 and July 8 2015. The sample size was N=32 in Dundee/Salt March and N=40 for Comfort Hall, Scarlet Hall and Greenside. Results from the analysis of the survey are presented as frequencies and percentages.

5.1 PHYSICAL ENVIRONMENT

5.1.1 Topography

The property shows two distinct types of terrain: the low lying wetland to the north which abuts against the highway and the upland area to the south (Figure 5.1). The flat, low lying area is approximately 3.05 metres above mean sea level (amsl) and is dominated by wetland. The wetland continues further north

towards the coastline, but is interrupted by the Northern Coastal Highway whose alignment impacted the wetlands.

5.1.1.1 Dry Limestone Hills

The property rises gradually from the wetlands in the north towards the south into a limestone hill at an elevation of approximately85 m near the southern boundary. Here the land steepens considerably forms a

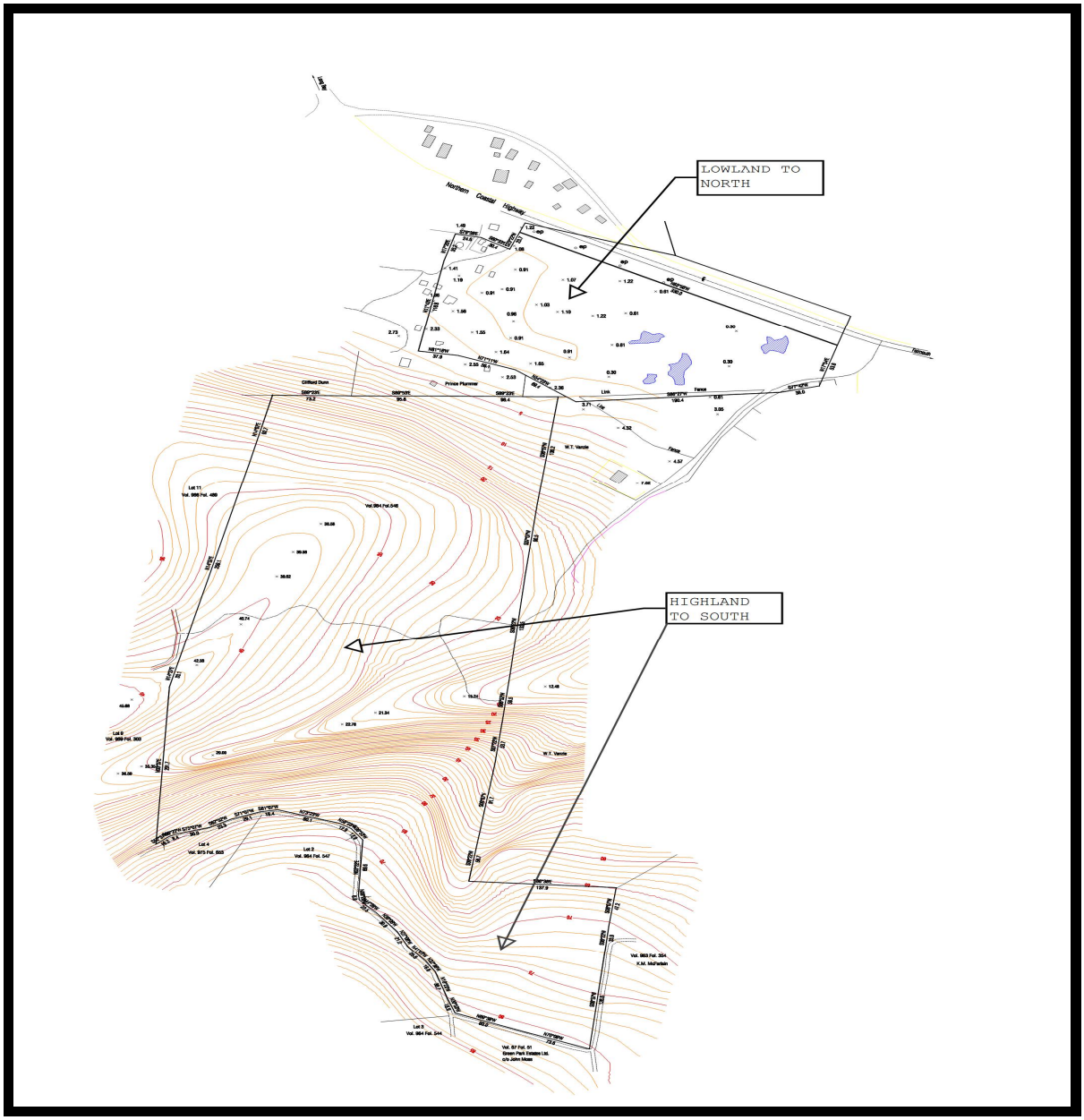


Figure 5. 1: Topographical Survey of the Dundee property highlighting the lowlands to the north and the highland area to the south

limestone scarp. The site is generally rocky/stony with little soil cover on the surface. A dry gully crosses the site forming a narrow limestone valley. Further south, outside the limit of the property boundary, the site stretches to the top of a limestone ridge and eventually forms part of the northern facing slope of the limestone hill. This limestone topography is not typical of limestone karst as it is devoid of features such as limestone cavities, sinkholes and conical hills that are consistent with this rock type..

Within the limestone hills, the slope gradients range from a low of 7 degrees to a high of over 30 degrees at its steepest section where it is dominated by a limestone scarp. The northern section of the dry forest area has a gentle to moderate slopes of approximately 7 degrees to 19 degrees (Figure 5.1).

5.1.1.2 Wetlands

Information from the 1961 aerial photographs at a scale of 1: 25,000 for the project site and surrounding areas shows the original scale of the coastal wetlands prior to the encroachment of the Northern Coastal Highway and urbanization of the area (Figure 5.2.) The wetland area can be described as a basin feature comprised of a layer of water-impermeable peat on top of a base of limestone rock (Figures 5.3 & 5.4).

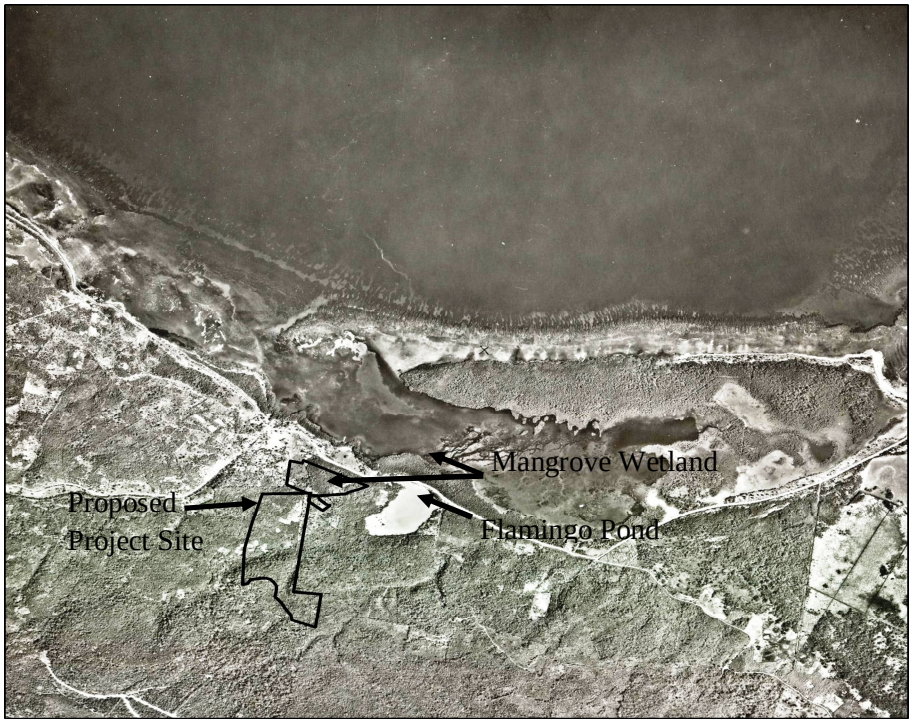


Figure 5. 2: A 1961 aerial photograph (1:25,000) of Dundee/Salt Marsh and surrounding wetland areas

Observations suggest that the area of the property occupied by wetland vegetation was also seasonally inundated with water. It is likely that the wetland is a point of collection for storm water naturally draining from lands south of the wetland development area. The storm water engineering report for the larger subdivision[13] shows one of ephemeral drainage channels traversing the wetland area (see Figure

[13] Engineering Report on Storm Water Drainage for Proposed Subdivision of Part of Dundee Trelawney by JATCO Consultants Ltd – Nov 2014

4.7). The wetland, therefore, plays an important role as a repository and slow-release mechanism for storm water.

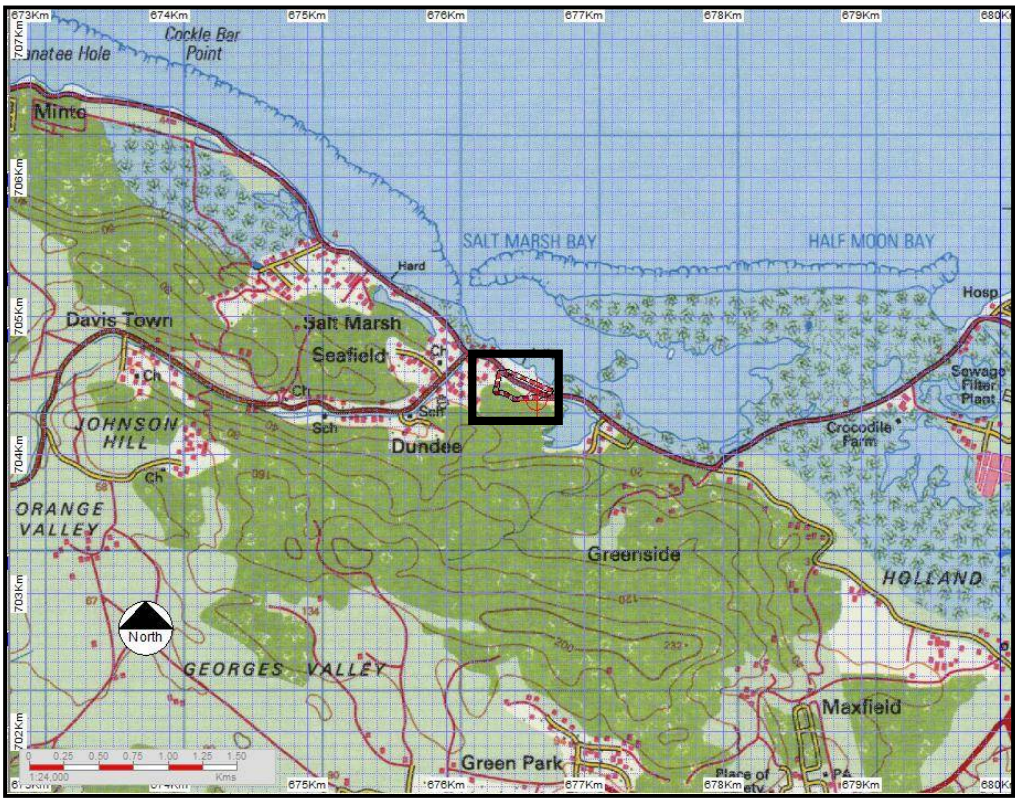


Figure 5. 3: The proposed Dundee subdivision wetland area superimposed on 1: Metric Map (black box = special area of interest)

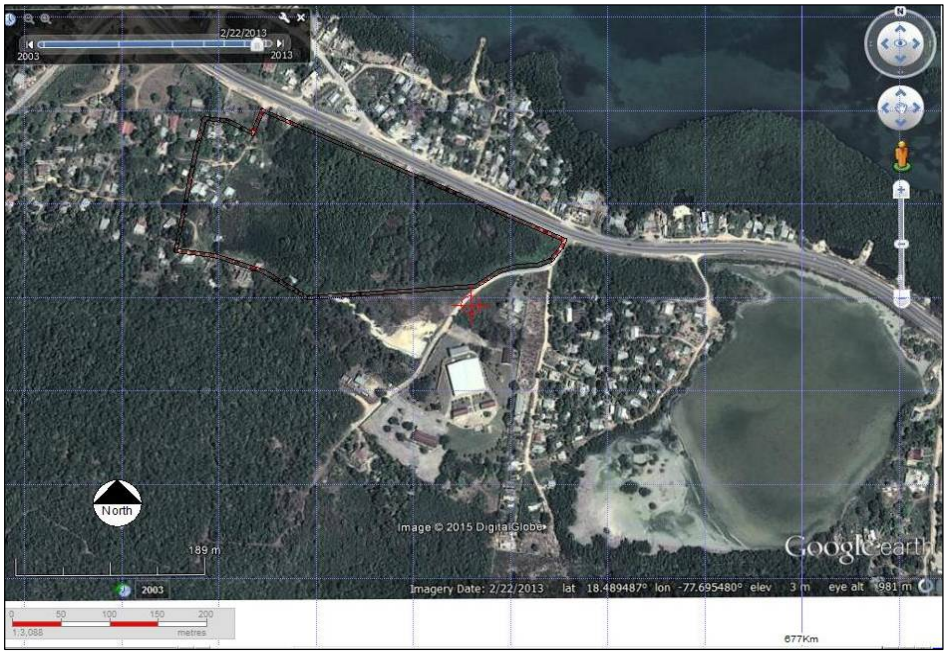


Figure 5. 4: The northern area at Dundee superimposed on Google earth image (red line = special area of interest

5.1.2 Surface Geology

5.1.2.1 Soils

The dominant soil type in the Project Area is the Bonygate stony loam-the thin brown or reddish soils on hard limestone (Figure 5.5). The soil near to the southern boundary of the mangrove at the project site is reddish brown, consisting of silty clay. When a test pit on the property was examined it was estimated that the soil has maximum depth of 2.5m, however, the soil thins out in the direction of the mangrove. Additionally, boreholes conducted in the wetlands show that there is approximately a 1.2m -1.8 m layer of peat and mud which overlay 0.3m-0.6m of granular sand. Limestone bedrock lies below the sand.

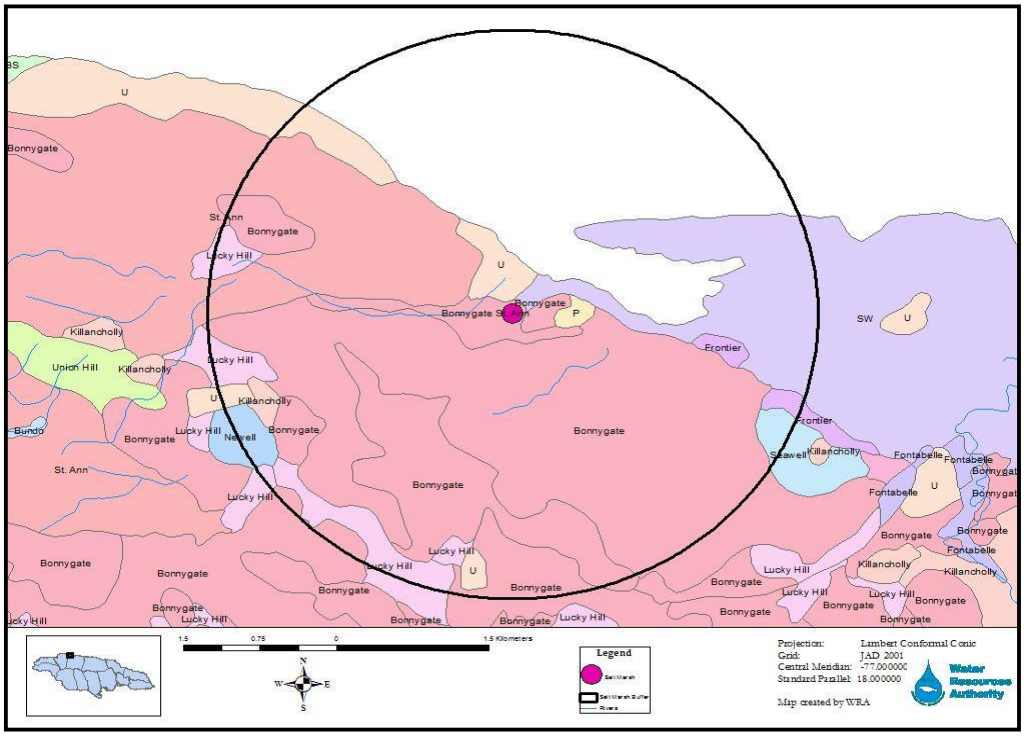


Figure 5. 5: Soils at the site and in the surrounding areas of the proposed Dundee development
Source: Water Resources Authority

5.1.3 Methodology for Percolation Test

Percolation tests were conducted in the three (3) test pits. Clean water was poured to partially fill each test pit and then left overnight to ensure full saturation (Appendix 4.1). Percolation tests were conducted the following day by pouring clean water into the test pits and observing the fall of each 3 inches (7.62cm) of water until a constant drop in water level was attained. Clean water was poured into each hole for a third time, following which the time taken for the water level to fall by 3 inches (7.62cm) in each test pit was recorded (Appendix 4.2). The final percolation rate was determined by the time taken for the water to fall 3 inches (7.62cm) into the pit and dividing by 3.

5.1.4 Soil Description in Test Pits

The number of test pits that were dug was limited because the rocky nature of the site posed a challenge for the excavation of the pits to the desired depth. In fact, a number of test pit sites had to be abandoned because of the rocky/stony nature of the property. As a result, the locations of the three boreholes were chosen to best represent the site.

The soils/rock contained in all three pits is essentially lateritic soils consisting of reddish brown silty clay and sandy silts dominated by limestone boulders. In Test Pit #1, ground water seeped into the bottom of the excavation at a depth of approximately 3.5ft indicating the water level at that location. Test pits 1, 2 and 3 were dug to depths of 1.05 m (3.5ft.), 1.13 m (3.75 ft.) and 0.91 m (3 ft.) respectively. The locations of the test pits and description of the soil profile in the test pits are shown in Appendix 14.1.

5.1.5 Test Results

The results of the percolation tests at Dundee, Trelawny indicate that the rate for test pit 1 is 62 min/inch (25 min/cm), while for test pit 2 it is is 52 min/inch (21min /cm) and in test pit 3, the percolation rate is 17 min/inch (7 min/cm). The results indicate that the soils have low percolation rates in test pits 1 and 2 and a moderate percolation rate in test pit 3 based on the type of soils in the pits. The results of the tests are shown in Table 5.1.

5.1.6 Interpretation of Results

Normally, the completion of only three percolation tests across a property of similar size of dry limestone forest would be inadequate. However, the nature of the site did not allow for further areas to be tested. Since the geological formation appears to be consistent throughout the property, the three tests reflect the general conditions for storm water percolation throughout the site to some extent.

The percolation rate in test pit 1 was possibly affected by the groundwater seepage at the bottom of the pit, and therefore most of the percolation would be at the sides of the pit through the silty, clay. marly limestone. The percolation rates in test pits 1 and 2 indicate that absorptive property of the soil/rock is low while the percolation rate in test pit 3 is moderate. It would suggest that the percolation rate is low across the northern section of the limestone dry forest while there is moderate permeability in the southern eastern section of the site.

Table 5. 1: Percolation rates at test pits 1-3 at the proposed project site Dundee, Trelawny

TEST PIT #	DEPTH		PERCOLATION RATE	
	Ft	m	Min/Inch	Min/cm
1	3.5	1.05	62	25
2	3.75	1.13	52	21
3	3	0.91	17	7

It implies that there will be relatively high overland flow throughout the site on sloping ground since percolation will not be rapid into the soil. Higher percolation is expected in the southern section of the site leading to lower overland flow. The presence of the geological fault in close proximity to test pit 3 (test pit with the highest percolation rate) could be the reason for the higher percolation rate in the southern section of the site.

5.1.7 Geology

5.1.7.1 Rock Type

The dominant rock type on the property is limestone of the Montpelier Formation (Figure 5.6). This limestone consists of white to grey chalks with interbedded bio-fragmental beds. In some areas, the limestone appears to be recrystallized as the exposed rock is moderately hard and massive. Large chert nodules are dominant in the limestone, which is typical of the lower horizon of the Montpelier Limestone (see Appendix 4.2). The geology of the northern section consists of swamp and marsh containing deposits of mud, silt and organic material.

Structurally, there is a northwest-southeast geological fault which crosses the central section of the upland area. This fault corresponds to the large dry gully which takes storm water into the wetland area to the north and northeast and into the Flamingo Pond. The fault is also responsible for the scarp slope as well as rocky nature of the slope which consists of large boulders and partly detached limestone into the bedrock.

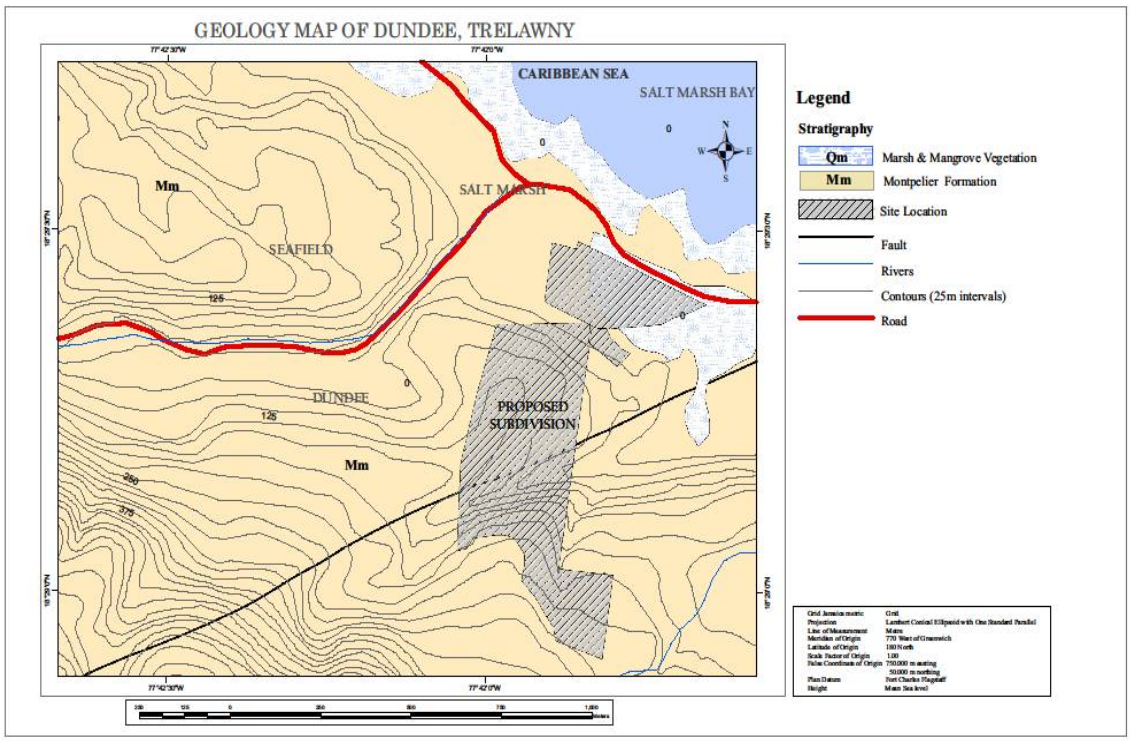


Figure 5. 6: Geology of the proposed development site and surrounding areas
Source: The updated 1: 50,000 Metric Geology Sheet 2

5.1.8 Engineering Geology and Geotechnics

Data obtained from the Mines and Geology Division show that the Uniaxial Compressive Strength conducted on 40 limestone samples of the Montpelier Limestone for St James vary from 2 MPa to 19MPa, which would fall within the range of a weak to moderately strong rock. However, the majority of the samples fall in the range of 3 MPa to 11MPa which approximates to seismic wave velocities of 1,200 m/s to 1,500m/s. It implies that the strength of the limestone is in the range of weak to moderately weak rock. The Montpelier Limestone is contiguous to the Trelawny (Dundee area) and therefore is strongly correlated with the Montpelier Limestone in St James.

With respect to excavation for earthworks construction such as access roads, trenches, man-holes, pits etc, the weak to moderately weak rocks of the Montpelier limestone can be ripped using a mechanical excavator like a D9 with the assistance of a hydraulic or pneumatic hammer drill mounted on the ripper. However, areas that are dominated by chert in the limestone will be more difficult to excavate because the chert is generally harder than the limestone.

A soil investigation was conducted on the project site by NHL Engineering Consultants to obtain data on the geotechnical characteristics of the rock and soil on the property. The investigation was confined to the wetland area on the northern section of the property which involved the drilling of 3 boreholes. The borehole logs show that the soil taken from the boreholes consists of very loose to loose, dark brown peaty soil with varying proportions of silt, sand and gravel to depths ranging from1.36m (4.5ft) -1.97m (6.5 ft). The limestone layer is encountered below the peaty soil at depths ranging from 4.5ft (1.36m) to 7.5ft.(2.27m). Ground water was encountered at 2.5ft (0.75m). The geotechnical characteristics of the peaty material are not favourable for engineering purposes. As a result of this, the report recommends that for any engineering construction, graded fill should replace the poor engineering soils in order for safe construction to take place (Appendix 4.1).

The site consists of variable slopes, from flat to gentle slopes in the north, to steep slopes in the south. Housing construction is proposed to be conducted on all areas of the property, except on the very steep slopes near the fault-controlled gully. The design of housing lots on the variable slopes, would be in accordance with the guidelines set out in the Hillside Development Manual prepared by the Mines and Geology Division.

5.1.9 Hydrogeology

Salt Marsh is located within the Orange Valley sub-Watershed Management Unit (WMU) of the Martha Brae Hydrological Basin. The site's underlying formation is the Montpelier White Limestone that is classified as limestone aquiclude (Figure 5.7). An aquiclude is a geological formation that does not allow the movement or storage of economic quantities of groundwater. The closest mapped fault to the site of interest lies about 180 m to the northwest, and trends Northeast-Southwest. Faults create conduits which may increase the transmission of groundwater. Wells have been developed in the Montpelier limestone along fault zones. Groundwater flow is towards the north. The estimated groundwater safe yield of the Orange Valley sub-WMU is 2.2 million m^3/year. (Draft Master Plan, 2005, WRA). There are four (4) wells located within 3 km of the property (Figure 5.8), and their information are presented in Table 5.2.

There is limited potential for surface development in the in this sub-WMU. Two unnamed ephemeral streams are located within the buffer zone (Figure 5.7).

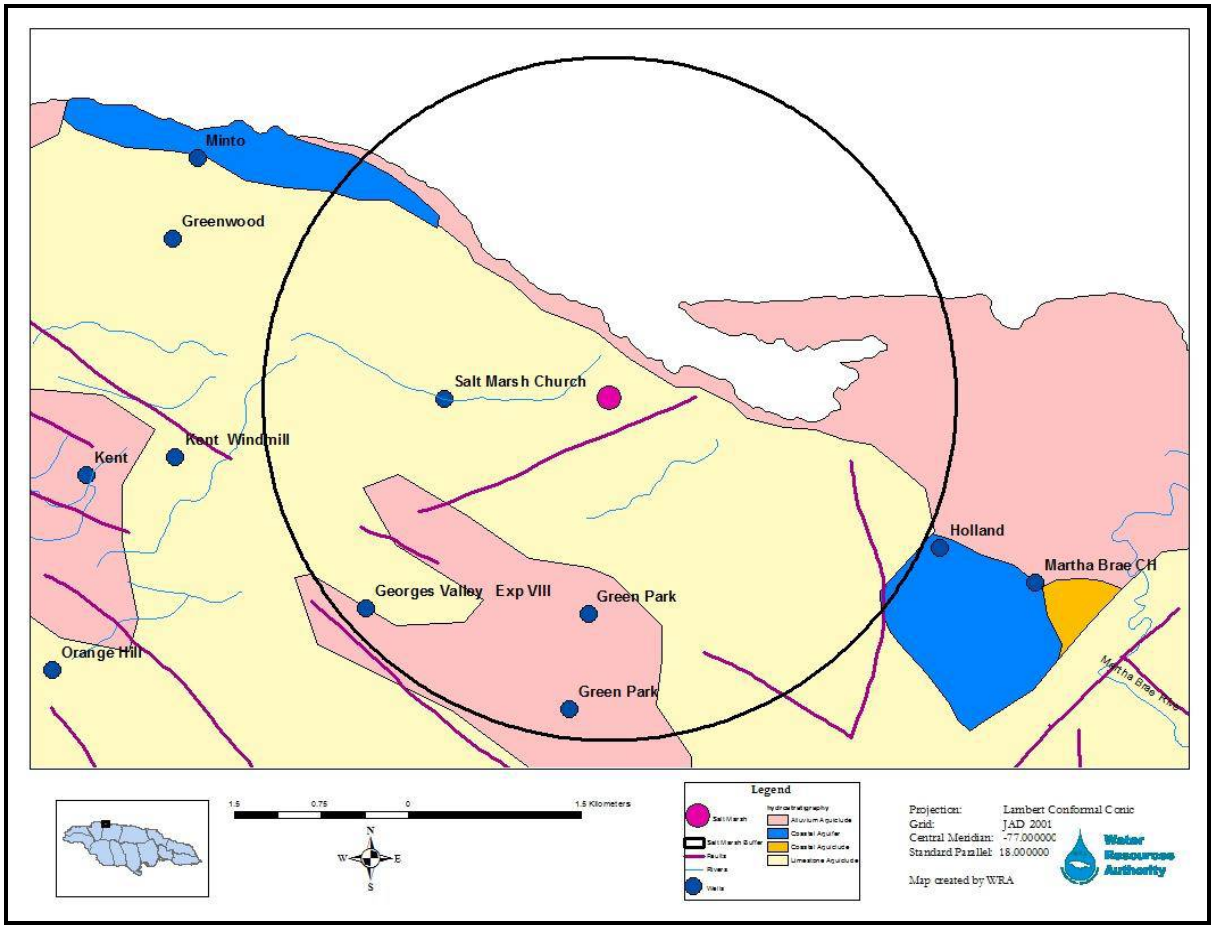


Figure 5. 7: Hydrostratigraphy of the project site and surrounding areas

Table 5. 2: Wells within a 3-kilometre radius of the proposed site, Dundee, Trelawny

WELL NAME	OWNER	WELL STATE	WELL TYPE	ELEVATION (m)	DEPTH (m)	WATER STRUCK (m)	PRINCIPAL FORMATION	REST WATER LEVEL (m)
Salt Marsh Church (Lynchfield)	-	Unkown	Dug Well	15.24	15.09	-	Montpelier Limestone	14.94
Georges Valley Expl VIII	Orange Valley Estates	Non Pumping	Dug Well	81.69	99.36	-	Montpelier Limestone	21.95
Green Park Dug	Kaiser Jamaica Bauxite	Non Pumping	Dug Well	99.97	41.45	-	Montpelier Limestone	27.74
Green Park	Cecil Germain	Unkown	Drilled Well	115.20	304.80	81.99	Montpelier Limestone	81.99

Source: Water Resources Authority

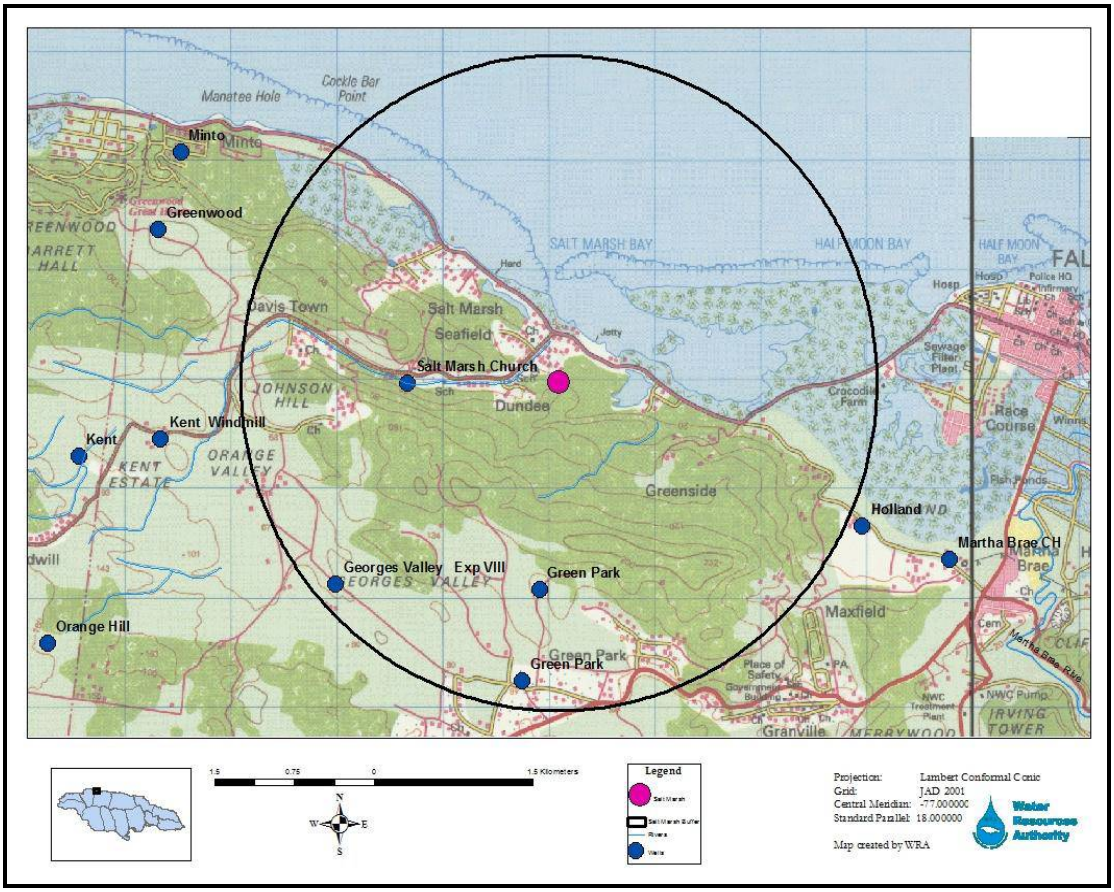


Figure 5. 8: Location of Dundee/Salt Marsh and their proximity to existing wells

5.1.9.1 Water Quality

Figure 5.9 shows the location of the two (2) water sample sites- one in the wetland area and the other at the adjacent Flamingo Pond. In addition, a sample for the marine water quality was taken at the pier that is located opposite the project site. The parameters analysed were total suspended solids (TSS), faecal coliform, nitrate, phosphate and salinity. The results confirm the high level of salinity in the Flaming Pond (96.35 ppt) and some salinity in the wetlands (16.44 ppt). When compared with the other locations, faecal coliform in the wetland area was relatively high (240 MPN/100mL). The nitrate content in the Flaming Pond (61.6 mg NO_3/L) and the wetland area (26.4 mg NO_3/L) fell above the NRCA Ambient Water Quality Standard of 0.1-7.5 mg NO_3/L. The phosphate level in the wetlands (0.06) indicates the potential for eutrophication.

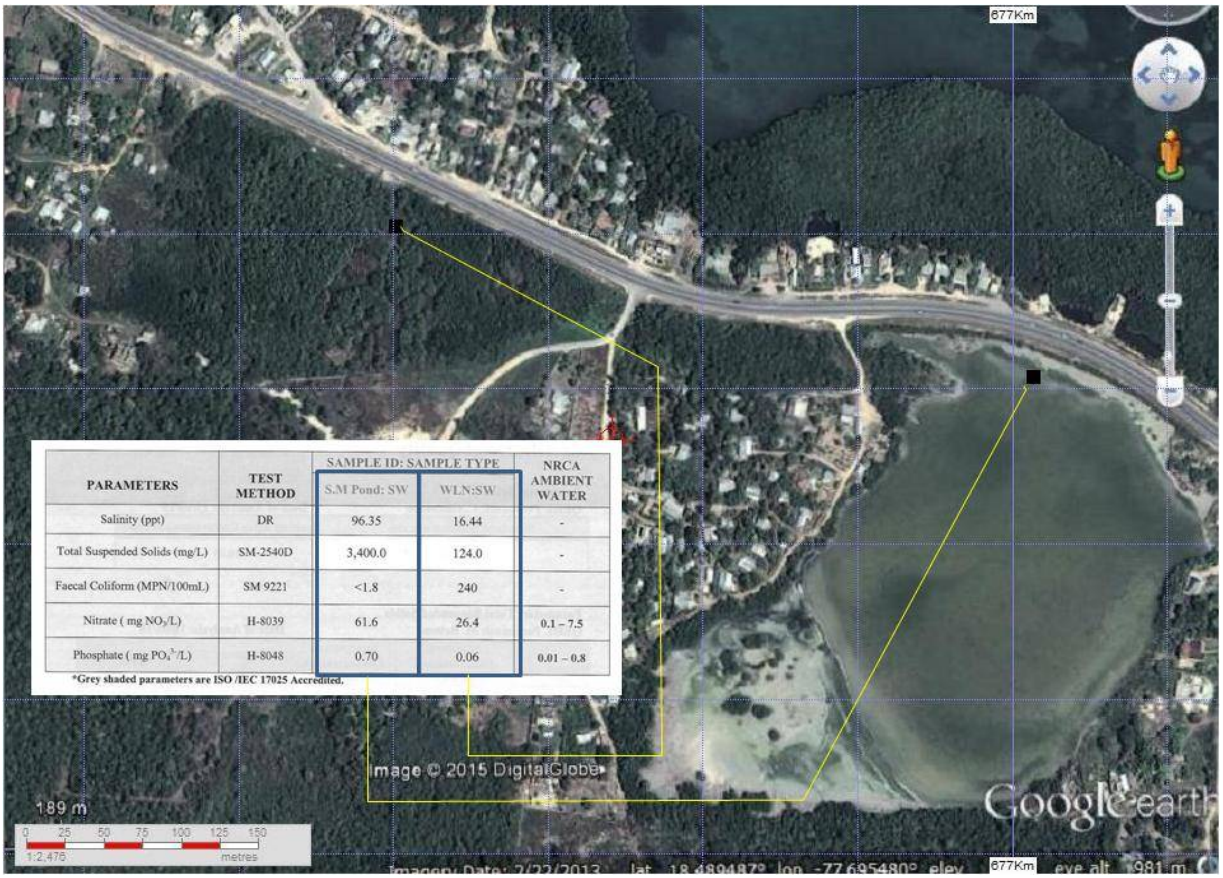


Figure 5. 9: Results of water quality analyses for sites within/adjoining the project site at Dundee

5.1.10 Water Demand

The scale of the demand for potable water resources from the public water supply system was assessed based on the projected demand for the utility. The population and the mean per capita consumption are used to determine the effective demand. Given the proposed scale of the development, potable water per capita demand is estimated at an average of 227 litres/day (50gd). At an estimated population of 1,000 persons, total daily demand would be approximately 227,000.00 litres per day. If an additional 20% is added for nonrevenue water, then the total would be approximately 272,000 litres per day.

5.1.11 Climatic Conditions

5.1.11.1 Precipitation

The Automatic Weather Station (AWS) is located 2km to the west south west of Salt Marsh and provided weather information for the area for the period 1975-2013. Jamaica's rainfall pattern is described as bimodal, consisting of two (2) peak periods, with higher values of rainfall occurring in May to June & September to November. The remaining months correspond to periods of lower rainfall. The island's primary peak is in October as shown for the Orange Valley (5.2 mm) (Table 5.3).

The secondary peak for the island is usually in May. However, the Orange Valley AWS data shows the secondary peak as November (3.3 mm) followed by September (2.9 mm) and then May (2.7 mm). Jamaica experiences the lowest rainfall levels during the period February (1.7 mm) to March (1.5 mm) and the month of July (1.6 mm) as demonstrated in the data for the Orange Valley AWS.

Table 5. 3:Monthly rainfall totals in millimetres 1975-2013 at Orange Valley AWS Station in Trelawny

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC	YEARS
Mean	2.0	1.7	1.5	2.0	2.7	2.0	1.6	2.0	2.9	5.2	3.3	2.6	29.5
Max	90.0	60.0	77.0	110.0	135.0	101.6	128.0	98.1	152.4	138.0	148.0	135.0	1373.1
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Meteorological Service of Jamaica

5.1.11.2 Temperature

Table 5.4 shows that the mean maximum temperature in 2013 (37.7°C) exceeded that of both 2012 (29.0°C) and 2014 (36.5 °C) at the Orange Valley Automatic Weather Station. The 2-year (2013 to 2014) warm weather trend was substantially higher than the mean recorded at the Norman Manley International Airport over the period 1992 to 2002 (Table 5.5). However, there is insufficient data to declare that this is necessarily a warming trend

Table 5. 4: Mean daily maximum and minimum temperatures C at the Orange Valley AWS in Trelawny 2012-2014

2012		2013		2014	
MAX	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**
29.0	18.9	37.7	20.6	36.5	20.9

Source: The Meteorological Service of Jamaica

Table 5. 5: Norman Manley International Airport Climatic Data - 1992 - 2002

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Max Temp. (C)	31.0	30.9	31.1	31.7	32.0	32.8	33.4	33.0	32.8	32.4	32.0	31.4
Highest Max.	32.8	32.7	32.6	33.0	33.6	34.4	35.1	34.9	34.7	34.3	34.0	33.2
Min Temp. (C)	22.6	22.6	23.1	23.9	24.9	26.0	25.8	25.6	25.5	25.0	24.2	23.2
Lowest Min.	20.7	20.5	20.7	21.5	23.4	23.7	23.7	23.5	23.3	23.0	22.1	21.3
Mean Daily Temp. (C)	26.8	26.7	27.1	27.8	28.5	29.5	29.6	29.3	29.2	28.7	28.1	27.3
Rainfall (mm)	29.7	25.7	22.3	24.3	73.0	51.2	31.7	63.8	147.0	103.5	120.6	40.0
No. of raindays	6	5	6	5	8	5	5	7	9	8	6	5
Rel. Hum.- 7am (%)	81	81	80	77	76	76	75	77	79	80	81	82
Rel. Hum.- 1pm (%)	63	64	63	63	67	65	63	67	68	68	66	63
Mean Sunshine (Hrs.)	8.3	8.4	8.5	9.0	8.0	8.2	8.2	8.0	7.4	7.7	7.5	7.8
Thunder (Days)	0	1	0	0	3	3	7	7	11	8	3	1
Evaporation (mm)	8.5	9.0	11.2	11.8	11.5	12.4	11.9	11.9	9.9	8.5	9.1	8.4

Source: Meteorological Service of Jamaica

5.1.11.3 Wind

Winds at the Orange Valley AWS blow from an easterly direction as indicated by the wind rose in Figure 5.10. For most of the year the wind pattern is from northeast. Along the North Coast, by day, the sea breeze when combined with the northeast Trades result in an east-northeasterly wind averaging 15 knots (17 miles per hour). The effects of the Trades are lowest from December – March when sea breeze, combines with the northerly or northwesterly (which is associated with cold fronts) resulting in cooler temperatures.

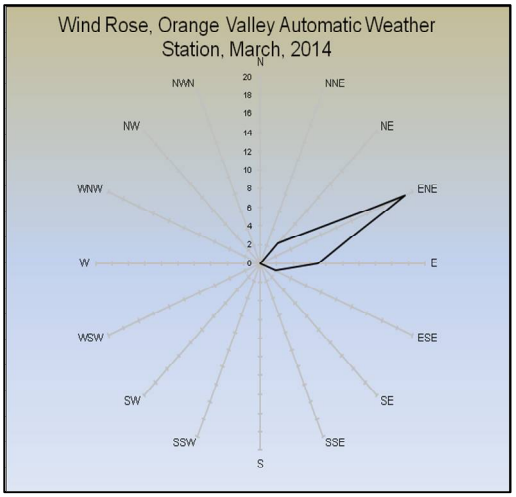


Figure 5. 10: The 24-hour mean wind direction at the Orange Valley, Trelawny Automatic Weather Station, 2014 March

Source: Meteorological Service of Jamaica

5.1.11.4 Air Quality

This section addresses the Project Site's characteristics with respect to air quality that includes the physical and regulatory setting, a description of the potential baseline conditions which determine potential impacts to existing air quality due to Project construction, operation and maintenance. The section also attempts to evaluate possible impacts of the existing operation on local and regional air quality due to any changes that might occur with respect to site related emissions. The analysis was conducted based on guidance provided by the Ambient Air Quality Guideline Document (Guidelines Document) for the Natural Resources Conservation Authority (Air Quality) Regulations (2006) under the Natural Resources Conservation Authority (NRCA) Act (Table 5.7).

Air Pollutants of Concern

Air quality is affected by the rate of pollutant emissions and by meteorological conditions including wind speed, atmospheric stability and mixing height which all affect the atmosphere's ability to mix and disperse pollutants in air. Variations in air quality may be influenced by changes in pollutant emissions

Table 5. 6: Criteria pollutants for Jamaica

Pollutants	Characteristics	Health Effects	Major Sources
Ozone (O^3)	A highly reactive photo-chemical pollutant created by the action of sunshine on ozone precursors (primarily reactive hydrocarbons and oxides of nitrogen). Often called photochemical smog.	Eye Irrigation Respiratory function impairment	The major sources of ozone precursors are combustion sources, such as, factories and automobiles, and evaporation of solvents and fuels.
Carbon Monoxide (CO)	Carbon monoxide is an odourless, colorless gas that is highly toxic. It is formed by the incomplete combustion of fuels.	Impairment of oxygen transport in the blood stream. Aggravation of cardiovascular disease. Fatigue, headache, confusion, dizziness. Can be fatal in the case of high concentrations.	Automobile exhaust, combustion of fuels, combustion of wood in the woodstoves and fireplaces.
Nitrogen Dioxide (NO^2)	Reddish-brown gas that discolors the air, formed during combustion.	Increased risk of acute and chronic respiratory disease.	Automobile and diesel truck exhaust, industrial processes, fossil-fueled power plants
Sulfur	Sulfur dioxide is a colorless gas with a pungent, irritating odor.	Increased risk of acute and chronic respiratory disease.	Diesel vehicle exhaust, oil-powered power plants, industrial processes.
Particulate Matter (PM10)	Solid and liquid particles of dust, soot, aerosols and other matter which are small enough to remain suspended in the air for a long period of time.	Aggravation of chronic disease and heart/lung disease symptoms.	Combustion, automobiles, field burning, factories and unpaved roads. Also a result of photochemical process.

Table 5. 7: Ambient Air Quality Regulations for Jamaica, August 1996

Pollutant	Averaging time	Standard (Maximum concentration in $\mu g/m^3$)
Total Suspended Particulate Matter (TSP)(a)	Annual 24 h	60 150
PM_{10} (b)	Annual 24 h	50 150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual 24 h 1 h	80 Primary; 60 Secondary (c) 365 Primary; 280 Secondary 700
Photochemical oxidants (ozone)	1 h	235
Carbon Monoxide	8 h 1 h	10,000 40,000
Nitrogen Dioxide	Annual	100

a) TSP – all particles and aerosols with aerodynamic diameter of 100 micrometres or less and can be measured by the high volume sampling method
b) PM_{10} refers to particles with an aerodynamic diameter of 10 micrometres or less as measured by the PM10 sampler.
c) The secondary standards for sulphur dioxide are designed to protect public health and welfare. They represent the long-term goal for air quality and provide the basis for an anti-degradation policy for unpolluted areas of the country and for continuing development of pollution control technology.

Table 5. 8: Jamaica National Noise Standard

Jamaica National Noise Standards
(Extracted from the Recommendations for National Noise Standards for Jamaica, 1999)

The Recommended Zone Limits:

ZONE	7 a.m. to 10 p.m.	10 p.m. to 7 a.m.
Industrial	75 dBA	70 dBA
Commercial	65 dBA	60 dBA
Residential	55 dBA	50 dBA
Silence	45 dBA	40 dBA

Notes
The measurements are to be made at the property line from which the sound is emitted or at the nearest point possible beyond that line. If the source of the sound is on public property then measurements are to be made at a distance of between 3 m and 4 m from the source. This excludes the mechanical noise made by moving vehicles, but includes other noise (such as music) from such vehicles.

5.1.12 Project Site Baseline Air Quality

Given the current land use of disturbed vegetation (dry limestone etc.), , there are no sources of regulated air emission (e.g. industrial activities with stacks). Sensitive air quality receptors in the vicinity of the site are the immediate residential areas to the north and west. Additionally, there is the Salt Marsh Primary School within the 1 km radius of the project area to the west, but there is no hospital, nor a health centre. This EIA presents data for PM_{10} emissions which would be the most significant parameter at the location. Sampling was conducted at a single central location on the property (Station 1). The 24-hour result was, as shown in Table 5.9, 14.7 $\mu g/m^3$. It fell well within the National Ambient Air Quality Standard (NAAQS) standard of 150 $\mu g/m^3$ established by the United States Environmental Protection Agency under the authority of the Clean Air Act (42 U.S.C. 7401 et seq.) and the AAQS of Jamaica.

Table 5. 9: Particulate sampling result for the Dundee project site in Trelawny

STATION: #1				
Parameter	Initial	Final	Initial - Final	PM_{10}
	30/10/14	31/10/14		ug/m^3
Location(GPS)	18.291447 -77.420001			
Elevation (ft)	425'			
Elapsed Time (hrs)			23.99	
Sample				14.7
Equipment: Leyland Legacy Pump – Calibration : Bios Defender 530				

5.1.12.1 Noise

The EIA considers the existing effects of environmental noise on receptors adjacent to the proposed Project Site. Currently, there are no sources of environmental noise on the property. However, during project implication/construction there will be noise from machinery, traffic and possibly controlled blasting. Readings taken at the central location station on May 12 and 13 2015 and July 8 2010 are shown in Table 5.10. The readings on the Dundee property at 50.0 and 54.8 decibels both fell within the NRCA Noise Standard for residential development., however, they were understandably elevated at the locations along the Northern Coastal highway (68 and 69.2 decibels). The results of the noise sampling shows that baseline noise impact on the adjacent receptor community of Salt Marsh is insignificant but is expected to increase intermittently once development is implemented. It is not expected to exceed the permissible levels.

Table 5. 10: Noise sample results at the proposed project site at Dundee, Trelawny 2015 May 12 and 13 and 2015 July 8

STATION 1 (DUNDEE PROPERTY)			**STATION 1 (DUNDEE PROPERTY)**			**STATION 2 (DUNDEE ENTRANCE)**			**STATION 3 (COMFORT HALL)**		
Item	**Value**	**unit**	**Item**	**Value**	**Unit**	**Item**	**Value**	**Unit**	**Item**	**Value**	**Item**
Date	05/12/2015		**Date**	05/13/2015		Date	08/07/15		Date	08/07/15	
Time	2.05		**Time**	1.55		Time	3.11		Time	3.42	,
Run Time	00:1		**Run Time**	00:1		Run Time	00:1		Run Time	00:1	
Leq	50	dBA	**Leq**	54.8	dBA	Leq	68	dBA	Leq	69.2	dBA
Metre: 3M Quest Sound Pro SE/DL, type 2 sound meter						AMPROBE Model SM-70					

5.1.13 Climate Change

Climate change may be defined as distinct changes in measures of climate lasting for a long period of time[14] (CGSM, 2012). The on-going impact of extreme weather events (hurricanes, storm surges, tsunamis, floods and droughts) in coastal areas has given rise to specific concerns about the impact of climate change on coastal areas of Small Island States (SIDS) like Jamaica. This is because continued coastal development is very likely to exacerbate risk to life and property from sea-level rise and storms.
Some of the likely impacts of climate change include; loss of high value land; deterioration of coastal road infrastructure; degradation of beaches; disruption of livelihoods; and loss of tourism infrastructure. Much of the climate change impacts in Jamaica are likely to take place in the coastal areas. Based on the

14 http://www.pioj.gov.jm/portals/0/sustainable_development/jamaica_climate_change_paper.pdf Retrieved 2015 May 29

http://www.pioj.gov.jm/Portals/0/Sustainable_Development/STATE%20OF%20THE%20JAMAICAN%20CLIMATE%202012%20-%20POLICY%20MAKER,%20JAN%2029,%202012.pdf Retrieved 2015 May 27

topography of the island, the available land for development and settlement is limited. Consequently, the coastal plains have been extensively developed. Most of the urban centres, industries, tourist resorts and population are located in coastal areas. These areas are also used for agriculture, mining, recreation and waste disposal.

The Intergovernmental Panel on Climate Change (IPCC) on Small Islands and Climate Change (2007) reported that the likely impacts of climate change for the Caribbean (including Jamaica) include sea level rise of 0.19 to 0.58 metres by 2090; increased air temperatures of 0.48-1.06 degrees Celsius between 2010 and 2039; and precipitation change by a range of -14.2 to +13.7 between 2010 and 2039. The report states that, based on the scale of land surface to sea surface in small islands, the given air surface temperatures may be more open ocean surface temperatures and not land surface air temperatures.

A rise in sea level of 30-35 mm over the next 50 years raises concern for the low lying coastal areas of Jamaica which are characterized by high population densities, industrial, commercial and tourism development. Jamaica's ability to predict storm surge activity is limited by lack of data. However, some analysis has been done by Mona Geo-Informatics, University of the West Indies (UWI). Mona Geo-Infomatics modeled the impacts of storm surge and sea level rise for Jamaica (Figure 5.11).

The model is based on national-scale data and is therefore not optimized for local scales.

- The model is based on terrestrial topography. Other parameters such as local coastal conditions as well as off-shore bathymetry are not considered. Tropical storm characteristics necessary for storm surge generation are not considered either.
- Sea level rise assumptions are based on IPCC global calculations, and were not specific to the tropics or to Jamaica
- Storm surges assume omni-directional impact; actual impact may vary within parameters of models.

Values used reflect range of historical storm surge and tsunami on Jamaica. The model revealed that there will be "critical loss of land in the several parts of the island." The predicted loss of land area is 101.9 km² if the sea level increases by a 0.18 m rise and 416.4 km² for a 10 m increase. The areas that are most likely to be affected are Palisadoes, Portmore, Old Harbour Bay, Rocky Point/Portland Cottage, Black River, Savanna-la-mar and Negril (see Figure 5.11). The main region of impact would therefore be southern coastal areas.

Values used reflect the range of historical storm surges and tsunamis on Jamaica. The model revealed that there will be "critical loss of land in the several parts of the island."(Richards, 2008). The predicted loss of land area is 101.9 km² if the sea level increases by a 0.18 m rise and 416.4 km² for a 10 m increase. The areas that are most likely to be affected are the Palisadoes, Portmore, Old Harbour Bay, Rocky Point/Portland Cottage, Black River, Savanna-la-mar and Negril. The main region of impact would, therefore, be southern coastal areas.

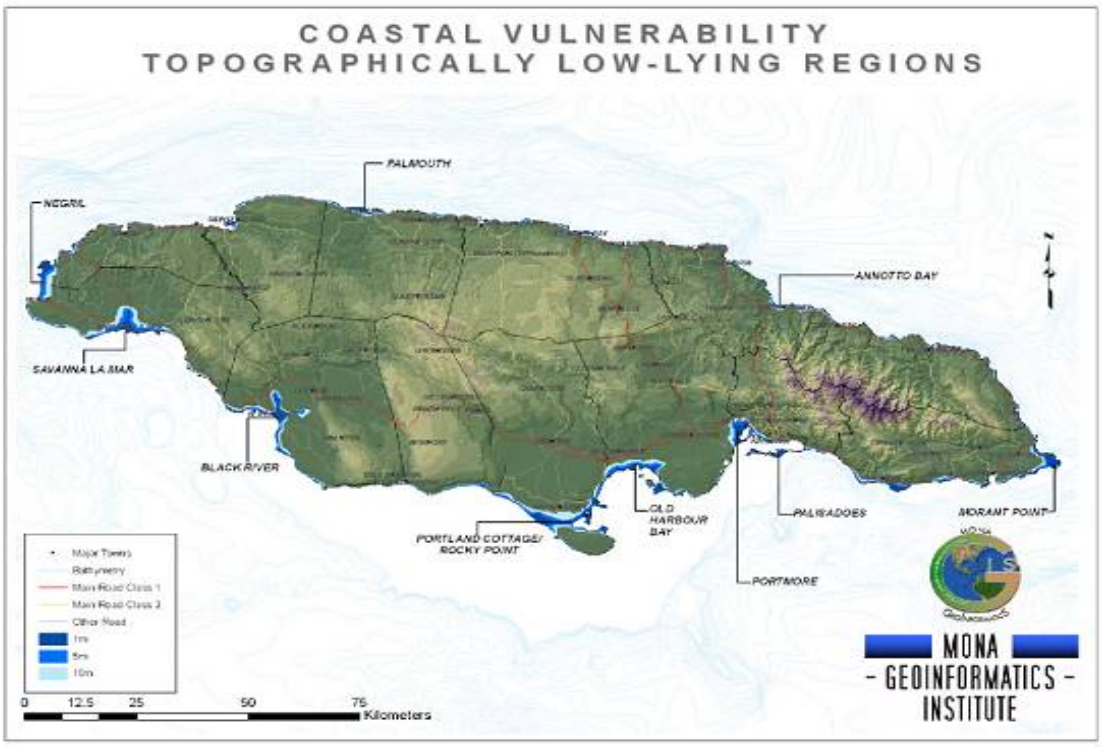


Figure 5. 11: Coastal vulnerability to the effects of sea level rise
Source:http://www.pioj.gov.jm/portals/0/sustainable_development/jamaica_climate_change_paper.pdf

An assessment was made of the potential vulnerability of Dundee utilizing the Caribbean Climate Online Risk and Adaptation (CCORAL) tool in which responses were to a series of relevant questions, as shown in Appendix 14.1. Based on the screening results it was concluded that the proposed project is a climate-influenced activity and a medium priority and will require further monitoring.

5.2 CARRYING CAPACITY

5.2.1 The Concept of the Carrying Capacity

The concept of carrying capacity is based on a general statement that any form of development within the carrying capacity of an ecosystem results in a sustainable development. In the context of a community, sustainability relates to the quality of life in that community. This refers to equilibrium within the economic, social and environmental systems in the community as all the basic present and future needs are being met as they relate to health, productivity and general wellbeing (Figure 5.12). In terms of urban planning, carrying capacity is the determined ability of the natural and artificial environment to support the demands of various uses as against the actual ecosystem services at the location.

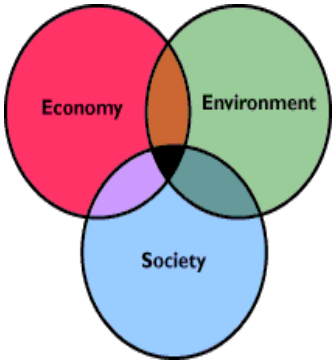


Figure 5. 12: How three parts of the ecosystem are linked

5.2.1.1 Ecosystem Services

What is the carrying capacity of Dundee to provide services? What are the service providing units (SPU)? Biodiversity plays an important role is the assessment of ecosystem services. Generally, these services may be classified into four types (1) Provisioning services, (2) Regulating services (3) Cultural services (4) Supporting services. Of these, the flora, in general and at Dundee contributes to the provisioning of services through global carbon sequestration, water infiltration, the water cycle, ensuring slope stability and provides a habitat for avifauna thus, may be considered as a Key Ecosystem Services Providers (ESP). With respect to the wetland ecosystem to the north, its main service is its contribution to water infiltration while other wetland services are limited. However, in the context of this project the aim is to trade off the existing ecosystem system services with the proposal in a sustainable manner as described above by adhering to existing environmental and planning governance structures and legislations.

Regulating Services

On the Dundee property, while the development will encompass the entire property, it is restrained due to the limitations established by (a) the northern wetland area and (b) the southern dry gully. The southern gully with its steep slopes provides a natural waterway for storm water flows towards the Flaming Pond, east of the property and adjacent to the Northern Coastal Highway. This gully (Gully #1) falls within the major storm water drainage area on the property that comprises 18.90 hectares (46.69 acres) which together with Gully #2, discharge into the Flaming Pond.

Gully #1 is located within the limestone hills, where slope gradients reach a high of over 30 degrees. The northern section of the dry forest area is gentle to moderately sloping with slopes of approximately 7 degrees to 19 degrees, while further south it is generally steep, that is, areas located south of the larger gully (Figure 5.1). Construction in these areas would be restricted, so the southern gully area is included in an amenity area of 2.43 hectares (6 acres) (including a bird sanctuary) while the eastern section of the wetlands that could accommodate approximately 12 single family residential units will be left in its natural state. These land use strategies ensure that the residential development falls below the required 30 habitable rooms per acre.

Provisioning Services

The property's habitat supports a fair degree of biodiversity. Bird species supported are migratory, endemic and resident. The habitat is not pristine as there are anthropogenic disturbances which impact the observed numbers.

An expected effect from the proposed sub-division is habitat loss, especially for birds and insects such as butterflies. This impact on migratory species may be greater i.e. winter and summer, as they tend to return to similar sites each year. However, the amenity area which would also function as a bird sanctuary, as indicated above, would reduce the impact of the development on biodiversity.

5.2.1.2 The Hamptons at Dundee and Sustainability

Sustainability, essentially, would mean that the development would be able to manage its own resources while minimizing the impacts on adjacent systems in order that that too would be sustainable. How would sustainability be assured with respect to the existing and the proposed community? The approach will be to make an assessment by establishing the sustainability indicators relevant to the proposed development. In practical terms, the community interacts with ecosystem elements. The objective is to achieve balance and equity among all components in a community. The level of sustainability is assessed and scored in Table 5.11.

Table 5. 11: Sustainability indicators and solutions

Elements of Sustaina-bility	Indicators	Issues Of Concern	Sustainable Solutions	Score	Geographic Scale
Environment	Potable Water	a. Access to supply b. Management of Storm water	NWC, Storage tank, Underground tank for units Storm water Management Plan – marine environment, Flamingo Pond, infiltration	90%	Community/ Local/ Regional
	Carbon dioxide	Fossil Fuel - (nonrenewable) – lighting, Gasoline – Fossil Fuel- travel (work, school), Development activities- building materials, infrastructure works	Accessible solar power systems (partial solution) Access schools and jobs in closest proximity, Connectivity Riding – walking trails Energy saving solutions, material selection Adherence to servicing schedule Conservation measures are implemented that help reduce the use of energy and natural resources.	80%	Community/ Local/ Regional
	Waste	a. Wastewater-	Onsite sewage Treatment Plant – treated effluent into marine environment Waste disposal at central municipal site,	90%	Com-munity

Elements of Sustaina-bility	Indicators	Issues Of Concern	Sustainable Solutions	Score	Geographic Scale
		b. Solid waste	implementing recycling options, composting		
	Ecosystem Health	Conservation	Promote biodiversity - Options to conserve wetlands, natural vegetation on steep slopes and along waterways, open spaces, replanting – using domestic trees and ornamentals, retaining mature trees, Reducing pollution of marine environment and adjacent water bodies Reduce air pollution – no burning of garbage, walk or ride for community activities and errands.	95%	Community/ local
Economy	Income and Expend-iture	Economic/ Financial sustainability – Residents	Employment options Opportunities for local businesses Investment Options Management of personal finances – savings, investments, retirement plans Management/ Financing of community development activities Investments in community employment opportunities Interest rates, inflation, return on investment, affordability	-	Community/ Local/ Regional
		Economic/ Financial sustainability-Developer	Return on Investment – funding options. Macroeconomic processes-interest rate options, inflation. Project development timetable	-	Community/ Local/ Regional
Social	Social Infra-structure	Transport, health, education, commercial (shopping)	Easy access to quality services – local, Falmouth, Montego Bay.	60%	Community/ Local/ Regional
	Wellbeing	Comfortable living conditions	Achieve harmony among community members including harmony between new and old communities. Ensure development meets expectation of purchasers as marketed. The physical, economic, social and cultural environment is enhanced. Public Occupational Health and Safety are assured.	-	Community
	Employ-ment	Available employment options Easy access to places of employment	Proximity to Falmouth, Ironshore, and Montego Bay.	75%	Community/ Local/ Regional

5.2.2 The Wetland Area

The Ramsar Convention defines wetlands as " areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres[15]. The Convention also classifies wetlands as: (a) Marine/Coastal (b) Inland (c) "Manmade". The site area would have likely fallen into the category Intertidal forested wetlands that include, mangrove swamps, nipah swamps and tidal freshwater swamp forests[16], based on 1961 aerial photographs. This coastal wetlands system was initially interrupted by the construction of the local road network and more recently the reclaiming of land for the construction of residential and commercial developments along the highway. Both actions diminished its role.

5.3 NATURAL HAZARDS

The hazards to which the property is potentially vulnerable are described below and illustrated in the Risk Matrix shown in Table 5:12

Table 5. 12: Risk matrix for the project site, Dundee, Trelawny

Probability				
	HIGH	Rock fall Erosion	Flooding (North)	
	MEDIUM		Hurricane	
	LOW	Land Subsidence	Earthquake	
		Low	Medium	High
		Impact		

In its present state, there is a high probability that flooding might occur in the northern, lowland area during intense rainfall events impacting residents on the property. There is a high probability of rock fall but with medium impact once the movement is managed during project implementation. The potential hazards are further discussed below.

5.3.1 Rock Fall Hazard

On the steeper slope to the south of the main gully there are large boulders and semi-intact rocks jutting from the hillside (Appendix 4.2). This is due to the geological fault which has contributed to extensive fracturing of the rock, resulting in limestone material being detached from the bedrock. The geological fault has increased the potential for rock fall, which is moderate to high; This situation will be

[15] http://www.ramsar.org/sites/default/files/documents/library/current_convention_text_e.pdf Retrieved 2015 May 29

[16] http://www.fao.org/docrep/003/x6611e/x6611e03d.htm Retrieved 2015 May 28

exacerbated if the land is disturbed for development. The removal of vegetation in this area should be managed as much as possible, since large, loose rocks can be easily mobilized down-slope to cause damage during intense and/or prolonged rainfall.

Areas to the north of the main gully have a lower potential for rock fall because large, loose boulders are less prevalent and the slopes are less steep than in the south. Smaller size boulders and cobble size material are observed but these will have low damage impact if mobilized.

In the event of an earthquake of similar or greater magnitude than the March 1 1957 earthquake, the potential for rock falls on the fault scrap of the project site is likely to be high. Currently the fault scarp towards the southern half of the property shows evidence of loose boulders and poorly detached rock on the steep slope. Ground shaking of the magnitude experienced in western Jamaica will result in loose rock being mobilized on the scarp slope.

5.3.2 Erosion Potential

There is also loose material in the form of small boulders, cobble and pebble sized limestone on the moderate to steeply sloping ground on the property. During high precipitation, the loose stones will be moved down the slope by storm water erosion. Once vegetation is removed for housing development, the potential for erosion will increase significantly. Eroded material from the higher slopes in the south will be deposited into the main gully and then transported into offsite drainage features such as the Flamingo Pond and the mangrove wetland in the north as well as into constructed drainage conveyance systems. Sediments entering gullies should be minimized in order to prevent sediment load into existing offsite water bodies.

5.3.3 Land Subsidence

In general, land subsidence may occur in karstic limestone areas due to the presence of caves and underground cavities. The Montpelier Limestone, which is described as chalky limestone and marls, does not form typical karst features and its physical characteristics does not favour the development of underground cavities. Therefore, it is unlikely that land subsidence would be a concern in this area.

5.3.4 Flood Potential

The potential for flooding exists around the mangrove areas where site drainage is poor. Storm water from the limestone hills in the south drains into the Flamingo Pond and mangrove areas to the north. The water table surrounding the mangroves is high and there is encroachment of the development into the mangrove, particularly on the western side (Appendix 4.2). With further encroachment and with the highway acting as a barrier to drainage flow towards the coastline, flooding is likely to occur.

There are two 600mm (2 ft.) diameter drainage culverts near the northern boundary of the property which drain storm water from the wetland and the highway. If the culverts are blocked and not properly maintained, then this will create backflow into the mangrove which is likely to cause flooding in areas surrounding the mangrove.

If the mangrove is a to be reclaimed by replacing the peat and mud with approved fill, then the wetland will lose a part of its function as a holding area for storm water which helps to reduce peak discharge. It therefore implies that drainage design will need to allow for measures that will minimize the impact of flooding given the loss of the wetland to reclamation.

The community recommends the following for flood mitigation from severe weather systems:

- Regular cleaning of gullies
- Increase in sizing and number of culverts particularly in the vicinity of the highway
- Improvements in garbage collection to reduce the volume of garbage entering gullies
- Public education and sensitization on recycling and reuse of garbage.

5.3.5 Earthquake Hazard

The only detailed account of earthquake damage in western Jamaican is the earthquake of March 1 1957, which struck the parishes of St. James, Westmoreland, Hanover and St. Elizabeth. The areas of greatest damage were St. James and Westmoreland. *The Star* of March 2 1957 and *The Jamaica Times* of March 9 1957 described the earthquake as the heaviest to hit Jamaica in 50 years, in reference to the January 1907 earthquake which partially destroyed the city of Kingston. The project site is near the border with St. James, the worst hit parish which suffered the greatest impact from the earthquake. The site is approximately 24 km from Montego Bay. There is no recorded the magnitude of the earthquake since Jamaica had not yet begun using seismic instruments to record earthquake events. However, historical data retrieved from the Earthquake Unit's website indicate that the intensity of the earthquake was 8 EMS (European Micro-seismic Scale).

Shepherd and Aspinall (1999) conducted seismic studies for Jamaica and classified the Dundee property and its surrounding areas as having a peak ground acceleration of 0.19 of gravity with a 10 percent probability of exceedance in 50 years (Figure 5.13). The International Building Code (IBC) adopted for Jamaica recommends that the Peak Spectral Site Response Acceleration for the project site and surrounding areas is 50 % of gravity for 0.2s short period waves and 20% of gravity for 1.0s long period waves with a 2% probability (2,475-yr Return Period) of exceedance in a 50- yr period (Figure 5.14).

5.3.5.1 Wetlands Area

The seismic risk map for Jamaica indicates that the spectral acceleration for short periods/two second periods for the maximum considered earthquake with a 10% probability of exceedance in 50 years, was deduced as $S_1 = 0.3g$. According to the IBC code (2003) and the IBC code (1997), the site can be classified as site class E (soft peaty soils). With soil modification, replacement/stabilization of the TOP1 (see Appendix 14.1), this could be upgraded to a site Class D.

5.3.5.2 Placement of fill

The Master Development Plan for the site requires the removal of peat and mud from the wetland area which will be replaced with limestone aggregate as fill. Based on soil tests conducted in the wetland, the estimated thickness for fill is 2.1 metres and estimated volume to be used for reclaiming the wetland is 72,563m^3

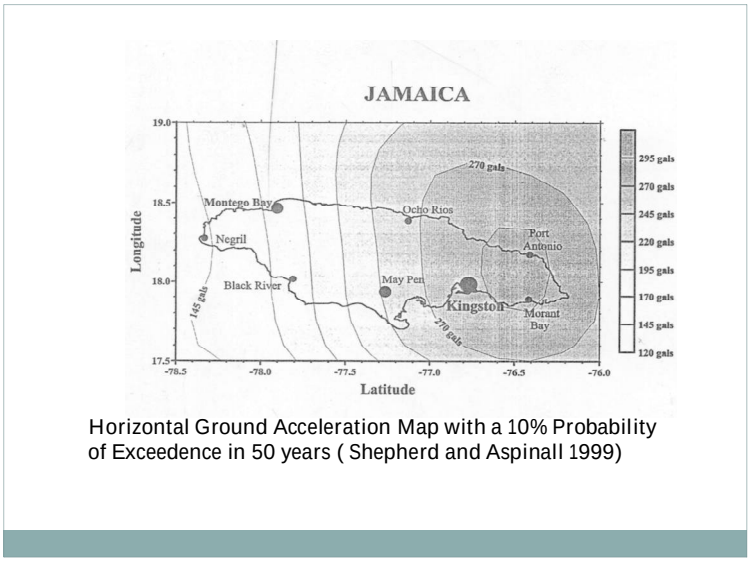


Figure 5. 13: Horizontal Ground Acceleration Map with 10% probability of exceedence in 50 years
Source: Shepherd and Aspinall (1999)

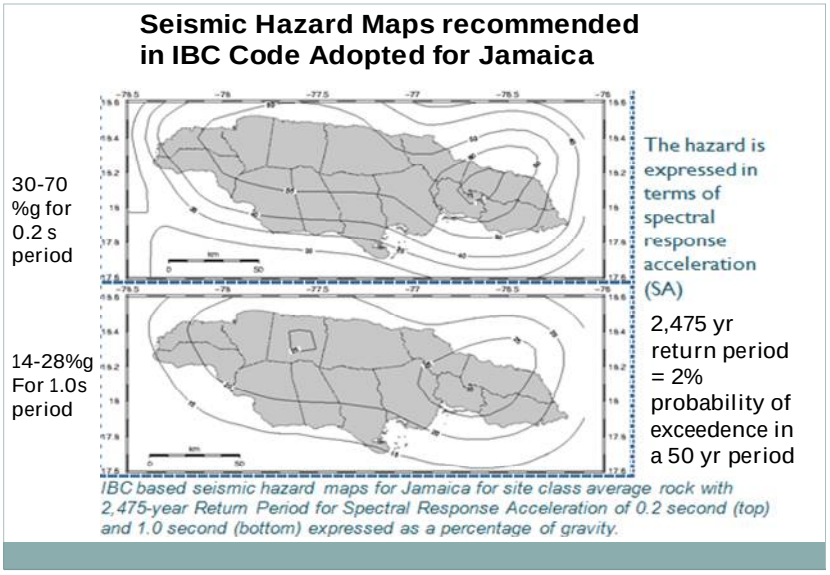


Figure 5. 14: Seismic hazards maps recommended in IBC Code adopted for Jamaica

Under seismic loading conditions, fill normally performs poorly, especially if not engineered or is poorly engineered. In the proposal for reclaiming a section of the wetland site, grading specifications for the placement of fill has been determined in order to minimize the impact of structures located in the fill (NHL Engineering, 2014).

5.3.6 Hurricanes and Tropical Storms

Jamaica is located in the northern Caribbean region between latitude 18° 36 N 175' S and longitude 76 ° 15' E and 78 22' W. It is also within the North Atlantic Hurricane Belt and therefore, in the path of tropical storms and hurricanes. Over the past two decades, tropical storms and hurricanes have done extensive damage to coastal and inland infrastructure. During the period, approximately seven severe weather systems have caused significant economic damage to the country. These include Hurricane Allen (1980), Hurricane Ivan (2004), Hurricane Dean (2007), Hurricane Sandy (2012), Tropical Storm Gustav (2008), Tropical Storm Nicole (2010). Severe tropical storm systems tend to cause flooding in low lying areas, while hurricane damage is generally caused by storm surges (coastal flooding) and wind. Recent hurricanes that have directly affected Jamaica from 1980 to 2008 are presented in Figure 5.15.

5.3.6.1 Hurricane Hazard History

Hurricane hazard data was obtained from the Social Development Commission (SDC) (2010). The Commission refers to the fact that the community of Salt Marsh was negatively impacted by hurricanes

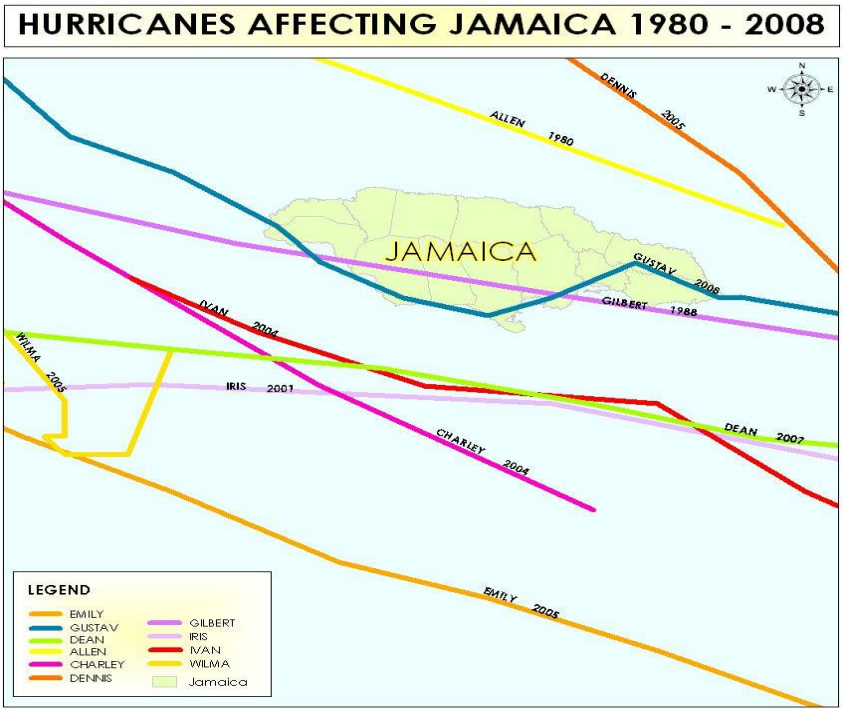


Figure 5. 15: Recent hurricanes that have impacted jamaica- 1980 – 2008
Source: ODPEM

Allen, Gilbert and Ivan in 1980, 1988 and 2004 respectively. The major impacts were coastal flooding (storm surge) resulting in damage to fishing equipment and coastal structures, wind damage (roofs of buildings; uprooted trees; displaced residents) as well as flooding from the Davis Pen to Salt March Gully. The Davis Pen to Salt Marsh Gully is located to the west of the Dundee Housing Project site and floods periodically during the passage of severe weather systems. It is reported that one (1) person died from drowning while trying to cross the gully during a severe storm event in the 1990's. Flooding from this gully is not known to have any negative impact on the project site.

Hurricane force winds and inland flooding from gullies and other drainage pathways are the major hurricane impacts for the project site. Storms surges from hurricanes are unlikely to have any negative impact, as the site is located approximately 250m from the coastline.

5.3.7 Environmental Issues and Hazard Vulnerability

Table 5:13 provides information on the impacts of Hurricanes Gilbert and Ivan on the Salt Marsh community.

Table 5. 13: Historical overview of disasters in Salt Marsh, Trelawny (Salt Marsh CDRMP)

HAZARD, YEAR	IMPACT	HOW DID COMMUNITY COPE
Hurricane Gilbert, 1988	Roof Blown off Loss of Electricity up to three (3) weeks Trees blown down Fishing Industry Persons displaced School used as shelter for 3 days Flooding from gully (Davis Pen to Salt Marsh)- Road impassable for few hours. Storage of food for a few days due to Falmouth being affected. Positive impact- Provide jobs for residents Storm Surge one day after – Fish Pots destroyed as nets, washed away damage to boats Storm surge deposited fish on roadway.	Fish Harvest and eaten Repaired fish pots Salt Marsh Primary School used as a shelter Children kept at Home City waited until water receded Travel further to get food e.g. Duncans
1990's (exact dates to be ascertained)	Flooding of Davis Pen to Salt Marsh Gully- 1 person died from drowning from crossing flooded waterway. Car washed away with 2 persons who were rescued. (Grandson awarded for Bravery)	
Hurricane Ivan 2004	Loss of electricity for two weeks Loss of water for less than one week Fruit trees/blown down Minor Flooding	Use Lamp, Candles Water Stored

Source: Social Development Commission (2010)

Seventy percent (70%) of the respondents in the survey indicated that the community is susceptible to natural disasters. About 62.9% of the respondents indicated that hurricane was the most common natural disaster. Flooding was the second highest (31.3%) followed by earthquake with 2.6%. Freak storms and mudslides/landslides both recorded similar percentages of 0.4%. Thirty-eight percent (38%) of the respondents indicated that the most recent natural disaster occurred 7-12 months prior to the survey.

5.4 ECOLOGICAL ANALYSIS

An assessment of the site's flora and fauna was conducted on March 13 and 14 2015 in light of the proposed residential subdivision for the area. The wetland area to the north was treated separately in the assessment process as presented below. To the south, four habitat types were identified –Disturbed Disturbed Dry Limestone Forest Patch, Disturbed Forest patch, Disturbed Woodland and Extremely Disturbed Woodland Patch while the wetland area is vegetated by the typical black and white mangroves.

5.4.1 Bird and Vegetation Assessment Sites

Table 5. 14: Bird and vegetation assessment sites on the Dundee property, Trelawny

Location Code	Habitat Type	Comments
1	Disturbed Dry Limestone Forest Patch	Most westerly area visited. Area where charcoal kiln observed as well as other anthropogenic material. Clear signs of secondary and coppiced growth of trees. Most observed trees 10 – 15m in height
2	Disturbed Forest patch	which seemingly is the border of the property. Again signs of anthropogenic activities but noticeably taller trees (15 – 25m) observed in the area.
3	Disturbed Woodland	Clear signs that there has been prior removal of vegetation. There is a dominance of shrubs in the area, and only a few emergent trees (most less than 15m)
4	Extremely Disturbed Woodland Patch	Areas closest to access points and areas where active charcoal kiln was observed. Greatest level of human disturbance from wood cutting as shown on Figure 5.16.

Table 5. 15: List of observed species on the Dundee property, Trelawny

#	Scientific Name	Common Name	Status	DAFOR	Other
1	*Gliricidia sepium*	Quick Stick	Native	O	None
2	*Samanea saman*	Guango	Native	O	None
3	*Inga Vera*	Panchok	Native	O	None
4	*Zanthoxylum martinicense*	Prickly Yellow	Native	R	None
5	*Bursera simarouba*	Red Birch	Native	F	Fruiting
6	*Guazuma ulmifolia*	Bastard Cedar	Native	O	Fruiting
7	*Blighia sapida*	Ackee	Introduced	O	None
8	*Haematoxylum campechianum*	Logwood	Native	F	None
9	*Bauhinia divaricata*	Bull Hoof	Native	O	Flowering
10	*Magnifera indica*	Mango	Introduced	O	Fruiting
11	*Melicoccus bijugatus*	Guinep	Native	F	None

#	Scientific Name	Common Name	Status	DAFOR	Other
12	*Tecoma stans*	Quick Wilt	Native	O	Flowering
13	*Matayba apetala*	Cobywood	Native	O	None
14	*Guaicum officionale*	Lignum vitae	Native	R	None
15	*Comocladia pinnatifolia*	Maiden Plum	Native	O	None
16	*Cedrela odorata*	West Indian Cedar	Native	R	None
17	*Leucaena leucocephala*	Lead Tree	Native	R	None
18	*Coccoloba* sp.		Native	R	Fruiting
19	*Pimenta dioica*	Pimento/All Spice	Native	R	None
20	*Ficus membranacea*	Fig	Native	O	None
21	*Allophylus comina*		Native	R	None
22	*Manilkara zapotilla*	Naseberry	Native	R	Fruiting
23	*Morinda citrifolia*	Noni	Introduced	R	Fruiting

Key: D – dominant; A – abundant; F – frequent; O – occasional; R – rare

Table 5. 16: Habit Survey - GIS points

GPS Point Number	Label	Latitude	Longitude	Habitat Description
392	A	18.487453	-77.699766	Disturbed Dry Limestone Forest
393	B	18.488579	-77.699152	
394	C	18.486863	-77.70052	Disturbed Woodland
395	D	18.486606	-77.699429	
398	E	18.487005	-77.698254	
399	F	18.487132	-77.697398	Extremely Disturbed Woodland Patch
400	G	18.487768	-77.697029	
396	H	18.486125	-77.697783	Disturbed Forest Patch
397	I	18.484944	-77.69783	

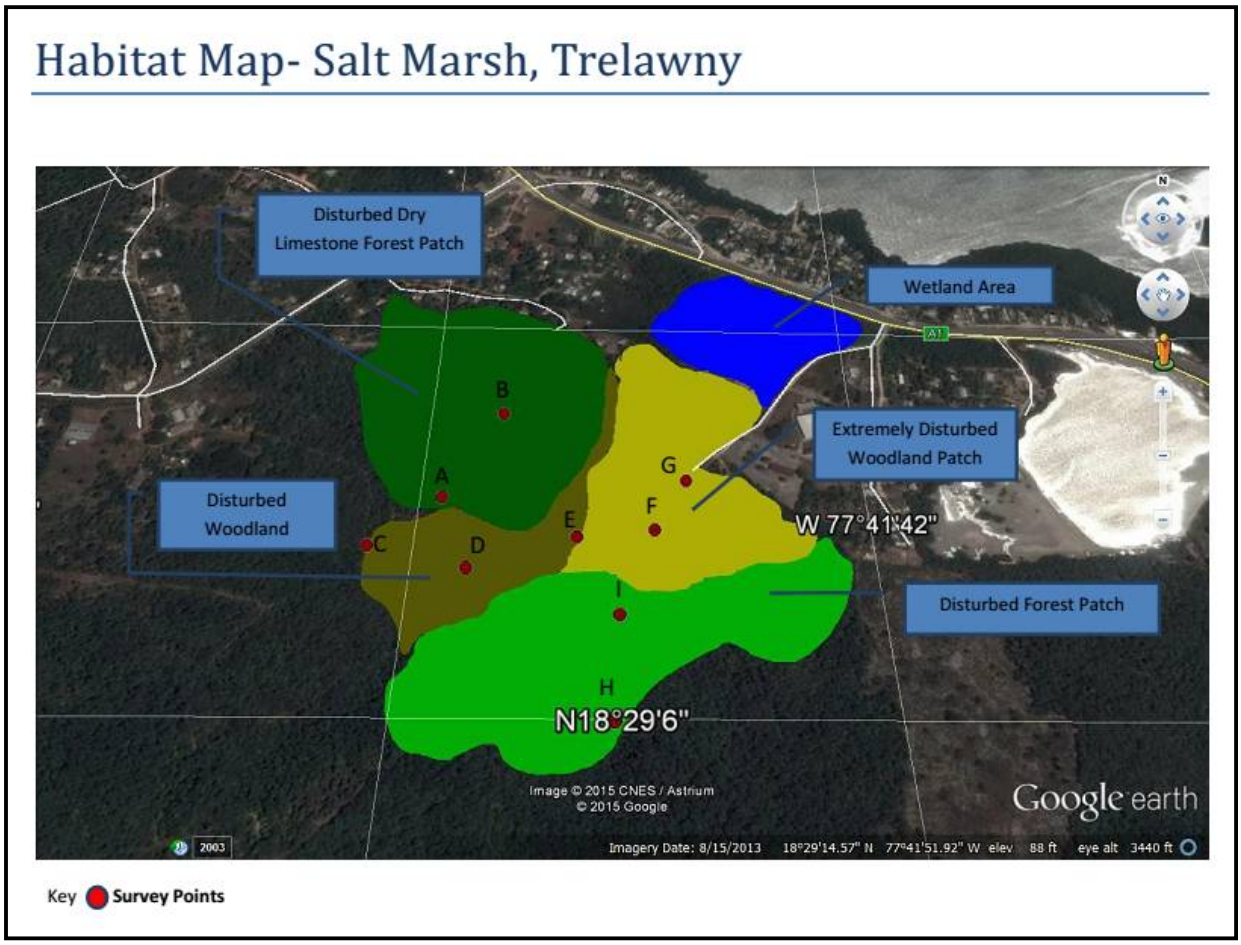


Figure 5. 16: Habitat Map for the site of the proposed development and adjacent area

5.4.1.1 Wetland Area - Flora

The entire northern development area, inclusive of the wetlands is approximately 4.7 hectares in area. Of this parcel of land, approximately 1.3 hectares is dry land, characterized by modified dry limestone vegetation. The remaining area (3.4 hectares) is occupied by wetlands. The wetland area is dominated[17] by white mangrove growth (see Appendix 4.2), with occasional representations of black mangroves[18] *(Avicennia germinans)* being observed along the periphery of the wetland area. The white mangrove stands bordering the western, southern and eastern boundaries of the wetland area were fairly mature (being between 4-5 meters tall) while examples observed towards the centre of the wetland were younger and much shorter (under 2 meters).

[17] Dominant designation under the DAFOR abundance scale

[18] Occasional designation under the DAFOR abundance scale

5.4.1.2 Mortality observed in the Wetland area

Remnants of what appear to be mature white and black mangrove trees were observed scattered and overturned around and within the wetland area This suggests that an undefined mortality event significantly affected the population, resulting in what appears to be a process of re-colonization by white mangroves (see Appendix 4.2). Growths of *Typha domingensis*[19] (Appendix 4.2) vegetation were also frequently observed within the wetland area, although they were confined to the outskirts of standing water areas present within the interior of the wetland. The central to eastern section of the wetlands has the least dense wetlands vegetation growth and a greater proportion of exposed standing water.

5.4.1.3 Faunal Assessment

In summary, the species observed towards the southern area of the Project Site were ten (10) endemics, three (3) endemic sub-species, thirteen residents (13) and two summer residents as shown in Table 5.17.

Table 5. 17: List of bird species observed from counts and transects

#	COMMON NAME	SCIENTIFIC NAME	STATUS
1	Black Whiskered Vireo	*Vireo altiloquus*	SR
2	Jamaican Vireo	*Vireo modestus*	E
3	Jamaican Tody	*Todus todus*	E
4	Jamaican Woodpecker	*Melanerpes radiolatus*	E
5	Jamaican Oriole	*Icterus leucopteryx*	ES
6	Red-Billed Streamertail	*Trochilus polytmus*	E
7	Caribbean Dove	*Leptoptila jamaicensis*	R
8	Yellow-faced Grassquit	*Tiaris olivacea*	R
9	White-Chinned Thrush	*Turdus aurantius*	E
10	Jamaican Euphonia	*Euphonia jamaica*	E
12	Bananaquit	*Coereba flaveola*	ES
13	Vervain Hummingbird	*Mellisuga minima*	R
14	Yellow Shouldered Grassquit	*Loxipasser anoxanthus*	E
15	Jamaican Lizard Cuckoo	*Saurothera vetula*	E
16	Mangrove Cuckoo	*Coccyzus minor*	R
17	Stolid Flycatcher	*Myiarchus stolidus*	R
18	Greater Antillean Bullfinch	*Loxigilla violacea*	R
19	Zenaida Dove	*Zenaida aurita*	R
20	Black Faced Grassquit	*Tiaris bicolor*	R
21	Common Ground Dove	*Columbina passerina*	R
22	Northern Mockingbird	*Mimus polyglottos*	R
23	Loggerhead Kingbird	*Tyrannus caudifasciatus*	ES
24	Antillean Palm Swift	*Tachornis phoenicobia*	R
25	Sad Flycatcher	*Myiarchus barbirostris*	E
26	White Winged Dove	*Zenaida asiatica*	R
27	Red Billed Streamertail	*Trochilus polytmus*	E
28	Smooth Billed Ani	*Crotophaga ani*	R
29	Grey Kingbird	*Tyrannus dominicensis*	SR

Key
Status: E – Endemic; ES – Endemic Sub-species; R – Resident; SR – Summer Resident

[19] Frequent designation under the DAFOR abundance scale

Table 5. 18 : List of migratory bird species from counts and transects

#	Common Name	Scientific Name	Status
1	Northern Parula	*Setophaga americana*	WM
2	Common Yellowthroat	*Geothlypis trichas*	WM
3	Black and White Warbler	*Mniotilta varia*	WM
4	Black Throated Blue Warbler	*Setophaga caerulescens*	WM
5	American Redstart	*Setophaga ruticilla*	WM

Key
Status: WM – Winter Migrants

Table 5. 19: Butterfly species observed

#	Common Name	Scientific Name	Status
1	Zebra	*Heliconius charitonius simulator*	R
2	Cloudless Sulphur	*Phoebis sennae*	R
3	Julia	*Dryas iulia delila*	R
4	Buckeye	*Junonia genoveva*	R
5	White Peacock	*Anartia jatrophae*	ES
6	Tropical Fritillary	*Euptoieta hegesia hegesia*	R
7	Eurema	*Eurema lisa euterpe*	R
8	Citrus Swallowtail	*Papilio demodocus*	R
9	Jamaican Mestra	*Mestra dorcas*	E
10	Jamaican Albatross	*Appias drusilla castalia*	R
11	Cadmus	*Historis acheronta cadmus*	R

Status: E – Endemic; ES – Endemic Sub-species; R – Resident

No nocturnal species were observed.

5.4.1.4 Other Animals – observed at all four sites

Snail – (Family: Pulmonata) shell evidence observed, and some live specimen seen during surveys
Wasp (1 species – possibly *Sceliphron assimile* DAHLBOM)
Honey Bee – *Apis* sp.
Grasshopper – *Orphullela punctata*

5.4.1.5 Wetland Area - Fauna

No swimming or tree living animal life were observed within the wetland area during the line transect traverses, with the exception of Fiddler Crabs (*Uca sp*) that were observed near to the exposed wet areas of the wetland. Further, only two individuals, representing 2 types of wading waterfowl were observed standing near to or flying over the wetland. These were the Great Blue Heron (*Ardea Herodias*) and the Great Egret (*Ardea alba*) (see Appendix 4.2). There were, however, frequent observations of birdlife at the boundary between the wetland and the adjoining dry limestone forest which include some already listed in Table 5.19.

Birds observed at this junction are listed below:

American Kestrel (*Falco sparverius*).
Red-tailed Hawk (*Buteo jamaicensis*).
Turkey Vulture (*Cathartes aura*).
Cattle Egret (*Bubulcus ibis*).

5.4.1.6 Summary

a. Vegetation

A total of 23 tree species were observed of which none were Endemic species.
Another ten (10) herbs and/or shrubs were observed from surveys of which one was Endemic.

b. Vertebrates

Avifauna
A total of 34 bird species were observed. The breakdown is as follows:

- 10 Endemics
- 3 Endemic Subspecies
- 5 Residents
- 2 Summer Residents
- 5 Winter Migrants

c. Invertebrates

Butterflies
A total of 11 species were observed:

- 1 Endemic
- 1 Endemic Subspecies
- 9 Residents

Additionally, 4 other types of invertebrates were observed on the proposed areas.

5.4.1.7 Conclusions

It is noted that the proposed area supports through its habitat, a fair number of floral and faunal species. With respect to bird species, the habitat supports migratory, endemic and resident species in fairly small numbers. As described the habitat is not pristine and the effect of anthropogenic disturbance impacts the observed numbers.

The expected impact from the proposed sub-division is habitat loss especially for birds and insects such as the butterflies. This may have a greater impact per se on some of the migratory species, i.e. winter and summer, as they tend to return to similar sites each year. As a result, the surveyor suggests that the retention of some areas of woodland/forests be done within the development phase.

In addition, as a part of the beautification strategy, similar herbs and plants as those observed can be used to promote habitat for some of the species of butterflies recorded during the survey.

5.4.1.8 Ecosystem Health function, value, threats and conservation significance for the area

The terrestrial habitats, as described in the report do provide some level of functionality for both floral and faunal species observed within them. The overall diversity is recognised to be low in abundance i.e. individual numbers was fairly high (for some species). The value of the area is its proximity to the coast and the connectivity it provides between the lowland hills, which are southerly and the coastal wetland (in the north). Noted also is the fact that though there is human disturbance and presence from developments (legal and squatting), the habitat is fairly connected across a large stretch of the northern coastline.

Threats for the area are predominantly habitat degradation through tree removal for charcoal burning activities and the use of the area for dumping of garbage which is somewhat exacerbated by the network of access points from the western side of the area. Additionally, the conservation value can be considered low for the terrestrial component based on the low level of endemism (flora and fauna), as well as, the current level of degradation of the vegetation, hence, there will be limited impact on biodiversity.

5.5 HERITAGE

5.5.1 History

Based on its assessment, the National Heritage Trust (JNHT) found no substantial historical artifacts on the site. The Trust also states that the archaeological evidence, the value of archaeological features and artifact assemblages are not considered significant enough to warrant national protection in situ. The JNHT therefore has no objection to the proposed (JNHT, 2015).

According to JNHT ,*(*2015*)*, the Dundee area was originally part of the parish of St. James, since the parish of Trelawny was only created in 1770. This area was sparsely settled as can be seen in Craskell and Simpson map of 1765 (Note the Flamingo Pond)(Figure 5.17). By 1804 several estates are recorded in the environs Figure 5.18). The Dundee property may have been settled around 1776. It should be noted that James Stothert of Cargen (Scotland) had two properties in the parish of Trelawny; the northernmost property was called Stothert and the southernmost Dundee. The southern property was a sugar estate with an animal mill.

James Stothart is recorded as owner in 1810. The property seemed to have remained in the Stothart (Stohert) family for several decades. In 1825-1826 William Stohart is recorded as owner. In 1840 the heirs of William Stothart owned Dundee covering 1461 acres. In 1844 this 644 acre property was owned by his heirs. By 1888 Dundee sugar estate was 850 acres. According to the 1888 Harrison map, Dundee was amalgamated with Greenside and covered 953 acres (Figures 5.18 & 5.19)

Figure 5. 17: Extract from 1765 map showing the Flamingo Pond and the unoccupied area that later became Dundee

Source: Jamaica National Heritage Trust (2015)

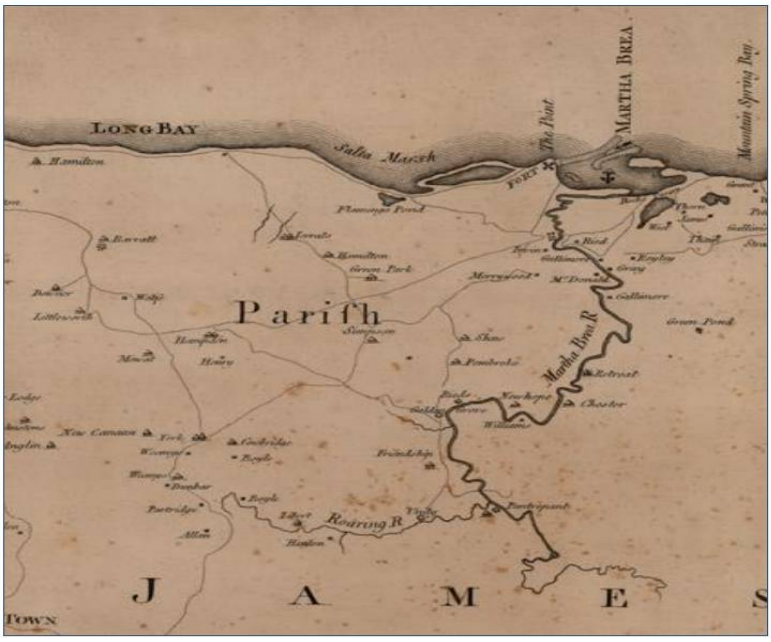


Figure 5. 18: Extract from James Robertson's Map showing the early owner of Dundee

Source: Jamaica National Heritage Trust (2015)

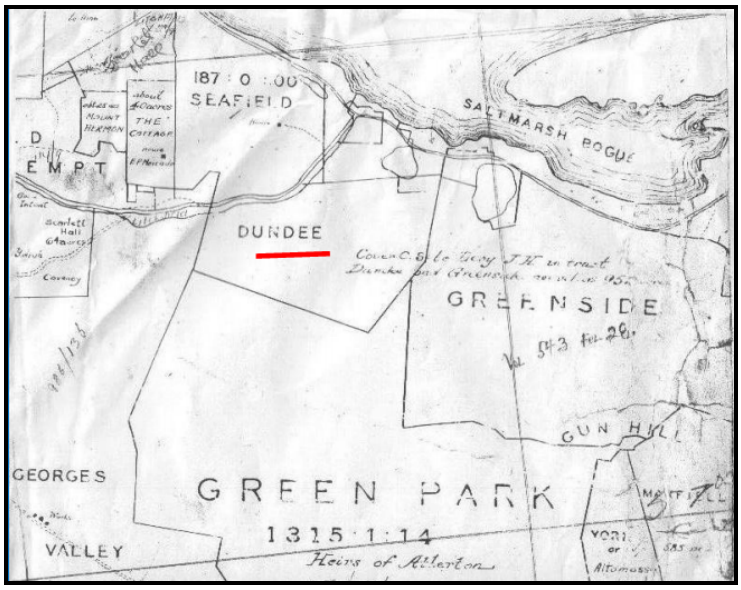


Figure 5. 19: Showing Dundee and Greenside in Trelawny in 1888
Source: Jamaica National Heritage Trust

5.5.2 Summary of some Cultural Activities

Figure 5. 20: Showing artefacts from the project site at Dundee
Source: Jamaica National Heritage Trust

Based on the images shown on Figures 5.20 to 21 there has been some squatting on the Project Site as evidenced by modern and historical artefacts observed. In addition, numerous spent shells were observed which suggests that the site is also used for bird hunting.

Charcoal kilns		Charcoal burning is the most prevalent cultural activity taking place on the property. Indications suggest that unarothorise persons have beeb making a livelihod from this practice for decades
Dumping		The property has been used as a dump with hotels using the area as a refuse area; for example the Half Moon hotel logo is seen on recovered ceramic.
Dwelling/ settlement		This vessel was found in area that was used in the past by squatters. An informal settlement is

		located to the northern section of the property.
Hunting (Birds)		Spent shells scattered on the ground is indicative of bird shooting activity in the recent past.
Lumbering	 	

Figure 5. 21: Showing summary of selected cultural actives on the Dundee property
Source: Jamaica National Heritage Trust

5.5.3 Conclusion

The area slated for the development has limited cultural material as this area seemed to have been used for pen keeping activities in the past, and as woodland for the sugar estate and possible provision grounds. The property also serves as a dump and several dirt roads and footpaths on the property not only serve to access these dump sites but also contiguous properties to the south, west and east.

5.6 SOCIO-ECONOMIC ENVIRONMENT

This section provides information on the social and economic characteristics of the receptor communities. The information was obtained from desktop research, field visits, a community survey and interviews with officers from the relevant government entities such as the Jamaica Constabulary Force, the Ministry of Education publications and the Jamaica Fire Brigade, The Ministry of Health, Western Regional Health Authority (WRHA) .

The SEIA model chosen for this assessment is an effective means of identifying or predicting the probable impacts of a development and recognizes levels of impacts at all stages of the project life cycle – Planning/Policy Development (Phase I), Construction/Implementation (Phase II), Operation/Maintenance (Phase III), and Abandonment/Decommissioning (Phase IV).

The socio-economic impact assessment will seek to understand the behaviours (past, present & future) of the individuals, communities, and agencies affected by the development. The social variables assessed are captured within the SEIA model (The Interorganizational Committee, 1994) and in the matrix in Table 5.23: These social variables are tailored to address the issued as far as is appropriate within the context of the following:

- Population Characteristics
- Community and Institutional Structures
- Political and Social Resources
- Individual and Family Changes
- Community Resources

Table 5. 20: Matrix relating project stage to social impact assessment variables

Matrix Relating Project Stage to Social Impact Assessment Variables				
Social Impact Assessment Variable	**Planning / Policy Development**	**Implementation / Construction**	**Operation / Maintenance**	**Decommissioning / Abandonment**
Population Characteristics				
Population Change	x	×	✓	×
Influx of temporary workers	x	✓	✓	×
Community and Institutional Structures				
Interest group activity	✓	✓	✓	x
Size and structure of local government	×	×	×	×
Historical experience with change	x	✓	✓	×
Employment / income characteristics	×	✓	✓	×
Employment equity of minority groups	×	✓	✓	×
Local / regional / national linkages	✓	✓	✓	×
Industrial / commercial diversity	×	×	×	×
Presence of planning and zoning activity	✓	✓	✓	×
Political and Social Resources				
Distribution of power and authority	✓	✓	✓	×
Identifications of stakeholders	✓	✓	✓	×
Interested and affected publics	✓	✓	✓	×
Leadership capability and characteristics	✓	✓	✓	×
Individual and Family Changes				
Perceptions of risk, health, and safety	✓	✓	✓	×
Trust in political and social institutions	✓	✓	✓	×
Residential stability	×	×	✓	×
Density of acquaintanceship	×	×	✓	×
Attitudes toward policy / project	✓	✓	✓	×
Family and friendship networks	×	×	✓	×
Concerns about social well-being	✓	✓	✓	×
Community Resources				
Change in community infrastructure	×	✓	✓	×
Land use patterns	✓	✓	✓	×
Effects on cultural, historical, and archaeological resources	✓	✓	✓	×

5.6.1 Regional & Local Setting

Trelawny is located in the county of Cornwall, saddled by the parishes of St. Ann to the east and St. James to the west (Figure 5.22). The coastal area of the parish is located between the resort towns of Ocho Rios and Montego Bay. Dundee lies within the sphere of influence of Falmouth, the administrative capital of the parish of Trelawny.

The Dundee property is located adjacent to the community of Salt Marsh. Salt Marsh forms the western boundary of the Greater Falmouth Area. Wetland areas are also prominent land use features in the area, mostly occurring along the coastline. Wetlands south of the highway have become isolated as they have been impacted by the construction of the coastal roads that separate them from the stands along the shoreline. This has served to minimize their true values and functions within the coastal ecosystem.

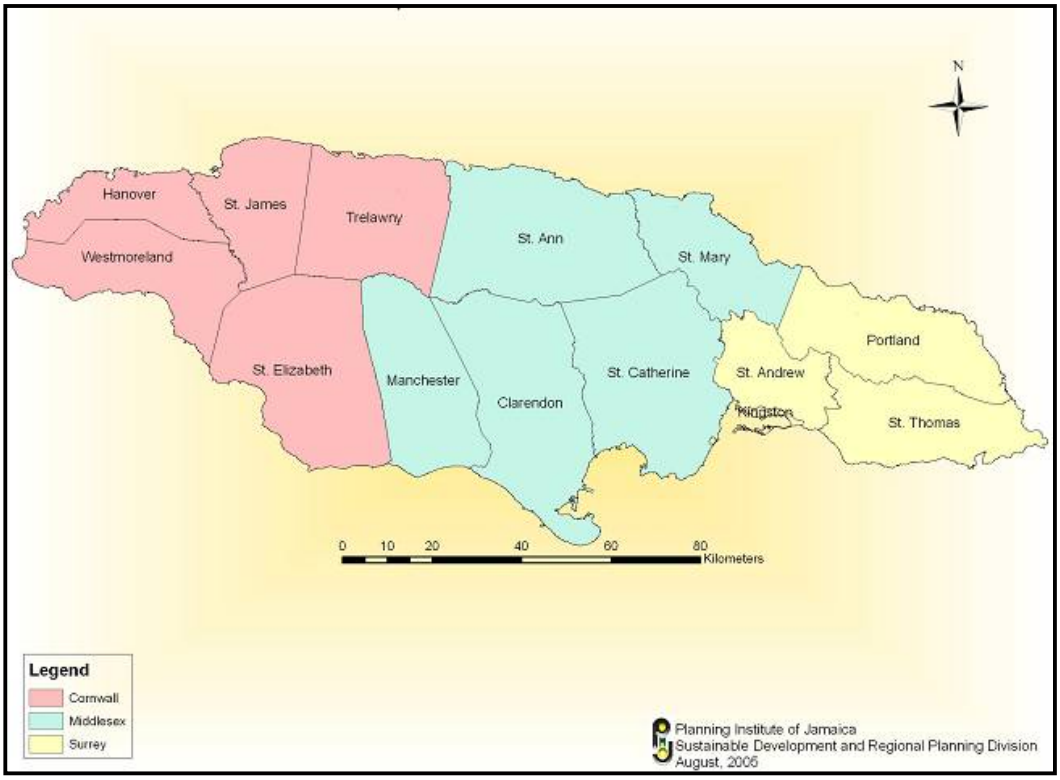


Figure 5. 22: Spatial boundaries of Jamaica – Counties
Source: Planning Institute of Jamaica

5.6.2 Urban and Rural Population Distribution

According to STATIN, urban centres are classified as regional, parish capitals, main towns and other towns. The Parish of Trelawny with total population of 73,066 and 75,264 in 2001 and 2011 respectively was declared 19.1 %(14,378) urban in 2011 down from 19.6% (14,290) in 2001, a negative trend that contrasts with the national scenario where the national average for urban population in 2001 stood at 52%, (1,355,334), increasing to 53.9% (1,453,438) in 2011. It appears unlikely that the negative urbanization trend will continue in the parish due to recent large scale housing developments such as those at Florence Hall and Coral Spring.

With a population of 8,686 in 2011, the population of Falmouth increased over that of 2001 when there were 8,188 inhabitants in the town. The Greater Falmouth area comprises Falmouth proper, Hague, Vanzie Lands, Cooper Pen, Rock, Coral Spring, Retreat Heights, Compound and Falmouth Gardens. Other major towns in the parish are Albert Town, Wakefield, Clarks Town and Duncans of which Clarks Town was the most populated (Figure 5.23)- although the town suffered a population decline of 24,03 % over the period 2001 to 2011 (3,953 and 3,003 respectively).

5.6.3 Hierarchy of Urban Centres in Trelawny

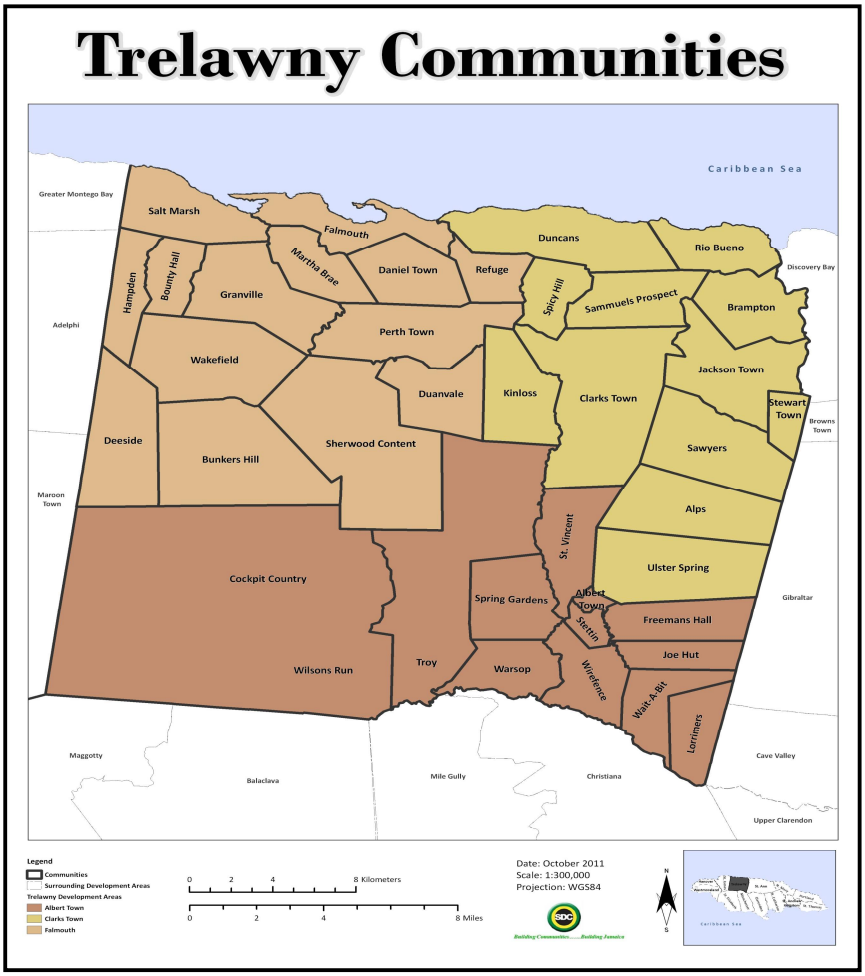


Figure 5. 23: Showing communities in the parish of Trelawny

Source: http://napdec.org.jm/html/wp-content/uploads/2012/01/Trelawny_Communities.jpg

Table 5. 21: Showing population growth of major urban centres along the North Coast

Population Centre	2011 Population	2001 Population	Margin	Percentage Change 2001-2011
Falmouth	8,686	8,188	498	5.73
Ocho Rios	16,671	15,769	902	5.72
Montego Bay	110,115	96,477	13,638	14.14
St. Ann's Bay	11,173	10,441	732	7.01

Source: STATIN

Major population centres along the North Coast include Montego Bay, Ocho Rios, St. Ann's Bay and Falmouth as shown in Table 5.24. The data confirms an increase of the population in the major urban centres along the North Coast since 2001. The population growth of Falmouth and Ocho Rios kept pace, growing by approximately 6%. Montego Bay experienced the highest population growth of approximately 14%.

5.6.3 Summary of Areas of Social Significance

The socio-economic, physical planning and spatial implications of the proposed development is significant within the context of an apparent latent demand for housing solutions in the Salt Marsh area of the parish, the limited capacity for further spatial growth in the town of Falmouth and the need to create opportunities for employment. The sustainable development of the proposed site is measured within the context of the carrying capacity of the receiving environment, specifically, the socio-demographic and political economic components based on their relevance in the SEIA process. As shown in Figure 5.24, the immediate Project Area is delimited within a 1 km radius of the site of the proposed development. The physical and ecological components of the proposal are addressed elsewhere in the EIA report.

The following are the primary issues relating to the development:

- The implications for carrying capacities - social services and amenities, physical infrastructure, employment and harmony
- The effects of the development on existing and adjacent populations and economic activities.
- Limitations and advantages of the physical environment.
- Its effects on the general growth and character of the area

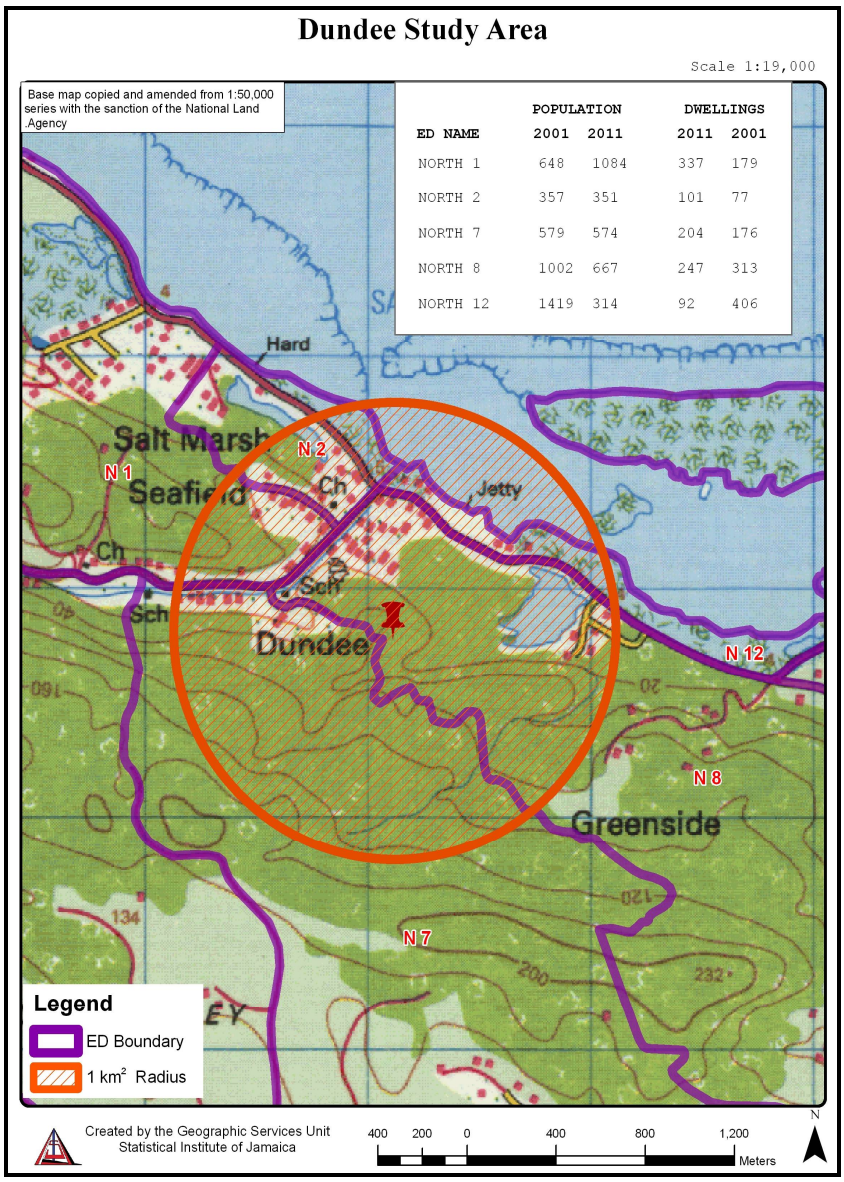


Figure 5. 24 : The 1 kilometre radius of the Socio-economic Impact Assessment Area for the proposed development

5.6.4 Population Characteristics

5.6.4.1 Demographics

According to STATIN (2012), the 2011 population of 2,697,983 reflects a positive population growth (0.36%) island wide over 2001 when the population stood at 2,607,632. With a population of 75,164, Trelawny was one of the least populated parishes in 2011, just ahead of Hanover where 69,533 persons were enumerated. There was a modest population increase of 2,098 at an annual growth rate of .30 % in 2011 over 2001. This rate of growth rate at 0.3 % was just below the national average.

Nationally, St. Catherine experienced the highest annual percentage rate of growth (0.72%) over the 10 year period. Along with St. James, at 0.51%, the annual percentage rate of growth for Trelawny was consistent with a higher growth rate among western parishes including Hanover (0.38 %) and Westmoreland (0.38%). The growth of the population of Falmouth by approximately 0.61 % (8,188 to 8,686), contrasted with the anemic population growth of approximately 0.07 percent within the EDs in the SEIA area (Figure 5.25).

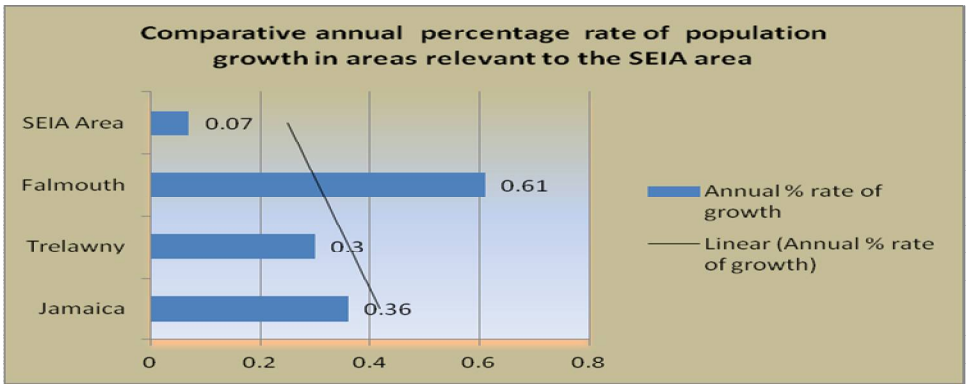


Figure 5. 25; Annual percent rate of growth in selected areas for the period 2001 – 2011

5.6.4.2 Population Density

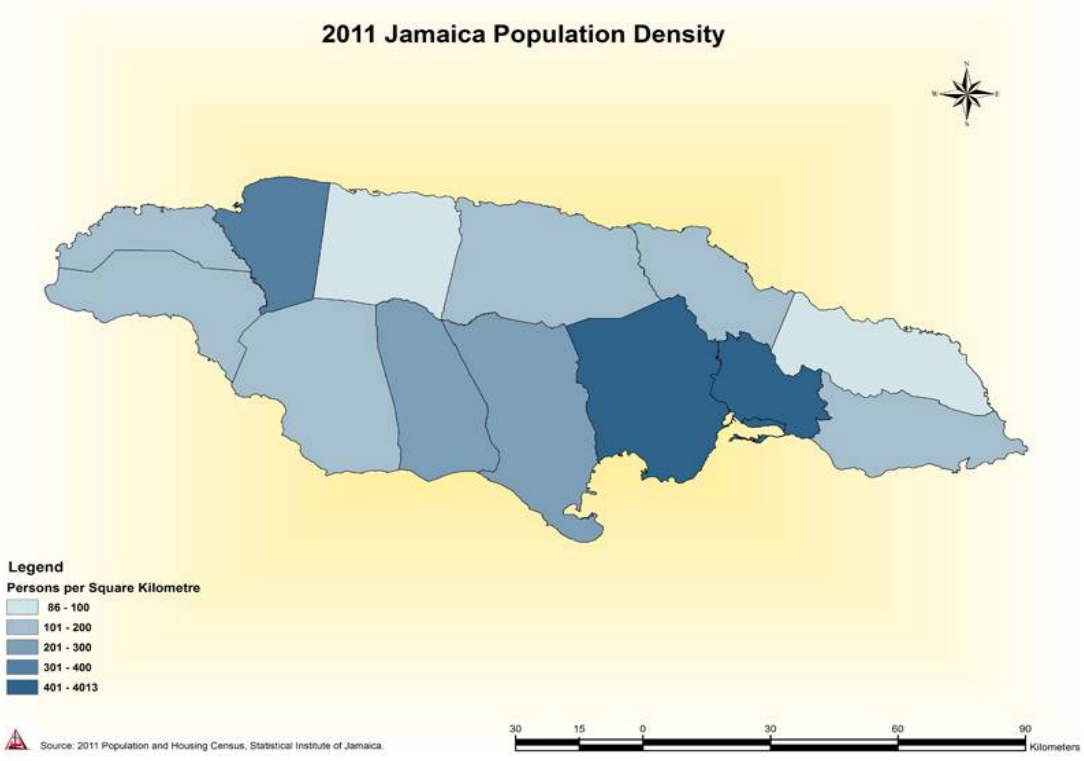


Figure 5. 26: Population density in Jamaica: 2011

According to the World Bank, in 2011, Jamaica had an overall density of 249 persons per square kilometre of land, however, Trelawny was one of the least densely populated of all parishes with an average of 86 to 100 persons per square kilometre. This is in stark contrast to the neighbouring parish of St. James that had 401-4013 persons per square kilometre of land, similar to the Kingston Metropolitan Area (Figure 5.26).

5.6.4.3 Sex Ratio

The sex ratio refers to the ratio of males to females in the total population (normalized to 100). In 2011, there were more males than females in Trelawny at a rate of 103 to 100 which contrasted with the national figures of 97 to 100 (more females than males). The ratio for the population that fell within the EDs was dissimilar to the parish trends as there were more females than male, this situation had actually worsened since 2001 with figures of 95 to 100 and 94 to 100 respectively. This is likely due to the employment opportunities that exist, especially in the tourism sector in adjacent parishes.

5.6.4.4 Dependency Ratio

The dependency ratio describes the number of persons in the population not economically active for every 100 persons who are. Nationally, the census period 2001-2011 was marked by lower fertility, declining numbers in the lower age groups and the aging of the population. According to STATIN (2012), based on the 2011 census, there were 702, 800 persons or 26 % of the population who were below the age of 15. This was 135, 000 less persons over the 2001 figure or a -16.2% decline. On the other hand, there was a positive change (8.80%) in the over 64 age cohort attributable to the aging of the survivors of the previous high fertility periods.

While the dependency ratio for the island stood at 57 in 2011, the ratio for the parish of Trelawny was 58. The EDs within the SEIA area was 112, possibly impacted by a high level of longevity and a high birth rate in the community.

5.6.4.5 Migration

In the absence of migration data from STATIN, the report deduces that given the close proximity of the Parish to the major urban centre like Montego Bay and Ocho Rios there would be some level of movement towards these towns in addition to the normal rural/urban migration into Kingston. However, there would also be some migration into the parish with the construction of the Trelawny Multipurpose Stadium and subsequent housing developments, such as, Holland Estate (1,200 units), Carol Spring (543 units) and Florence Hall (828 units).

According to the SDC (2010), an estimated 73.5% of household heads were from the parish of Trelawny, while the remaining were migrants from other parishes, with St James and Kingston and St. Andrew accounting for 7.7% and 4% respectively. Most of the respondents (95.2%) were living in the parish for ten or more years, 2.6% were living in the parish for six to nine years and 1.8% for one to five years. Only 0.4% were living in the parish for less than a year.

5.6.5.6 Population Projection

Assuming that the annual growth rates for the island of (0.36%), Trelawny (0.3%) and Falmouth (0.61) for the period 2001 – 2011 remain constant it, is projected that the population of Trelawny will reach 79,566 by 2030 and that Falmouth would grow to 9,749 (Table 5.25) based on the Exponential Growth/decay formula below:

$x(t) = x_0 \times (1 + r)^t$
x(t) is the value at time t.
x_0 is the initial value at time t=0.
r is the growth rate when r>0 or decay rate when r<0, in percent.
t is the time in discrete intervals and selected time units[20].

Table 5. 22:Population projection - Jamaica, Trelawny & Falmouth 2011-2030

LOCATION	ANNUAL % RATE OF GROWTH 2001-2011	2011	2015	2020	2025	2030
Jamaica	0.36	2,697,983	2,737,044	2,786,678	2,837,190	2,888,628
Trelawny	0.30	75,164	76,070	77,218	78,383	79,566
Falmouth	0.61	8,686	8,900	9,174	9,457	9,749

5.6.6 Community and Institutional Structure

5.6.6.1 Political Organization

The parish of Trelawny is divided into two constituencies- Northern Trelawny and Southern Trelawny. Salt Marsh/Dundee is located in the Trelawny North Constituency. Within this constituency there are five (5) electoral divisions – Duncans, Falmouth, Martha Brae, Sherwood Content and Wakefield. Salt Marsh/Dundee falls into the Falmouth Division.

5.6.6.2 Community Leadership

There is no active Citizens' Association in Salt Marsh, however, there is a football club. A Citizens' Association is an established way of promoting community leadership by fostering and maintaining the wellbeing of community members. It is likely with the establishment of The Hamptons at Dundee a Citizens' Association will be established.

5.6.6.3 Employment

As of April 2015, the national employment rate stood at 85.8% compared to the unemployment rate of 13.2%. The community survey data indicated that over 90 % of the respondents were employed. According to the community survey data, within the receptor community, the professions of community

[20] http://www.rapidtables.com/calc/math/exponential-growth-calculator.htm Retrieved 2015 June 4

members include shopkeepers, teachers, engineers, barbers, masons, taxi drivers and grounds men. It is anticipated that the immediate communities will be a significant source of construction workers. Additionally, materials and equipment will be sourced from the adjacent sources that are legitimate.

5.6.6.4 Economic Activity

Within the SIEA area land use is mixed featuring, small commercial businesses (Appendix 4.2). Except for an asphalt and aggregate company, there is limited industrial development in the area. Anecdotally, it was the opinion of one resident that Salt Marsh was the first area on the North Coast that produced carvings and offered fried fish for sale. These items along with seashells are also sold along the roadside.

5.6.7 Community Resources

5.6.7.1 Housing

The total number of dwelling units on the island grew from 723,041 in 2001 to 853,660, an increase of 18%. Further, the number of households increased from 748,326 to 881,078 or by 17.7%. The total number of dwelling units in Trelawny moved from 21,263 in 2001 to 24,741 in 2011 an increase of 16 %while the number of households increased from 21,732 to 25,207 or 16 %, The situation in Falmouth contrasted slightly to the parish scenario as the number of dwellings increased from 2,607 in 2001 to 2,987 which was a 14 percent increase. Households grew from 2,681 in 2001 to 3,041 in 2011 or by 13 per cent. It appears that the slower rate of growth of dwelling units in the parish capital when compared to the parish level is the result of residential developments occurring at other locations in the parish. The average household size of 3.4 at the parish level is just below the national figure of 3.5 and is even lower (3.2) in the parish capital.

The National Housing Trust's (NHT) *Housing Demand Report, Trelawny, 2009*identified a potential housing market of 2,344 persons. These persons had an average monthly income of $27,921.88. This income level is low and approximately 29% of the market would not qualify for a NHT loan. The most popular occupational groups identified were production related (28%), the agricultural sector (24%) and service workers (23%). The occupational distribution was skewed toward seasonal forms of employment. The potential effective demand was placed at 615 persons or 4% of the population. Salt Marsh was named among the top ten locations for likely future residential development.

There are fourteen (14) mainly wooden residential structures on the northern section of the property. The residents have indicated their willingness to vacate the property once the property owners require it.

5.6.7.2 Social Services and Amenities Infrastructure

Fire Protection

The Project Site is located within Area III of the four (4) administrative zones of the Jamaica Fire Brigade (JFB). Each area is further divided into thirteen (13) divisions that coincide with parish boundaries. Area II includes Portland, St. Mary, St. Ann and Trelawny. There are eight (8) fire stations in the zone but only one (1) in Trelawny

The role of the JFB is to protect life and property from fire or other disasters within the island and its territorial seas. Specifically, its fire suppression and other functions in the area include responding to structural, vehicle and brush fires, road traffic accidents, hazardous materials spills/releases (HazMat), urban search and rescue (USAR) and water rescue. The primary equipment are operational (firefighting and rescue) and utility vehicles. There are also three (3) fireboats, but these are assigned to the harbours in Spanish Town, Montego Bay and Ocho Rios.

The Falmouth Fire Brigade Station is the first responder for the area. The fire station has two (2) fire engines and an Ambulance. A search and rescue unit is currently in the garage for mechanical works. On an average the station receives in excess of 30 fire calls monthly. The calls are mainly for bush fires, structure fires and motor vehicle accidents.

Law Enforcement

The Jamaica Constabulary Force (JCF) is responsible for the maintenance of law and order, the prevention and detection of crime, the investigation of alleged crimes, the protection of life and property, and the enforcement of all criminal laws as defined by the Jamaican jurisdiction. The JCF also provides general assistance to the public as the case may arise. The current Corporate Strategy of the Jamaica Constabulary Force is the employment of community policing in its efforts to fight crime instead of the traditional style of policing. They are of the opinion that our modern age requires that the police act in partnership with the public and with other public, private and voluntary sector organizations to deliver collaborative services that address crime, fear of crime and other safety issues which concern communities[21].

In the administration of the operations of the JCF, the parishes are divided into five (5) areas. Trelawny falls in Area 1 along with St James, Hanover and Westmoreland. Apart from its regular policing, the activities of the Traffic Division of the JCF are of particular relevance to this proposed project. The Traffic Division is responsible for the monitoring of traffic and the actions of motorists along the Northern Coastal Highway.

The Falmouth Police Station serves the Project Area with its Local Policing, Operations and Community Safety activities. The Criminal Investigation Branch (CIB) is also According to the World Bank, in 2011, Jamaica had an overall density of 249 persons per square kilometre of land, however, , Trelawny, was one of the least densely populated of all parishes with an average of 86 to 100 persons per square kilometre. This is in stark contrast to the neighbouring parish of St. James that had 401-4013 persons per square kilometre of land, similar to the Kingston Metropolitan Area (Figure 5.26).

located at the Falmouth Police Station. Checks with the station indicate that crime within the area is mainly of a domestic nature.

[21] http://www.jcf.gov.jm/service/community-policing. Retrieved September 1, 2014

Schools

Public schools are grouped into six (6) Regions by the Ministry of Education. The schools in Trelawny fall in Region III along with St. Ann. The Salt Marsh Primary School with a capacity of 200 is the only public school that falls within the Project Area (based on the Ministry of Education's 2012 data) (Figure 5.27). The schools that fall within the within a 5 kilometre radius, and their 2012-2013 student capacities are shown in Table 5.23.

Table 5. 23: Showing public schools in a 5-kilometre radius of the project site, 2012-2013

School	Gender	Capacity	Enrolment	Student Teacher Ratio
Falmouth All Age	Co-ed	550	458	29:1
Granville Primary	Co-ed	280	371	22:1
Salt Marsh Primary	Co-ed	200	193	28:1
Holland High School	Co-ed	1200	1008	24:1
William Knibb Memorial High School	Co-ed	1000	1427	30:1

Source: Ministry of Education

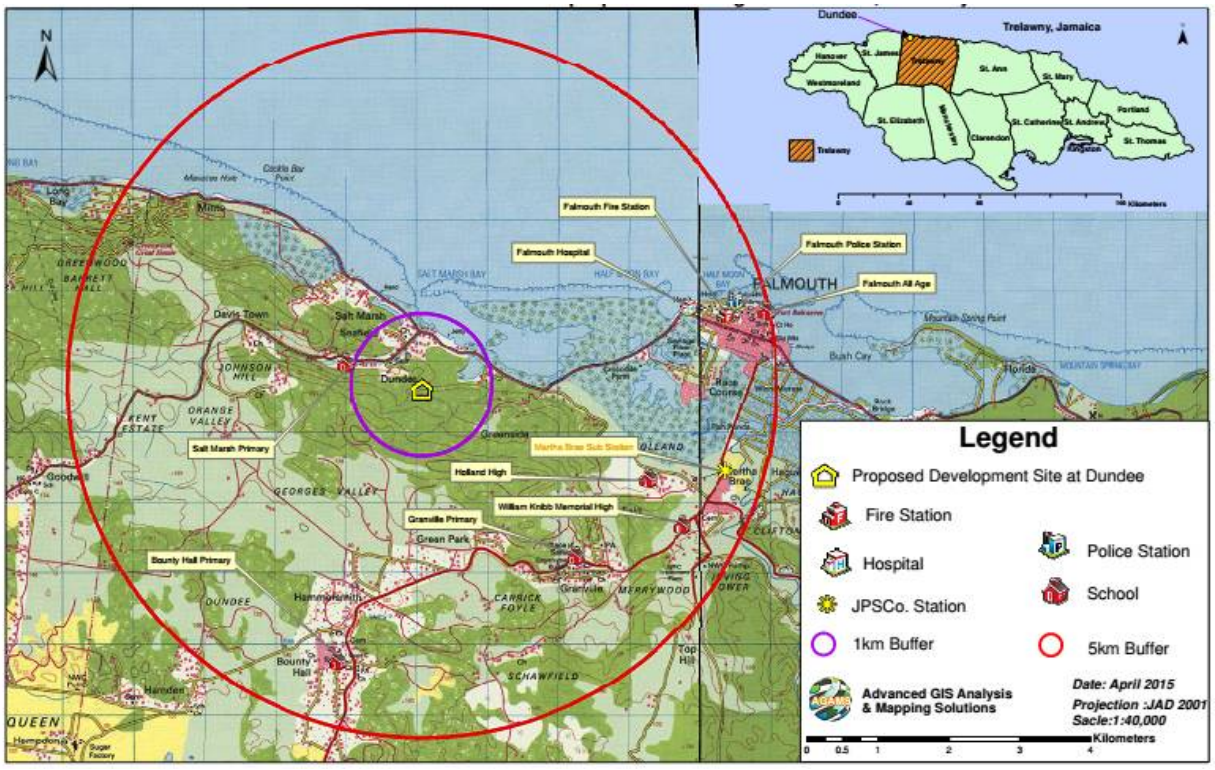


Figure 5. 27: Social services within 1 & 5 kilometre radius of the proposed developent site, Dundee, Trelawny

1. Early Childhood

Presently, the privately run Jacob's Well facility operated by the Jacob's Well Church provide basic school and day care services. During the 2014 to 2015 academic year there were 82 children enrolled in their day-care, pre-school and infant programme. The school also serves the adjacent communities of Hague, Falmouth, Stonebrook, Comfort Valley, Scarlett Hall and Martha Brae. Furthermore, the school

provides transportation. The Salt Marsh Primary school has also recently introduced an infant department.

2. Primary and All Age

Salt Marsh Primary (200 capacity), Falmouth All Age (550 capacity) and Granville Primary (280 capacity) are the schools in closest proximity to the Project Site (Salt Marsh and Falmouth). The latter two (2) are both operating below their capacities, however, this is more so in the case of Falmouth All Age that is 92 students below its enrollment capacity.

In 2012, the student: teacher ratio of 28.1:1 at the Salt Marsh Primary (ages 6-12) fell below the national standard of 35:1. The Falmouth All Age School (ages 6-15) has a student: teacher ratio of 29:1 (Table 5.23).

3. Secondary

There are two public high schools within the 5 kilometre radius of the site (Figure 5.27). They are the Holland (1,200 capacity) and William Knibb High Schools (1,000 capacity). The latter had exceeded its capacity by nearly 50 % during the 2012-2013 academic year, resulting in overcrowding with teacher pupil ratio of 30:1 that was above the required 20.1 teacher pupil ratio set by Ministry of Education (Table 5.26). Holland High School, however, was below capacity with 1,008 students enrolled.

It is anticipated that if the school age population (Ages 1 – 19) is estimated at 38% (based on Trelawny's population in 2011); at complete build - out there could be approximately 380 persons in that age cohort. The presence of several secondary in the adjacent parish of St. James also provides options for the potential secondary school age cohort of the proposed development.

5.6.8.4 Health Services

The Western Regional Health Authority (WRHA) provides primary healthcare to the population of Jamaica's Western Parishes via a network of four (4) hospitals and eighty-four Health Centres strategically deployed throughout the region. All health facilities are ranked based on the type and level of service which they provide. The four hospitals are:

Cornwall Regional Hospital (CRH) - *Type a* (St. James)
Savanna-la-mar Public General Hospital - *Type B* (Westmoreland)
Falmouth Public General Hospital - *Type C* (Trelawny)
Noel Holmes Public General Hospital - *Type C* (Hanover)
The health centres are distributed strategically. The Trelawny Health Services include the Falmouth, Duncans and Clarks Town Districts. There are three (3) Health Centres and one hospital (Falmouth) within this district. The development area is served by the Falmouth Hospital(Type C) which provides primary care services and basic secondary care services along with the Type IV Health Centre located at the hospital. The Type IV Health Centre administers the health programme of the parish and accommodates the medical officer of health and the staff for parish. The Trelawny Health Services, under its vision for the parish of *'Healthy People Living in Healthy Communities'*, provides the following Primary Health (Clinic & Community) Preventative Services:

- Water and Sanitation Monitoring
- Food and Nutrition Monitoring
- Immunization
- Family Health Care
- Prevention and Control of Locally Endemic Diseases
- Prevention and Control of Diarrheal Diseases
- Treatment of common Diseases and Injuries
- Health Education and Promotion
- Dental Health Care
- Mental Health Care
- Provision of Essential Drugs

In addition to the services offered by the Trelawny Health Services, the Project site is located in close proximity to the Type A Cornwall Regional Hospital (located in the adjacent parish of St. James), which provides comprehensive secondary and tertiary health care services and is also a referral centre for hospitals both in the public and private health systems.

The Falmouth Community Profile (SDC, 2010) indicates that 55.9% of the respondents in the Survey of Living Conditions, 2007, indicated that the main obstacle they faced in accessing primary health care was "waiting too long for the services". The projected population from the proposed development would acerbate the existing condition.

Recreation

According to the *Town and Country Planning (Trelawny Parish) Provisional Development Order (*2013*)*, there is a designated seaside town park in Salt Marsh, unfortunately, during our assessment, that amenity could not be identified. There is however, a roadside beach at the nearby Comfort Hall which is used by the community, images of which are shown in Appendix 4.2. A community playing field does exist along with nearby tourist attractions including the J. Charles Swaby Swamp Safari attraction in Falmouth. The safari is a 45-minute tour featuring aspects of the island's biodiversity such as crocodiles, iguanas and mangroves.

5.6.8 Utilities & Services Systems

5.6.8.1 Water Service

The Project Area generally falls under the jurisdiction of the Trelawny Parish Council which manages Rural Water Supply, however, the area is served by the NWC. Water supplied to NWC facilities at Martha Brae, Trelawny, will be significantly boosted to 11 million gallons per day following the completion of two major projects valued at approximately $1.6 billion. The projects will benefit 200,000 residents in Martha Brae and the adjoining communities who are currently served by NWC The projects will also benefit residents of districts in St. James and St. Ann that are situated close to Trelawny's borders[22].

[22] http://go-jamaica.com/pressrelease/item.php?id=4258 Accessed May 20, 2015

In 2011, approximately 44 % of the households in Falmouth accessed potable water piped into their dwellings, indicating that more than 50 % of the population obtained potable water from other sources such as catchments (17 %) and standpipes (14%). There were also those residents whose potable water was piped into their yards (12.77%). Based on the results of the community survey, the primary source of water for residents of Salt Marsh is piped into their yards.

5.6.8.2 Wastewater Service

In 2011, a survey of 25,207 households in the parish revealed that 50% of the households disposed of their wastewater via water closets that were not linked to sewers (STATIN, 2012) Other forms of wastewater disposal accounted for 44% of the total, of which pit latrines accounted for 38%.

5.6.8.3 Storm water

The Project Area generally falls under the jurisdiction of the Trelawny Parish Council. The NWA stipulates that (a) drainage systems should be designed to convey only storm water (b) The designing/construction of drainage schemes should be economical (c) The drainage plan should correlate with the proposed ground level plan to minimize the passage of high flows on roadways and properties.

As shown on Figure 4.7, storm water drains in two (2) main directions. Storm water from the watershed area to the south flows easterly into the adjacent Flamingo Pond, while much of the rest of the property drains into the northern wetland area and towards the sea by a series of culverts. The northern section of the property also captures storm water runoff from the Northern Coastal Highway. The Proposed Action would, therefore, manage storm water flows within the existing natural and manmade systems.

5.6.8.4 Solid Waste

The National Solid Waste Management Authority (NSWMA) is the agency responsible for administering integrated waste management programs, including arranging for solid waste collection services for residential and commercial clients. The NSWMA is divided into four (4) regions and Trelawny falls under WPM Waste Management Limited that also serves St. James, Westmoreland and Hanover. The collection schedule for Salt Marsh in once weekly on Wednesdays, although service is somewhat unreliable. The waste disposal site is the Retirement solid waste facility in St. James. It is anticipated that at a solid waste generation rate of 1 kilogram per person per day, approximately 1,000 kilograms of solid waste will be generated daily based the estimated population of 1,000 persons at total build out.

Table 5.24 shows the methods of solid waste disposal within the parish. The 2011 data revealed that majority of the respondents' dispose of their garbage via burning; however, a relatively high percentage (45%) of the population relies on the pick-up service.

Table 5. 24: Methods of garbage disposal in Dundee/Salt Marsh, Trelawny

Trelawny Households - Methods of waste disposal	Totals	Percentage %
Total	25,207	100

Trelawny Households - Methods of waste disposal	Totals	Percentage %
Regular disposal by garbage truck	9,069	35.98
Irregular disposal by garbage truck	2,367	9.39
Private Collection	62	0.25
Burn	11,815	46.87
Bury	243	0.96
Sea / River / Pond / Gully	55	0.21
In own yard	352	1.40
At Municipal Site	533	2.12
Other methods	343	1.36
Not Reported	368	1.46

5.6.8.5 Energy and Energy Conservation

Jamaica Public Service (JPSCo) is responsible for the national supply of electricity through a system of substations distributed island wide. Electricity is supplied to the area by means of a 24 kV line from the company's substation at Falmouth. The main source of energy for the JPSCo is oil however; the company's renewable energy portfolio also includes hydropower and wind power as part of its fuel diversification efforts. Two (2) of the nine (9) hydroelectric plants are located in Trelawny (Rio Bueno A and Rio Bueno B).

Net Billing is another option with the company which allows JPS customers who own renewable energy generators such as wind turbines and photovoltaic (solar) systems to not only generate electricity for personal use, but to sell excess energy to JPS at wholesale or "avoided cost" prices set by the Office of Utilities Regulation (OUR). The Proposed Development will provide for that option as photovoltaic systems will be offered to potential purchasers.

5.6.9 Other Services and Amenities

An overview of other services and amenities based on interaction with residents in November, 2013 provided an insight into the status of selected social services and amenities. At that time Internet service, solid waste collection and recreational facilities were listed as needing improvement. Services that were considered adequate were policing and postal (Table 5.25).

Table 5. 25: Status of selected social services and amenities, 2013

Social Services and Amenities	Need for improvement (Yes/No)
Postal	No
Transportation	No
Fire	No
Electricity	No
Telephone	No
Internet	Yes

Social Services and Amenities	Need for improvement (Yes/No)
Recreational	Yes
Solid Waste Collection	Yes
Police	No

5.6.10 Transportation & Traffic

The structure of the road network is very simple. It features the main Class A Northern Coastal Highway that forms the northern boundary of the property. This road is the primary east west arterial road along the island's North Coast that accommodates all the typical types of public and private vehicular traffic such as cars, tour buses and trucks.

Twelve-hour traffic counts conducted by the NWA in Duncans, Falmouth and the Clarks Town Road intersection with the Northern Coastal Highway on January 19 2015 yielded the results shown in Table 5.26.

5.6.10.1 Projection of Traffic Growth

The traffic count figures underscore the steady volume of traffic along the Trelawny stretch of the Northern Coastal Highway. Based on the standard recommended by the NWA, traffic is expected to increase at rate of 3% annually (Table 5.26).

Table 5. 26: 12-hour traffic counts: Falmouth-Duncans, Falmouth - Salt Marsh, Clarks Town - Duncans, Trelawny, January 19 2015

Date	Location	Direction		Volume		Total	Projection -5 years @ 3% growth
2015 January 19	Falmouth -Duncans	West		3634		7002	8117
			East		3368		
"	Falmouth-Salt Marsh	West		3968		7225	8376
			East		3257		
"	Duncans-Clarks Town	North		2107		3769	4369
			South		1662		

Source: National Works Agency

According to nationally accepted data contained in The Institute of Transportation Engineers (ITE) Trip Generation Handbook which outlines specific generation rates for planning purposes for all development types, the proposed development may be classified as mixed and would, therefore, fall in codes 210 (single family) and 220 (multi-family). Based on the projected 182 single family units and 84 multi-family units, it is expected that a total of 2,437 trips will be generated daily including 182 during the AM peak and 244 during the PM peak. This projected volume of traffic will have implications for traffic management and will be guided by the recommendations of the NWA.

5.6.10.2 Internal Layout & Parking Requirements

Access and Egress

The road design discourages movement of through traffic and improves site distances. The main access will be off the Northern Coastal Highway

Road Reservation

The width of road reservations has been designed based on recommendation from the Ministry of Transport and Works /NWA and NEPA.

Design Features

The internal road design would accomplish the following goals:

- Reduce speed
- Accommodate pedestrians;
- Accommodate large vehicles such as buses and solid waste removal trucks; and
- Maintain compatibility with existing infrastructure and adjacent land uses.
- Parking

6.0 PUBLIC PARTICIPATION

During the EIA process public involvement and consultation allowed for the views and concerns of stakeholders to be given due consideration. This is an essential element of the EIA/environmental permitting process that assists in ensuring a successful implementation of a development project. The objective of such a consultation and participation of affected stakeholders is to identify early in the EIA process, concerns about potential impacts of the proposed project in order to address such issues in the actual study, reflect stakeholder feedback and to offer opportunities to take corrective actions prior to project implantation.

6.1 COMMUNITY SURVEY

A community survey was conducted within the Project Area on March 18 2015 and July 08 2015. Based on the 2011 national census data produced by STATIN, there are five (5) Enumeration Districts (EDs) associated with the Project Area (1 km radius) with a total population of 3,014 persons (Figure 5.24). As a result of the lack of site specific data from STATIN, it was estimated that approximately one third of the population within the EDs reside in the Project Area. The structured questionnaire that was administered comprised nineteen (19) items divided into five (5) sections – housing and population, employment and income, social services and infrastructure, awareness of the proposed development/community concerns and historical sites/ monuments.

Due to logistical constraints a non-probability, convenience sampling method was used because it involves selecting respondents wherever they are found within the study area. As a result, there was no specified inclusion criteria required to be involved in the survey. The survey was administered to 32 residents in the Dundee/Salt Marsh area. Forty (40) residents from the towns of Greenside to the east of Dundee, Comfort Hall and Scarlet Hill to its west were also sampled. The results of the survey are presented in descriptive statistics as frequencies and percentages. The survey instrument and survey results are shown in Appendices 14.3 and 14.8 respectively.

6.1.1 Population and Housing

6.1.1.1 Population

The majority of the participants in the survey were male (Dundee - 53%, other communities -63%). It appears that persons tend to be permanent residents of the Dundee/Salt Marsh as only 4 persons (12.5%) from the sample originated from outside of the area (Kingston (2), Montego Bay, Martha Brae) and most have been residents of Salt Marsh for over ten (10) years.

6.1.1.2 Housing

In terms of tenure, most (53% in Dundee/Salt Marsh (Figure 6.1) and 90% in the other communities) own their houses.

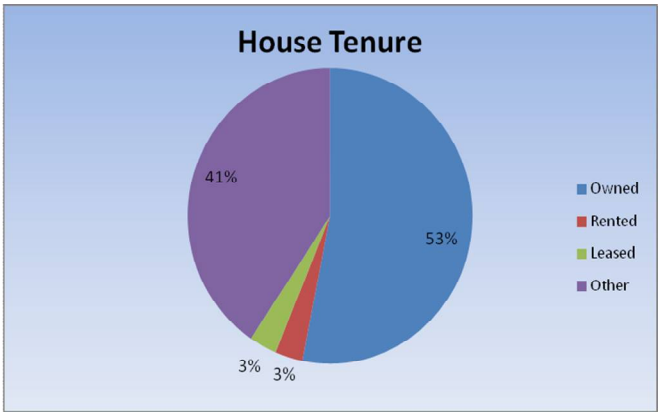


Figure 6. 1: Tenure within the Project Area of the proposed Dundee development

The survey points in Salt Marsh/Dundee essentially, points to a population of informal settlers within the survey sample. The construction materials for houses were predominantly block and steel (72%) followed by board (19 %). Regardless of the structure type, all of the respondents reported having water piped into their houses. In addition, the size of the dwellings (1-2 rooms - 44%) and the size of the households (1-3 persons - 38%) were relatively small.

6.1.2 Employment and Economy

The survey data point to local economic activities and the main areas of employment. At the time of the survey persons were employed within the communities as fisher folk, wood carvers and small business operators/shopkeepers. Persons in other occupations such as security officers, housekeepers and waitresses work outside of the communities within the tourism sector in the nearby tourist resort. The places of employment for construction workers were found to be more diverse. They indicated the nearby areas of Martha Brae and Montego Bay as their place of employment. In the adjacent communities there appears to be a significant number of retirees and less persons employed in the tourism sector when compared with the Salt Marsh community. Those employed mostly work within the communities. Income levels were relatively low with the majority (59 %- Salt Marsh and 48% -others) earning less than $10,000.00 week (Figure 6.2). The need for employment opportunities was reported as an urgent community need by respondents (34 %). No doubt the proposed development is considered a potential source of employment for local residents.

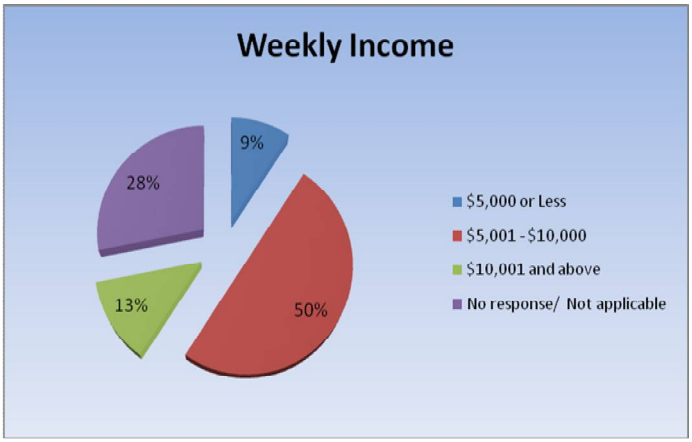


Figure 6. 2: Weekly income within the Project Area of the proposed Dundee development

6.1.3 Social Services and Physical Infrastructure

The Salt Marsh community, as indicated above, falls within the sphere of influence of Falmouth, therefore, it relies on the town for most of its social services. Respondents have indicated their desire for their community to be provided with primary health services (6%). With respect to Salt Marsh and the other communities the need for a community centre was expressed by 34 % and 22% of respondents respectively. While the Northern Coastal Highway offers high end road conditions for the public, the internal community roads in the Salt Marsh are generally in need of improvement as gleaned from 34% of the respondents in Salt Marsh (Figure 6.3).

4.1.1.1.1

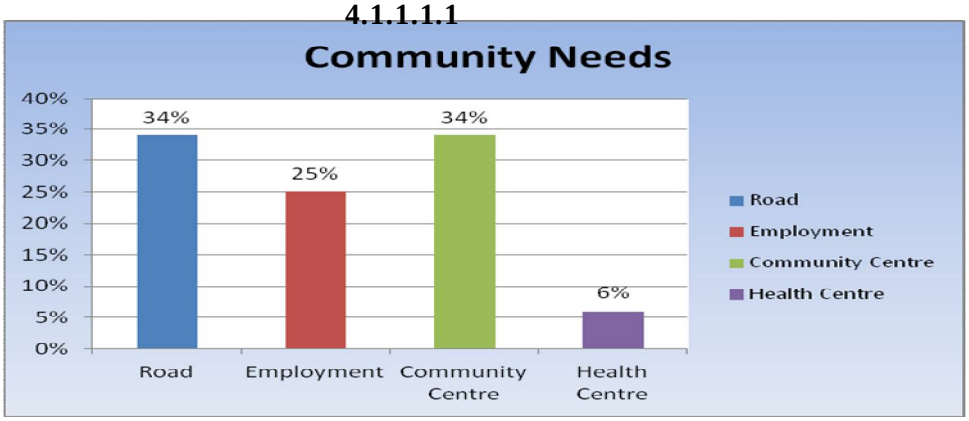


Figure 6. 3: List of community concerns based on a survey within the Project Area of the proposed development at Dundee

6.1.4 Local sentiments about the Development and community needs

Most respondents in Salt Marsh/Dundee and the adjacent communities indicated an awareness of the proposed development and pointed out employment opportunities (72% and 73% respectively) as the main benefits that are anticipated (Figure 6.4).

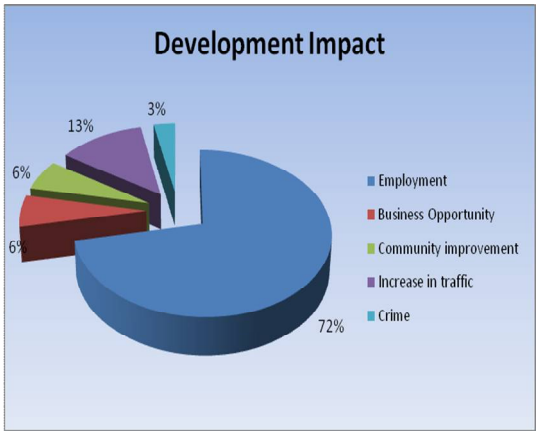


Figure 6. 4: Feedback on potential impact of proposed Dundee development: Dundee/Salt Marsh

In Salt Marsh/Dundee there were also some concerns that there might be an increase in traffic (13%). Others saw the potential for an increase in business opportunities (6%) and community improvement (6%), but there was minimal concern for an increase in crime (3%). The general sentiment was that the appropriate use for the property is housing. Moreover, there were no specific concerns raised for any potential negative effect of the proposed project on the environment, however, the presence of wildlife (birds) and flooding were mentioned as associated with the property.

6.1.5 Conclusions

The proposed development would positively impact the Salt Marsh community as there would be an improvement in the social and economic character of the area given the middle to upper income target market for the proposed housing units. The proposed Hamptons at Dundee would add value through the fostering of economic activities and economic growth. The nearby Greenside to the east is an example of a similar upscale community in the area. In addition to the findings of the survey, the development would also serve to improve the property tax base of the parish

The reliance on Falmouth for social amenities will be necessary, at least in the short to medium term since, except for the primary and infant schools, most of these community assets do not yet exist in the area. However, there was a general positive response to the proposal.

6.2 STAKEHOLDERS' CONSULTATION

Telephone and face-to-face interviews were conducted with community stakeholders and their responses are outlined in Table 6.1.

Table 6. 1:List of selected stakeholders and their comments on the proposed development

Name	Occupation	Contact date	Comments
Neville Miller	Resident of Salt Marsh	May, 2015	"Good for the area & also recommend that a play field be a part of the development".

Name	Occupation	Contact date	Comments
Novelet Miller	Resident of Salt Marsh	May, 2015	"Good for the development of the area".
Winston Reddish	Resident of Salt Marsh	May, 2015	"It would be a feasible idea and of great benefit to the community".
Tom Brown	Businessman	May, 2015	"Good for the area, however he would like to know where the entrance would be".
Lloyd Dunn	Resident of Salt Marsh	May, 2015	
Julette Duncanson J.P.	Resident of Salt Marsh	May, 2015	"It will be of great benefit to the community, however when it rains they walk through the land. I would like to know if there will be infrastructure in place to deal with this issue".
Renford Jackson	Retired Inspector of Police	May, 2015	"Good for the community and also would minimize crime in the area. It would provide employment; I give it my thumbs up".
Victor Black J.P.	Retired businessman	May, 2015	"Fully with the proposal as long as it is within the laws of the country and should not offend any citizen. Full speed ahead!!!"
Venicia Brown-Gordon	Vice Principal, Salt Marsh Primary School	May, 2015	Support for the proposal, fully aware that the school population would increase. An Infant Department is to be introduced at the school in September.
Garth Wilkinson	Councilor (Mayor of Falmouth	December, 2014	Gives his full support for the development

Source: Telephone and face-to-face interviews

7.0 IMPACT IDENTIFICATION

This chapter details the environmental consequences associated with construction and operation of the Proposed Project based on the assumptions and assessment guidelines outlined below. The chapter also rates the impacts, their significance, duration, and whether they are direct, indirect, short term or long term.

1. Physical Resources

a. Geology

The Proposed Action would normally have a significant effect on the environment if it would:

- Expose people or structures to major geologic hazards

b. Soils Resources

The Proposed Action would normally have a significant effect on the environment if it would:

- Cause substantial erosion

c. Surface waters

The Proposed Action would normally have a significant effect on the environment if it would:

- Substantially degrade water quality
- Contaminate a public water supply
- Cause substantial flooding or siltation
- Substantially alter surface flow conditions, patterns, or rates.

d. Ground Waters

The Proposed Action would normally have a significant effect on the environment if it would:

- Contaminate a public water supply
- Substantially degrade or deplete ground water resources

2. Air Resources

The Proposed Action would normally have a significant effect on the environment if it would:

- Violate any regulatory requirement of NEPA
- Violate any ambient air quality standard
- Expose sensitive receptors to substantial pollutant concentrations

3. Biological Resources

The Proposed Action would normally have a significant effect on the environment if it would:

- Substantially affect a rare or endangered species of animal or plant or the habitat of the species

- Interfere substantially with the movement of any resident or migratory wildlife species
- Substantially diminish habitat for wildlife, or plants

4. Social Impact Assessment

The Proposed Action would normally have a significant effect on the environment if it would:

- Substantially exceed carrying capacities of community resources
- Present risk to human health and safety
- Present a risk to historical and archeological heritage
- Substantially affect the visual and landscape views of receptor communities

5. Environmental issues and Definitions

Direct effects - are caused by the action and occur at the same time and place.

Indirect effects - are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Magnitude & Intensity - Any development which can cause effects over a wide area, to a large number of receptors, or effects which are of an intensity that is significantly in excess of those normally experienced.

Duration - Any development which can cause impacts for a long period of time (more than one generation) or which will cause permanent changes to any aspect of the environment.

The checklists below rate impacts identified, their duration, and significance and whether these impacts are direct or indirect, based on the following legend:

Table 7.1 Legend: Environmental Issues

DESCRIPTION OF IMPACT	**RATING**	
IMPACT	Minor	(L)
	Moderate	(M)
	Major	(H)
SIGNIFICANCE	**RATING**	
	Not significant	(N)
	Potentially Significant Impact	(Y)
DURATION OF IMPACT	**RATING**	
	Short Term	(S)
	Long Term	(L)
DIRECT/INDIRECT IMPACT	**RATING**	
	Direct	(D)
	Indirect	(I)
* - Indicates positive Impacts		

7.1 PHYSICAL

Table 7.2: Geology and Soils: Impacts on Structures

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/L)	DIRECT/ INDIRECT IMPACT (D/I)
I. Geology and Soils Would the project:	-					
i) Rapture of a known earthquake fault, as delineated on the most recent earthquake fault-zoning map issued by the Mines and Geology Division or based on other substantial evidence of a known fault? ii) Seismic related ground failure, including liquefaction and solution cavities? iii) Landslides?	-		L L L	L L L	N/A N/A N/A	N/A N/A N/A
b) Result in substantial soil erosion or the loss of top soil?	The process of the removal of vegetation and excavation works (earthworks) for land readjustment will create open spaces with exposure of soils which could cause a subsequent increase in surface runoff which may in turn result in soil erosion. This could result in sediment loading of waterways.	**Construction/ Implementation**	M	L	M	D
c) Be located in a geological unit or soil that is unstable, or that would become unstable, as a result of the project, and potentially result in on or off-site landslide lateral spreading, subsidence, liquefaction or collapse?	Rocks will be, however, be removed during excavation works – removal of geological resource. Seismic induced lateral load instability of soils within the critical depth of structure loads. Undesirable total and differential deformation problems between the spans due to deformation characteristics of adjacent areas from soft/loose peaty silts/clay to the dense gravels and sands/ limestone rock formation.	**Construction/ Implementation**	L	L	N/A	N/A

Table 7.3: Hydrology/Water: Impacts on Eco-systems

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT /INDIRECT IMPACT (D/I)
III. Hydrology Would the project:						
c) Substantially alter the existing drainage pattern of the site or the area, including thorough alteration of the course of a stream or river, in a manner, which will result in on or off site erosion or siltation?	The proposed development site at Dundee slopes gently towards the north and east. Disruption of flow pattern can result in water logging, erosion and increased flood risk Potential for increased sedimentation and turbidity of waterways from site preparation and preparing ground for construction	**Construction/ Implementation**	M	Y	M	D
e) Create or contribute to runoff water that would exceed the capacity of existing or planned storm water drainage systems or provide substantially additional sources of polluted runoff?	Removal of vegetation will increase flooding risk and increase in flow velocity	**Construction/ Implementation**	H	Y	L	D
g) Place proposed development within a 100-year flood hazard area, as mapped on a national flood hazard boundary or flood, or other flood hazard delineation map?	-		N/A	N/A	N/A	N/A
h) Place structures that would impede or redirect flood flows within a 100-year flood hazard area?	-		N/A	N/A	N/A	N/A

Table 7.4: Local Climate: Impacts on Ecology and the Public

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
VI. Local Microclimate Would the project:						
a) Have a substantially adverse effect on microclimate through the use of concrete and asphalt?	Construction of houses, driveways and roads	**Operation/ Maintenance**	H	Y	L	D
b) Substantially reduce the number of trees in the project area?	Extensive tree removal due to present land use and that proposed	Implementation/ Development	H	Y	L	D
c) Create a new source of substantial light or	This will occur due introduction of sources of	**Operation/**	H	Y	L	I

glare which would adversely affect day or nighttime views in the area?	light/glare to presence of street light etc.	**Maintenance**				

7.2 NATURAL HAZARDS

Table 7.5: Natural and Manmade Hazards: Impacts on Public Safety, Structures and Ecology

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Natural Hazards -Natural Would the project:						
a) Result in substantial damage from flooding caused by torrential rainfall?	The potential for flooding is to be seen around the mangrove areas where site drainage is poor.	**Construction/ Implementation**	L	N	N/A	N/A
b) Result in serious loss or damage from the primary and secondary effects of a hurricane?	Some minor damage to buildings exposed to strong hurricane wind forces during a severe tropical weather system given the coastal location	**Operation/ Maintenance**	M	N	S	I
b) Result in serious loss or damage from the primary and secondary effects of an earthquake?	In the event of an earthquake of similar magnitude or greater than the March 1, 1957 earthquake, the potential for rock falls on the fault scrap of the project site is likely to be high.	**Operation/ Maintenance**	L	N	S	I
Manmade Hazards – Other Would the project:	-					
a) Expose the population to hazardous?	Areas to the north of the main gully have a lower potential for rock fall because large loose boulders are less prevalent and the slopes are less steep than in the south. If there is blasting energy released from blast excavation can cause damage to adjoining building structures and facilities in the immediate environs, create noise nuisance and cause personal injury due to 'fly rock' from air blast.	**Construction/ Implementation**	L	N	N/A	N/A
b) Expose the natural environment to hazardous materials?	Pollution could occur from suspended materials in storm water and from spills or leaks of fuel oil and construction materials. The use of pesticides and herbicides and spillage	**Construction/ Implementation** **Operation/ Maintenance**	L	N	N/A	N/A

7.3 BIOLOGICAL

Table 7.6: Biology - Impacts on the Terrestrial Environment

ENVIRONMENTAL ISSUES		PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Biological Resources Would the project:						
a) Have a substantial adverse effect, either directly or through habitat modification on any species identified as rare or endangered in local or regional plans, policies or regulations, or by NEPA?	-		N/A	N	N/A	N/A
b) Have substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies or regulations or by the NRCA?	-		L	N	N/A	N/A
c) Have a substantial adverse effect on Protected Wetlands as defined under NRCA/NEPA Policy for Protected Areas through direct removal filling, hydrological interruption, or other means?	Modification of the wetlands proposed for access to the proposed development. Location of the waste water treatment plant and commercial activities.	**Operation/ Maintenance**	H	Y	L	D
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native residents or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	This change in land use will in turn dramatically alter the composition of fauna of the site by way of a sharp decrease in both numbers of individuals, species diversity, and a significant loss of endemic fauna/birds at the site. The development will produce a change in the avian community and other fauna from one dominated by forest dependent species, composed of endemic species and subspecies, to a community comprised of a few species almost totally of non-endemic. Habitat loss especially for birds and other insects such as the butterflies. This may have a greater impact per se on some of the migratory species, i.e. winter and summer, as they tend to return to similar sites each year.	**Construction/ Implementation** **Operation/ Maintenance**	M	Y	L	ID
e) Conflict with any local policies or ordinances protecting biological resources such as a tree preservation policy or ordinance?	-		N/A	N/A	N/A	N/A

f) Have a substantial adverse effect on any protected areas identified by local policies and regulations or by NRCA/NEPA?	Modification of the wetlands would impact its function of in the control of storm water flows	**Construction/ Implementation Operation/ Maintenance**	L	Y	N/A	N/A

7.4 HERITAGE

Table 7.7: Cultural Resources: Impacts on Historical Features and Resources

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Cultural Resources Would the Project:						
a) Cause a substantial adverse change in the significance of a historical resource?			N/A	N/A	N/A	N/A
b) Cause a substantial adverse change in the significance of an archaeological resource?			N/A	N/A	N/A	N/A
c) Directly or indirectly destroy a unique palaeontological resource or site or unique geologic feature?			N/A	N/A	N/A	N/A
d) Disturb any human remains, including those interred outside of formal housing			N/A	N/A	N/A	N/A

7.5 HUMAN/SOCIAL/CULTURAL

Table 7.8: Social Infrastructure: Impacts on Public Services within the Development Area

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Social Infrastructure Would the project:						
a) Result in substantial adverse impacts associated with the provision of new or physically altered governmental facilities, or the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public service? Fire Protection?	-	Operation	L	N/	L	!

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Police Protection? Schools?						
b) Provide a substantial number of employment opportunities for neighbouring community members throughout the project lifecycle?	Employment opportunities would result from the development. Priority for employment would be given to the residents within the immediate community. The opportunity for employment of laborers in the operation phase will still be significant, and limited to gardeners, helpers, and security personnel if necessary.	**Construction/ Implementation** **Operation/ Maintenance**	H	Y	L	I

Table 7.9: Land Use and Planning: Impacts on Community Conservation and Habitat Conservation

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
VII. Utilities and Services:						
a) Exceed wastewater treatment restrictions or standards of NEPA and the Ministry of Health?	-		N/A	N/A	N/A	N/A
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	Construction of waste water treatment plant to specifications of the Ministry of Health and NEPA	**Construction/ Implementation Operation/ Maintenance**	L	N	N/A	N/A
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	Construction of new storm water drainage facilities , for example a detention pond, to the specifications of the National Works Agency	**Construction/ Implementation Operation/ Maintenance**	L	N	N/A	N/A
d) Have sufficient water supplies available to serve the project from existing sources.	National Water Commission confirmed its ability to serve the development; however, plans include water harvesting.	**Operation/ Maintenance**	L	N	N/A	N/A

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
e) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	The proposed development will produce large volumes of solid waste. This is considered a significant environmental impact, as it will include excavated soil, rocks and vegetation removed to make way for construction. The effects include: • Increased demand for and consumption of limited landfill space. • Increased demand for municipal collection services. • Increased use of roads by collection trucks which could affect the surface of the road, congestion, fugitive dust along roads. • breeding of pests and disease vectors such as flies, vermin and roaches if storage areas are not hygienically maintained. • visual dis-amenity and odours .if storage areas are not hygienically maintained	**Construction/ Implementation** **Operation/ Maintenance**	L	N	N/A	N/A

f) Comply with NEPA/ NSWMA statutes and regulations as they relate to solid waste?	All statues will be observed.		N/A	N	N/A	N/A
g) Significantly increase energy consumption in the project area, which would contribute substantially to the greenhouse gases?	Although the power demand of the development can be met by JPSCo. The issue pertains to the use of non-renewable resources, and the national fuel bill as well as individual contributions to greenhouse gases, which raises issues regarding climate change. The concern is the carbon footprint of the development and how to adopt the best measures to reduce its carbon output.	**Operation/ Maintenance**	H	Y	L	I
Land Use and Planning Would the project:						
a) Physically divide an established community?			N/A	N/A	N/A	N/A
b) Conflict with the applicable land use plan, policy, or regulation of NEPA/NRCA (including, but not limited, to a general plan, specific plan, local zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.			N/A	N/A	N/A	N/A
c) Conflict with any applicable habitat conservation plan or natural community conservation?			N/A	N/A	N/A	N/A

Table 7.10: Population Growth: Impacts on the Public and Social Infrastructure

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Population and Housing Would the project:						
a. Induce substantial population growth in the area, indirectly (for example, through extension of roads or other infrastructure)?	Would result in easier access to inland properties	**Operation/ Maintenance**	M	N	L	I
b. Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	Displacement of about 14 housing units	**Construction/ Implementation**	L	N	L	I
c. Growth in population resulting in a change in the character of the community?	Significant growth in the population of the community Also resulting in employment opportunities	**Operation/ Maintenance**	H	Y	L	D

Table 7.11: Transportation and Traffic: Impacts on Public Safety and Travel

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Transportation and Traffic Would the project:						
a. Cause a substantial increase in traffic, in relation to existing traffic load and the capacity of the street system (i.e., a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	Significant increase in traffic is anticipated, including haulage trucks etc. - Based on the projected 182 single family units and 84 multi-family units, it is expected that a total of 2,437 trips will be generated daily including 182 during the AM peak and 244 during the PM peak.	**Construction/ Implementation** **Operation/ Maintenance**	H	Y	L	I
b. Exceed, individually or cumulatively, the level of service standards established for the designated roads or highways?	-		L	N	N/A	N/A
e. Result in inadequate emergency access?	-		L	N	N/A	N/A
f. Result in inadequate parking capacity?	-		L	N	N/A	N/A
g. Conflict with adopted policies, plans or programmes supporting alternative transportation (e.g., bus turnouts, bicycle rack)?	-		L	N	N/A	N/A

Table 7.12: Aesthetics: Impacts on the Landscape and Visual Resources

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Aesthetics Would the Project:						
a) Have a substantially adverse effect on the scenic vista?	Construction of the proposed development warrants removal of the majority of tree species currently on the site. This would negatively affect the scenic vista of the area	**Construction/ Implementation**	H	Y	L	i
b) Substantially damage scenic resources, including, but not limited to trees, within a scenic highway?	-		N/A	N/A	N/A	N/A
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	-		N/A	N/A	N/A	N/A

7.6 PUBLIC HEALTH ISSUES OF CONCERN

Table 7.13: Water Quality: Impacts on Eco-systems and Public Health

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
III. Water Quality Would the project:						
a) Violate any water quality standards or waste discharge requirements?			N/A	N/A	N/A	N/A
i) Expose people or structures to a significant risk of loss, injury, or death from flooding, including flooding resulting from the failure of a levee or dam?			N/A	N/A	N/A	N/A
f) Substantially degrade water quality?			L	N	N/A	N/A

Table 7.14: Air Quality: Impacts on Public Health

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Air Quality Would the Project:						
a) Violate any air quality standards or contribute substantially to an existing or projected air quality violation?	-		N/A	N/A	N/A	N/A
b) Result in a considerable cumulative net increase of any criteria pollutant based on NEPA ambient air quality standards (including releasing emissions, which exceed quantitative thresholds for ozone precursors)?	The operations of heavy-duty vehicles and equipment are likely to produce increased combustion emissions. Atmospheric dust from bare soils, stockpiles, uncovered, overloaded trucks and storage equipment. The movement of heavy trucks results in additional road wear. Removal of trees shrubs and bushes could result in a change in carbon dioxide absorption capacity.	**Construction/ Implementation** **Operation/ Maintenance**	L M	N N	S L	D D

	Release of greenhouse gases/emissions due to increased combustion of fossils fuels in homes and from the potential increase in traffic.					
c) Expose sensitive receptors to substantial pollutant concentrations?	-		N/A	N/A	N/A	N/A
d) Create objectionable odours affecting a substantial number of people?	-		N/A	N/A	N/A	N/A

Table 7.15 Noise and Vibration: Impacts on the Public

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE L/M/H	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Noise and Vibration Would the project:						
a) Generate or expose people to noise levels in excess of standards established in a local general plan or noise guidelines, or in other applicable local standards?	-	**Construction/ Implementation**	L	L	M	D
b) Generate or expose people to excessive ground-borne vibrations or ground-borne noise levels?	-		L	N	S	D
c) Create a substantial permanent increase in ambient noise levels near the project (above levels without the project).	Impacts will invariably be generated, due to infrastructure works and as lots are prepared for housing construction. Noise nuisance would be likely from periodic controlled blasting and use of heavy equipment.	**Construction/ Implementation**	L	N	S	D
d) Create a substantial temporary or periodic increase in ambient noise levels in excess of noise levels existing without the project?			M	Y	S	D

Table 7.16: Waste and Hazards: Impacts on Public Health and the Environment

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
Waste and Hazards Would the project:						
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous material?			N/A	N/A	N/A	N/A
b) Create a significant hazard to the public or the environment through reasonable foreseeable upset and accident conditions involving the release of hazardous materials in the environment?			N/A	N/A	N/A	N/A
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?			N/A	N/A	N/A	N/A
e) Substantially increase solid waste in the project area thereby exceeding the present landfill capacity?	Land clearance will generate vegetation waste and rock waste during the preparation of areas for the construction. If construction waste is improperly stored on site, it can be easily removed /eroded during storm events thereby affecting the wetland area to the North	**Construction/ Implementation**	M	Y	S	D
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?			N/A	N/A	N/A	N/A
g) Expose people or structures to a significant risk of loss, injury, or death involving wild land fires, including where wild lands are adjacent to urbanized areas or where residences are intermixed with forested areas?			N/A	N/A	N/A	N/A

7.7 RISK ASSESSMENT

Table 7.17: Geology and Soils: Impacts on Public Safety and Structures

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/ INDIRECT IMPACT (D/I)
III. Hydrology and Water Quality Would the project:						
a) Violate any water quality standards or waste discharge requirements?			N/A	N/A	N/A	N/A
b) Expose people or structures to a significant risk of loss, injury, or death from flooding, including flooding resulting from the failure of a levee or dam?			N/A	N/A	N/A	N/A
c) Result in inundation by hurricane or tsunami?			N/A	N/A	N/A	N/A

Table 7.18: Geology and Soils: Impacts on Public Safety and Structures

ENVIRONMENTAL ISSUES	IMPACTS	PHASE	IMPACT (L/M/H)	SIGNIFICANCE Y/N	DURATION OF IMPACT (S/M/L)	DIRECT/INDIRECT IMPACT (D/I)
I. Geology and Soils Would the project:						
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: i) Rapture of a known earthquake fault, as delineated on the most recent earthquake fault-zoning map issued by the Mines and Geology Division or based on other substantial evidence of a known fault? ii) Seismic related ground failure, including liquefaction and solution cavities? iii) Landslides/Rockslides?		**Construction/ Implementation**	L	N	S	D

7.8 CUMULATIVE IMPACTS

Environmental impacts are considered cumulatively considerable when the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other, current projects and the effects of future projects. The site of the Proposed Action was assessed in the context of the proposed development occurring in the Greater Falmouth and the adjacent parish of St. James, Montego Bay, in particular (Region). Additionally, the effect of the construction of recent housing solutions in the parish was also taken into account. The geographic scope of the proposed development is shown in Table 7.19 below:

Table 7.19: Geographic scope of cumulative impacts

Resource Issue	***Geographic Area***	***Impacts***
Visual/Landscape Resources	Local	Change of on and off site views
Air Quality	Local	Ambient air quality
Biological Resources	Local, Regional	Effects on the local ecosystem
Land Use Planning	Regional and local	Zoning requirements
Geology, Soils and Seismicity	Local	Effects on the existing population
Hazards	Local (within the vicinity of the project)	Effect of increase in storm water flows
Hydrology	Local, regional	Potential impact on water quality
Groundwater Resources	Local, regional	Reduction in resources in aquifer
Noise	Local (within immediate project vicinity)	Construction activities on site
Employment, Population & Proposed development	Local (within the parish, and adjacent parishes), national and international.	Positive impact on demand for housing options locally and regionally
Public Services and Utilities	Regional (potable water, electricity, health, solid waste, police, fire)	Need for management of solid waste Increase in demand for services
Transportation and Traffic	Regional and local	Increased traffic volumes.

Source: Personal Interpretation

8.0 IMPACT MITIGATION

The following are the mitigation measures for the impacts of significance outlined in Chapter 7 some of which are elaborated on in the Environmental, Health, Safety, Management and Monitoring Plan in Chapter 12, the Storm Water Management Plan, the Erosion and Sediment Control Plan and the Solid Waste Management Plan for the project in Appendix 14.1.

8.1 PHYSICAL

Table 8.1: Geology and Soils: Specific Impacts

INDICATOR	MITIGATION
Construction/Implementation	
Geology and Soils Excavations	Rocks will be removed during excavation works and utilized as fill and construction material where appropriate – removal of geological resource. In the northern area excavation and removal of the upper 2 metres of topsoil and replace with a layer of river shingle and compacted granular fill and use a stiff raft foundation. This may require the drawdown of the water table by well pointing prior to excavation , or: Preload the site with approved backfill and consolidate the peaty clays over tine or with vertical drains (wick drains) over a significantly shorter time and use raft or ties pad footings. The spacing and size of wick drains would be designed along with the height of fill required to accomplish the consolidation in the timeframe required for construction.

Table 8.2: Hydrology/Water: Specific Impacts

INDICATOR	MITIGATION
Construction/Implementation	
Hydrology Surface water hydrology and channel morphology	Peak flows and total volume runoff estimated from the runoff models used in the design of the internal drainage system and other drains, for example, those that discharge into the Eastern Gully.
Surface water	• Discharge of gully areas 1 and 2 into the Flaming Pond • Collection of storm water Channeling of storm water: via curb and channel into swales, through culverts, pipe drains and U drains. • In the north towards the Flamingo Pond and the culverts that cross the Northern Coastal Highway. • Construction of a detention pond in the lowlands to the north • Design of storm water management infrastructure for up to 100 year flood events - Culverts: 25 years storm return period - Pipe/Open drains: 25 years storm return period - Ditches/Swale /Gullies– 10 years storm return period - Curb and Channel – 2 years storm return period - Detention Pond : 10 and 100 years storm return period - Wetland flood control : 100 years storm return period Infrastructure cost to the tune of US $ 3.5 million would ensure the best engineering options to mitigate any issues related to the management of storm water.
Groundwater hydrology	Effort will made to discourage the construction of paved surfaces on areas such as driveways to encourage rainfall infiltration.
INDICATOR	**MITIGATION**
Operation/Maintenance	

Hydrology Surface water hydrology and channel morphology *Flooding*	The main gully is sufficiently large to accommodate significant volume of storm water from a 100 year event. However, it is critical the arrangements be made between Dundee and the Trelawny Parish Council with respect to the culvert along the Northern Coastal Highway so that flooding can be significantly reduced or eliminated.

Table 8.3: Local Climate: Specific Impacts

INDICATOR	MITIGATION
Operation/Maintenance	
Local Climate	Landscaping of lawns using drought resistant grass such as zoysia grass limits the possible effects of heat trapping along with the planting of ornamental plants, fruit trees and the replanting of trees where feasible.
Climate Change	Implement the Life Cycle Assessment methodology to reduce the carbon footprint of the proposed development by applying it from the project planning and design stages of the proposal for example in the selection of building materials as shown in Figure 8.1, Sustainable lighting options would be included in the budget -approximately US $ 100,000.00 budgeted for external lighting and landscaping.

Aspect	Sources of GHG Emissions		
Construction Stage			
I	Materials Consumed during Construction	i.	Steel Formwork for Superstructure
		ii.	Timber Formwork for Superstructure
		iii.	Steel Formwork for Substructure
		iv.	Timber Formwork for Substructure
II	Materials for Structure	i.	Steel for Superstructure
		ii.	Concrete for Superstructure
		iii.	Steel for Substructure
		iv.	Concrete for Substructure
Occupation Stage			
III	Electricity Consumption by Communal Building Services	i.	Lighting
		ii.	Lift
		iii.	Security
		iv.	Television
		v.	Air Conditioning and Ventilation
		vi.	Fire Services
		vii.	Water Supply
		viii.	Electrical Distribution
IV	Carbon Reduction by Renewable Energy Installations	i.	Photovoltaic Panel, Wind Turbine, etc.
V	Carbon Absorption by Plants	i.	Trees (Taller than five metres)
Demolition Stage			
VI	Demolition	i.	Dismantling of Building
		ii.	Transportation of Building Debris from Site to Landfill

Figure 8. 1: Coverage of carbon estimate

Source http://www.housingauthority.gov.hk/mini-site/hasr1011/en/common/download/09_case_study.pdf. Accessed August 11, 2015

The implementation/construction phase of the proposal is critical for a development that responds to the need to reduce carbon emissions even at the planning and design stage. This can be achieved by applying the Life Cycle Assessment (LCA) methodology where green house gases (GHG) in terms of the CO^2-emissions are estimated from cradle to grave. This process also enables the establishment of benchmarks of emission levels for the housing estate throughout the project's life cycle. The result to be achieved is the CO^2-e per square metre of gross floor area (GFA) and construction floor area (CFA) of the building. In sourcing building materials, the developer will, therefore, seek to estimate the coverage of carbon where relevant based on Figure 8.1.

8.2 NATURAL HAZARDS

Table 8.4: Hazards: Specific Impacts

INDICATOR	**MITIGATION**
Operation/Maintenance	
Natural Hazards	
Rock fall	Development should be concentrated in the upland limestone area to the north of the main gully with minimum disturbance of land within the periphery of the gully In areas consisting of loose rocks where development may be contemplated and which fall outside the moderate to high rock fall potential zone, these should be removed by mechanical means and taken to safe areas offsite if there is an excess, this may be used as fill and during the construction process.
Erosion	Erosion control should be given priority, as controlling sediment load is more difficult and costly. Vegetation cover should only be removed where it is absolutely necessary and should be targeted at the construction sites only. Vegetation on the scarp slope near the major gully should not be disturbed but remain in its natural state. In the design of storm water drainage, erosion and sediment control structures should be considered as integral to the drainage network. During construction phase, loose material should be kept within the curtilage of the site and not allowed to be transported off the site. The use of silt fences, maintaining vegetation cover and riparian vegetation are strongly encouraged.
Flooding	It is assumed that the housing development will be done on a 'design and build' basis which implies that the developer will build the houses over a short period. It also implied that the property will be stripped of vegetation to accommodate housing construction. It is recommended that construction should be done on a phased basis so that vegetation is maintained as long as possible in areas where construction is not required during site development. Sediment holding ponds may need to be constructed to assist in trapping sediments during construction as a method of sediment control. The management of peak flows into the wetlands to be adopted as a feature of the storm water drainage design. The culverts which drain storm water across the highway should be regularly maintained to prevent blockage and mitigate against flooding. The community recommends the following for flood mitigation from severe weather systems: • Regular cleaning of gullies • Increase in sizing and number of culverts particularly in the vicinity of the highway • Improvements in garbage collection to reduce the volume of garbage entering gullies That would result in blockage. • Public education and sensitization on recycling and reuse of garbage. Adherence to the Storm Water Management Plan, Erosion and Sediment Control Plan (Appendix 14,1)

Earthquake	Loose rocks will be dislodged from the scarp slope during ground shaking from a moderate to large earthquake. To minimize the impact of rock-falls, development along the fault scarp should be strongly discouraged. The impact of dislodged boulders would be minimal if there is no residential development on the scarp slope. Typical reinforced block and steel structures tend to perform well during seismic events. The design of housing structures should be done by a qualified and experienced structural engineer and in accordance with the Adopted IBC code for Jamaica. The use of approved fill in the reclamation of the impacted area of the wetlands is essential. It should be rolled and compacted in accordance with the ASTM standard and that the fill must be further tested to determine its bearing capacity if structural loads are to be imposed on the fill.
Hurricane	• Assuming non-slab roof construction for the structures, wooden roofing to the wall structure must be adequately secured. • Design specification for the roof to withstand hurricane force winds should be based on the 1:50 year return period and in accordance with the current building code • The Jamaica Application Document for the International Building Code (IBC) has a wind speed map for the Island which is recommended to be used to aid in roof designs to withstand hurricane gale force winds. • Salt Marsh Community Disaster Risk Management Plan is a document which should be consulted for information pertaining to the location of shelters, emergency response systems in the community as well as an understanding of the community's vulnerability with respect to hurricanes and other natural hazards.
Manmade Hazards Blasting	Due to the physical nature of the limestone blasting will only be required if large deposits of the harder chert deposits are found in the path of construction activities. The appropriate management of blasting would be observed at blast sites to ensure rules of safety are observed. These would include precautionary measures, such as, appropriate safety and protective gears, warning signs and signals

8.3 BIOLOGICAL

Table 8.5: Biology: Specific Impacts

INDICATOR	**MITIGATION**
Construction/Implementation	
Biology *Flora & Fauna*	Retention of some areas of woodland/forests is recommended within the development phase. Also as a part of the beautification strategy similar herbs and plants observed can be used to promote habitat for some of the species of butterflies observed during the assessment. Within the remaining wetlands, replanting and drainage compensation interventions would be conducted to help to maintain and enhance the viability of the remaining wetlands as well as to convey surplus storm water off the site. These drainage compensations are illustrated on the drainage plan for the site. It is important to note that the drainage preparations being proposed are designed to ensure that the wetlands are not starved of vital surface water flow, due to the diversion of flows that would normally be received by the wetlands. In addition, the wetlands area will be appropriately landscaped to improve its aesthetic appeal and mangroves replanted where necessary. Normally wetlands are also surrounded by a buffer zone of native grasses which helps protect them. Populations of mangroves, shrubs, and flowering perennials can be added and augmented, and a bridge or boardwalk can provide a point of interest and entice visitors to take a closer look. Such a buffer zone can be integrated into the development and will attract more birds and butterflies and add splash of color.
INDICATOR	**MITIGATION**

INDICATOR	MITIGATION
Construction/Implementation	
Operation/Maintenance	
Biology *Flora* *Fauna*	Adhere to the Landscape Plan – Maintain and/or recreate habitat characteristics where possible, such as, those areas of above 18 – 25 degrees or 32- 48 % slope.

8.4 HUMAN/SOCIAL/CULTURAL

Table 8.6: Social Infrastructure: Specific Impacts

INDICATOR	IMPACT MITIGATION
Other General Considerations	Management of the operations to minimize disturbance to residential areas

Table 8.7: Land Use and Planning: Specific Impacts

INDICATOR	IMPACT MITIGATION
Construction/Implementation	
Land Use and Land Value	Measures stated above to mitigate negative environmental impacts for the soil will be applicable here also. Application of best practices to minimize impacts. Adequate screening methods should be used to minimize visual impact. Altered landforms should be stabilized to reduce erosion. Increase in tax base of the parish*

INDICATOR	IMPACT MITIGATION
Construction/Implementation	
Potable Water *Water Conservation*	The developer would install environmental friendly fixtures for water conservation such as Installation of: • Water-efficient irrigation system such as drip irrigation for trees, shrubs, and flowers. • high-efficiency toilets, such as, duel flush toilets • Faucets with aerators on the kitchen faucet to reduce flows to less than 1 gallon per minute. • Waterless urinals.

Table 8.8: Transportation and Traffic: Significant Impacts

INDICATOR	MITIGATION
Construction/Implementation	
Traffic	Traffic management measures such as the use of flag men during access and egress to the Northern Coastal Highway
Operation/Maintenance	
Traffic	Appropriate traffic management measures, including signage and a round-a-bout at main access point.

Table 8.9 Aesthetics: Specific Impacts

INDICATOR	IMPACT MITIGATION
Construction/Implementation	
Landscape /Scenic Vista	Areas would be left bare before re-vegetation, therefore, need to remove vegetation incrementally as construction advances in each phase. There would be a permanent change in the landscape.
Operation/Maintenance	
Landscape/ *Scenic Vista	Implementation of a Landscape Plan along with replanting of domestic plants and ornamentals where possible, such as, open spaces where the vegetation has been removed.

8.5 PUBLIC HEALTH ISSUES OF CONCERN

Table 8.10: Air Quality: Specific Impacts

INDICATOR	IMPACT	MITIGATION
Construction/Implementation		
Air Quality	Trucks and other equipment should maintain a set maintenance schedule. Stockpiles of fill should be covered or sprinkled daily to reduce particulate count especially in the vicinity of sensitive receptors.	
INDICATOR	**IMPACT**	**MITIGATION**
Operation/Maintenance		
Air Quality	Implementation of energy saving measures	

Table 8.11: Noise and Vibration: Specific Impacts

INDICATOR	IMPACT MITIGATION
Construction/Implementation	
Noise & Vibration	Establish a timetable for the use of heavy equipment ensuring that activities that generate noise and vibration are conducted within the workday.

Table 8.12: Waste and Hazards: Mitigation

INDICATOR		MITIGATION
Construction/Implementation/ Operation/Maintenance		
Solid Waste	Implementation of the Waste Management Plan Organic waste would be composted on site and used for soil improvement (soil conditioning) during landscaping. Branches can be put through a wood chipper to prepare soil cover for garden beds, etc. Excess inorganic waste would be stockpiled away from drainage features. Rocks will we incorporated, for example, used as fill for low points in road network.	

8.6 RISK ASSESSMENT

Table 8.13: Waste and Hazards: Specific Impacts

INDICATOR	IMPACT MITIGATION
Construction/Implementation	
Waste and Hazards Hazards	Creation of a dedicated location for the storage of hazardous waste materials and ensure adequate labeling. Strict health and safety procedures for workers such as the use of personal protection equipment

9.0 ENERGY USE AND CONSERVATION

According to the *Vision 2030 Jamaica National Development Plan* (PIOJ, 2009) Energy conservation is a broader measure that encompasses energy efficiency as well as behavioural changes that reduce energy consumption. Energy efficiency and green building programs deliver economic benefit through building practices that reduce operating costs, increase property values, and reduce the carbon footprint of the community through methods of energy conservation. The measures outlined would be applicable from the Implementation/Construction phases. While the Developer would be responsible for their installation during the initial phases, during the operation phase homeowners would be asked to conform to an agreement to implement the recommendations where applicable.

9.1 IMPLEMENTATION/CONSTRUCTION

During the construction stage of the development the installation of measures to reduce electricity consumption include:

1. Passive Design –

    - Optimize the use of daylight and natural ventilation
    - Provide adequate air movement

2. Reducing Consumption of Lighting Systems

    - Electronic ballasts (save about 20 - 30% energy as compared with electromagnetic ballast) and T-5 fluorescent tubes (save about 20% energy as compared with T-8 tubes) since 2000
    - Photo sensors and time switches to fully utilize daylight
    - Develop a two-level lighting control system for corridors and staircases, using motion sensors and on-demand switches with timer control (save about 30% energy)
    - Pilot light emitting diode (LED) bulkheads (save about 40% energy as compared with compact fluorescent lamp bulkheads)
    - Solar street lighting

3 Solar Orientation

The development proposes the use of orientation strategies to maximize cooling options

- The sloping of roofs towards the south will allow for the efficient use of solar panels
- Locate patios and decks on cooler side of the building.
- Properly shade houses with correctly placed shade trees to provide summer comfort. At least one tree to be planted on each lot, at a minimum.

10.0 RESIDUAL IMPACTS

Residual effects of this project are considered as those that remain significant after the mitigation measures, have been applied. These impacts nonetheless would likely to have been reduced in magnitude with the implementation of the mitigation measures proposed in Chapter 8.

Generally, residual impacts of the project could be significant, as change in land use will produce the greatest effect. This land use change will primarily affect biological resources. With respect to positive impacts, the community specifically will be transformed in terms of the quantity and quality of its housing assets.

Potential residual impacts are summarized below.

10.1 PHYSICAL ENVIRONMENT

1. Soils, Geology and Hydrogeology

a. Soils – the thin layer of soil generally will need to be supplemented with new topsoil

b. Geology- Site geology remains constant but topographical changes will result from the need to grade and fill to prepare lots for construction.

c. Hydrogeology - Drainage pathways will be maintained as far as is possible, however, engineering works will seek to manage the direction and flow of storm water. Waterways should maintain their capacity to facilitate groundwater recharge.

2. **Climate**

There will be residual impact on micro-climate due to the large scale removal of vegetation.

3. **Water quality**

Implementing mitigation measures will result in no significant residual impact on underground water quality. Besides which water quality in the wetland, Flamingo Pond and the marine environment are already of poor quality.

4. **Natural Hazards**

A change from natural vegetation will reduce biomass. There is a greater potential for damage to buildings and infrastructure such as utility poles from hurricane winds and the accompanying rains.

5. **Biological**

The role of the proposed site as a habitat will change permanently and will therefore impact biodiversity and biomass. However, the vegetation on the steepest slopes, such as, those in the vicinity of the main waterway will remain.

10.2 SOCIO-ECONOMIC

a. Land use

Permanent changes would occur to the form/land use of the community.

b. Traffic

Significant increase in the generation of local traffic the effects of which can only be partially mitigated by traffic control measures and structures

Changes will occur to the socio-economic character of the community – higher income levels.

c. **Carrying Capacity**

Potential impact on social services such as health and education, however, lasting improvement in community infrastructure such as roads and drainage structures.

d. Social services and amenities

Increase in demand in the area for social services such as removal of solid waste, health and postal services.

11.0 ANALYSIS OF ALTERNATIVES

11.1 THE NO ACTION ALTERNATIVE

The No Action alternative does not meet the need and purpose of the proposed action, however, it reflects the status quo conditions as outlined in Chapter 5 and acts as a benchmark against which the effects of the Proposed Action can be evaluated. Two additional options were considered.

11.2 THE PROPOSALS

Two development avenues have been considered to offer various levels of mitigation against wetland impacts and are presented as Alternatives A & B.

ALTERNATIVE #A

Alternative A advocates the use of the entire 4.7 hectares of land (to include the 3.4 hectares of wetland), with the condition that the loss of wetlands within the development area be compensated for through the re-growth of equivalent wetland vegetation within close proximity to the development area. Figure 11.1 shows the adjacent Flaming Pond. The margin of this pond is lined with both White and Black Mangroves that have colonized the area under natural conditions. Compensatory growth of mangrove types similar to that found at the proposed development site could easily be encouraged at the pond provided that: Access to the pond area can be obtained by purchase, lease or letter of agreement from the owner/owners to facilitate the process of re-growth. Drainage mechanisms are in place to route the expected development-influenced runoff that would have been accommodated by the wetland to the pond area.

ALTERNATIVE #B

The second development option is illustrated by Figure 11.2, which superimposes a modification to the originally submitted subdivision design for the northern lands. This modification effectively reduces the area of land to be developed from 4.7 hectares to 2.6 hectares. Of these 2.6 hectares, approximately 1.4 hectares of wetland would be displaced as a consequence of the development of the land leaving 2 hectares of wetland behind. Within the remaining wetlands, replanting and drainage compensation interventions would be conducted to help to maintain and enhance the viability of the remaining wetlands as well as to convey surplus storm water off the site. These drainage compensations are illustrated on the attached drainage plan for the site and the resulting spatial changes in land/wetland character are outlined on Figure 11.3. It is important to note that the drainage preparations being proposed for the second development option are designed to ensure that the wetlands are not starved of vital surface water flow, due to the diversion of flows that would normally be received by the wetlands as shown in engineering drawing Figure 11.4. In order to regulate surface flow a 450 mm wide berm along with a 900mm earth swale with a 4 % slope would be introduced at the eastern boundary that would effectively control the flow of water away from the wetland.

Figure 11.1**:** Overlayed Google earth Image (A) showing pond and area of wetlands re-growth for development of wetland compensation (Impact Wetland Area =B)

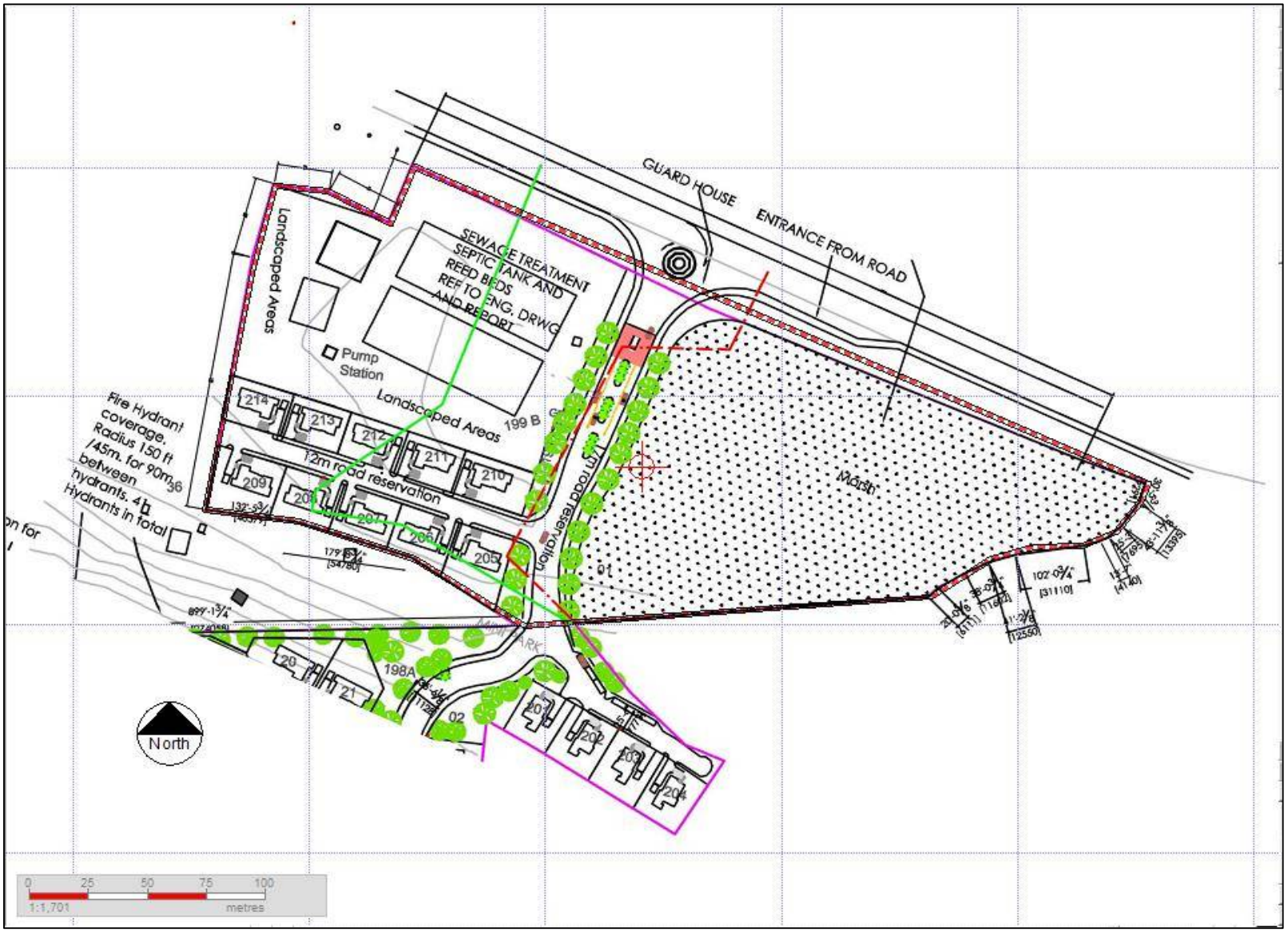


Figure 11.2: Illustration of proposed alteration to the Northern Subdivision Development Area (**dotted area represents wetland**)

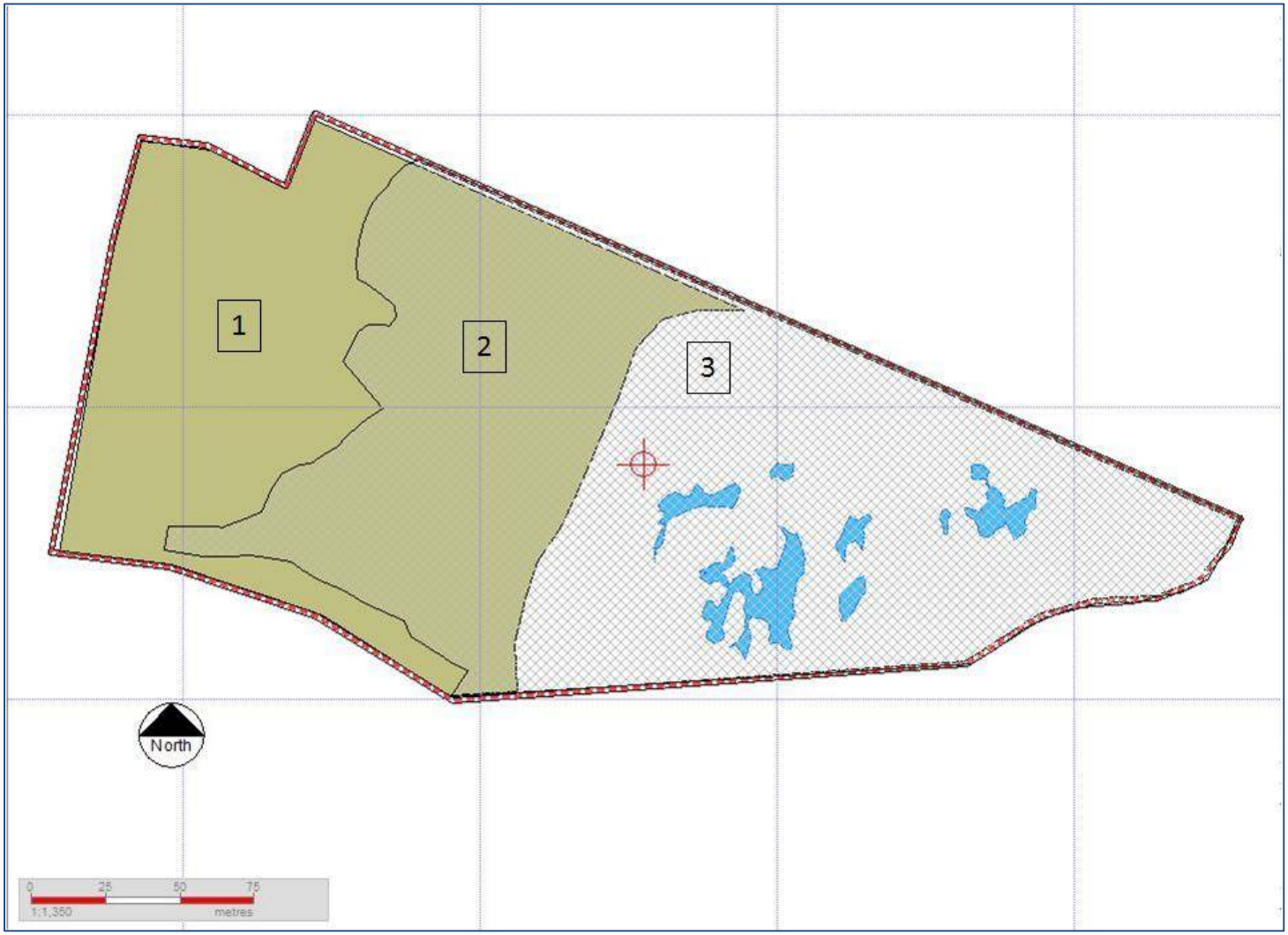


Figure 11.3**:** Spatial distribution of dry land area (**1**), Reclaimed wetland area (**2**) and Undisturbed wetland area (**3**) within the proposed Northern Subdivision Development Area

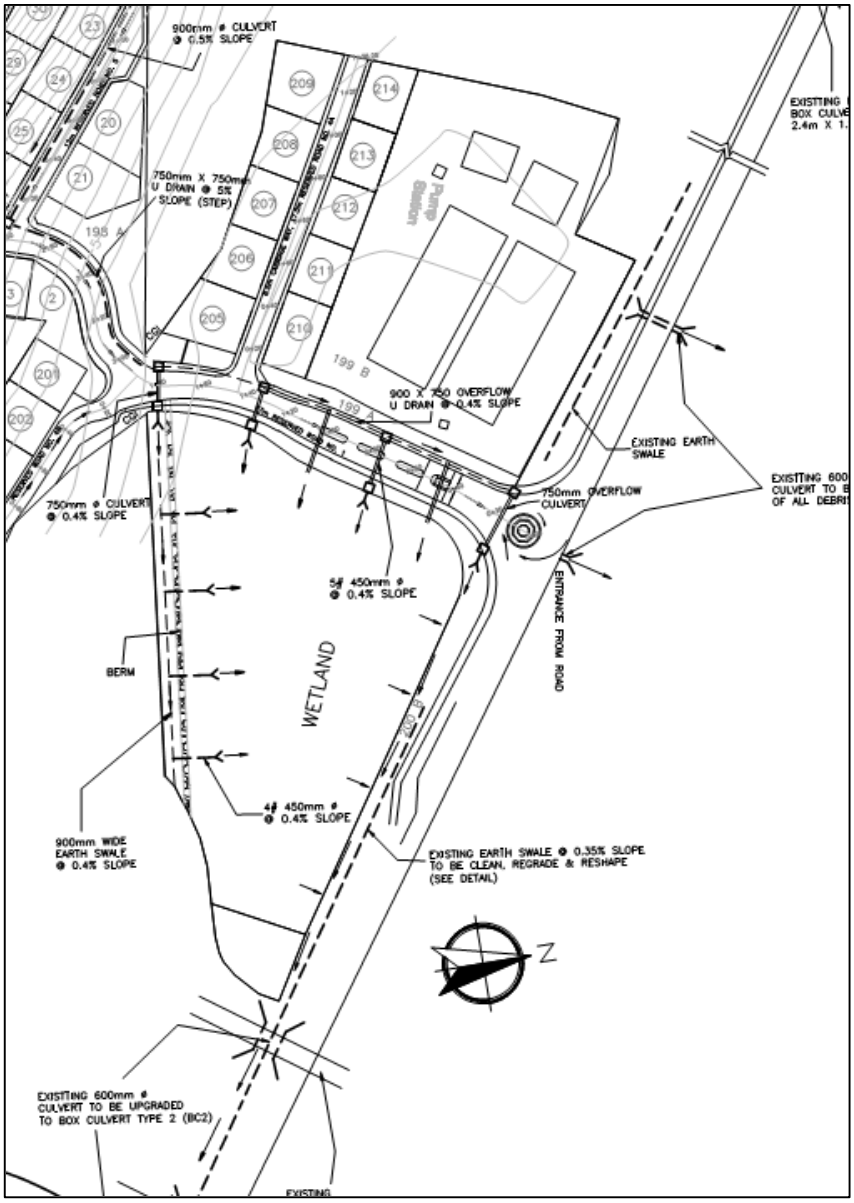


Figure 11.4: Storm water layout for Alternative B for the proposed Dundee development

Tables 11.1 and 11.2 below outline potential benefits and costs of the proposed development.

Table 11.1: Swift Benefit/Cost Analysis of Environmental Resources

INDICATORS	BENEFITS TO THE ENVIRONMENT	COST TO THE ENVIRONMENT	MONETARY VALUE
1) Aesthetics	The sustainable development of the property into the proposed middle income community	Vast removal of trees in the development area and the resulting loss of habitats.	Injection of USD 33.5 million investment into the proposed housing development in the Salt Marsh Community over a 5-year period
2) Air Quality	_	Air quality would be negatively affected as a result of construction activities (increase in particulates). The impact, however, would not be long-term.	_
3) Waste & Hazardous Material	_	The environment would be negatively impacted if waste and hazardous materials are not properly disposed of.	Cost, such as, the outlay for acquiring a skip for solid waste storage.
4) Topography & Drainage	_	Both drainage and infiltration capacity would be reduced significantly possibly causing increased surface runoff.	Cost for building on and off site drainage structures
5) Climate	_	Temperatures in the development area may increase slightly due to changes in the micro-climate combined with the effects of climate change.	Cost for purchase and operation of cooling equipment.
6) Energy Consumption	Alternate forms of energy will be utilized where feasible e.g. use of solar energy.	Negligible increase in Energy consumption.	Cost per kilowatt of energy used.
7) Natural Hazards	Proper construction practices would be encouraged and employed so as to reduce the risk of loss of life and damage to property by natural hazards such as hurricane, earthquake and fire.	Natural Hazards, such as, hurricanes and flooding may cause damage to the structures on the property, as well as, destroy flora and fauna on the property.	▪ Cost to rebuild/repair structures on property (cost depends on the extent of damage) ▪ Cost to replant trees and plants (cost depends on the extent of damage). ▪ Cost of property insurance
8) Other Hazards	The risk of other hazards such as health-ecological and social-organizational hazards may be less anticipated than that of natural hazards, such as, fires and earthquake.	Other hazards such as health–ecological and social-organizational hazards may pose a threat mainly to employees.	Cost of health insurance for workers.

INDICATORS	BENEFITS TO THE ENVIRONMENT	COST TO THE ENVIRONMENT	MONETARY VALUE
9) Upset Accidental Conditions		Accidents are unpredictable and may result in injury, loss of life and damage to property.	▪ Cost of liability insurance for employees on the site ▪ Cost for Property Insurance (depends on the value of the property).
10) Use change		The anticipated change would impact on two fronts: 1. Loss of lands 2. Loss of habitat	▪ There is no agricultural production, the vegetation is degraded, and impact on biodiversity and impact on ecosystem services are not considered significant. ▪ The economic value of this decision (use value/ non use value) ▪ The development cost vs. costs associated with the anticipated loss of ecosystem services

Table 11.2: Socio-economic Benefits/Costs

INDICATORS	SOCIO-ECONOMIC BENEFITS	SOCIO-ECONOMIC COSTS	MONETARY VALUE
10) Solid Waste Disposal	–	Increase in solid waste generation during the construction phase. Also, increase in pressure on the Retirement solid waste disposal site in Montego Bay to accommodate the additional waste. The continuation and enhancement of recycling efforts will reduce costs to the facility and the developer.	Cost to the service provider (WPM parks and Markets) for the removal of solid waste during the construction stage.
11) Infrastructure works	Development of the road network, site drainage structures, electrical conduits, external lighting, security fencing, landscaping, waste water disposal works and waste water treatment plant. Impact on local community in terms of improved infrastructure and employment	Impact on the movement of traffic due to increased movement of heavy duty haulage trucks traffic	Infrastructure costs of approximately USD 2.25 Million mostly to be borne by developer.
12) Health & Safety	Measures will be incorporated to ensure that health and	Health and safety of both employees may be at risk mainly	▪ Cost to cover medical expenses for injured visitors/employees

INDICATORS	SOCIO-ECONOMIC BENEFITS	SOCIO-ECONOMIC COSTS	MONETARY VALUE
	safety are maintained for the employees, mourners and other visitors.	during the construction phase especially if the necessary precautions are not taken. Potential impact on vehicular and pedestrian traffic within the Salt Marsh Community	(cost depends on the severity of injury) ▪ Cost for Liability Insurance ▪ Cost to implement Occupational Health & Safety programme ▪ Cost to monitor to ensure that best construction practices are kept. ▪ Cost of security services
13) Noise & particulates (dust)	–	The ongoing noise and levels of particulates during the construction and operation phases which may affect near-by residents.	Cost for residents affected by the noise to acquire relief (doctor's visit / medication) – approximately $3,500 (minimum for doctor's visit and medication). - Additional strain on the health services

This Draft Environmental Impact Assessment Report is a response by the Directors of BC Enterprises Limited to the National Environment and Planning Agency (NEPA)/Natural Resource Conservation Authority (NRCA) after having applied to the Agency for an environmental permit to subdivide 28.75 hectares (71 acres) of land at Dundee in Trelawny for a proposed housing development. The property is located in the Salt Marsh area of Trelawny approximately 4.5 km (3 miles) west of Falmouth. The land/property stretches southwards from the Falmouth to Montego Bay Highway into the upland area. The Falmouth to Montego Bay leg of the Northern Coastal Highway borders the northern boundary of the property.

The aim of this report is to provide a Plan that will serve as a management tool which will be used to ensure that undue or reasonably avoidable adverse impacts of the implementation/construction phases of a project are prevented and that the positive benefits of the projects are enhanced.

1. The proposed Hamptons at Dundee

The EHSMMP has been developed specifically for use at the proposed Hamptons at Dundee worksite. The EHSMMP has been produced to address potential issues based the findings of the Environmental Impacts Assessment for the proposed development. The EHSMMP is intended to complement other documents such as the Waste Management Plan.

The approach adopted for this EHSMMP is derived from the concept of the continuous framework cycle that entails the reiterative actions of plan-do , check, act and then return to the planning phase (Figure 12.1).

Plan, Do, Check, Act flowchart

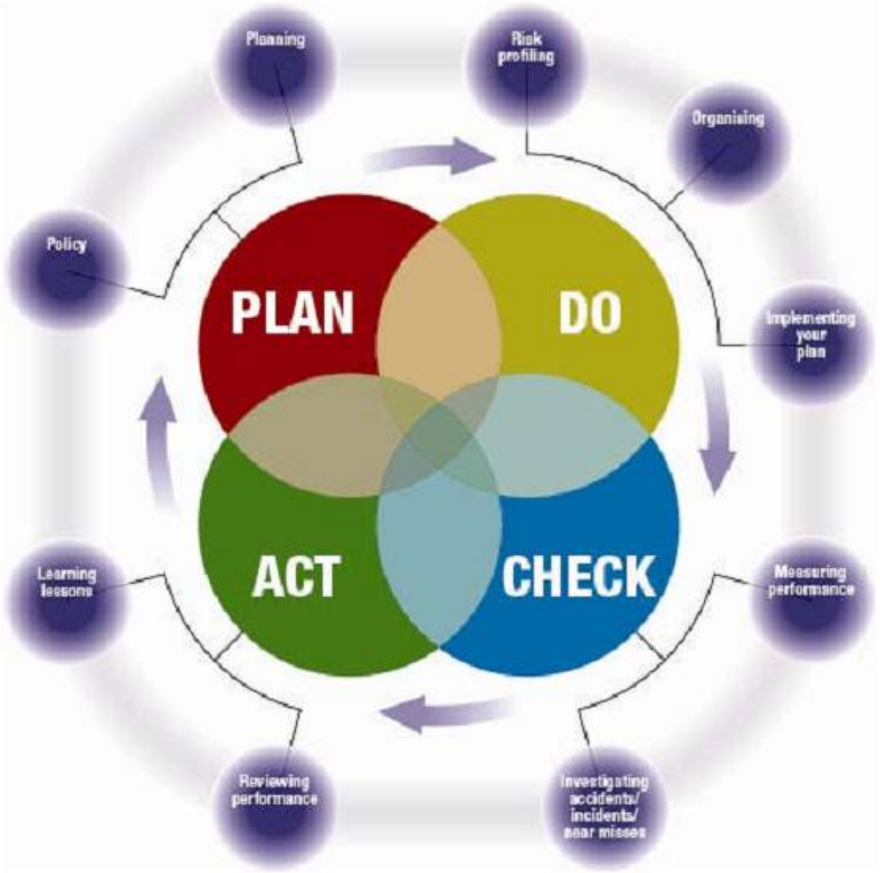


Figure 12. 1: Plan, Do, Check. Act Flowchart

Source: Health and Safety Executive
http://www.hse.gov.uk/managing/hsg65-flowchart.pdf 2015 Accessed July 10

The following is a list of environmental issues that require environmental management plans based on the potential impacts of the proposed development during implementation and construction:

- Air Quality
- Energy Management
- Noise and Vibration
- Waste Management
- Storm Water Management

To ensure the purpose of this EHSMMP will be achieved, the environmental management plans will be established as follows:

- Objectives to be achieved
- Management strategies

- Tasks
- Responsibilities
- Monitoring and reporting
- Corrective actions

The EHSMMP is be based on the requirement for an Environmental Permit and has been prepared in accordance with, Section 9 of the Natural Resources Conservation Authority (NRCA) Act, 1991, in respect of the Subdivision of 10 or more lots

a. Management of Air Quality

The main source of pollution to be managed is dust produced during construction activities - construction materials, such as, marl and sand, preparing site for construction.

Performance objectives:

- To minimize the impact on air quality from site operations.
- To ensure that the relevant provisions of the Natural Resources Conservation Authority (Air Quality) Regulations (2006) under the Natural Resources Conservation Authority (NRCA) Act.

Management Strategies:

The performance objectives above will be achieved by the following management strategies:

- Use of improved technology where economically feasible.
- Evaluate the effect of air emissions where appropriate.
- Employment of dust extraction equipment on construction equipment.
- Use of PPE.
- Use of an equipment truck to sprinkle exposed surfaces through wet suppression
- Construction activities are to be contained to reasonable hours during the day, avoiding periods of sunrise and sunset

Tasks: The following actions will be undertaken to implement the above management strategies.

- EHSMMP awareness training to be included as part of inductions.
- Dust suppression units to be maintained and repaired as required.

Responsibilities: This EHSMMP is the responsibility of the Project Manager (PM) and the Environmental Manager (EM). The actions outlined in this plan are the responsibility of the contractor, subcontractors, foremen and other employees.

Performance Indicators: No complaints relating to air quality management. Dust suppression unit t maintained as per maintenance schedule.

Monitoring and reporting. Monitoring would be ongoing and any complaints relating to the management of onsite air quality will be directed to the Contractor and the PM as soon as is practical. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site

management.

Corrective actions: Review dust management procedures.

b. Energy Management

The energy management EHSMMP is aimed at minimizing electricity use and reducing the development's carbon footprint. The main sources of use are:

- Site equipment
- Lighting

Performance objectives: To minimize electricity usage on site.

Management Strategies: The performance objective above will be achieved by the following management strategies:

- Monitor energy usage to determine high-use areas.
- Establishing areas of wastage.
- Install energy management systems where economically viable.
- Take energy rating into account when purchasing new equipment.

Tasks: The following actions will be undertaken to implement the above management strategies:

- Undertake EHSMMP awareness training as part of inductions.
- Maintain energy control systems.

Responsibilities: This EHSMMP is the responsibility of the PM, the Contractor and the Environmental Manager. The actions outlined in this plan are the responsibility of management, subcontractors, foremen and other employees.

Monitoring and reporting: Ongoing. Any complaints related to the management of onsite energy usage will be directed to the Contractor and the PM as soon as is practical. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.

Corrective actions: Undertake energy monitoring and establish where and how increased usage in electrical energy has occurred

c. Noise And Vibration Management

The potential sources of noise are from land clearing and construction activities (machinery, drilling, equipment and traffic)

Performance objectives: To meet requirements of the National Noise Standard, 1999:

- To avoid nuisance noise to nearby residents.

- To avoid vibration nuisance to nearby residents.

Management Strategies: The performance objective above will be achieved by the following management strategies:

- Activities that produce excessive noise will be restricted, where practical, to the hours permitted by the NEPA.
- Maintain on-site equipment including noise reduction equipment.
- Where economically feasible, enclose excessively noisy equipment likely to generate community complaints.

Tasks: The following actions will be undertaken to implement the above management strategies.

Responsibilities: This EHSMMP is the responsibility of the PM and Contractor. The actions outlined in this plan are the responsibility of management, subcontractors, foremen and other employees.

Performance Indicators: No complaints relating to noise or vibration nuisance. Conformance with the provisions of the National Noise Standard, 1999

Monitoring and reporting: Ongoing. Any complaints related to the management of onsite air quality will be directed to the Contractor and PM as soon as is practical. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.

Corrective Actions: Immediate shutdown of noisy activities Investigate complaint immediately

d. Waste Management

The main wastes likely to be produced on-site:

Recyclables include:

- paper
- corrugated cardboard
- plastic and glass bottles, drums, bins and jars
- metal cans
- crates

Other Waste

- Stones
- Vegetable matter

Performance objectives: To meet the objectives of the Solid Waste Management Act, 2001. To manage waste in a manner that is sustainable and sensitive to the environment.

Management Strategies: The performance objective above will be achieved by the following management strategies:

- Components of waste streams will be separated at source, where possible, to minimize contamination and maximize potential for reuse and recycling of materials.
- Waste will not be stored on areas where it could contribute to the generation of contaminated runoff.

- Waste storage on-site will generally be organized by the head contractor.
- Waste management will form part of the on-site induction process.

Tasks: The following actions will be undertaken to implement the above management strategies:

Organize regular waste collection to minimize excessive waste storage.
Audit the locations of waste storage to ensure that the above strategies are being met.

Performance Indicators: No complaints about waste storage or removal.

Monitoring and reporting: Ongoing. Any complaints as to the management of onsite waste nuisance will be directed to the Contractor and PM as soon as practical. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.

Corrective Actions: PM and Contractor to recommend corrective actions

e. Storm Water Management Plan

The water management plan is designed to manage:

- Sediment and Process
- Water usage and disposal.

Performance objectives: To comply with the National Works Agency conditions of approval.

Management Strategies: The performance objective above will be achieved by the following management strategies:

- Divert clean storm water runoff from site to prevent it entering operations area.
- Ensure waste is located in areas which will not contaminate surface water runoff.

Tasks: The following actions will be undertaken to implement the above management strategies.

- Undertake EHSMMP awareness training at inductions.

Responsibility: This EHSMMP is the responsibility of the PM and the Contractor. The actions outlined in this plan are the responsibility of management, subcontractors, foremen and other employees.

Performance Indicators: No contaminated runoff. No flooding.

Monitoring and reporting: Ongoing. Any complaints as to the management of onsite waste nuisance will be directed to the Contractor and PM as soon as is practical. Complaints and any actions arising from a complaint will be recorded in a complaints register to be maintained by site management.

Corrective Actions: Investigate any non complying runoff.

A summary of the specific requirements are outlined in Table 12.1 below:

Table 12.1: Showing Indicators, Agency/Individual Responsible and Activities

INDICATORS	AGENCY/INDIVIDUAL RESPONSIBLE	ACTIVITIES
Preparation, Construction, Operation and Maintenances Phases		
Health, Safety & Environment		
1. Noise	Developer	Monitor to ensure agreed schedule protocols are adhered to and noise levels to ensure minimal effect on the population in the receptor community
2. Solid Waste	NSWMA/Developer	Sorting and storing and disposal of solid waste based on guidelines outlined in a developed Solid Waste Management Plan
3. Air Quality	Contractor	Management of the storage of excavated earth to be recycled for infilling during construction of houses and undertaking infrastructure works and in landscaping.
4. Traffic Control	Developer/Contractor	Manage the movement of traffic to ensure minimal interference to traffic on the Northern Coastal Highway.
5. Aesthetics	Developer/Contractor/ Landscape Architect	Ensure replanting as erosion control, re-vegetation and improving community aesthetics
6. Flood Control Measures	Engineer/Contractor	Ensure adherence to NWA approved Storm water Management Plan.
7. Construction Materials	Contractor/ Project Engineer	Ensure materials are sourced from The nearest appropriately licensed source (where applicable) and that haulage vehicles are covered to prevent spillage of materials on the roadways
8. Subdivision and Building Plans, Licenses	Trelawny Parish Council /Ministry of Land and Environment/NEPA /Contractor/ Developer	Ensure all approvals and permits are in place and the conditions are being met.
9. Roads and Storm water	Developer/National Works Agency	Seeking and obtaining approval to ensure site drainage issues are appropriately addressed.
10. Removal of trees	NEPA/Developer	Ecologically viable large diameter trees (e.g. >20cm) should be marked and preserved as far as is possible
11. Carbon Emissions Estimation	Developer/Energy Specialist	Estimate the potential GHG emissions using the LCA methodology.
Operation and Maintenance Phases		
Health, Safety & Environment		
1. Aesthetics	Developer/Landscape Architect	Adherence to the Landscaping Plan.
2. Education of employees and	NSWMA and Public Health	Monitoring of the facility.

INDICATORS	AGENCY/INDIVIDUAL RESPONSIBLE	ACTIVITIES
residents	Department	
3. Potable Water	NWC/Developer	Monitoring the availability of potable water.
4. Noise	Developer	Ensure activities do not breach the Noise Abatement Act
5. Solid Waste	Developer	Adherence to the Solid Waste Management Plan
6. Public Health	Trelawny Parish Council/NEPA	Monitoring of environmental health conditions especially as it relates to the functioning of the wastewater treatment system
7. Energy Use and Conservation	Developer, home owner, Citizen's Association	Monitoring of energy consumption

13.0 REFERENCES

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

Bibby C.J.; Jones, M.J. and S.J. Marsden. 1998. *Expedition Field Techniques: Bird Surveys*. Expedition Advisory Centre, Royal Geographical Society, London.

Climate Studies Group, Mona (CSGM), 2012: *State of the Jamaican Climate 2012: Information for Resilience Building (Summary for Policymakers)*. Planning Institute of Jamaica (PIOJ), Kingston, Jamaica.

Garraway, E. & A. Bailey 2005. *Butterflies of Jamaica*. Macmillan Publishers Limited

Jamaica National Heritage Trust. 2015. *Archeological Impact Assessment Report, Dundee Estate, Trelawny*

JATCO Consultants Limited. 2015. *Revised Engineering Report on Storm Water Drainage for Proposed Subdivision Part of Dundee, Salt Marsh, Trelawny*

JATCO Consultants Limited. 2015. *Engineering Report for Sewage Treatment Plant at Dundee, Salt Marsh, Trelawny.*

NHL Engineering Limited . 2014. *Geotechnical Report: A Soil Investigation for the proposed Housing Development at Salt Marsh, Trelawny*

Town and Country Panning Authority. 2015. *The Town and Country Planning (Trelawny Parish) Provisional Development Order 2013*

National Housing Trust. 2009. *Housing Demand Report*, Trelawny.

Parker, Tracey 2003. *Manual of Dendrology – Jamaica*. Forestry Department, Ministry of Agriculture, Government of Jamaica.

Planning Institute of Jamaica. 2009. Vision 2030 Jamaica National Development Plan

Raffaele, Herbert; Wiley, James; Garrido, Orlando; Keith, Allan and J. Raffaele 1998. *A Guide to the Birds of the West Indies*. Princeton University Press

Richards, A. 2008. *Development Trends In Jamaica's Coastal Areas and the Implications for Climate Change*. Sustainable Development and Regional Planning Division Planning Institute of Jamaica

Social Development Commission. 2010. *Salt Marsh Community Disaster Risk Management Plan*

Wilson-Kelly, P. 2015. Wetlands *Environmental Sensitivity Mapping, Trelawny Report*.

Wunderle Jr, J.M. 1994. *Census Methods for Caribbean Land Birds*. Gen. Tech. Rep. SO-98. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.

14.0 APPENDICES

14. 1 APPENDIX

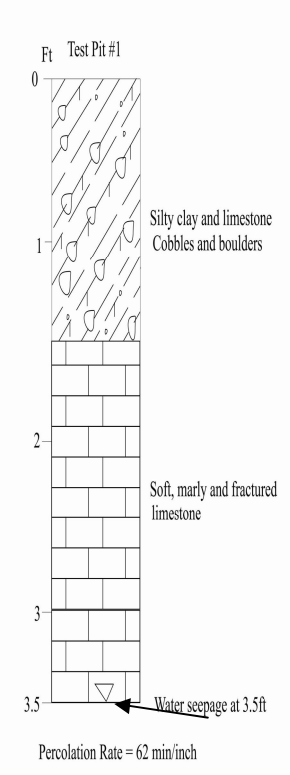
Reference Documents

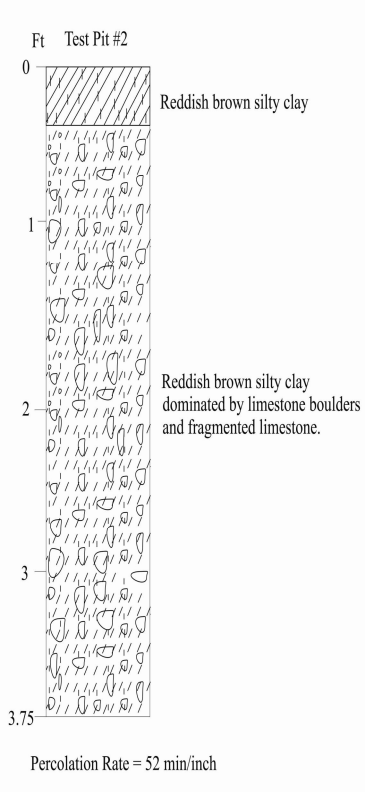
Site Layout for Residential Development at Dundee, Trelawny showing Test Pit (TP) locations

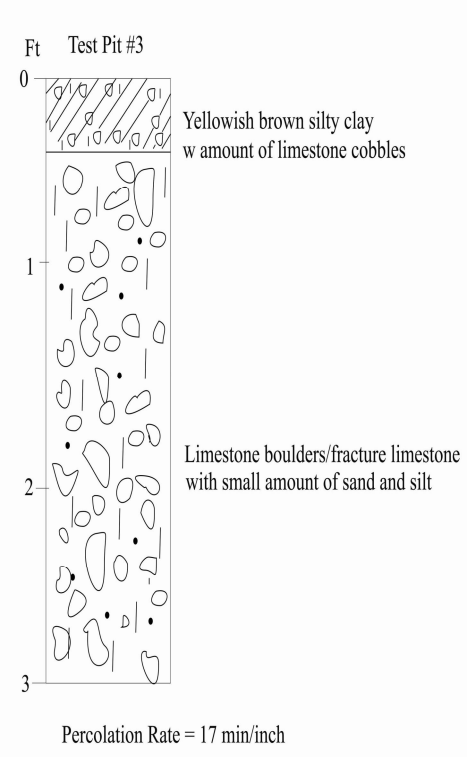
Geographical cordinates in degree minutes and seconds (WGS 84)

Test Pit 1:	18.291580	-77.415088
Test Pit 2:	18.291392	-77.419120
Test Pit 3:	18.296719	-77.415783

TEST PIT LOGS







CCORAL
Screening Report Card

Introduction

This report summarises the results of your Caribbean Climate Online Risk and Adaptation tooL (CCORAL) sreening exercise.

Title of your activity : Housing Development
Activity description: Housing development along the North Coast at Salt Marsh

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Screening Results

The main purpose of the screening exercise is to allow you to assess in less than 5 minutes if your activity (e.g. a project, plan, policy) is climate-influenced and a priority for further assessment using CCORAL. Based on your overall score you can determine if further analysis under CCORAL is desirable.

Below are your scores:

1.) Is your activity located in/ relevant to an urban, coastal or marine area, or any other environmentally sensitive or protected area?	**Y**
2.) Will the effects/outcomes of the activity last longer than 10 years?	**Y**
3.) Does the activity involve the tourism, agriculture, forestry, fisheries, water, energy or health sectors?	**N**
4.) Are existing similar activities already experiencing impacts due to adverse weather effects?	**N**
5.) Is the activity, once it is implemented, irreversible and inflexible (i.e. it cannot be reviewed and adjusted periodically)?	**Y**
6.) Does the activity focus on vulnerable population groups as a primary target?	**N**
7.) Will this activity contribute to improving disaster risk management?	**N**
8.) Is the activity focussed on the provision or dependent upon the availability of national or locally critical infrastructure?	**Y**
9.)Will this activity require in a significant investment from your Ministry's/ organisation's annual capital and/or operational expenditure?	**N**
10.)Will the activity deliver or make a significant contribution towards the achievement of a priority4 national development plan objective?	**N**

Engineering Report

for

Sewage Treatment Plant

at

Dundee, Salt Marsh, Trelawny

Date: January 2016

Table of Content Pages

PROPOSAL

The site proposed for development is within an area that requires tertiary level treatment plant and as such, the option of anaerobic baffle reactor to a reed bed followed by chlorination chamber will be explored. The final treated effluent is by means of irrigation with the excess to wetland.

The wastewater treatment plant will be undertaken in four (4) phases. Each phase will be completed depending on the level of development and the number of units to be served. For example, phase 1 will be completed to serve up to 25% of the total number of units, phase 2 will serve up to 50%, phase 3 will serve up 75% and phase 4 will serve to entire development.

This wastewater treatment and disposal system is expected to satisfy the minimum requirement set out by the Ministry of Health and Environment- Environmental Health Unit (MOHE-EHU) and other regulatory agencies.

Description and Function of System Proposed

A **Septic Tank (ST)** is simply a big concrete, plastic or steel tank that is buried in the ground. Wastewater flows into the tank at one end and leaves the tank at the other. Anything that floats rises to the top and forms a layer known as the **scum layer**. Anything heavier than water sinks to form the **sludge layer**. In the middle is a fairly clear water layer. This body of water contains bacteria, suspended particles and nutrients like nitrogen and phosphorous which can be further treat by another sewage treatment component.

The **Subsurface Flow Reed Bed (SFRB) systems** are suitable for treating primary treated wastewater, because there is no direct contact between the wastewater and the environment. There is no opportunity for mosquitoes to breed, and from the view point of public health this system is harmless. The system is particularly useful for treating septic tank effluent, landfill seepage and other wastes that require removal of high concentrations organic materials, suspended solids, nitrate, pathogens and other pollutants. The environment within the SFRB bed is mostly either anoxic or anaerobic. Oxygen is supplied by the roots of the emergent plants and is used up in the Biofilm growing directly on the roots and rhizomes. SFRD systems are good for nitrate removal (denitrification) and for polishing secondary and tertiary effluents but not for ammonia oxidation (nitrification), since oxygen availability is the limiting step in nitrification.

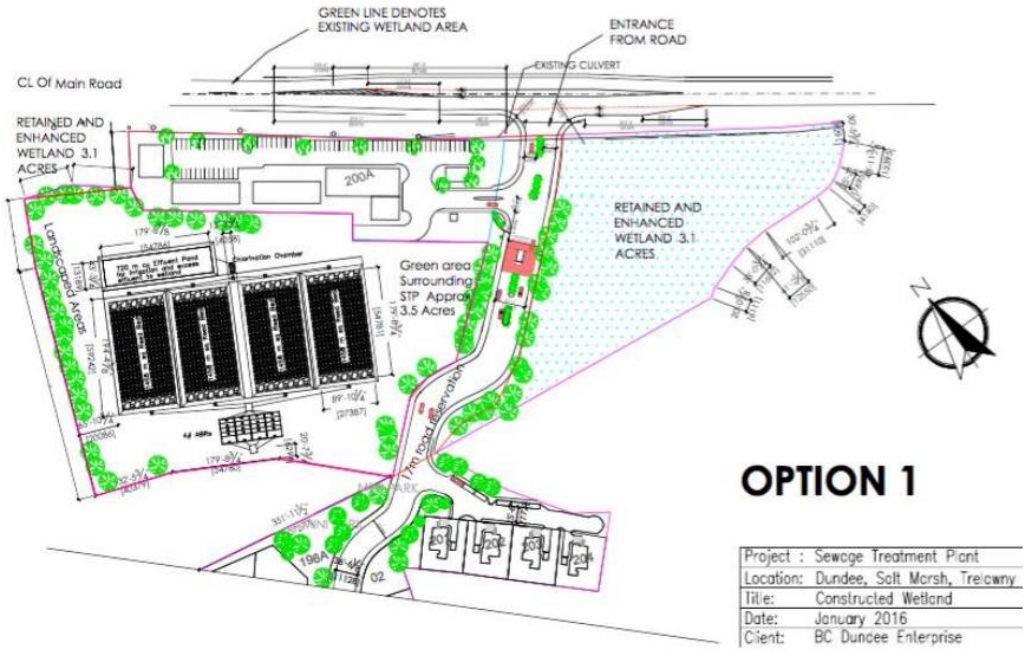
The **chlorination chamber** is designed to reduce fecal coliform levels to acceptable standards prior to discharge into the

PROJECT BREIF

Location:

Proposed location of subdivision at Dundee, Salt Marsh, Trelawny

Proposed Sewage Layout Plan



PROJECT DESCRIPTION

The proposal involves the construction of a reed bed system to serve a proposed development of:

- 137 Single story units (3 Bedroom)
- 72 Two storey units (3 bedroom)
- 84 Two bedroom apartments
- Commercial area with a projected flow of 20mcu /d

DESIGN ASSUMPTIONS

Volume expected = {(137*3*2*0.23)+ (72*3*2*0.23)+ (84*3*2*0.23)+ 20}+(10% increase)+(10% infiltration)**=467m^3/d**

The proposed treatment plant is design to treat sewage from a projected flows **480m^3/d**

The Anaerobic Baffle Reactors (ABR) and reed beds will be design as four (4) parallel models with one influent and one effluent. Each models will treated a total of **120m^3/d**

Anaerobic Baffle Reactor (ABR)

A new ABRs will be constructed with a 1.5 day capacity to treat the wastewater.

The capacity of the septic tanks is satisfy the minimum 1.5 days retention.

Volume of Anaerobic Baffle Reactor required =120*1.5=180m^3

Internal dimension for Septic Tank

L= 4m (1st chamber) + 2m (2nd to 5th chamber) = 12m

W=8m

D=2m

Proposed Volume = 192m^3

Reed Bed

Using Reed's method for the design of constructed wetlands

The cross sectional area for flow through a subsurface flow system is calculated according to the following equation:

$A_c = Q \div (k_s * S)$

where,

A_c = d•W, cross-sectional area of wetland bed, perpendicular to the direction of flow, m^2

Q= flow rate, $120m^2/d$

d = bed effective depth, 0.7m

W= bed width, 27m

k_s =hydraulic conductivity of the gravel, $500m^3/ m^2$ - d

S = slope of the bed, 1% or hydraulic gradient (as a fraction or decimal)

Reed et al. have indicated the need to check

the value ksS< 8.60. Choose a media of gravel, n = 0.35, ks =500

ksS = (500) (0.01) = 5 < 8.60 {OK}

Due to organic loading on bed the minimum cross-sectional area, A_c is $24m^2$

However with the use of the ABRs the organic loading will be significantly less

The design equations based on Reed *et al.* (1995) are as presented below:

$n = V_v/V$

$$K_T = K_R \theta_R^{(T_W - T_R)}$$

$$\ln\left(\frac{C_i}{C_e}\right) = K_T t$$

$$A_s = \frac{Q \ln\left(\frac{C_i}{C_e}\right)}{K_T y n} = \frac{[Q(\ln C_o - \ln C_e)]}{K_T y n}$$

Where,

A_s = treatment area of the wetland required (m^2)

C_e = outlet effluent pollutant concentration from ABR (100mg/l)

C_i = influent pollutant concentration (20mg/l),

K_R = rate constant at reference temperature ($1.104day^{-1}$)

K_T = Rate constant at temperature TW ($1.47day^{-1}$)

L = length of the wetland (57m) ,

n = porosity (0.35)

Q = average flow rate through the wetland ($20m^3$/day)

t = hydraulic residence time (3day)

T_W = water temperature ($25^{o}C$)

T_R = reference temperature ($20^{o}C$)

W = width of the wetland (20m)

y = depth of the wetland (0.7m)

θ_R = temperature coefficient for rate constant(1.06)

V_v and V are the volume of the voids and total volume, respectively.

Using hydraulic loading for nutrient removal

Reed Bed

Width of 27m

Depth of 0.7m

Length of 54m

Surface area $1458m^2$

Total surface area $5,832m^2$

Chlorination Chamber

For at least 30min retention, the size required is $(480\ m^3/d)/48 = 10m^3$

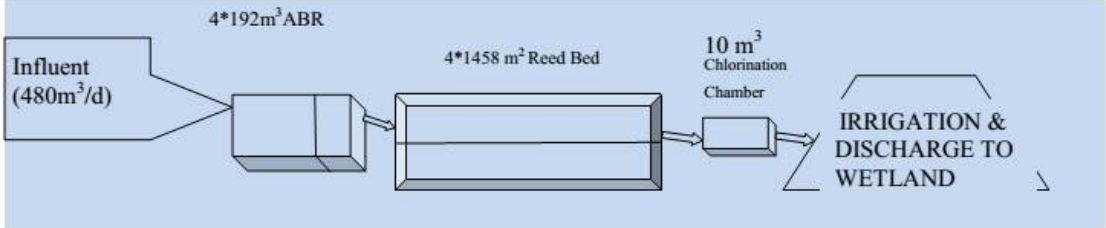
Proposed volume = $10m^3$

Proposed depth = 1m

Proposed length = 5m

Proposed width = 2m

CONCLUSION



RECOMMENDATION

Maintenance and setbacks of ABR

- Basically three products should go into the septic tank: human wastes, toilet paper, and water from toilets, bathing fixtures, kitchen sinks and laundry washers.
- Do not use your septic tank to get rid of oils, paints, insecticides or other poisonous liquids.
- Your septic tank should be routinely pumped at least every three years
- The EHU requires a setback of least 1.5m from the boundary line and building foundation.

Maintenance and setbacks of Subsurface Flow Reed Bed

- Remove dead vegetation from reed bed.
- Bed should be constructed in such a manner so not to allow surface run off to enter.
- The EHU requires a setback of least 1.5m from the boundary line and building foundation.

REFERENCE

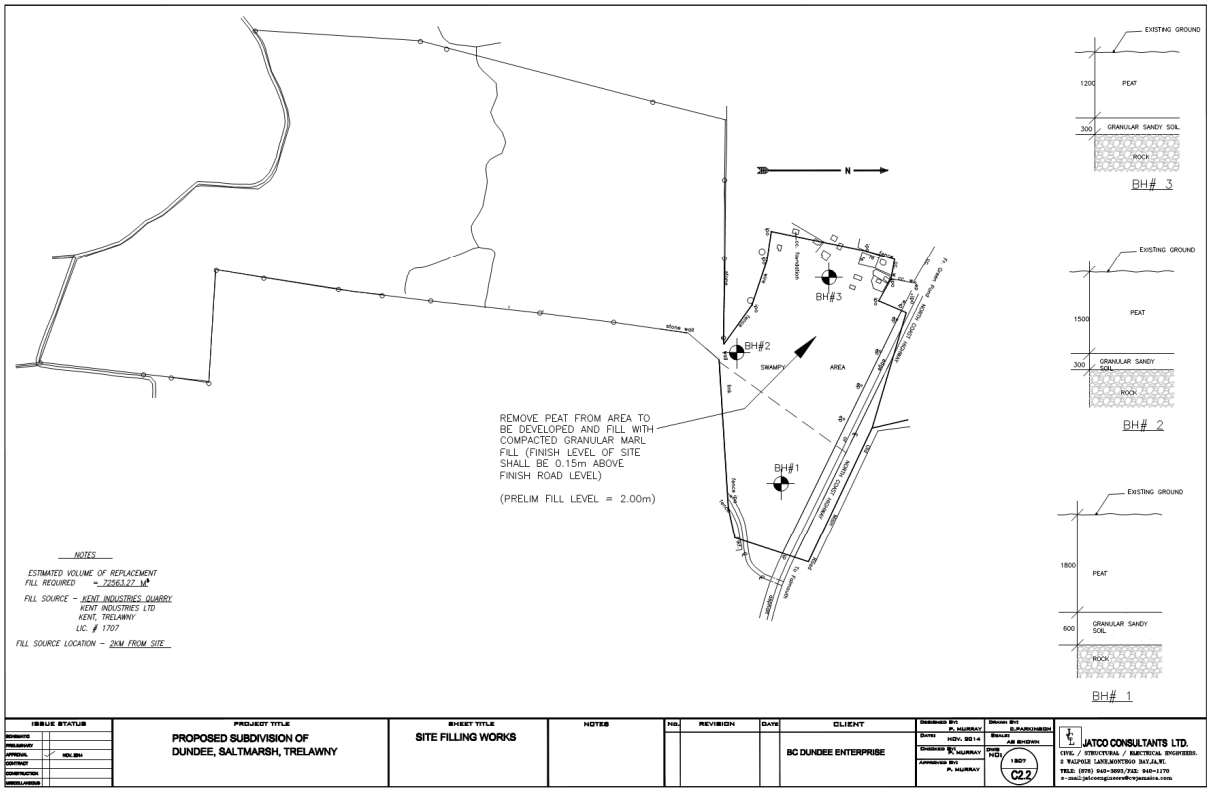
Development and Investment Manual: Vol 3 section 4 - *Minimum Requirements for Wastewater Treatment Systems and Dry Excreta Management in Jamaica*

Metcalf and Eddy, Inc, Wastewater Engineering Treatment and Reuse (4th Edition)

U.S. Environmental Protection Agency (February 2002): *USEPA Onsite Wastewater Treatment Systems Manual.*

S. Kayombo, T.S.A. Mbwette, J.H.Y Katima. Chapter 3: Constructed Wetland. *Waste Stabilization Ponds and Constructed Wetlands Design Manual*, pp 29-53

"Water for the World", Designing Subsurface Absorption Systems Technical Note No. SAN. 2.D.l


N
BH#1
BH#2
BH#3
SWAMPY
AREA
REMOVE PEAT FROM AREA TO BE DEVELOPED AND FILL WITH COMPACTED GRANULAR MARL FILL (FINISH LEVEL OF SITE SHALL BE 0.15m ABOVE FINISH ROAD LEVEL)
(PRELIM FILL LEVEL = 2.00m)
NOTES
ESTIMATED VOLUME OF REPLACEMENT FILL REQUIRED = 72563.27 M³
FILL SOURCE – KENT INDUSTRIES QUARRY
KENT INDUSTRIES LTD
KENT, TRELAWNY
LIC # 1707
FILL SOURCE LOCATION – 2KM FROM SITE
EXISTING GROUND
1200
PEAT
300
GRANULAR SANDY SOIL
ROCK
BH# 3
EXISTING GROUND
1500
PEAT
300
GRANULAR SANDY SOIL
ROCK
BH# 2
EXISTING GROUND
1800
PEAT
600
GRANULAR SANDY SOIL
ROCK
BH# 1
ISSUE STATUS
PROJECT TITLE
PROPOSED SUBDIVISION OF DUNDEE, SALTMARSH, TRELAWNY
SHEET TITLE
SITE FILLING WORKS
NOTES
NO.
REVISION
DATE
CLIENT
BC DUNDEE ENTERPRISE
DESIGNED BY: P. MURRAY
DRAWN BY: S.PARKINSON
DATE: NOV. 2014
SCALE: AS SHOWN
CHECKED BY: P. MURRAY
APPROVED BY: P. MURRAY
DWG NO: C2.2
JATCO CONSULTANTS LTD.
CIVIL / STRUCTURAL / ELECTRICAL ENGINEERS.
2 WALPOLE LANE,MONTEGO BAY,JA,WI.
TELS: (876) 940-3095/912: 940-1170
e-mail:jatcoeng@cwjamaica.com

Revised Engineering Report

on

Storm Water Drainage

for

Proposed Subdivision of Part of Dundee, Salt Marsh, Trelawny

Client: BC Dundee Enterprise

Consulting Engineer:

JATCO consultants Ltd
Civil/Structural Engineers
2 Walpole Lane, Montego Bay, St. James
Telephone : (876) 940-3893 * Fax (876) 940-1170
Email: jatcoengineers @cwjamaica.com

January 2016

Revised Engineering Report on Storm Water Drainage

for

Proposed Subdivision of part of Dundee, Salt Marsh, Trelawny

Table of Contents

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Tables

Engineering Report on Storm Water Drainage

for

Proposed Subdivision of Part of Dundee, Salt Marsh, Trelawny

1. Introduction

It is proposed to develop a residential subdivision to part of Dundee, Salt Marsh community in the parish of Trelawny and JATCO **Consultants Ltd., Civil/Structural Engineers** has been engaged to carry out the analysis and design for the storm water infrastructure.

This "Storm Water Drainage Report" sets out the design parameters and criteria used to determine the storm water drainage works necessary to collect, convey and safely discharge the storm water run-off from the proposed development.

2. Background

The subject property (referred to as "The ***Development"*** hereafter) comprises approximately 28.7 hectares (71.0 acres) of land to be developed by BC Dundee Enterprise and comprises 297 residential lots and 1 commercial lot. It is bounded by the North Coast Highway to the North and is located approximately 3.0. Miles (4.8 km) West of the Falmouth Town Centre.

The proposed development is divided into Two (2) distinct geographical zones, namely the Highland property to the south and the Lowland property to the North. See FIG 1 for topographical survey of the property.

The Highland property is undulating with moderately steep slope and a major gully traversing it. It is predominantly of stable marly limestone outcrop and covers an area of approximately 23.61 hectares (58.34 acres).
The Lowland property covers an approximate area of 5.12 hectares (12.66 acres) and is flat with elevations varying from 0.3m (1.0ft) to 2.36m (7.74ft). This section of the property is generally of 1.2m (4ft) to 2m (6.7ft) combined clay/peat layer overlaying stable marly limestone outcrop.
Above the 1.0m (3.3ft) elevation was found to be consistently dry and is reasonable as the inverts of the NWA drains along the North coast highway within close proximity to the site were not submerse in water and found to be at 0.85m (2.83ft) or lower elevation. This dry lowland area covers approximately 1.72 hectares (4.25 acres). Below the 0.85m (3 ft.) elevation was found to be consistently wet.

3. **Hydrology**

The standards used in arriving at our recommendations are generally in accordance with the "Jamaica Institution of Engineers (JIE) Guidelines for Design & Construction of Housing Infrastructure"- vol. 1 – 1984 - Storm Water Drainage and "NWA Guidelines for Drainage Review of Subdivisions & Development Application".

The surveyor's topographical plan of the site and 1:12,500 map of the region were used to study the characteristic and areas of catchments impacting the development.

The Sangster's International Airport rainfall Intensity Duration Frequency (IDF) curves were used in the analysis.

The time of concentration for each Catchment was computed from the following expression:

$$\frac{1.32 \times (n \times L)^{0.6}}{(C \times A)^{0.4} \times S^{0.3}} = \frac{T_i - T_g}{(T_i \times B)^{0.4}}$$

C _ run- off coefficient for the Catchment

N – Roughness coefficient for the Catchment

L – Average Overland flow length (ft)

S – Average Ground slope (ft/ft)

A & B – Design parameter for the storm depending on the storm return period

T_g – the gutter flow time (minutes)

T_i – time of concentration (minutes)

The rate of storm water run-off from each catchment was computed using the Rational Formula, which is as follows:

Q = C x I x A; where

Q – the peak flow from the catchment (ft^3/s)

A – the area of the catchment (acres)

I – the intensity of the Runoff (in/hr)

The detention pond sizing was estimated using the Modified Rational Method (trapezoidal hydrograph) for 10 year storm where the duration was varied to determine various post and pre development storage. The storage required was estimated by subtracting the Pre-development from the Post-development storm water quantity. The maximum storage obtain was used in sizing the detention pond. Overflow structures were design for the 100 year storm flow.

4. Existing drainage (Pre-development)

Pre-development storm water from 18.90 hectares (46.69 acres) of the Highland property together with those from external catchments flows into the existing Gully #2 and discharge into an existing 7.1 hectares (17.5 acres) pond adjacent to the North Coast Highway. Storm water from this pond overflows into the existing NWA existing culvert drains crossing the highway and into the sea via wetland to the North of the Highway.

Pre-development storm water from the remaining 4.73 hectares (11.69 acres) of the highland property, together with those from the complete lowland property and external catchments flows into the wetland area of this property and wetland on adjacent properties to the East. Some of the storm water from the wetlands flows to the 7.1 hectares detention pond in the East and the remainder flows to the West via NWA roadside swale (ditch).

Storm water flowing westward along the NWA roadside swale (ditch) is collected by Two (2#) existing 600mm (2ft) dia. culverts crossing the North Coast highway and disposed into the sea via Two (2#) 600 mm(2 ft) wide earth swales(ditches ED # 4). The outlet invert of the NWA culverts was found to be approximately 0.79m (2.59ft) and the general ground elevation to be 1.3m (4.27ft). The drainage path of the Two (2) earth swales (ditches ED#4) were blocked by informal developments but was subsequently cleared. See FIG 2 for catchment layout and outfall to sea and FIG 3 for Existing Drainage Structures.

Analysis of the storm water Pre-development properties and run-off from the catchments for different return periods are summarized in Table 1 and FIG 4.

5. **Proposed Drainage System (Post Development)**

Post-development storm water from 18.90 hectares (46.69 acres) of the Highland property together with those from external catchments is channeled along the roadways via curb and channel to low points, where it is collected and discharged via systems of swale (ditch), culverts, pipe drains and U drain to nearby existing Gully #2 where it is detained in a proposed pond on the property. Pre- development flow continues from the proposed pond to the existing 7.1 hectares (17.5 acres) pond adjacent to the North Coast Highway.

Post-development storm water from the remaining 4.73 hectares (11.69 acres) of the Highland property, together with those from the undeveloped area of the Lowland property and external catchments flows into the remaining wetland area of this property and wetland on adjacent properties to the East. The wetland will provide a detention effect and release Pre-development (restricted) flows to the existing 7.1 hectares detention pond in the East. The maximum expected 100 year flood elevation of the wetland is 1.3m at pre-development outflow. The preliminary fill level for the developed section of the Lowland site is 2.00m and the final level will be in the order of 2.3m. The existing 525mm (21") diameter culvert under the existing access road to the East of the Lowland property is partially submerged with invert estimated of 0.56m (1.87ft). This culvert cannot carry the estimated 25 year pre-evelopment flow and a new culvert (C3.7) is proposed.

Post-development storm water from the developed area of the Lowland property (Excluding the entrance road) flows into the existing NWA roadside ditch and into the Two (2) existing 600mm diameter culverts North of the property and crossing the North Coast Highway. Existing earth ditches (ED#4) discharge the water in the sea.

Analysis of the storm water Pre-development properties and run-off from the catchments for different return periods are summarized in Table 1 and FIG 5.

6. **Design**

The proposed drains are designed for storm return periods as follows :-

- Culverts : 25 years storm return period
- Pipe/Open drains: 25 years storm return period
- Ditches/Swale /Gullies– 10 years storm return period
- Curb and Channel – 2 years storm return period
- Detention Pond : 10 and 100 years storm return period
- Wetland flood control : 100 years storm return period

Hydraulic structures such as circular culverts, swales and open channels were design using the Manning's Formula; while Table 2-6 of the JIE Guidelines was used to determine capacities of the curb and channel/inlets along the streets.

A minimum free board of 25% was also incorporated in the design.

Flow Capacities for the various drainage structures are shown in Table 2 and identified in FIG 6.

Detention Pond (DP#1) using Modified Rational method

Q_{10} Pre-development flow from catchment 1 & 2 =176.85cfs.
Q_{10} Post –dev. flow from catchment 1 & 2 =252.45cfs (T_c = 32.6 mins)
From analysis of varied storm duration vs storage , the optimum storm duration =32.6 mins; Q post =252.45cfs;
Post-dev. volume$_{10}$ =494,100cu.ft.
Pre -dev. volume $_{10}$=449,660cu.ft.
Minimum Detention $_{10}$ = 44,440 cu.ft. (1258 cu.m.)

Wetland Detention Effect using Modified Rational method

Q_{25} Pre-development flow from catchment 4 =19.46cfs.

Q_{100} Post -development flow from catchment 3 & 4=114cfs (T_c = 28.2 mins)

From analysis of varied storm duration vs storage , the optimum storm duration =79 mins; Q post =62.12cfs;

Post-dev. volume$_{100}$ =294,469cu.ft.

Pre -dev. volume $_{25}$=114,853cu.ft.

Minimum Detention $_{100}$ = 179,616 cu.ft.

Undeveloped wetland area = 3.1 acres (135,036 sq.ft.)

Average flood depth = 1.33ft (0.41m)

Flood Water avg. elevation = o.85m +0.41m =1.26m Say 1.3m (4.27ft)

7. **Summary**

Drawing # 1307/C1-C3.2 shows the recommended drainage structures

PROFESSIONAL ENGINEERS REGISTRATION BOARD JAMAICA
PATRICK A. MURRAY
PE/01:06/0266

.....

JATCO Consultants Ltd

January 2016

FIGURES

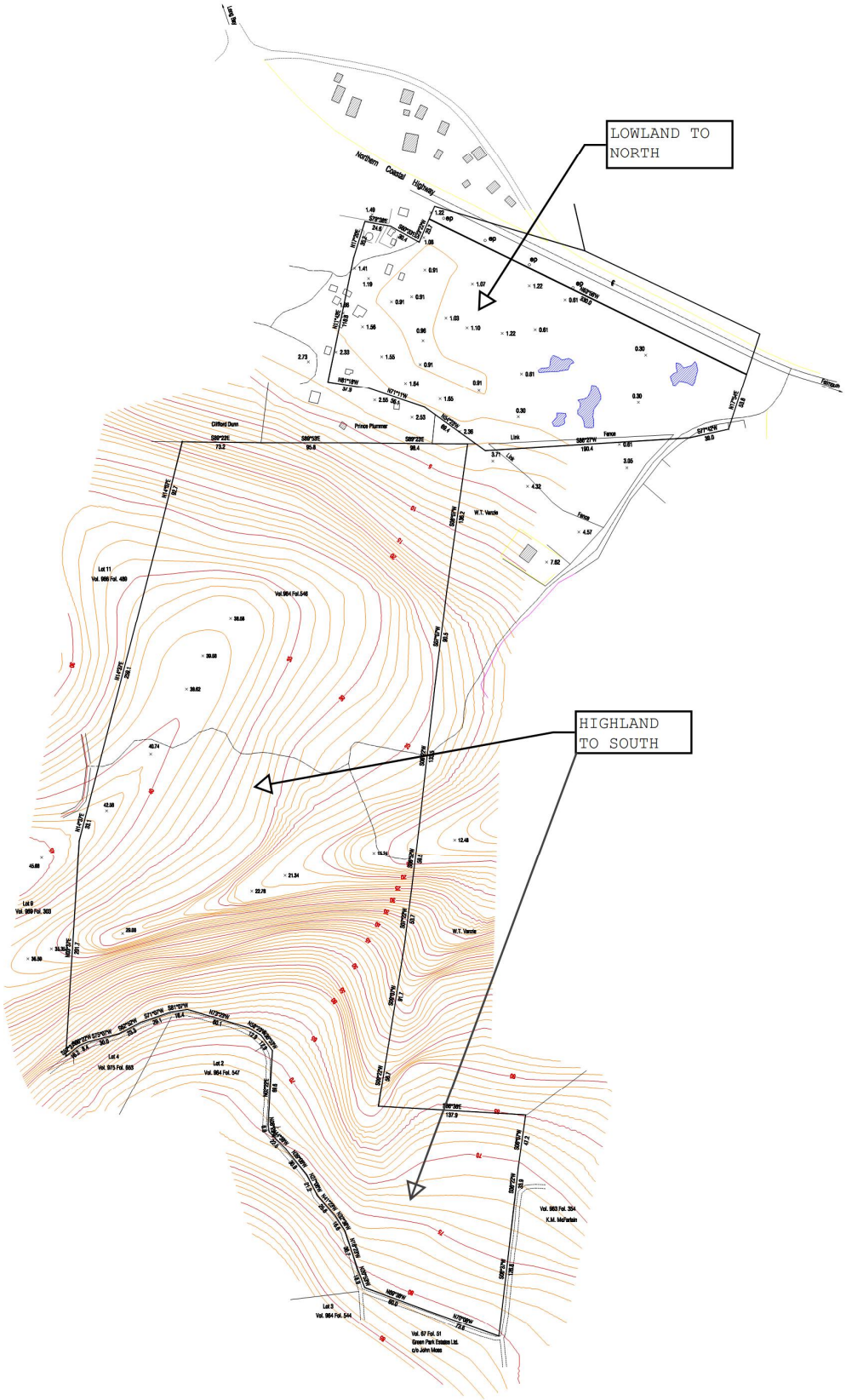


FIG 1 - TOPOGRAPHICAL SURVEY OF PROPERTY

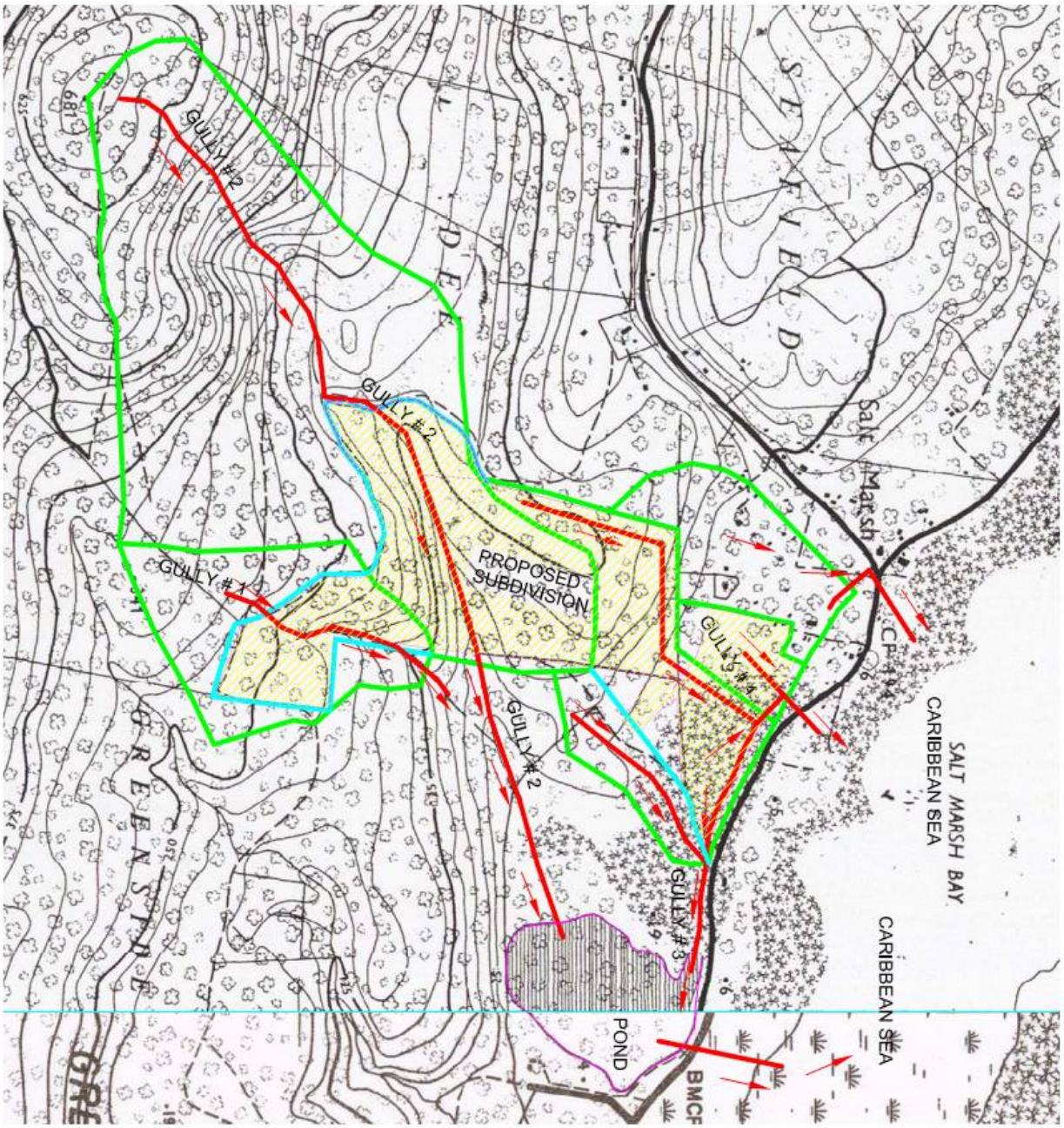
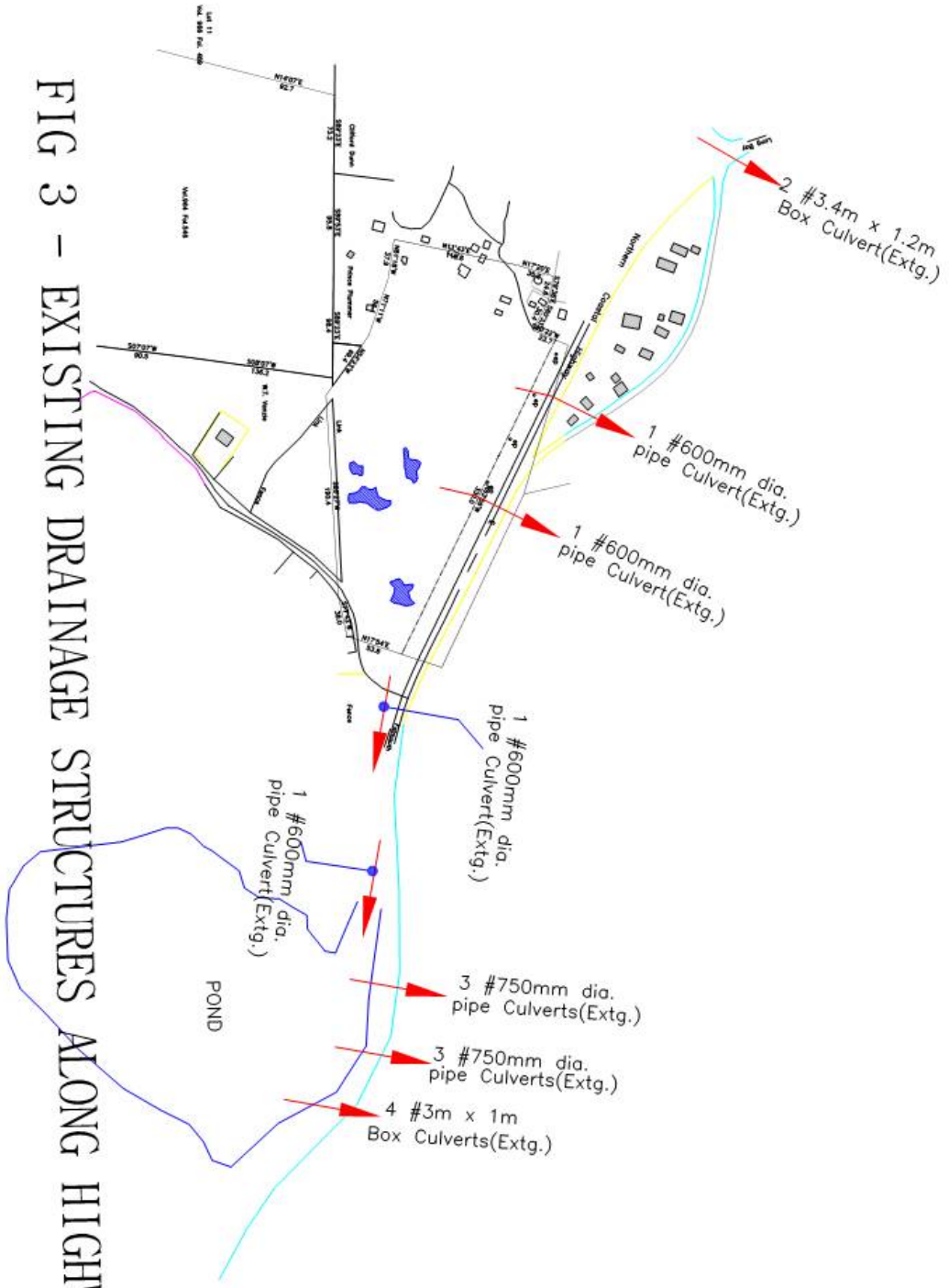


FIG 2 - CATCHMENT LAYOUT & OUTFALL TO SEA

FIG 3 – EXISTING DRAINAGE STRUCTURES ALONG HIGHWAY



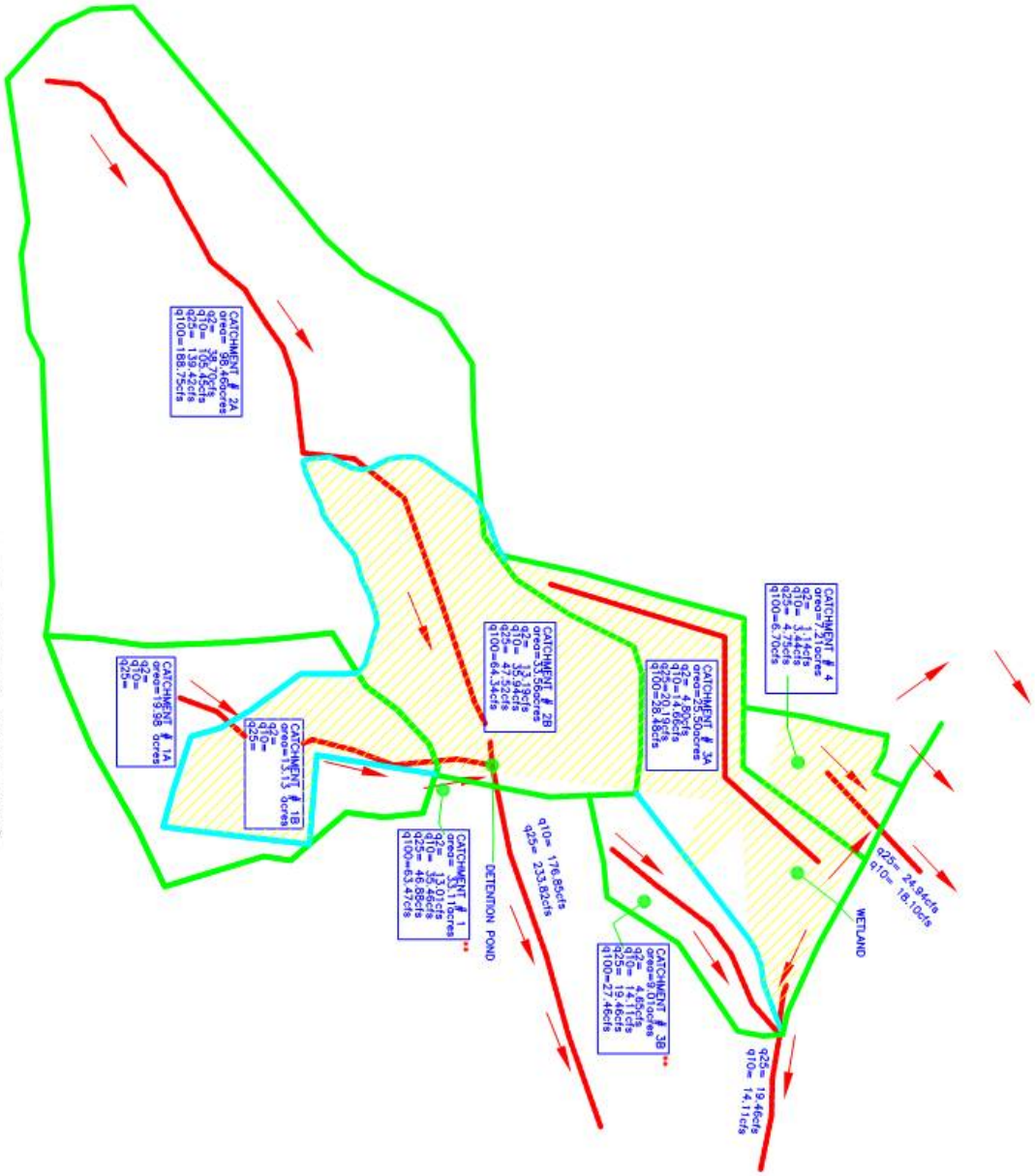


FIG 4 – CATCHMENTS STORM WATER FLOW(PRE-DEV)

** BASE ON LONGER TIME OF CONCENTRATION

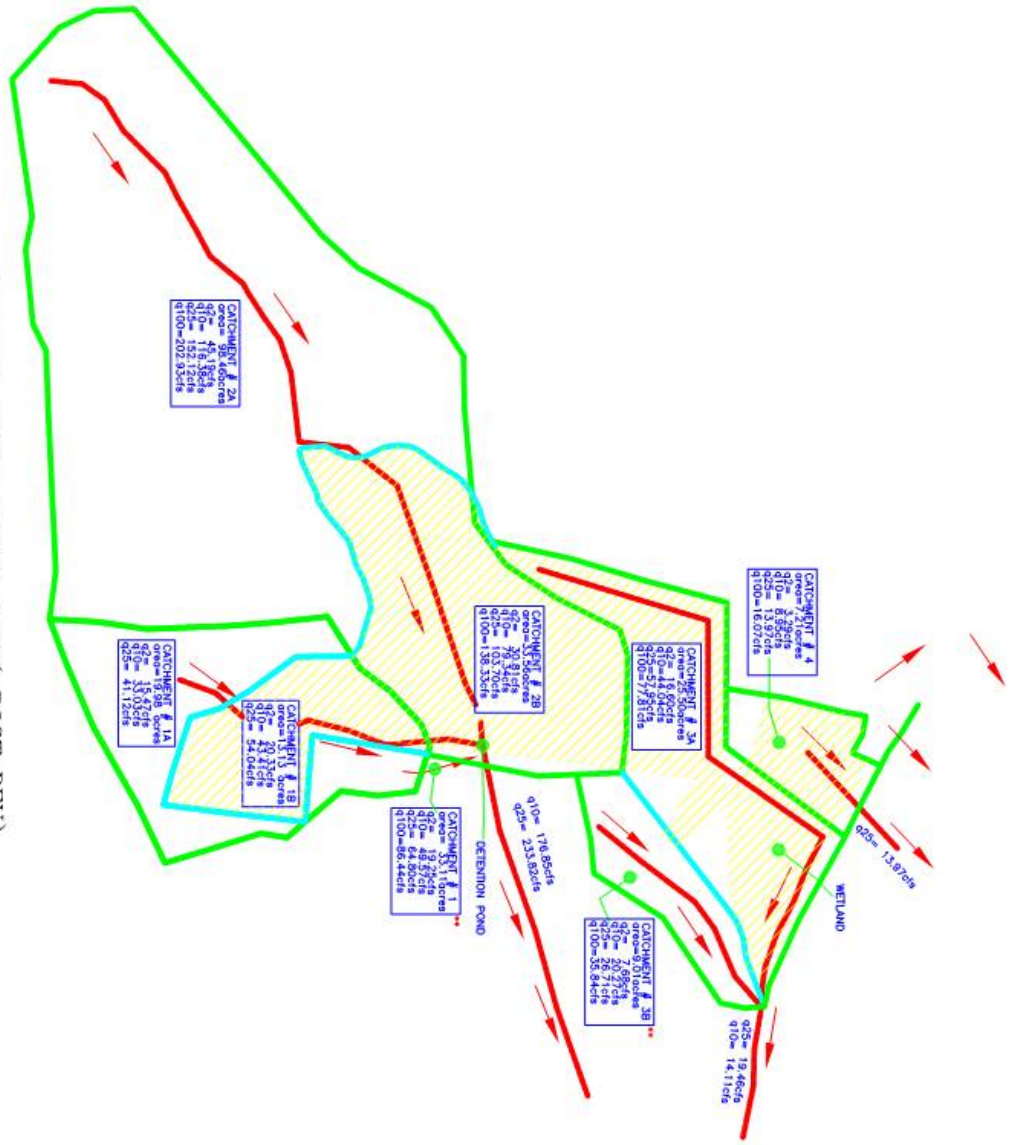


FIG 5 – CATCHMENTS STORM WATER FLOW (POST-DEV)

** BASE ON LONGER TIME OF CONCENTRATION

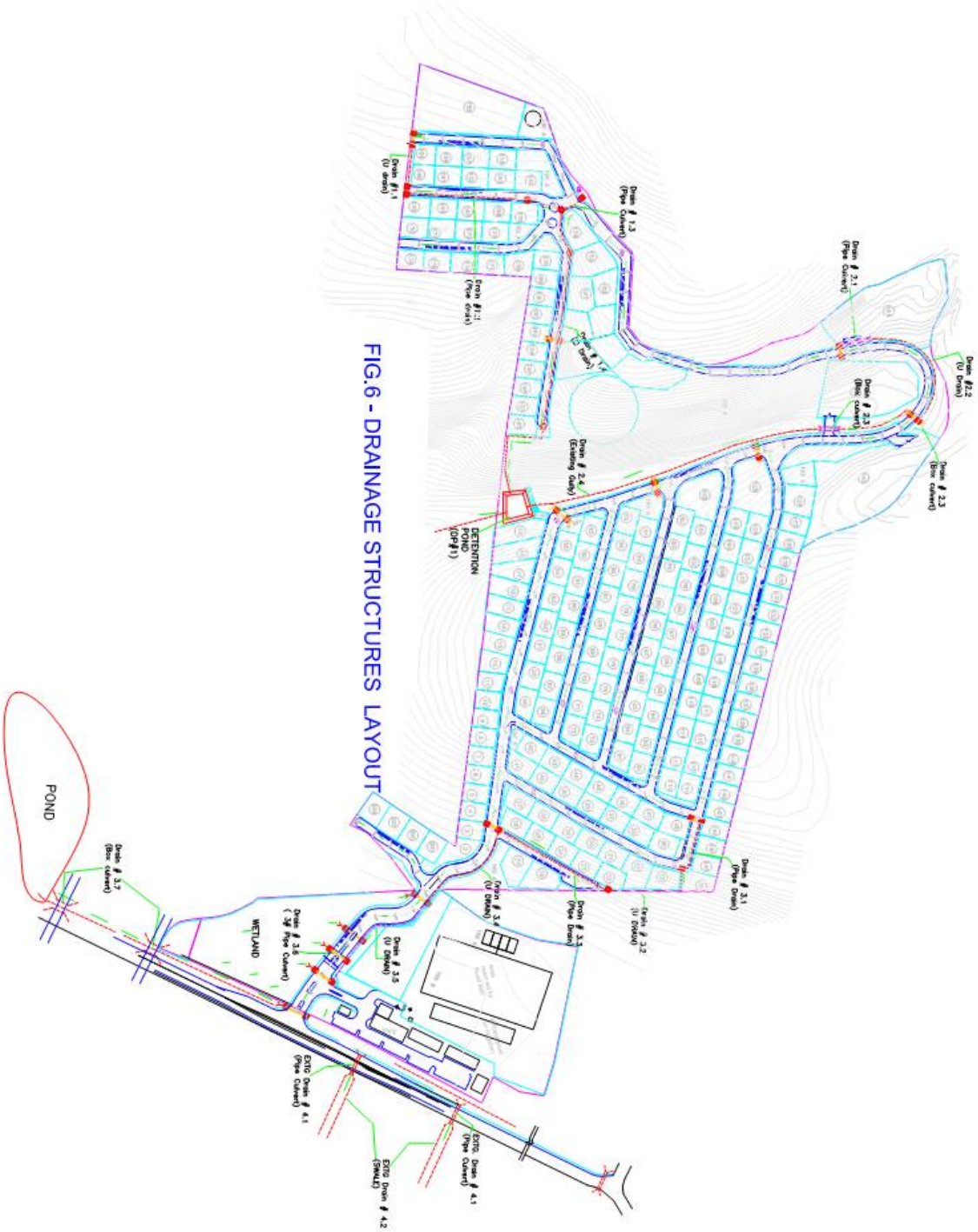


FIG.6 - DRAINAGE STRUCTURES LAYOUT

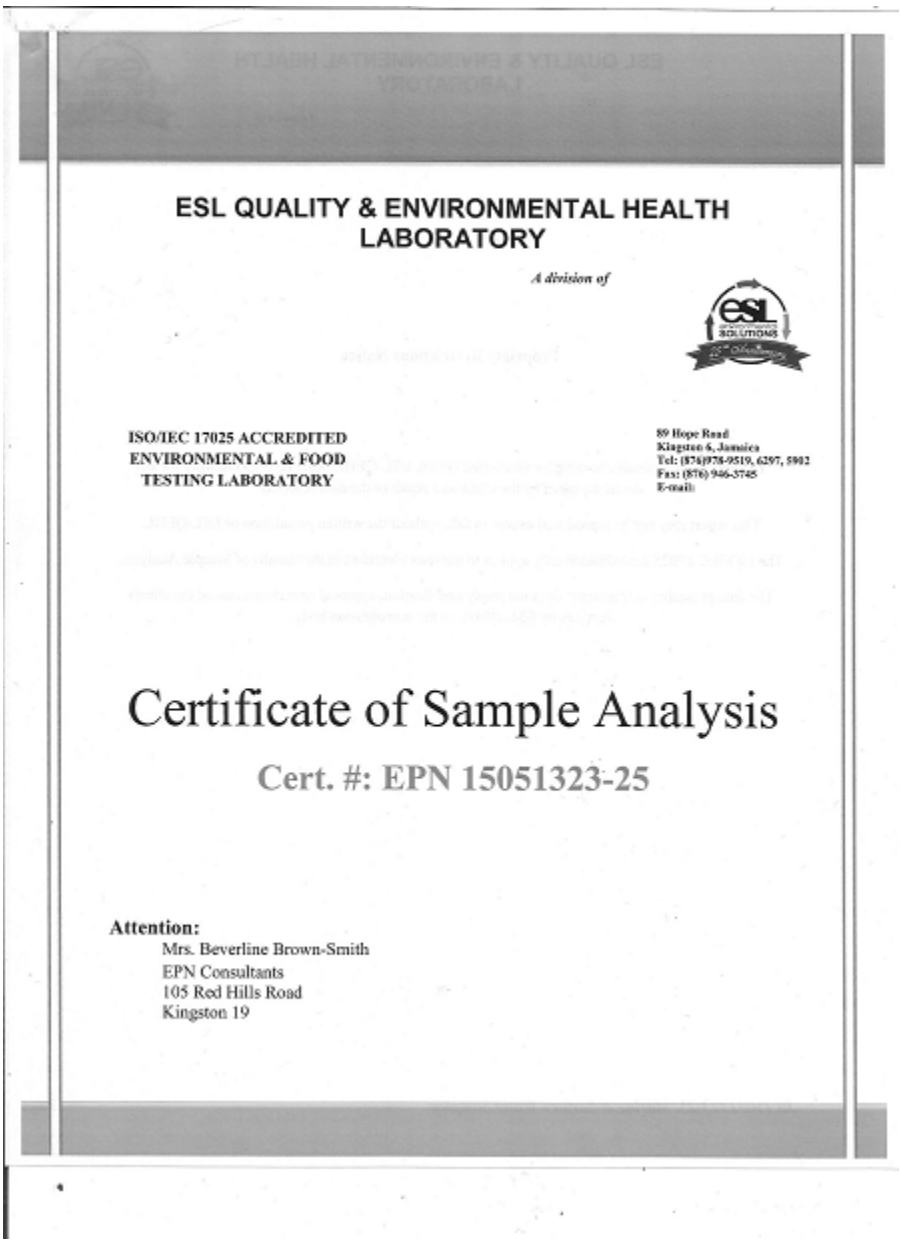
TABLES

TABLE 1 - CATCHMENT PROPERTIES

Catchment	Area (acres)	Co (pre)	Co (post)	No(pre)	No(post)	Lo (ft)	So
1	33.11	0.3	0.42	0.03	0.027	1414	0.1061
1A	19.98	0.3	0.3	0.03	0.03		
1B	13.13	0.3	0.6	0.03	0.022		
2	132.02	0.3	0.38	0.03	0.028	3763	0.161
2A	98.46	0.3	0.3	0.03	0.03		
2B	33.56	0.3	0.6	0.03	0.022		
3A	25.5	0.22	0.46	0.038	0.032	2493	0.0562
3A-1	15.56	0.3	0.6	0.03	0.022		
3A-2	7.77	0.1	0.1	0.05	0.05		
3A-3	2.17	0.1	0.75	0.05	0.04		
3B	9.01	0.6	0.6	0.022	0.022	1460	0.045
4	7.21	0.183	0.35	0.039	0.047	873	0.021
4A-1	3	0.3	0.2	0.024	0.05		
4A-2	2.21	0.1	0.2	0.05	0.05		
4A-3	2	0.1	0.75	0.05	0.04		

TABLE 2 -Hydraulic Analysis of Drains

Drain #	Catchment	Return Period	CAT Flow (cfs)	Freeboard	Design Flow	Slope	Drain type	Min. Drain Size
1.1	20% x CAT 1A +20% x CAT 1B	25 years	19.06	25%	23.825	1%	Pipe culvert	2'-0" dia.
1.2	20% x CAT 1A +20% x CAT 1B	25 years	19.06	25%	23.825	1%	Pipe drain	2'-0" dia.
1.3	55% x CAT 1A	25 years	22.62	25%	28.275	1%	Pipe culvert	2'-6" dia.
1.4	85% x CAT 1A + 85% x CAT 1B	25 years	80.8	25%	101	5%	U drain	2' 6" x 2'
2.1	20% x CAT 2A + 10% x CAT 2B	25 years	40.79	25%	50.9875	5%	Pipe culvert	2ft dia.
2.2	20% x CAT 2A + 10% x CAT 2B	25 years	40.79	25%	50.9875	5%	U drain	2' x 2'
2.3	100% x CAT 2A + 20% x CAT 2B	25 years	172.86	50%	259.29	1%	Box culvert	6.25' x 3.25'
2.4	100% x CAT 2A + 100% x CAT 2B	10 years	195.72	25%	244.65	5%	Swale/Gully	4'-6" x 2'-6"
3.1	40% x CAT 3A	25 years	23.18	25%	28.975	1%	Pipe culvert	2'-6" dia.
3.2	50% x CAT 3A	25 years	29	25%	36.25	5%	U drain	2' 6" x 1' 6"
3.3	**60% x CAT 3A**	**25 years**	**34.77**	**25%**	**43.4625**	**0.5%**	**Pipe drain**	**3ft dia.**
3.4	80% x CAT 3A	25 years	46.36	25%	57.95	5%	U drain	2' 6" x 1' 6"
3.5	95% x CAT 3A	25 years	55.05	25%	68.8125	1%	U drain	2' 6" x 2' 6"
3.6	1/3 x 95% x CAT 3A	25 years	18.35	25%	22.9375	0.5%	Pipe culvert	2'-6" dia.
3.7	100% x CAT 3B-pre	25 years	19.46	25%	24.325	0.18%	Box culvert	4' -0"x 1'6"
4.1	1/2 x 100% x CAT 4	25 years	6.99	25%	8.7375	0.27%	Pipe culvert	2ft dia.
4.2	1/2 x 100% x CAT 4	10 years	4.48	25%	5.6	0.18%	Earth Swale	2' x 1'6"



ESL QUALITY & ENVIRONMENTAL HEALTH LABORATORY

A division of

ISO/IEC 17025 ACCREDITED
ENVIRONMENTAL & FOOD
TESTING LABORATORY

89 Hope Road
Kingston 6, Jamaica
Tel: (876)978-9519, 6297, 5902
Fax: (876) 946-3745
E-mail:

Certificate of Sample Analysis

Cert. #: EPN 15051323-25

Attention:
Mrs. Beverline Brown-Smith
EPN Consultants
105 Red Hills Road
Kingston 19

ESL QUALITY & ENVIRONMENTAL HEALTH LABORATORY

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Results of Sample Analysis

PARAMETERS	TEST METHOD	SAMPLE ID:SAMPLE TYPE	NRCA AMBIENT MARINE WATER STANDARD
		Jetty S-M: MW	
Salinity (ppt)	DR	35.26	-
Total Suspended Solids (mg/L)	SM-2540D	14.2	-
Faecal Coliform (MPN/100mL)	SM 9221	2.0	<2-13
Nitrate (mg NO_3/L)	H-8192	0.09	0.007-1.16
Phosphate (mg PO_4^{3-}/L)	H-8048	0.07	0.001-0.003

***Grey shaded parameters are ISO /IEC 17025 Accredited.**

JB 15051323-25, Marine & Surface Water Samples Page

PARAMETERS	TEST METHOD	SAMPLE ID: SAMPLE TYPE		NRCA AMBIENT WATER
		S.M Pond: SW	WLN:SW	
Salinity (ppt)	DR	96.35	16.44	-
Total Suspended Solids (mg/L)	SM-2540D	3,400.0	124.0	-
Faecal Coliform (MPN/100mL)	SM 9221	<1.8	240	-
Nitrate (mg NO_3/L)	H-8039	61.6	26.4	0.1 – 7.5
Phosphate (mg PO_4^{3-}/L)	H-8048	0.70	0.06	0.01 – 0.8

***Grey shaded parameters are ISO /IEC 17025 Accredited.**

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Certificate of Quality

Parameter: Salinity
QEHL Personnel: C. Giscombe **Date of Analysis: 13/05/15**

Standard Solution mS/cm	Reading After Calibration mS/cm
10.0 ± 0.1	10.03

Parameter: Total Suspended Solids
QEHL Personnel: M. Betton **Date of Analysis: 18/05/15**

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	Recovery (%)	RPD
MB		<2.5		
BD		124.0		0.0
		124.0		

Parameter: Phosphate
QEHL Personnel: M. Betton **Date of Analysis: 14/05/15**

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	Recovery (%)	RPD
MB		0.02		
BD		0.26		3.7
		0.27		
SRS	2.00	2.01	100.5	0.5

JB 15051323-25, Marine & Surface Water Samples Page

Parameter: Nitrate (Low Range)
QEHL Personnel: M. Betton **Date of Analysis: 15/05/15**

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	Recovery (%)	RPD
MB		<0.01		
BD		0.09		0.0
		0.09		
SRS	0.40	0.41	102.5	0.5

Parameter: Nitrate (High Range)
QEHL Personnel: M. Betton **Date of Analysis: 14/05/15**

	Standard Concentration (mg/L)	Determined Concentration (mg/L)	Recovery (%)	RPD
MB		0.5		
BD		24.6		1.7
		24.2		
SRS	10.0	9.7	97.0	3.0

Parameter: Faecal Coliform
QEHL Personnel: K. Simpson **Date of Analysis: 14/05/15**

Media/Test Item (Batch #)	DS LTB (12/5/15)	EC (15/5/15)	SS LTB (12/5/15)
Sterile (Yes/No)	Yes	Yes	Yes
Media performance (Typical, not typical)	Typical	Typical	Typical

SOLID WASTE MANAGEMENT PLAN

Company Name: **BC Dundee Enterprises Ltd.** **Contact Person: Mr. Carl Erskine, Mr. Baldwin Jarrett**

Address:

Project Location: **Dundee, Trelawny**

Superintendent: **Mr. Carl Erskine**

Telephone #: **561-1439**

Recycling Coordinators: To be named
Architect: Mr. Robin Baston

Project Description: Residential Development at Dundee, Trelawny

Waste Management Goals:

- This project will recycle or salvage for reuse a minimum of **95%** by weight of the waste generated on-site.
- Waste reduction will be achieved through reuse and recycling efforts will be maintained throughout the construction process.

Waste Prevention Planning:

- Recyclables include:
  - paper
  - corrugated cardboard
  - plastic and glass bottles, drums, bins and jars
  - metal cans
  - crates
- Other Waste
  - Stones
  - Vegetable matter

Project Construction Documents – Requirements for waste management which will be included in all work allocations. The General Contractor will contractually require all subcontractors to comply with the Company's recycling requirements. A copy of this Solid Waste Management Plan will accompany all Subcontractor Agreements and requires the subcontractor participation.

- The Construction Waste Reduction Plan shall be implemented and executed as follows and as on the chart:
    - Salvageable materials will be diverted from disposal where feasible.
    - There will be a designated area reserved for a row of dumpsters/barrels
    - Before proceeding with any removal of construction materials from the construction site, the Superintendent or the Assistant Superintendent will inspect containers for compliance with the Company's requirements.
    - Hazardous waste will be managed by a licensed hazardous waste vendor.

Communication & Education Plan:

- The Company will conduct an on-site pre-construction meeting with subcontractors. Attendance will be required for the subcontractor's key field personnel. The purpose of the meeting is to reinforce to subcontractor's key field employees the commitments made by their companies with regard to the Company's goals and requirements.
- As each new subcontractor comes on site, he/she will be advised of the requirements.
- The subcontractor will be expected to make sure all his/her crew complies with the Waste Management Plan.
- All recycling containers will be clearly labeled. Containers shall be located in close proximity to areas under construction where recyclables/salvageable materials will be generated.

Motivation Plan:

- The Company will develop and publish a mission statement that can be distributed to the subcontractors, attached to the subcontracts, and posted at the jobsite.

- This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the job site.

Evaluation Plan:

- The Superintendent will develop, update, and post at the jobsite a graph indicating the progress to date for achieving the project's waste recycling goal of 95% by weight of the total project waste stream.

Expected Project Waste, Disposal, and Handling:

The following charts identify waste materials expected on this project, their disposal method, and handling procedures:

Material	Disposal Method	Handling Procedure
Grass and wood cutting	Keep separate for reuse and or landscaping	Keep separated in designated areas on site.
particle boar	Reuse, landfill	Keep separated in designated areas on site. Place in "Trash" container.
Painted or treated wood	Reuse, landfill	Keep separated in designated areas on site. Place in "Trash" container.

Concrete Masonry Uni	Keep separate for re-use by on-site construction or by site employees	Keep separated in designated areas on site
Metals	-	Keep separated in designated areas on site.
Paint	-	Keep separated in designated areas on site
Glass	-	Keep separated in designated areas on site. .
Plastics	-	Keep separated in designated areas on site.
Beverage	-	Keep separated in designated areas on site. Cardboard" container
Cardboard	-	Keep separated in designated areas
Paper newsprint	-	Keep separated in designated areas on site.
Stones	Reuse as fill	Store safely in designated areas
Vegetable matter	Reuse-coal burners, gardeners, home owners, contractor, farmers	Separate and store according to expected use

GEOTECHNICAL REPORT

A SOIL INVESTIGATION REPORT
FOR THE PROPOSED HOUSING DEVELOPMENT
AT
SALT MARSH, TRELAWNEY

COMMITTED
TO A BETTER
FOUNDATION

PREPARED BY: NHL ENGINEERING LTD. 29 MONROE ROAD, KINGSTON 6

SOIL INVESTIGATION REPORT

PROPOSED HOUSING DEVELOPMENT
Salt Marsh, Trelawney, Jamaica.

Prepared for:
Jatco Consultants Limited
2 Walpole Lane,
Montego Bay, Jamaica

Prepared by:
NHL Engineering Limited
29 Munroe Road,
Kingston, Jamaica

June 10, 2014

TABLE OF CONTENTS

1.0. INTRODUCTION

1.1. Authority

The services of NHL Engineering Ltd. were retained to undertake a geotechnical survey on a parcel of land in Salt Marsh, Trelawney for a proposed residential development.

The fieldwork was delayed due to the swamp - like environment resulting in major access problems and subsequent preparation.

This report contains the results of the work done; the conclusions drawn; and the recommendations made regarding the main areas of engineering concerns as defined by the scope of this investigation.

1.2. Scope of Work

The locations of the borings are as shown in the Test Location Plan (Figure 5.2). NHL Engineering Ltd., was to arrange:-

i) The SPT/Coring field exploration based on the proposed testing locations
iii) The laboratory testing programme, which in our judgment, was necessary to provide a satisfactory basis for evaluating the site for the foundation design of the structural and infrastructural elements proposed on site.

On completion, a report presenting the results obtained, together with our recommendations should be submitted to the Client.

1.3. Project Description

1. SITE LOCATION:

The site is located along the Trelawney main road approximately 8 km ENE of Falmouth Town Centre. The area forms part of the White Limestone Group, specifically the Montpelier Formation. Given the topography and site conditions observed, the insitu subsoil materials were likely to be soft to medium limestone rock overlain by an upper layer of soft clays and possible peat. The depth to bedrock is unknown and may not be encountered during the field exploration. The rocks are expected to be moderately faulted and fractured - typical of this area.

1

2. SUPERSTRUCTURES:

According to the information obtained from the client, it is proposed to construct single and double storey residential buildings and amenities laid out as shown in Figure 5.2. These structures are likely to be comprised of reinforced concrete structural elements such as concrete beams, columns and slabs.

2

Plate 1 – Picture showing drilling crew at work in the vicinity of BH #1

Plate 2 – Picture showing drilling crew at work in the vicinity of BH #3

4

2.0. DATA BASE

2.1. Proposed programme

The proposed investigation will seek to establish the following:

i) The insitu density of the soils on site.
ii) Soil stratification and distribution across the site including depth to bedrock
iii) The design parameters relevant to the design of the anticipated structural and infrastructural elements required on site.

The field investigation entailed the drilling of three (3) boreholes located as shown in Figure 5.2. The Boreholes were to be taken to refusal on the auger or to a maximum depth of at least 12.2m. The method of drilling and sampling were in accordance with the Standard Penetration Testing specifications, using the Split Spoon Sampling technique.

2.2. Anticipated Design Approach

Given the nature of the likely superstructure to be constructed on the sites and their accompanying dead, live and dynamic loadings, the foreseeable problems are as follows:

i) Seismic induced lateral load instability of the soils within the critical depth of the structure loads.
ii) Undesirable total and differential deformation problems between the spans due to the deformation characteristics of adjacent areas from the Soft/Loose peaty silts/clays to the dense gravels and sands/limestone rock formation.

The likely modes of failure for shallow foundation placed on this site are therefore load induced shear failure and or failure related to vertical or lateral deformation. A soil modification/replacement approach or a foundation type that reduces or mitigate the effects of these possibilities will be suitable for this site.

2.3. Soil Boring & Sampling

1. Methodology:

The borings were made by NHL Drillers using a truck Mounted Mobile Drill Rig, with a 160 mm hollow stem auger string. Sampling was to be done with a Split Spoon in accordance with Standard Penetration Test specifications, using a Cathead Hammer (N_{55} values). In general, S.S samples were to be taken at 0.76m intervals of depth to the first 3.81m and thereafter at 1.5 metre intervals to the maximum depth.

If refusal on the auger was encountered in the upper strata, the use of tricone drilling and or NX coring would be recommended to determine the thickness and quality of the rock formation.

2. Discussion of results:

The soils encountered were generally a mixture of very soft Silty Clays and loose calcareous sands and gravels overlying the limestone rock formation.

Refusal on the auger was encountered in Boreholes 1 and 2 at depths of 1.8m and 2m respectively.

The insitu densities of the soils within the upper 2m were generally within the soft/loose firm range. Below the 2m depth, the soils are generally the medium hard limestone rock.

The locations tested were low and below the Ground water table prior to access preparation and is likely to be at the very least at the ground surface.

6

3.0. LABORATORY TEST RESULTS

Nine samples were selected for laboratory testing; four Grainsize Distribution tests, two moisture content tests and three unconfined compression tests. The samples chosen are deemed to be representative of the collective group of soils encountered on site.

3.1. Classification & Index Testing:

1. Grainsize Distribution:

The indications are that the soils have gradation that falls essentially into one group. The following is the group description:

1) Group A – the Gravelly Coarse to Fine Sands + Some Silts/Clays

2. Soil Plasticity:

The samples tested appeared to have significant peat content. Their Moisture Contents from ranged from 87.2% to 96.4%.

Based on these results, it is expected that these soils will exhibit high compressibility due to biodegrading and therefore will bear significantly affect the choice and design of the pavements and foundations where they were encountered.

3. Unconfined Compression Test

Three samples have been tested, Compressive Strength values ranged from 1800psi to 2300 psi with an average strength of 2100 psi. The rocks can therefore be classified as Medium hard limestone.

4.0. GEOTECHNICAL DISCUSSION

4.1. Presumptive Soil Profile

The subsoil layers applicable for evaluating engineering behavior and construction concerns can be characterized as Two (2) distinct types (see typical site profiles below). The types are as follows:-

TOP 1

1) The Soft to very Soft Clays/peat plus Some Calcareous Gravels & Sands
   Depth Range 0 - 2
   Deduced Average N_{55} = 3
   Borehole #s 1 and 2.

BOT 1

2) The Limestone Rock Formation
   Depth Range 2+ metres
   Average RQD = 12%
   Borehole #s, All

4.2. Depth and Type of Foundations

The soils encountered were fairly variable in distribution vertically across the site as shown in the figure below. The Top1 soils are soft and peaty and will undergo significant settlement under the anticipated building loads. The Bot 1 soils are competent and will exhibit no deformation under the proposed vertical loads. The problem on this site is the high water table and the highly compressible Top1 soils. Consequently, the use of conventional shallow isolated pad and strip foundation on this site is not recommended without soil replacement/modification.

Recommendations

The following recommendations appear the most economical given the resources available;

a) Excavate and remove the upper 2m of the TOP1 soils and replace with a layer of River shingle and compacted granular fill and use a stiff raft foundation. This may require the drawdown of the water table by well pointing prior to excavation.

b) Preload the site with approved backfill and consolidate the peaty clays over time or with vertical drains (wick drains) over a significantly shorter time and use raft or tied pad footings. Note the spacing and size of wick drains will have to be design along with the height of fill required to accomplish the consolidation in the timeframe required for construction.

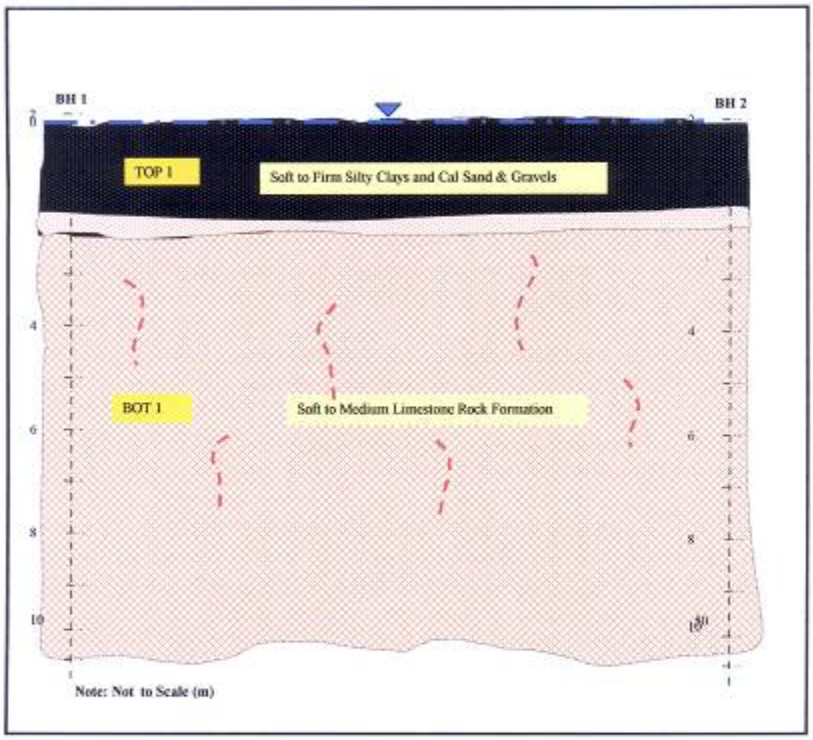

FIG. 4.1 – TYPICAL PRESUMPTIVE PROFILE

10

4.3. Allowable Bearing Capacity

4.3.1. Shear Considerations:

Note that Ultimate values are given for the insitu soils. A Factor Of Safety of 2.0 for maximum safe load capacity is recommended based on the high variability and compressibility of the soils on site.

The proposed use of a 2m thick compact layer of granular fill will have a number of positive effects on the foundation design;

- It will increase the stiffness of the footing effectively producing a composite concrete/marl pad.
- It will effectively increase the bearing capacity of the subgrade soils by spreading the structure loads
- It will reduce the seasonal effects of moisture induced swell/shrinkage by limiting subgrade exposure
- It will minimize total and differential settlement for isolated pad footings

1. TOP 1 SOILS – Soft/Loose Peaty Clays + Some Silts and Clay

Raft/Beam/Pad Foundation

Modulus of Subgrade Reaction (Ks) is a parameter of relevance for design. Using the Design Profile shown in Figure 4.1, the recommended value for this parameter is :-

i) $K_s = 3718*(1+0.2*B/L)$ KN/m3

Raft/Beam/Pad Foundation

For Shallow Foundations, the Ultimate Bearing Capacity and other relevant parameters recommended on this site are:-

i) $Q_{ult} = 92.95*(1+0.20*B/L)*(1+0.20*D/B)+ 16.78$ KPa

2. BOT 1 SOILS – Limestone Rock Formation

The results of the Unconfined Compressive Strength are fairly comparable. Allowances however are taken for local and spatial variability; with respect to the percentage recovery, the high and low values are discarded and the mean used to determine the average shear strength of the samples:

q_u avg. = psi (average unconfined compressive strength)
The estimated average REC = 50%
Accounting for spatial variability across site;

q_u avg. = 2100 psi

Also q_u avg. = 14,469.0 KPa

Shear Strength (undrained) is estimated at approximately;

$Qu = q_u$ avg./2 = 7234.5 KPa

Accounting for fractures and spatial variation etc.;

Qu = 7234.5 x REC% = 3,617.3 KPa

TABLE 4.0 SUMMARY OF SOIL PARAMETERS

LAYER IDENTIFICATION	TOP 1 SOILS	BOT 1 SOILS	
Bulk Unit Weight	20.0 KN/m3	22.0	
Submerged Unit Weight	7.2 KN/m3	19.5	
Compression Index	0.84		
Void Ratio	2.134		
Undrained Cohesion (KPa)	18.1		
Drained Cohesion (KPa)	1.0		
Effective PHI/PHI	8.0 deg.	43.1	
Relative Density		100.0	
Ka		0.188	
Kp		5.327	
Permeability Coef. (k)			

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4.4. Seismic Considerations

Information obtained from available seismic risk map for Jamaica indicates that the spectral acceleration for short periods/two second periods for the maximum considered earthquake with a 10% probability of exceedance in 50 years, was deduced as S_1 =0.3g. According to the IBC code (2003) and the UBC (1997) code, the site can be classified as site class E (Soft peaty Soils). With soil modification, replacement/stabilization of the TOP1 Soils, this site could be upgraded to a site class D.

4.5. Vertical Deformation Considerations:

Settlement is unlikely to be a concern on this site if our first recommendation were adopted. For the second recommendation of preloading, settlement is likely to be in the range of 355.6mm (14"). The preloading exercise and drainage are designed to account for both primary and secondary settlements. Uncertainties do exist with the accurate prediction of deformation for soils with high peat content as deduced with the Top1 Soils. Details of this process can be obtained upon request.

4.6. Other Considerations:

1. Drainage Considerations:

The topography of the areas surrounding the site indicates that stormwater disposal could be a major problem. The relatively low elevation of the ground level (high water table) is cause for concern during extreme weather conditions (hurricanes), and for prolonged periods of inclement weather (flooding). It would therefore be prudent to obtain hydrological data on the area for site drainage design. The proposed granular fill finished levels should be of significant benefit to the overall drainage plan for the building and its foundation.

2. Infrastructural Considerations:

It is recommended that a CBR value of 2% be used for the subgrade soils on site (worst case), for the pavement structure design. The use of a granular subbase is recommended for the long term stability of the roadways, due to the plastic nature of the TOP1 soils. A drainable base such as quarry crushed aggregates is recommended to dissipate pore pressure development in the pavement structure.

NHL ENGINEERING LIMITED

Carlton Hay PhD
Registered Professional Engineer (PE)
Geotechnical Engineer

APPENDICES

Appendix 1 - Figures

Fig. 5.1	-	Site Plan
Fig. 5.2	-	Test Location Plan
Fig. 5.3	-	Borehole Log - 1
Fig. 5.4	-	Borehole Log - 2
Fig. 5.5	-	Borehole Log - 3
Fig. 5.6	-	Grainsize Distribution

FIGURE 5.1 – SITE PLAN

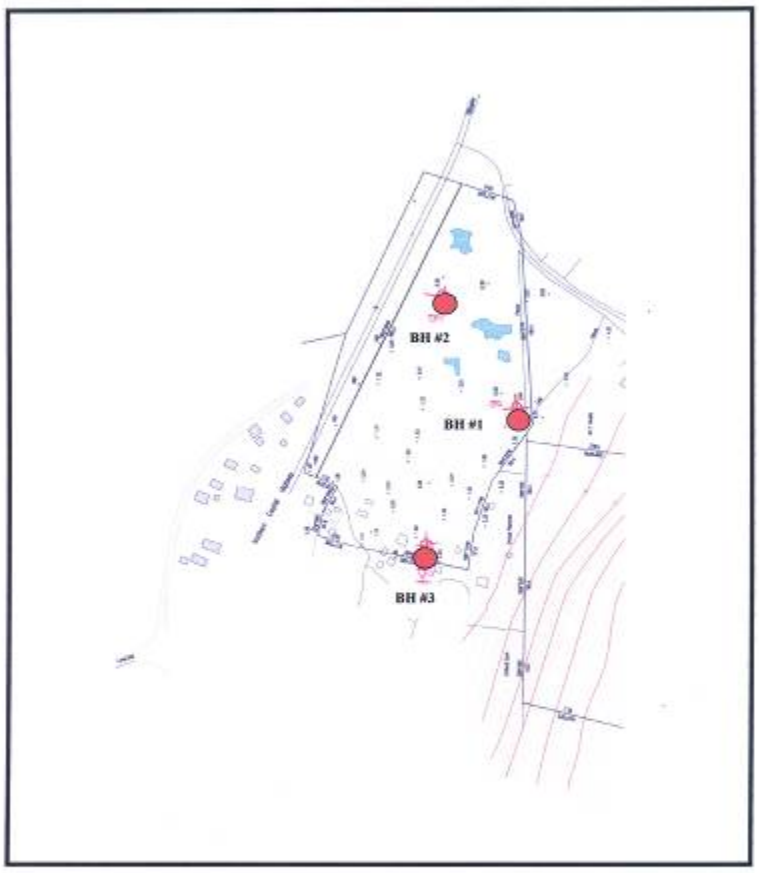

FIGURE 5.2 – TEST LOCATION

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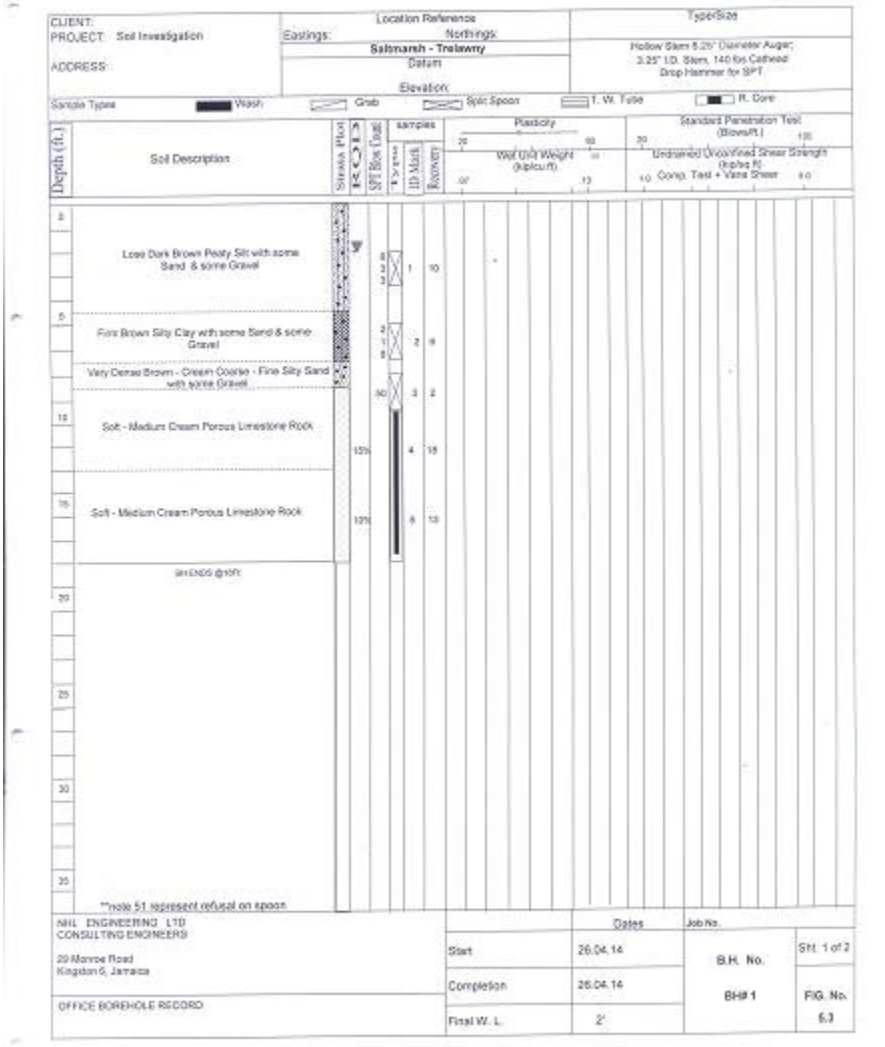
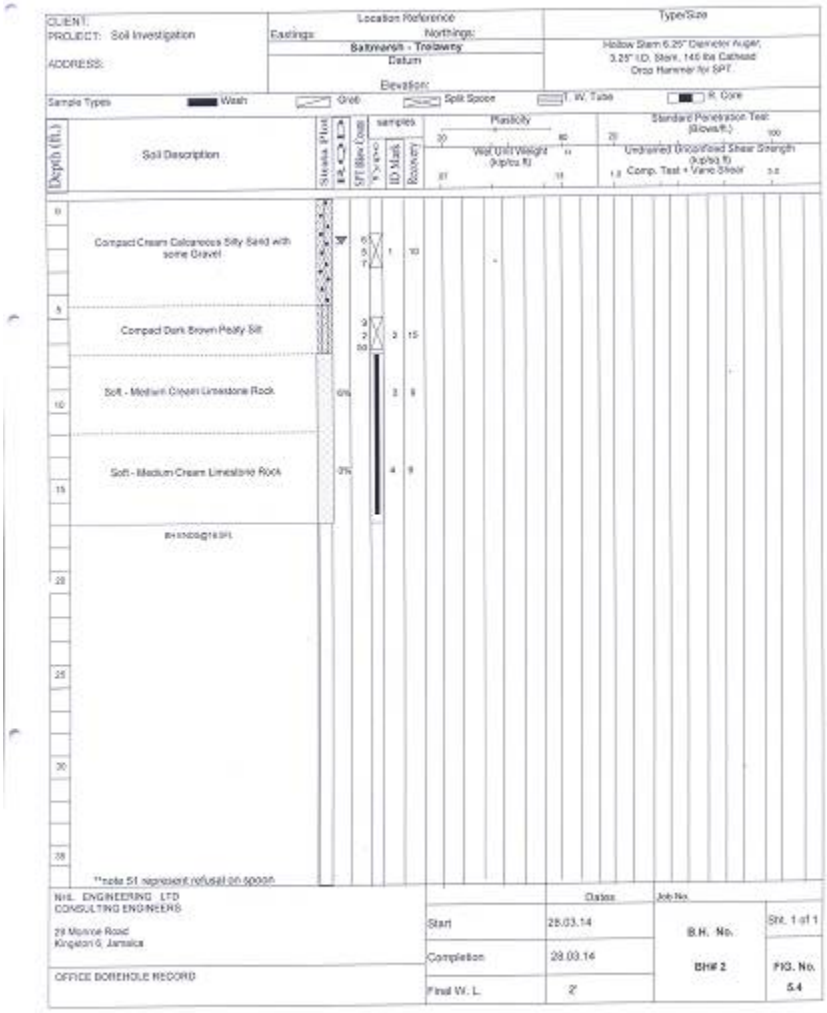
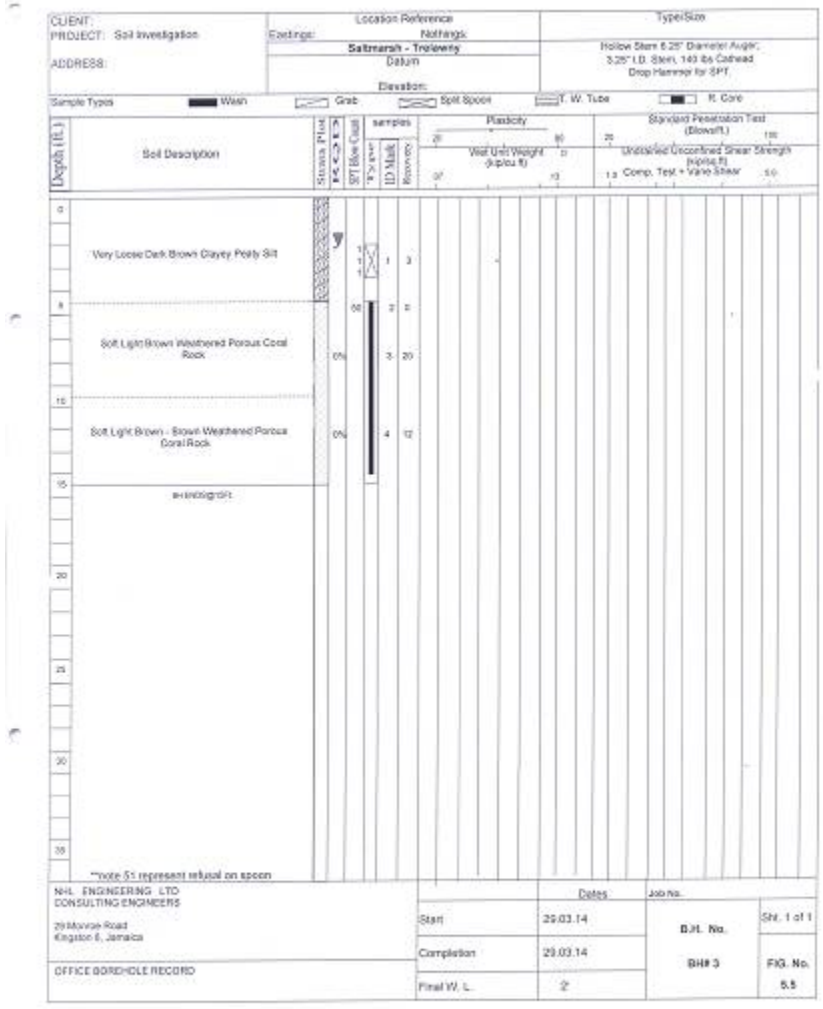

CLIENT:
PROJECT: Soil Investigation
ADDRESS:
Location Reference
Eastings:
Northings:
Salmarsh - Trelawny
Datum
Elevation:
Type/Size
Hollow Stem 8.25" Diameter Auger;
3.25" I.D. Stem, 140 lbs Cathead
Drop Hammer for SPT
Sample Types
Wash
Grab
Split Spoon
T. W. Tube
R. Core
Depth (ft.)
Soil Description
Stratia Plot
RECOVERY
SPT Blow Count
samples
Type
ID Mark
Recovery
Plasticity
Wet Unit Weight (kip/cu.ft)
Standard Penetration Test (Blows/ft.)
Undrained Unconfined Shear Strength (tsf/sq ft)
Comp. Test + Vane Shear
Loose Dark Brown Peaty Silt with some Sand & some Gravel
Firm Brown Silty Clay with some Sand & some Gravel
Very Dense Brown - Cream Coarse - Fine Silty Sand with some Gravel
Soft - Medium Cream Porous Limestone Rock
Soft - Medium Cream Porous Limestone Rock
BH ENDS @ 16ft
**note 51 represent refusal on spoon
NHL ENGINEERING LTD
CONSULTING ENGINEERS
29 Monroe Road
Kingston 6, Jamaica
OFFICE BOREHOLE RECORD
Dates
Job No.
Start
26.04.14
Completion
26.04.14
Final W. L.
2'
B.H. No.
BH# 1
Sht. 1 of 2
FIG. No.
5.3


CLIENT:
PROJECT: Soil Investigation
ADDRESS:
Location Reference
Eastings:
Northings:
Baltyvanis - Trelawny
Datum
Elevation:
Type/Size
Hollow Stem 6.25" Diameter Auger,
3.25" I.D. Stem, 140 lbs Cathead
Drop Hammer for SPT
Sample Types
Wash
Grab
Split Spoon
T. W. Tube
R. Core
Depth (ft.)
Soil Description
Strata Plot
samples
SPT Blow Count
% Recovery
ID Mark
Recovery
Plasticity
Wet Unit Weight (kip/cu ft)
Standard Penetration Test (Blows/ft.)
Undrained Unconfined Shear Strength (kip/sq ft)
Comp. Test + Vane Shear
Compact Cream Calcareous Silty Sand with some Gravel
Compact Dark Brown Peaty Silt
Soft - Medium Cream Limestone Rock
Soft - Medium Cream Limestone Rock
BH ENDED @ 15 Ft.
**note 51 represent refusal on spoon
NHL ENGINEERING LTD
CONSULTING ENGINEERS
29 Monroe Road
Kingston 6, Jamaica
OFFICE BOREHOLE RECORD
Dates
Job No.
Start
28.03.14
Completion
28.03.14
Final W. L.
2'
B.H. No.
BH# 2
Sht. 1 of 1
FIG. No.
5.4


CLIENT:
PROJECT: Soil Investigation
ADDRESS:
Location Reference
Eastings: Nothings:
Saltmarsh - Trelawny
Datum
Elevation:
Type/Size
Hollow Stem 8.25" Diameter Augar;
3.25" I.D. Stem, 140 lbs Cathead
Drop Hammer for SPT
Sample Types
Wash
Grab
Split Spoon
T. W. Tube
R. Core
Depth (ft.)
Soil Description
Strata Plot
samples
SPT Blow Count
ID Mark
Recovery
Plasticity
Wet Unit Weight (kg/cu ft)
Standard Penetration Test (Blows/ft.)
Undrained Unconfined Shear Strength (kg/sq ft)
Comp. Test + Vane Shear
Very Loose Dark Brown Clayey Peaty Silt
Soft Light Brown Weathered Porous Coral Rock
Soft Light Brown - Brown Weathered Porous Coral Rock
**note 51 represent refusal on spoon
NHL ENGINEERING LTD
CONSULTING ENGINEERS
29 Monroe Road
Kingston 6, Jamaica
OFFICE BOREHOLE RECORD
Dates
Job No.
Start
29.03.14
Completion
29.03.14
Final W. L.
B.H. No.
BH# 3
Sht. 1 of 1
FIG. No.
5.5

Client: Jaico Consultants Limited
Project: Saltmarsh - Trelawny
Date: May, 2014

Reserve	BH1@0°	BH1@270°	BH2@270°	BH3@0°						
25	100	100	100	100						
14	100	84.9	100	100						
8	86.1	77.5	68.2	49.1						
5	76.8	69.3	57	46.5						
2	73.4	64.7	54.5	45.9						
0.8	40.1	38.1	48.7	28.8						
0.4	34.7	27.1	34.7	20.8						
0.08	31.1	23.2	29.4	19						

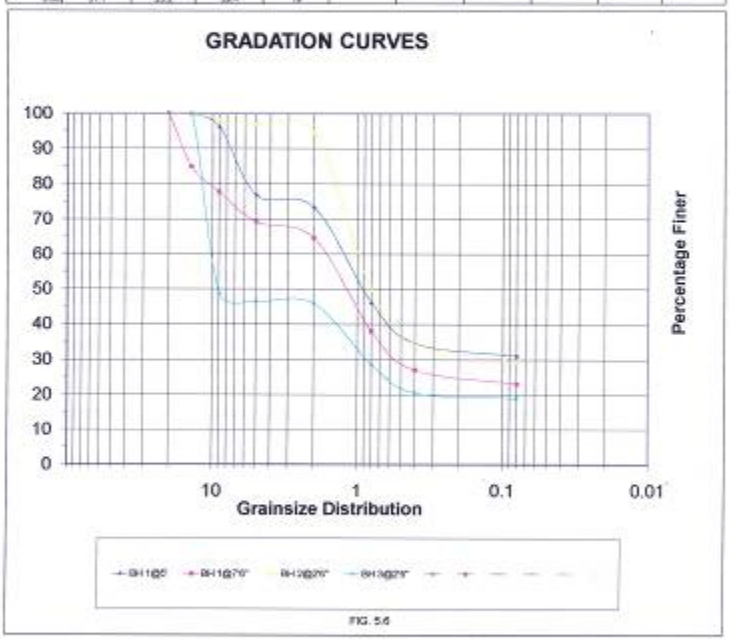


FIG. 5.6

Appendix II - Tables

Table 5.0 - Moisture Content

NHL ENGINEERING LIMITED

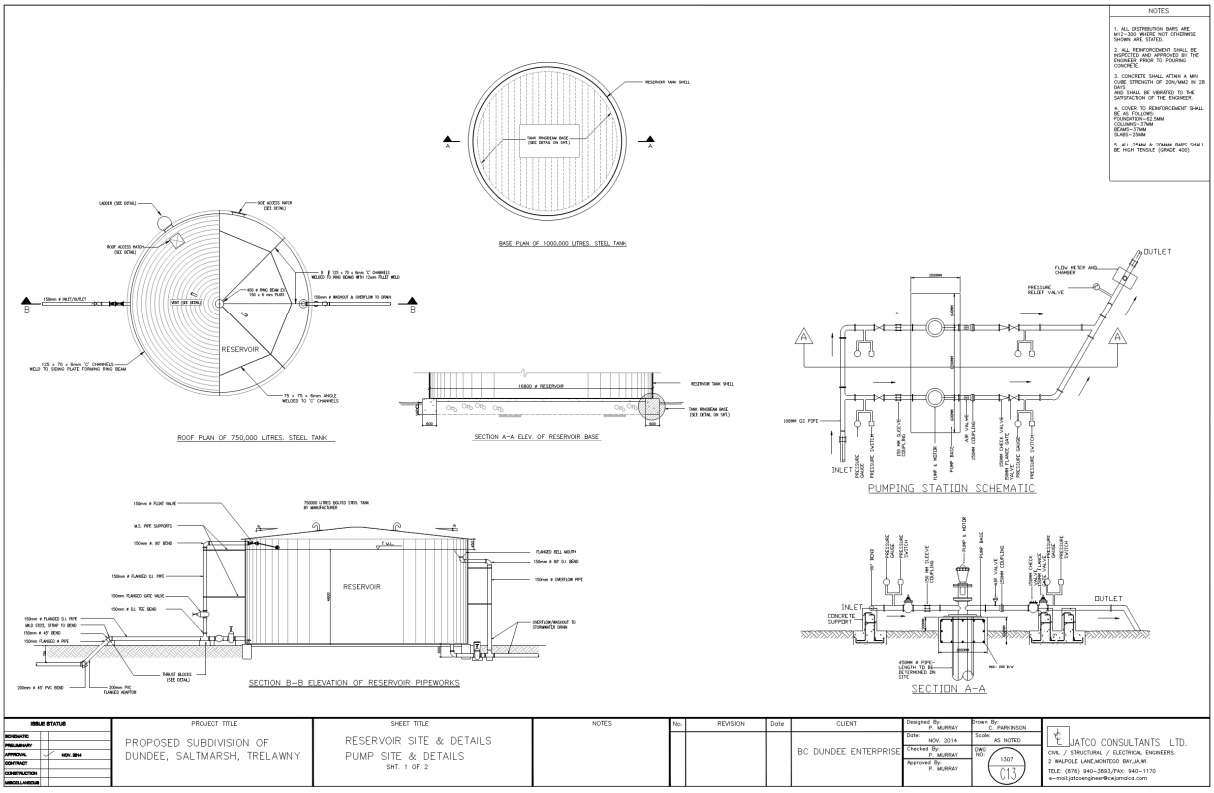
29 MONROE ROAD, KINGSTON 6

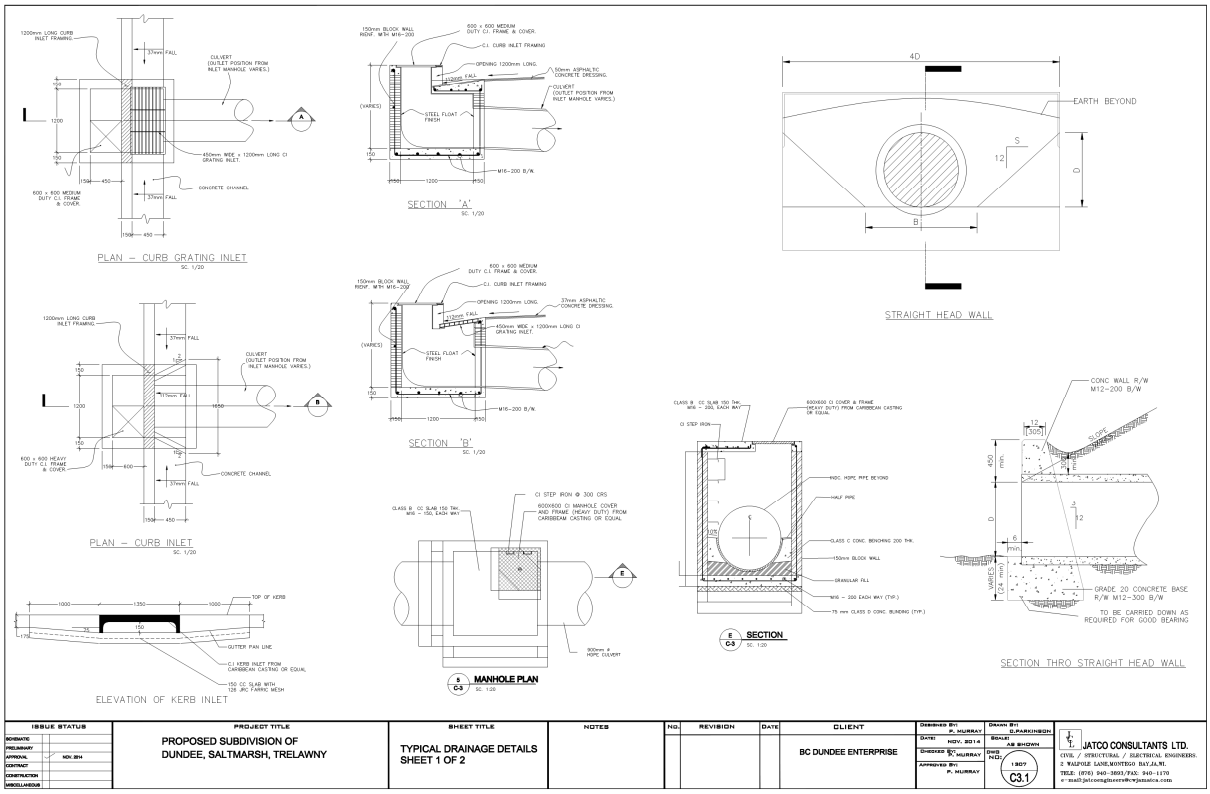
Project: Salt Marsh	**Client Rep: Patrick Murray**
Client: JATCO Consultants Limited	**Road: .....**
Material I.D. :	**Date Retested:.....**
Date Tested: 08.05.14	**Report to: Client**

ID #	BH	MOISTURE CONTENT VALUE
	BH# 1@2'6"	87.2
	BH# 2@6'	96.4

TABLE 5.0 - MOISTURE CONTENT

Steel water storage tank design




PLAN – CURB GRATING INLET
SC. 1/20
SECTION 'A'
SC. 1/20
STRAIGHT HEAD WALL
PLAN – CURB INLET
SC. 1/20
SECTION 'B'
SC. 1/20
ELEVATION OF KERB INLET
MANHOLE PLAN
SC. 1/20
SECTION
SC. 1/20
SECTION THRO STRAIGHT HEAD WALL
PROPOSED SUBDIVISION OF DUNDEE, SALTMARSH, TRELAWNY
TYPICAL DRAINAGE DETAILS SHEET 1 OF 2
BC DUNDEE ENTERPRISE
JATCO CONSULTANTS LTD.
C3.1

NATIONAL WATER COMMISSION
Water is life

☐ 28-48 Barbados Avenue
P.O. Box 65, Kingston 5
Tel: (876) 929-5430-5
Fax: (876) 926-1329

☐ 18 Oxford Road
Kingston 5
Tel: (876) 926-5825-7
Fax: (876) 929-1480

☐ 4 Marescaux Road
Kingston 5
Tel: (876) 929-3540-5
Fax: (876) 960-0582

☐ 231A Old Hope Road
Kingston 6
Tel: (876) 977-4998-9
977-5000
Fax: (876) 927-1870

☐ 231B Old Hope Road
Kingston 6
Tel: (876) 977-2496
(876) 977-9330
Fax: (876) 977-2708

☐ 2A Manhattan Road
Kingston 5
Tel: (876) 929-3540-5
Fax: (876) 968-8247

December 15, 2015

Mr. Carl Erkstine
Dundee
Trelawny

Dear Mr. Erkstine

Re: Proposed Subdivision: Part of Dundee, Trelawny
NWC Ref # 0165/15, 245 Lots

The National Water Commission (NWC) advises that we may be in a position to extend potable water supply services to the development. However you are required to submit drawings approved by the Jamaica Fire Brigade and an Engineering Report prepared and stamped by a registered professional engineer to:

National Water Commission
Subdivision Unit
4 Marescaux Road
Kingston 5

The attached document (No. 4 under Potable Water Requirements) outlines what ought to be included in the Engineering Report.

We trust that you find this information useful and look forward to hearing from you.

Yours truly
NATIONAL WATER COMMISSION

.....
Marjorie Segree
VP, Planning and Special Projects

Storm Water Management Plan

Hydrological Assessment for the Hamptons at Dundee, Salt Marsh, Trelawny

Erosion and Sediment Control Plan for the Proposed Hamptons at Dundee

14.2 Photographs/ maps

View of existing 600 mm drainage culvert which takes storm water across the main road to the coast. Note highway in background

Test pit near marshland reddish brown silty clay intermixed with limestone cobbles and boulders

Percolation rate measurement being conducted in Test Pit 3

Recrystallized Montpelier Limestone

Chert nodules in limestone

Large Limestone boulders perched on steep slope in upland area

The Great Egret – seen in vegetation adjoining wetland at Project Site

The Great Blue Heron – taken after flight over adjoining wetland

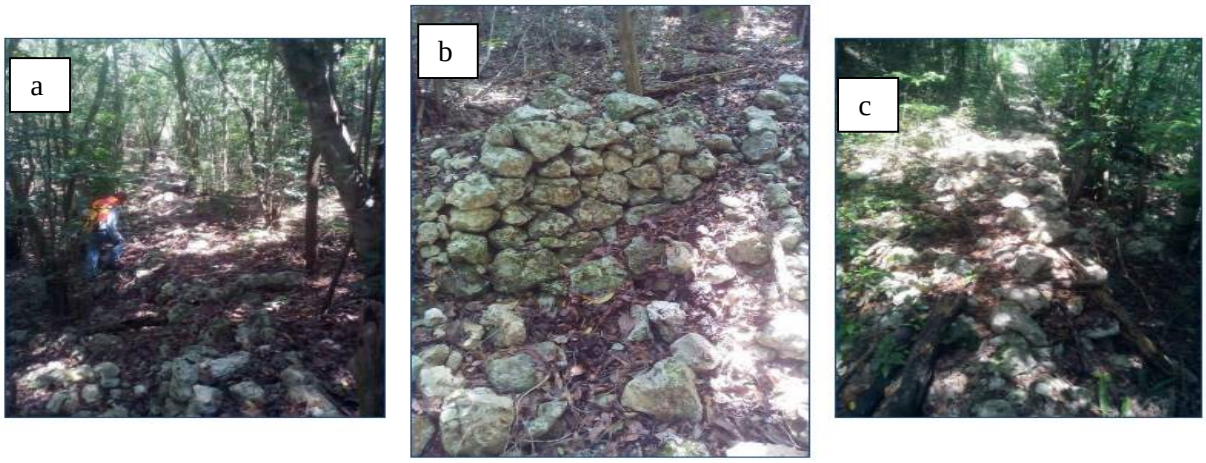
Young white mangrove growth within wetland area

Encroachment of informal housing in mangrove

Wetland vegetation mortality

Typha domingensis wetland vegetation observed around standing water at the Dundee

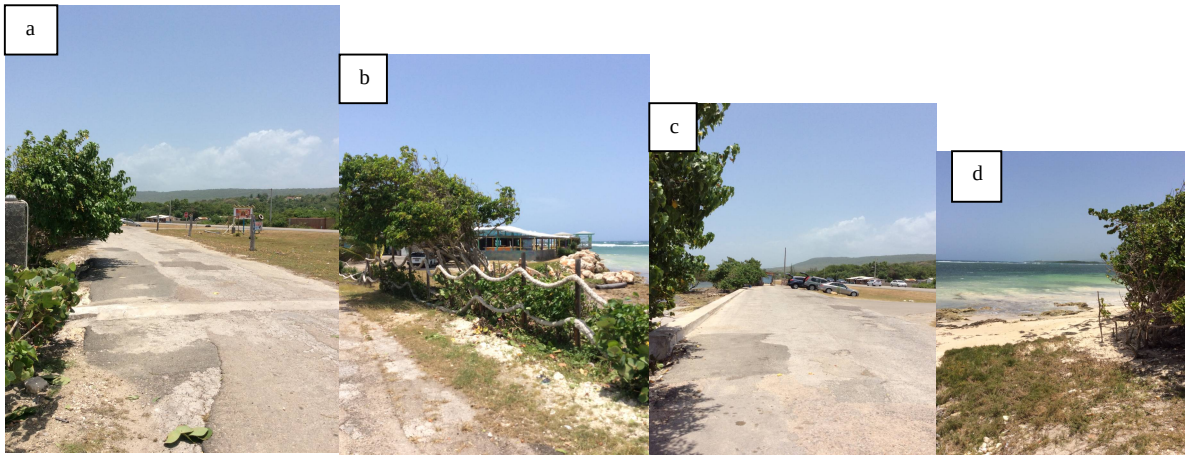
Close-up of white mangrove vegetation observed at the proposed Dundee Project Site



Historic stone boundary wall on the Dundee property

Residential development at Salt Marsh,

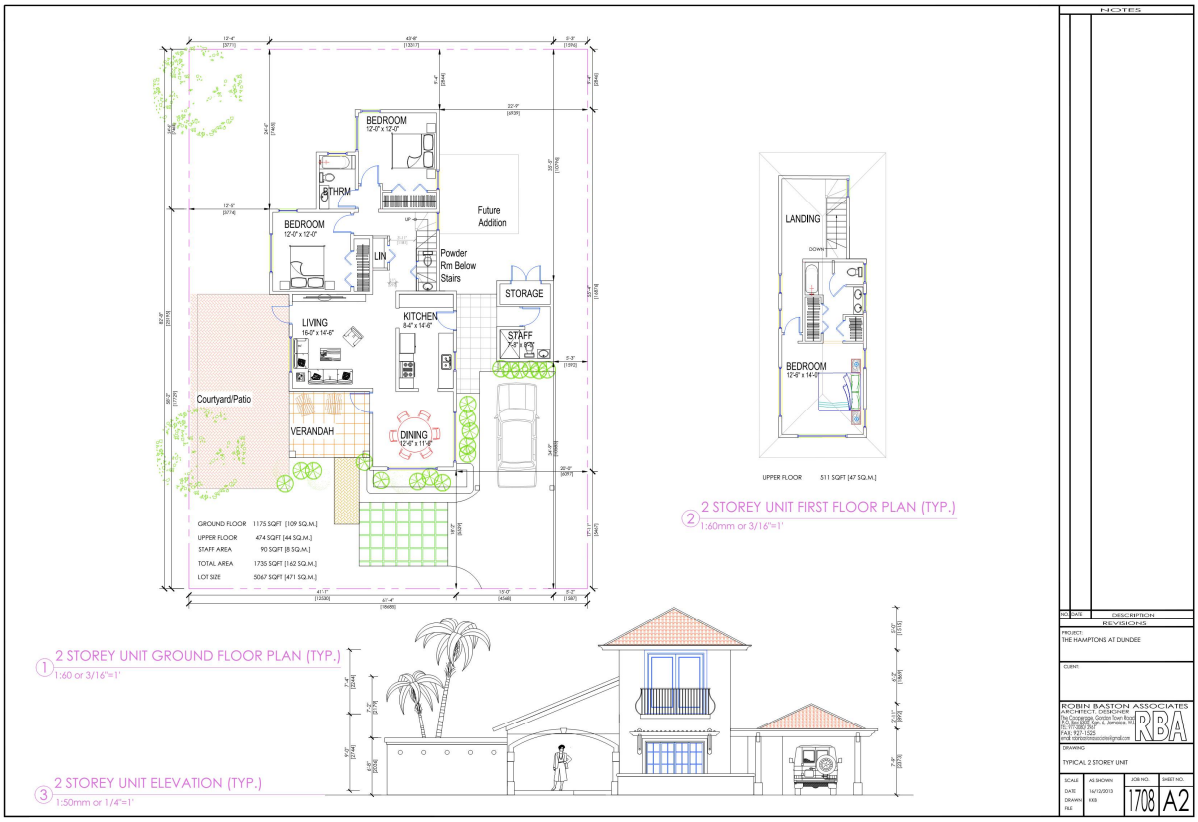
Economic activities in Dundee, Salt Marsh



Images of a road side park at, Comfort Hall

Jacobs Well Early Childhood School and the Salt Marsh Primary School

Photographs were taken over the period November 2013 to May 2015


BEDROOM
12'-0" x 12'-0"
BATHRM
BEDROOM
12'-0" x 12'-0"
LIN
Future
Addition
Powder
Rm Below
Stairs
STORAGE
KITCHEN
8'-4" x 14'-6"
LIVING
16'-0" x 14'-6"
STAFF
Courtyard/Patio
VERANDAH
DINING
12'-6" x 11'-6"
GROUND FLOOR 1175 SQFT [109 SQ.M.]
UPPER FLOOR 474 SQFT [44 SQ.M.]
STAFF AREA 90 SQFT [8 SQ.M.]
TOTAL AREA 1735 SQFT [162 SQ.M.]
LOT SIZE 5067 SQFT [471 SQ.M.]
LANDING
DOWN
BEDROOM
12'-0" x 14'-0"
UPPER FLOOR 511 SQFT [47 SQ.M.]
2 STOREY UNIT FIRST FLOOR PLAN (TYP.)
1:60mm or 3/16"=1'
1 2 STOREY UNIT GROUND FLOOR PLAN (TYP.)
1:60 or 3/16"=1'
3 2 STOREY UNIT ELEVATION (TYP.)
1:50mm or 1/4"=1'
NOTES
NO. DATE DESCRIPTION
REVISIONS
PROJECT:
THE HAMPTONS AT DUNDEE
CLIENT:
ROBIN BASTON ASSOCIATES
ARCHITECT DESIGNER
RBA
DRAWING:
TYPICAL 2 STOREY UNIT
SCALE AS SHOWN
JOB NO. 1708
SHEET NO. A2
DATE 16/12/2013
DRAWN KKB

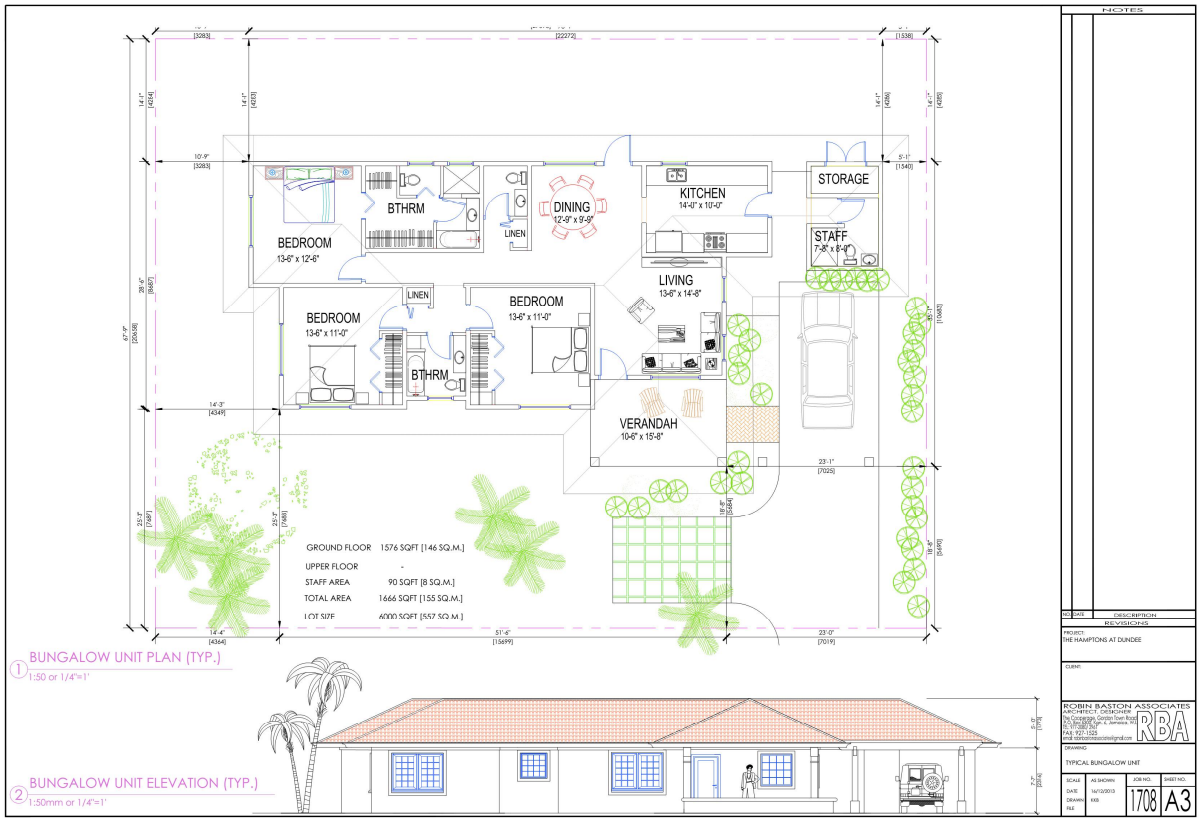
1 LOT 153 SITE PLAN
1:400 or 1/32"=1'

2 LOT 125 SITE PLAN
1:400 or 1/32"=1'

3 LOT 102 SITE PLAN
1:400mm or 1/32"=1'

4 TYPICAL APARTMENT BLOCK FLOOR PLAN (APTS 1-6)
1:60mm or 3/16"=1'

4 TYPICAL APARTMENT BLOCK ELEVATION
1:60mm or 3/16"=1'



① BUNGALOW UNIT PLAN (TYP.)
1:50 or 1/4"=1'

② BUNGALOW UNIT ELEVATION (TYP.)
1:50mm or 1/4"=1'

14.3 DATA TABLES

SALT MARSH

Community	Code	Gender	Age Range	How long live in area 1	Previously Live 2	Is the house 3	Size of dwelling 4	Persons occupying household 5	Source of water 6	Building material 7	Occupation 8	Work location 9	Weekly income 10	Recommendation for improvement 11	Awareness for development 12	Demand for houses 13	Impacts of development 14	Community needs 15	Knowledge about Dundee 16	Recommendation for Dundee Property 17	Feelings about the community 18	Historical Site 19
		1	4	3		4	1	3	2	3	Businessman	Salt Marsh	4	Training centre	1	1	emp.	Road	1	Housing	1	Orange valley Farm
		2	1	3		4	1	3	2	3	Waitress	Sandals	2	Community centre	1	1	emp.	emp.	2	Housing	1	Orange valley Farm
		2	4	3		4	1	3	2	3	Self employed		1	Training centre	1	1	business opp.	Road		Housing	1	Orange valley Farm
		2	1	3		4	1	3	2	3	Student			Health centre	1	1	emp.	Road	2	Housing		1
		1	3	3		1	3	3	2	3	fisherfolk	Salt Marsh	2	Community centre	1	1	emp.	Com, centre	1	Housing	1	
		1	2	3	Kin.	4	3	3	2	3	fisherfolk	Sandals	2	Road	1	1	emp.	Com, centre		Housing	1	
		2	2	1	Kin.	2	1	1	2	3	House-keeper	Ibero Star	4	Community centre	1	1	imp'mt to comm.	Road	2	Housing	1	
		1	4	3		1	2	2	2	3	Wood Carver	Salt Marsh	2	Community centre	1	1	emp.	Road		Farming	1	
		1	4	3		3	2	1	2	3	Driver		2	Health centre	1	1	Crime	Road	1	Housing	1	
		1	4	3		1	2	2	2	3	Constr.		3	Road	1	1	Pop. increase	Com, centre	1	Housing	1	
		2	1	3		1	1	1	2	3	Bar Tender	Mobay	2	Road	1	1	emp.	Com, centre		Housing	1	
		1	3	3		1	3	2	2	3	Carpenter		4	Health centre	1	1	emp.	Road		Housing	1	
		1	3	3		4	3	2	2	3	Constr.		3	Road	1	1	increase in traffic	emp.		Housing	1	
		1	4	3	Marta Brae	1	1	2	2	3	Constr.	Mobay	4		1	1	increase in traffic	Road	2	Housing	1	
		1	1	3		1	2	1	2	3	fisherfolk	Salt Marsh	2	Road	1	1	emp.	Road		Housing	1	
		1	1	3		4	2	3	2	3	Constr.	Green Side	2	Road	1	1	emp.	Com, centre		Housing	1	
		2	5	3		1	3	3	2	3	Nurse		2	Road	1	1	emp.	Com, centre		Housing	1	
		1	4	3		1	1	1	2	1	Self employed		4	Road	1	1	emp.	Health centre		Housing	1	
		2	4	3		1	1	2	2	1	Helper		1	Road	1	1	emp.	Com, centre	3		1	
		2	2	3		1	2	1	2	1	Farmer		1	Road	1	1	emp.	Com, centre	3	Housing	1	
		2	1	3	Mobay	4	2	1	2	1	Unemployed		4	Road	1	1	emp.	emp.	3	Housing	1	

	1	1	3		1	1	1	2	2	Constr. fisherfolk		4	Road	1	1	emp.	Com, centre	3	Housing	1				
	1	6	3		4	1	1	2	3	Carpenter		2	Road	1	1	emp.	Com, centre		Housing	1				
	2	2	3		1	2	1	2	2	Security officer	Airport	3	Post office	1	1	emp.	emp.		Housing	1				
	1	1	2		1	1	1	2	2	fisherfolk		2	Road	1	1	emp.	Road	3	Housing	1				
	1	2	3		1	1	1	2	1	fisherfolk		2	Road	1	1	emp.	emp.	2	Housing	1				
	2	3	3		1	2	2	2	3	Security officer	Sandals	2	Road	1	1	increase in traffic	Health centre	3	Housing	1				
	2	4	3		1	3	3	2	3	Business woman		3	Road	1	1	business opportunity	emp.	2	Housing	1				
	2	2	3		4	2	2	2	1	Bar Tender		2	Road	1	1	emp.	Road	2	Housing	1				
	1	6	3		4	1	2	2	3	Wood Carver	Salt Marsh	2	Road	1	1	increase in traffic	Com, centre	2	Housing	1				
	2	6	3		4	2	2	2	3	Teacher	Marta Brae	2	Road / Health centre	1	1	emp.	emp.	3	Housing	1				
	2	1	3		4	3	3	2	3	Student		4	Road	1	1	emp.	emp.	2	Housing	1				
Total 1	17	9	1	0	17	14	12	0	6	0	0	3	0	32	32	0	0	4	0	32	0			
Total 2	15	6	1	0	1	11	10	32	3	0	0	16	0	0	0	0	0	9	0	0	0			
Percent 1	53.13	28.13	3.13	0.00	53.13	43.75	37.50	0.00	18.75	0.00	0.00	9.38	0.00	100.00	100.00	0.00	0.00	12.50	0.00	100.00	0.00			
Percent 2	46.88	18.75	3.13	0.00	3.13	34.38	31.25	100.00	9.38	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	28.13	0.00	0.00	0.00			
Total 3	0	4	30	0	1	7	10	0	23	0	0	4	0	0	0	0	0	7	0	0	0			
Percent 3	0.00	12.50	93.75	0.00	3.13	21.88	31.25	0.00	71.88	0.00	0.00	12.50	0.00	0.00	0.00	0.00	0.00	21.88	0.00	0.00	0.00			
Total 4	0	9	0	0	13	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0			
Percent 4	0	28.125	0	0	40.625	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0			
Total 5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Percent 5	0	3.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total 6	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			
Percent 6	0	12.5	0	0	0	0	0	0	3.125	0	0	0	0	0	0	0	0	0	0	0	0			

ADJACENT COMMUNITIES OF COMFORT HALL, SCARLETT HALL AND GREENSIDE

Code	Gender	Age Range	How long live in area 1	Previously Live 2	Is the house 3	Size of dwelling 4	Persons occupying household 5	Source of water 6	Building material 7	Occupation 8	Work location 9	Weekly income 10	Recommendation for improvement 11	Awareness for development 12	Demand for houses 13	Impacts of development 14	Community needs 15	Knowledge about Dundee 16	Recommendation for Dundee Property 17	Feelings about the community 18	Historical Site 19
AJ001	2	6	3		1	2	2	3	3				Community centre	1	1	1	emp.		Housing	1	Wharf
AJ002	1	4	3	Scarlett Ha	1	2	2	2	3	ShoperKeeper	ComfortHall	3		1	1	1	Road	2	Housing	1	
AJ003	2	1	3		4	2	2	2	3	Student				1	1	1	Com, centre	2	Housing	1	
AJ004	1	5	3		1	2	2	2	3	Retired				1	1	2	Road	2	Housing	1	
AJ005	1	1	3		4	2	2	2	3	Student				1	1	1	Road	1	Housing	1	
AJ006	2	1	3		4	2	1	2	3	Student				2	2	2	emp.	2	Housing	1	
AJ007	1	4	3	St. James	1	2	3		3	Business person	Falmouth	3		1	1	3	emp.	1	Housing	1	
AJ008	2	2	3		1	2	1	2	3	Security officer	Ocho Rios	3		1	1	1	emp.	1	Housing	1	
AJ014	1	3	3	St. James	1	2	1	2	3	Driver	Falmouth	2		1	1	1	emp.	2	Housing	1	
AJ015	2	2	1	Johnson H	1	3	2	2	3	Bar Tender	Falmouth	1		2	1	1	Road	2	Housing	1	
AJ016	1	4	1	Johnson H	1	3	2	2	3	Constr.	Falmouth	2	Road	1	1	1	Road	2	Housing	1	
AJ017	1	2	3		1	2	1	2	3	Driver	Falmouth	1	Road	1	1	1	Road	2	Housing	1	
AJ018	1	2	3		1	2	2	2	3	Teacher	Mo-Bay	2	Road	1	1	1	Road	1	Housing	1	
AJ019	2	5	3	Falmouth	1	2	2	2	2	Business person	Falmouth	2	Road	1	1	5	Com, centre	2		1	
AJ020	1	4	3	St. James	1	2	1	2	3	Farmer	Green Side	1		1	1	1	Com, centre	2	Housing	1	
AJ021	1	4	3	Falmouth	1	2		2	3	Security officer	Falmouth	1		1	1	1	Road	2	Housing	1	
AJ025	1	6	3		1	1	1	2	3	Business person		3	Electricity	1	1	1	Com, centre	3	Com. Centre	1	Falmouth
AJ027	1	6	3	St. James	1	3	1	2	3	Retired			Road	1	1	1	Road			1	
AJ028	2	6	3	St. James	1	2	2		3	Retired				1	1	5	emp.		Housing	1	Falmouth
AJ029	1	4	1	USA	1	3	1	2	3	Retired			Road	2	1	3	Road		Farming	1	Salt March
AJ026	1	3	1	Scarlett Hi	1	2	1		3	fisherfolk		3	Road	1	1	1	Road		Housing	1	
AJ030	1	2	3	St. Cath	4		2	2	3	Steel Worker		3	Shopping Center	1	1	5	Sports	1	Farming	1	
AJ031	1	6	3	Falmouth	1	2	2	1	3	Retired				1	1	1	Supermarket		Farming	1	
AJ009	1	4	3		1	1	2	2	2	Constr	Scarlet Hall	1	Road	1	1	5	Road	1	Housing	1	
AJ010	2	6	3		1	1	2	2	3	Retired			Health centre	1	1	1	Com, centre	2	Housing	1	
AJ011	2	6	3	St. James	1	2	1	2		Retired			Road	2	1	1	Road			1	

AJ012	2	6	3		1	2	1	2	3	Retired			Community centre	1	1	1	Development		Housing	1			
AJ013	1	2	2	Negril	1	2	3	1	3	fisherfolk		1	Road	2	1	4	Road		Housing	1			
AJ022	2	1	3		1	2	2	2	3	Unemployed				1	1	1	Road	2	Housing	1			
AJ023	1	1	3		1	1	1	2	3	fisherfolk	Falmouth	1	Road	1	1	1	Road	2	Housing	1			
AJ024	1	5	3		1	2	1	2		Scupture	Salt Marsh	1	Community centre	1	1	1	emp.	2	Housing	1			
AJ032	1	3	3		1	2	2	2	3	Driver	Falmouth	1		1	1	4	emp.	2	Housing	1			
AJ033	1	4	3	Salt March	1	2	2	2	3	fisherfolk	Salt Marsh	1		1	1	1	Road	2	Housing	1			
AJ034	2	2	3		1	2	2	2	3	Nurse	Mo-Bay	2	Health centre	1	1	1	Com, centre	2	Housing	1			
AJ035	1	3	3	St. James	1	2	2	2	3	Welder	Falmouth	2		1	1	5	emp.	2	Housing	1			
AJ036	2	4	2	St. Eliz.	1	2	2	2	3	House wife				1	1	1	Road	2	Housing	1			
AJ037	2	3	2	Comfort H	1	2	2	2	3	Business persor	Scarlet Hall	2		1	1	1	Com, centre	2	Housing	1			
AJ038	2	1	3		1	2	2	2	3	Unemployed				1	1	1	Road	2	Housing	1			
AJ039	1	1	3		1	2	2	2	3	Teacher		2		1	1	1	Road	2	Housing	1			
AJ040	1	2	3	St. James	1	2	1	2	3	Pump Attendan	Mo-Bay	1		1	1	1	Com, centre	1	Housing	1			
	25	7	4	0	36	4	14	2	0	0	0	11	0	35	39	29	0	7	0	40	0		
	15	8	3	0	0	31	23	34	2	0	0	8	0	5	1	2	0	23	0	0	0		
	62.50	17.50	10.00	0.00	90.00	10.00	35.00	5.00	0.00	0.00	0.00	27.50	0.00	87.50	97.50	72.50	0.00	17.50	0.00	100.00	0.00		
	37.50	20.00	7.50	0.00	0.00	77.50	57.50	85.00	5.00	0.00	0.00	20.00	0.00	12.50	2.50	5.00	0.00	57.50	0.00	0.00	0.00		
	0	5	33	0	0	4	2	1	36	0	0	6	0	0	0	2	0	1	0	0	0		
	0.00	12.50	82.50	0.00	0.00	10.00	5.00	2.50	90.00	0.00	0.00	15.00	0.00	0.00	0.00	5.00	0.00	2.50	0.00	0.00	0.00		
	0	9	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		
	0	22.5	0	0	10	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0		
	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0		
	0	7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	12.5	0	0	0	0	0		
	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

14.4 GLOSSARY OF TECHNICAL TERMS USED

AAQS	Ambient Air Quality Standards Ambient Air Quality Standards
AMSL	Above Mean Sea Level
AWS	Automatic Weather Station
CCORAL	Caribbean Climate Online Risk and Adaptation
CDRMP	Community Disaster Risk Management Plan
CN	Curve Number
CO	Carbon Monoxide
dBA	Decibels
ED	Enumeration District
EHU	Environmental Health Unit
EIA	Environmental Impact Assessment
GHG	Green House Gases.
GIB	Green Infrastructure and Buildings
IBC	International Building Code
IDF	Intensity Duration Frequency
IPCC	Intergovernmental Panel on Climate Change
IFF	Intergovernmental Forum on Forest
JNHT	Jamaica National Heritage Trust
LCA	Life Cycle Assessment
MOH	Ministry of Health
MOJ	Meteorological Office of Jamaica
NEPA	National Environment and Planning Agency
NLA	National Land Agency
NMIA	Norman Manley International Airport
NO^2	Nitrogen Dioxide
NRCA	Natural Resources Conservation Authority
NSWMA	National Solid Waste Management Authority
NWA	National Works Agency
NWC	National Water Commission
O^3	Ozone
ODPEM	Office of Disaster Preparedness and Emergency Management
PCQ	Point Centered Quarter
PM	Particulate Matter
RCN	Runoff Curve Number
SDC	Social Development Commission
SIA	Social Impact Assessment
SO^2	Sulphur Dioxide
STATIN	Statistical Institute of Jamaica
TOR	Terms of Reference
TSS	Total Suspended Solids
UDC	Urban Development Corporation
UNCED	United Nations Conference on Environment and Development
UNCCD	United Nations Convention to Combating Diversification
WMU	Water Management Unit
WRA	Water Resource Authority

14.5 TERMS OF REFERENCE

The purpose of this document is to establish the Terms of Reference (TOR) for the EIA.

The EIA report must be produced in accordance with the approved TOR.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the Agency. Approval for the TOR must be obtained from the Agency, in writing, prior to the commencement of the EIA study.

The Terms of Reference to conduct the Environmental Impact Assessment are as follows:

The National Environment and Planning Agency and the Natural Resources Conservation Authority reserves the right to reproduce, transfer and disclose any and all contents contained in the submitted environmental impact assessment report without the written consent of the proponent, consultants and/or its agents.

The Terms of Reference to conduct the Environmental Impact Assessment (EIA) are as follows:

1. EXECUTIVE SUMMARY

Provide a brief statement on the content of the EIA report. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project etc. In addition, it should include relevant background information and provide a summary of the main findings, including but not limited to main impacts and mitigation measures, analyses and conclusions in the report.

2. INTRODUCTION

Provide the context of the project and the EIA, the delineation and justification of the boundary of the study area, general methodology, assumptions and constraints of the study.

The study area shall include at least the area within 1km radius of the boundaries of the proposed site.

3. LEGISLATION AND REGULATORY CONSIDERATION

Outline the pertinent regulations, standards, government policies and legislation 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 Natural Resources Conservation Authority Act 1991, Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013, the Housing Act, the Town and Country Planning Act, Building Act and Codes and Standards promulgated there under, Development Orders and Plans and **all** appropriate international convention/protocol/treaty where applicable. Describe traditional land use and advice of any prescriptive rights including public access rights.

4. PROJECT DESCRIPTION

Prepare a detailed description of the project. This section will provide information on the proposed project and should include:

- History and background of the project,
- A location map at a scale of 1:12,500 (or an appropriate scale)
- The total area of the site.
- A site layout plan showing the various components and design elements of the proposed development.
- A comprehensive description of all components e.g. parks, pool and club house and the various design elements of the project.
- Expected project components and alternatives that may be considered by the developer,
- Schematic plans,
- A detailed landscape plan highlighting grading and proposed changes in topography.

- Details of proposed access(es) to the site to be used for pre-construction, construction and operational phases
- Details on infrastructure development including design plans for all components of the development including the proposed wastewater/sewage treatment system and disposal of treated effluent must be clearly outlined.
- A comprehensive drainage assessment. This assessment should take into consideration existing natural drainage channels, proposed man-made drainage/water features or any proposed changes in topography. Potential issues of increased surface runoff and sediment loading must also be addressed. Special emphasis should also be placed on the storm water run-off, drainage patterns, characteristics of the aquifer, including the level and status of the groundwater. Account must be made of the presence of the natural pond and highway to the northeast and north of the site, as well as the natural stream traversing the southern section of the site which empties into the pond.
- In addition plans for providing utilities, particularly details relating to the source of potable water and electricity generation, roads and other services should be clearly stated.
- A Waste Management Plan which clearly outlines expected quantities of construction waste during the construction phase, general waste arising from material consumption of the workforce, as well as, all expected waste during the operational phase should be completed. Details should also be provided for any central disposal area(s) being considered to serve the proposed development
- Details of equipment and machinery to be involved, how these will be mobilized and areas to be used for storage of machinery and material should be clearly indicated.
- Details of workforce, including proposals for mobilization and accommodation should be indicated.
- All phases of the project should be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids included in the Environmental Impact Assessment report.
- The study area should be clearly delineated and referenced. Taking into account the types of resources located in the area and the magnitude of the associated impacts, the study area should be large enough to include all valued resources that might be significantly affected by the project.

5. DESCRIPTION OF THE ENVIRONMENT

A natural resources survey of the proposed development site should be conducted for both the wet and dry seasons. This information will form the basis upon which impacts of the project will be assessed.

The following aspects should be described in this section:

5.1 PHYSICAL ENVIRONMENT

- Topography, soils, climate, drainage, geology (including but not limited to seismicity and faults), geomorphology of the site and hazard vulnerability including impacts on current landscape, aesthetic appeal and hydrology should be examined. Special emphasis should be placed on storm water runoff, drainage patterns. Percolation tests should also be conducted within the proposed study area.
- Water quality for any riverine environment or surface water feature in the vicinity of the development. Quality Indicators should include but not be limited to Nitrate, Phosphate, Faecal Coliform, Salinity and Total Suspended Solids.
- Climatic conditions and air quality in the area of influence including particulates
- Noise levels of undeveloped site and the ambient noise in the area of influence.
- Sources of existing pollution and extent of contamination.
- Availability of solid waste management facilities.

5.2 CARRYING CAPACITY

- The ecological carrying capacity of the site should be assessed

5.3 NATURAL HAZARDS

A risk assessment of the development in relation to the following must be undertaken

- Hurricanes, Earthquakes
- Natural hazard risk assessment should take in account climate change projections.

5.4 BIOLOGICAL ENVIRONMENT

Description of terrestrial habitats, existing vegetation, flora and fauna surveys inclusive of a species list; commentary on the ecological health, function and value in the project area, threats and conservation significance.

This should include:

- A detailed qualitative and quantitative assessment of terrestrial habitats in and around the proposed project sites and the areas of impact. This must also include flora and fauna surveys and should include species lists.
- Special emphasis should be placed on rare, endemic, threatened, protected or endangered species. Migratory species should also be considered. There may be the need to incorporate micro-organisms to obtain an accurate baseline assessment. Generally, species dependence, habitats/niche specificity, community structure and diversity ought to be considered.

The field data collected should include, but not be limited to:

- Vegetation profile
- Other benthic features of the proposed development areas as well as the areas of potential impact
- Species lists must be provided for each community
- A habitat map of the area

5.5 HERITAGE

- Archaeological and cultural assessments should be undertaken

5.6 SOCIO-ECONOMIC ENVIRONMENT

Demography, regional setting, location assessment and current and potential land-use patterns (of neighbouring properties); description of existing infrastructure such as transportation, electricity, water and telecommunications, and public health safety; cultural peculiarities, aspirations and attitudes should be explored; and other material assets of the area should also be examined. A socio-economic survey to determine public perception of the project (both negative and positive) should also be completed and this should include but not be limited to potential impacts on social, aesthetic and historical/ cultural values.

6. PUBLIC PARTICIPATION

Describe the public participation methods, timing, type of information provided and collected from public and stakeholder target groups meetings. The sampling methodology employed must be appropriate for the population size and distribution and must be weighted towards the communities in closest proximity to the proposed development. The instrument used to collect the information must be included in the appendix. Stakeholder meetings should also be held to inform the public of the proposed development and the possible impacts, and will also gauge the feeling/response of the public toward the development.

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.

Public Meeting(s) should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the National Environment and Planning Agency (NEPA). A public meeting will be held to present the findings of the EIA once the EIA is completed and submitted for consideration. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project will require a further public meeting to be undertaken by the developer and all changes made to the document should be clearly outlined to the public.

7. IMPACT IDENTIFICATION AND ANALYSIS

A detailed analysis of the project components should be done in order to: identify the major potential environmental and public health impacts of the project; distinguish between levels of impact, significance of impact, positive and negative impacts, duration of impacts (long term of short term), direct and indirect and impacts, reversible or irreversible, long term and immediate impacts and identify avoidable impacts.

Cumulative impacts should also be evaluated taking into account previous developments and any proposed development immediately adjacent to the subject development within the area. The identified impacts should be profiled to assess the magnitude of the impacts. The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental issue is determined after examining the impact (positive and negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate and minor and presented in separate matrices for all the phases of the project (i.e. preconstruction, construction and occupation and operational). All impacts should be listed, ranked and assessed in a single table.

The impacts to be assessed will include but not be limited to the following:

7.1 PHYSICAL

- Impacts of construction activities such as site clearance, earthworks and spoil disposal.
- Impacts of spills (such as oil and chemical spills)
- Impacts on Air Quality
- Impacts on Water Quality (pollution of potable, coastal, surface and ground water
- Impacts on Climate Change
- Demands/requirements of the following must be quantified
    - Water Supply
    - Sewage Treatment and Disposal - Empirical data must be provided to show that the proposed sewage treatment facility has the capacity to remove the nutrients to meet the National Sewage Effluent Standards;
    - Wastewater Disposal
    - Trade Effluent Discharges (if any)
    - Solid Waste Disposal
    - Electrical Power(fossil fuels, wind, sun, wave and tidal)
    - Communications and other utility requirements
    - Transport Systems and supporting infrastructure required
- Operation and maintenance – waste disposal, site drainage, sewage treatment and disposal solution, and air quality;
- Impacts on visual aesthetics and landscape
- Noise
- Change in drainage pattern
- Carrying capacity of the proposed site

7.2 NATURAL HAZARD

Impact of Natural Hazards: (such as Hurricanes and Earthquakes) and flooding potential

7.3 BIOLOGICAL

An assessment of the direct and indirect impacts of the project on the ecology of terrestrial and marine habitats with emphasis being placed on any rare, endangered, threatened and endemic species found. This should include habitat loss and fragmentation, loss of species and natural features due to construction and operation. Impact of noise and vibration

especially on marine mammals and sea turtles should be examined as well as the impact of light pollution.

7.4 HERITAGE
Loss of and damage to: artifacts, archaeological, geological and paleontological features

7.5 HUMAN/SOCIAL/CULTURAL
Effects on socio-economic status such as changes to public access & recreational use, impacts on existing and potential economic activities, public perception, contribution of development to national economy and development of surrounding communities. Socio-economic and cultural impacts to include land use/resource effects.

7.6 PUBLIC HEALTH ISSUES OF CONCERN

7.7 RISK ASSESSMENT
Analyze the risks to human health and ecosystems associated with the development from both human activities and natural phenomenon. This should include: 1) Identifying the hazards 2) Assessing the potential consequences 3) Assessing the probability of the consequences and 4) Characterizing the risk and uncertainty. The monetary costs of the risks, the costs of emergency response and/or avoidance of risks should also be considered. The physical, biological and sociological status will provide the framework in which to assess the impacts of the proposed project.

8 IMPACT MITIGATION
Mitigation and abatement measures should be developed for each potential negative impact identified. This should include recommendations for the enhancement of beneficial impacts and quantify and assign financial and economic values to mitigating methods. Green building technology should be examined. A statement is to be made on strategies that will be used to conserve energy and water in relation to this development.

9 ENERGY USE AND CONSERVATION

This section should provide methods of energy conservation that could be applied. Alternate sources of energy could also be provided and assessed, and a justification provided for the preferred energy source.

10 RESIDUAL IMPACTS
Identify any residual negative impacts that potentially have no solution for mitigation.

11 ANALYSIS OF ALTERNATIVES
This should include the no action alternative and project design alternatives**.** These should be assessed according to the physical, ecological and socio-economic parameters of the site. The examination of project alternatives should incorporate the use history of the overall area in which the site is located and previous uses of the site itself. A rationale for the selection of any project alternative should be provided.

12 ENVIRONMENTAL MONITORING AND MANAGEMENT
An environmental monitoring and management plan should be developed which will detail the requirements for construction and operational phases of the project. This should include, but not be limited to training for construction and operation staff, as well as include recommendations to ensure the implementation of mitigation measures and long term minimization of negative impacts

A draft environmental monitoring programme should be included in the EIA, and a detailed version submitted to NEPA for approval should the permit be granted and prior to the commencement of the development. At the minimum the monitoring programme and report should include:

- Introduction outlining the need for a monitoring programme and the relevant specific provisions of the permit license(s) granted.

- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- Energy and water conservation measures
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored. These may in instances, be pre-determined by the local authority and should incorporate a control site where no impact from the development is expected.
- Frequency of reporting to NEPA

The Monitoring report should also include, at minimum:

- Raw data collected. Tables and graphs are to be used where appropriate
- Discussion of results with respect to the development in progress, highlighting any parameter(s) which exceeds the expected standard(s).
- Recommendations
- Appendices of data and photographs if necessary.

13 LIST OF REFERENCES

14 APPENDICES

The appendices should include but not be limited to the following documents:

14.1 REFERENCE DOCUMENTS

14.2 PHOTOGRAPHS/ MAPS

14.3 DATA TABLES

14.4 GLOSSARY OF TECHNICAL TERMS USED

14.5 FINAL TERMS OF REFERENCE

14.6 COMPOSITION OF THE CONSULTING TEAM, TEAM THAT UNDERTOOK THE STUDY/ASSESSMENT, INCLUDING NAME, QUALIFICATION AND ROLES OF TEAM MEMBERS

14.7 NOTES OF PUBLIC CONSULTATION SESSIONS

14.8 INSTRUMENTS USED IN COMMUNITY SURVEYS

15 ACTIVITIES

In order to effectively and efficiently conduct the Environmental Impact Assessment it will be necessary to carry out various activities which include:

15.1 DOCUMENTATION REVIEW

All documentation pertaining to the development will need to be reviewed. These should include, but not limited to, the project profile, site plan, drainage plan, vegetation clearance plan, applications made for financing or planning approval, and any technical and engineering studies that have been done.

15.2 ANALYSIS OF ALTERNATIVES

Alternatives to the site location, project design and operation conditions will be analyzed including the "no-action" alternative. These alternatives will be assessed based on the physical, ecological and socio-economic parameters of the site identified. The consultant should provide justification for the selection of the chosen alternative(s). The physical, biological and sociological settings will provide the framework in which to assess the different project alternatives.

15.3 IMPACT ASSESSMENT

The consultant should carry out a detailed impact assessment of the project components (pre-construction, construction and operation stages) in order to identify the potential impacts (positive, negative and cumulative impacts) that will be

associated with the project. The significance and magnitude (major, moderate and minor) of the impacts identified will also be evaluated through the use of a weighted matrix.

The impacts to be assessed will include but not limited to the following:

- Effects of project design and engineering;
- Effects on visual aesthetics and landscape;
- Effect of noise and vibration;
- Effects of construction activities such as site clearance and geological formation, earthworks, hurricanes, access routes, transportation networks and spoil disposal;
- Effects of operation and maintenance activities such as waste disposal, traffic management, site drainage, sediment, sewage, public access and air quality; and
- Effects on ecology including effect on terrestrial and marine habitats
  Emphasis should be placed on any rare, endangered, and endemic species found
  Effects on socio-economic status such as changes to public access, recreational use, existing and potential agricultural activities, contribution of development to national economy and development of surrounding communities.

The physical, biological and sociological status will provide the framework in which to assess the impacts of the proposed project.

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as, references. GIS references should be provided where applicable. One hard copy and an electronic copy must be submitted to NEPA for review after which fifteen (15) hard copies and an electronic copy of the report should be submitted. One copy of the document should be perfect bound.

The report should include an appendix with items such as maps, site plans, the study team, photographs, and other relevant information.

See outline below:-

16 OUTLINE OF A TYPICAL EIA REPORT

The report should contain an introduction explaining the need for, and context of the project. This document should have the following basic aspects included in the Table of Contents, unless specified otherwise in the Terms of Reference.

- Executive Summary
- Policy, Legal and Administrative Framework
- Description of the Proposed Project in detail
- Environmental Analysis
  - Physical Environment
  - Natural Hazards
  - Carrying Capacity
  - Biological Environment
  - Heritage
  - Socio-economic Environment
- Identification and Assessment of Potential Environmental Impacts
  - Environmental Impact Assessment
  - Mitigation Measures

    - Cumulative Impacts
    - Positive Impacts

- Public Participation
- Identification and Analysis of Alternatives
- Environmental Management of the Project
- Environmental Quality Objectives
- Draft Outline Monitoring Programme
- List of References
- Appendices including:

    - Reference documents
    - Photographs/ maps
    - Data Tables
    - Terms of Reference
    - Composition of the consulting team
    - Notes of Public Consultation sessions

14.6 COMPOSITION OF THE CONSULTING TEAM

Team Leader/Project Manager:	Beverline Brown Smith, MURP, B.A (Hons), Dip- Mgmt. of the Env.
Project Design:	Robin Baston, B.Sc, - Architect Patrick Murray, B.Sc. - P.E, Engineer Jerome Lofters, B.Sc. - Surveyor
Physical Resources & Hazard Assessment:	Norman Harris. M.Sc. - Engineering Geologist
Biological Resources:	Marlon Beale, M. Phil. - Zoologist
Socio-Economic Impact Assessment: **Land Use and Conservation** **Project Impacts and Mitigation**	Beverline Brown Smith, MURP, B.A (Hons), Dip- of the Env.
Air Quality & Water Quality:	ESL Quality and Environmental Laboratory

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14.7 NOTES OF PUBLIC CONSULTATION SESSIONS

No information available.

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14.8 INSTRUMENTS USED IN COMMUNITY SURVEYS

SOCIO-ECONOMIC SURVEY

Community _____ **Date** Age: _____

_____

Gender: Male [ ] Female [ ]

Housing and Population

1. How long have you lived in area?
   _____
2. Where did you live previously?
   _____
3. Is the house you occupy-
   a) Owned? [ ]
   b) Rented? [ ]
   c) Leased? [ ]
   d) Other []
   _____
4. What is the size of your dwelling (no. of rooms)?
   _____
5. How many persons occupy your household?
   a) 1-3 [ ]
   b) 4-6 [ ]
   c) 7 + [ ]
6. What is your main source of water?
   a) Pipe in yard [ ]
   b) Pipe in house [ ]
   c) Stand Pipe [ ]
   d) Spring [ ]
7. What is main material used for the construction of your house?

   i. Board ii [ ] Ply iii. [ ] Block & Steel iv. [ ] Nog

Employment & Economy

8.. What is your occupation? _____

9,. Where do you work? _____

10. What is your average weekly income?
    a. Up to $5000 [ ]d) $5001-$10,000 [ ] e) $10,001 and above [ ]

Social Services /Physical Infrastructure

11. List any public service/infrastructure that needs improvement
    _____

Awareness of Proposed Development & Community Concerns

12. Did you have prior knowledge of the proposed development of the Dundee Property?
    Yes □ No □
13. Do you think there is a demand for more houses in the area?
    Yes □ No □ State reason for answer
    _____
14. What impacts do you think the proposed development will have on the area?
    _____
15. What, if any, do you consider to be the most urgent community needs? _____
    _____
16. What do you know about the Dundee property, (birds, farming, flooding etc.)?
    _____
17. What use would you recommend for the Dundee property?
    _____
18. Do you like the area? _____ State reason_____
    _____

Historical Sites and Monuments

19. Can you name a site of historical importance in the community? _____
    _____

15.0 ACTIVITIES

In order to effectively and efficiently conduct the Environmental Impact Assessment it was be necessary to carry out various activities which include:

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All documentation pertaining to the development will need to be reviewed. These should include, but not limited to, the project profile, site plan, drainage plan, vegetation clearance plan, applications made for financing or planning approval, and any technical and engineering studies that have been done.

15.2 ANALYSIS OF ALTERNATIVES

Alternatives to the site location, project design and operation conditions were analyzed including the "no-action" alternative. These alternatives were assessed based on the physical, ecological and socio-economic parameters of the site identified. The consulting team provided justification for the selection of the chosen alternative(s). The physical, biological and sociological settings provides the framework which assess the different project alternatives.

15.2 IMPACT ASSESSMENT

The consulting team carried out a detailed impact assessment of the project components (pre-construction, construction and operation stages) in order to identify the potential impacts (positive, negative and cumulative impacts) that will be associated with the project. The significance and magnitude (major, moderate and minor) of the impacts identified were also be evaluated through the use of a weighted matrix.

The impacts assessed included the following:

- Effects of project design and engineering;
- Effects on visual aesthetics and landscape;
- Effect of noise and vibration;

- Effects of construction activities such as site clearance and geological formation, earthworks, hurricanes, access routes, transportation networks and spoil disposal;
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Effects on socio-economic status such as changes to public access, recreational use, existing and potential agricultural activities, contribution of development to national economy and development of surrounding communities.

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