JANUARY 2010

ENVIRONMENTAL IMPACT ASSESSMENT

FOR THE PROPOSED LAND & HOUSING SUBDIVISION AT HOLLAND ESTATE, MARTHA BRAE TRELAWNY

[Prepared for KENCASA Project Management & Construction Limited]

KENCASA CONSTRUCTION & PROJECT MANAGEMENT
OPENING DOORS FOR YOU

CONRAD DOUGLAS & ASSOCIATES LIMITED
14 Carvalho Drive
Kingston 10
Jamaica W.I.

Telephone: 929-0023/0025/8824
Email: estech@infochan.com;
cdaestech@hotmail.com; conraddouglasnassociatesltd@gmail.com
Website: www.cda-estech.com

ENVIRONMENTAL IMPACT ASSESSMENT

FOR THE ESTABLISHMENT OF

A LAND AND HOUSING SUBDIVISION

AT HOLLAND ESTATE, MARTHA BRAE, TRELAWNY

Rev. 01

Prepared for:

KENCASA Construction and Project Management Limited

PROPRIETARY RESTRICTION NOTICE

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Acronyms

CBD – Convention on Biological Diversity

CDMP – Caribbean Disaster Mitigation Project

CITES – Convention on International Trade of Endangered Species

dB – Decibel acoustic

dBA – Decibel A-weighting

ECD – Environmental Control Division

ED – Enumeration District

EHU – Environmental Health Unit

EIA – Environmental Impact Assessment

JNHT – Jamaica National Heritage Trust

JPSCo – Jamaica Public Service Company

MGU – Marine Geology Unit

NEPA – National Environment & Planning Agency

NRCA – Natural Resources Conservation Authority

NWA – National Works Agency

NWC – National Water Commission

ODPEM – Office of Disaster Management

STATIN – Statistical Institute of Jamaica

ToR – Terms of Reference

UNCED – United Nations Convention on Environment and Development

WRA – Water Resources Authority

EXECUTIVE SUMMARY

1 Executive Summary

1.1 Introduction

Zuccherina Developments [Jamaica] Limited, in collaboration with KENCASA Construction and Project Management Limited, are seeking to develop approximately 78 hectares (192 acres) parcel of land located south of the Martha Brae exit off the North Coast Highway, and in close proximity to the William Knibb Memorial High School in the parish of Trelawny.

These plans involve a land and housing subdivision development project of approximately 1,385 housing solutions.

The past decade has seen house prices double in real terms and if the rising pressure for more homes is ignored, the result will see wealth inequality widening, frustrated aspirations, resulting in crime and further damage to the economy. At present, Jamaica has over 700 squatter settlements, a figure that has been highly publicised by Prime Minister Golding as well as the Minister of Housing and Water, Minister Horace Chang.

KENCASA has commissioned Conrad Douglas and Associates Limited, environmental management consultants, to carry out an environmental impact assessment (EIA) to evaluate the proposed development lands, surrounding community, baseline environmental conditions (physical, biological and socio-economic), and the master plan for the proposed development to ensure it is socially, economically and environmentally suitable.

As a result of falling into the National Environment and Planning Agency (NEPA's) prescribed categories of projects requiring Environmental Impact Assessments (EIAs), NEPA directed that an EIA be done in keeping with the Natural Resources Conservation Authority (NRCA) Act of 1991. This EIA Report documents the studies and processes involved in conducting the EIA and the findings of the assessment.

1.2 Project Objective & Concept

The objective of the project is to develop a land and housing subdivision to address the housing needs of the greater Falmouth area of Trelawny. It is planned to construct 1385 residential units of various sizes all with pre-approved expansion plans. The units will be built in four (4) phases.

The main goals of the design concept are:

- To design a functional community which will achieve a sense of order, safety and convenience for both residents and visitors, taking advantage of all identified potentials of the site.
- To minimise the environmental impact of the development , and
- To minimize construction cost from design inefficiencies, by maximizing lot yield based on the number of lots per length of infrastructure; and by working with the terrain to reduce site grading expenses and avoiding identified site constraints.

Treated potable water will be supplied by the National Water Commission. Electricity will be supplied from the National grid. The North Coast Highway and the Falmouth to Martha Brae main roads are the main transportation corridors.

The layout of the proposed development will also allow for light commercial and other social requirements that are necessary under the national planning regulations. Similarly, the drainage design will take into full consideration offsite and onsite drainage requirements.

1.3 Approach & Methodology

Standard and creative approaches and methods were used by a highly qualified and experienced project development team working in collaboration with the environmental assessment team. The approaches and methods involved a combination of desk, literature and field studies, meetings and investigations, leading to analysis, assessment and preparation of the EIA report.

On receipt of NEPAs approval of the TOR, some of the studies undertaken were as follows:

- Review of the plans and designs
- Analysis of alternatives
- Bio-physical surveys (terrestrial)
- Socio-economic surveys
- Baseline studies on water quality, noise and dust
- Natural hazard vulnerability and assessment
- Review of the regulatory framework
- Impact identification
- Impact mitigation
- Identification of the parameters for and outline of an environmental monitoring plan

1.4 Applicable Policy, Legislative, Standards and Regulations

The relevant policies and legislation identified and analyzed were as follows:

- The NRCA Act of 1991
- Natural Resources (Permit and Licence) Regulation (1996)
- The Watershed Protection Act of 1963
- The Wildlife Protection Act of 1945
- The Water Resources Act, 1995
- The Underground Water Control Act of 1959
- The Town and Country Planning Act of 1957
- The Jamaica National Heritage Trust Act 1985
- The Public Health Act, 1974
- The Disaster Preparedness and Emergency Management Act of 1993
- The National Solid Waste Management Act of 2001
- Occupational Safety and Health Act of 2003
- Agenda 21
- Convention on Biological Diversity 1992

1.5 Impact Identification & Mitigation

The major potential negative impacts identified were as follows:

- Loss of vegetation
- Change in the run-off regime
- Fugitive dust formation and dispersion during construction
- Change in aesthetic appeal
- Increased demand on social services
- Increased population density

The major positive potential impacts are:

- Allocation of vital housing solutions
- Substantial direct investment
- Demand for local goods and services during construction
- Job creation during construction
- Improved run-off water control

1.5.1 Impact Mitigation

Standard methods will be used to mitigate the potential negative impacts. These include:

- Creative conservation of flora through landscaping
- Irrigation for dust control during construction
- Creation of adequate drains for surface water control
- Maintenance of construction vehicles for noise control
- Traffic Management
- Site management
- Off-site provisions for concrete batching and vehicle maintenance

1.6 Environmental Management & Monitoring Plans

Critical parameters for environmental monitoring and management will be formulated to ensure that the project complies with the regulatory framework and the impact mitigation actions that have been outlined. These will be further developed for strict implementation, in the event that the project is permitted by NEPA.

1.7 Conclusion

The project has carefully integrated the features of the natural environment in the excellent, complementary, non-conflicting baseline and setting of the area, to enhance the development, conserve on natural resources and protect the environment. In so doing it has ensured sustainability and protects the investment.

1.7.1 Recommendations

Given the baseline and setting of the area, the care with which the project has been designed, its emphasis on resource conservation and environmental protection, the few relatively minor potential impacts (which can be readily mitigated) and the number of substantial major positive impacts, we recommend that the project be permitted for implementation.

PROJECT DESCRIPTION

2 Project Description

2.1 Introduction

The Government of Jamaica, through its mandate has listed the provision of housing as one of its main priorities. An approach that tailors housing supply solutions to the needs and affordability of different target markets is being promoted. For far too long the supply of new homes has not kept pace with rising demand. In fact, the last officially published housing needs assessment stated that 15,000 houses were required per year for the period 1987 – 2006, to keep up with the demand resulting from the estimated population growth.* The average annual production is approximately 4,350 units per year, which signals a huge backlog. The past decade has seen house prices double in real terms and if the rising pressure for more homes continues to be ignored, the result will see wealth inequality widening, frustrated aspirations, resulting in crime and further damage to the economy. At present, Jamaica has over 700 squatter settlements, a figure that has been highly publicised by Prime Minister Golding as well as the Minister of Housing and Water, Minister Horace Chang.

KENCASA is pleased to introduce a project as part of the solution to the critical housing shortage that exists along the Western corridor of the North Coast. This solution is a proposed housing development at Holland Estate in Trelawny.

Zuccherina Developments [Jamaica] Limited, in collaboration with KENCASA Construction and Project Management Limited, are seeking to develop approximately 78 hectares (192 acres) of land located south of the Martha Brae exit off the North Coast Highway, and in close proximity to the William Knibb Memorial High School in the parish of Trelawny.

These plans involve a land and housing subdivision development project of approximately 1,385 housing solutions. These lands are registered as follows:

- parcel of land part of THE HOLLAND ESTATE AND THE IRVING TOWER ESTATE in the parish of TRELAWNY being the Lot Numbered TWO on the plan of part of The Holland Estate and The Irving Tower Estate
- Volume 1428, Folio 871

KENCASA has commissioned Conrad Douglas and Associates Limited, environmental management consultants, to carry out an environmental impact assessment (EIA) to evaluate the proposed development lands, surrounding community, baseline environmental conditions (physical, biological and socio-economic), and the master plan for the proposed development to ensure it is socially, economically and environmentally suitable.

This section of the report describes the concepts and design criteria to be employed in the design of housing solutions, roads, drainage, water supply and sewerage treatment and disposal systems.

2.1.1 Location

The proposed development is located within the district of Holland, approximately 2.3km south of Falmouth, the Trelawney Parish capital, south of the Martha Brae exit off the North Coast Highway, and in close proximity to the William Knibb Memorial High School in the parish of Trelawny. The location of

the proposed development enjoys access by road via the Falmouth to Martha Brae main road. The area is comfortably serviced with infrastructural utilities and social services to support the project, including electricity and water supplies.

The North Coast Highway provides access to major towns and cities along the north coast such as Montego Bay, St. James to the west and Ocho Rios to the east. Secondary arterial roads connect to communities to the south such as Granville.

The vegetation on the proposed site is typical and consistent with the types of vegetation found along the North Coast, primarily dry limestone forest. This aspect will be discussed in detail in Section 5.

Plate 2-1 below shows the regional setting of the proposed land and housing subdivision development.

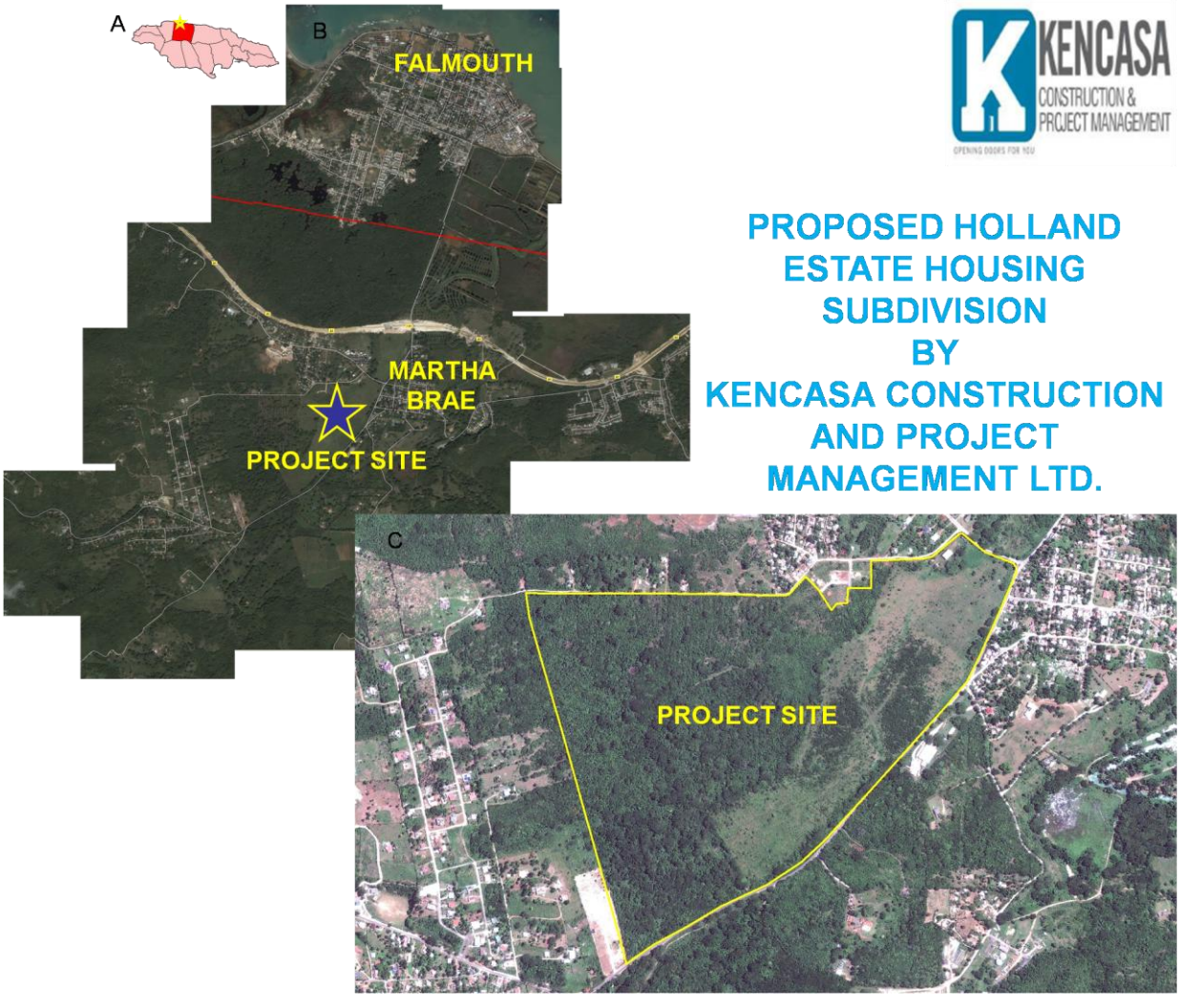

Plate 2-1: Regional Setting of the Proposed Holland Estate Development Project, Trelawny

2.1.2 Project Summary

The Holland Estate development consists of housing units, commercial lots, recreational/green space, and utility corridors on approximately 78 hectares (192 acres) of land. The development proposes to have 1,385 habitable units varying in size from duplex studios, detached studios, 2 & 3 bedroom detached units, and modular apartment units. These units will be priced to ensure a single individual

accessing the National Housing Trust (NHT) fund will be able to afford a unit. The target market is primarily the low to middle socio-economic income levels. The Master Plan is outlined in **Figure 2-1** and **Figure 2-2** below.

The following table outlines the lot summary for the entire development.

Table 2-1: Holland Estate - Proposed Lot Summary

Lot Summary	No. of Lots	Areas (m^2)	Ratio (%)
Duplex	448	122,503	15.6
Detached	748	309,150	39.4
Row	189	45,660	5.8
Commercial	1	6,515	0.8
Open Space	12	114,676	14.6
Social Services	1	21,202	2.7
Roads	1	136,229	17.3
Utilities	1	29,630	3.8
TOTAL	**1417**	**785,566**	**100**
Total Residential	**1385**	**477,313**	**60.8**

2.1.2.1 Design Process

This design and layout of this development involved the design of alternative layout scenarios to determine the optimum locations of various land uses within the development. The layout which best maximized the potentials, minimized constraints and satisfied criteria previously established from the analysis were selected. Further research was conducted to identify any potential techniques that could be used to reduce development cost, enhance the development potential of the site and meet specific site constraints.

2.1.2.2 Phasing Plan

The proposed development is projected to be completed in four (4) phases. The phases of development are expected to follow the following format (**Table 2-2** and also outlined in **Figure 2-3**).

Table 2-2: Phasing plan allocation for the Subdivision

	Hectares	Acres	Lots
Phase 1	**29.9**	**73.9**	**457**
Residential	13.4	33.0	425
Commercial	0.7	1.6	1
Utilities	2.7	6.7	5
Education	2.1	5.2	1
Open Space/Recreational	5.0	12.5	4
Mixed Use	0.5	1.2	21
Road	5.5	13.6	

	Hectares	Acres	Lots
Phase 3	**17.1**	**42.2**	**340**
Residential	12.1	30.0	318
Commercial	0.0	0.0	0
Utilities	0.1	0.2	4
Education	0.0	0.0	0
Open Space/Recreational	1.4	3.4	2
Mixed Use	0.4	1.0	16
Road	3.1	7.7	

Phase 2	**16.0**	**39.5**	**335**
Residential	11.6	28.8	315
Commercial	0.0	0.0	0
Utilities	0.1	0.3	5
Education	0.0	0.0	0
Open Space/Recreational	0.7	1.8	2
Mixed Use	0.3	0.8	13
Road	3.1	7.7	

Phase 4	**17.0**	**42.0**	**284**
Residential	8.8	21.7	252
Commercial	0.0	0.0	0
Utilities	0.1	0.1	3
Education	0.0	0.0	0
Open Space/Recreational	4.3	10.7	4
Mixed Use	0.6	1.5	25
Road	3.3	8.0	
Total	80.0	197.5	1,416

Master Plan

LOT SUMMARY	No. Lots	Areas	Ratio
Duplex	448	122,503 sq.m	15.6%
Detached	748	309,150 sq.m	39.4%
Row	189	45,660 sq.m	5.8%
Social Services	1	6,515 sq.m	0.8%
Open Space	12	114,676 sq.m	14.6%
Education	1	21,202 sq.m	2.7%
Road	1	136,229 sq.m	17.3%
Utilities	17	29,630 sq.m	3.8%
Total Lots	1,417	785,566 sq.m	100.0%
Total Residential	1,385	477,313 sq.m	60.8%

Figure 2-1: Holland Estate Subdivision Master Plan

Figure 2-2: Holland Estate Master Layout - Central Park

Phasing Plan

LOT SUMMARY	No. Lots	Areas	Ratio
Duplex	448	122,503 sq.m	15.6%
Detached	748	309,150 sq.m	39.4%
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Total Lots	1,417	785,566 sq.m	100.0%
Total Residential	1,385	477,313 sq.m	60.8%

Figure 2-3: Holland Estate Phasing Plan

2.2 Project Description

2.2.1 Vision

The overall vision of the plan, consistent with the goals of Vision 2030 for Jamaica, is to design a holistic development which is primarily focussed on providing housing for varied income levels, and is balanced with community facilities that will provide the full gamut of conveniences and services for work, play, shopping and leisure.

The vision is also to create a community which is secure and walkable, and offers a high level of energy efficiency, social equity and economic vitality by expanding all the opportunities the site offers while mitigating any negative environmental impacts and natural hazards.

2.2.2 Goals

2.2.2.1 Energy Efficiency

The goal is for the development to act as a model as an 'energy efficient community', as studies suggest that a more compact community form with high densities and mixed uses would consume far less material and energy resources in transportation.

Energy efficient planning and design will allow for increased access to affordable housing, public services and employment and to stimulate local economic opportunities.

Initiatives are also being planned to maximise energy efficiencies through the development of this mixed use development being designed around new techniques of Remote Metering and shared energy resources to maximise process efficiencies.

2.2.2.2 Security

The security goal of the plan is to create a safe environment for visitors and residents, with a reduced threat of harassment, violence or other criminal behaviour by designing counter-measures to mitigate these threats. Techniques such as: the circulation road network was designed to channel visitors through controlled site access portals, creating limited access to properties; well-lit roadways; good surveillance systems to control/monitor unauthorised access into private/semi-private areas; and a sense of ownership and responsibility were also created in the design.

2.2.2.3 Walkability

The goal of the plan was to design a walkable community that will be ultimately seen as a place in which residents of all ages and abilities feel that it is safe, comfortable, convenient, efficient and welcoming to walk, not only for recreation but also for utility and transportation.

With the concern over the negative health impacts of sedentary lifestyles, part of the goal of the plan is to improve the health, safety and welfare of residents through design by promoting walking. The plan does this by paying close attention to detailed design features that support walking. The mixture of land use, safety features, road network, sidewalks, building facades, landscaping and other elements of human scale design were all taken into consideration.

2.2.2.4 Construction Efficiency

To minimize construction cost from design inefficiencies, by maximizing lot yield based on the number of lots per length of infrastructure; and by working with the terrain to reduce site grading expenses and avoiding identified site constraints.

2.2.3 Issues and Opportunities

2.2.3.1 Issues

Hazard Mitigation: With the north-eastern corner of the development being susceptible to flooding; the design has been planned to locate the land use that would be least impacted by such occurrences in that zone. The sports park was therefore selected and designed with a detention pond area and infiltration pits.

2.2.3.2 Opportunities

Tourism Potential: With the development falling in the centre of the country's primary tourism region and being in close proximity to the North Coast Highway and Falmouth town centre, and with the new cruise ship pier under construction; the development will have an excellent opportunity to take advantage of its tourism potential. The development's design is cognizant of this by creating a safe, attractive, authentic environment with its streetscape and architectural theme along the main boulevard as well as with the historical themed central park, making it an ideal tour bus stop-off point. The opportunity could eventually extend to residents within the community for a bed & breakfast cottage industry within the residential neighbourhoods, as obtains with Cardiff Hall.

University Potential: With the development also falling in the north-western region of the country and its absence of tertiary level facilities and the increasing demand for more highly trained professionals in the region from the growing ICT and tourism sector; the development has a strategic opportunity to provide an excellent location and environment to accommodate an urban-designed university campus within the commercial district. A university on this site could also benefit from tourism opportunities with the planned bed & breakfast hotel which could also double as a Hospitality Training facility.

2.3 Housing Plan

The design and planning of the housing types was a significant component of the design effort. The options developed were primarily market dictated to ensure affordability based on the economic conditions of the region. The primary market is from hotel workers, civil servants and other tourist related services in new and planned hotels in the region. The Master Housing Plan and Typical Units are outlined in **Figure 2-4** - **Figure 2-6** below.

2.3.1 Residential Types

2.3.1.1 Apartment Units

By providing apartment units catering to singles and newly migrant workers who may be temporarily employed (option essential to reduce squatting potential). Immediate targeting of rental units.

2.3.1.2 Duplex Units

By providing duplex and detached studio unit options – the project will cater to the lower middle income families giving them starter unit options with an opportunity to build incrementally.

2.3.1.3 Detached Units

By providing 2 and 3 bedroom units, the development will cater to more established and larger sized families with higher incomes giving them the opportunity to move into a completed unit.

Table 2-3: Residential Housing Types allocation

Type	Apartments	Duplex Studio	Detached Units	
Subtype	studio, 2 & 3 Bedroom		2 Bedroom	3 Bedroom
Average Lot Size (m^2)	1330	250	350	600
Lot Aspect (m)	7.3x26 (1:3.6)	8.5x27 (1:3.2)	13x27 (1:2.1)	11.68x40 (1:3.42)
Density (units/acre)	33.54	14.80	11.02	7.08
Height	2 Stories	1 Story	1 Story	1 Story
Coverage	25%	13%	20%	15%
Building Size (sq.m)	56	33	70	88
# of Units	228	448	586	162
Expandable	NO	YES	YES	NO
Total Area (acres)	6.80	30.26	53.19	22.89

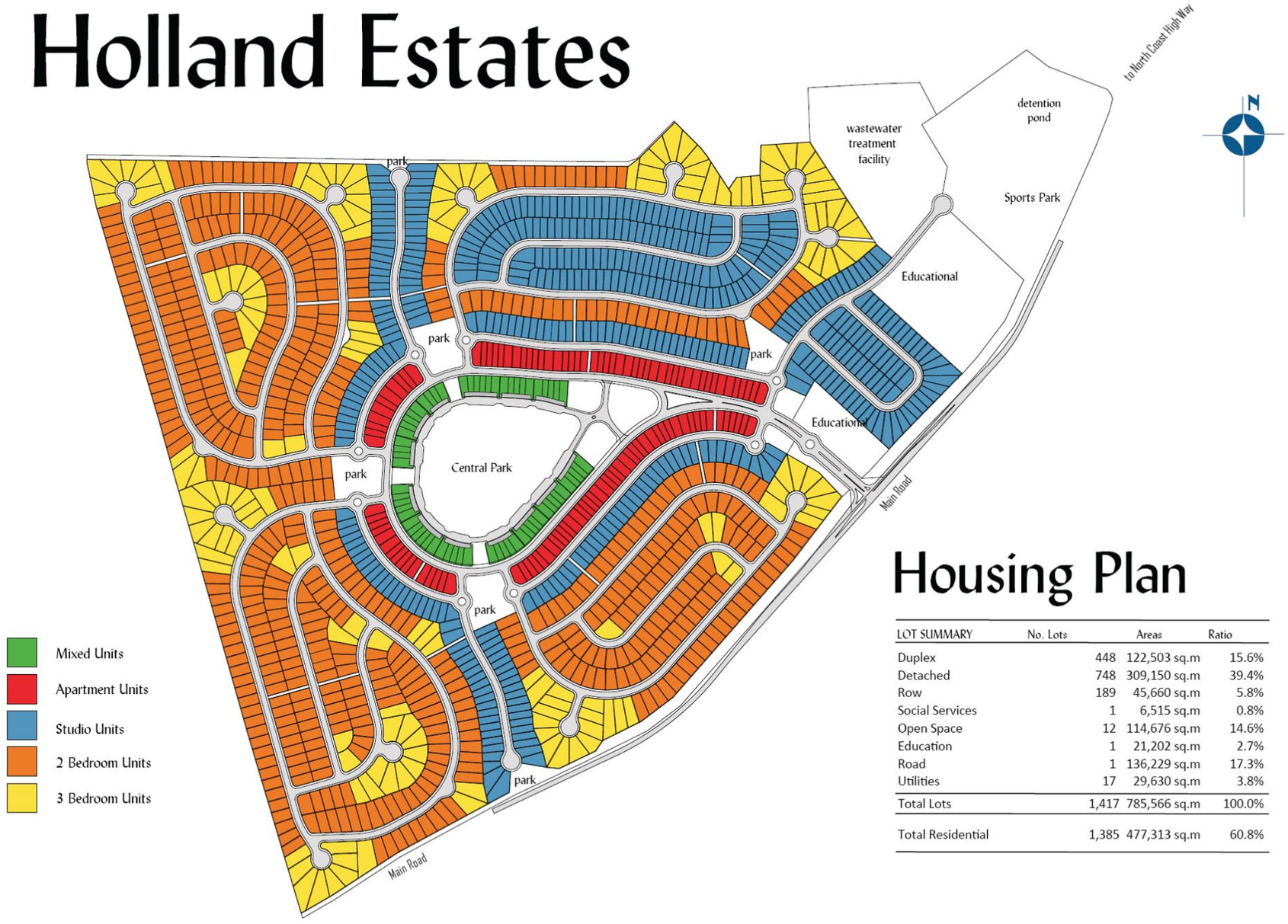
Residential lots within the sub-division will range in size from 250 m^2 (2,690 ft^2) to 600 m^2 (6,500 $ft^{2.}$). The land allocation has also been made bearing in mind the tendency of Jamaicans to improve on their dwellings based on the size of the household and resources over time. Additionally, each unit type will have pre-approved expansion options at the time of sale. These preapproved plans MUST be used for all expansion by homeowners which will ensure that the development retains some amount of uniformity and guarantees each household security in value of their respective units as well as pride of community.

In addition to the economic factors, the architectural style was also an important factor in the planning of the development. The regional vernacular, climatic conditions and cost had affected the design style of the housing options selected.

The architectural vernacular of the region is dictated by Falmouth, which has retained a significant amount of its original housing stock that boasts a fairly unique architecture that blends the Georgian style with a local tropical adaptation.

The architectural façade of the apartment units and all the other buildings facing the main boulevard in the development will have a style in harmony Falmouth dominated by strong Georgian elements. The other housing units were designed to also be sensitive to the regional vernacular with strong development control guidelines to ensure that the appearance of the community is preserved.

Another important planning consideration related to housing was the project density. With a total project site of (192 acres) and a total of 1,385 units, the gross density is designed at 7 units/acre. Using the net developable area of 53.4 Ha (132 acres) - which is the total project area less open space and infrastructure. The net density was designed at 10.4 units / acre which create a massing which is in scale with the surrounding community character of Falmouth.



Housing Plan

LOT SUMMARY	No. Lots	Areas	Ratio
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Total Lots	1,417	785,566 sq.m	100.0%
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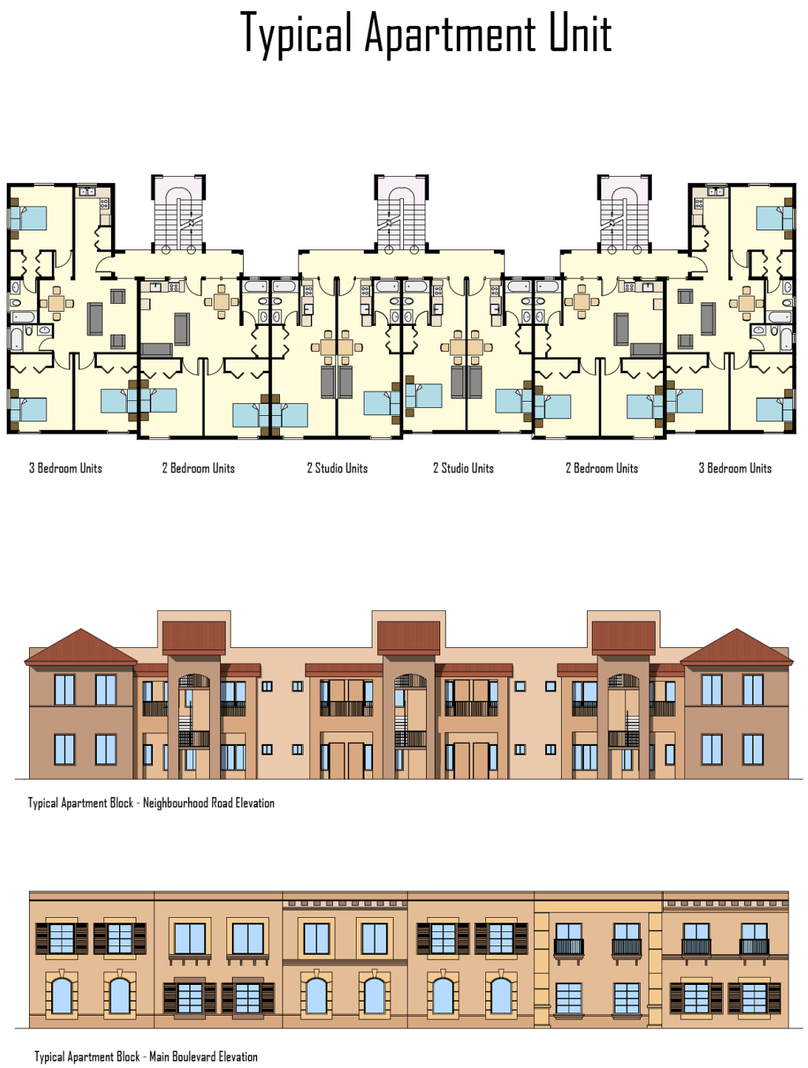
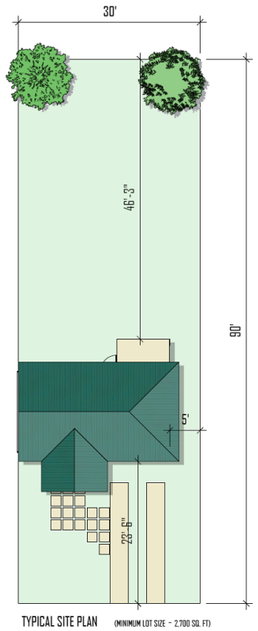
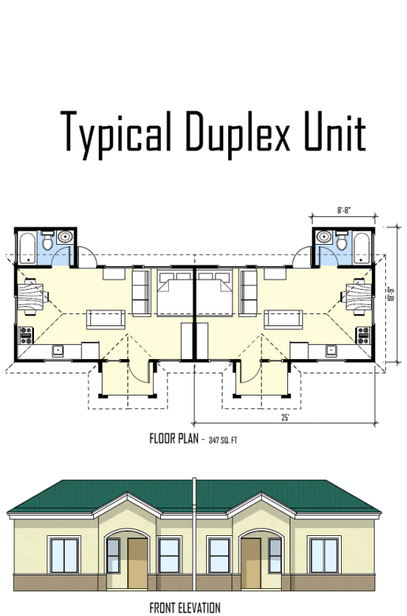
Figure 2-4: Holland Estate Housing plan







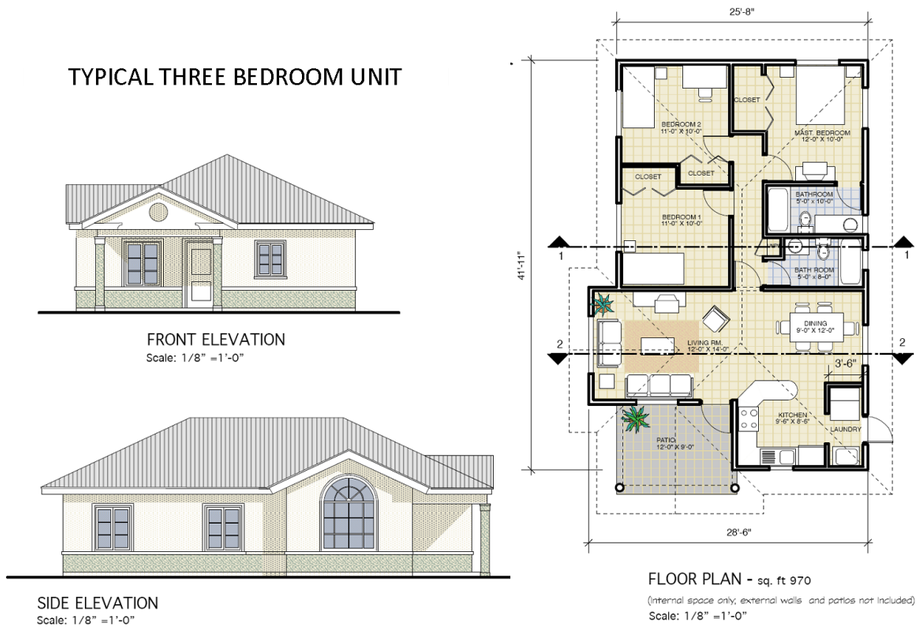


Figure 2-5: Typical Duplex, Apartment and 3 Bedroom Units

2-Bedroom cul-de-sac

Studio Unit cul-de-sac & Typical Unit Structure

Figure 2-6: Typical Studio Unit and 2 Bedroom cul-de-sacs

2.4 Community Facilities Plan

The community facilities are all the assets within the development designed to provide a service to the public.

It is proposed that the facilities remain privately owned and operated, to ensure adequate level of service in a timely, orderly and cost effective manner.

One major goal of the facilities plan is to create an "Intelligent Community System" that provides high-tech facilities monitoring system to each home. All home utilities are to be monitored by remote meters and delivered to both the utility company and the residents via the internet and cable television. This will allow the residents to better monitor and manage the consumption of the utility and make payments more easily. This will also allow the utility companies to have a more efficient bill collection, payment, disconnection and leak detection system, thereby lowering operation and energy costs. Utilities planned to be monitored are: water, electricity, telephone, cable-television, internet, cooking gas, smoke detection and security surveillance.

An inventory of all the community facilities planned for the development is outlined below:

2.4.1 Recreation

2.4.1.1 Requirements

The legal amount of community space required for a development of 1,385 residential units is 34.625 acres – using the formula of 1 acre to 40 residential units.

The amount of open space designed for community space is 35.174 acres which includes parks, landscaped areas and the school facilities.

2.4.1.2 Goals

The goals of the recreation plan are

- The protection of the natural bio-diversity
- Creation of places for recreation
- Support for economic development opportunities
- Development of neighbourhood gathering places
- Promotion of public health benefits
- Creation of civic and cultural infrastructure

2.4.1.3 Plan

The recreation plan was designed to distribute park locations to ensure a balanced service across the development.

The network of recreational services will provide an even mixture of activities across every strata of the population.

Park facility was placed within a five-minute walking distance of every residence, ensuring that parks are easily accessible by foot; and was placed near the entrance of each neighbourhood block so they can be visually accessible to the greater public.

The four neighbourhood parks (approximately ¾ acres each) are designed for smaller children who require supervision during play. Hence, this park will include observation and playground facilities.

The main park was designed in the centre of the development to preserve a large cluster of the existing mature trees (primary vegetation) and to provide equal accessibility by each neighbourhood cluster and by the general public.

This central park is designed as a key anchor feature of the development. It will incorporate civic and cultural infrastructure. These will showcase ornaments with historical, tourism and educational themes (sculptures and murals). The park will be designed for leisure and passive activities for all ages; with scattered seating throughout; cleared areas designed for small group meetings/activities; and a jogging/ trail around the periphery. Pathways through the park are designed to also act as connections to other facilities surrounding the park, namely, the Chapel, outdoor restaurants and other commercial and educational facilities.

The major sports park is located at the north-eastern corner of the development, along the main road. This will allow accessibility by the residents, the school and residents from neighbouring communities (thus connecting the adjacent communities).

This facility will provide for active recreation with group activities by larger children and adults. Also designed are a grassed running track, football field, hard surfaces for basketball, netball and a tennis court.

Two landscaped buffer areas are designed along the existing roads on the north and south boundaries. The areas can also act as (possible connectors) alternative access points into the development and for road reservation if some road widening is contemplated in the future.

2.4.2 Utilities

The goal of the utilities plan is to design systems that are efficient, reliable and will have as little impact as possible on the environment.

The sewage treatment system is designed to provide an on-site tertiary system and will discharge into the mangroves north of the highway in accordance with local planning regulations. The system is located to the northern corner of the development and near the lowest elevation on the site, and also where it can be of least impact to any residence. A forty-foot thick buffer of densely planted trees is designed around the facility to reduce any possible fugitive odour from the site.

The storm drainage detention system is designed to manage the possibility of flooding taking into consideration of full onsite/offsite drainage requirements; by temporarily storing excessive runoffs during storm episodes. Infiltration wells will also assist in reducing runoff. The sports park surrounding the detention area is also designed with a grading that will allow for it to be flooded containing peak amounts to not impact buildings or roadways.

All cable utilities are designed on an overhead network except along the main boulevard which gets its service from the parallel local road to the rear. The main boulevard is designed to be fitted with ornamental street lights via underground cabling.

2.4.3 Public Safety

The safety plan proposes designed areas to erect gatehouses at the main entrance to the development and nine (9) access points to each neighbourhood block, which could convert block into separate gated communities. These areas can also be used as surveillance points for remote monitoring of these community access points.

A 60 m^2 facility is allocated in the design within the commercial district as a central staging area for the security services. (Enquiries will be made for a possible Police Post).

2.4.3.1 Controlled Points of Entry

Existing access to the proposed development will be provided via a single entry/exit point from the main road. The decision was taken to limit access to one point in order to strengthen the residents' ability to monitor vehicular and pedestrian movements through the community.

The placement and configuration of the entryway into each of the four neighbourhood blocks, which has a limit of two access points also facilitates a gated community should this be preferred by the residents in the future.

The additional incorporation of cul-de-sacs presents the added benefit of safety on a "street-scale", as any vehicular entry is denied a drive through option, as such this acts as a deterrent to potential intruders.

2.4.4 Healthcare

The healthcare plan is designed to provide basic, privately run healthcare services for the convenience of the residents within the development.

A 180 m^2 facility is reserved in the development within the commercial district for a General Practitioner and Dental office along with a Pharmacy (or possibly a government-run health clinic pending enquiries).

2.4.5 Education

The education plan is designed to provide convenient facilities for students living in the development and possibly surrounding areas. Their locations were placed to the northeast corner and are easily accessed via a safe walkable/bicycle route through the development or via the main road.

2.4.5.1 Requirements

The plan provides for a Primary/Basic school facility which is generally required for a development of this magnitude. The required lot area is 2 hectares and should be within 1km of residencies which is provided for in the design.

2.4.6 Cultural

As part of the overall development goal to provide a fairly comprehensive mixture of services and enhancing the quality of life, the plan is designed to provide desirable cultural services such as a Chapel; an auditorium/theatre and a library which would be part of the proposed university campus (if implemented).

2.5 Commercial District

The goal of the commercial district plan is to provide a balanced development that is primarily residential, within a more holistic lifestyle setting, creating a variety of basic retail services to residents in the district surrounding the central park, which is within walking distance from all homes (which is required by local planning standards for a development of this size). In the development this would reduce the added congestion on Falmouth that would have originated from this development, in their effort to procure basic commerce which would have exacerbated the already congested streets within Falmouth.

Another goal is to create new economic opportunities for the region by stimulating employment, wealth creation and opportunities to work within walking distance from home.

2.5.1 Quality of Success

Special urban design characteristics were also planned into the design which is essential to a specialty commercial district. These include:

- High density / high floor ratio
- Shallow setbacks along the streets
- Mixed uses
- On street parking
- Rear parking lots and garages
- Street use management (which could include closure for events)

People are more likely to visit specialty retail districts to conduct day to day activities in authentic social spaces. The quality and diversity of experiences are as important as the merchandise acquired. Two types of experiences need to be accommodated:

1. Observation of events, such as cinema, theatre, sports or people-watching.
2. Participation, self expression and engagement with both friends and strangers.

Maximizing these experiences is achieved in the design of the district through the arrangement of spaces connecting into the central park, resulting in added anticipation of adventure and indulgence from visitors. This type of setting should appeal to people who integrate their work, home and leisure lives and constantly seek social settings for generating ideas and discussing activities with both business colleagues and personal friends as well as for making new acquaintances, which are a fundamental aspect of learning and growing.

To ensure the success of this commercial district, the strategy is to target a combination of major specialty anchor stores, activities, food, lifestyle, festival, educational and commercial services.

2.5.1.1 Educational Anchor

The primary anchor to be targeted is a university campus. (The University of Technology - UTECH) has expressed an interest in the development for the establishment of their western campus facility). The design has created about 9,850 m^2 of building space on two floors over the commercial district with an additional 4,600 m^2, designed for a bed and breakfast hotel which could be part of the university's Hospitality Department.

2.5.1.2 Festival Marketplace Anchor

The central park will act as a touristic anchor that has emphasis on leisure/cultural spaces for small day and night performances. Also included would be spaces for arts & craft shops, outdoor restaurants and a theatre for performances along the district.

2.5.1.3 Food Anchor

A supermarket is designed as the primary retail anchor. This is separated into specialized grocers and distributed throughout the commercial district. Restaurants are strategically designed adjacent to small parklets which connect into the central park, to create opportunities for outdoor cafes.

2.5.1.4 Lifestyle Anchors

Small retail stores are distributed along the commercial strip which will provide essential lifestyle services such as: barber/hairdresser, cosmetics and high end clothing stores.

2.5.1.5 Commercial Service Anchors

Businesses which provide essential and convenient daily services will be strategically selected in the layout of the commercial district. Such services include: bank (ATM), post office, internet café, etc.

2.6 Corridor Plan

2.6.1 Wayfinding System

The wayfinding system planned for the development consists of:

2.6.1.1 Landmarks

A unique piece of Public Art is proposed to be placed in each of the four parklets surrounding the Central Park. The chapel will act as the major entry landmark of the development.

2.6.1.2 Gateway

A low level sign structure is to be placed on the corner of the playground parks at the entrance of each neighbourhood with the name of the Community embossed on it.

2.6.1.3 Visitor Centre

A structure is proposed to be placed at the main entrance guardhouse to display: a guide map, a business directory, and other information about the development, for visitors to easily find their way throughout the development.

2.6.2 Street Network

The development is laid out using a road network that follows the grade through the property, but is also constrained by the shape of its boundaries. A series of roads and cul-de-sacs creates a layout style that reduces overall road lengths and infrastructural cost by limiting the number of intersections, and by working with the terrain as much as possible to create a cost-efficient flow of utilities.

The design utilizes cul-de-sac road termination design to facilitate easier turnaround areas at points where loops could not have been facilitated.

The entrance of the development is designed to facilitate ease in vehicular drop-offs/pickups and turnarounds. This entrance can also facilitate gating of the community to provide additional security measures if it becomes necessary in the future.

2.6.3 Parking

The design provides for a total of 570 parking spaces in the commercial district. There are 180 on-street parallel parking on both sides of the main boulevard; 240 spaces are to be provided in two multi-storey parking facilities at either end of the commercial district; and 150 spaces are provided at the rear of the commercial units along the central park periphery.

Requirements: With the total maximum building area in the commercial district being 19,377m^2, the parking required would be approximately 520 spaces, using a ratio of 1 car park to 37 m^2 (400 ft^2) of building space.

2.7 Infrastructure

2.7.1 Potable Water

This section is informed by work done by FCS Consultants Limited[1]. The water quantity and quality is to be provided by the National Water Commission (NWC) existing transmission system in the area (**Appendix V**).

2.7.1.1 Estimate of the development's potable water use

The estimate of water demand used in this design is based on the projected population to occupy the development. The Statistical Institute of Jamaica states that the average number of persons per dwelling in 2001 was 3.6 down from 4.2 in 1991.

For this evaluation 5 persons per dwelling is used to give a conservative population estimate and resulting water demand for the proposed development, especially with there being expansion options for the residential units.

The peak factors are taken from the "Jamaica Institution of Engineers Recommended Guidelines for Design and Construction of Housing Infrastructure, Volume 3 Water Supply Systems.

Table 2-4 below displays the calculation of the daily water demand for the proposed development. Water losses on the distribution network are taken as 20% of the estimated average day water demand

[1] FCS Consultants Limited. 2009. Engineering Report – Preliminary Water and Sewerage Design

as recommended by the NWC. The daily quantity of water required from the source is estimated to be 2067 m^3/d to accommodate provisions for system loss.

Water usage in this type of residential developments is typically such that there will be peak and minimum water demand during specific months of the year, days of the week and hour of the day.

The peak day in the peak month factor and peak hour factor used to set the upper range of demand on the system are shown in **Table 2-4**. The minimum demand is estimated to be 0.125 of the average day demand.

The water distribution system will be required to deliver water to the user during the varying conditions. As the demand increases and more water is expelled from the system the pressure in the system will fall. In simple terms the distribution system is adequate if the variation of user demand results in pressures and flows that satisfy the design criteria.

Table 2-4: Estimate of the Water Quantity Required for the Proposed Development

Item	Description	Qty	Unit
1	**Number of residential lots**	1,385	No
2	Estimate of the number of persons per lot	5.00	No
3	Population Estimate	6,925	No
4	Average per capita consumption per household	227	Litres
5	Estimate of domestic water use	1,571,975	Litres
6	**Commercial**		
7	Commercial and Recreational area	15,184.28	m^2
8	Usage per unit area commercial space	14.68	L/m^2
9	% Area used for commercial floor space	10%	
10	Estimate of floor space	1,518.43	m^2
11	Water for commercial and Recreational	22,291	L
12	**Basic & Junior High School**		
13	Basic Student Population	100	No
14	Basic Staff Population	10	No
15	Total Basic School population	110	No
16	JH Student Population	700	No
17	JH Staff Population	56	No
18	Total Junior High school population	756	No
19	Per Capita demand for school population	57	Litres/day
20	Estimate of Basic & Junior High School demand	49,362	Litres/day
21	**Other water use** (5% domestic use)	78,598.75	Litres
22	**Average day demand**	**1,722,226.45**	**Litres**
23		**1,722**	**m^3/d**
24	Peak day in peak month factor	1.40	
25	Peak hour factor	1.50	
26	Peak factor	2.10	
27	Leak factor	20%	
28	**Average day including leaks**	**2067**	**m^3/d**

Item	Description	Qty	Unit
29		545,957.01	US gpd
30	Peak day water demand	2,893.34	m^3/d
31		764,339.82	US gpd

2.7.1.2 Water distribution network criteria

The service delivery standards for water distribution systems in Jamaica are set by the Office of Utilities Regulation (OUR). The recommended minimum pressure at the service connection during peak demand is 20 psi (14 m of water or 138 kPa). The Jamaica Institution of Engineers (JIE) Guidelines for Design and Construction of Housing Infrastructure recommend that the residual pressure at the hydrant during fire events be 5 psi (3.52 m of water or 34.47 kPa). The water scheme was designed by taking into account the guidelines of the latest National Water Commission Developer's Manual requirements, the AWWA M-31 Distribution system requirements for fire protection and JIE guidelines. The pressure requirements during fire events and the maximum pressure of 689 kPa (100 psi) as stated in the JIE guideline were used in the evaluation of the system acceptability.

The NWC Developers manual recommends that "Pipelines should be sized to carry flows capable of servicing the maximum demand flow plus fire flows based on individual or group hydrant requirements."

It further states that "In urban sub-divisions street mains should be at least 100 mm (4") diameter except for short dead ends where 51 mm (2") diameter pipe running not longer than 45 m (150') are allowed at the discretion of the NWC. Velocities in pipes should not exceed 1.2 m/s (4 f.p.s) under normal circumstances and at no time should exceed 3.0 m/s (10 f.p.s)."

2.7.1.3 Water Distribution Network

Figure 2-7 below shows the layout of the water distribution model superimposed on the proposed Holland Estate Development layout. The model includes a reservoir, storage tank, pipes and nodes (which are pipe junctions). The water source is idealised as a reservoir with the total head set at the assumed pressure from the Rural Water Supply pipeline used to supply the subdivision.

The layout of the water distribution network was developed by identifying the areas throughout the development that are likely to demonstrate the upper and lower limits of demand, pressure and flow. The demand at each node (pipe junction) in the distribution model represents the estimated water usage for a group of users in close proximity to that junction.

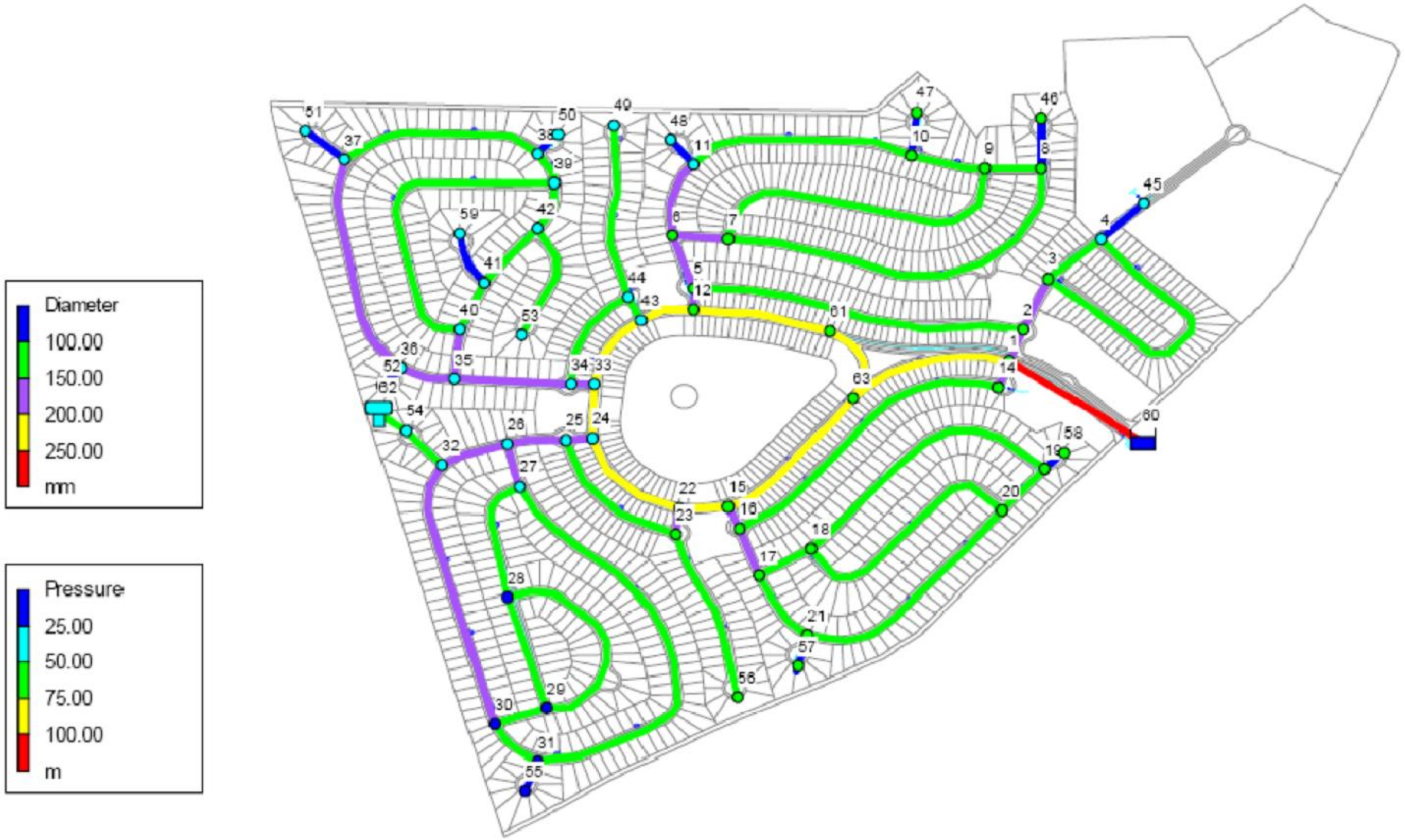


Figure 2-7: Water distribution model for the proposed Holland Estate Development - Preliminary Design Fire Flow

The nodes were assigned a base demand equal to the average water demand for a group of users that are located in a sub area of the development. The boundaries of the subareas are generally midway between nodes.

The distribution network was modelled with varying sizes of PVC pipe ranging from 250 mm to 50 mm diameter, with the latter size serving a maximum of 16 lots. The network was modelled and analysed to ensure that the minimum pressure is 14 m of water (20 psi) during peak demand (without fire flows) periods .The network was also checked to ensure that a minimum pressure of 5 psi (34 kPa or 3.5 m of water) is maintained at hydrants when fire flows are drawn off the system while peak day demand flows are also drawn from the system.

The water supply was modelled as a reservoir at main entrance towards the eastern side of the development with total head of 100 m. A storage tank was also included at the highest elevation in the development (located towards the western section of the subdivision). The tank was modelled with minimum level 0.5 m and maximum level 10 m. The diameter of the tank was taken to be 18 m.

2.7.1.4 Analysis of Network for fire flows

The AWWA M31 manual outlines a number of methods to assess the Needed Fire Flow (NFF) and duration. The method used in this report is the Insurance Services Office method to determine the fire flow needed for a fire in an extended house in the proposed development.

The fire flow used for this project is two streams from a hydrant anywhere in the subdivision.

Two streams from a single hydrant can supply 30.4 Lps which will be adequate to suppress a fire from the building considered.

The fire flow used to check the distribution network is 32 Lps at selected hydrants. Quantity of water for fire is estimated to be 32 Lps for two hours, that being a minimum of 230.4 m^3.

Fire flows were set at two nodes at high and intermediate elevations in the housing development. The fire flows were set at time steps 7:00 – 8:00 p.m., and 8:00 – 9:00 p.m. for the two nodes.

2.7.1.5 Water storage

Distribution storage can be economically justified if it takes care of normal daily variation and provide needed reserve for fire protection and minor emergencies.

A tank should be constructed at an elevation that will supply peak demands at the minimum required pressure. In this case the tank was placed at an elevation capable of supplying majority of the development at the required minimum pressure.

The proposed tank size for the development is 2066.7m3 or 545,957US gallons. The tank was modelled with minimum level 0.5m and maximum level 10m. The diameter of the tank was taken to be 12m.

Table 2-5: Estimate Sizing of Water Storage Tank

Fire Flow	32 Lps
Duration	1 hr.
30% day's supply and fire flow	735,201.52 Lpd
One day's supply	2,066,671.74 Lpd

2.7.2 Electricity

Power lines runs along the main road from Falmouth to Martha Brae and beyond. The area is adequately serviced with power and streetlights by the Jamaica Public Service (JPSCo.). Electricity demand for the various aspects of the development will be serviced through the services of the JPSCo.

All necessary arrangements will be made with JPSCo. to ensure this service will be ready in time for development of the site (**Appendix V**).

2.7.3 Landscaping

The development lands are currently fully vegetated. In order to maintain and/or improve the existing characteristics of the site, various existing habitats/micro-ecosystems will be retained in part. As many existing mature trees that can be saved will be incorporated into the development.

The layout was informed by the site characteristics and as such several satellite parks will be a feature of the site. To bring forward these elements the site will be actively landscaped using plants that are predominantly found within the general area as well as garden varieties typically used in landscaping in Jamaica.

No introduced plant or animal species will be allowed as part of the landscaping plan. The landscaping plan will be phased to allow for the various aspects of the development. Elements of the plan will include, at a minimum:

- Road verges
- Site boundaries
- Central and Satellite parks
- Setback expanses fro sewage treatment facility and detention ponds

2.7.4 Solid Waste Disposal

Based on the national average waste production by household, it is estimated that the development will generate approximately 2,275 tonnes of solid waste per annum. Neighbouring communities are serviced by the Western Parks and Markets (WPM), the western arm of the National Solid Waste Management Authority (NSWMA). It is anticipated that this development will also be serviced by the WPM.

Solid waste generated from this development will be disposed of at the approved Retirement Dump Facility in St. James. It is expected that private contractors will be utilized during the pre-construction and construction phases. NSWMA will be expected to collect waste material generated by residential on hand-over. All necessary arrangements will be made to ensure this service will be ready in time for development of the site through the NSWMA. Commercial units are required to make arrangements with either private haulers or the NSWMA to have their waste collected and disposed of.

2.7.5 Roads

This section is informed by a study done by FCS Consultants Limited.[2] The roadways are being designed to meet a combination of the NWA and the American Association of State Highway and Transportation Officials (AASHTO) road design standards.

Carriageway widths will vary based on the classification or primary use of the road such as access to housing blocks, collector road for multiple blocks or ingress egress for the subdivision.

The road reservation provided by the planner for this subdivision is typically 12 m. This road reservation will meet the requirements of the National Works Agency (NWA) in providing a paved carriageway of 6m (2 x 3.0 m lanes) with 1.80 m verges and 1.2 m sidewalks within the various housing blocks. There is also a 21 m wide road reservation provided by the planner for the entrance road to the site consisting of a 13.0 m wide dual carriageway (6.5 m in each direction). The roads connecting the main entrance road to the housing blocks will have a 12 m wide reservation but will have 6.5 m wide carriageways. However, it should be noted that roads with drains beneath the surface of the carriageway will require a 3.5 m lane width.

The carriageways will be designed with a crown in the middle, such that the transverse slope will be 2.5% with the channel against the kerb having a triangular section with a slope of 2.5 to 6.25%.

The access road to the subdivision is to be upgraded. The turning radius for the main ingress/egress will be designed with a minimum radius of 12 m.

Internal intersections within the subdivision will be designed with a 10 m radius based on recommendations by the NWA. The turning radius at curves within the subdivision is to be at least 25 m.

The vertical alignments of all roads are below the maximum slope of 15% in order to meet the NWA standard. Road profiles are designed to meet the stopping sight distance criteria for a minimum design speed of 65-70 kmph.

Where additional guidance is required the following manuals are used

1. Road pavement structure to conform to AASHTO flexible pavement design method or the Asphalt Institute design method.

2. Road structures to conform to Bridge and Culvert Design CALTRANS Bridge Design Practice Manual

3. All soil gradation to be specified in the AASHTO Soil Classification system.

4. All soil strength to be specified in accordance with the ASTM 04429-04 Standard Test Method for CBR (California Bearing Ratio) of Soils in Place and 01883-07 Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils

5. All soil compaction to be specified as a percentage of Modified Proctor Compaction ASTM 01557- 07 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

[2]FCS Consultants Limited. 2009. Engineering Report – Preliminary Drainage Design

2.7.6 Conservation Measures & Other Amenities

No concrete batching plants will be erected on the site; neither is there a temporary diesel storage facilities proposed. Though these elements are essential in a project such as the one proposed, efforts are being made to have all concrete batching done at a nearby aggregate site. This will retain such works within an area already slated for such activities and eliminate the likelihood of air pollution and other health and safety compromises at the development site. Similarly it is envisaged that heavy equipment will be maintained at an offsite garage specifically geared for such purposes.

Each unit will be furnished with low flush toilets, and bathroom and kitchen faucets to aid in water conservation. Units will also be oriented to maximize light from the sun and wind to keep units at comfortable daytime and night-time temperatures.

Strategies for the treatment of storm water include a retention pond and grasses perimeter drains to allow for the reduction of runoff leaving the development, which will increase infiltration and trap some amount of silt, debris and other pollutants off the roads and development lots.

In order to ensure the sustainability of the development, a community association is proposed to be established immediately upon sale of units. The association, which is made up of all the land owners in the community, will be assigned at least one unit within the commercial complex, the rental of which will go towards the maintenance of the landscape areas, parks and drains within the community indefinitely.

During construction, there will be no wholesale clearance of tree cover throughout the site. This clearance will be restricted to roadways and service areas and will also be informed by the phase construction schedule. Efforts will be made to ensure applicable techniques are applied in areas with slopes that may be prone to erosion during site clearance and construction such as terracing.

2.8 Drainage Design

This section is informed by a study done by FCS Consultants Limited.[3] The criteria used for the drainage design are determined by the GOJ Development and Investment Manual, and the Jamaica Institution of Engineers guidelines and best practices of the industry.

The Government of Jamaica (GOJ) Development and Investment Manual, Volume 3 Section 1, Chapter 12, article 12.1, part (ix) set out the design storm return frequency as follows:

- Minor Drainage systems designed to accommodate 1 in 5 year flood event.
- Major Drainage system to be designed to accommodate 1 in 25 year flood event.
- Bridges designed for 1 in 50 year flood event.

The Jamaica Institution of Engineers recommended “Guidelines for the design and Construction of Housing Infrastructure” Vol 1: 1984 Storm Water Drainage recommends that the design storm frequency of storm sewers be 2 years and for culverts, bridges and flood control projects a minimum of 10 years.

[3]FCS Consultants Limited. 2009. Engineering Report – Preliminary Drainage Design

In the Standard Handbook for Civil Engineers by Merritt, Loftin and Ricketts article 14.9 states "Flooding problems and surface drainage as concerns of community and regional planning studies, differ primarily in degree of severity. The principal concern with flooding is the desire to avoid injury and loss of life and reduce property damages caused by major floods (those having a recurrence interval of 25 to 100 years).Surface-drainage systems on the other hand are primarily concerned with convenience and providing access to property in relatively minor storms (those having a recurrence interval of 2 to 10 years)".

The development is being designed to contain surface drainage systems to accommodate stormwater runoff generated within the development and main or regional drainage systems that convey storm water through the development to the final discharge points.

Investigations are conducted for the 1 in 25 year event for the main drainage channels and 1 in 10 year event for the subdivision drains. The surface drainage and inlet sizing is designed as local streets and the design event is the 1 in 5 year frequency.

The FHWA HEC 22 recommendation is shown in Table 4-1 and is used for the designs.

Table 2-6: Suggested Minimum Design Frequency and Spread

Road Classification		Design Frequency	Design Spread
High Volume or Divided or Bi-Directional	< 70 km/hr (45 mph)	10-year	Shoulder + 1 m (3 ft)
	> 70 km/hr (45 mph)	10-year	Shoulder
	Sag Point	50-year	Shoulder + 1 m (3 ft)
Collector	< 70 km/hr (45 mph)	10-year	1/2 Driving Lane
	> 70 km/hr (45 mph)	10-year	Shoulder
	Sag Point	10-year	1/2 Driving Lane
Local Streets	Low ADT	5-year	1/2 Driving Lane
	High ADT	10-year	1/2 Driving Lane
	Sag Point	10-year	1/2 Driving Lane

Where additional guidance is required the following manuals are used

The FHWA documents to be referenced are:

1. Hydraulic Design Series No.2 – Highway Hydrology
2. Hydraulic Design Series No.4 - Introduction to Highway Hydraulics
3. Hydraulic Design Series No 5 – Hydraulic Design of Highway culverts
4. Hydraulic Engineering Circular No.9 - Debris Control Structures Evaluation and Countermeasures Third Edition
5. Hydraulic Engineering Circular No. 12 - Drainage of Highway Pavements
6. Hydraulic Engineering Circular No. 14, Hydraulic Design of Energy Dissipators for Culverts and Channels Third Edition
7. Hydraulic Engineering Circular No. 15, - Design of Roadside Channels with Flexible Linings Third Edition
8. Hydraulic Engineering Circular No. 22, URBAN DRAINAGE DESIGN MANUAL Second Edition

2.8.1 Method of Determining Design Peak Flows

Storm runoff generated within the development is intercepted at multiple locations from several sub-catchments. The size of the drainage structures is determined by the peak flow generated from the sub-catchment.

2.8.1.1 Rational Method

For drainage areas less than 200 acres, the design engineer shall use the Rational Method (Q=CIA) procedure for determining runoff flow. For drainage areas between 200 and 2,000 acres, the design engineer shall use the most recent NRCS Method, for determining runoff rates. For drainage areas greater than 2,000 acres, or (800 hectares) the design engineer shall use the most recent WRA Regression methods or HEC HMS to estimate runoff rates.

The calculation for peak runoff using the rational method is set out below:

Q = C i A x 1/Ku

Where: Q = Flow, m^3/s (ft^3/s)

C = coefficient of runoff (dimensionless)

i = rain intensity mm/hr (in/hr)

A = drainage area, hectares, ha (acres)

Ku = units conversion factor 360 (1 in English units)

Table 2-7: Rain data from the National Meteorological Service's estimates of maximum 24 hour rainfall for selected return periods converted to rainfall intensity [Sangster International Airport rain gauge]

Return Period - TR (years)	Rainfall Intensity in mm/hr or in/hr	
	t < 60 min	t > 60 min
2	$i = 5.6559Pt^{-0.5171}$	$i = 24.8880Pt^{-0.8790}$
5	$i = 6.4753Pt^{-0.5704}$	$i = 20.5852Pt^{-0.8529}$
10	$i = 6.7976Pt^{-0.5893}$	$i = 19.2810Pt^{-0.8439}$
25	$i = 7.0630Pt^{-0.6047}$	$i = 18.2178Pt^{-0.8361}$
50	$i = 7.1972Pt^{-0.6123}$	$i = 17.6826Pt^{-0.8320}$
100	$i = 7.2901Pt^{-0.6181}$	$i = 17.2759Pt^{-0.8288}$

Where

i= Rainfall intensity in millimetres per our

P = 24 hour rainfall in millimetres

t= rainfall duration in minutes

The proposed development is located southwest of the parish capital Falmouth. The rainfall data for Falmouth was used as it is relatively close to the site (**Table 2-8**).

Table 2-8: Falmouth, Trelawny rainfall data

24 hr Return	mm/day
1 in 2 yr	102
1 in 5 yr	131
1 in 10 yr	159
1 in 25 yr	194
1 in 50 yr	220
1 in 100 yr	246

2.8.1.2 NRCS TR-55 Method of Determining Peak Flows

The community or main drainage system that conveys storm water through the Holland Estate to be developed into housing solutions has several contributing drainage areas larger than 200 acres; as such the NRCS TR55 method is being used to determine the peak flows at critical points along the channel.

The proposed development has been superimposed on the Jamaica Survey Department 1:12,500 topographic map series for the area and the catchments that direct surface runoff toward the proposed development delineated. Given the data available, catchment sizes and the times of concentration the USDA NRCS Urban Hydrology for Small Watersheds Technical Release 55 most commonly called the TR-55 method of determining the peak surface runoff flow is used to determine the peak 1:10 year and 1:25 year flows.

This method requires the following inputs

1. Catchment area
2. Time of concentration and time of travel
3. Land use and soil type to determine the curve number CN
4. 24 Hour precipitation for the watershed considered.

Technical Release 55 (TR-55) presents simplified procedures to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for floodwater reservoirs. These procedures are applicable in small watersheds, especially urbanizing watersheds, in the United States.

The model described in TR-55 assumes a rainfall amount uniformly imposed on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). CN is based on soils, plant cover, amount of impervious areas, interception, and surface storage. Runoff is then transformed into a hydrograph by using unit hydrograph theory and routing procedures that depend on runoff travel time through segments of the watershed.

2.8.1.3 Storm Sewers

The storm sewer system being the buried drainage conveyance system below the roadway pavement is designed to convey a 1:10 year storm without surcharging.

The discharge of the storm sewers will generally be directed to paved drains and positive drainage will be maintained in the design. Minimum cover will be to the manufacturers' specifications.

2.8.1.4 Open Drains

The GOJ Development Manual, Volume3, Section 1, Chapter 10, article 10.1.7 parts ii) and iii) recommend minimum easement and freeboard in drains as shown below:

(ii) A minimum easement of 1.22m from each side of the design water way is recommended.

(iii) Bridges and open channels should be designed with a freeboard not less than 25% of the design flow depth.

As recommended in the GOJ Development document all drains are being designed with a minimum 25% of the design depth as freeboard.

The open drains are used where possible and erosion protection using both rigid and flexible linings used in the design.

2.8.1.5 Erosion Control

CALTRANS Highway Design Manual CHAPTER 870 CHANNEL AND SHORE PROTECTION - erosion control and FHWA HEC 14 hydraulic design of energy dissipaters for Culverts and Channels are being used to design the erosion control features.

The maximum velocity for unlined channels as described in table 862.2 of the CALTRANS Highway Design Manual chapter 860 for Open Channels are being used to guide the designs and determine if channels should be lined.

The storm runoff from the development is being directed toward the necessary features of the drainage system such as storm sewers or minor paved drains that will fall toward the outlets designed. If the drainage system for the development sub areas is obstructed by debris the drainage design should allow for storm water to overtop the drainage infrastructure and to flow toward the natural drainage path.

2.8.2 Pre-Development Drainage Assessment

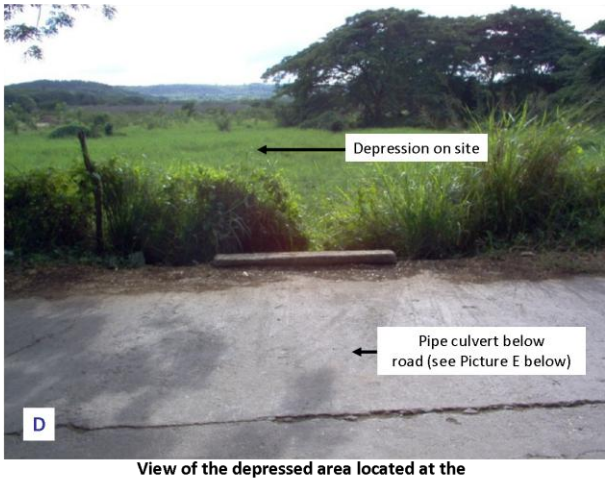
The existing vegetation is a combination of short grasses and scrub trees (**Plate 2-2**). A few scattered fruit trees were also seen. The soil type is predominantly silty clay.

Plate 2-2: View of site from the southern parochial road

The following pictures highlight key drainage features entailed in the design (**Plate 2-3**).

Drainage Channel leading to culvert crossing the parochial road south of the site. This water presently flows through the proposed development's lands

Debris and garbage in Box culvert crossing parochial road south of site (see picture B above)



View of the depressed area located at the northeast corner of the site

Existing Pipe culvert exiting at the northeast of the site

Paved Drain (from pipe culvert in picture E) leading towards the North Coast Highway

Plate 2-3: Aspects of the current drainage regime for the property and adjoining areas.

The proposed site consists mainly of flat lands. Surface elevations range from 2 m to 34 m above sea level. The highest point is closest to the western boundary.

The site has natural drainage paths forming parts of its relatively flat terrain. The site mainly drains to the watercourse running towards the northeast of the property which crosses the North

Coast Highway via under-road drains and enters the mangroves prior to flowing into the Martha Brae River.

The topographic maps showed that the contributing drainage area to this culvert can be subdivided into three watersheds which include the site for development.

A basic Hydrologic model was created using HydroCAD storm water modelling software (which is based on USDA TR-55 and TR-20 routing methods).The runoff potential of the soil within the watersheds was estimated based on the observed land use and vegetative cover within the area. The model was used to determine the rate of runoff entering and leaving the site, as well as to predict the levels of flooding that are experienced within the property during various storm events.

The pre-development catchments have been delineated and shown in **Figure 2-8**. The results of the model are shown in **Table 2-9**.

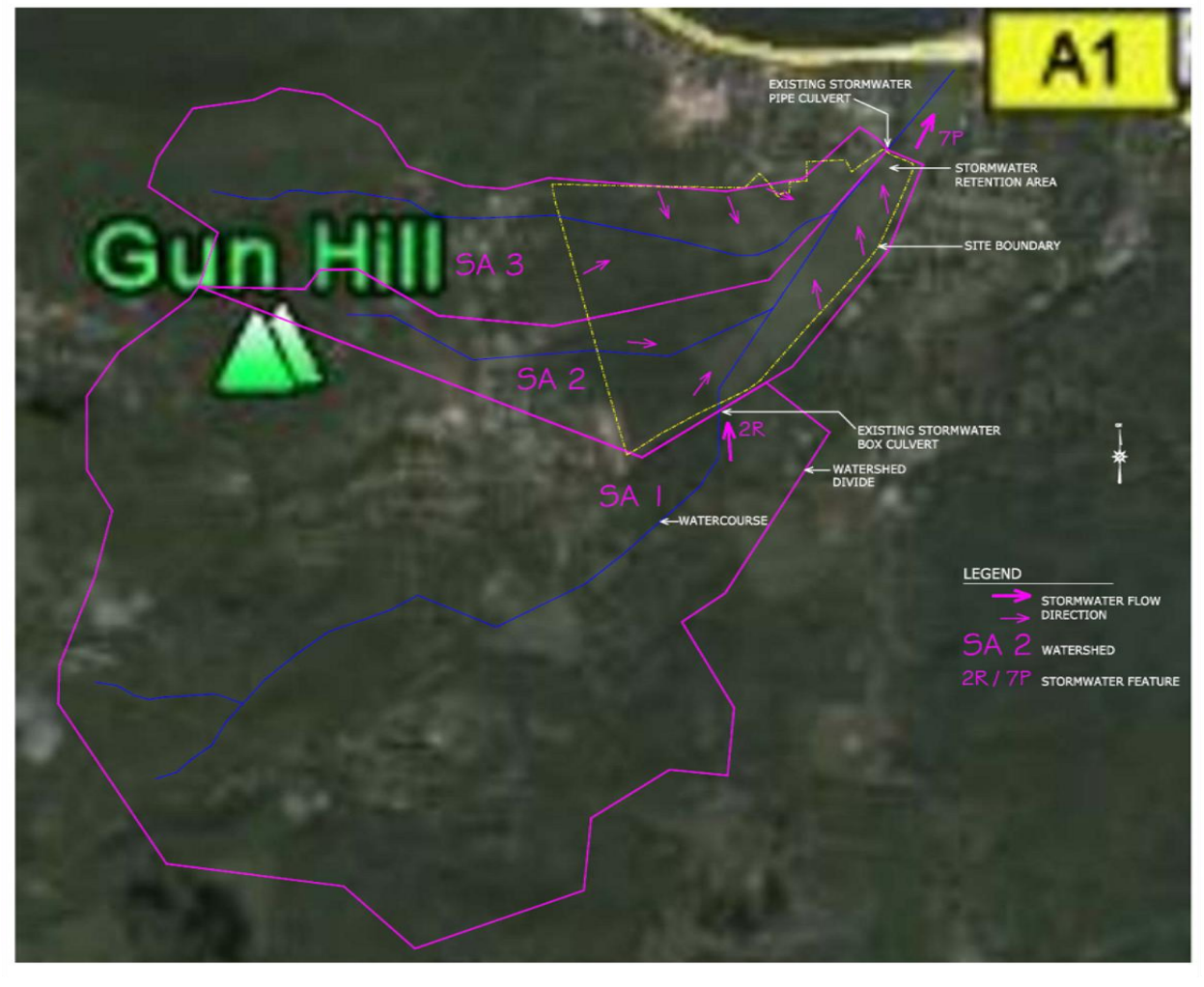


Figure 2-8: Pre-development GoogleEarth™ image of the Proposed Holland Estate development site showing key drainage features

Table 2-9: Results from the Pre-development model

Drainage Feature	Rainfall Return Period	Outflow m^3/s	Expected water elevation at Peak Storage, m
1S	T 10	57.066	-
Southern Watershed	T 25	80.305	-
Channel 2R	T100	109.630	-
2S	T 10	8.770	-
Western Watershed	T 25	12.340	-
Overland Flow	T100	17.900	-
3S	T 10	11.998	-
N Western Watershed	T 25	17.122	-
Overland Flow	T100	25.190	-
7P	T 10	56.103	4.299
Culvert exiting	T 25	75.614	4.396
Northeast of Site	T100	105.069	4.522

2.8.3 Post Development Drainage Assessment

Following the predevelopment assessment the project area was then analyzed based on the proposed subdivision layout in order to create a drainage model for the post development stage of the project. The entire site area was divided in the areas shown in **Table 2-10** below. The results of the post development analysis based on the change in land use resulting from the development are shown in **Table 2-11**.

Table 2-10: Description of the Sub-division's internal drainage areas

Architectural Description	Drainage Catchment Description	Curve number (CN)
Residential Lots	1/8 acre lots, 65% imp, HSG C	90
STP Site	Industrial 72% imp, HSG D	93
Stormwater retention site	Pond & Lake surfaces Imp., HSG D	98
School	Commercial & business 85% imp, HSG B	92
Open space	50-75% Grass cover, Fair, HSG C	79
Road carriageway	Paved; curbs and storm sewers, HSG D	98

Table 2-11: Results from the post-development model

Drainage Feature	Rainfall Return Period	Outflow m3/s	Expected water elevation at Peak Storage, m
1S	T 10	60.759	-
Southern Watershed	T 25	80.305	-
Channel 2R	T100	109.629	-
2S	T 10	13.257	-
Western Watershed	T 25	17.181	-
Overland Flow	T100	23.016	-
3S	T 10	15.322	-
N Western Watershed	T 25	20.847	-

Drainage Feature	Rainfall Return Period	Outflow m3/s	Expected water elevation at Peak Storage, m
Overland Flow	T100	29.268	-
7P	T 10	60.674	4.323
Culvert exiting	T 25	80.574	4.419
Northeast of Site	T100	110.391	4.542

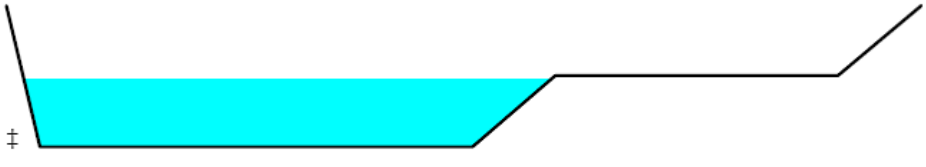
Increased development coverage is not expected to contribute significantly to the peak discharge from the site or the flood elevation in the drainage basin. During detailed design the open space adjacent to the outflow culvert will be graded to provide storm water retention and ensure flooding is contained and does not extend into the residential sections of the development.

The regional drainage channel currently flows through land identified for commercial development. Aligning the drain through this section of the development may limit its development potential. We recommend aligning the drain with the main road so that the subdivision infrastructure is separated from the potential flooding of this drain when filled with debris. Based on calculations; in order to convey the T25 storm in a drain parallel to the main road, a grassed drain is required with a cross section of 14.5 m^2 with a longitudinal slope of 0.011m/m (**Figure 2-9**).

This drain would consist of a stone faced retaining wall on the development side and grassed bottom and cut slope.

Peak Storage= 13,077.8 m³ @ 13.20 hrs, Average Depth at Peak Storage= 0.96 m
Bank-Full Depth= 2.000 m, Capacity at Bank-Full= 188.9584 m³/s

Custom cross-section, Length= 940.00 m Slope= 0.0110 m/m
Constant n= 0.028
Inlet Invert= 13.340 m, Outlet Invert= 3.000 m



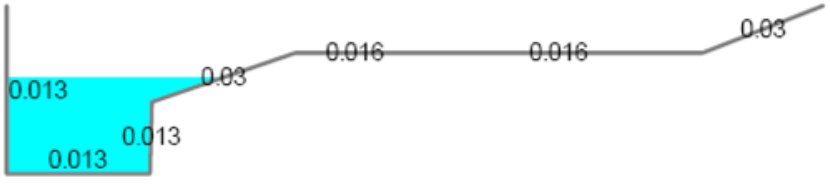
Offset (meters)	Elevation (meters)	Chan.Depth (meters)
-11.500	2.000	0.00
-10.490	0.000	2.00
0.000	0.000	2.00
2.500	0.000	2.00
5.000	1.000	1.00
7.501	1.000	1.00
13.500	1.000	1.00
16.000	2.000	0.00

Figure 2-9: Cross-section for regional grassed drain adjacent main road east of development property

Alternatively, a narrower and deeper concrete paved drain, 3 m wide by 1.5 m deep can be used. However, due to safety concerns a drain with maximum design depth of 1 m is recommended unless guard rails will be installed adjacent to the roadway. The following diagram shows the appropriate cross section for a concrete drain section (**Figure 2-10**).

Peak Storage= 5,986.9 m³ @ 13.18 hrs, Average Depth at Peak Storage= 2.00 m
Bank-Full Depth= 3.500 m, Capacity at Bank-Full= 180.0361 m³/s

Custom cross-section, Length= 940.00 m Slope= 0.0110 m/m (102 Elevation Intervals)
Flow calculated by Manning's Subdivision method
Inlet Invert= 13.340 m, Outlet Invert= 3.000 m



Offset (meters)	Elevation (meters)	Chan.Depth (meters)	n	Description
-1.010	2.000	0.00		
-1.000	-1.500	3.50	0.013	
1.990	-1.500	3.50	0.013	
2.000	0.000	2.00	0.013	
5.000	1.000	1.00	0.030	
7.501	1.000	1.00	0.016	
13.500	1.000	1.00	0.016	
16.000	2.000	0.00	0.030	

Figure 2-10: Appropriate cross-section for a concrete drain

The most cost effective drain cross-section will be the wider earth drain. Where crossings are required the cross section can be adjusted to the concrete 3 m by 1.5 m section.

2.9 Personnel Requirements

A maximum of 350 persons are expected to be employed directly working on site when the site is in full production. It is estimated that another 150 persons will be working indirectly through subcontractors on elements of the project, such as window and cabinet fixtures etc.

The following represents the primary manpower services required for this project

- Carpenters
- Masons
- Steel Fixers
- Machine Operators
- Other tradesmen (plumbers, electricians etc.)
- Professionals
- Labourers

2.10 Sewage Waste Management

The Sewage Treatment Plant proposed for the Holland Farms site is an Orbal system manufactured by Siemens, to be provided and installed by SAFAVI and Associates Ltd. SAFAVI & Associates is a local waste water treatment plant contractor and operator. They typically install Siemens products as they are an authorized dealer.

The Orbal is a multichannel oxidation ditch. The system is a complete mix, looped reactor system and is well-suited for conventional activated sludge, advanced secondary sludge treatment, simultaneous nitrification-denitrification, and biological phosphorus removal. There is an Orbal system in operation by the NWC at Inswood Village St. Catherine. Key features of the Orbal system are the following:

- Process adaptability – the basin can be easily expanded to accommodate for future load conditions
- Dual basin capability – the process can be modified to meet a wide assortment of influent conditions and effluent requirements
- Operator convenience – complete mix characteristics and ability to operate at high MLSS concentrations combine to form a high buffer capacity for shock loads
- Easy maintenance – only routine greasing of bearings is required; aerator discs are non-fouling
- Energy savings – the process requires less power to operate than any other oxidation ditch system

The oxidation ditch is the most typical mechanical plant installed in Jamaica as it is familiar to the National Water Commission. The Orbal system is a hybrid oxidation ditch and will satisfy the simplicity required by the NWC if it is handed over to them for operation.

The capacity of this system will be equivalent to the peak daily water demand totalling 2,893 m^3. The system will be designed in a modular build to accommodate the various phases of construction. The system is proposed to provide tertiary treatment in order to meet the following effluent standards:

Table 2-12: Design Specifications & NEPA Standards

Parameter	Design Influent	Design Effluent	**NEPA Effluent Standard** Direct Discharge	**Units**
COD	500	100	100	mg/l
BOD	250	20	20	mg/l
TSS	220	20	20	mg/l
Total Nitrogen	40	10	10	mg/l
Phosphates – P	8	4	4	mg/l
Faecal Coliform	10^7 - 10^8	200	1000	MPN/100 ml

The quantity and rate of water used is very important in sewer design. Not all water for the development enters the sewer system as water is used for cleaning, cooking, internal irrigation of plants and other miscellaneous uses. Studies have shown that approximately 90% of water used for domestic and commercial purposes enters the sewage collection system. Wastewater entering the sewer system is expected to originate from the potable water used in the development as well as water that infiltrates into the buried pipes and appurtenances from the ground or surface.

The sewerage designs will include the street main collection system and sewage pump station design. An overall layout of the sewer system is shown on a drawing included in the appendix to this document.

The peak water use and consequential peak sewage flow is expected to occur during the peak hour on the peak day of water use. This would likely occur on the day most persons do laundry and prepare to be active during the same time period. The peak day and peak hour factor is calculated as 2.1 based on a peak day factor of 1.4 and peak hour factor of 1.5.

Infiltration is generally considered groundwater entering the sewers and for this project it is considered to occur seasonally during the wet weather months. An accepted contingency for infiltration into the sewer system is 10% of the average wastewater flow.

For this project a minimum of one lift station is required at a low point in the subdivision to pump sewage flows to the wastewater treatment plant. The estimated peak flow for the overall sewer system is 41.9 Lps using a peak flow factor of 2.1.

2.10.1 Design References

The sewer collection design is being prepared with reference to the Jamaica Institution of Engineers (JIE) Guidelines for Design and Construction of Housing Infrastructure Vol. 2 1984 sewerage systems ,the British Standard European Union Code, BS EN 752-4 1998 and the NWC manual for developers.

2.10.2 Design Criteria

The JIE guideline requires that sewers be designed and constructed to attain velocities when flowing full of not less than 2.0 ft. per second (approximately 0.6 m/s).

Based on the JIE guideline the minimum pipe size is 8" with minimum slope of 0.4%. The British Standard requires either "velocity of 0.7m/s daily, or a gradient of at least 1: DN is specified. DN is the pipe diameter in mm.

2.10.3 Flow Calculations

The sewer flow rates will be checked using the British Standard European Union Code, Drain and Sewer systems outside buildings BS EN 752-4: 1998, Part 4:

Hydraulic design and environmental considerations, section 10 Wastewater design flows. The empirical approach in Annex C will be adopted.

Calculation of wastewater flows for sewer systems is shown below:

Where Q = Lps

k_{DU} = frequency factor

DU = discharge unit

The peak flow rates are given by $Q = k_{DU} \sqrt{\Sigma^{DU}}$

The frequency factor (k_{DU}) for dwellings and offices is 0.5.

The following table details the discharge unit for the sanitary appliances considered.

Table 2-13: The discharge unit for the sanitary appliances considered

Sanitary fixture	Discharge unit	DU used	Qty. per dwelling	Σdu
Shower	0.3 to 0.6	0.4	1	0.4
Water closet (4.0L to 9.0L)	1.2 to 2.5	1.8	1	1.8

Sanitary fixture	Discharge unit	DU used	Qty. per dwelling	Σdu
Washing machine	0.5 to 0.8	0.6	0.33	0.198
Washbasin	0.3 to 0.6	0.4	1	0.4
Kitchen sink	0.8 to 1.3	0.8	1	0.8
Lavatory basin	0.3 to 0.6	0.4	1	0.4

The discharge units for each dwelling will be calculated assuming that the average dwelling will consist of a shower, sink, water closet, kitchen sink, wash basin, and approximately 1/3 of the houses will have washing machines giving a total of 4.0 discharge units per house. Each house will be connected by a lateral to the sewer main.

The sewage collection design for the Holland Estate may include 200, 250 and 300 mm diameter PVC pipes in the collection system. The minimum slopes for those pipe sizes are shown in **Table 2-14** which was extracted in part from the NWC Developer's Manual of 2006 (**Table 2-5**).

Table 2-14: Minimum sewer slopes

Sewer Size [Dia mm]	Min Slope [m/100m]
203	0.40
254	0.28
305	0.22

2.10.4 Hydraulic Design

The Manning's equation is being used to determine the velocities in the pipes proposed for the development.

The sewer collection system will be constructed of polyvinyl chloride pipes. The "n" value for minimum slope design of PVC sewer pipe is 0.009 as stated in the Uni-Bell PVC industry publication Handbook of PVC Pipe: Design and Construction.

Based on the preceding specifications the following **Table 7** was developed as a guide for setting the slopes of the uppermost sewer pipe receiving wastewater flow from the least cumulative number of houses.

Table 2-15: 200mm diameter PVC pipe minimum slopes

No of lots on pipe leg	Flow (Lps)	Slope (%)	Velocity (m/s)
2	1.4	1.4	0.656
4	1.94	1.2	0.682
6	2.37	1.0	0.685
10	3.16	0.80	0.683
12	3.35	0.75	0.686
32	5.48	0.50	0.682
56	7.25	0.40	0.678

Each sewer pipe in the proposed development will be analyzed to determine the peak flow that will flow through it on any single day.

A table containing manhole inverts, pipe lengths, number of houses potentially connected to the pipe, the estimated flow through the pipes and the anticipated peak velocity of sewage flow in the pipes that will occur at least once per day will be included in the appendix of the final design report.

Pipe bedding and installation details will be shown and described in the design drawings.

2.10.5 Sewage Pump Station

The pumping designs are to be guided by the requirements of the NWC, and article 15-6 Water Supply and Sewerage sixth edition by Terence J. McGhee. Sewage pump station(s) may be used at specific locations in the subdivision to pump to the Sewage Treatment Plant site. The pump station will consists of Reinforced Concrete sewage well with submersible pumps.

All sewage entering the Pump Station will be through a single 200 mm diameter PVC pipe that will discharge into a steel trash basket and into the storage volume of the well. A trash basket is proposed to screen rags and debris out of the wastewater that could damage the pumps in the sewage well. The operator of the treatment plant will be required to clean the trash basket at least twice per day. The trash will be stored and removed with the other trash from the sewage treatment plant.

The volume of the sewage well is based on the pumping regime and the influent flow characteristics. The maximum sewage influent rate into the sewage well is based on a peak flow factor of 2.1; while the minimum pumping rate is based on 12.5% of average flow.

The pump station will be designed to provide submersible duty and standby pumps, each capable of removing the wastewater from the well at a rate greater than the anticipated maximum flow into the well. The pumps should cycle to ensure that the sewage does not become septic. A minimum running time will be assumed to be 3 minutes and minimum cycle time of 17.5 minutes. The minimum cycle time can be shown to occur when Q_{in} is equal to 0.5 Q_{out}. The relationship for cycle time, filling time and running time is shown below.

As total cycle time (t_c) = Filling time (t_f) + running time (t_r)

$t_c = t_f + t_r$

$t_f = V/Q_{in}$

$t_r = V/(Q_{out} - Q_{in})$

$t_c = V/Q_{in} + V/(Q_{out} - Q_{in})$

Standby power will be required for the pump station.

At the detailed design stage of the project the pumps will be sized to satisfy the total dynamic head (TDH) required to lift the wastewater in the sewage well to the head works of the Sewage Treatment Plant at the flow rate required.

ANALYSIS OF ALTERNATIVES

3 Analysis of Alternatives

3.1 Introduction

In considering the development options, the following alternative analysis is considered.

1. The No Action Alternative
2. The Proposed Development
3. Any Proposed Development Alternatives

3.2 The "No-Action" Alternative

The selection of the "No Action" alternative would mean the discontinuation of project designs and result in the site being retained in its existing form. There are physical, biological and socio-economic implications of this alternative.

Physically, the site is unlikely to undergo any major changes from its present condition. Biologically, the vegetation present on the site is unlikely to be severely affected, other than the potential for uncontrolled growth of weeds, bushes and trees introduced by avifauna, wind or other means on the proposed lot. Unless the vacant lot is maintained, the possibility exists that the illegal dumping may occur, as well as the area becoming a possible venue for illicit and otherwise objectionable activities.

The "No Action" Alternative is likely to have the greatest implications on the socio-economic environment of the area and surrounding communities. Due to the proposed quality of the development it is anticipated that it would provide a major opportunity for employment, benefits associated with the construction industry, and potentially significant business opportunities for the Greater Falmouth area. In addition, a development of this type will add to the parishes housing solutions. It may also fuel the growth and development of the area.

3.3 The Proposed Development

This alternative would see the construction of the development as proposed by the developers, and as outlined in this EIA document. This option has good support (based on results of socio-economic survey) by the persons who would be most affected by its implementation, i.e., residents within the Martha Brae area. Therefore, community support is anticipated for the development.

This alternative will provide positive benefits to the surrounding communities as well as reduce the required housing solutions needed for the parish. Potential benefits to be accrued include: employment opportunities, foreign exchange earnings, increased property values, and benefits to the tourism industry. Additionally, the multiplier effects to the construction and support industries during construction are likely to affect a much larger number of persons.

The proposed project will also make a positive contribution to social infrastructure, overall residential development, upkeep and renewal of the surrounding residential community. The proposed development is being designed and built to meet or exceed local and international standards and regulations. A key benefit also is the installation of a central tertiary level sewage treatment facility.

The development, as proposed, is in line with other current and projected developments for the parish.

3.4 Any Proposed Development Alternatives

If there are issues concerning the project that may be enhanced, changed or modified to increase the acceptability of the project, then these issues should be considered. At this time based on communication with residents of surrounding communities, it appears that there are several issues that once resolved satisfactorily, whether through modification or compromise, would further increase support for the development. These include but are not limited to:

- Guarantees that the central tertiary sewage treatment system will treat wastewater to acceptable standards. The system has been designed to achieve this.
    - Very few sewage treatment technologies could be implemented that would treat to the same level, with the low operational and maintenance costs and reliability anticipated for this system.
- Guarantees that the development will not worsen the existing flood issues in the immediate area.
    - The drainage report outlined in Section 2 identifies the various options and will ensure that the selected option will not worsen but improve the surface water run-off of the area.
- Economics and Aesthetics, particularly the timely removal of construction fencing surrounding the site and construction of an aesthetically pleasing perimeter border.
    - Based on the phased development option highlighted in Section 2, it is felt the phasing approach will be a better approach to developing this area instead on a complex one-time construction of the entire facility.
    - This alternative will also ensure that the economic cost of the development are in sync with the economic conditions nationally and globally and ensure the project is not abandoned partway through.
    - It will also ensure the required elements are included as outlined in Section 2.

Some of these concerns will not exist on project completion e.g. incidental flooding. All other issues are easily resolvable through either modification or compromise and we do not foresee these issues resulting in disapproval of the development by interested community and regulatory agencies. The developers will work with the communities and residents to construct a quality development that will be the pride of all involved.

POLICY, LEGISLATIVE & REGULATORY FRAMEWORK

4 Policy, Legislative & Regulatory Framework

4.1 Introduction

The policies, legislation, regulations and environmental standards of the Government of Jamaica (GOJ), which pertain to this development as well as relevant international treaties, policies and conventions to which Jamaica is signatory have been researched and analyzed, to ensure that the project complies with all policy, legal and regulatory requirements. The areas examined included environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels, which relate to or should be considered within the framework of the project.

All development applications are submitted for approval to the Town & Country Planning Authority, through the local Parish Council and then forwarded to the relevant authorities including NEPA and the Environmental Control Division (ECD) of the Ministry of Health.

NEPA, the governing environmental agency, may require an environmental impact assessment (EIA) to be considered along with the development plan for the Authority's approval. The ECD imposes guidelines for air, water and soil standards to be maintained after construction.

In this case, NEPA has dictated that an EIA be conducted based on the fact that this development is in excess of 10 housing units to be built. This section serves to address all applicable policies, legislation, standards, and regulations that may affect this project.

4.2 Applicable Jamaican Policies, Legislations, Standards & Regulations

Legislation relevant to the establishment of a housing subdivision at Martha Brae in the parish of Trelawny is outlined below.

4.2.1 The NRCA Act, 1991

The NRCA Act (1991) is the overriding legislation governing environmental management in Jamaica. It requires that all new projects, (or expansion of existing projects), which fall within prescribed categories be subject to an environmental impact assessment (EIA).

The regulations and the approved Terms of Reference (ToR) require that ten (10) copies of the EIA Report be submitted to the Authority for review. There is a preliminary review period of ten (10) days 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 which address the proposed project are:

s.10:(1) Subject to the provisions of this section, the Authority may by notice in writing require an applicant for a permit of the person responsible for undertaking in a prescribed area, any enterprise, construction or development of a prescribed description or category-

(a) to furnish the Authority such documents or information as the Authority thinks fit; or

(b) where it is of the opinion that activities of such enterprise, construction or development are having or are likely to have an adverse effect on the environment, to submit to the Authority in respect of the enterprise, construction or development, an EIA containing such information as may be prescribed, and the applicant or, as the case may be, the person responsible shall comply with the requirement.

s.12: Licenses for the discharge of effluents etc.

s.17: Information on pollution control facility

s.18: Enforcement of Controls – threat to public health or natural resources

s.32-33:Ministerial Orders to protect the environment

s.38: Regulations

All the necessary applications have been submitted to the Agency. An application for an Environmental Permit and License was completed and submitted to NEPA as well as a Project Information Form (PIF) and Terms of Reference (ToR). The approved ToR for this EIA is included in the appendix of this document (Appendix I). This EIA document satisfies the penultimate review process, mandatory public meeting next, before the required licences and permits can be issued.

Various standards and regulations that apply under this Agency are outlined below:

4.2.1.1 The Natural Resources Conservation Authority (Air Quality) Regulations, 2006

These regulations were gazetted on July 12, 2006. This regulation is considered although it was designed primarily for the quality of the airshed within which an industrial entity is discharging emissions (gases or particulate matter).

The environmental impact from any air emissions (gasses or particulate matter) will be influenced by the ambient meteorological conditions within the area, such as wind (speed and direction), and rain.

Table 4-1 below outlines the ambient air quality standards as issued by NEPA.

Table 4-1: Air Quality Standards for Jamaica (NEPA)

Pollutant	Averaging Time	Standard (maximum concentration in µg/m3)
Total Suspended Particulates Matter (TSP)	Annual	60
	24 hour	150
PM10	Annual	50
	24 hour	150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual	80 primary, 60 secondary
	24 hour	365 primary, 280 secondary
	1 hour	700
Photochemical oxidants (ozone)	1 hour	235
Carbon monoxide	8 hour	10,000
	1 hour	40,000
Nitrogen Dioxide	Annual	100

The proposed housing subdivision has the potential to impact on surrounding residential communities particularly during site clearance and construction. All efforts will be utilised to ensure the project will not result in a significant loss in air quality within the sphere of influence of the project. The applicable mitigation strategies outlined further in this report will be monitored during site clearance and construction to ensure compliance.

4.2.1.2 Trade Effluent Standards

The Trade Effluent Standards have existed in draft format since 1996. These standards regulate the quality of effluent discharged from any entity into public drains/sewers and all surface and water bodies such as rivers, ponds, sea or lake. Similar to the Air Quality regulations, a discharge license is required to release any trade effluent and guidelines set forth for acceptable water quality standards including sewage effluent.

A new tertiary sewage effluent treatment plant is proposed for this project. As outlined in the project description section it has been designed to cater to the demands envisaged by this development. The treatment plant is designed to meet and exceed all applicable effluent treatment standards. Workers at the construction site will utilise portable chemical toilets.

The following table highlights aspects of this standard to which this new facility must comply.

Table 4-2: NRCA Proposed Sewage Effluent Standards – New Plants & the NRCA Interim Sewage Effluent Irrigation Standards

Proposed Sewage Effluent Standards – New Plants	
Parameter	**Effluent Standard**
BOD_5	20 mg/l
TSS	20 mg/l
Total Nitrogen	10 mg/l
Phosphates	4 mg/l
COD	100 mg/l
pH	6-9
Faecal Coliform	1000 MPN/100ml
Residual Chlorine	1.5 mg/l
Natural Resources Conservation Authority (NRCA) Interim Sewage Effluent Irrigation Standards	
Parameter	**Standard Limit**
Oil & Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100mL

4.2.1.3 Noise Standards

Noise Standards for Jamaica have been proposed by NEPA based on the World Bank standards. The guideline for daytime perimeter noise is 75 decibels and 70 decibels for night-time noise.

Environmental management and monitoring policies will be put in place to monitor noise during the construction of this development. This will include ensuring that suppliers and contractors ensure that associated mechanical equipment that may generate noise be fitted with manufacturer specified silencers and other devices to ensure noise levels do not exceed standards.

4.2.2 The Watershed Protection Act, 1963

This Act governs the activities operating within the island's watersheds, as well as protects these areas. There are twenty-six (26) watershed management units designated under this Act, including the Martha Brae Watershed Management Unit in which this project falls.

Determinations have been made to identify any potential impacts that this project may have on the watershed and mitigative actions proposed where impacts are identified further in this document.

The lands proposed for development are currently vegetated to different extents. The project will utilise a phase build-out. As such, only areas designated for construction per build-out phase will be cleared at any time. Green space has been included in the design of this development to ensure an aesthetically and environmentally pleasing development. This will be guided by an approved landscape plan which is outlined further in this report.

The ecological assessment has determined that there are endemic species on the site. A management plan has been outlined to address the care of specified plant species as necessary.

4.2.3 The Wildlife Protection Act, 1945

This act involves the declaration of game sanctuaries and reserves, game wardens, control of fishing in rivers, protection of specified rare or endemic species. The Act also provides for the protection of animals and makes it an offence to harm or kill a species which is protected. It stipulates that, having in one's possession "whole or any part of a protected animal living or dead is illegal. This Act has to be considered for the proposed project. The ecological assessment has determined that there are endemic species on the site. A management plan has been outlined to address the care of specified species as necessary.

4.2.4 The Endangered Species (Protection, Conservation and Regulation of Trade) Act (2000)

This Act governs the restriction on trade in endangered species, regulation of trade in species specified in the schedule, suspension and revocation of permits or certificates, offences and penalties, and enforcement.

The proponent does not intend to engage in the trade of endangered species.

4.2.5 Water Resources Act, 1995; Underground Water Control Act, 1959

The Underground Water Control Act of 1959 is the legal instrument. However, the Water Resources Act is expected to provide for the management, protection, controlled allocation and use of the water

resources of Jamaica. Thus, the water quality control, for both surface and ground water, are regulated by this Act.

Any activity that negatively influences the quality of the existing water, whether ground or surface, would be relevant to this Act. There are no defined activities that are expected to undermine water resources in the area. The developers are in discussions with the NWC and all indications suggest they will be able to supply the required demand, especially in light of the phased demand.

4.2.6 The Clean Air Act, 1964

The Clean Air Act speaks generally to aspects of industrial operations. This Act also makes reference to the use of inspectors to inspect any premises, carry out tests, and take samples of any substance that he/she considers necessary or proper for the performance of duties. This development has the potential to discharge particulate matter to the atmosphere.

This project will be regulated by this Act in accordance with the NRCA (Air Quality) Regulations. The proponent intends to abide by all regulations regarding air quality and intends to put in place best management practices used in similar operations globally at this project site.

4.2.7 The Town and Country Planning Act, 1957

This Act governs the development and land use (excluding agriculture) in specified areas, through Development Orders, local planning authorities, development planning processes and Tree Preservation Orders. Under this Act the Town Planning Department is the agency responsible for the review of any plans involving development. The Act allows for specific conditions to be stipulated and imposed on any approved plans. The planning decision is based upon several factors, including;

- Location of the development;
- Land use and zoning;
- Effect of the proposal on amenities, traffic, etc.

4.2.7.1 Development Orders

The Town and Country Planning Act empower the Town and Country Planning Authority to prepare in consultation with the Local Planning Authority, legal documents called Development Orders for specific areas throughout Jamaica.

The aim of these Development Orders is to regulate and control the use of land ensuring that land is not misused. The Trelawny Parish Confirmed Development Order of 1982 governs development within the parish of Trelawny. A new development order has been drafted for Trelawny but this order is yet to be gazetted, and as such has not been reviewed for this project.

The change of land use from agriculture to residential/commercial allows for this development in the project area.

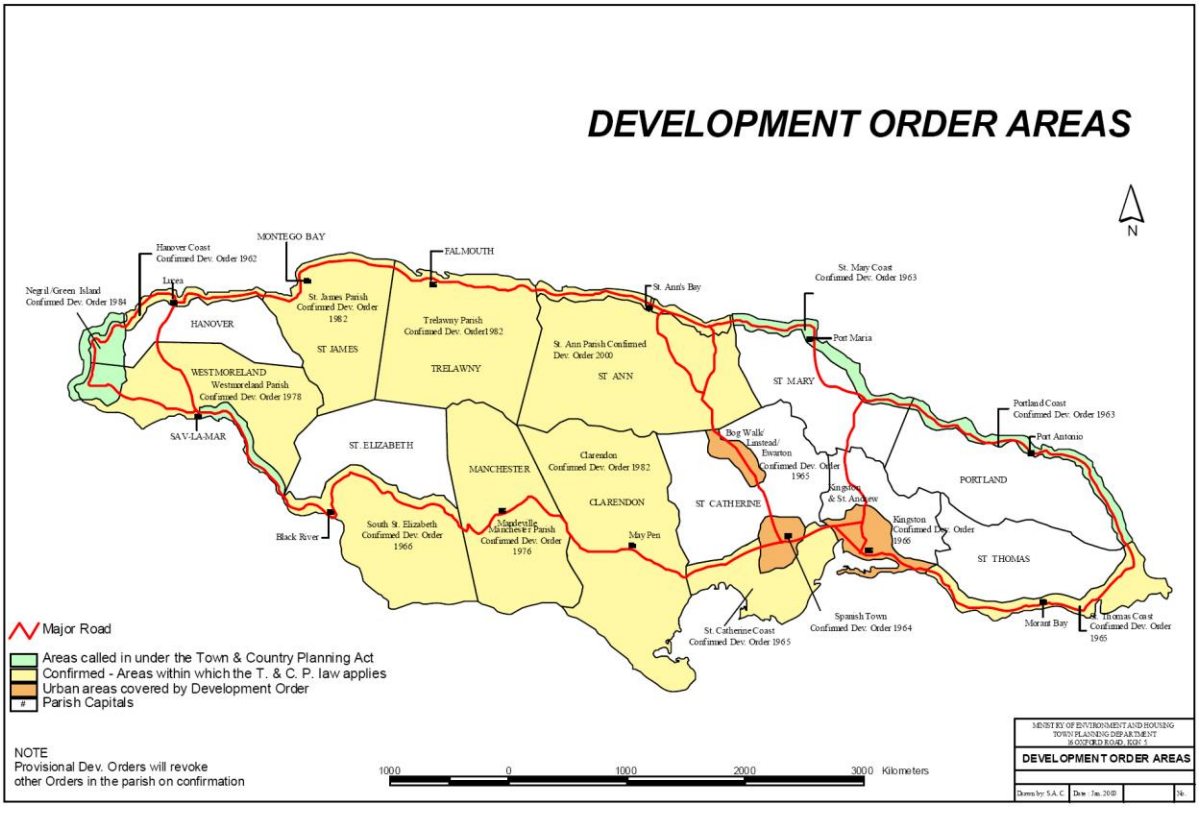


Figure 4-1: Development Orders of Jamaica

4.2.8 The Jamaica National Heritage Trust Act, 1985

The Jamaica National Heritage Trust, formerly the Jamaica National Trust, administers the Act. This Act provides for the protection of important areas, including the numerous monuments, forts, statues, and buildings of historic and architectural importance in Jamaica.

This Act will prove applicable if any structures of archaeological and/or architectural importance are located on the site, affected by the site activities or unearthed during site activities. The JNHT has reported that no heritage artefact of significance is known to be on the property. The environmental management plan will also be guided by this Act where any development works that uncovers heritage artefacts will result in the cessation of operations and the subsequent intervention of the JNHT.

4.2.9 The Public Health Act, 1985

This Act falls under the ambit of the Ministry of Health (MOH) and governs all matters concerning the handling of food material. In addition, provisions are also made under this Act for the activities of the Environmental Health Unit (EHU) (formerly the Environmental Control Division), 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. Action against any breaches of this Act would be administered by the Central Health Committee. The functions of the department include:

- The monitoring of waste water quality, including regular water quality analysis, using water standards published by NEPA;

- Monitoring of occupational health as it relates to industrial hygiene of potentially hazardous working environments;
- Monitoring of air pollutants through its laboratory facilities.

In addition, there are various sections of this legislative instrument which governs and protects the health of the public. Relevant sections under the Public Health Act of 1985, are Sections 7.- (1) *A Local Board may from time to time, and shall if directed by the Minister to do so, make regulations relating to (0) nuisances* and 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 (d) air, soil and water pollution.*

This Act has been consulted for the proposed sewage disposal system. The sewage treatment licence application is currently before NEPA for approval and is informed by the sewage treatment option outlined in the project description of this document.

4.2.10 Disaster Preparedness and Emergency Management Act, 1993

The principal objective of the Act is to advance disaster preparedness and emergency management measures in Jamaica by facilitating and coordinating the development and implementation of integrated disaster management systems. The project proponents will establish procedures and guidance documents, as outlined in the environmental management section of this report, in respect of disaster preparedness and emergency management. These measures will be tailored, as necessary, with assistance from various agencies.

4.2.11 National Solid Waste Management Authority Act, 2001

The National Solid Waste Management Authority (NSWMA) under this Act has the responsibility to manage and regulate the solid waste sector. It includes requirements for licences for operators and owners of solid waste disposal facilities (in addition to permit requirements of NEPA).

The necessary arrangements for solid waste management and disposal for all solid waste generated from this proposed project will be implemented. Where possible, the project will recycle solid waste.

4.2.12 Occupational Safety & Health Act, 2003 (Draft)

This Act oversees the prevention of injury and illness resulting from conditions at the workplace, the protection of the safety and health of workers and the promotion of safe and healthy workplaces.

Sampling of sections from the Draft Act that are relevant to this project, include:

4. (1) This Act applies to all branches of economic activity and to all owners, employers and workers in all such branches.

5. (1) The owner of every industrial establishment or mine which carries on business on or after the appointed day shall, subject to subsection (8), apply to the Director in the prescribed form to be registered under this Act.

18. (1) Provides a description of the duties of employers, outlining the need for quality work areas and work environments, procedures and guidelines that will result in safe and healthy workplaces.

19. (1) discusses the duties of employers at construction sites in terms of employee safety and health during work activities.

25. (1) an employer shall make or cause to be made and shall maintain an inventory of all hazardous chemicals and hazardous physical agents that are present in the workplace.

26. (1) this section provides guidelines and procedures for employers to follow in terms of identification of hazardous chemicals. This includes labelling and identification protocols.

30. (1) Basically, this section of the Act requires an employer to provide training of its employees with a potential for exposure to hazardous chemicals or physical agents.

It is expected that this Draft Act will be Gazetted in the near future. The project proponent has an understanding and appreciation for the contents of this policy. Occupational safety and health policies will be extended to this project as outlined in the environmental management section of this report.

4.3 International Policies

4.3.1 Agenda 21

In June 1992, Jamaica participated in the United Nations Conference for Environment and Development (UNCED) in Rio de Janeiro, Brazil. One of the main outputs of the conference was a plan of global action, titled Agenda 21, which is a "comprehensive blueprint for the global actions to affect the transition to sustainable development" (Maurice Strong). Jamaica is a signatory to this Convention. Twenty seven (27) environmental principles were outlined in the Agenda 21 document. Those most relevant to this project, which Jamaica is obligated to follow are outlined below:

- Principle 1: Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.
- Principle 2: States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies.
- Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.
- Principle 8: To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.
- Principle 10: Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes.

- Principle 15: In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- Principle 16: National authorities should endeavour to promote the internationalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.
- Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.

The project proponents are cognisant of and will abide by the international treaties and protocols. The principles of Agenda 21 that relate to this project will be applied throughout the project lifespan as necessary.

4.3.2 Convention on Biological Diversity (Rio de Janeiro, 1992)

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

Jamaica signed to the convention on June 11, 1992 and ratified it on January 6, 1995. Under this treaty, Jamaica is ranked fifth among islands of the world in terms of endemic plants. The country also enjoys a high level of endemism for animal species, as these examples illustrate: 98.2% of the 514 indigenous species of land snails and 100% of the 22 indigenous species of amphibians are endemic to Jamaica. Nearly 30.1% of this mountainous country is covered with forests. Jamaica's highest point, the Blue Mountain Peak, reaches a maximum height of 2,256m. There are 10 hydrological basins containing over 100 streams and rivers, in addition to several subterranean waterways, ponds, springs, and blue holes.

The activities undertaken by Jamaica derive from seven goals, which are:

- to conserve Jamaica's biodiversity;
- to promote sustainable use of biological resources;
- to facilitate access to biological resources (to promote biotechnology and ensure benefit sharing);
- to ensure safe transfer, handling and use of Living Modified Organisms (LMOs);
- to enhance resource management capacity;
- to promote public awareness, education, and public empowerment; and
- to promote regional and international cooperation and collaboration

The action plan comprises specific projects that have been elaborated with regards to these goals. Those most relevant aspects of this convention to this project, which Jamaica is obligated to follow are outlined below:

- Article 6. General Measures for Conservation and Sustainable Use
- Article 7. Identification and Monitoring
- Article 8. In-situ Conservation
- Article 9. Ex-situ Conservation
- Article 10. Sustainable Use of Components of Biological Diversity
- Article 13. Public Education and Awareness
- Article 14. Impact Assessment and Minimizing Adverse Impacts

Although the project will result in a loss in regional biodiversity, it is not expected that the project will significantly affect the Biodiversity of Jamaica. The project will entail the retention of green spaces that will incorporate the natural vegetation of the area.

DESCRIPTION OF THE ENVIRONMENT

5 Description of Bio-Physical Environment

5.1 Introduction

The project site is located adjacent to the Greater Falmouth area of Martha Brae on the north coast of Jamaica, in the parish of Trelawny. It lies approximately 500 m south of the North Coast Highway. The site comprises approximately 77.7 hectares (192 acres) of land and is an undeveloped real estate, much of which was previously used for growing papayas. The lot has been allowed to naturally re-vegetate. The vegetation communities observed, are a remnant of the original vegetation in most instances, and contain a small portion of the species usually found in a typical coastal community. This area is typical of the Dry Coastal Limestone Forests of the North Coast of Jamaica.

The environmental setting of the project site and immediate environs were assessed to determine the existing status of environmental resources prior to the establishment of the proposed development. Aspects of the environment that were assessed, were selected on the basis of the likelihood of the project impacting on these resources, and are discussed in full in this section of the document.

5.2 Physical Environment

5.2.1 Meteorology

Jamaica is surrounded by the Caribbean Sea and is located in the Tropics at approximately latitude 18ºN and longitude 77ºW. Among the most important climatic influences are the Northeast Trade Winds, the range of mountains which runs east-southeast to west-southwest along the centre of the island, the warm waters of the Caribbean Sea, and weather systems such as upper- and low-level low-pressure centres, troughs and cold fronts.

The cold fronts, usually weak after migrating from the North American continent, are evident from mid-October to mid-April; whilst the Tropical Weather Systems, namely Tropical Waves, Tropical Depressions, Tropical Storms and Hurricanes occur from April to December. The official hurricane season is from June to November.

Much of this data is provided by the Meteorological Office[4].

5.2.1.1 Rainfall

Rainfall is the most variable of the climatic parameters exhibiting a bimodal nature. The thirty (30) year (1951-1980) average monthly rainfall values highlights the typical rainfall pattern for the region (**Figure 5-1**). The driest period runs from December to March and is associated with cold fronts migrating from North America. There are two distinct wet seasons, May to June and September to November occurring as regular yearly cycles.

[4] Jamaica Meteorological Service, Climatological Data, Sangster International Airport

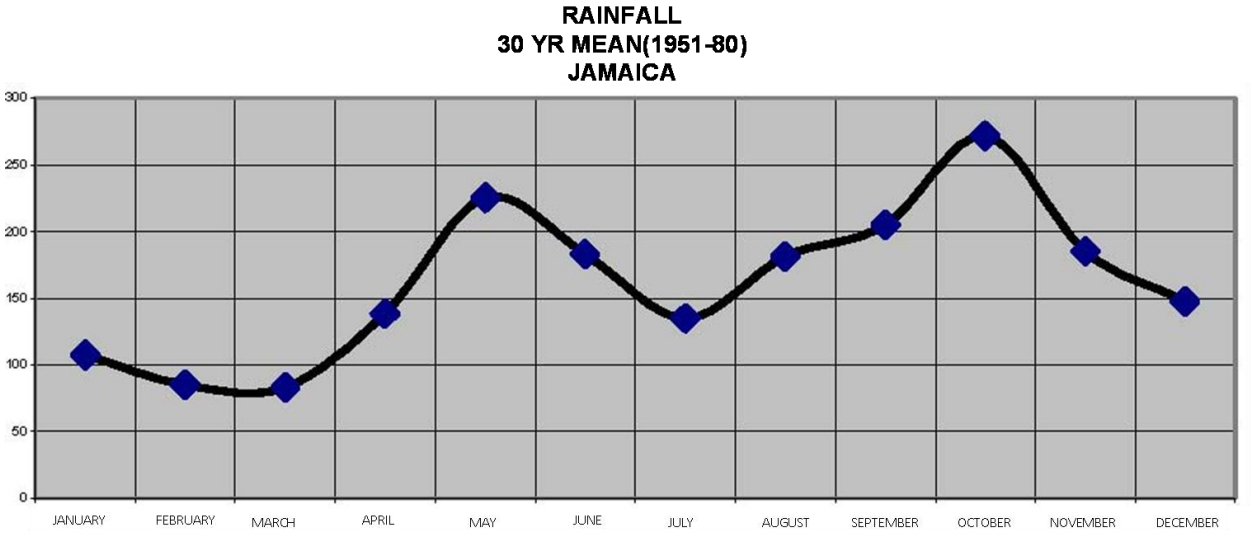


Figure 5-1: Jamaica 30 Year Rainfall Mean (1951-1980)

Of the weather parameters, rainfall is the most variable. Islandwide, during the period 1951 to 1980, annual rainfall ranged from a maximum of 2593 mm (102.09 in) in 1963 to a minimum of 1324 mm (52.13 in) in 1976, with an average of 1940 mm (76.38 in) annually. The hundred-year (1881-1990) mean annual rainfall is 1895 mm (74.61 in). Historically, the wettest year on record was 1933 with an annual rainfall of 2690 mm (116.54 in) whilst the driest year was 1920 with an annual rainfall of 1299 mm (51.14 in). **Figure 5-2** shows the mean long-term mean rainfall for Trelawny for 1951-1980.

Weather during the dry or rainy season along with other rain-producing systems are influenced by the sea breeze and orographic effects which tend to produce short-duration showers, mainly during mid-afternoon.

The parish of Trelawny receives an annual average of 1660 mm of rainfall per year mainly during the rainy period, between the months of May and November. The driest period occurs from January through March, with less than 75 mm per month.

Figure 5-3 shows the average yearly rainfall at Sangster International Airport in Montego Bay, St. James. Though this Met Station is approximately 26 km to the west, it provides generally reliable data and a reasonable indication of rainfall for the Martha Brae area. The data shows average annual rainfall for the period 2000-2008 being 925.81 mm, slightly less than historical average indicated for the parish of Trelawny. This may have been influenced by the drought conditions that the island has been experiencing due to the prolonged "El Nino" effect globally. Rainfall readings at Braco (**Figure 5-4** – ~21 km east) show fairly similar patterns for the period 2000-2006.

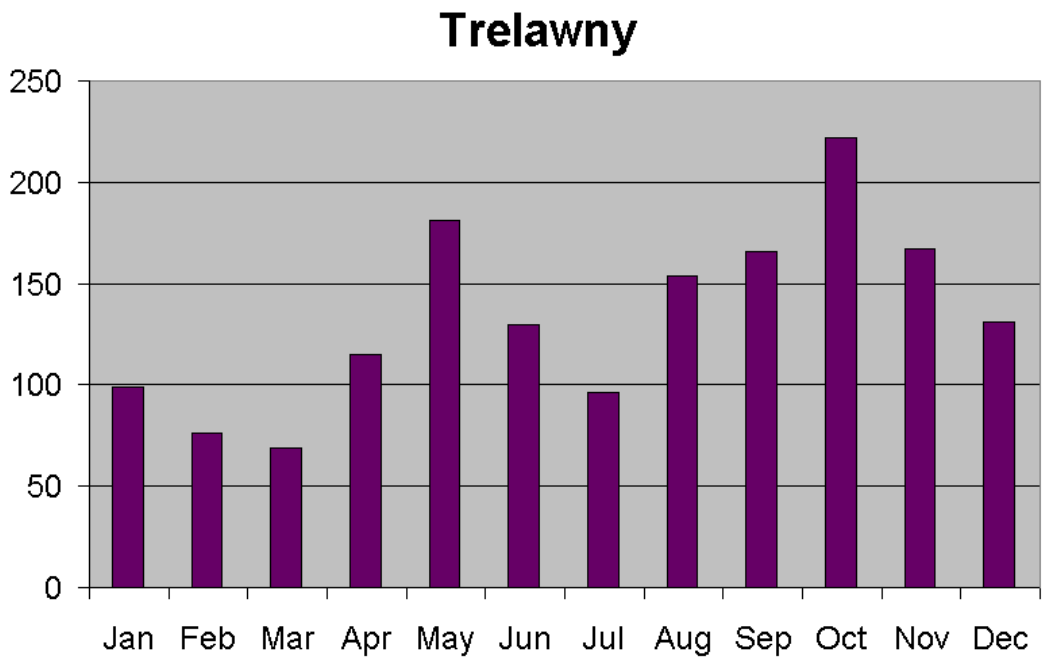


Figure 5-2: Trelawny Long-Term Mean Rainfall (mm) - 1951-1980

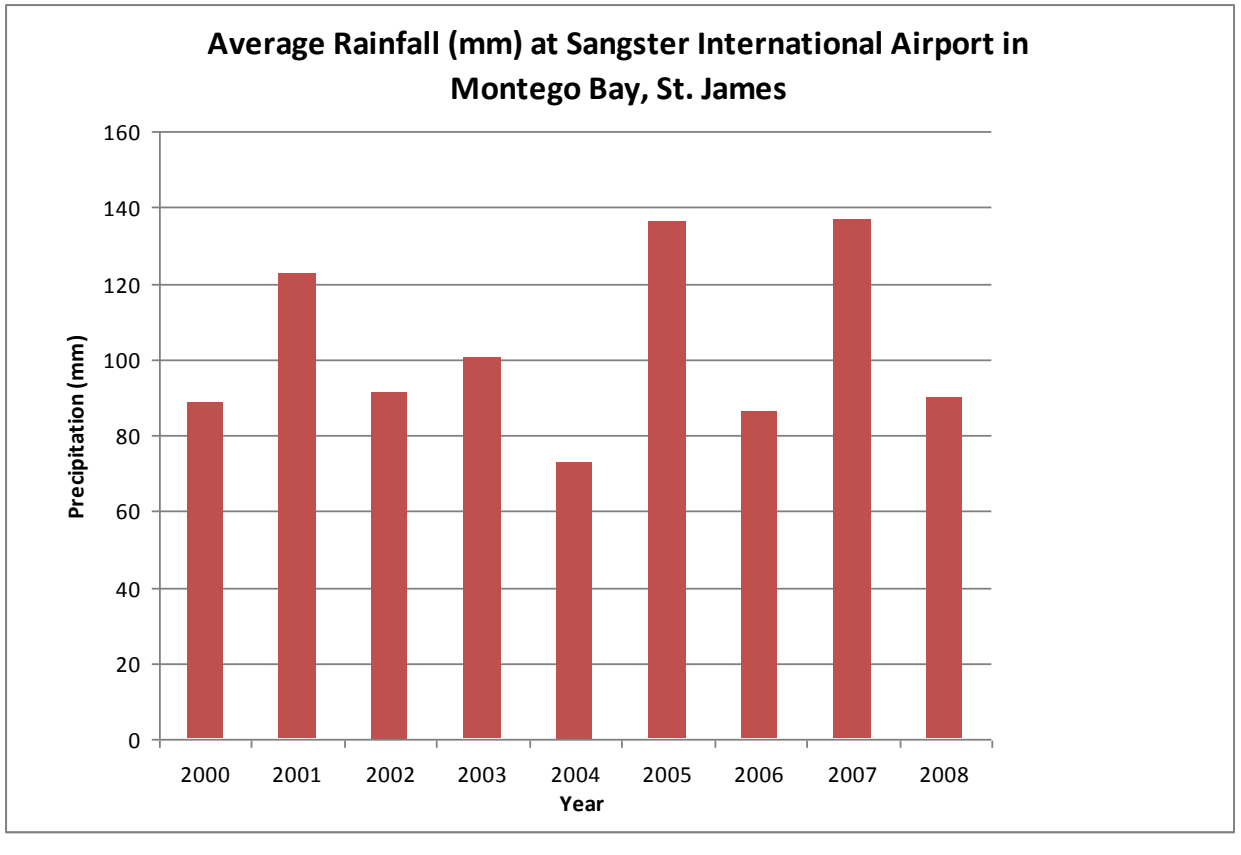


Figure 5-3: Average annual rainfall (mm) at Sangster International Airport in Montego Bay, St. James

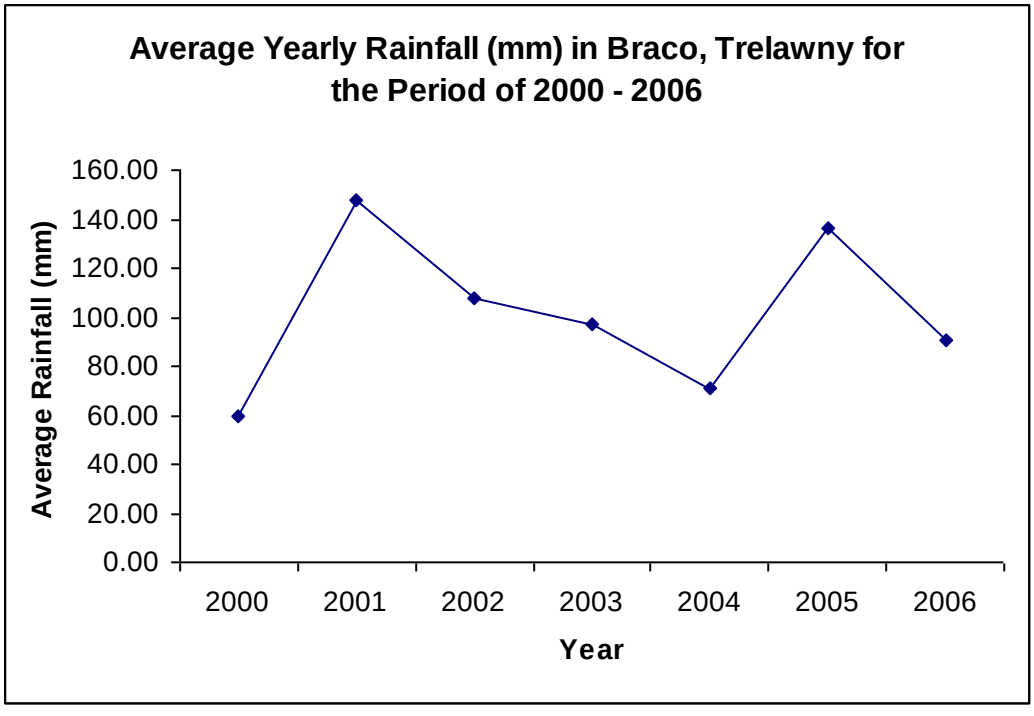


Figure 5-4: Average Yearly rainfall at Braco in Trelawny, the closest monitoring site to the east of the proposed development site at Holland.

5.2.1.2 Wind

The daily wind pattern is dominated by the Northeast Trades. During the day, on the North Coast, the sea breeze combines with the Trades to give an east-north-easterly wind at an average speed of 15 knots (17 miles per hour). In the period December to March, however, the Trades are lowest and the local wind regime is a combination of trades, sea breeze, and a northerly or north-westerly component associated with cold fronts and high-pressure areas from the United States.

By night, the trades combine with land breezes which blow offshore down the slopes of the hills near the coasts. As a result, on the North Coast, night-time winds generally have a southerly component with a mean speed of 5 knots (6 miles per hour). By day, from June to July, mean onshore winds often reach a maximum of up to 23 knots (26 miles per hour) along the North Coast during mid-afternoon.

Specific wind data was not available for the project area. The closest available data that could be considered reliable was from the Sangster International Airport in Montego Bay which is approximately 27 km (17 miles) to the west of the project area.

5.2.1.3 Temperature & Relative Humidity

Apart from rapid fluctuations associated with afternoon showers and/or the passage of frontal systems, the island's temperatures remain fairly constant throughout the year under the moderating influence of the warm waters of the Caribbean Sea.

In coastal areas, daily temperatures average 26.2 degrees Celsius (79.2ºF), with an average maximum of 30.3ºC (86.5ºF) and an average minimum of 22.0ºC (71.6ºF). The warmest months are June to August

and the coolest December to February. Night-time values range from 18.9 to 25.6ºC (66 to 78.1ºF) in coastal areas.

Variations of sunshine from month to month in any area are usually small, approximately one hour. Differences, however, are much greater between coastal and inland stations. Maximum day-length occurs in June when 13.2 hours of sunshine are possible and the minimum day-length occurs in December when 11.0 hours of sunshine are possible.

Afternoon showers are the major cause of most daily variations in relative humidity. Highest values recorded during the cooler morning hours near dawn, followed by a decrease until the early afternoon when temperatures are highest.

Although relative humidity in coastal areas average 84% at 7 a.m., temperatures at this time are in the mid 20's (ºC), therefore, little or no discomfort results. At 1 p.m. the average relative humidity on the coasts is 71%.

Table 5-1 below outlines the average daily temperature and relative humidity at 7 a.m. and 1 p.m. for the period 2000-2008 from the Sangster International Airport Met Station, the closest reliable data source.

Table 5-1: Average daily Temperature and Relative Humidity for the Period 2000-2008

Year	Temp (°C)	Rel. Hum.-7 a.m. (%)	Rel. Hum. – 1 p.m. (%)
2000	27.55	71.08	74.25
2001	27.36	79.50	71.00
2002	27.53	79.83	70.42
2003	27.58	81.42	72.42
2004	27.51	81.5	71.75
2005	27.54	84.58	76.75
2006	27.60	84.75	77.08
2007	27.94	84.17	78.08
2008	27.38	83.83	76.83

5.2.2 Background Noise Levels

Noise generation at the proposed site will mainly be generated from motor vehicle engines (start and stops), horns, and animal sounds such as dog barks. Although the North Coast Highway is approximately 500 m north of the proposed project site it is not expected to generate noise levels that will interfere with the proposed residential community, especially since it is elevated in this area.

The impact from noise should only be significant during construction and this will be mitigated by employing best construction noise management practices. During operation the site will also be a minor noise impediment on the community. The siting of the various infrastructure and the landscaping measures to be employed will ensure that a reduction in the attenuation of noise waves from the development is attained. The surrounding vegetated lands will also assist with this effort.

At the present time, sound transmission at the south and western boundaries is limited due to ground absorption, as well as shielding by interposing topography and vegetation. The Falmouth Cruise Terminal development has added to the baseline noise levels in this section due to the movement of trucks delivering aggregate material. Traffic movements along the eastern and northern boundaries are primarily related to vehicular traffic to and from the high schools and the communities south of Martha Brae respectively.

Ambient noise in the north-east section, where most noise is generated, averages 27.79 dBA, mostly from traffic sources and from natural events including wind and animal sounds. This data was generated during a six and a half hour period. The maximum value recorded 42.30 dBA. The audiometric survey was conducted using a calibrated hand-held digital audiometer (Norsonic 118). Noise levels were measured at the selected location because of their proximity to planned activities and residential areas closest to the proposed project.

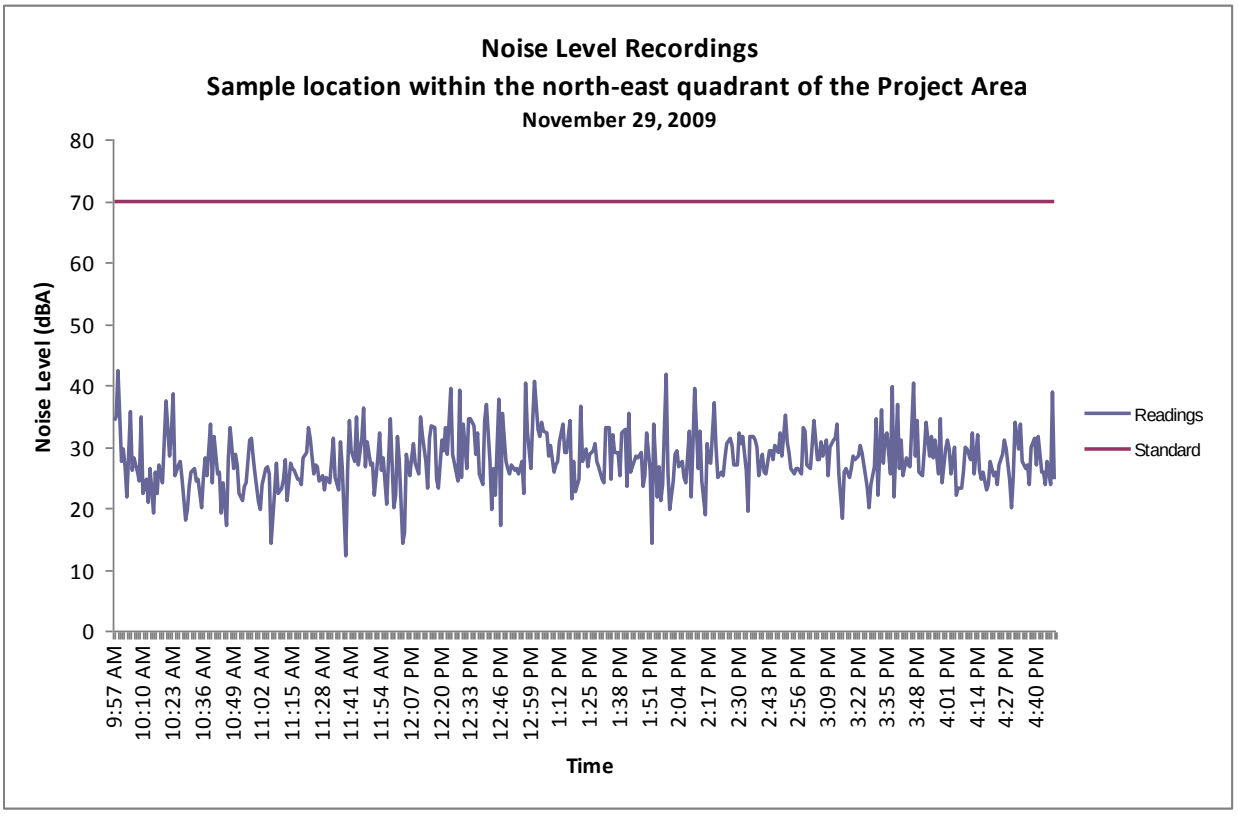


Figure 5-5: Baseline Noise recorded at the selected sample location closest to the north east corner of the property.

5.2.3 Ambient Air Quality

The primary emissions anticipated from the proposed development will come from equipment and machinery that will be utilised in the transporting of material or construction of the various structures. While not deemed insignificant, it is not anticipated that any of these operations will generate significant amounts of air emissions that should be a cause for alarm or concern to the citizens of the area or any other potential receptor once the recommended mitigation measures are followed.

Emissions of particulate matter may be intermittently released as a result of bulk material handling, transportation of, and stockpiling of material. Ambient air quality assessments were recorded within the sphere of influence of the proposed project.

The results of the sampling showed the level of emissions to be 53.03 µg/m^3 during the week while a value of 63.62 µg/m^3 was recorded over the weekend. It should be noted that all recorded values were below the Standard for ambient air quality for a 24-hour sample – 150 µg/m^3.

Sample Analysis of Concentration of Total Suspended Particulate Matter (TSP) (The additional analyses are attached as **Appendix Table 1**).

LOCATION:	Along the Wakefield Main Road near the North-East Section of Property				
EQUIPMENT # :	07-0396				
FILTER # :	P8027228				
WEATHER CONDITIONS:	Sunny				
START DATE & TIME :	26-Nov-09	11:00 AM			
END DATE & TIME :	27-Nov-09	11:01 AM			
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V				
Where Wf = final mass of filter element					
Wi = initial mass of filter element					
V = corrected sample volume					
Now					
Wf =	0.1486	g	(=)	148600	µg
Wi =	0.1483	g	(=)	148300	µg
Wf - Wi =	300	µg			
Corrected Volume =	5657.25	L	(=)	5.7	m^3
Mass Concentration (MC)			(=)	**53.03**	**µg/ m^3**
Run Time	1441	min			
Regulatory Standard for TSP is					
24 hr (average)	**150**	**µg/ m^3**			
Annual Average	60	µg/ m^3			

Proven particulate control and dust suppression strategies will be employed at the project site to minimise particulate and fugitive dust emissions. These may include but are not limited to the use of sprinkler systems.

The implementation of dust minimising protocols and procedures will allow the project managers to effectively measure and report the impacts that the operations may have in terms of particulate air quality. This may include:

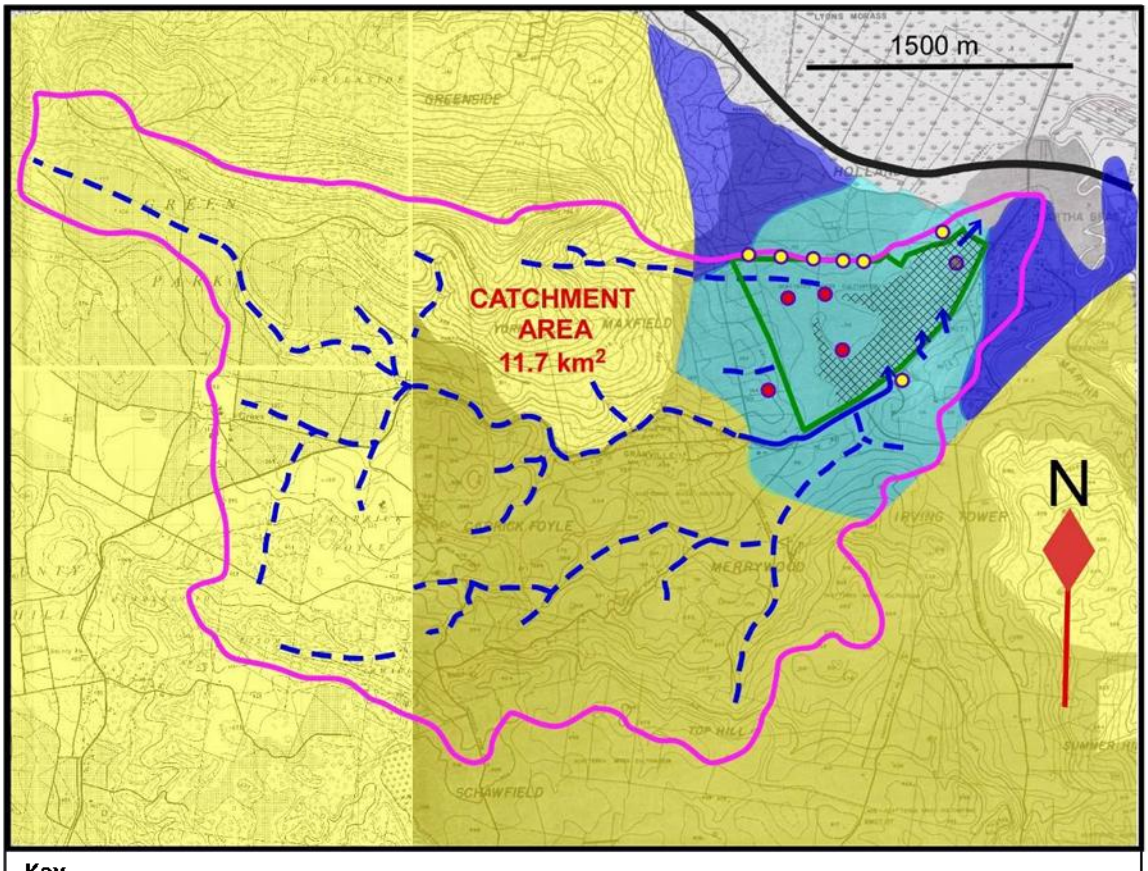
- Limiting the clearance of vegetation to only areas that fall within a specified construction phase.

- Watering of unpaved surfaces as often as necessary to minimize re-entrainment of fugitive particulate matter from these surfaces.
- Maintaining good housekeeping practices to minimize the accumulation of materials, which could become fugitive.
- Limiting the storage of construction material such as sand, stone, and marl.
- Ensuring aggregate material is transported via covered trucks.

5.2.4 Topography

The topography of the site is generally low-lying, about 5 m or less above sea-level (asl) at the northeastern extremity and sloping upward towards the south and west to about 25 to 30 m asl. On the northeast the site is bounded by the flood plain of the Martha Brae River; on the northern margin a low ridge carries the road to Maxfield. On the western side of the property the land rises towards the 200 m high ridge overlooking Green Park. The southern boundary is marked by the main road to Bounty Hall and Wakefield.

The topography is such that the property forms a natural basin for overland flow from a catchment that is separate from that of the much larger Martha Brae watershed and finds its exit across the northeastern corner of the site. The main drainage is carried by a gully that borders the southeastern corner of the site, along the main road, but the drainage enters the property and becomes diffuse towards the north. Two other small drains also enter the property across the main road, one of them from the Advance Farm Technology property (**Figure 5-6**). Exit for the drainage from the site is to the northeast, towards the Martha Brae floodplain (**Figure 5-6**). Locals reported flooding by the William Knibb High School in heavy rain, but no one knew about the Holland site itself.



Key

- Site boundary green; catchment boundary for overland flow to site pink; gullies and drains blue lines, dashed where based on 1:12 500 topographic map and continuous where observed in the field. Arrows show flow directions.
- Geology (general geology taken from the published geological sheet of Falmouth; circled observations taken at exposures at the site)
- Montpelier Formation -yellow; Hope Gate limestone-dark blue; Falmouth Formation (if correct)- light blue; alluvium and morass- grey. Approximate section of site underlain by clay, criss-cross ornament. See text comments on Falmouth Formation.

Figure 5-6: Geology, drainage and catchment boundary of the site and environs

5.2.5 Geology

The geology of the site and surrounding area is indicated on **Figure 5-6**. Exposure of bedrock was poor and most data was obtained from cuts in the boundary roads. On the site loose blocks and the presence of terra rosa soils confirmed the bedrock as seen in the road cuts (**Plate 5-1**). However over the flat land and towards the northeastern corner the red topsoil was replaced by clay soils (**Plate 5-2**) of an impermeable nature.

The site itself rests on limestones marked on the published geological sheet as Falmouth Formation. However, our site survey (circled localities on **Figure 5-6**) indicated that the area is underlain by marly limestones, probably belonging to the somewhat older Hope Gate Formation, of probable Pliocene age, rather than the Falmouth Formation. Both formations belong to the Coastal Group of rocks. Description of the site and regional geology follows:

• Brownish clay topsoil	Recent
• Red soils over limestone	Pleistocene to Recent
• Falmouth Formation (if present); poorly to well-lithified limestones with numerous, well-preserved macrofossils	Upper Pleistocene
• Hope Gate Formation; marly limestones; bedding very poor to absent	Pliocene to possibly upper Miocene?
• Montpelier Formation; evenly bedded chalky limestone with infrequent layers of brown chert	Lower to middle Miocene

Plate 5-1: A - Limestone exposed on road along the northern boundary of the property and B – Red soil on cover on limestone

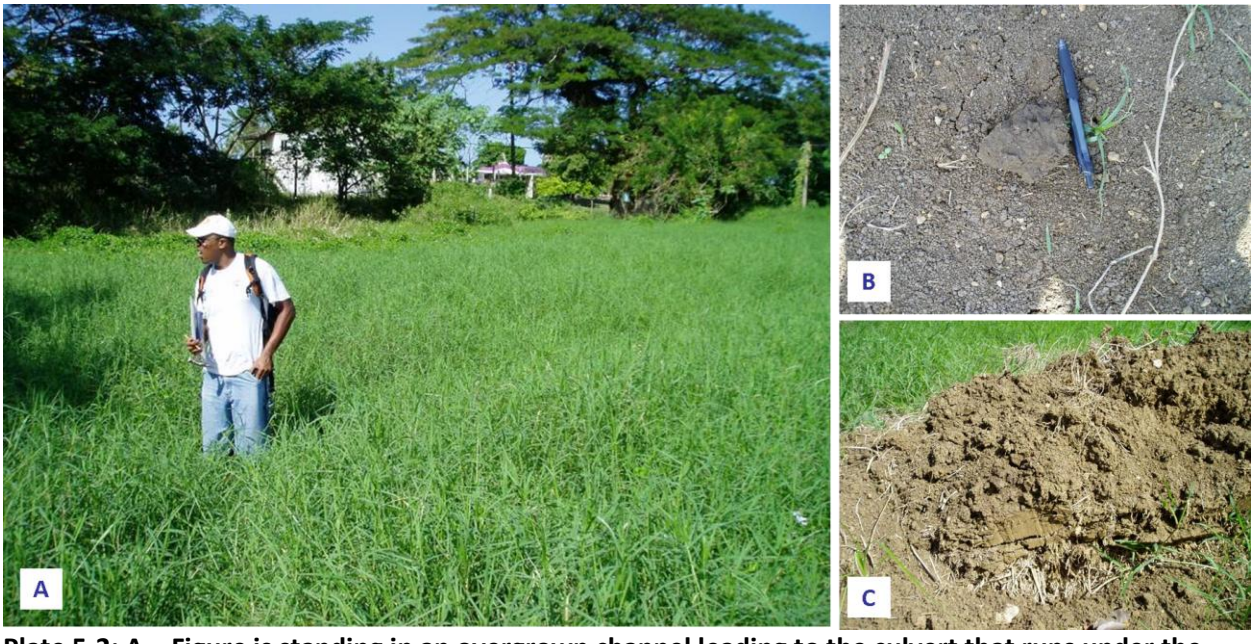


Plate 5-2: A – Figure is standing in an overgrown channel leading to the culvert that runs under the road in the south east section of property; B – clay soil exposed by tractor; C – clay form top four inches of soil exposed by tractor.

5.2.6 Hydrogeology & Hydrology

Figure 5-7, courtesy of the Water Resources Authority (WRA), indicates the general conditions affecting groundwater flow in the region. All the rocks underlying the catchment for the site are classified as aquicludes, although the adjacent Montpelier Formation is acknowledged to be semi-permeable. At the time of completing this report no information was available on any of the boreholes indicated on **Figure 5-7**. Inspection of the site indicated the absence of springs, as suggested by the WRA map. The gully courses in the catchment carry seasonal flow. Nevertheless there are anecdotal reports of flooding in the region covered by the clay of the northeastern corner of the site, and the presence of the clay itself strongly suggests ground subject to frequent flooding.

Current drainage of the site is rudimentary (**Plate 5-3** and **Plate 5-2 (A)**), with the major gully courses becoming diffuse in the lower part of the site. The main outlet for the drainage is merely an open trench without concrete lining and, when we visited, was badly overgrown and partly collapsed (**Plate 5-2 (A)**).

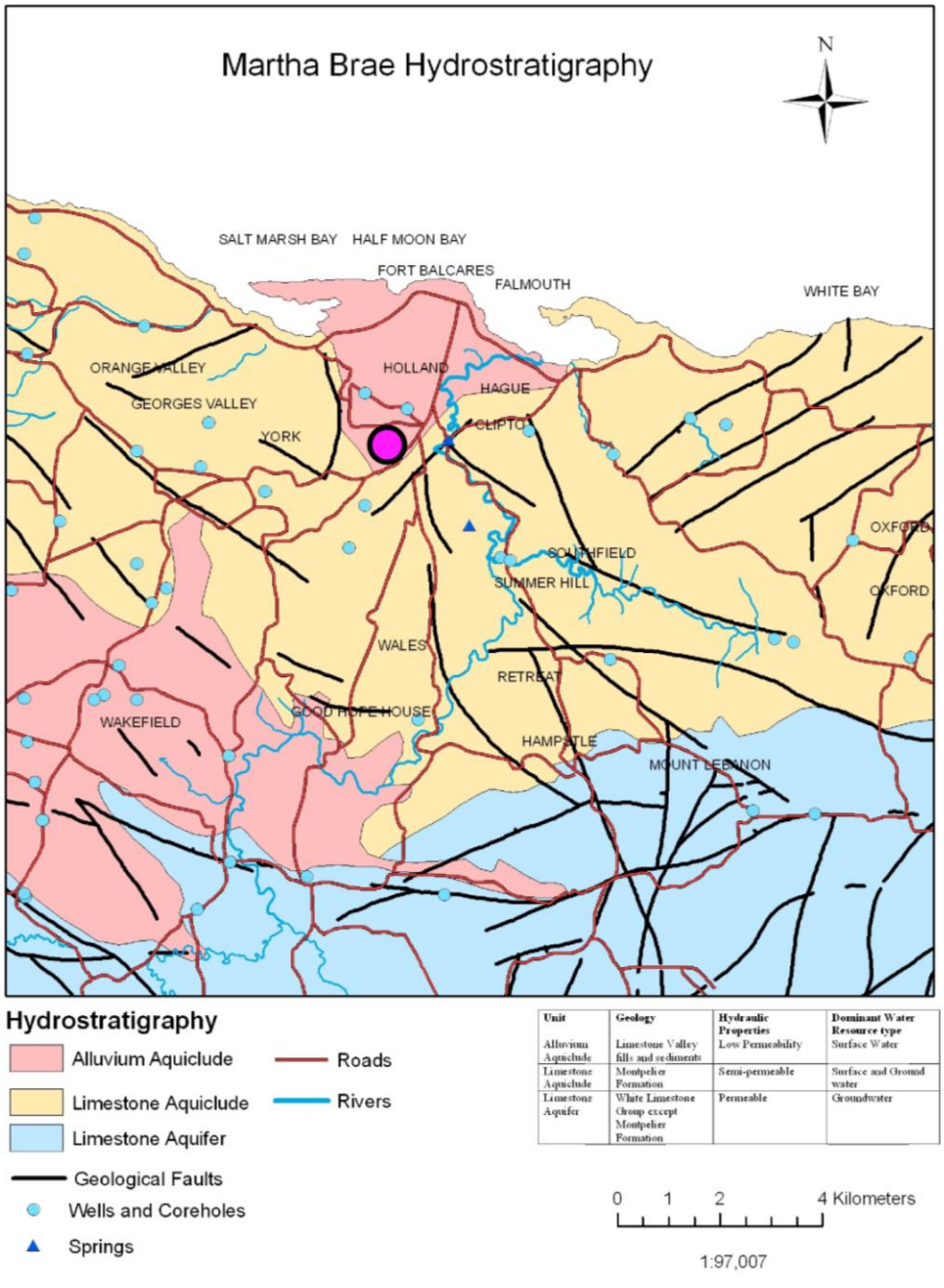


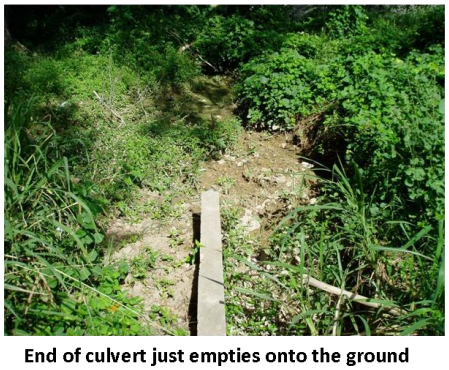
Figure 5-7: Hydrostratigraphy of the region around the Holland site (marked with pink dot). Adapted from a map by the Water Resources Authority

Showing where runoff from the culvert goes

Culvert on roadside opposite to property

Culvert that now carries runoff under the road from the property

Looking southwest: view of the property



End of culvert just empties onto the ground

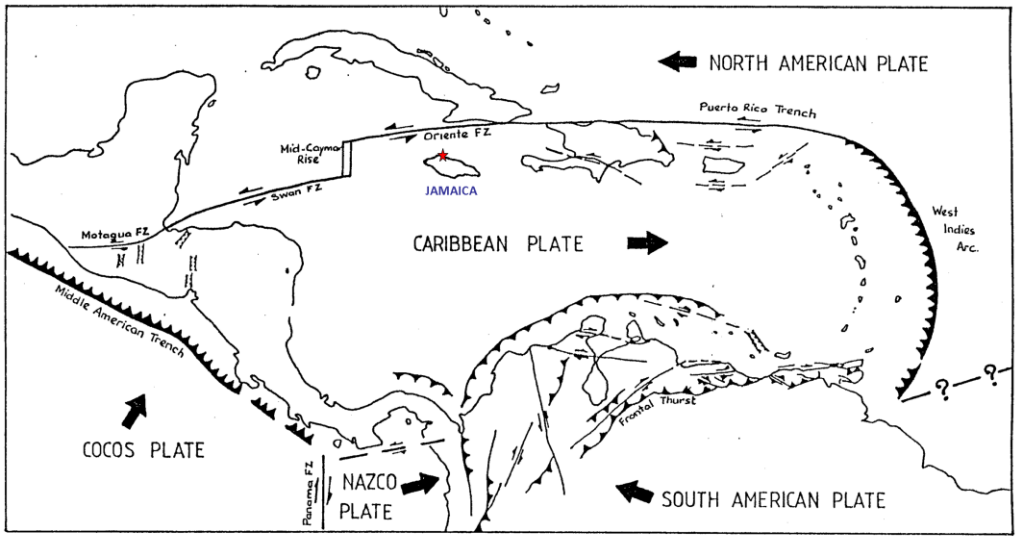
Plate 5-3: Photos showing drainage features adjacent or on the property

5.2.7 Natural Hazard Vulnerability and Risks

5.2.7.1 Earthquakes & Landslides

The risk of damage from seismic events is likely to be relatively low due to the presence of limestone bedrock under most, if not all the site, even under the region of clay soil at the northeastern side of the site. The geology, with limestone bedrock near to the surface, and topography of the area suggest that risks from slope failures would be small.

The island sits on the Bartlett (Cayman) Trough, which is the major seismic feature in the region. The region's demonstrated susceptibility to liquefaction and ground failure during moderate sized earthquakes makes it extremely vulnerable to economic disruption as well as loss of life (**Figure 5-8**).



Tectonic Setting of the Caribbean
(after Molnar and Sykes, 1969)

Figure 5-8: Tectonic Setting of Jamaica

There is no evidence of recent fault activity at the project site. Also, although local faults might still be active, the potential damage that would result from a large regional seismic event needs to be considered. **Figure 5-9** shows the frequency of events of Modified Mercalli VI or greater over Jamaica. The site lies within the zone of 5-9 such events per century.

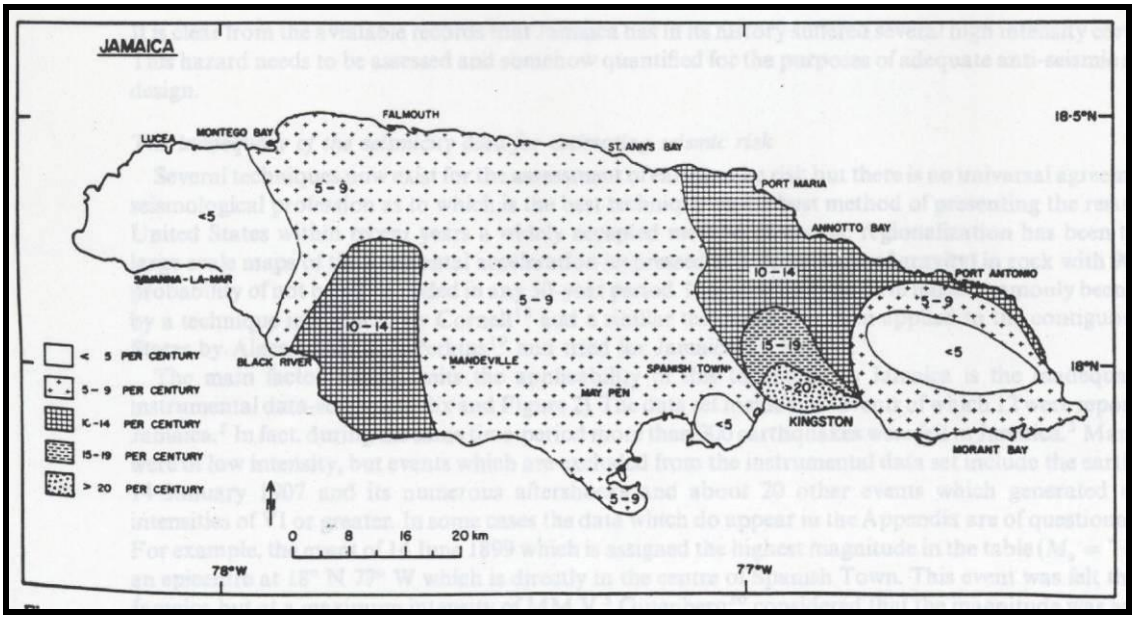


Figure 5-9: Map showing number of times per century that intensities of MM VI or greater have been reported, 1880-1980 (from Shepherd & Aspinall, 1980)

According to the USGS Earthquake Density Map, Jamaica fall in the lowest category regarding the average number of earthquakes per year with a magnitude 5 and Greater at all depths (**Figure 5-10**). However, it should be noted that Jamaica also has peak ground acceleration of 2.4 - 4.8 m/s with a 10% probability of exceedance in 50 years which is high in respect of all Caribbean countries.

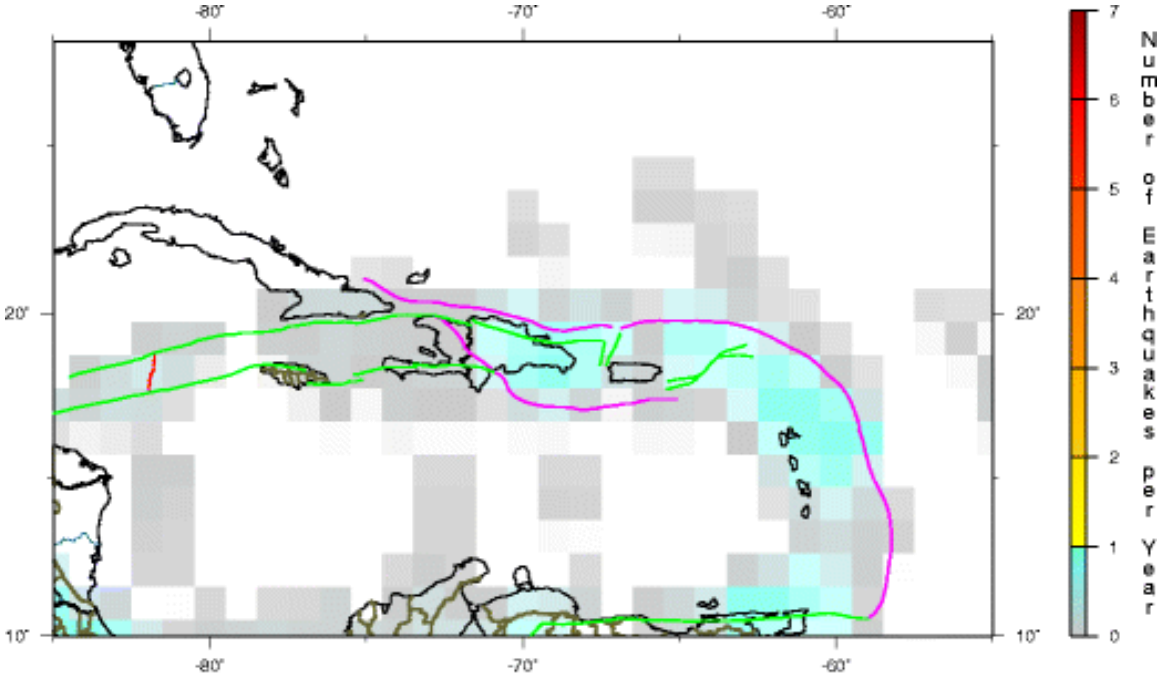


Figure 5-10: Average Number of Earthquake per Year, Magnitude 5 and Greater in the Caribbean[5]

The severity of an earthquake is generally expressed in two ways, magnitude and intensity. The intensity as expressed by the Modified Mercalli intensity scale, is a partly subjective measure which depends on the effects of a quake, such as damage, at a particular location. Although there is only one magnitude number for a selected earthquake, there may be many values of intensity. On the Modified Mercalli intensity scale, values range from I to XII. The most commonly used adaptation covers the range of intensity from the conditions of MMI - not felt except by very few, favourably situated," to MMXII - damage total, lines of sight disturbed, objects thrown into the air." While an earthquake has only one magnitude, it can have many intensities, which decrease with distance from the epicentre. The proposed development site has an expected Maximum Mercalli Intensity of 6 (MMVI) - Felt by all: many frightened and run outdoors; damage minor to moderate (**Figure 5-11** below).

[5] USGS Earthquake Hazards program, http://earthquake.usgs.gov/regional/world/caribbean/density.php

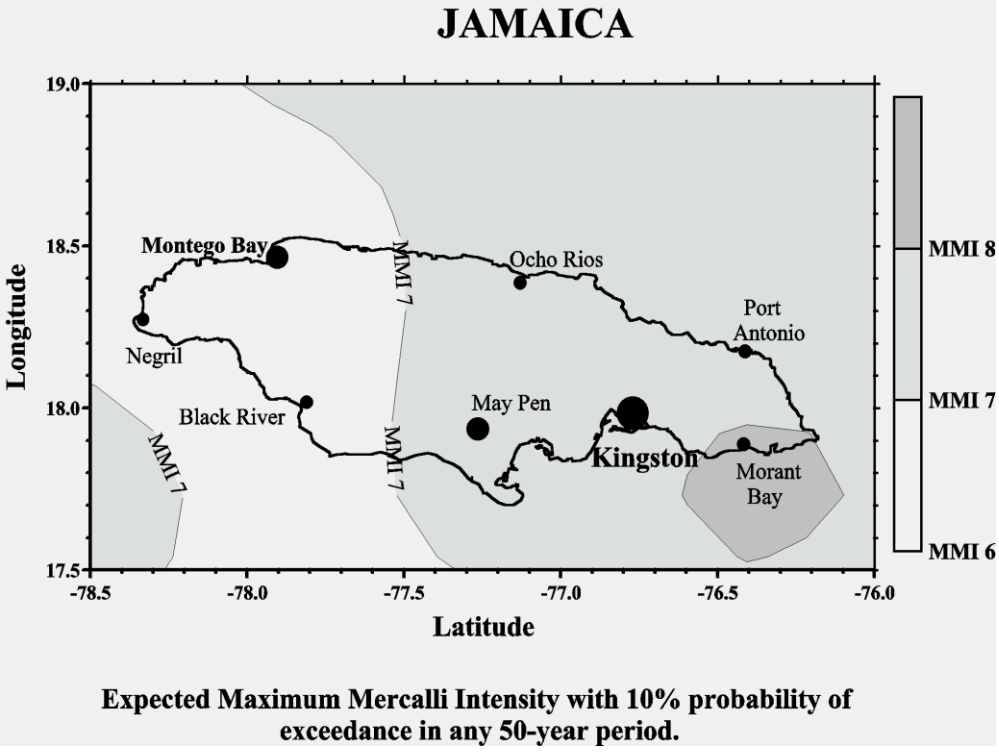


Figure 5-11: Expected Maximum Mercalli Intensity[6]

With respect to seismic risk, the design approach calls for adoption of the Uniform Building Code (UBC), which categorizes varying locations in the world into Zones. An increasing Zone number implies a greater risk of more frequent and intense, earthquakes. For Jamaica, the UBC recommends Zone 3 in general outside the Kingston Metropolitan area (Zone 4). Zones 3 and 4 correspond approximately to Richter magnitudes 5-6 and 6-7 respectively.

5.2.7.2 Hurricanes & Storm Surge Potential

Hurricanes are a serious seasonal threat from June to November; since 1886, 21 hurricanes have made landfall in Jamaica, while over 100 have passed within 240 km (150 miles) of the island. Tsunamis are also a major risk.

Considerations have been given to issues related to storm water and potential for erosion during the construction and operational phases of the development. As such, a storm water management system, involving the use of drains, retention ponds and/or absorption pits has been recommended.

Using Sangster International Airport in Montego Bay as a reference point location: 18.50N 77.92W, all recorded tropical storm and hurricane activity over a period of 100 years are considered to estimate any trends related to the hurricane activity and the return period of such activities to the island[7]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

[6] Caribbean Disaster Mitigation Project, http://www.oas.org/CDMP/document/seismap/jamaica.htm, Accessed August 2006

[7] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/

So far this year, no hurricanes have affected the island. However, the island was last affected during the 2008 cycle by Hurricane Gustav a tropical storm which crossed the island along the southern parishes. No significant storm surge activity was recorded along the north coast from this event. Storm surge is not considered a problem for the development site based on the distance from the coast. The 50 year return period for hurricane winds for the Montego Bay (the closest area modelled) is 49 m/s. This prediction is based on the TAOS predictions for storm surge for the "50-year return storm" by the Caribbean Disaster Management Programme project (1999).

Analyses of tropical systems passing within 60nm (= 60mi.) of the island is shown below. Latitude/longitude coordinates (18.50N, 77.92W) used is for Sangster International Airport, one of the island weather stations. **Figure 5-12** shows whether there are more storms lately or which 5-year period in the last 60+ years was most active.

Figure 5-13 highlights the storm track and intensity of storm activity (hurricanes and tropical storms) within 60 miles of Jamaica for the period 2000-2008.

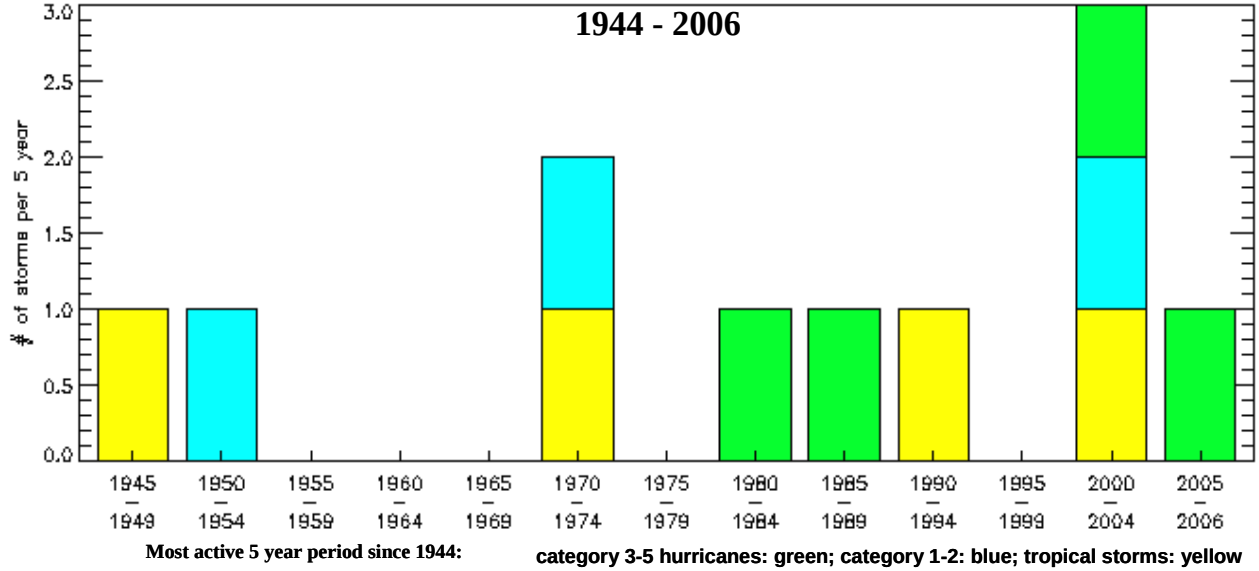


Figure 5-12: Hurricane Activity for the Period 1944-2006[8]

[8] StormCarib – Caribbean Hurricane Network http://stormcarib.com/climatology/MKJP_dec_isl.htm

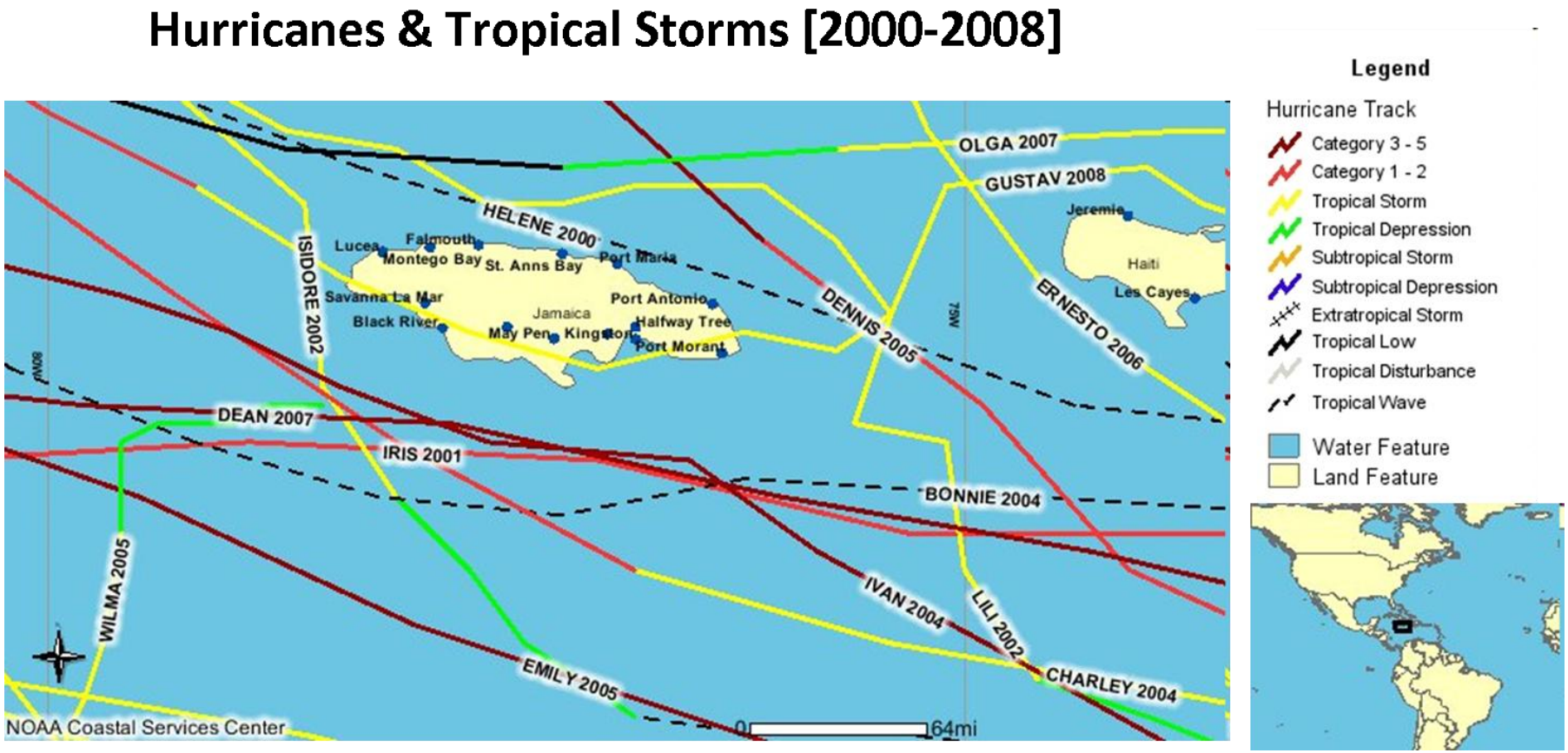


Figure 5-13: Hurricane & Tropical Storms that have passed within 60 mi. of Jamaica during the period 2000-2008[9]

[9] http://csc-s-maps-q.csc.noaa.gov/hurricanes/viewer.html

5.2.7.3 Flooding

The catchment for the Holland site is only slightly smaller than the Milford River catchment feeding into Ocho Rios, the scene of extensive flooding and devastation in the deluge of April, 2008. The overall geology and hydrogeology of the Holland site is quite similar to that of the Milford River catchment. Flooding in these situations is triggered by short duration, high intensity rainfall such as occurred in the Ocho Rios area (as observed at Murphy Hill - 121.9 mm in 5 hours, and at Dunn's River - 144.3 mm in 5 hours). In 1995 rainfall of similar intensity (175 mm of rainfall in 24 hrs as observed at Epworth) damaged the Fern Gully area near Ocho Rios.

Return periods for such precipitation events are difficult to quantify because of the very local nature of such events. The exposure of the Holland site to flooding from intense rainfall events will likely increase through and after development due to housing and roads facilitating runoff.

Although no springs were seen or reported by the locals, the possibility of limited augmentation of overland flow by groundwater along the southwest margin of the site and from sources higher in the catchment is possible if flash flooding has been preceded by an extended rainy period, given the semi-permeable nature of the Montpelier Formation.

The design of a drainage system from the site, and perhaps partly circumventing the site, will need to be examined in detail. At least, a reconnaissance survey of the hydrological features of the entire Holland catchment is desirable. This, indeed, should be carried out in any case, as the Falmouth area is being developed as a tourist destination. The drainage design was informed by these observations.

5.2.8 Traffic Analysis

5.2.8.1 Methodology

A traffic survey was conducted along the Martha Brae to Falmouth main to observe traffic flow on roads where the proposed project would more likely impact on traffic (**Plate 5-4**). The survey was done by the National Works Agency (NWA) over a 24 hours continuous assessment during the period December 17 – 30, 2009. The survey was conducted on the Martha Brae/Falmouth main road as shown in the image below.

Classification was based on the type of vehicles that were counted. The vehicle classes that were used for the surveys were:

- Light Vehicles – includes short sedan, wagon, 4WD, utility, light van that are greater than 1.7 m in length but less than 3.2 m.
- Medium Vehicles – includes truck or bus greater than 3.2 m in length and comprise 2 – 4 axles
- Heavy Vehicles – includes trucks, trailers, etc. that are 3 or 4 axle articulated or having more than 4 axle with more than 3.2 m in length.

The traffic analysis for each location is provided below.

Plate 5-4: Location of Traffic Assessment along the Martha Brae to Falmouth Main Road

Classification was based on the type of vehicles that were counted. The vehicle classes that were used for the surveys were:

- Light Vehicles – includes short sedan, wagon, 4WD, utility, light van that are greater than 1.7 m in length but less than 3.2 m.
- Medium Vehicles – includes truck or bus greater than 3.2 m in length and comprise 2 – 4 axles
- Heavy Vehicles – includes trucks, trailers, etc. that are 3 or 4 axle articulated or having more than 4 axle with more than 3.2 m in length.

The traffic analysis is outlined below.

5.2.8.2 Findings

Northbound

The periods for which average peak traffic volume were observed northbound was between the hours of 8 a.m. – 9 a.m. in the morning. During this period, on average, there were 293 vehicles travelling northbound Monday to Friday, towards the highway or the parish capital, Falmouth during the morning

peak hour. On weekends this tapered off to approximately 163 with higher numbers on Saturday. The highest number of vehicles recorded during the morning peak hour was 357, recorded on a Friday.

During the afternoon, peak traffic was not consistent during any particular hourly period. The data revealed the 1-2 p.m. and 5-6 p.m. time slots as being most active. This first period appears to coincide with the lunch hour and school traffic, and the latter with residents returning home from work. During the 1-2 p.m. period traffic volume was, on average, approximately 245 vehicular movements; whereas the 5-6 p.m. time slot recorded 240 vehicular movements.

The lowest traffic volumes were observed between hours 11 p.m. – 6 a.m. Average total traffic volume on the northbound was 3562 vehicles. Of this total, light vehicles represent more than 92%, medium more than 4% and heavy below 0.3%.

Southbound

Peak traffic volumes were observed during the hours of 9 a.m. – 10 a.m. in the morning and 6 p.m. – 7 p.m. in the afternoon during week-days. During this period, on average, there were 185 vehicles travelling southbound Monday to Friday, towards communities such as Martha Brae and Holland and towns further south such as Granville during the morning peak hour. However, it should be noted that the hours of 8-9 a.m. and 10-11 a.m. also had fairly similar traffic volumes on average, 176 and 170 respectively. On weekends this tapered off to approximately 163 with higher numbers on Saturday during the 10-11 a.m. period. The highest number of vehicles recorded during the morning peak hour was 269, recorded on a Wednesday.

During the afternoon, peak traffic increased, on average, from 193 vehicles during the 1-2 p.m. period to a high of 234 during the 5-6 p.m. and 6-7 p.m. periods. The latter two time periods appear to coincide with residents returning home from work. On the weekends, traffic volume peaked during the morning period of 10-11 a.m. with 163 vehicular movements; while in the afternoon, traffic volume consistently increased from 167 traffic movements during the 1-2 p.m. time slot to a high of 196 during the 4-5 p.m. period. It should be noted that weekend traffic volume remained fairly high, on average, at 186 during the hours of 4-8 p.m.

Similar to northbound traffic, the lowest traffic volumes were observed between hours 11 p.m. – 6 a.m. Average total volume from the southbound was 3081. Of this total, light vehicles represented more than 95% of the traffic volume, medium more than 4% and heavy vehicles less than 0.3%.

Data tables are outlined in **Appendix Table 3 and 2.**

5.2.9 Conclusions

The site is not prone to any significant hazard vulnerability that cannot be overcome through the typical construction engineering techniques currently in use in Jamaica. All best practices should be utilised during construction and management of this development.

5.3 Biological Environment

5.3.1 Introduction

A survey of the flora and fauna for the Holland Estate housing development was conducted between November 14 and 29, 2009. The development area has previously been cleared for agriculture and the vegetation has been allowed to regenerate into three habitat types: pasture, a young Guango forest, and a secondary forest.

Sixty-seven (67) species of plants from 40 families were recorded. The only large trees observed on the property were Guango (*Samanea saman*) and Red Birch (*Bursera simaruba*). One hundred and nineteen (119) species of arthropods including 35 species of butterflies were documented. Also recorded were 47 species of birds (14 endemics), 19 reptiles and 10 species of amphibians.

No species were identified that requires special conservation. However, every attempt should be made to preserve some of the majestic Guango and Red Birch trees for their aesthetic value. Moreover, if several of the other trees could be incorporated in the development it would provide a habitat for a number of the birds and other fauna that can coexist in a disturbed habitat. The planting of various trees will encourage birdlife.

The full species list can be viewed in **Appendix VI**.

5.3.2 Local Setting

The area is generally flat with a gentle slope rising to the highest point towards the south. The predominant soil found on the property is clay. A few temporary pools of water were observed on the property suggesting some amount of waterlogging during the rainy season. There were also a few small man-made ponds or water holes for animals (cows, horses and goats). A few horses are kept in a small pen at the northeastern edge of the property.

Preliminary survey indicated three vegetation zones; a Secondary Forest, an Immature Guango Forest, and a Pasture/Grassland (**Figure 5-14**).

Figure 5-14: The observed vegetation zones (sample zones) used in the biological assessment

5.3.3 Survey Methods

5.3.4 Flora

At each vegetation zone, a 100 x 100 m^2 area was explored along parallel transect lines 20 m apart. All macroscopic plant species detected within a belt of ±10 m along the transect was recorded and, where possible, identified in the field. Samples of some species were collected for verification or identification in the herbarium of the Department of Life Sciences, University of the West Indies or at the Natural History Division of the Institute of Jamaica. At points every 20 m along the transect, ground cover of the tree, shrub and herb layer was assessed.

A DAFOR rating was established for all recorded species for each transect. Signs of past or present habitat use by humans were also recorded. Canopy structure was estimated using clinometers and rangefinder.

The nomenclature used for the ferns follows that of Proctor's "Ferns of Jamaica" (1989), while that of the flowering plants follows that of Adams' "Flowering Plants of Jamaica" (1972), except for a few cases where revisions have been made. All taxa (families, genera, and species) are listed alphabetically.

5.3.5 Invertebrates

The invertebrate assessment focused on larger species (body length ≥ 3 mm) of land snails, myriapods, spiders, hymenopterans and butterflies. At each sampling site, a 100 x 100 m^2 area was investigated along parallel transect lines 20 m apart. All butterflies and spiders observed within a belt of ± 5 m along the transect line were recorded. Litter was searched in 1 x 1 m^2 quadrats every 20 m along the transects.

All species of snails, myriapods, spiders, and hymenoptera with a body length ≥ 3mm were recorded. All species observed were identified in the field, where possible. A DAFOR rating was established for all recorded species for each transect. Specimens of some species were collected for verification or identification in the laboratory.

Given the nature of the vegetation in some areas it was necessary to expand the methods above to further increase recovery and identification of species. It was not always possible to identify some insects in flight. In such cases, a flight net was used to collect specimens which were taken to the laboratory for storage and identification.

To increase the number of species collected from the vegetation a sweep net was used along the transects. A 15 cm sweep net with cotton bag was swept from side through the shrub and herb layer along the transects. The invertebrates were later transported to the laboratory where they were sorted, labelled and stored. The species were later identified and counted.

Beating trays were also utilized to collect material from the trees. A 1 m^2 beating tray was placed below the branches and the vegetation wacked five times to dislodge the animals. The material was later transported to the laboratory for processing.

Soil and litter samples collected in the field were examined in the laboratory using a dissecting microscope and the animals present recorded.

Organisms that were not identified in the field were identified using the available literature and comparison with specimens at the Entomology museum at the Department of Life Sciences, University of the West Indies, or the Museum of the Natural History Division of the Institute of Jamaica. In cases where identification to the level of species was not possible the classification was done to the nearest taxon.

Land snails were surveyed using a method developed by Garraway and Blake. This method entails a combination of hand search of soil surface and trees combined with dry sieving of soil.

Shells were hand-picked from substrate systematically working along the established transects, covering an area approximately 4 m wide checking all possible hiding places including rotting or fallen logs, rock crevices, beneath large loose rocks, under leaf litter, and on trees (trunks and leaves).

Soil was collected from random points in the site. Large shells were removed by hand while small shells were collected using standard field sieves followed by examination using the dissecting microscope. Most specimens were identified readily. Others were identified from descriptions from the literature or by comparison with the “Blake & Garraway Collection” and the “Munroe & Garraway Collection” at the University of the West Indies.

5.3.6 Avifauna

The point count, observance of water bodies and line transects methods were utilized in this study (**Figure 5-15**). Identification of bird species was done through visual and audio identification. Anecdotal notes on the behaviour of the bird species were noted.

It should be noted that the "Phishing method" was used to attract birds, while conducting point count and the line transect methods. This is done by making "pssh" or high pitch sounds which attract birds; mostly warblers. The surveys were conducted from sunrise until approximately 10:30 am and also in the evenings over a 3 day period.

5.3.6.1 Point count method

The point count method is based on the principle of counting birds at a defined point or area and determining the distance of each bird. This is done for a predetermined time, usually 10 minutes, before moving to another point at a specified distance away (Bibby et al. 1998).

In this study the points selected were at least 200 m apart and the point count method was carried out for 10 minutes at each point. In addition, birds observed, while moving from one point to another that were not on the species list were also noted. The point method was used in areas where there were no trails or walking was difficult or where there was a good vantage point.

Advantages of the point count method include:

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

5.3.6.2 Line transect census method

The line transect method entails walking at a steady pace along selected routes for a given distance or time period and noting all the birds present in the area (Wunderle 1994).

The line transects were conducted in areas, where there were roads and tracks on the property (**Figure 5-15**).

Advantages of line transect method include (Bibby et. al. 1998):

- It covers the area quickly and the number of bird sightings is usually higher.
- It reduces the chance of double counting.
- It is good for observing mobile and conspicuous species.

Figure 5-15: The transects (green) and points used to conduct the avian assessment

5.3.6.3 Observance of pool areas

This method is based on the principle of counting birds at an area where water has accumulated. The survey is conducted recorded for a time period usually 20 – 30 minutes.

5.3.6.4 Night Survey

This method entailed walking the property at night and noting all the nocturnal birds present.

5.3.6.5 Bird survey technique weaknesses

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

- Time of Day – the best time for conducting a census is in the morning from sunrise until about 10am 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).
- Time of Year – the change in behaviour of birds during the breeding and non-breeding seasons affects detection. However, for this report, the assessment was done in the non-breeding season, when birds are less vocal. (Wunderle 1994).

Weather – things such as wind, rain, fog or heat, affect the conduct of a census (Wunderle 1994)

5.3.7 Other Vertebrates

The hiding places of reptiles and amphibians were also studied. The techniques employed include searching the following: bark, trunk and canopy of trees; litter and grass piles; abandoned termite nests; under large logs and rocks; through piles of logs, rocks and rock walls; inspection of pools/ponds and tree holes. Searching was generally coupled with listening for sounds/calls.

5.3.8 Findings

The property has been cleared and used for agriculture in the past, mainly cattle rearing and the growing of papaya. Some areas have been allowed to revert to natural vegetation while others appear to have been maintained as pasture.

Presently there are three distinct zones: a pasture, a young Guango forest, and a secondary forest; each making up approximately one third of the area.

5.3.9 Floral Resources

A total of sixty-seven (67) species of plants from 40 families were recorded. Few large trees survived the original clearing, the remainder of the vegetation found here are opportunists/colonizers usually associated with open fields and thickets and young secondary forest. The species found were generally widespread in their distribution (**Table 5-2 and Appendix Table 5**).

Table 5-2: Distribution of various families and species in various habitat types

Taxon	Number of each Taxon in Habitat Type			
	Pasture	Guango Forest	Secondary Forest	Entire Site
Family	20	19	33	40
Species	33	29	58	67

5.3.9.1 Zone 1: Pasture

An active pasture dominates the northerly third of the site, horses, goats and cattle graze here. Thirty-three (33) species of flowering plants from twenty families were recorded from this area (**Table 5-2**). The vegetation was dominated by 4 species of grasses (most notably the Bermuda Grass, *Cynodon dactylon*), and the vine *Psophocarpus palustris*, a native of tropical Africa which has become naturalized. A few large Guango trees (*Samanea saman*), canopy spread up to 12 m, still remain especially at the western and eastern edges, while young plants < 2 m high are scattered around the site (**Plate 5-5 and Plate 5-6**).

Plate 5-5: Pasture, dominated by grasses. Note fire-damaged Guango forest in background (arrow)

Plate 5-6: The pasture is interspersed with large Guango trees

5.3.9.2 Zone 1: Young Guango Forest

The action of livestock and natural factors has spread the Guango seeds, resulting in a very dense forest (average nearest neighbour 2.5 m) of immature Guango trees (**Plate 5-7**). These plants form a canopy between 3 and 6 meters, and have a dbh <15 cm. The understory had the same composition as the grassland, however the quality of this layer decreased as the canopy got denser. Twenty-nine (29) species of plants from nineteen families were recorded. A significant portion of this area showed signs of recent fires (**Plate 5-5** & **Plate 5-8**). The grass/herb layer has already been re-established but many of the Guango plants appear to have died.

Plate 5-7: Forest of young Guango trees. Note herb layer formed by degenerating pasture

Plate 5-8: Significant sections of the Young Guango Forest shows extensive damage by fire, which resulted in death of many trees

5.3.9.3 Zone 1: Pasture

The southern portion of the site is dominated by secondary forest. Most of the original vegetation was removed for pasture, however, these have been abandoned for some time and the vegetation has been allowed to re-grow into a dense forest (difficult to push through, visibility <10 m) with a close canopy reaching up to 5-6 m. The trunk diameters are small, dbh < 15 cm. The density of plants is high and vines are very prominent, creating a thick canopy with little undergrowth (**Plate 5-9**). The only large trees remaining are a few Guango and Red Birch (*Bursera simaruba*) which emerge from the secondary forest and may reach to 20 m in height (**Plate 5-10**). On the western edge the secondary forest is subjected to intense human disturbance and *Acacia farnesiana* plants are very prominent.

Fifty-eight (58) species of plants from 36 families were recorded. The dominant trees were immature Guinep (*Exothera paniculata*), Guango, and *Acacsia* on the fringes. Dominant vines/scramblers were *Posophocarpus palustris* and *Pisonia aculeate* (Cock spur).

Plate 5-9: Dense Secondary Forest composed mainly of small trees and prominent vines

Plate 5-10: Large Guango and Red Birch trees occasionally emerge from the canopy of the Secondary Forest

5.3.10 Faunal Resources

5.3.10.1 Arthropods

The Arthropods from the different habitats were not treated separately. Most of the Arthropods collected were very mobile and dispersed between the three habitat types. Moreover, the light trap attracted insects from all three habitats and these could not be separated.

One hundred and nineteen (119) species of Arthropods were collected. These include 35 species of Lepidoptera (butterflies and moths), 18 species of Coleoptera (beetles) and 13 species of Hemiptera (bugs).

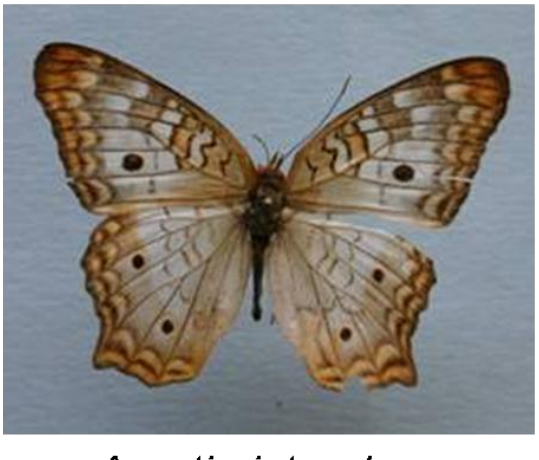
Of the 35 species of Butterflies and moths, 3 species (*Mestra dorcas, Anea troglodyta* and *Hemiargus dominica*) are endemic, and two others (*Anartia jatrophe jamaicensis* and *Heliconius charitonus simulator*) are endemic subspecies (**Plate 5-11 and Appendix Table 6**). *Anea troglodyta* and *Heliconius charitonus* were found mainly in the forested area. All Lepidoptera collected have well established populations and very wide distributions across Jamaica.

Mestra dorcas

Eurema nicippe

Dione vanilla

Anaea troglodyta



Anartia jatrophae

Pyrgus oleus

Plate 5-11: Butterflies from Holland Estate

5.3.10.2 Land Snails

The land snail fauna was not very diverse; only 11 of Jamaica's 552 species were recorded (**Appendix Table 7**). Nine (9) are endemic, one (1) is an endemic subspecies, and one native. The level of endemism was not surprising when national level is 91% endemism, however, in disturbed sites native and

introduced species often become dominant. The strong endemic presence is probably being maintained by the well developed secondary forest. Species such as *P. invalida* occurred in all areas, while *A. mitis* occurred mainly in the forests. All species collected have wide distributions across Jamaica (Rosenberg 2006, Blake 2007).

Plate 5-12: *Annularia mitis* grazing algae from surface of rocks

5.3.10.3 Avifauna

Forty-seven (47) bird species were identified on the property during the assessment of the avifauna (**Appendix Table 9**). The majority of the bird species observed on the property were terrestrial species (n=4) and only a few were wetland bird (n=3). The bird species diversity increased from Site 1 (Grassland) to Site 3 (Secondary Forest).

The bird species diversity on the property was typical of a dry limestone forest. Birds typical of a dry limestone forest include Columbids (White-wing Dove, White-crowned Pigeon, and Caribbean Dove), Parakeets, Hummingbirds, Jamaican Woodpeckers, Orioles and Warblers (resident and Migrant) (Downer 1990). The distribution of bird species varied on the property; for example, Columbids are usually abundant in disturbed woodlands; however in this study a few were seen. It is possible that they have migrated to another area where food is plentiful.

The wetlands birds were found in Site 1 and Site 2 because both areas floods occasionally (**Appendix Table 10**). In addition, several water holes were located in both areas which provide a habitat for them. The cattle egrets were feeding on the ticks on the horses, which forage in the grasslands.

Fourteen (14) of the island's twenty nine (29) endemics were seen on the property and only six (6) species were forest dependent (**Appendix Table 11**). The majority of the endemics were seen in Site 3 (Secondary Forest). A number of the endemics were also seen in the large shade trees at the periphery of the grassland. The Holland Estate is near other woodlands, which influences the avifauna distribution on the property. This explains why there were so many forest dependent birds such as the Yellow-billed

parrot and the Arrow-headed warbler, in the degraded woodland. The olive-throat parakeets were seen foraging on the *Neme* sp. trees located in Site 1

There were a large number of migrants (n=14) on the property. They arrive as early as September in Jamaica from North America. They were the most dominant group of birds in Site 2. They were the most abundant group of birds in Site 2 and 3.

Barn Owl was the only nocturnal birds observed in the study.

5.3.10.4 Herpetofauna

In the study of the Herpetofauna two habitats were recognized: the Secondary forest, and the Pasture/grassland; the latter being a combination of the Pasture and the Young Guango Forests described above.

Nineteen (19) of Jamaica's 54 reptilian species were recorded from Holland Estate. A total of 25 species have been recorded within a 10 mile radius of this site beginning with the work of Sir Hans Sloane in the 1600's. Seventeen (17) of the species recorded here are endemic to Jamaica, while the *Anolis sagrei* is native, and the *Hemidactylus mabuya,* is introduced. **Plate 5-13** and **Appendix Table 5** identifies some of these species.

Ten (10) species of amphibians were recorded (**Appendix Table 18**). Thirteen (13) of Jamaica's 27 species of amphibians have been recorded within a ten mile radius of this site. Eight (8) species are endemic, *Eleutherodactylus planirostris* is native, and *Bufo marinus* is an introduced species.

The frogs called throughout the day in most sections of the property. They were mostly identified by calls. Large Bromeliads which usually provide a microhabitat for many species were not observed in the area.

The reptile result is not far from expectation; however the absence of *Anolis opalinus* is very interesting as it is generally common in such sites. There are no new species or subspecies from the area. However in the disturbed forest area more species were found. The two subspecies of *Anolis lineatopus* were seen in this location; however, previous records indicated separate habitats. The *Celestus crusculus crusculus* was found inside the termite mounds. The *Anolis garmani* seen in the area were smaller than that collected from nearby surrounding areas, they were noted to have bands in their colouration.

None of the species recorded are in need of any special conservation procedures. The area is highly disturbed and with the exception of the rock wall did not show signs of great activity for the reptile population. The open pasture/grassland area had many predatory birds present and only those reptiles and amphibians that have adapted to living in the few trees and in the grass could survive. The disturbed forest had most species however, the population density was low and only near the south western section of the property does the population density increase. This is due to the stone wall which seems to have been undisturbed for a much longer period on time.

Sphaerodactylus gonirhynchus

Hypsirhynchus funereum

Anolis lineatopus merope

Celestus crusculus crusculus

Anolis grahami graham

Plate 5-13: Selected reptiles found on the property

5.3.11 Conclusions

The bird distribution on the property was very diverse, although it is influenced by nearby forest. The removal of the vegetation is going to displace a number of the birds. However, a number of the species could survive in the vegetation adjacent to the property.

A large number of the birds were seen in the shade trees that border the property (**Appendix Table 12**). If several of these trees could be incorporated in the development it would provide a habitat for a number of the birds that can coexist in a disturbed habitat. Trees should also be planted to encourage birdlife.

While a wide diversity of flora and fauna were recorded from Holland Estate, no species was recorded which require special conservation at this time. It should be noted that there are several large Guango and Red Birch trees on the property, every attempt should be made to preserve these specimens for their habitat and aesthetic value.

SOCIO-ECONOMIC & SOCIO-CULTURAL ENVIRONMENT

6 Socio-Cultural & Socio-Economic Environment

6.1 Introduction

Aspects of this section contain information acquired from the website of the Jamaica National Heritage Trust (JNHT).

6.2 Cultural Heritage Resources

The parish of Trelawny has various cultural heritage sites scattered throughout, some protected. Within the geographic sphere of this project is represented some of these cultural heritage resources. In 1770, the parish of Trelawny was created from part of the old parish of St. James. It was originally named Barrett Town after the designer Edward Barrett, but later renamed in 1790 after Governor William Trelawny. The chief town and first capital of this new parish was Martha Brae. Falmouth is the first heritage site. The town has the largest collection and some of the finest examples of Georgian architecture in the Caribbean.

The following is a list of heritage sites in the parish of Trelawny

- Kettering Baptist
- Good Hope Great House
- Green Park Great House
- Fort Dundas
- Falmouth
- Rio Bueno
- Stewart Castle
- Granville
- Kettering
- Time and Patience
- Falmouth Court House
- Falmouth Wharves
- Falmouth Parish Church

None of these cultural resources stands to be affected by this project.

As indicated by the JNHT (**Appendix V**), Martha Brae is designated as one of Jamaica's earliest Spanish settlements. The historic records show that the Martha Brae River overflowed its bank and destroyed the settlement. With the downturn in sugar many estates turned to cattle rearing.

Grazing pens included Holland, Carrickfoyle and Maxfield properties. These entities would have had enslaved villages, great houses, work complexes and in some cases burial grounds. It should be noted that Taino settlements, midden, midden burials and enslaved villages did not have monumental structures.

In 1832 Holland belonged to David Lyon and possessed 155 enslaved persons and 119 heads of cattle. The enslaved village of Holland lies within the proposed development.

The lands have since been sub-divided into many smaller units of which this development remains one of the largest single units. The lands in question have been utilized for agricultural purposes for many decades. While no archaeological resources have been found on these lands to date, due to the nature of the area, the JNHT has expressed an interest in the site and recommends that an Archaeological Impact Assessment (AIA) be done before construction work begins.

The developers recognize the significance and importance of any such archaeological resources and are willing to have an AIA conducted prior to any site clearance or construction works.

6.2.1 Approach & Method

Land use was examined from both a historical and regional perspective. Site specific analysis of the proposed development site and for areas within 2 km of the site was seen as an appropriate extent for the area of interest. Relevant land uses immediately adjacent to the outer limits of the selected buffer (2 – 5 km) was also taken into account. The following were also useful in the investigation:

1. Aerial Photographs,
2. Satellite Imagery of the area dating 2006 (Google Earth), and
3. The use of field surveys to incorporate regional observations and documentation of existing land use, while providing verification of land use patterns depicted on the maps.

An accurate and thorough account of past and current land uses in the study area demanded a multi-faceted approach for collating land use information for the area.

6.2.2 Present Land Use

The site for the proposed development consists of approximately 192 acres of land at Holland Estate, located just south of the Martha Brae exit of the North Coast Highway. The property is bordered by Holland Avenue to the north, Martha Brae main road to the east and vacant, forested land to south and west. The site was previously under agricultural land use with the property extensively under papaya cultivation by a private entity. However, the owners of the property have since obtained planning permission for change of use from agriculture to residential/commercial and the land is no longer under cultivation.

At present, the land use on the property can be classified as forest/brush/vacant. The area is dominated by brush vegetation and small trees, typical of lands previously under agricultural production that have been left fallow. Grazing is currently an 'informal' use by residents in the area who allow a few livestock, mostly horses, to wander and feed on the property.

6.2.2.1 Land Use (0-2 km of Proposed Site)

This area includes the communities of Holland, Martha Brae, Clifton, Irwin Tower, Maxfield, and Race Course It is predominantly rural with minimal commercial activity supporting the sparse settlements affiliated with the area. The general land use in the area can be classified as, but not limited to the following

- Residential
- Industrial

- Transportation
- Wetlands
- Recreational
- Public Educational

Residential: Residential land use exists in small pockets of scattered settlements developed in linear pattern along major roadways. The communities mentioned above act as dormitory residential areas for people working in Falmouth and surrounding areas. The area is constituted by a mixture of planned and unplanned settlements that have grown and secured themselves as permanent features of the landscape. In addition, there is also a mixture of residential and commercial uses in some of the larger communities such as Martha Brae, where residential activity is supported by small-scale economic activity in the form of shops and small retail/wholesale outlets.

Industrial: Industrial activity in the area is minimal. However, in the Holland community to the immediate north of the site, industrial activity exists where PIHL has its staging facility for their construction works at the Falmouth Cruise Pier. This area currently houses equipment and machinery for the construction company. It must however be noted that this is a temporary land-use and will cease to perform as such once the construction of the Pier is completed.

Transportation: The North Coast Highway represents a major allocation of land to transportation in the immediate vicinity of the proposed site. It is situated to the north of the property and will provide easy and quick transportation in and out of the area. Class A and Class B roads connect the North Coast Highway to the communities in the area.

Wetlands: Wetlands, in the form of mangroves and swamps, are dominant features of the land use in communities to the north, north east and northwest of the proposed site. The communities of Holland, Sewage Filter Plant, Race Course and Greenside are located amongst wetland vegetation to the south of Falmouth. In addition, in the latter stages of the Martha Brae River, approaching the mouth of the river, wetlands currently occupy most of the area to the north of the North Coast Highway.

Recreational: Recreational activity in the area is limited. However, the Rafters Village in Martha Brae currently represents the major recreational land use in the area with several attractions available to visitors. Its spacious parkland represents the starting point of the 90-minute 3 mile raft ride on the Martha Brae River, with the capacity to accommodate up to 140 individuals on the river at any given time. It constitutes a major tourist attraction as well as livelihood for residents in the area.

Public Educational: The William Knibb Memorial High, Holland High, and Hague Primary and Infant Schools are public educational institutions that are situated within the area. Other private educational facilities are also located in the area.

6.2.2.2 Land Use (2-5km of Proposed Site)

This area includes more communities with a greater diversity of land uses. Referred to as the Greater Falmouth area, it includes but is not limited to the communities of Falmouth, Hague, Granville, Carrick Foyle, Schawfield, Top Hill, Rock, Coopers Pen and Daniel Town.

The land use in the area can be generalized as:

- Residential
- Forest
- Wetlands
- Recreational
- Resort/Tourism
- Public

Residential: Residential land use dominates the area due to the many communities that are found within 5 km of the proposed development site. There is also a mixture of planned and unplanned development in this area. Hague, for example, contains formal residential housing scheme while on the other hand the community of Rock, is an informal residential community containing a fishing beach and small businesses. This is a common feature of the residential areas where there is a mixture of residential and commercial activity. This is especially so in Falmouth, the parish capital, and therefore the administrative and commercial centre and market centre for produce distributed throughout the parish.

Forest/Open Space: Pockets of forested land and open space are present in the area acting as major buffers between communities. Although most of it has been disturbed by human activity, there are some areas that appear relatively undisturbed.

Wetlands: There are wetland areas (Mangrove) occurring north of the Highway and project site.

Recreational: The Trelawny Multipurpose Stadium in Daniel Town and the Outameni Experience Recreational Facility represent the major structured commercial recreational facilities in the study area. Other areas include football fields and basketball/netball courts that can be found in some of the communities. The Burwood Beach is a public beach that is also located within the geographic sphere of influence.

Resort/Tourism: The Breezes Trelawny Resort, formerly known as the Starfish Hotel and the FDR Pebbles Resort are major hotel/resort in the area. They are situated in the Cooper's Pen area and provide a contrast to the substandard housing in that area.

6.2.3 Potential Land Use Conflicts

Potential conflicts were identified in relation to the activities involved in the construction and operation of the proposed development, and their effect on land uses in the immediate area. They were assessed in the context of noting conflict of interests that are likely to result from the location, scale and nature of the proposed development and its interaction with the various land uses in the study area. Given the nature of land use in the area and the proposed development, very little conflict is anticipated from the proposed development. The residential areas in the vicinity of the site stand the chance to be the most affected land use, with noise and dust nuisance being the common conflicts identified. The type and nature of potential land use conflicts arising are summarized in the table below.

Table 6-1 Type and Nature of potential Land-Use Conflicts

Phases of Operations	Affected Land Use/Area		Nature of Potential Conflicts
Land/Vegetation	Residential	Holland, Martha	○ Noise nuisance due to the

Phases of Operations	Affected Land Use/Area		Nature of Potential Conflicts
Clearance		Brae, Carrick Foyle	movement of trucks and other vehicular traffic related to on-site activities. ○ Dust
	Forest/Brush		○ Loss of forest/brush cover
Construction	Residential	Holland, Martha Brae, Carrick Foyle, Top Hill	○ Noise nuisance due to the movement of trucks and other vehicular traffic related to on-site construction operations.
			○ Dust
Operation	N/A	N/A	N/A

6.3 Synopsis of Focus Group Consultations

In keeping with the approach to get feedback from the community, additional stakeholders were identified and interviewed. Stakeholders included banks, schools, government agencies, public service agencies, fishermen, river rafting captains, small business owners, and vendors in the Greater Falmouth area. Their perceptions, views and concerns are considered vital and are therefore a critical component to be included in this socio-economic assessment.

According to fifty-three per cent (53%) of the respondents, the Greater Falmouth area is a safe community. Their sentiments are further supported by another twenty-eight per cent (28%) who rated the area as very safe. However, one cannot overlook the fact that nineteen per cent (19%) considered the area to be unsafe, of whom the fishers were the majority.

The majority of the interest groups thought that the business community was adequately serviced by health facilities, water, electricity and other basic social services. Over ninety per cent (90%) of the respondents have indicated satisfaction with the level and provision of social services except for health and police services in the area, which was adequate for eighty-three (83%) of the respondents.

Most of the respondents were not aware of the proposed development at Holland Estate. Only approximately, thirty-two per cent (32%) of those interviewed had prior knowledge of the proposed housing development. However, the feedback from the respondents was mostly positive with approximately seventy-four per cent (74%) indicating that the proposal would have a positive effect on their business. This may be justified by the fact that all (100%) of the respondents stated that the area is in need of the development.

Most respondents held the opinion that the proposed housing development would bring more people into the community which is also very good for business, as it would present an opportunity for increase in sales. “More people, more customers” was common response for small business owners, fishermen and raft captains. In addition, it was also made clear that there is a desperate need for housing solutions in the area. Many respondents highlighted the current limited housing opportunities and high levels of squatting in the area.

However, it must be noted that some respondents indicated concern regarding the capability of public services such as schools, health care and the fire department, to adequately cope with the growth in population and demand on already limited resources.

The focus groups identified have expressed expectations from the proposed housing development at Holland Estate on the basis of job creation, improvement in business and contribution to the overall development of the Greater Falmouth area and Trelawny as whole. In this light, based on their responses, the community is looking forward to the development. However, based on some concerns raised, there exists the need for improvements in several social services to adequately meet the anticipated increase in demand.

6.4 General Survey Population

KENCASA Construction Limited has a special interest in the opinions, attitudes and views of the communities in which it does business. In an attempt to comprehensively analyze the potential impacts associated with the proposed development a social impact assessment is necessary to obtain data on the demographic and cultural characteristics of the communities and residents within the sphere of influence, and most importantly, their knowledge, views and concerns regarding the proposed development. As such, within the context of the nature of the proposed development, affected communities were identified and surveyed. This report presents the demographic and social profile of the affected communities and the findings of a survey that was conducted in November 2009.

A systematic approach was undertaken to identify the areas that will be impacted by the proposed development. Areas within a 2 kilometer radius of the site were immediately identified as the sphere of influence for the proposed housing development. This includes the communities of Holland, Martha Brae, Clifton, Irwin Tower, Maxfield, and Race Course. However, given the nature of the proposed development and the dispersed locations of communities in the area, other communities on the periphery of the 2 km radius were also included in the sample. These communities are Hague, Granville, Carrick Foyle, Top Hill, Greenside, Green Park and Sewage Filter plant.

The selection of the areas for interviewing was based on Enumeration Districts (ED) as defined by the Statistical Institute of Jamaica (STATIN). However, it must be noted that it is possible for some communities to cross ED boundaries. As a result, the communities as presented in this report were also defined in the field by the interviewer and the respondent.

The survey population was devised from a 7% sample of the total number of households within the area according to the 2001 Population Census. A total of 175 surveys were conducted in the EDs as outlined by STATIN, which were within and on the periphery of a 2 kilometer radius of the project site (**Table 6-2**). These statistics were obtained from the Population Census 2001 at the Statistical Institute of Jamaica.

Table 6-2: Enumeration Districts Surveyed

Parish and Enumeration District	ED Communities	Population	Number of Households	Sample Population (7%)
NORTH 005	Carrick Foyle	422	155	11
NORTH 006	Granville	328	87	6

NORTH 007	Green Park	577	176	12
NORTH 008	Maxfield, Greenside	1000	314	22
NORTH 009	Holland	1420	421	29
NORTH 010	Sewage Filter Plant	570	158	11
NORTH 021	Race Course	619	178	12
NORTH 022	Martha Brae	529	151	11
NORTH 023	Hague	258	79	6
NORTH 024	Clifton	686	219	15
NORTH 058	Irwin Tower	175	61	4
NORTH 059	Martha Brae	179	65	5
NORTH 060	Martha Brae	375	126	9
NORTH 061	Schawfield, Merrywood	143	46	3
NORTH 063	Carrick Foyle, Schawfield	338	101	7
NORTH 080	Top Hill	282	78	5
TOTAL		**7901**	**2415**	**169**

6.4.1 Demographics & Social Profile

The affected communities identified within the sphere of influence together have a total population of 7901 individuals and 2415 households. The age-sex pyramid indicates that the majority of the respondents (38%) are between the ages of 20 and 39 years, while individuals under the age of 20 years accounted for the smallest (9%) (**Figure 6-1)**. Of the 169 households interviewed, the ratio of male to female respondents was relatively even with females slightly outnumbering males as females account for approximately 53% (89) and males account for 47% (80).

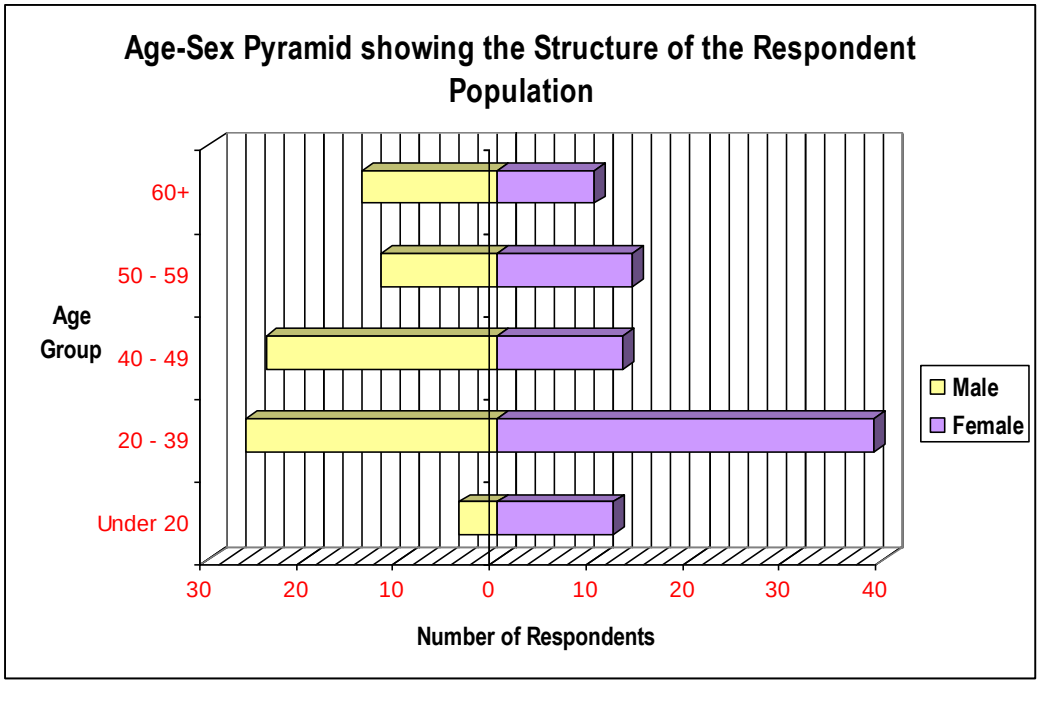


Figure 6-1: Age-Sex Pyramid of Respondent Population

Most of the households surveyed have at least one or two male and female. Households with only one male account for 33% while those with only one female make up 31% of the surveyed households. The

individuals found in the households of the surveyed population are mostly between the ages of 20 to 35 years with most households having two dependents. The number of dependents is determined by individuals under the age of 20 years and over the age of 60 years and the number of individuals who are unemployed. Approximately 64% (109) of the respondents are currently in paid employment with 39% of the households having at least one person in paid employment. In addition, secondary education is the most common education attained with 40% of the respondents (68 individuals) not achieving more than secondary education. Only thirty-nine respondents (23%) have tertiary level education and were outnumbered by those with only primary education at fifty-one respondents (30%). Vocational or technical training is low in the area at only 5%.

The majority of the respondents have been living in the community for over a decade with (41%) of the respondents residing there for over 20 years and another 25% for 11 to 20 years of residence (**Table 6-3**). Information gathered from them can be considered valid based on years of experience and familiarity with the area. Only twenty-two individuals, representative of only 13% of the respondents have been residing in the area for five years or less. The respondent population is also a mature one with only sixteen (9%) under the age of twenty years and the majority between the ages of 20 – 39 years and 40 – 59 years at 38% and 22% respectively.

Table 6-3: Age and Years of Residency of Respondents

Community ► / Parameter ▼	N 05 Carrick Foyle	N 06 Granville	N 07 Green Perk	N 08 Maxfield/Greenside	N 09 Holland	N 10 Sewage Filter Plant	N 21 Race Course	N 22, N 59, N 60 Martha Brae	N 23 Hague	N 24 Clifton	N 58 Irwin Tower	N 61, N63 Schawfield, Merrywood	N 80 – Top Hill	TOTAL
AGE RANGE														
Under 20	0	1	1	2	4	3	2	1	0	1	1	0	0	**16**
20-39	1	5	7	3	12	4	6	10	4	6	2	5	0	**65**
40-49	7	1	4	2	4	2	0	6	1	5	1	3	1	**37**
50-59	2	0	0	2	5	1	3	6	1	3	0	2	1	**26**
60-Over	2	0	0	3	5	1	2	8	0	0	0	3	0	**24**
NR	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Total	**12**	**7**	**12**	**12**	**30**	**11**	**13**	**31**	**6**	**15**	**4**	**13**	**3**	**169**
YEARS OF RESIDENCY														
0-5 Yrs	0	0	5	1	1	1	2	4	1	4	1	2	0	**22**
6-10 Yrs	3	1	2	3	4	2	2	1	4	5	0	2	0	**29**
11-20 Yrs	0	3	2	7	8	6	4	7	1	0	1	3	1	**43**
20+ Yrs	8	3	2	1	17	2	4	17	0	5	2	6	2	**69**
No Response	1	0	1	0	0	0	1	2	0	1	0	0	0	**6**
Total	**12**	**7**	**12**	**12**	**30**	**11**	**13**	**31**	**6**	**15**	**4**	**13**	**3**	**169**

6.4.2 Findings

6.4.2.1 Housing and Amenities Characteristics

The majority of houses in the area are constructed with concrete based material, accounting for approximately 34% (58) of the households covered. This was closely followed by block and steel (33%) and wood (31%). In must be noted that some respondents indicated a combination of wood and concrete, for which the material covering a larger portion of the house was used. Seventy-five percent (75%) of the households surveyed were detached housing with semi-detached housing being significantly fewer in number accounting for only 17% of the housing stock in the area. Other dwelling types identified include part of a house and part of a commercial building. However, these dwelling type together account for less than 10% of the housing in the area. Home ownership appears to be high in the area as a majority of respondents (68%) suggested that they owned the property. However, rental properties and squatters were also prevalent, but to a lesser degree, accounting 15% and 12% of the households respectively.

Most of the houses are serviced with electricity with 114 households (88%) indicating it as their source of lighting. However, there are some residents without electricity such as those using kerosene (6%), and those with no light (3%).

Similar to the access to electricity, the availability and provision of water in the area appears to be satisfactory with a total of 159 (95%) households having water either by indoor tap or outdoor tap (**Figure 6-2**). Of this total, one hundred and fourteen (114) households, accounting for approximately 68% of the respondents, indicated having water from indoor tap and the other forty-five (27%) having outdoor tap as their water source. The use of public stand pipes and rainwater still exist in some communities, but accounts for a small number of households which make up a minor 4% of the household surveyed.

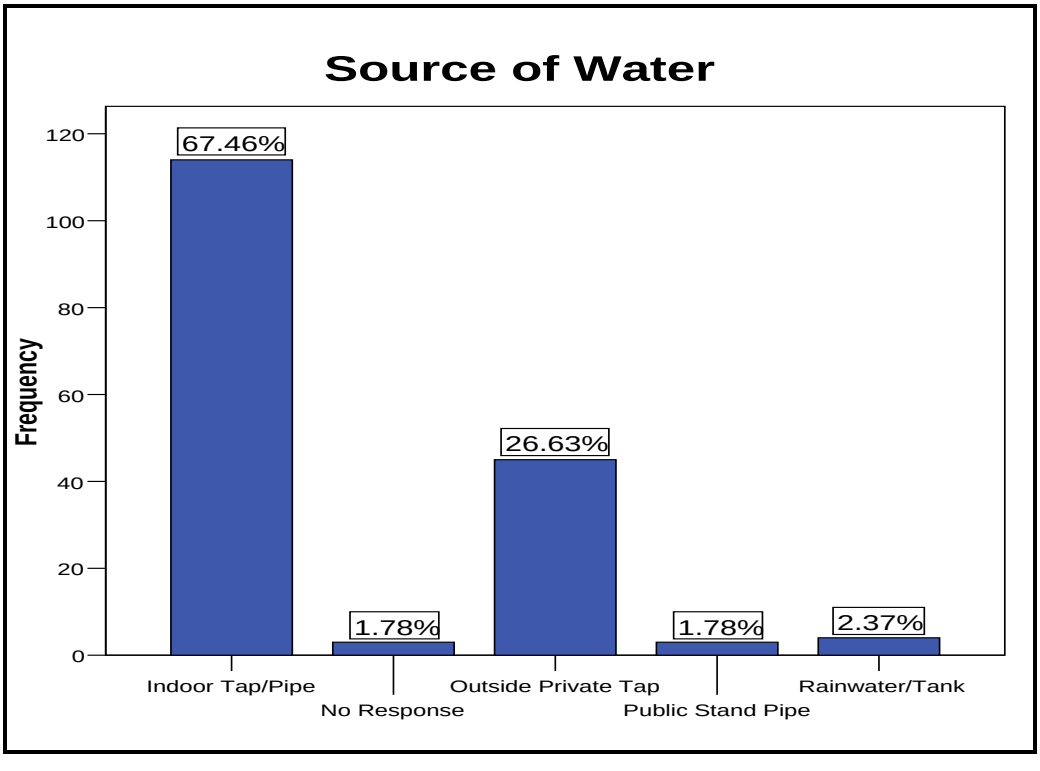


Figure 6-2: Bar Chart showing major source of water in the areas surveyed

The high availability of water and the prevalence of indoor tap as the water source could be the major determining factor in the type of toilet facilities in the area. Table 3 shows the relationship between the household water source and the type of toilet facility used. It is evident that the most common toilets facility in the area is that with the water closet linked to sewer as it is present in approximately 60% (95) of the households surveyed. Of this ninety-five, approximately 73% were households that had indoor tap as the main water source, suggesting that there is positive correlation between the indoor tap and toilet facilities with the water closet linked to sewer. The majority of households with water closet linked to sewer were found in the communities of Holland and Martha Brae. Pit was the second most common toilet facility as indicated by 35% of the households surveyed. However, this was more common in households with outside private tap water source.

Table 6-4: Relationship between the toilet facilities and water source for households

		SOURCE OF WATER					Total
		Indoor Tap/Pipe	Outside Private Tap	Public Stand Pipe	Rainwater/Tank	NR	
TOILET FACILITIES	WC Linked to Sewer	79	13	1	2	0	95
	WC not linked to Sewer	4	3	0	0	1	8
	Pit	26	27	2	2	1	58
	None	5	1	0	0	0	6
Total		**114**	**44**	**3**	**4**	**2**	**167**

6.4.2.2 Opinions of the Community

Friendly people (37%), quiet community (24%), and no crime and violence (17%) are the most favoured community traits respectively. The preference of the respondents can be considered a reflection of the perceived safety rating given to the area. The 54% of the respondents surveyed that preferred the friendliness of the people and no crime and violence may account for the majority of respondents indicating that the community was either safe (63%) or very safe (32%).

Crime is evidently not a problem faced by residents in the area with less that 2% of the respondents highlighting crime and violence as an issue. However, there appears to be a need for improvement on the road networks which would account for the 36% of the respondents highlighting poor road conditions as the major dislike in their community. This was identified as the major dislike in all the communities surveyed except for Hague, Martha Brae, Holland and Sewage Filter plant, where unemployment was the most popular. Second to the poor road conditions, the other major issue is unemployment as identified by approximately 30% of the households surveyed. Flooding and garbage collection were also identified as problems in the communities. Flooding was mostly popular in Carrick Foyle, Holland, Green Park, Sewage Filter plant, Granville and Maxfield/Greenside, while garbage collection was a major dislike in Holland, Hague and Race Course.

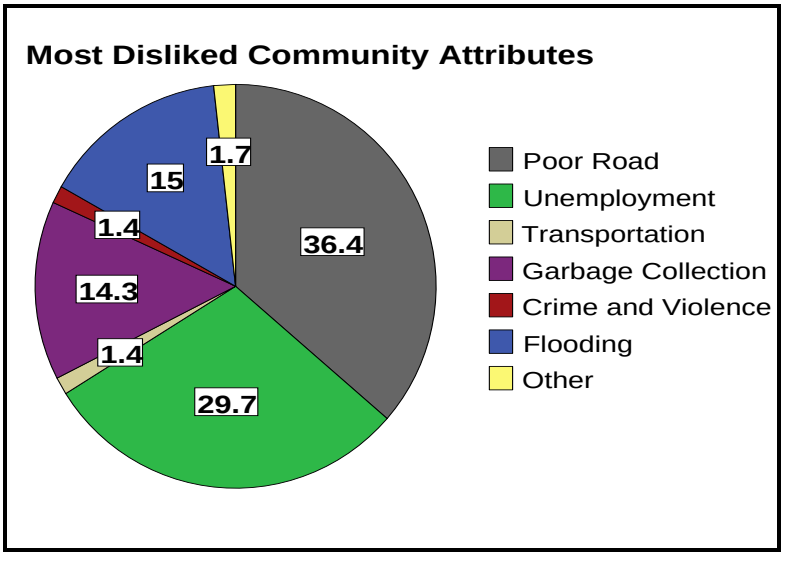


Figure 6-3: Most Disliked Community Attributes

None of the respondents surveyed believe the area is adequately serviced by a tertiary level institution. Residents are currently more satisfied with basic and primary level education with 86% and 68% of the respondents, respectively, indicating that the area is adequately serviced. There is generally high satisfaction with water supply, transportation and electricity among the residents as over 90% of the respondents stated that the area was adequately serviced by each. Although most residents expressed contentment with the provision of health services in the area, approximately 31% disagreed, stating that there is a lot more room for improvement. Police services and telecommunication (cable/telephone) were also relatively satisfactory (**Figure 6-4**).

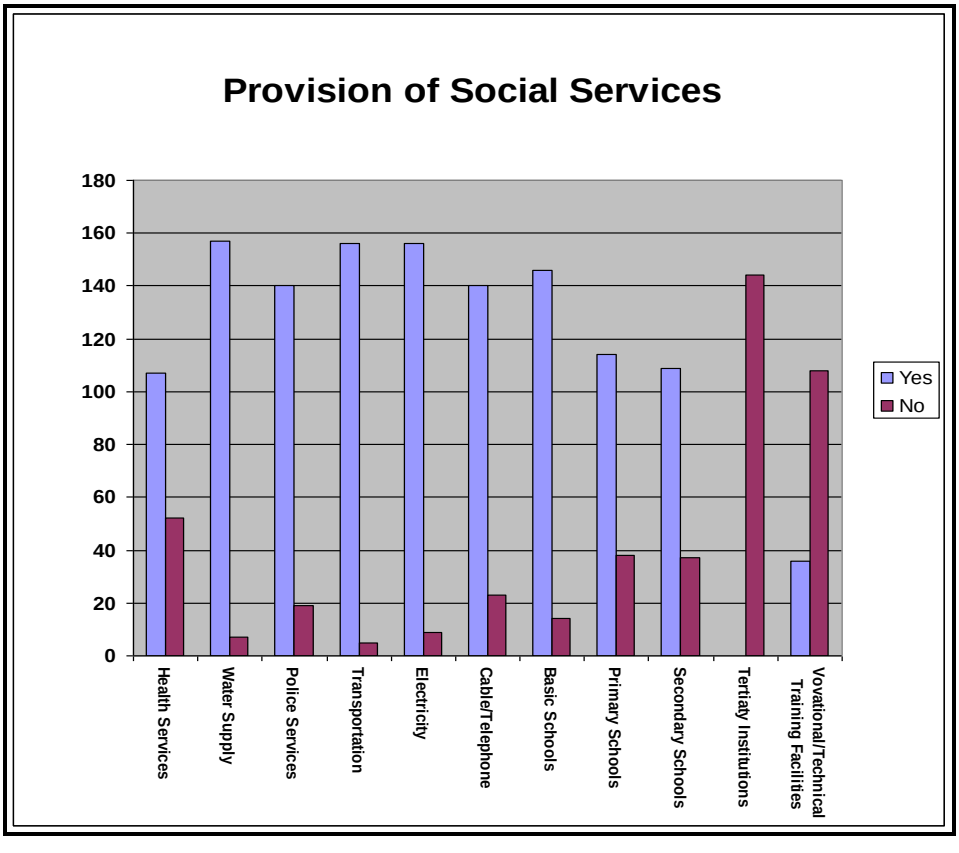


Figure 6-4: Household perception of the adequacy of social services

6.4.2.3 Knowledge, Attitudes and Perceptions related to Proposed Housing Development

Although knowledge and awareness of the proposed housing development at Holland Estate is relatively low, with approximately 41% of the respondent having knowledge of the proposed development, residents are greatly anticipating and are in favour of the development. While 97% (164) of the surveyed household have indicated that they are looking forward to the development, another 96% have expressed to be either strongly in favour, or in favour. Only one respondent (less than 1%) claimed to be against the proposed development. One half of the households (50%) are strongly in favour and another 46 % indicated that they are in favour of the proposed development (**Figure 6-5**).

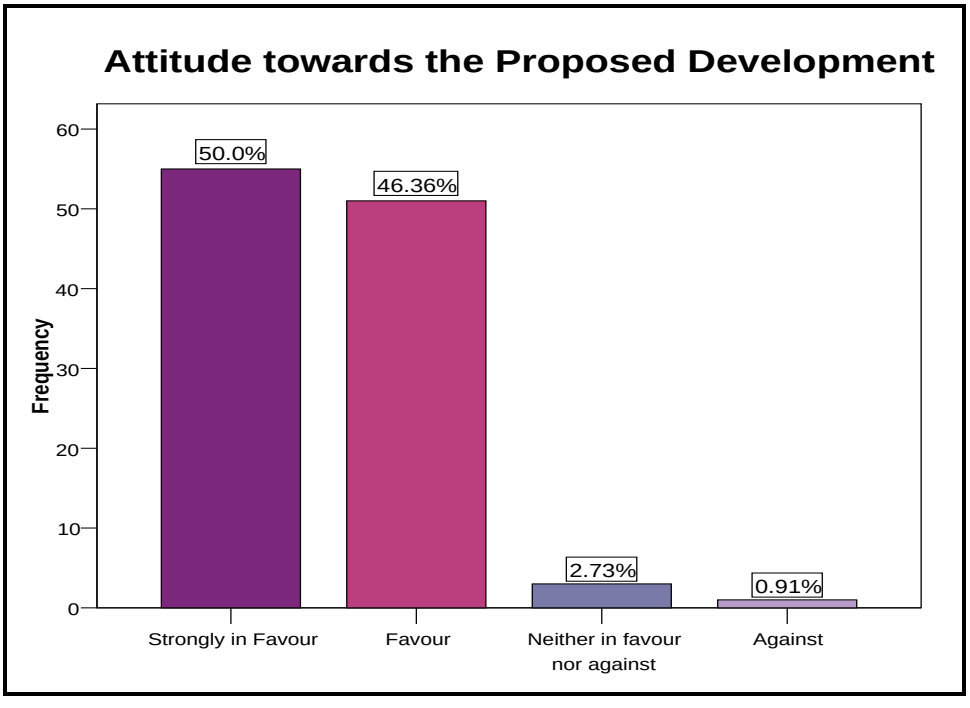


Figure 6-5: Attitude towards the Proposed Development

Feedback from the residents was generally positive when it relates to the perceived impact of the proposed development on the community. As is illustrated in **Figure 6-6**, the majority of the residents thought the development would have a positive effect on the economic value of the community and creating job opportunities, accounting for 81% and 91% of the households surveyed respectively. This is further supported by the statements of all the respondents who claimed that the area is expected to benefit from employment opportunities created and home ownership made possible. Other residents highlighted the influx of people into the area and positive impact on business activity. These dominate the responses of the residents as their reasons for favouring and looking forward to the proposed development. It was highlighted by a few residents that improvements to the drainage system and ultimate reduction in the occurrence of flooding after heavy rainfall are also expected.

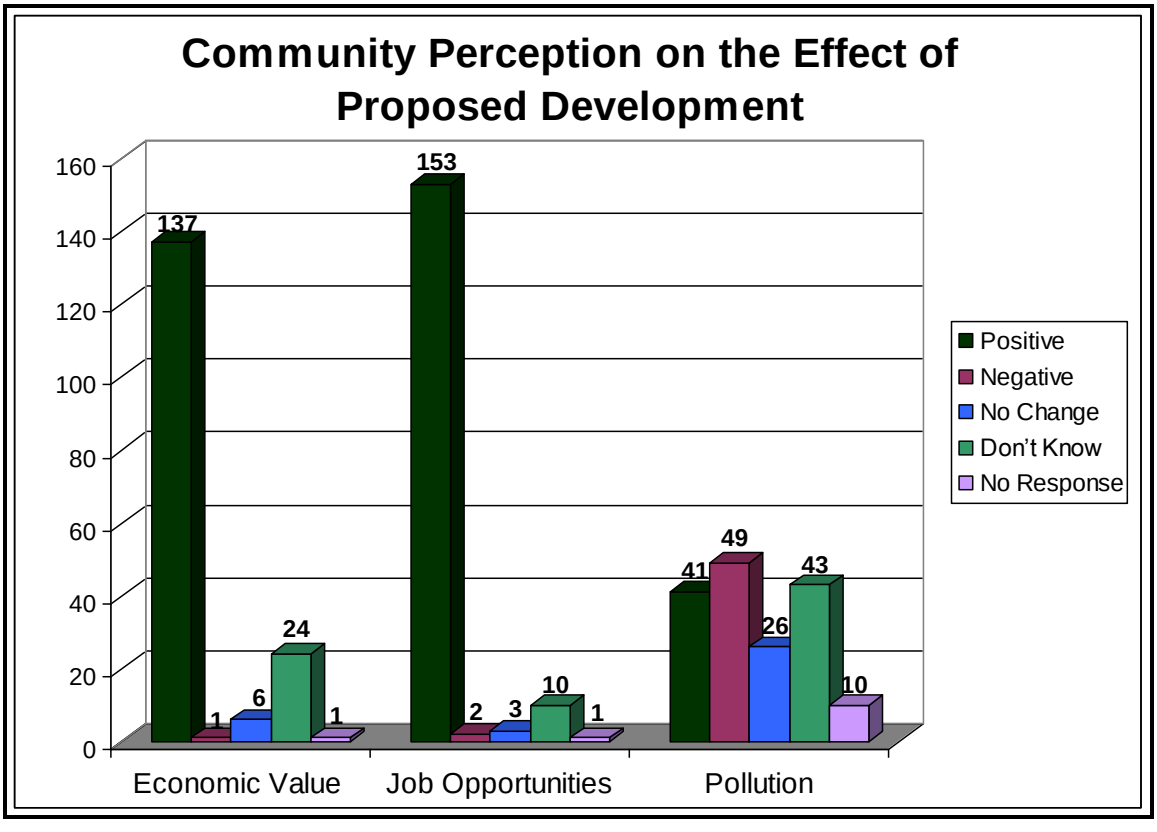


Figure 6-6: Community Perception on the Effect of the Proposed Development on Communities

It must be noted that most of residents (29%) highlighted that the proposed development will have a negative effect on pollution. However, an astounding 80% stated that they did not think the development will have a negative impact on the environment (**Figure 6-7**). The other 17% that thought it would have a negative effect mentioned the loss of trees, dust from construction and waste generation as potential impacts.

It is safe to assume that most of the residents did not think that the proposed development will impact significantly on the environment due to the fact that the majority of the respondents have no knowledge of sensitive natural resources on the site location. Approximately 95% of the respondents (160) indicated that there were no sensitive natural resources on the site, while 88% (148) indicated that there was nothing of cultural or historical significance on or near the proposed site. The 9% (14) of the households surveyed that implied the presence of such cultural resources quoted a water well, a windmill on the William Knibb School campus and the rafting village in Martha Brae as the cultural and historical resources on or near the site.

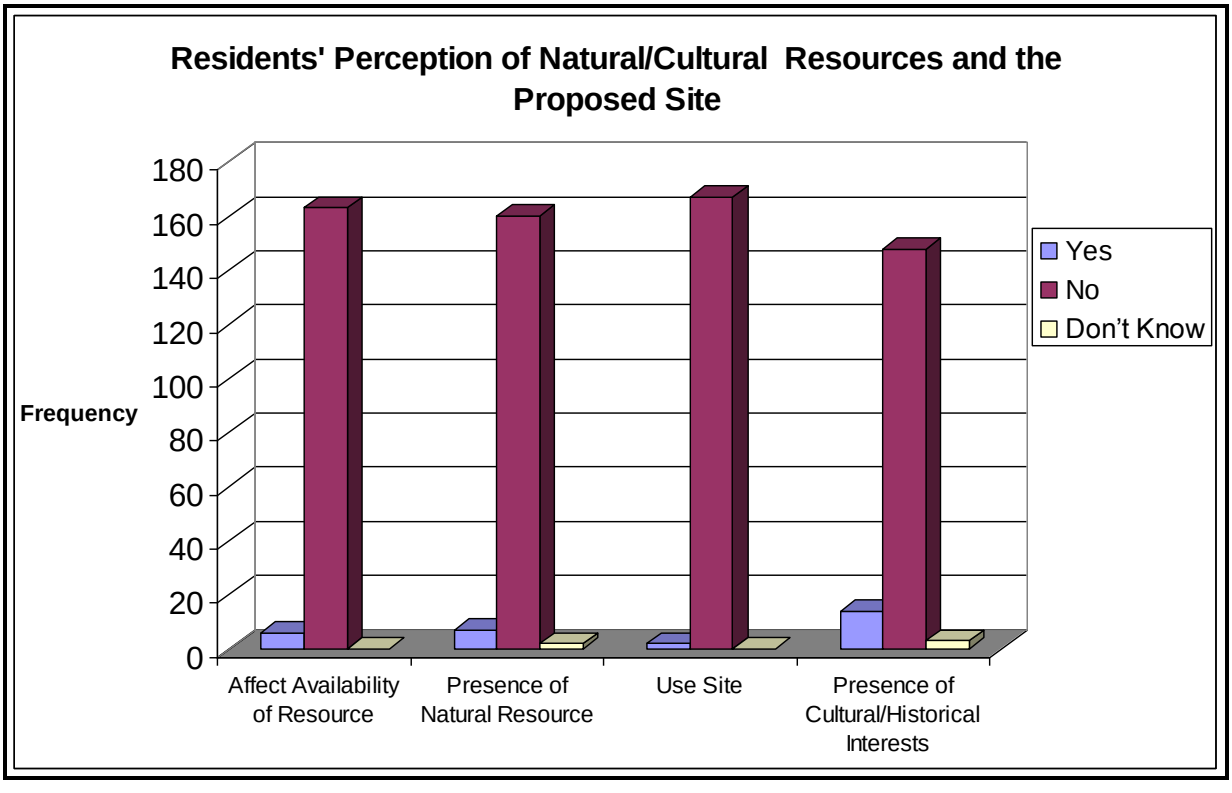


Figure 6-7: Residents Perception of Natural/Cultural Resources and the Proposed Development

It is also evident that not many residents use the site earmarked for the Holland Estate Housing Development. One hundred and sixty-seven respondents (99% of the surveyed households) state that they do not use the site. This corresponds with the fact that the majority of the respondents proclaimed that the proposed development will not affect the availability of any resource that they utilize. Those who expect to be affected expressed concerns for the availability of water (especially as it relates to water pressure) due to increased demands that would be associated with the proposed housing project.

6.5 Conclusions

The survey covered several communities and total of one hundred and sixty-nine (169) households, which accounts for 7% of the households in the area defined as the sphere of influence of the proposed development. Interviews were conducted with a mature population with the age group 20 - 39 and 40 – 59 accounting for approximately 60% of the respondents, who have mostly been living in the area for over a decade. Their opinions and perception on current situations and prospective development are therefore considered critical and important in understanding the social ramifications that may be associated with the proposed housing development at Holland Estate.

With 88% of the households surveyed having electricity and 95% having access to water by either indoor tap or outdoor private tap no significant impact is expected on these amenities. Although pit toilets were prevalent in the area, being present in 35% of the surveyed households, the majority of the households (60%) had toilet facilities with water closet linked to sewer.

In addition, the provision of water, electricity, and transportation were among the services that the residents were most satisfied with, as expressed by over 90% of the households surveyed. Most

respondents expressed dissatisfaction with the provision of secondary and tertiary education facilities, cable and telephone, and lack of recreational facilities. The condition of the roads and unemployment in the area are major dislikes of the residents as indicated by approximately 36% and 30% of the households surveyed respectively. As such, there is a general consensus of anticipation and approval of the development amongst residents with 96% of the household surveyed being in favour of the development and 97% of the respondent eagerly anticipating the development.

Approximately 96% of households surveyed indicated a need for development in the area which will in part be satisfied by this project. Although most respondents (129) claim that they will not be affected personally, 96% (124) of these respondents believe the area needs the development.

Employment, home ownership possibilities, increased business and economic activity, and more opportunities for the youths, were the most cited factors by respondents as benefits to be attained by the community. As stated earlier, unemployment is a major problem in the area with 34% of the respondents not currently being in paid employment. With 44% of the respondents being employed or trained in construction related jobs, optimism is high as a result of potential employment. Although home ownership in the area is high, the 27% of the household that is either squatting or renting, are looking forward to the possibility of owning one of the houses to be constructed in the Holland Estate Housing Development. Along with other developments currently underway or proposed, this project will go a far way to solving the housing need in the Greater Falmouth area.

Additionally, it should be emphasized that there exists the possibility for areas to be provided for a university in light of the need for tertiary education which was a major concern of respondents in the area.

The residents expect mostly positive impacts from the proposed development, highlighting that there were no sensitive natural resources or anything of cultural significance on the proposed site. The removal of trees and generation of dust were the cited impacts on the environment. The majority of the residents thought the development would have a positive effect on the economic value of the community and creating job opportunities, accounting for 81% and 91% of the households surveyed respectively.

DETERMINATION OF POTENTIAL IMPACTS

7 Determination of Potential Impacts

7.1 Introduction

The proposed development has the potential to create a variety of impacts if it is implemented. These potential impacts can be either positive or negative depending on the receptors involved and other parameters such as magnitude, duration, project management and monitoring. Since this report is geared primarily towards identification of potential environmental impacts their definitions and significance are presented in greater detail in the appendix, especially to assist the public review process (**Appendix VII**).

In assessing the significance of potential impacts, various measures are used. These include the use of checklists/matrices, expert knowledge and a keen assessment of the project plans and details. Each parameter is evaluated according to the following:

- *Potential impact* - any change to the environment, whether adverse or beneficial, wholly or partially resulting from the proposed activities, products or services
- *Activity* – phase of development that action takes place in
- *Environmental receptor* – sensitive component of the ecosystem that reacts to or is influenced by environmental stressors
- *Magnitude* – A measure of how adverse or beneficial an effect may be
- *Duration* – the length of time needed to complete an activity
- *Significance* – A measure of importance of an effect
- *Mitigation* – Measures taken to reduce adverse impacts on the environment

Outlined below are the various phases of the proposed development on which assessments of potential impacts will be based, namely:

- Physical environment
- Biological environment
- Socio-economic environment

Mitigation measures are provided, where necessary, within the impact identification tables.

7.2 Impact Identification & Mitigation

This project will provide employment opportunities during all phases of the project. Additionally, the developers intend to utilise existing contractors and engineers, where available in the immediate area, who may seek to employ residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there.

Foreign Exchange Earnings/Benefit to Economy – The proposed development represents an investment of at least J$5.5 billion to the Jamaica economy in new investment. The Island should see increased revenues from Income, Royalties and General Consumption Taxes related to the construction of the

development and the subsequent revenue such as land tax that will be generated from each housing unit. Similarly, the local economy of the area will benefit from increases in goods and services in the general area. This is a significant positive, both direct and indirect, long-term impact on the economy of the communities and the country.

The following tables provide a clear indication of potential environmental impacts associated with this development, and provide information on potential receptors, duration, magnitude, and mitigation measures. Since these are potential impacts, there is no certainty that they will materialize. However, the developers will be prepared to address any adverse potential impacts should they arise, during any phase of this project.

Mitigation costs associated with this project have been incorporated into the overall development cost and are not detailed in the mitigation assessment.

7.2.1 Impacts to Physical Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Aesthetics							
Pre-Construction, Construction, Operation	Humans	***Item A1*** – The clearance and removal of vegetation from the development lands will result in a visually negative impact as it represents a change from what is customary. Similarly, the construction site. All activities on the site will be carefully examined to ensure as little impact on the surrounding community as possible	Low & Short-term	Limited & Minor Negative	High & Direct (Cumulative)	Land should only be cleared based on the phased development approach. This will allow for the development lands to remain largely vegetated. The proper upkeep and maintenance of the construction site will significantly reduce the potential for this impact. Vegetation cover should be maintained along the property boundaries, where possible to reduce the visual impact. Where necessary, hoarding of not less than 2.4 m above ground level should be provided along the entire length of that portion of the site boundary except for any site entrances or exits. Other measures include: minimizing height of temporary structures, replanting of disturbed vegetation, and the re-use of topsoil stripped during site clearance. A management and operation plan will be implemented so that the development can be properly maintained. Effective monitoring and solid waste storage and disposal must be put in place so that the cleanliness of the facility and its environs is maintained.	Minor
Geological and Geotechnical							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item GG1*** – In a few areas, slope reinforcement and stabilization may be required to eliminate the potential for erosion. If the overall contour is maintained and vegetation cover is retained at these potential hotspots, the potential for erosion to occur should be reduced.	Minor & Long-term	Local & Minor Negative	Low & Indirect	Construction planning and monitoring should ensure that all agreed slope reinforcement and stabilization designs are properly implemented.	Minor
		Item GG2 – The inclusion of existing drainage features (which will be upgraded, where necessary) into the project's overall drainage design will allow for better control and management of stormwater. This will reduce or eliminate any erosion.	Minor & Long-term	Local & Minor Negative	Low & Direct	A properly designed drainage system will be a feature of the proposed development. Once implemented along with other protective measures it should provide adequate protection from any residual flooding during heavy and prolonged rainfall. The development will seek to improve on the current stormwater surface flow and reduce or eliminate the residual flooding that currently obtains. Vegetated areas outside the design footprint must be maintained to reduce the risk of erosion. Stockpile material near drainage corridors must be bermed.	Minor
Water Quality, Surface Water Hydrology and Groundwater							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item WQ1*** – The impacts on groundwater for this development is expected to be negligible. The primary waste stream will be surface water	Low & Long - term	Local & Minor Negative	Low & Indirect	The water quality of these systems will be evaluated on a periodic or event basis to determine if negative impacts are being realised. The project monitoring phase will play a major role in this activity. The mangrove will also provide natural filtering	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
		run-off and treated sewage effluent. The coastal waters are not expected to be impacted if significant because there exist a substantial stand of mangroves that will also assist in reducing water quality impacts.				systems It is recommended that portable chemical toilets be used at the site and that the tertiary treatment system to be put in place must meet or exceed NEPA's Trade Effluent and/or Irrigation Standards All drainage features must be designed as stipulated by the NWA and outlined in this report.	
Air Quality							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item AQ1*** – During site clearance and construction activities, there is a possibility that stockpiles of various materials associated with the proposed project may have to be maintained in the project area. These stockpiles, without proper management and monitoring can dry out and result in fugitive dust formation which can be dispersed in the wind affecting local air quality. This is a short term, reversible and mitigable impact.	Moderate & Short -Term	Local & Minor Negative	Low & Indirect	All stockpiles of construction material should be kept onsite for a minimum amount of time. This will limit the potential for stockpiles drying out and becoming airborne. If unavoidable, the stockpiles should be wetted or in the worst case covered to limit dispersion of dust. Stockpile material that may generate fugitive dust should be totally covered during transportation on land (truck). Proper personal protection equipment (PPE) devices such as face mask should be provided to workers as necessary. The developers do not intend to have a batching plant on site.	Minor
		Item AQ2 – Various mechanical equipment and vehicles are expected to be used at the project site. The heavy duty vehicles are expected to be primarily diesel fuel vehicles. When properly maintained heavy duty vehicles can operate without causing a significant decrease in air quality. However, if maintenance is poor, excessive fugitive emissions may result.	Low & Short-Term	Local & Minor Negative	Low & Indirect	Heavy duty equipment and vehicles using diesel fuel must be properly maintained and inspected at regular intervals. As much as possible, all vehicular maintenance should be done at an approved off-site maintenance location such as a garage. Vehicles causing excessive fugitive emissions should be removed from service.	Minor
		Item AQ3 – The removal of vegetation from the site during site clearance activities may increase the potential for particulate matter to get into the atmosphere. This is as a result of exposed soil that may dry out.	Moderate & Short-term	Local & Minor Negative	High & Direct	During site clearance activities, the area must be monitored and dust suppression techniques applied, where necessary. Phase development must be adhered to as stated in the project description to limit the amount of area with exposed soil.	Minor
Noise							
Pre-Construction, Construction, Operation	Humans and Fauna	***Item N1*** –Vehicles and site activities, and various mechanical equipment, can generate noise that may exceed acceptable levels.	Low & Medium-term	Local & Minor Negative	Medium & Direct	Silencers or mufflers on construction equipment should be properly fitted and maintained. If site activities are known to be noisy, they should be scheduled at times least likely to impact those in hearing distance.	Minor

7.2.2 Impacts to Biological Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Faunal Resources							
Pre-Construction, Construction, Operation	Fauna	***Item WR1*** – The potential for the loss of wildlife resources exists within the immediate area. This loss is temporary since any resident wildlife will temporarily relocate to surrounding areas that are not affected. No region-specific wildlife resource occupies the area that will be endangered should this project be permitted. The retention of some mature trees and the proposed landscape plan are intended to provide some mitigation for the loss of habitats. The project will also be phased negating any whole-scale clearing of the property.	Moderate & Long-term	Local & Minor Negative	High & Direct	The removal of ecological habitats is unavoidable notwithstanding the fact that the area is disturbed. Wildlife is mobile in nature and will more than likely relocate to other areas in the vicinity where they are less likely to be in danger. The phasing of the development will also allow for the retention of some habitats though only temporary. The maintenance of buffer areas will also provide for "corridor" pathways to existing forested areas adjacent the property. Those deemed important will be tagged, relocated or otherwise placed in a nursery during site clearance and construction to be restored in the immediate vicinity. Special effort should be made to protect the large Guango and Red Birch trees on the property. They serve as habitats for a range of organisms particularly birds.	Minor
Floral Resources							
Pre-Construction, Construction, Operation	Flora	***Item VR1*** – In order to construct this development some aspects of the existing vegetation will be removed. This presents a loss of biodiversity within the immediate area. Established habitats will be lost. No region-specific endemic plant species were found in the area.	Major & Long term	Local & Major Negative	High & Direct	The removal of vegetation and ecological habitats is unavoidable and is the main trade-off to be made against the benefits to be derived from project implementation. The proposed phased clearance must be adhered to. Vegetation should only be removed within the design footprints. Any landscaping measures to be put in place must incorporate plants that are growing in the area only.	Minor

7.2.3 Impacts on Socio-Economic & Socio-Cultural Resources

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Employment & Worker Health & Safety							
Pre-Construction, Construction, Operation	Humans	***Item E&HS1*** – This project will provide employment opportunities during all phases of project implementation, which will include residents of the surrounding communities due to their proximity to the project site, and their knowledge of the area and operations there.	Major & Medium-term	Regional & Major Positive	High & Direct	No mitigation required.	Positive
		Item E&HS2 –Occupational Safety Risk are associated with any working condition. This is primarily important where workers interact with moving and heavy equipment.	Moderate & Medium-term	Local & Minor Negative	Low & Direct	Proper PPE should be issued to workers depending on the area they work in. This should include boots, ear muffs, goggles, gloves and hard hats at a minimum, where necessary. Management should ensure a safety training exercise is conducted for all categories of workers. Compliance audits and accident/injury records must be kept throughout the duration of the project.	Positive
Water Supply							
Pre-Construction, Construction, Operation	Humans	***Item WS1*** – The main water requirements will be during the construction and operational phases. The project intends to provide more than 1000 housing units. This will require significant amounts of water annually. Preliminary discussions with the NWC have indicated they will be able to supply the required water supply.	Moderate & Long-term	Regional & Minor Positive	High & Direct	The developers intend to utilise conservation measures such as low flush toilets and water conserving shower heads. Additionally, the units will have water harvesting amenities such as roof drain gutters for collecting rain water. Additional measures such as water harvesting and storage should be encouraged.	Positive
Electricity							
Pre-Construction, Construction, Operation	Humans	***Item E1*** – The project intends to provide more than 1000 housing units. This will require significant amounts of electricity annually. Although the country has been dealing with a major energy bill, JPSCo has indicated they will be able to supply the required energy demand.	Moderate & Long-term	Regional & Minor Positive	High & Direct	The developers intend to utilise pre-approved development plans that will allow for a budgeted build-out of the full development.	Positive
Fire-Fighting Capability							
Pre-Construction, Construction, Operation	Humans	***Item FF1*** – This new development will add to the service area that must be covered by the Jamaica Fire Brigade in Trelawny. There is only one fire station servicing the entire parish. The resources of the station will be stretched with the addition of more development projects in the parish.	Major & Long-term	Regional & Minor Negative	Medium & Indirect	The development will adhere to existing building codes that are reviewed by the Jamaica Fire Brigade with respect to fire safety. The necessary number of fire hydrants will be installed throughout the development. Each unit will also adhere to the required exit and entry, and setback limits. It is hoped the government will re-evaluate the available resources for the parish and ensure there is adequate coverage in light of the	Positive

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
		The development is located less than 5km from the station that offers fire-fighting and EMT services. Response time should be adequate.				proposed developments expected in the near future from this and other developments.	
Health-Care Facilities							
Pre-Construction, Construction, Operation	Humans	***Item HC1*** – This development will add to the service area that must be covered by the Trelawny Parish Health Services The Falmouth Hospital was recently upgraded to a Type C facility.	Major & Long-term	Regional & Minor Negative	Medium & Indirect	The provision of health resources is controlled by the government. It is hoped the government will re-evaluate the available resources for the parish and ensure there is adequate coverage in light of the proposed developments expected in the near future from this and other developments.	-
Education Facilities							
Pre-Construction, Construction, Operation	Humans	***Item EF1*** – This development will add to the service area that must be covered by the Ministry of Education. There are educational institutions in the area of various types with adequate spaces.	Moderate & Long-term	Regional & Minor Positive	Medium & Indirect	This development has set aside land for the provision of an educational institution. It is expected that this institution will mitigate against the projected increase in the number of students within the immediate area. It is hoped the government will re-evaluate the available resources for the parish and ensure there is adequate coverage in light of the proposed developments expected in the near future from this and other developments.	Positive
Relocation/Compensation							
Pre-Construction, Construction, Operation	Humans	***Item RC1*** – The proposed development area is a private property. No squatting currently obtains on the property.	N/A	Local & None	N/A	No mitigation required.	Positive
Recreation & Heritage Sites							
Operation	Human	***Item R1*** – The project lands are not used for any recreational and/or heritage/cultural purposes. No known heritage resources are known to occur on the property. Much of the property has been used for agriculture in the past. The JNHT has expressed a request to have an Archaeological Impact Assessment (IAI) done prior to any pre-construction and construction works.	Minor & Short-term	Regional & Minor Positive	Minor & Indirect	The proposed development intends to provide lands for recreational purposes for the proposed population. As such it will improve the current standard in the area. Should an environmental permit be granted, it is recommended that a special condition be issued regarding the IAI by the JNHT to be conducted prior to the pre-construction activities such as site clearance. Based on the nature of the previous site usage and the proposed phase development, it is not anticipated that archaeological heritage resources will be found.	Positive
Traffic							

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
Pre-Construction, Construction, Operation	Humans	***Item T1*** – The existing main roads will be used to deliver and remove any materials, and equipment to and from the proposed site. The added vehicles and the frequency of their movement have the potential to add to the existing volume on the roads during peak usage periods.	Moderate & Short-term	Regional & Minor Negative	Medium & Direct	At a minimum, proper ingress and egress must be designed into the development plans to accommodate the smooth flow of traffic in and out of the development through all phases of the project. Heavy duty vehicles such as trucks should be scheduled to deliver and/or remove construction waste during off-peak times. Based on the existing and the projected traffic loads, and the current road allowance no significant impact is expected on the motoring public. The ingress and egress and accompanying signs must be installed prior to the handing over of any unit. The development must conform to Parish Council and the NWA requirements	Minor
Solid Waste							
Pre-Construction, Construction, Operation	Humans	***Item SW1*** – Site clearance activities during the pre-construction phase and other waste from packaging and materials in the other phases will generate solid waste. If these waste streams are not properly managed then the potential exists for a negative impact. A properly implemented and executed solid waste management plan can remove this negative potential.	Low & Medium-term	Limited & Minor Negative	Low & Indirect	All solid waste generated during all phases will be collected, handled and disposed of appropriately. Centralized storage areas (dumpsters, bins etc.) will be located within the development for proper solid waste handling and storage. Solid waste removal will be facilitated by using approved licensed haulage contractors during site clearance and construction phases. A comprehensive on-site waste management plan will be prepared for the construction period. Such a management plan will incorporate site specific factors, such as the designated areas for the temporary storage of solid waste. It is expected that the NSWMA through the Western Parks & Markets will handle solid waste generated by individual housing units once handed over.	Minor
Sewage Waste							
Pre-Construction, Construction, Operation	Humans	***Item SeW1*** – The potential for sewage waste pollution during site clearance and construction activities exist though remote.	Low & Short-term	Limited & Minor Negative	Low & Indirect	The use of regularly serviced portable chemical toilets will negate this potential negative impact. Sewage handling and disposal should be effectively managed as part of the project management and monitoring plans.	Minor
Storm Water Management							
Pre-Construction, Construction, Operation	Humans, Flora and Fauna	***Item SWM1*** – The potential for localised flooding exists during adverse weather conditions such as hurricanes, tropical storms and heavy downpours of rainfall during a short period of time. Adequate drains and retention ponds will be built to handle potential impact. There are no existing floodplain maps for the area.	Moderate & Long-term	Regional & Major Negative	High & Direct	The flood analysis detailed in this report and the accompanying drainage design must be adhered to. The area is prone to limited localised flooding. A swale drain historically allows water to enter the flat areas previously used for agriculture from the south east. Every effort must be taken to ensure there will be no flood potential for the units that will be constructed. Additionally, no flooding beyond what currently obtains along the perimeter boundary should be allowed to occur as a result of this project.	Minor

Activity	Environmental Receptor	Potential Impact	Magnitude & Duration	Extent/Location & Significance Level	Likelihood & Nature	Mitigation	Residual
						The developers have designed the drainage system in collaboration with accepted practice and guidelines required by the NWA	
Neighbouring Communities							
Pre-Construction, Construction, Operation	Humans	***Item NC1*** – There are a myriad array of potential impacts to the neighbouring communities from this development. Some are already outlined in this section. Other aspects such as community social structure, livelihood, and property values among other similar impacts may be impacted by this development.	Low & Long-term	Regional & Minor Positive	High & Direct	The design and other elements of the development should improve property values in the general vicinity of the project. The project is not expected to negatively affect the social structure and recreational resources of the surrounding communities. The aesthetics of the development should be a positive for the area despite the loss of the natural landscape.	Positive

7.3 Cumulative Impacts Identification & Mitigation

The potential cumulative impacts as a result of this development are as follows:

- Impacts to Biological Resources
- Impacts to Physical Resources
- Impacts on Socio-Economic and Socio-Cultural Resources

7.3.1 Impacts to Physical Resources

The surrounding economic zone comprises existing, future/planned developments such as hotel resorts, cruise ship port, and various new residential communities.

Water demands for the proposed development have been considered and will be met by the improved water system put in place in 2006. This system was designed to accommodate the Trelawny Multi-Purpose Stadium, the Harmony Cove Development and other developments particularly along this section of the north-coast. The cumulative impact of water supply to the development is not projected to be detrimental to existing users. However, the continued drought being experienced by the country is a cause of concern. All efforts must be made by the developers to encourage conservation of this precious resource during construction and throughout occupation of residences. Sewerage demands for the proposed development have been considered. No central sewerage system exists in the region. As a result, a tertiary level sewage treatment facility is being proposed to process all sewage waste that will be generated from this development.

The proposed project area is not known to be prone to land slippage and erosion. The area is known for its agricultural base in the past. However, the land has already been issued a "change-of-use" designation to residential/commercial. Although this will reduce the available agricultural lands in the immediate area, it is not expected to be a significant loss.

The development will add to the existing land-use pattern of residential development for the general region. This will go a far way to addressing the need for housing in the area. It will also serve as a base for the planned developments expected in the parish in the near future. This development is consistent with the general land-use planning goals and densities of the area.

7.3.2 Impacts to Biological Resources

Biological resources within the Greater Falmouth area are being impacted negatively through illegal charcoal burning, squatting and removal of mangroves among others.

It is not anticipated that the development will significantly add to any existing impacts resulting in worsening of that impact cumulatively. To the contrary, the reduction of squatting, illegal solid waste disposal and the illegal removal of trees for charcoal among other things will be reduced. The target market will ensure that some squatters may be able to legally afford a housing solution.

The loss of vegetation land is considered a major impact. Cumulatively, all current and future developments in the region will reduce the forested coverage in the area. This loss, though unavoidable, must be mitigated through landscaping measures as well as the provision of green/open space within the confines of the existing land.

Impacts to groundwater and surface water may be realized from this development. The increase in hard surfaces will contribute to increases in surface run-off. All measures must be taken to ensure that adequate drains are installed throughout the development. The area also suffers from a flood problem occasioned by heavy rainfall. All efforts must be taken to ensure no additional flooding takes place in the area by way of this development. The necessary detention ponds and drains must be installed to handle the projected increase in surface water. The development should retain as much as possible the large trees on the property to secure the micro habitats that they provide for fauna that can withstand human impacts.

7.3.3 Impacts on Socio-Economic & Socio-Cultural Resources

The socio-economic and socio-cultural resources of the Greater Falmouth area may be strained by the addition of this development. The development will increase economic opportunities through job creation. Additionally, the region will benefit from the increase in housing solutions that can satisfy the staff requirements for existing and future developments such as the cruise ship pier and the Harmony Cove development as well as the tourism sector. The commercial benefits to the parish of Trelawny will also increase as it positions itself to be among Jamaica's top economic earners.

Cultural resources in the region may receive a positive spin-off from this and other developments through visitations etc. The region will also be well positioned to benefit from improved services (utilities etc.) through this and other developments. However, despite these benefits, other areas may suffer without a resource incentive to ensure they can adequately address the needs of the increased population.

The parish of Trelawny falls within the Jamaica Fire Brigade's Area III which covers the parishes of St. Ann, St. Mary and Portland. The parish accommodates only one (1) fire station at Falmouth. With the projected increase in and type of developments for the parish it is expected the fire station at Falmouth will become strained in its fire-fighting and EMS capabilities. The GoJ needs to review the projected plans for the parish and ensure that the fire-fighting and EMS capabilities of the station at Falmouth is appropriate to handle the population and developmental increase expected. This development is approximately 10 minutes away from the Falmouth station.

There are nine (9) police stations within the parish of Trelawny. The closest to the proposed development is the station in Falmouth, approximately 10 min or less away. The Constabulary Force (JCF) and the GoJ are expected to upgrade this facility in the near future. The planned solution should be similar to the 100 man police station at Portmore in St. Catherine. Additionally, the JCF has recently (November 2009) upgraded the police post at Granville to the south of the proposed development to a police station. The cumulative project impact on police protection is therefore considered to be less than significant.

There are two potable water systems located on the nearby Martha Brae River. Martha Brae #1 is a rapid gravity filter plant with a treatment capacity of 1.5 million gallons per day. It supplies the areas of: Martha Brae, Hague, Falmouth, Coopers Pen, Carib Road, Salt Marsh and Wiltshire. This system is capable of providing potable water for the proposed development. The cumulative impacts on water resources in the Greater Falmouth area are considered to be less than adverse. The sewerage demands of the development will be handled through a newly built central tertiary sewage treatment plant. The cumulative impact is therefore negligible. Adherence to existing standards and regulations must be ensured through-out the construction and operation of the plant.

The immediate area is devoid of recreational services. The proposed development as outlined in Section 2 has identified and reserved areas suitable for recreational use. Significant green/open areas have been provided to ensure the residents of the development will not be limited in recreational options.

The parish of Trelawny has one Type C Hospital at Falmouth. This facility was recently upgraded to a 60-bed facility with amenities such as: an operating theatre, a surgical ward, a medical ward, a delivery room, an emergency department, and a paediatric room. The parish does not have a facility that can offer tertiary treatment. These cases are referred to the Cornwall Regional Hospital in Montego Bay. There are approximately nineteen (19) health centres in the parish. Though the health services may be considered adequate currently, it should be noted that the increase in development projects, particularly housing and resort developments will require more of the health services. The GoJ may need to examine the needs of the parish in light of projected increases in population and developments slated for the near future.

Based on the number and types of educational facilities in the parish it does not appear that the area is starved for these resources. The proposed project lies in an area that is serviced by approved infant, primary and secondary schools. There appears to be adequate educational spaces currently. However, it should be highlighted that principals of schools in the area have voiced concerns that increases in population in the area may adversely affect the number of spaces required in the near future. The development has set aside land for the provision of an educational facility to alleviate any pressure expected from the increase in population of the area.

The roads currently handle the volume of traffic adequately. However, with increase in population through developments such as these, there will be greater traffic volumes in the area in the future. The NWA must ensure that the proposed designs are carried out to specifications to ensure the continued smooth flow of traffic in the area. The necessary signage must also be put in place to warn the motoring public of the development during construction.

Solid waste generation is expected to increase significantly in the immediate area. Currently, it appears to be adequately serviced but there have been reports of incidences of poor collection. There are no approved disposal sites in the parish. The development must ensure there are adequate provisions made to address the issue of solid waste disposal once the solutions have been completed and handed over.

7.4 Impact Matrices

Table 7-1: Impact Identification of the Proposed Development

	EIA Activities																
	Site Preparation				Construction								Build-Out				
	Site Surveying	Site Clearance	Site Access	Solid Waste Generation &Disposal	Materials Sourcing	Materials Transport	Materials Storage	Construction Works	Solid Waste Generation &Disposal	Sewage Treatment &Disposal	Surfacing/Paving	Landscaping	Traffic	Solid Waste Generation &Disposal	Amenities	Effective Drainage	Landscaping
Physical Parameters																	
TOPOGRAPHY																	
GEOLOGY & GEOTECHNICAL																	
AMBIENT NOISE & VIBRATION																	
FUGITIVE DUST																	
DRAINAGE																	
NATURAL HAZARD VULNERABILITY																	
Ecological Parameters:-																	
TERRESTRIAL ECOSYSTEMS																	
TERRESTRIAL VEGETATION																	
AVIFAUNA																	
OTHER FAUNA																	
Socio-Economic Parameters:-																	
AESTHETICS																	
LAND USE COMPATIBILITY																	
EMPLOYMENT																	
SOCIAL SERVICES DEMAND																	
WASTE GENERATION																	
TRAFFIC INCONVENIENCES																	
CRIME POTENTIAL																	
HAZARD VULNERABILITY																	
SEWAGE DISPOSAL																	
OCCUPATIONAL HEALTH & SAFETY ISSUES																	

Table 7-2: Impact ID Matrix Key

KEY	
No Impact	
Minor Negative	
Major Negative	
Minor Positive	
Major Positive	

Table 7-3: Impact Mitigation Matrix - Residual Effect (Pre-Construction Phase)

	Proposed Mitigation Measures										
	Detailed Topographic Surveys	Effective Site Management	Solid Waste Management Plan	Effective Traffic Management	Road Paving and Surfacing	Dust Management Techniques	Proper Vehicle Maintenance	Monitoring	Security & Fencing	Effective Community Relations	Landscaping Plan
Impacts – Pre-construction Phase											
Clearing of Site Vegetation											
Levelling of Site											
Transportation of Construction Material											
Increase in Noise											
Increase in Dust											
Disturbance of flora and fauna											
Aesthetics											
Employment Potential											
Road Wear											
Occupational Health & Safety Issues											
Change in the Natural Drainage Patterns											
Solid Waste Generation & Disposal											
Sewage Waste Generation & Disposal											
Traffic Inconveniences											

KEY (See Appendix VII for definitions)					
Major		Minor		Positive	
Moderate		Negligible			

Table 7-4: Impact Mitigation Matrix - Residual Effect (Construction Phase)

	Proposed Mitigation Measures											
	Detailed Topographic Surveys	Phasing of Building Plans	Solid Waste Management Plan	Road Paving and Surfacing	Dust Management	Proper Vehicle Maintenance	Landscaping Plan	Effective Site Management	Security & Fencing	Monitoring	Effective Traffic Management	Effective Community Relations
Impacts - Construction Phase												
Preparation of Site												
Transportation of Construction Material												
Increase in Noise												
Increase in Dust												
Occupational Health & Safety Concerns												
Aesthetics												
Employment Potential for Community												
Traffic Inconvenience												
Road Wear												
Change in the Natural Drainage Patterns												
Solid Waste Generation & Disposal												
Sewage Waste Generation & Disposal												

KEY (See Appendix VII for definitions)

Major		Minor		Positive	
Moderate		Negligible			

Table 7-5: Impact Mitigation Matrix - Residual Effect (Build-Out Phase)

	Proposed Mitigation Measures					
	Effective traffic Management	Effective Drainage Plan	Solid Waste Management	Sewage Waste Management Plan	Community Amenities	Landscaping Plan
Impacts – Build-Out Phase						
Employment opportunities						
Sewage Treatment System Management						
Flooding Potential						
Solid Waste Management						
Water Conservation						
Energy Conservation						
Aesthetics						
Regulatory Compliance						
Traffic Inconvenience						
Fugitive Dust						

KEY (See Appendix VII for definitions)

Major		Minor		Positive	
Moderate		Negligible			

OUTLINE ENVIRONMENTAL MONITORING PLAN

8 Outline Environmental Monitoring Plan

8.1 Introduction

The Monitoring Plan to be devised for the development should be implemented during the pre-construction and construction phases of the project. Monitoring involves the observation, review and assessment of onsite activities to ensure adherence to regulatory standards and the recommendations made to reduce or eliminate potential adverse impacts. The Plan must be comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies based on a mutually agreed frequency. It is recommended that a minimum monthly monitoring report be submitted to NEPA.

The monitoring report will include at a minimum:

- Raw data collected
- Tables/graphs (where appropriate)
- Discussion of results with respect to the development in progress, highlighting parameters which exceed standards
- Recommendations
- Appendices with photos/data, etc.

At a minimum, the following activities will be monitored in the various phases:

8.1.1 Pre-Construction Phase Monitoring

- During site clearing activities, any trees that will be saved and incorporated into the development must be identified and protected. The plants to be retained should be flagged, and if necessary fenced. It is suggested that the developers assess a monetary value to be placed on each plant, for which the contractor will be made liable. Should the contractor damage or remove a flagged tree, the penalty should be assessed. An inventory and map (if applicable) of all trees to be retained must be developed. (Weekly Monitoring).
- Where identified, endemic and rare species should be preserved in place or collected for transplanting (As Observed).
- Stockpiles of soil and vegetative debris generated during site clearing activities should be monitored and maintained to eliminate generation of fugitive dust. (Daily Monitoring)
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

8.1.2 Construction Phase Monitoring

- Sewage - Ensure that temporary portable chemical toilets are available for construction personnel and that the contents are disposed by an approved waste hauler in an appropriate waste disposal facility. (Weekly Monitoring)
- Sand/Marl/Aggregate Supply - Routinely monitor sourcing of quarry materials to ensure supplier is obtaining supplies from licensed operations. (Monthly Monitoring)
- Solid Waste Management - Ensure that a solid waste management plan is prepared, and that workers are aware that no solid waste material should be scattered around the site. Monitor availability and location of skips/dumpsters. (Weekly Monitoring)

  Monitor the disposal of refuse to ensure that skips/dumpsters are not overfilled. (Weekly Monitoring)

  Routine collection of solid waste for disposal must be implemented, and disposal monitored to ensure use of approved disposal facilities. (Weekly Monitoring)
- Erosion/Siltation Management – Exposed soil areas must be monitored to determine potential for erosion, silting and sedimentation particularly during storm events. (Weekly Monitoring)

  If erosion, silting or sedimentation is a potential or occurs, immediate steps must be taken to negate their impacts, where applicable. (As Needed)
- Equipment staging and parking areas must be monitored for releases and potential impacts. (Weekly Monitoring)
- If any cultural heritage resources are unearthed during construction, activities should be stopped and the JNHT and NEPA immediately informed. (As Needed)
- Noise levels along the perimeters of the project area should be monitored and recorded to ensure that activities at the site are not exceeding standards. (Daily Monitoring)

8.1.3 Operational Phase Monitoring – During Phase Construction

- Sewage - Monitor effluent quality periodically to determine compliance with regulatory standards. (Monthly Monitoring or as determined by regulatory standards)
- Solid Waste - Monitor solid waste skips/dumpsters and removal contractor to ensure proper waste handling and disposal. (Weekly Monitoring)
- Drainage - Regular inspections of installed drainage systems should be performed to ensure that the drains remain clear of blockages to safeguard against flooding or damage to adjoining properties. (Monthly Monitoring).

8.2 Outline Environmental Monitoring Plan

This section outlines the main environmental parameters to be monitored, timing of the monitoring work and the recommended frequency of monitoring for general aspects of the proposed project. A

more detailed scope of work will be provided once an environmental permit with accompanying conditions have been issued, and will be subjected to NEPA's approval prior to the commencement of any pre-construction/construction work.

The main objectives of the proposed monitoring plan are:

1. to clarify and identify sources of pollution, impact and nuisance arising from the proposed works;
2. to confirm compliance with legal and contract specifications;
3. to provide an early warning system for impact prevention;
4. to provide a database of environmental parameters against which to determine any short term or long term environmental impacts;
5. to propose timely, cost-effective and viable solutions to actual or potential environmental issues;
6. to monitor performance of the mitigation measures;
7. to verify the EIA predicted impacts;
8. to collate information and evidence for use in public, NEPA, and any other required regulatory consultation; and
9. to audit environmental performance

The proposed environmental monitoring will take the form of site inspection and supervision. The two main phases of the project for which the proposed monitoring will cover are the pre-construction (baseline) and construction phases.

Environmental monitoring for dust and noise during the construction phase is recommended in order to ensure all proposed mitigation measures are implemented and effective.

Obtaining a suitable and representative baseline data set will be critical to the whole monitoring and audit process because it forms the standard against which environmental impacts are assessed. Thus, baseline monitoring for dust and noise will be required prior to the commencement of pre-construction and construction activities.

In addition, monitoring of mitigation measures to avoid impacts on various aspects of the development will be required during the construction period. Maintenance and monitoring will be the responsibility of the management team for the development.

The basic details of monitoring are discussed in the following sections and summarised in **Table 8-1** below.

Table 8-1: Framework for Environmental Monitoring Plan

Monitoring	Period	Parameters	Monitoring Frequency
Noise	Baseline (1 occasion)	Leq* (30 mins) GPS location	One set of measurements at selected locations (within and surrounding project site)
	Construction Phase	Leq (30 mins) GPS location	One set of measurements between 0700-1900 hours on normal weekdays once per

Monitoring	Period	Parameters	Monitoring Frequency
			week.
Air Quality	Baseline (1 occasion)	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (24 hour sampling) at selected locations.
	Construction Phase	Total Suspended Particulates, wind speed/ direction GPS location	One set of measurements (1 hour sampling) between 0700-1900 hours on normal weekdays once per week. , At selected locations, identified with the assistance of the local governing body, NEPA
Waste	Baseline	Visual Survey of area around proposed sites	Once
	Construction Phase	Routine supervision of construction works	As per site inspection schedule
Landscape/ Visual Resources	Construction Phase	Survey of protection measures for trees and landscaping GPS location	Once every two (2) months during construction works
	Operational Phase	Survey of establishment of planting	Once every four (4) months for a one year period after completion of the works.
Chemical Waste & Control of Spills	Construction	Materials and chemicals that will be used during construction	Once per week during construction works
Construction Camps	Construction	Establishment and operation	Once per week

Note (1): Should the construction schedule require works in restricted hours, monitoring in the form of 3 consecutive $L_{eq\ (5mins)}$ readings should be taken.
Leq: One of the more common descriptors used to characterize the fluctuating noise levels is called the Equivalent Sound Level or Leq. The Leq sound level is the steady A-weighted sound energy which would produce the same A-weighted sound energy over the same given period of time as the specified time-varying sound.

8.2.1 Specific Action and Limit Levels

Monitoring stations will be set up at representative sensitive receivers and the results will be used to ensure compliance with determined performance criteria, based upon specific action and limit levels. The definitions of these are as follows:

- the Action Level represents a level at which some appropriate action will be required to prevent conditions deteriorating to the extent that statutory or guide criteria are breached; and
- the Limit Level represents the upper limit permitted and is generally equivalent to the statutory levels specified in legislation

8.2.1.1 Noise

To minimise the amount of noise generated at the construction site, a Noise Control Plan will be prepared.

The construction noise level will be measured in terms of the A-weighted equivalent continuous sound pressure level (L_{eq}). L_{eq} measurements will be taken during 30 minutes of typical construction activity during unrestricted periods. No work during restricted periods is anticipated at this stage; however, three consecutive $L_{eq\ (5mins)}$ readings will be taken to monitor the noise during these periods if required.

Sound level metres in compliance with NEPA specifications will be used for carrying out the noise monitoring, in accordance with any Specific Conditions issued under the Environmental Permit. The noise measurements should be carried out 10m from the worst affected external receptors and not be made in the presence of fog, rain or excessive steady or gusty wind.

The proposed construction phase sampling frequency will be once per week and action and limit levels for work during the unrestricted period, and restricted periods for reference, are shown in the table below.

Table 8-2: Action and Level Limits for Construction Noise

Time Period	Action Level	Limit Level
Unrestricted Period Normal work days (0700 -1900)	When one documented complaint is received	75 dB(A)
Restricted Period 1 All days during the evening (19.00-23.00) and general holidays (including Sundays) during the daytime and evening (07.00-23.00)	When one documented complaint is received	65 dB(A)
Restricted Period 2 All days during the night-time (23.00-07.00)	When one documented complaint is received	45 dB(A)

8.2.1.2 Air Quality

To minimise the emissions from vehicles and equipment used for construction activities, and minimise fugitive dust from construction areas and unpaved roads within construction areas, an Emissions & Dust Control Plan will be prepared.

Monitoring of the Total Suspended Particulates (TSP) levels shall be carried out to detect any deterioration in air quality and so enable early action to be taken for impact prevention or amelioration. One 24-hour TSP levels shall be measured, at designated levels e.g. once per week, to indicate the impacts of construction dust on air quality using direct reading methods. Other relevant data that will need to be recorded will include the prevailing weather conditions, namely wind speed and direction and rainfall. Also, any other point sources with photographic evidence.

The sampling frequency will be once per week. Action and limit levels are shown in the following table.

Table 8-3: Action and Level Limits for Air Quality

Parameters	Action	Limit
24 Hour TSP Level (µg/m³)	For baseline level ≤150 µg/m³, action level = average of baseline level plus 30% and limit level For baseline level >150 µg/m³, action level = limit level	150 µg/m³

8.2.1.3 Waste

Supervision of the construction works should be undertaken during site inspections to ensure that waste material is being properly stockpiled and handled. Any malpractice should be reported and remedial measure recommended.

Table 8-4 below lists the manner in which each type of waste will be managed.

Table 8-4: Waste Material Management during Pre-Construction and Construction Phases

Type of Waste	Description	Fate or Deposition
Plant material and cuttings	All plant material, including invasive plant removal, shrubs and trees removed from project site	Chip and compost small material, recycle tree logs as needed or disposal in an approved landfill
Construction debris	Large pieces of non-toxic waste from packing material, concrete, wire and lumber	Lumber recycled in landscaping where possible, Unusable material compacted and disposed of at an approved landfill
Recycled material	Glass, tin, paper, and plastic	Any material that can be recycled in the operations or otherwise should be recycled
Sewage and wastewater treatment	High organic content, potential public health hazards	Tertiary treatment facility , Composting and/or chemical toilets

8.2.1.4 Landscape and Visual Aesthetics

To minimise vegetation clearing for construction activities and control erosion and sedimentation from disturbed areas a Vegetation Clearing Plan will be prepared. This will include specifications for the removal of vegetation from the construction areas and the management of runoff from disturbed areas, and will utilise site vegetation surveys and construction plans to mark out areas to be cleared. It will also be informed by the phase construction design.

The landscape and visual mitigation proposals comprise a combination of preventive measures to protect the existing landscape resources, including careful layout of development avoiding the loss of mature trees and or plants identified for saving, as well as new tree and shrub planting. To ensure these impacts mitigation measures are carried out satisfactorily, monitoring during the pre-construction and construction phases are proposed.

An assessment of landscape character will be made against which future change can be monitored. The landscape resources and elements of particular concern will be noted. Reference to the terrestrial findings included in the EIA shall be made.

Trees identified for protection or transplanting shall be identified at the outset of the construction contract and all approved protection measures such as hoarding and fencing, and nursery setup shall be in place prior to any excavation or site formation works. The tree felling, transplanting, protection and new planting works shall be carried out with the assistance of NEPA.

Upon completion of the works, monitoring of the maintenance and establishment works to all planted areas shall be undertaken for a 12 month period over the responsibility management structure put in place. Inspections of the works shall be undertaken at scheduled instalments during the establishment period to ensure the intended mitigation of landscape and visual impacts is achieved. That is, the trees and shrubs planted or kept create the desired screen and provide a fully vegetated cover.

8.2.1.5 Soil Conservation

Soil erosion rates, slope stability, effectiveness of soil conservation measures should be monitored at frequent intervals during construction, as necessary.

8.2.1.6 Chemical Waste & Control of Spills

The objective to minimise the potential for impacts associated with handling, storage, use and disposal of any chemicals on site during construction. A Chemical Waste & Spillage Management Plan will be prepared, which will include implementation and monitoring of the use of chemicals and chemical wastes to cover materials such as fuel and oils, paints, solvents, and concrete additives.

8.2.1.7 Traffic and Access

To implement measures to manage traffic and access on the construction site during construction works, a Traffic and Access Management Plan will be prepared and should be monitored by the Police and NWA, as necessary.

8.2.2 Reporting

Deliverables in the form of the baseline survey reports and regular and summary environmental monitoring reports should be prepared in accordance with any requirements issued by NEPA as part of the Environmental Permit.

It is recommended that reports are issued monthly during the construction phase and bi-monthly during the operational phase in respect of the tree planting monitoring. Further details on the contents of these reports should be provided in the Contractors Operating Manual.

OUTLINE ENVIRONMENTAL MANAGEMENT PLAN

9 Outline Environmental Management Plan

9.1 Introduction

An Environmental Management Plan (EMP) is necessary for this project, particularly during the construction phase of the project. The primary objective of the EMP is to ensure that the project complies with the terms and conditions of NEPA and other applicable and relevant authorities. The plan will provide guidance in the following areas:

1. Training of contractors and labourers
2. Solid waste handling and disposal
3. Hazardous material storage and disposal
4. Sewage treatment and disposal
5. Natural Hazards Management

As required or as necessary, active environmental monitoring will be undertaken to provide quantitative information on the state of the environment as it relates to the phases of the project.

Areas of concern are:

- Air quality
- Noise levels
- Creative conservation

9.2 Outline Environmental Management Plan

9.2.1 Natural Hazard Management & Safety

It is necessary to develop a natural hazard response plan to offset the worst effects of hurricanes and storms events on the project area. This plan will be prepared as a separate document on the advice from the Office of Disaster Preparedness and Emergency Management (ODPEM).

Losses due to hurricanes can be reduced through an effective response plan. The principal features of such a plan are:

- Comprehensive risk assessment based on historical precedent and vulnerability of the site. Distribution of occurrences, frequencies of wind strengths and direction.
- Appropriate preventative design and engineering (e.g. structures built to withstand hurricane force winds etc.)
- Contractor and labourer training in disaster response

9.2.2 Operational Hazard Management & Safety

A clearly defined emergency response and preparedness policy will be developed. An effective response is seen as the direct outcome of quality environmental management and comprehensive training and awareness of safety procedures. The principal objective of emergency preparedness is to localize accidents, and if possible contain and minimize them.

9.2.2.1 Response

The defined emergency response plan is necessary for training and implementation purposes at the work site should the project be approved.

The proposed development should have an Emergency Response Plan, which will provide guidelines to allow for flexible response to a range of potential circumstances. The plan would include:

- Chain of command and coordination procedures
- Lines of communication
- Means of obtaining needed information and assistance

Copies of the plan or relevant portions will be strategically located on site to allow for immediate access.

All employees should receive safety and emergency response training as a part of the initiation process.

9.2.2.2 Fire Safety

Considerations will be made for fire safety, especially during the dry season when forest fires are a possibility. All water stored on site for both domestic and potable should be made available for alternative emergency use for fire safety.

9.2.2.3 Temperature Extremes

The procedures presented below shall be followed to limit the potential for heat related illnesses.

Be conscious of situations that can create heat stress, i.e., high temperatures, humidity and confined spaces.

- Have a cool water or carbohydrate electrolyte replenishment solution available. Drink small amounts of the water or the solution frequently to limit the potential for dehydration.
- Count the pulse rate for 30 seconds at the beginning of the break. If the pulse rate exceeds 110 beats per minute, shorten the next work period by one-third.
- Do not continue working if you become disoriented, feel nauseous, or become lightheaded. If these symptoms occur, take a break and drink cool water or a carbohydrate electrolyte replenishment solution. If the symptoms persist, seek medical assistance.

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APPENDIX

Appendix I: Approved Terms of Reference

FINAL Terms of Reference

For the preparation of an Environmental Impact Assessment of the Proposed Holland Estate Housing Subdivision, Martha Brae, Trelawny

Introduction

Zuccherina Developments [Jamaica] Limited in collaboration with KENCASA Construction and Project Management Limited are seeking to develop a 192 acre parcel of land located south of the Martha Brae exit off the North Coast Highway, and adjacent to the William Knibb High School.

The Government of Jamaica, through its mandate has listed the provision of housing as one of its main priorities. An approach that tailors housing supply solutions to the needs and affordability of different target markets is being promoted. With the vast number of hotel rooms that have recently been added to the room stock, as well as those that are slated to be added, it is imperative that solutions be designed and built that will adequately meet the anticipated demands of the staff who are expected to support the burgeoning industry. Trelawny is also home to a host of other developments that are currently being planned or undertaken such as the build out of the Falmouth Pier to accept the world's largest vessel, the "Geneses".

There is currently huge potential for increased squatting in the development area between Ocho Rios and Montego Bay. If the housing demand is not met there will be significant growth in existing, and the creation of new squatter settlements. The situation necessitates an immediate solution. There are already well over 700 squatter settlements across the island as was reported by the Prime Minister and the Minster of Housing and Water, and therefore housing solutions must be created to meet the ensuing demand as we have now come to the realization, that squatting is one of the major catalysts for criminal activities in our country.

The proposed development is aptly located between Ocho Rios and Montego Bay, providing ideal location for persons living and serving the hospitality and other related industries along the Northern coast line.

The proposed Holland Estate Development will alleviate the desperate housing demand in the development area. Housing solutions will be designed and built to match different income levels. The result will be a masterfully designed community consisting of multi-level housing. There will be adequate social and physical infrastructure to meet the needs of the proposed development.

The National Environment and Planning Agency has advised KENCASA Construction and Project Management Limited that an Environmental Impact Assessment is required as part of the permitting process. Conrad Douglas & Associates Ltd. (CD&A) has been contracted to carry out the EIA. The EIA will be conducted according to an approved Terms of Reference (ToR).

Terms of Reference

This document presents the FINAL ToR for the proposed Holland Estate Housing Subdivision and is based on issued raised by the project proponents and NEPA staff at the site visit conducted on September 9, 2009 and a meeting at NEPA on October 21, 2009. It is also informed by comments generated by NEPA on November 12, 2009 based on the Draft ToR that was submitted for approval on November 6, 2009.

The ToR is based on the generic Terms of Reference for Human Habitations provided by NEPA, and have been modified to reflect the specific aspects of the project and issues of the site, including those raised by NEPA.

The Environmental Impact Assessment will:

1) Provide a complete description of the existing site proposed for development and will detail the elements of the development, highlighting areas to be reserved for construction and the areas which are to be preserved as green space.
2) Identify the major environmental issues of concern through the presentation of baseline data which will include physical, biological, social and cultural considerations.
3) Assess public perception of the proposed development.
4) Outline the Policy, Legislative and Regulatory Framework relevant to the project.
5) Describe the alternatives that were considered for the project.
6) Predict the likely impacts of the development on the described environment, including direct, indirect and cumulative impacts, and indicate their relative importance to the design of the development's facilities.
7) Identify mitigation measures to be implemented to minimise or eliminate adverse impacts.
8) Prepare an Outline Monitoring Plan which should ensure that the mitigation plan is adhered to, and Outline Environmental Management Plan.

To ensure that a thorough Environmental Impact Assessment is carried out, the following tasks will be undertaken:

Task #1: Description of the Project

Provide a comprehensive description of the project, noting areas to be reserved for construction, areas to be preserved in their existing state as well as activities and features which will introduce risks or generate impact (negative and positive) on the environment. This should involve the use of maps, site plans, aerial photographs and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post construction plans. All phases of the project will be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids be included. The method, level and location of the sewage treatment facility and the impact of effluent disposal will be presented.

Information will be provided regarding the proximity of the treatment system to the proposed housing units and basic infrastructure. The source of potable water will also be identified.

Energy conservation measures will be employed using best management practices (inclusion of such devices and infrastructure) in the design of the development.

Task #2: Description of the Environment

Baseline data will be generated which will be used to describe the study area as follows:

i) physical environment
ii) biological environment
iii) socio-economic and cultural environment

Methodologies employed to obtain baseline data and other data will be clearly detailed, and references provide as appropriate.

Baseline data will include:

(A) Physical

i) A detailed description of the existing geology and hydrology. Special emphasis will be placed on storm water run-off and drainage patterns. Any slope stability issues that could arise will be thoroughly explored. Drainage, especially with respect to existing natural drainage channels or any proposed man made drainage/water features. Issues with respect to increased surface runoff will also be addressed.
ii) A flood analysis will be conducted and will include an assessment of the flood risk potential of sections of the site and areas located adjacent to the property, and will include the identification of appropriate and practical mitigation measures to address the problem. Identification of all drainage outfalls and evaluation of the storm water management system proposed, inclusive of return periods will be incorporated in the EIA. Sediment control mechanisms during construction will also be highlighted.
iii) Hazard vulnerability will be assessed.
iv) Climatic conditions and air quality in the area of influence including particulate emissions from stationary or mobile sources, wind speed and direction, precipitation, relative humidity and ambient temperatures,
v) Noise levels of the undeveloped site and the ambient noise in the area of influence.
vi) Obvious sources of pollution existing and extent of contamination.
vii) Availability of solid waste management facilities.
viii) All routes to be used for delivery and disposal of construction and waste material to and from the site will be identified and the state of the roads highlighted. The impacts of the usage of these roads by the developer will be identified and mitigation measures suggested.

(B) Biological

Present a detailed description of the flora and fauna of the project site, with special emphasis on rare, endemic, protected or endangered species.

Migratory species will also be considered. A survey will be conducted on the existing vegetation, vegetation loss and hence loss of habitat for the fauna on the project site.

(C) Socio-Economic & Socio-Cultural

A socio-economic evaluation will be conducted and will include present and projected population; past, present and proposed land use; planned development activities, issues relating to squatting and relocation, community structure, employment, distribution of income, goods and services; recreation; public health and safety; cultural peculiarities, aspirations and attitudes should be explored. The historical importance of the area should also be examined. While this analysis is being conducted, it is expected that an assessment of public perception of the proposed development be conducted. This assessment may vary with community structure and may take multiple forms such as interviews, meetings or questionnaires.

Task #3: Legislative and Regulatory Considerations

The EIA will outline the pertinent policy, legislation, regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. The examination of the legislation will include at a minimum, legislation such as the NRCA Act, the Housing Act, the Town and Country Planning Act, Building Codes and Standards, Development Orders and Plans and the appropriate international convention/protocol/treaty where applicable.

Task #4: Project Alternatives

The EIA will examine alternatives to the project including the no-action alternative. This examination of project alternatives should incorporate the history of the overall area in which the site is located and previous uses of the site itself.

Task #5: Identification of Potential Impacts

The EIA will identify the major environmental and public health issues of concern and indicate their relative importance to the design of the subdivision. Potential impacts will be identified as they relate to, the following:

i) change in drainage pattern
ii) flooding potential
iii) landscape impacts of excavation and construction
iv) loss of natural features, habitats and species by construction and operation
v) pollution of potable, coastal, surface and ground water
vi) air pollution

vii) capacity and design parameters of proposed sewage treatment facility
viii) socio-economic and cultural impacts
ix) risk assessment
x) noise
xi) solid waste management
xii) the capacity of the social infrastructure to manage/support this new development

Potential impacts will be identified as significant positive or negative, direct or indirect, long term or short term impacts, avoidable as well as irreversible impacts. The extent and quality of the available data, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts will be characterized. Project activities and impacts will be represented in matrix form. Cumulative impacts of this project will be discussed.

Task #6: Mitigation

The EIA will present guidelines for avoiding, as far as possible, potential adverse impacts due to proposed use of the site and use of the existing environmental attributes for optimum development. Where possible mitigation measures will be quantified and assigned financial and economic values.

Task #7: Monitoring

An Outline Monitoring Plan will be given for monitoring the implementation of mitigatory or compensatory measures and project impacts during construction and occupation of the units. This Plan will include a soil erosion management plan based on the quantity of vegetation cover which will be removed and the resultant impacts.

An Outline Environmental Management Plan for the long term operations of the site will also be presented.

Detailed versions of the Monitoring Plan and the Environmental Management Plan will be submitted to NEPA for approval after the granting of the environmental permit and prior to the commencement of the development.

The Outline Monitoring Plan and report should include:

- Introduction outlining the need for a monitoring plan.
- The activity being monitored and the parameters chosen to effectively carry out the exercise.
- The methodology to be employed and the frequency of monitoring.
- The sites being monitored.
- Frequency of reporting to NEPA

The Monitoring report should also include:

- Raw data collected.
- Tables and graphs 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.

Reporting

All findings will be presented in the **EIA report** and must reflect the headings in the body of the ToR, as well as references. Eight hard copies and an electronic copy of the report will be submitted to NEPA. The report will include appendices with items such as maps, site plans, the study team, photographs, and any other relevant and appropriate information.

Appendix II: General Socio-Economic Survey Instrument

SURVEY INSTRUMENT
ENVIRONMENTAL IMPACT ASSESSMENT
For
Holland Estate Housing Subdivision, Martha Brae, Trelawny

Name of Community: _____ Community Code: | | | | | |

Name of Interviewer: _____ Date: _____

SECTION 1: PERSONAL CHARACTERISTICS

1. Gender: Male ☐ Female ☐
2. Age Range

   Under 20 ☐ 20 – 39 ☐ 40 – 49 ☐

   50 – 59 ☐ 60 – over ☐ Not Stated/No Response ☐
3. How many years have you been living in the community?

   0 – 5 Years ☐ 6 – 10 Years ☐ 11 – 20 Years ☐

   more than 20 Years ☐ Not Stated/No Response ☐
4. How many people live in this household? M _____ F _____ Total _____

   - How old are they?

Age Range	#	Age Range	#
0-14	_____	36-45	_____
15-19	_____	46-55	_____
20-35	_____	56-64	_____
		65 and over	_____

   - How many persons are in paid employment? _____
   - How many persons are unemployed? _____
6. Are you in paid employment? Yes ☐ No ☐
7. What is your occupation? _____
8. What is the highest level of education attained?

   Primary ☐ Secondary ☐ Tertiary ☐

   Vocational/Technical ☐ Not Stated/No Response ☐

HOUSING CONDITIONS

(Surveyor can ask these questions if he cannot ascertain the answers from observation)

The following questions relate to the household. This is basic demographic data.

9. Type of Dwelling

Separate house, detached ☐ Semi-detached ☐

Part of a house ☐ Part of a commercial building ☐

Other _____

10. Construction Material

Block and Steel ☐ Wood ☐ Concrete ☐

Stone/Brick ☐ Wattle and Daub ☐

Other _____

AMENITIES

11. Toilet Facilities

Type:

WC linked to sewer ☐ WC not linked to sewer ☐

Pit ☐ None ☐

Other _____

Shared

Yes ☐ No ☐

12. Source of Water

Indoor tap/pipe ☐ Outside Private tap/pipe ☐ Public stand pipe ☐

River/Pond/Well ☐ Rainwater (tank) ☐

13. Source of Lighting

Electricity ☐ Kerosene ☐ None ☐

Other _____

14. Tenure

Owner ☐ Rent-free ☐ Rented ☐ Squatter-occupied ☐

Other _____

SECTION 2: OPINIONS ON THE COMMUNITY

15. How would you rate your community as a place to live?

Very Safe ☐ Safe ☐ Unsafe ☐ Very Unsafe ☐

16. What do you like most about the community? ***ASK & WAIT FOR RESPONSE***

Friendly people ☐ Clean environment ☐ Availability of farmland ☐
Quiet ☐ No crime & violence ☐ Not Stated/No Response ☐
Other, specify) _____

17. What don't you like about the community? ***ASK & WAIT FOR RESPONSE***

Poor roads ☐ Water supply ☐ Unemployment ☐
Transportation ☐ Garbage collection ☐ Crime ☐
Dirty environment ☐ Not Stated/No Response ☐ Flooding ☐
Other, (specify) _____

18. Is the community adequately serviced by the following? ***ASK & WAIT FOR RESPONSE***

					Schools:				
Health facility	Yes	☐	No	☐					
Water supply	Yes	☐	No	☐	Basic	Yes	☐	No	☐
Police	Yes	☐	No	☐	Primary	Yes	☐	No	☐
Transportation	Yes	☐	No	☐	Secondary/High	Yes	☐	No	☐
Electricity	Yes	☐	No	☐	Tertiary	Yes	☐	No	☐
Cable/Telephone	Yes	☐	No	☐	Vocational	Yes	☐	No	☐

SECTION 3: KNOWLEDGE AND VIEWS ON THE HOUSING SUBDIVISION PLANS

19. Are you aware of the proposal to develop a housing subdivision on 192 acres of land at Holland Estate near the William Knibb Memorial High School in Martha Brae?

Yes ☐ No ☐
If yes, are you:

Strongly in favour ☐ In favour ☐ Neither in favour or against ☐
Against ☐ Strongly against ☐

20. What are your reasons?

_____
_____
_____

21. What effect do you think the proposed housing subdivision will have on the following:

- Economic value of ***your*** community

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

- Job Opportunities

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

- Pollution

Positive ☐ Negative ☐ No Change ☐

Don't Know ☐ Not Stated/No Response ☐

22. Do you think the proposed development will affect you personally?

Yes ☐ No ☐

Don't Know/Not Sure ☐ Not Stated/No Response ☐

If Yes, how?

_____

_____

_____

23. Do you think that the area needs any new development?

Yes ☐ No ☐

24. Are you aware of any other new development in or near your community?

_____

_____

_____

SECTION 4: SOCIAL ATTITUDES

25. Have you or any member of your household ever worked in the construction industry?

Yes ☐ No ☐

Don't Know/Not Sure ☐ Not Stated/No Response ☐

26. Do you look forward to this development?

Yes ☐ No ☐

If Yes, how?

_____

_____

If no, why not?

_____

_____

27. Do you think that the construction and operation of the proposed development will affect the availability of any of your resources (e.g. water, light, aesthetics etc)

Yes ☐ No ☐

If Yes, please state which of the resource(s) you suspect will be affected?

_____

_____

28. For each affected resource, describe briefly, the nature/extent of the effect

Resource	Nature/ extent of effect
_____	_____
_____	_____
_____	_____
_____	_____

29. Do you use the proposed site for any activity?

Yes ☐ No ☐

If Yes, what do use the proposed site for?

_____

_____

30. Are there any natural resources on the site that you know of?

Yes ☐ No ☐

If Yes, what are these?

_____

_____

31. What impacts do you think the proposed housing development will have on this community?

_____

_____

32. Will the development have any impact on your livelihood?

Yes ☐ No ☐

If Yes, what are these impacts?

_____

_____

33. Do you think the proposed development will have any impacts on the environment?

Yes ☐ No ☐

If yes, please explain.

_____

_____

34. Do you experience flooding in your community?

Yes ☐ No ☐

If yes, where and to what extent?

_____

_____

35. What benefits do you think the proposed development will have on the community, if any?

_____

_____

36. Is the site of any cultural/historical interest?

Yes ☐ No ☐

If Yes, what/where?

_____

_____

_____

37. Do you have any involvement in the proposed development?

Yes ☐ No ☐

If Yes, how are you involved?

_____

_____

The completed survey instrument is available for review at your discretion.

Appendix III: Focus Group Survey Instrument

Holland Estate Housing Subdivision
FINAL Focus Group Socio-Economic Survey Instrument

KENCASA Constructions & Project Management Ltd.

SURVEY INSTRUMENT – FOCUS GROUP
ENVIRONMENTAL IMPACT ASSESSMENT
For
Holland Estate Housing Subdivision, Martha Brae, Trelawny

Date:_____

1. What is the name of your business? _____
2. Approximately how many persons are employed by your business? _____
3. How many years have you been working in the Greater Falmouth community? _____

OPINIONS ON THE BUSINESS COMMUNITY

4. How would you rate your business community?

   Very Safe ☐ Safe ☐ Unsafe ☐ Very Unsafe ☐

5. Is the business community adequately serviced by the following?

Health facilities	Yes ☐	No ☐		Water supply	Yes ☐	No ☐	
Police	Yes ☐	No ☐		Transportation	Yes ☐	No ☐	
Electricity	Yes ☐	No ☐		Internet/Telephone	Yes ☐	No ☐	

KNOWLEDGE AND VIEWS ON THE HOUSING SUBDIVISION PLANS

6. Are you aware of the proposal to develop a housing subdivision on 192 acres of land at Holland Estate near the William Knibb Memorial High School in Martha Brae?

   Yes ☐ No ☐

7. What effect do you think the proposed housing subdivision will have on your business?

   Positive ☐ Negative ☐ No Change ☐ Don't Know ☐

   What are your reasons?

   _____
   _____
   _____

8. Do you think that the area needs any new development?

   Yes ☐ No ☐

9. Are you aware of any other new development in or near your business community?

_____
_____
_____

10. Do you look forward to this development?

Yes ☐ No ☐

If Yes, how?

_____
_____
_____

If no, why not?

_____
_____
_____

Thank You

End of Survey

Appendix IV: List of Preparers

List of Preparers:

1. Dr. Conrad Douglas – Process and Environmental Management Specialist – Project Planning & Project Director
2. Mr. Orville Grey Jr. – Project Manager – Project Management & EIA Specialist
3. Prof. Edward Robinson and Geology Team Members (Marine Geology Unit) – Geologist - Geology, Hydrology and Natural Risk Assessment
4. Mr. Wayne Morris – Staff Engineer – Field Coordination, Database Management, Air Quality, Noise & Traffic Assessment
5. Mr. Doran Beckford – Process and Environmental Engineer – Air Quality & Noise Assessment
6. Mr. Damion White – Consulting Ornithologist
7. Dr. Eric Garraway – Consulting Entomologist/Invertebrate Zoologist
8. Dr. Catherine Murphy – Consulting Entomologist
9. Ms. Sloane Jackson – Consulting Herpetologist
10. Dr. George Proctor – Consulting Botanist
11. Mr. Delford Morgan Jr. – Land Use Planning & Development
12. Mr. Burklyn Rhoden, Mr. Noel Watson & Team – Socio-Economic Field Survey Team

Appendix V: Inter-Agency Communications

Letter from NEPA re: Approval of ToR

2009- 07017-EN00007

November February 12, 2009

Mr. Kirk Kennedy
Chief Executive Officer
KENCASA Construction Limited
7A Barbados Avenue
Kingston 5

Dear Mr. Kennedy,

re: Terms of Reference for Subdivision and Housing Development – Holland Estate Trelawny 2009 - 07017-EP000077

Please be advised that the National Environment and Planning Agency (NEPA) has received and reviewed the draft terms of reference (TOR) submitted for the above captioned application. The document addresses the major areas of concern for this project. The Agency is however kindly requesting that the following additional comments are included in the Environmental Impact Assessment Study:

- The TOR should include a statement on energy conservation measures and the inclusion of such devices and infrastructure in the design of the development.
- Flood analysis should include an assessment of the flood risk potential of sections of the site and areas located adjacent to the property, and should include the identification of appropriate and practical mitigation measures to address the problem. Identification of all drainage outfalls and evaluation of the storm water management system proposed, inclusive of return periods should be incorporated in the EIA. Sediment control mechanisms during construction should also be highlighted.
- All routes to be used for delivery and disposal of construction and waste material to and from the site should be identified and the state of the roads highlighted. The impacts of the usage of these roads by the developer need to be identified and mitigation measures suggested.
- The capacity of the social infrastructure to manage/support this new development should be mentioned under task five (5) of the TOR.
- A soil erosion management plan should be included under project monitoring and management based on the quantity of vegetation cover which will be removed and the resultant impacts.

You are therefore permitted to proceed with the execution of the Environmental Impact Assessment study. Upon completion of the report ten (10) copies including a digital copy should be submitted to the offices of the National Environment and Planning Agency. Be reminded that a public presentation of the findings of the EIA will also be required.

Please do not hesitate to contact the undersigned for any queries which may become necessary.

Yours sincerely,

Peter Knight
Chief Executive Officer

CC. Conrad Douglas and Associates.

Letter from JNHT re: Archaeological Resources of Proposed Development Lands

RECEIVED 02 DEC 2009

JAMAICA NATIONAL HERITAGE TRUST

79 DUKE STREET,
HEADQUARTERS HOUSE,
KINGSTON,
P.O. BOX 8934, KINGSTON C.S.O.,
JAMAICA, W.I.

TELE: (876) 922-1287-8
(876) 922-3990
FAX: (876) 967-1703

November 25, 2009

Conrad Douglas & Associates Ltd.
Project Planning, Development Management
Engineering & Technical Consultants
14 Carvalho Drive
Kingston 10

Dear Mr. Douglas:

This communiqué is to acknowledge receipt of your letter dated November 4, 2009 re information on the heritage or archaeological sites of importance that exist in the general area of Martha Brae, Trelawny.

Martha Brae is designated as one of Jamaica's earliest Spanish settlements. The specific location of this historic settlement is not clearly defined. The historic records show that the Martha Brae River overflowed its bank and destroyed the settlement. It is assumed that the site is in close proximity to the river. Any major excavation in the area may uncover sections of the settlement. In 1770 the parish of Trelawny was formed from the eastern portion of St. James and Martha Brae was named as the first capital of this new parish.

The Sites and Monuments Records (SMR) of the JNHT have indicated several Taino sites in the vicinity with two of these sites within close proximity of the proposed development.

The area also includes historic sugar plantations such as Holland, Hague, Irving Tower, Maxfield, Green Park, Merrywood and Carrickfoyle.

With the down turn in sugar many estates turned to cattle rearing. Grazing pens included Holland, Carrickfoyle and Maxfield properties. These entities would have had enslaved villages, great houses, work complexes and in some instances burial grounds. It should be noted that Taino settlements, midden, midden burials and enslaved villages did not have monumental structures.

In 1832 Holland belonged to David Lyon and possessed 155 enslaved persons and 119 heads of cattle. The enslaved village of Holland lies within the proposed development.

Due to the nature of the area, the Jamaica National Heritage Trust has an interest in the site and recommends that an Archaeological Impact Assessment (AIA) be done before construction work begins.

An Archaeological Impact Assessment (AIA) is a systematic survey and analysis of a site proposed for development. It seeks to address direct and indirect impact on any potential and known archaeological resources. In essence, the objective of the AIA is to provide information for the deciding agency to consider in the decision-making process, and further give bodies with relevant environmental and cultural responsibilities the opportunity to comment and act before the development commences.

Yours sincerely,

Selvenious Walters
Deputy Technical Director of Archaeology
Jamaica National Heritage Trust

C: Mrs. Laleta Davis- Mattis, Executive Director
Jamaica National Heritage Trust

JAMAICA NATIONAL HERITAGE TRUST
79 DUKE STREET

Letter from JPSCo re: Power Availability

Jamaica Public Service Company Limited
CHANGING LIVES WITH OUR ENERGY

6 Knutsford Boulevard, Kingston Jamaica, W.I.
Telephone: (876) 926-3190-9
Fax: (876) 511-2167
Website: www.jpsco.com

January 12, 2010

Kencasa Construction & Project Management
7a Barbados Avenue
Kingston 5

Attention: Mr. Kirk Kennedy – President & CEO

Dear Sirs,

Re: Proposed Sub-division Development at Holland Estate - Trelawny

With reference to the captioned development in Trelawny, the JPS will be pleased to provide you with supply at this proposed site.

The Proposed Holland Estate Development is adjacent to a 12kV 3 phase primary line which can be upgraded and extended to traverse onto the property and supply all areas requiring electricity.

We await your application for processing.

The Jamaica Public Service will always be of service to you and fully appreciates your business.

Yours truly,
JAMAICA PUBLIC SERVICE COMPANY LIMITED

for Steve A. Dixon
Head-Engineering & Technology Department
693[A] Spanish Town Road
Kingston 11
Tel. # 514-0318, Fax # 514-0259

Email Response from NWC re: Potable Water Availability

Fwd: Holland Estate Development, Trelawny, NWC Ref. #: 0705/09

From: **Kirk Kennedy** (kcpm.kirk@gmail.com)
Sent: Fri 1/22/10 3:59 PM
To: cda estech (cdaestech@hotmail.com); David Chung (doc@fcsconsultants.com); lmw@fcsconsultants.com; addymar@yahoo.com
Attachments:
Application Requirements - Handout.doc (30.0 KB)

All,
Please see attached from NWC, their indication that they can supply water to the proposed subdivision.

Regards,

Kirk

---------- Forwarded message ----------
From: **Ian Bennett** <ian.bennett@nwc.com.jm>
Date: Fri, Jan 22, 2010 at 2:03 PM
Subject: Holland Estate Development, Trelawny, NWC Ref. #: 0705/09
To: kcpm.kirk@gmail.com
Cc: Franklin Williams <franklyn.williams@nwc.com.jm>, Ajaykumar Vijayan <ajaykumar.vijayan@nwc.com.jm>, Oniel Shand <oniel.shand@nwc.com.jm>, David Watt <david.watt@nwc.com.jm>, Carlton Green <carlton.green@nwc.com.jm>

Mr. Kirk Kennedy

President & Chief Executive Office

KENCASA Construction and Project Management Ltd

7A Barbados Avenue

Kingston 5

Dear Sir

The National Water Commission (NWC) acknowledges receipt of your correspondence dated September 24, 2009 enquiring about the availability of water supply to your proposed development at captioned. We apologise for not responding formally before now.

The NWC now advises that it will be possible to supply potable water, once you have made a formal application and have paid the associated charges, which will be made known after your application has been examined by our Development Committee. This formal application is to be submitted to the Office of the Chief Engineer, 4 Marescaux Road, Kingston 5.

The attachment outlines what ought to be submitted in your application.

We trust that you find this information useful and look forward to hearing from you.

Yours truly

Ian Bennett

Manager, Engineering Design

NATIONAL WATER COMMISSION

4 Marescaux Road

Kingston 5

511-5448

322-4498

--
KIRK KENNEDY
PRESIDENT & CEO

KENCASA CONSTRUCTION AND PROJECT MANAGEMENT LTD

"opening doors for you"

Appendix VI: Data Tables

Appendix Table 1: Ambient Air Quality Data

TECHNICIAN	Wayne Morris		
LOCATION:	Wakefield Road		
EQUIPMENT # :	07-0396		
FILTER # :	P8027228		
WEATHER CONDITIONS:	Sunny		
NOTES:	No work being done on site		
START DATE & TIME :	26-Nov-09 11:00		
END DATE & TIME :	27-Nov-09 11:00		
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V		
Where Wf = final mass of filter element			
Wi = initial mass of filter element			
V = corrected sample volume			
Now			
Wf =	0.1486 g	(=)	148600 µg
Wi =	0.1483 g	(=)	148300 µg
Wf - Wi =	300 µg		
Corrected Volume =	5657.25 L	(=)	5.65725 m^3
Mass Concentration (MC)		(=)	53.03 $\mu g/m^3$

TECHNICIAN	Wayne Morris		
LOCATION:	Wakefield Road		
EQUIPMENT # :	07-0396		
FILTER # :	P8027226		
WEATHER CONDITIONS:	Sunny		
NOTES:	No work being done on site		
START DATE & TIME :	29-Nov-09 10:03		
END DATE & TIME :	30-Nov-09 10:03		
Mass Concentration (MC) is given by	MC = (Wf -Wi) / V		
Where Wf = final mass of filter element			
Wi = initial mass of filter element			
V = corrected sample volume			
Now			
Wf =	0.146 g	(=)	146000 µg
Wi =	0.1458 g	(=)	145800 µg
Wf - Wi =	200 µg		
Corrected Volume =	3143.83 L	(=)	3.14383 m^3
Mass Concentration (MC)		(=)	63.62 $\mu g/m^3$
Run Time	1440 min		

Appendix Table 2: Background Noise

BASELINE NOISE RECORDING WAKEFIELD ROAD		min	14.10	unit: decibels
TECHNICIAN:	**WAYNE MORRIS**	avg	28.11	
DATE:	29-Nov-09	max	42.30	
START TIME	9:57	Standard	70	
END TIME	16:48			
Time Period	Every 1 min.			
EQUIPMENT:	Norsonic 118			
EQUIPMENT # :	31756			
WEATHER:	Sunny			

Time	Readings	Time	Readings	Time	Readings
9:57 AM	34.1	10:37 AM	28.2	11:17 AM	24.7
9:58 AM	34.8	10:38 AM	25.3	11:18 AM	24.5
9:59 AM	42.3	10:39 AM	33.6	11:19 AM	23.7
10:00 AM	27.5	10:40 AM	24	11:20 AM	28
10:01 AM	29.7	10:41 AM	31.5	11:21 AM	29
10:02 AM	26.6	10:42 AM	25.4	11:22 AM	33.1
10:03 AM	21.7	10:43 AM	25.8	11:23 AM	31.2
10:04 AM	35.6	10:44 AM	19.1	11:24 AM	25.5
10:05 AM	26	10:45 AM	24	11:25 AM	27.1
10:06 AM	28.1	10:46 AM	17.2	11:26 AM	26.6
10:07 AM	25.8	10:47 AM	28.2	11:27 AM	24.3
10:08 AM	24.4	10:48 AM	33	11:28 AM	25.3
10:09 AM	34.7	10:49 AM	26.3	11:29 AM	22.8
10:10 AM	22.2	10:50 AM	28.8	11:30 AM	24.8
10:11 AM	24.7	10:51 AM	26.9	11:31 AM	24.2
10:12 AM	20.8	10:52 AM	22.2	11:32 AM	27.6
10:13 AM	26.4	10:53 AM	21.2	11:33 AM	31.4
10:14 AM	19.1	10:54 AM	23.4	11:34 AM	24.9
10:15 AM	25.7	10:55 AM	24.2	11:35 AM	22.8
10:16 AM	22.4	10:56 AM	31.1	11:36 AM	30.8
10:17 AM	26.9	10:57 AM	31.3	11:37 AM	26.7
10:18 AM	24.2	10:58 AM	28.2	11:38 AM	12.3
10:19 AM	30.8	10:59 AM	25.6	11:39 AM	26
10:20 AM	37.5	11:00 AM	20.9	11:40 AM	34.1
10:21 AM	28.4	11:01 AM	19.7	11:41 AM	29.4
10:22 AM	32.2	11:02 AM	23.9	11:42 AM	27.5
10:23 AM	38.5	11:03 AM	26.3	11:43 AM	34.8
10:24 AM	25.3	11:04 AM	26.8	11:44 AM	26.9
10:25 AM	26.9	11:05 AM	25.6	11:45 AM	31.3
10:26 AM	27.4	11:06 AM	14.3	11:46 AM	36.2
10:27 AM	24.5	11:07 AM	22.7	11:47 AM	26.8
10:28 AM	18	11:08 AM	27.3	11:48 AM	30.8
10:29 AM	19.7	11:09 AM	22.2	11:49 AM	27
10:30 AM	23.6	11:10 AM	23.2	11:50 AM	27.3
10:31 AM	25.7	11:11 AM	24.6	11:51 AM	21.9
10:32 AM	26.3	11:12 AM	27.7	11:52 AM	28
10:33 AM	24.3	11:13 AM	21.1	11:53 AM	32.1
10:34 AM	24.7	11:14 AM	27.2	11:54 AM	26.2
10:35 AM	20	11:15 AM	26.5	11:55 AM	28.1
10:36 AM	24.8	11:16 AM	26.1	11:56 AM	20.7

Time	Readings	Time	Readings	Time	Readings
11:57 AM	27.8	12:47 PM	35.5	1:37 PM	29.1
11:58 AM	34.5	12:48 PM	27.6	1:38 PM	25.3
11:59 AM	20.1	12:49 PM	26.3	1:39 PM	32.3
12:00 PM	22	12:50 PM	25.5	1:40 PM	32.7
12:01 PM	31.5	12:51 PM	27	1:41 PM	23.5
12:02 PM	27.9	12:52 PM	26	1:42 PM	35.3
12:03 PM	14.1	12:53 PM	26.5	1:43 PM	25.9
12:04 PM	15.9	12:54 PM	25.5	1:44 PM	27.6
12:05 PM	28.8	12:55 PM	27.6	1:45 PM	28.3
12:06 PM	25.2	12:56 PM	22.2	1:46 PM	28.1
12:07 PM	28.1	12:57 PM	40.2	1:47 PM	29.1
12:08 PM	30.4	12:58 PM	32.4	1:48 PM	23.5
12:09 PM	27.3	12:59 PM	26.3	1:49 PM	25.1
12:10 PM	25.4	1:00 PM	34.1	1:50 PM	32.1
12:11 PM	34.7	1:01 PM	40.5	1:51 PM	26
12:12 PM	31.8	1:02 PM	32.8	1:52 PM	14.2
12:13 PM	27.6	1:03 PM	31.6	1:53 PM	33.5
12:14 PM	23.1	1:04 PM	34	1:54 PM	21.6
12:15 PM	31.2	1:05 PM	32.6	1:55 PM	26.6
12:16 PM	33.2	1:06 PM	32.1	1:56 PM	21.3
12:17 PM	32.9	1:07 PM	28.4	1:57 PM	23.7
12:18 PM	24.7	1:08 PM	30.2	1:58 PM	41.6
12:19 PM	23.1	1:09 PM	25.9	1:59 PM	25.9
12:20 PM	30.9	1:10 PM	27	2:00 PM	19.7
12:21 PM	29.4	1:11 PM	27.5	2:01 PM	24.3
12:22 PM	33.1	1:12 PM	30.6	2:02 PM	28.6
12:23 PM	28.7	1:13 PM	33.6	2:03 PM	29.2
12:24 PM	39.5	1:14 PM	29.1	2:04 PM	26.8
12:25 PM	28.6	1:15 PM	29.1	2:05 PM	27.5
12:26 PM	27.2	1:16 PM	34.2	2:06 PM	24.8
12:27 PM	24.3	1:17 PM	21.4	2:07 PM	24.1
12:28 PM	39	1:18 PM	27.4	2:08 PM	32.4
12:29 PM	24.8	1:19 PM	22.6	2:09 PM	21.6
12:30 PM	33.7	1:20 PM	24.7	2:10 PM	30
12:31 PM	26.5	1:21 PM	36.6	2:11 PM	39.4
12:32 PM	34.4	1:22 PM	27.5	2:12 PM	26.4
12:33 PM	34.4	1:23 PM	29.7	2:13 PM	32.4
12:34 PM	33.4	1:24 PM	26.8	2:14 PM	24.3
12:35 PM	28.8	1:25 PM	28.7	2:15 PM	18.9
12:36 PM	32.2	1:26 PM	29.2	2:16 PM	30.5
12:37 PM	25.6	1:27 PM	30.5	2:17 PM	27.6
12:38 PM	23.8	1:28 PM	27.5	2:18 PM	27.2
12:39 PM	34.1	1:29 PM	26.8	2:19 PM	37.1
12:40 PM	36.7	1:30 PM	24.6	2:20 PM	29.8
12:41 PM	27.4	1:31 PM	24.1	2:21 PM	25
12:42 PM	19.8	1:32 PM	32.9	2:22 PM	25.7
12:43 PM	26.3	1:33 PM	33	2:23 PM	25.2
12:44 PM	21.9	1:34 PM	24.7	2:24 PM	28.1
12:45 PM	37.6	1:35 PM	31.8	2:25 PM	30.5
12:46 PM	17.2	1:36 PM	29	2:26 PM	31.4

Time	Readings	Time	Readings	Time	Readings
2:27 PM	30.1	3:17 PM	26.4	4:07 PM	23.3
2:28 PM	26.9	3:18 PM	25	4:08 PM	25.8
2:29 PM	26.9	3:19 PM	26.5	4:09 PM	30
2:30 PM	32.1	3:20 PM	28.4	4:10 PM	29.7
2:31 PM	30.3	3:21 PM	27.8	4:11 PM	27.8
2:32 PM	31.7	3:22 PM	28.5	4:12 PM	32.1
2:33 PM	26.2	3:23 PM	30.2	4:13 PM	25.6
2:34 PM	19.5	3:24 PM	29.1	4:14 PM	31.9
2:35 PM	31.7	3:25 PM	25.1	4:15 PM	26.2
2:36 PM	31.5	3:26 PM	23.2	4:16 PM	24.7
2:37 PM	31	3:27 PM	20	4:17 PM	25.7
2:38 PM	29.9	3:28 PM	23.8	4:18 PM	23
2:39 PM	25.3	3:29 PM	26.6	4:19 PM	23.8
2:40 PM	28.8	3:30 PM	34.6	4:20 PM	27.5
2:41 PM	25.8	3:31 PM	22.1	4:21 PM	25.3
2:42 PM	25.4	3:32 PM	35.9	4:22 PM	25.9
2:43 PM	29.2	3:33 PM	27.2	4:23 PM	23.9
2:44 PM	29.2	3:34 PM	31.7	4:24 PM	27.1
2:45 PM	27.7	3:35 PM	32.2	4:25 PM	28.6
2:46 PM	30.1	3:36 PM	25.5	4:26 PM	31
2:47 PM	28.9	3:37 PM	39.6	4:27 PM	29.7
2:48 PM	32.1	3:38 PM	21.8	4:28 PM	24.4
2:49 PM	28.3	3:39 PM	36.8	4:29 PM	19.9
2:50 PM	35	3:40 PM	26.4	4:30 PM	25.3
2:51 PM	30.8	3:41 PM	31	4:31 PM	33.8
2:52 PM	28.9	3:42 PM	25.2	4:32 PM	29.6
2:53 PM	26.3	3:43 PM	28.2	4:33 PM	33.5
2:54 PM	25.6	3:44 PM	27	4:34 PM	27.4
2:55 PM	26.4	3:45 PM	26.7	4:35 PM	26.5
2:56 PM	26.4	3:46 PM	40.3	4:36 PM	26.9
2:57 PM	25.6	3:47 PM	28.5	4:37 PM	23.7
2:58 PM	32.9	3:48 PM	34.3	4:38 PM	30
2:59 PM	32.5	3:49 PM	25.9	4:39 PM	31.2
3:00 PM	27.1	3:50 PM	25.2	4:40 PM	26.9
3:01 PM	26.4	3:51 PM	29.2	4:41 PM	31.6
3:02 PM	30.2	3:52 PM	33.9	4:42 PM	25.8
3:03 PM	34.1	3:53 PM	28.3	4:43 PM	25.9
3:04 PM	27.8	3:54 PM	31.6	4:44 PM	23.7
3:05 PM	27.7	3:55 PM	28.2	4:45 PM	27.5
3:06 PM	30.7	3:56 PM	31	4:46 PM	23.7
3:07 PM	28.4	3:57 PM	25.4	4:47 PM	38.8
3:08 PM	30.9	3:58 PM	34.4	4:48 PM	24.7
3:09 PM	25.1	3:59 PM	24.2		
3:10 PM	30	4:00 PM	29.6		
3:11 PM	30.9	4:01 PM	31		
3:12 PM	31.3	4:02 PM	29.5		
3:13 PM	33.6	4:03 PM	25.4		
3:14 PM	25.4	4:04 PM	30		
3:15 PM	18.3	4:05 PM	22		
3:16 PM	25.9	4:06 PM	23.3		

Appendix Table 3: Traffic Volume on the Martha Brae to Falmouth main road – NORTHBOUND

	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Averages	
Hour	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec	24-Dec	25-Dec	26-Dec	27-Dec	28-Dec	29-Dec	30-Dec	**5 Day**	**7 Day**
0000-0100		27	85	56	32	20	23	59	119	52	55	40	21	38	**51**	**48**
0100-0200		21	48	28	19	25	12	54	102	28	43	39	20	22	**42**	**35**
0200-0300		22	38	36	16	11	6	29	107	25	33	21	19	10	**34**	**29**
0300-0400		35	35	12	6	8	13	18	71	23	51	8	9	14	**23**	**23**
0400-0500		41	42	27	17	25	19	39	74	25	39	10	17	18	**35**	**30**
0500-0600		72	81	51	60	59	72	69	105	55	50	62	57	77	**73**	**67**
0600-0700		159	123	78	140	116	153	148	96	78	63	132	134	163	**131**	**122**
0700-0800		255	192	112	224	225	258	205	88	112	125	238	210	244	**200**	**191**
0800-0900		**357**	253	142	308	308	349	306	102	131	125	302	323	288	**275**	**253**
0900-1000		306	**263**	158	263	277	309	304	121	141	167	272	268	306	**255**	**243**
1000-1100		287	230	164	288	230	335	286	116	147	165	291	244	240	**251**	**233**
1100-1200		273	226	156	247	240	287	238	118	174	155	279	248		**226**	**220**
1200-1300		254	234	179	241	220	296	244	118	162	126	240	208		**224**	**210**
1300-1400	246	**301**	229	193	271	275	281	263	128	164	144	259	254		**244**	**231**
1400-1500	211	266	233	139	231	200	291	228	125	183	173	234	177		**215**	**207**
1500-1600	255	262	235	149	246	191	257	245	144	147	161	228	194		**217**	**209**
1600-1700	254	251	216	168	259	169	257	247	122	160	156	220	201		**211**	**206**
1700-1800	232	276	**260**	218	256	215	291	264	173	207	165	224	227		**240**	**231**
1800-1900	222	278	222	162	185	192	281	252	159	222	168	223	191		**214**	**212**
1900-2000	188	207	198	109	149	109	221	244	137	146	119	175	146		**172**	**165**
2000-2100	121	177	144	90	127	97	202	206	137	127	106	124	94		**154**	**135**
2100-2200	127	162	159	63	89	82	148	206	143	99	94	95	99		**134**	**120**
2200-2300	90	128	106	59	87	52	108	179	92	98	76	70	84		**104**	**95**
2300-2400	70	120	67	38	46	39	68	146	71	77	50	53	43		**74**	**68**
TOTAL		4537	3919	2587	3807	3385	4537	4479	2768	2783	2609	3839	3488	1420	**3562**	
AM Peak					PM Peaks											

Appendix Table 4: Appendix Table 1: Traffic Volume on the Martha Brae to Falmouth main road – SOUTHBOUND

	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Averages	
Hour	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec	24-Dec	25-Dec	26-Dec	27-Dec	28-Dec	29-Dec	30-Dec	**5 Day**	**7 Day**
0000-0100		59	119	80	43	20	32	77	187	74	94	67	50	56	**72**	**74**
0100-0200		30	61	46	26	8	19	42	158	27	71	38	29	31	**51**	**454**
0200-0300		49	41	40	20	5	10	32	188	26	43	16	15	19	**51**	**39**
0300-0400		32	33	16	11	1	6	28	96	12	24	14	8	14	**28**	**23**
0400-0500		25	25	16	5	2	10	37	84	23	23	9	8	12	**28**	**21**
0500-0600		37	33	35	30	6	37	37	69	23	26	41	35	35	**36**	**34.**
0600-0700		110	83	43	84	17	94	85	68	56	39	82	84	94	**70**	**72**
0700-0800		184	125	85	154	34	182	134	98	77	88	149	150	169	**120**	**125**
0800-0900		223	151	100	195	38	238	191	88	107	101	188	202	220	**150**	**157**
0900-1000		263		129	141	51	269	213	97	112	134	211	207	218	**154**	**170**
1000-1100		224	199	153	8	36	260	236	103	148	152	241	211	213	**129**	**168**
1100-1200		242	198	134	93	23	263	222	92	148	134	234	195		**139**	**165**
1200-1300		228	230	135	102	15	258	208	124	156	145	220	212		**141**	**169**
1300-1400	245	242	216	152	124	112	246	227	130	162	137	225	188		**168**	**185**
1400-1500	215	240	197	147	132<	200	309	245	118	164	137	227	198		**218**	**200**
1500-1600	251	239	268	144	111	250	273	242	148	176	141	227	205		**205**	**206**
1600-1700	242	288	236	244	107	242	324	266	154	155	149	87	247		**219**	**211**
1700-1800	285	305	267	162	72	249	347	299	133	171	159	141	274		**220**	**220**
1800-1900	278	281	237	158	68	231	322	326	165	176	186	265	259		**222**	**227**
1900-2000	209	256	230	140	77	179	303	254	164	169	140	206	202		**195**	**194**
2000-2100	156	228	227	103	43	152	240	239	125	158	118	159	150		**160**	**161**
2100-2200	149	194	171	95	37	124	192	225	139	138	104	112	115		**143**	**138**
2200-2300	113	197	128	68	35	78	149	204	109	114	86	95	98		**115**	**113**
2300-2400	92	203	107	62	24	64	105	165	90	118	89	82	88		**90**	**99**
AM Peak					PM Peaks											

Appendix Table 5: Flora Recorded From Holland Estate, Falmouth, Parish of Trelawny, November 2009

FAMILY	SCIENTIFIC NAME	COMMON NAME	SECONDARY FOREST	Guango Forest	PASTURE
Amaranthaceae	*Achyranthes indica*	Devil's horse whip	R	O	O
Aristolochiaceae	*Aristolochia odoratissum*		O		
Asclepiadaceae	*Asclepias curassavica*	Redhead, Red top	O	O	O
Bignoniaceae	*Crescentia cujete*	Calabash	O		
Bitaceae	*Cissus sicyoides*	Pudding wiss, Snake wiss	F		
Boraginacea	*Cordia laevitata*		O		
Bromeliaceae	*Bromelia pinguin*	Ping wing	O		
	Tlilandsia fassciculata	Wild pine	F		
Burseraceae	*Bursera simaruba*	Red birch	O		R
Cactaceae	*Hylocerus triangularis*		F		
	Selenicereus grandiflora	Queen of the night	F		
Caesalpinaceae	*Senna emarginata*	Senna tree, Yellow candle wood	O		
Capparaceae	*Capparis flexuosa*	Bottle-cod Root	O		
	Capparis cynophallophora	Black williow	O		
Caricaceae	*Carica papaya*	Papaya	O		
Commelinaceae	*Commelina diffusa*	Water grass	O	O	O
Compositae	*Bidens cynapiifolia*	Spanish needle		O	F
	Eupatorium odoratum	Jack in the bush	O	O	O
Convolvulaceae	*Ipomoea tiliacea*	Wild potato, Wild slip	F	O	O
Cucrbetaceae	*Momordica charantia*	Cerasee	O	O	O
	Cucumis anguria			O	O
	Buchenavia tetrafila		O		
Cyperaceae	*Scleria lithosperma*		O		
Euphobeaceae	*Acalypha alopercuroidea*			O	O
	Croton humilis	Pepper rod	O		
	Ricinus communis	Castor oil plant			O
Fabaceae	*Clitoria ternatea*	Blue pea			O
	Aeschynomene americana			O	F
	Abrus precatorius		O		
Gramineae	*Cynodon dactylon*	Bermuda grass	R	F	D
	Cynodon mlenfuensis			F	F
	Lasiacis divaracata	Climbing bamboo	F		
	Lithachne paucifloura		R		
	Cenchrus echinatus		R	O	O
	Themuda arguens	Christmas grass	R	R	F
Libateae	*Ocimum micranthum*	Wild basil		O	O

FAMILY	SCIENTIFIC NAME	COMMON NAME	SECONDARY FOREST	Guango Forest	PASTURE
Malpighiaceae	*Malpighia glibra*	Wild cherry	R		
Malvaceae	*Malvastrus americanum.*		F	O	F
	Wassidula amplissima		O		
	Abutilon permolle		O		
Meliaceae	*Trichilia hirta*		O		
	Trichilia mosachata		O		
Mimosaceae	*Samanea saman*	Guango	F	D	O
	Acacsia farnesiana	Cassie flower	F		O
	Leucaena leucocephala		O		
Moraceae	*Cecropia pelata*	Trumpet tree	R		
Myrtaceae	*Pimenta dioica*	Pimento	O		
Nyctaginaceae	*Pisonia aculeate*	Cockspur	A	O	
Orchidaceae	*Oeceoclades maculata*	Ground orchid	F		
	Brassavila cordata		F		
Oleaeceae	*Jasminum fluminense*	Azore jasmine	A	R	O
Papilioniaceae	*Centrosema virginianum*				O
	Crotalaria redusa		R	R	O
	Teramnus libialis			O	O
	Psophocarpus palustris			O	F
Plumbaginaceae	*Plumbago scanens*	Wild Plumbago		R	O
Rutaceae	*Zanthoxum martinicense*	Prickly yellow	F		
Polygonaceae	*Antigonon leptopus*	Coralita, coralilla		R	O
	Citrus aurantifolia	Lime	O		
	Spathelia sorbifolia	Mountain pride	O		
Sapindaceae	*Melicoccus bijugatus*	Guinep	A	R	R
Sapotaceae	*Chrysophyllum cainito*	Star apple	O		
Solanaceae	*Solanum erianthum*	Wild susumber	O	O	
	C|aspicum sp.	Bird pepper	O		
Smilaceae	*Smilax balbisiana*	Chainy root,	F		
Sterculeaceae	*Emichola pyrimidata*				O
	Guazuma ulmfolia		F		O
	Sachytarpheta jamaicensis	Vervine		R	O
	Lantana camara	White Sage, Wild sage	O	O	O
Zygophyllaceae	*Guaiacum offiicinale*	Lignum vitae	R		

Appendix Table 6: Arthropods collected from Holland Estate

FAMILY	GENUS & SPECIES	COMMON NAMES	DAFOR
LEPIDOPTERA (Butterflies & Moths)			
Nymphalidae	*Mestra dorcas*	Dorcas**	O
	Siproeta stelenes stelenes	Antillean Malachite	O
	Euptoieta hegesia hegesia	Tropical Fritillary	O
	Phyciodes proclea	Jamaican Crescent Spot	O
	Anartia jatrophae jamaicensis	Jamaican White Peacock*	F
	Precis evarete zonalis	West Indian Buckeye	F
	Anea troglodyte	Jamaican Goat Weed	O
Pieridae	*Phoebis sennae sennae*	Cloudless Sulphur	F
	Ascia monuste	Antillean Great White	F
	Eurema nicippe	Sleepy Orange	F
	Eurema lisa euterpe	Little Sulphur	A
	Eurema elathea	Cramer's Barred sulphur,	D
	Eurema nise nise	Cramer's Little Sulphur,	D
	Eurema daira palmira	Poey's Barred sulphur	D
	Anteos maerula	Maerula	R
Papilionidae	*Papilio andraemon*	Cuban Swallowatail	F
	Papilio thersites	The Thersites Swallowtail	R
Danaidae	*Danaus plexippus*	The Monarch	R
Hesperiidae	*Pyrgus oileus*	Syrichtus	F
	Chiodes cattilus churchi	Church's Jamaican Skipper	O
Hesperiidae	*Urbanus proteus*	The Common Tailed Skipper	O
	Wallengrenia otho vesuria	Vesuria	R
	Panoquina sylvicola woodruffi	Watson's Cane Skipper	R
	Lerodea eufala eufala	Eufala	O
	Calpodes ethlius	The Canna Skipper	R
Heliconiidae	*Heliconius charitonius simulator*	Jamaican Zebra*	D
	Dione vanillae	Tropical Silverspot	D
	Dryas iulia delia	Julia	A
Lycaenidae	*Hemiargus dominica*	Jamaican Blue**	O
	Strymon columella cybira	Hewitson Hairstreak	A
Apaturidae	*Anaea troglodyta*	The Jamaican Goatweed Butterfly	O
Satyridae	*Calisto zangis*	The Jamaican Satyr	O
Pyralidae	*Diaphania indica*		R
Noctuidae	*Diphthera festiva*	Hieroglyphic Moth	O
	Ascapapha odorata	Messenger from the dark	R
Psychidae	*1 sp.*	Bagworm Moth	O
COLEOPTERA (Beetles)			
Coccinellidae	*Brachyacantha bistrpustula*		F
	Cycloneda sanguinea		R
	Exochomus ritchei		O
	3 spp. unidentified		R

FAMILY	GENUS & SPECIES	COMMON NAMES	DAFOR
Chrysomelidae	*Chalpeus sanguinicollis*		R
	Coleomegilla cubensis		R
	Cryptocephalus sp.		O
	Disonycha laevigata		O
	1 Cryptocephaline sp.	Case bearing leaf beetle	R
	1 Alticinae sp.	Flea beetle	R
	1 sp. unidentified		R
Cerambycidae	*Oxymerus* sp.		A
Elateridae	*Stercula roetida*	Click Beetle	O
Curculionidae	*1 sp.*	Snout Beetle	R
Scolytidae	*1 sp.*	Bark Beetle	R
Mordellidae	*1 sp. unidentified*	Tumbling flower Beetle	R
DIPTERA (Flies)			
Muscidae	*Musca domestica*	Housefly	O
Tachinidae	*2 spp.*		R
Tabanidae	*Chrysops sp.*		R
Syriphidae	*Toxomera violaceous*		F
	Palpada vinetorum		O
Bombyliidae	*Poecilanthrax lucifer*		R
Sarcophagidae	*1 sp.*		R
	Hystricocnema plinthopyga		R
Culicidae	2 spp.	Mosquitoes	O
HYMENOPTERA (Ants, Wasps & bees)			
Apidae	*Apis mellifera*	Honeybee	A
	Xylocopa sp.	Carpenter bee, Bumble bee	O
Sphecidae	*Sphex jamaicensis*		O**
Vespidae	*Polistes hunteri*	Paper wasp, Red wasp	F
	Polistes crinitus	Paper wasp, Red wasp	F
	Polistes major	Paper wasp, Red wasp	F
	Stenodynerusbacus		R
Anthophoridae	*Exomalopsis sp.*	Sweat bee	R
Formicidae	*Campanotus* sp.	Carpenter ants	O
	2 spp.		O
Chalcididae	*Brachymeria sp.*		R
	.1 sp. unidentified		R
Ichneumonidae	2 spp. unidentified		R
NEUROPTERA (Lace Wings)			
Chrysopidae	1 sp.	Green Lacewing	F
HEMIPTERA (Bugs)			
Reduviidae	*Zelus longipes*	Assassin bug	R
Coreidae	*Niesthrea pictipes*		O
	1 sp. unidentified		O
Pyrrhocoridae	*Dysdercus mimulus*	Lovebugs	O
Pentatomidae	*Euschistus bifibulus*		O

FAMILY	GENUS & SPECIES	COMMON NAMES	DAFOR
	Edessa bifida		O
	Oebalus pugnax		O
	Thyanta sp.		O
	2 spp. unidentified		O
	Nezara viridula		O
Lygaeidae	*2 spp. unidentified*		R
Scutelleridae	*1 sp. unidentified*		O
HOMOPTERA (Plant bugs)			
Cicadidae	*Odopoea dilata*		**O**
Cicadellidae	*Tylozygus fasciatus*		O
	Hortensia similis		D
	5 spp.		F
Membracidae	*1 sp.*		O
Cixiidae	*1 sp.*		A
Issidae	*1 sp.*		O
Kinnaridae	*1 sp.*		R
ODONATA (Dragonflies)			
Libellulidae	*Tramea binotata*	Needle case	F
	Erythremis plebja	Needle case	D
	Erythrodiplax berenice naeva	Needle case	F
	Macrodiplax balteata	Needle case	
	1 sp. Red body	Needle case	O
ORTHOPTERA (Grasshoppers & Crickets)			
Tettigoniidae	*Conocephalus sp.*		R
Acrididae	*Schistocera nitens*		R
	Orphulella punctata	Grasshopper	A
ARACHNIDA (Spiders)			
Buthidae	1 sp. unidentified		O
Chaeliferidae	1 sp. unidentified	Pseudoscorpion	O
DIPLOPODA (Millipedes)			
Spirostretidae	3 spp. unidentified	Millipedes	O

* Endemic subspecies; ** Endemic species

Appendix Table 7: Land snails recorded from Holland Estate. * Endemic subspecies. ** Endemic species

FAMILY	SPECIES	DAFOR
Class: GASTROPODA		
Pleurodontidae	*Pleurodonte invalida***	D
	*Pleurodonte lucerna***	O
Urocoptidae	*Urocoptis aspera***	O
	*Spirostemma simile***	O
Subulinidae	*Subulina octona*	O
Sagdidae	*Sagda spei***	R

FAMILY	SPECIES	DAFOR
Helicinidae	*Lucidella aureola aureola***	F
Bulimulidae	*Drymaeus immaculatus***	R/O
Neocyclotidae	*Cyclochittya chittyi***	F/O
Sagdidae	*Hyalosagda arboreoides***	F
Orthalicidae	*Orthalicus undatus jamaicensis**	F
Annulariidae	*Annularia mitis*	F

Appendix Table 8: DAFOR scale used to rank bird species abundance

	Total number of birds observed during the survey
D	≥ 20
A	15 – 19
F	10 – 14
O	5- 9
R	< 4

Appendix Table 9: Birds observed on Holland Estate during the study

Proper Name	Code	*Scientific Name*	Status	DAFOR
American Redstart	AMRE	*Setophaga ruticilla*	Migrant	O
Antillean Palm Swift	ANPS	*Tachornis phoenicobia*	Resident	A
Arrow-Headed Warbler	AHWA	*Dendroica pharetra*	Endemic	R
Bananaquit	BANA	*Coereba flaveola*	Resident	O
Barn Owl	BAOW	*Tyto alba*	Resident	
Black and White Warbler	BAWW	*Mniotilta varia*	Migrant	O
Black-Throated Blue Warbler	BTBL	*Dendroica caerulescens*	Migrant	O
Black-Whiskered Vireo	BWVI	*Vireo altiloquus*	Migrant	R
Caribbean Dove	CADO	*Leptotila jamaicensis*	Resident	R
Cattle Egret	CAEG	*Bubulcus ibis*	Resident	D
Common Ground Dove	COGD	*Columbina passerine*	Resident	O
Common Yellow throat	COYT	*Geothlypis trichas*	Migrant	O
Great Egret	GREG	*Casmerodius albus*	Resident	R
Greater Antillean Grackle	GRAG	*Quiscalus niger*	Resident	D
Green-rumped Parrotlet	GRPA	*Forpus passerines*	Resident	R
Jamaica Tody	JATO	*Todus todus*	Endemic	R
Jamaican Crow	JACR	*Corvus jamaicensis*	Endemic	O
Jamaican Elaenia	JAEL	*Myiopagis cotta*	Endemic	R
Jamaican Euphonia	JAEU	*Euphonia Jamaica*	Endemic	O
Jamaican Lizard Cuckoo	JALC	*Saurothera vetula*	Endemic	R
Jamaican Oriole	JAOR	*Icterus leucopteryx*	Endemic	R
Jamaican Pewee	JAPE	*Contopus pallidus*	Endemic	R
Jamaican Vireo	JAVI	*Vireo modestus*	Resident	R
Jamaican Woodpecker	JAWO	*Melanerpes radiolatus*	Endemic	O
Little Blue Heron	LBHE	*Egretta caerulea*	Resident/Migrant	R
Loggerhead Kingbird	LOKI	*Tyrannus caudifasciatus*	Resident	F
Mourning Dove	ZEMA	*Zenaida macroura*	Resident	R
Northern Mockingbird	NOMO	*Mimus polyglottos*	Resident	A

Olive-throated Parakeet	OTPA	*Aratinga nana*	Endemic sub-species	F
Ovenbird	OVEN	*Seiurus aurocapillus*	Migrant	R
Palm Warbler	PAWA	*Dendroica palmarum*	Migrant	R
Prairie Warbler	PRAW	*Dendroica discolour*	Migrant	O
Red-Billed Streamertail	RBST	*Trochilus polytmus*	Endemic	O
Rock Dove	RODO	*Columba livia*	Resident	R
Sad Flycatcher	SAFL	*Myiarchus barbirostris*	Endemic	R
Saffron Finch	SAFI	*Sicalis flaveola*	Resident	R
Smooth-billed Streamertail	SMBS	*Crotophaga ani*	Resident	D
Turkey Vulture	TUVU	*Carthartes aura*	Resident	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	Resident	O
White Crowned Pigeon	WCPI	*Columba leucocephala*	Resident	R
White-Winged Dove	WWDO	*Zenaida asiatica*	Resident	R
Worm-eating Warbler	WEWA	*Helmitheros vemivorus*	Migrant	R
Yellow-billed Parrot	YEBP	*Amazona collaria*	Endemic	O
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	Resident	F
Yellow-shouldered Grassquit	YSGR	*Loxipasser anoxanthus*	Endemic	O
Yellow-throated Warbler	YETW	*Dendroica dominica*	Migrant	O
Zenaida Dove	ZEDO	*Zenaida aurita*	Resident	R

Appendix Table 10: The Wetland birds observed in the study

Proper name	Code	Scientific name	Status	DAFOR
Cattle Egret	**CAEG**	*Bubulcus ibis*	Resident	**F**
Little Blue Heron	**GBHE**	*Ardea herodias*	Migrant	**R**
Great Egret	**GREG**	*Egretta caeruela*	Resident	**R**

Appendix Table 11: Endemic birds observed in the study

Proper name	Code	DAFOR	Forest dependent Y/N
Arrow-Headed Warbler	AHWA	R	Y
Jamaica Tody	JATO	R	N
Jamaican Crow	JACR	O	Y
Jamaican Elaenia	JAEL	R	Y
Jamaican Euphonia	JAEU	O	N
Jamaican Lizard Cuckoo	JALC	R	N
Jamaican Oriole	JAOR	R	N
Jamaican Pewee	JAPE	R	Y
Jamaican Vireo	JAVI	R	N
Jamaican Woodpecker	JAWO	O	N
Red-Billed Streamertail	RBST	O	N
Sad Flycatcher	SAFL	R	Y
Yellow-billed Parrot	YEBP	O	Y
Yellow-shouldered Grassquit	YSGR	O	N

Note: Six of the 14 endemics observed on the property are forest dependent species

Appendix Table 12: The birds observed in the shade trees at Site 1 (Grassland)

Proper Name	Code	*Scientific Name*	Status	DAFOR
American Redstart	AMRE	*Setophaga ruticilla*	Migrant	O
Bananaquit	BANA	*Coereba flaveola*	Resident	O

Proper Name	Code	*Scientific Name*	Status	DAFOR
Black and White Warbler	BAWW	*Mniotilta varia*	Migrant	O
Cattle Egret	CAEG	Bubulcus ibis	Resident	D
Common Ground Dove	COGD	*Columbina passerine*	Resident	O
Common Yellow throat	COYT	*Geothlypis trichas*	Migrant	O
Great Egret	GREG	Casmerodius albus	Resident	R
Greater Antillean Grackle	GRAG	Quiscalus niger	Resident	D
Jamaican Crow	**JACR**	***Corvus jamaicensis***	**Endemic**	**O**
Loggerhead Kingbird	LOKI	*Tyrannus caudifasciatus*	Resident	F
Mourning Dove	ZEMA	Zenaida macroura	Resident	R
Northern Mockingbird	NOMO	*Mimus polyglottos*	Resident	A
Olive-throated Parakeet	**OTPA**	**Aratinga nana**	**Endemic/ sub-species**	**F**
Palm Warbler	PAWA	*Dendroica palmarum*	Migrant	R
Red-Billed Streamertail	**RBST**	***Trochilus polytmus***	**Endemic**	**O**
Rock Dove	RODO	*Columba livia*	Resident	R
Smooth-billed Streamertail	SMBS	Crotophaga ani	Resident	D
Turkey Vulture	TUVU	*Carthartes aura*	Resident	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	Resident	O
White-Winged Dove	WWDO	*Zenaida asiatica*	Resident	R
Yellow-billed Parrot	**YEBP**	***Amazona collaria***	**Endemic**	**O**
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	Resident	F
Yellow-throated Warbler	YETW	*Dendroica dominica*	Migrant	O

Appendix Table 13: Birds observed in Site 1 (Grassland)

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
Antillean Palm Swift	ANPS	*Tachornis phoenicobia*	Resident	A
Cattle Egret	CAEG	*Bubulcus ibis*	Resident	D
Great Egret	GREG	*Casmerodius albus*	Resident	R
Little Blue Heron	LBHE	*Egretta caerulea*	Resident	R
Northern Mockingbird	NOMO	*Mimus polyglottos*	Resident	A
Olive-throated Parakeet	OTPA	*Aratinga nana*	Endemic	F
Prairie Warbler	PRAW	*Dendroica discolor*	Migrant	O
Turkey Vulture	TUVU	*Carthartes aura*	Resident	O
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	Resident	F

Appendix Table 14: Birds observed in Site 2(Grassland with small trees)

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
American Redstart	AMRE	*Setophaga ruticilla*	Migrant	O
Bananaquit	BANA	*Coereba flaveola*	Resident	O
Black and White Warbler	BAWW	*Mniotilta varia*	Migrant	O
Black-Throated Blue Warbler	BTBL	*Dendroica caerulescens*	Migrant	O
Cattle Egret	CAEG	Bubulcus ibis	Resident	D
Jamaican Vireo	JAVI	*Vireo modestus*	Resident	R
Little Blue Heron	LBHE	Egretta caerulea	Resident / Migrant	R
Northern Mockingbird	NOMO	*Mimus polyglottos*	Resident	A
Olive-throated Parakeet	**OTPA**	**Aratinga nana**	**Endemic**	**F**
Ovenbird	OVEN	*Seiurus aurocapillus*	Migrant	R

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
Palm Warbler	PAWA	*Dendroica palmarum*	Migrant	R
Prairie Warbler	PRAW	*Dendroica discolor*	Migrant	O
Rock Dove	RODO	*Columba livia*	Resident	R
Sad Flycatcher	**SAFL**	***Myiarchus barbirostris***	**Endemic**	**R**
Saffron Finch	SAFI	Sicalis flaveola	Resident	R
Smooth-billed Streamertail	SMBS	Crotophaga ani	Resident	D
Turkey Vulture	TUVU	*Carthartes aura*	Resident	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	Resident	O
White-Winged Dove	WWDO	*Zenaida asiatica*	Resident	R
Worm-eating Warbler	WEWA	*Helmitheros vemivorus*	Migrant	R
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	Resident	F
Yellow-throated Warbler	YETW	*Dendroica dominica*	Migrant	O

Appendix Table 15: Birds observed in the forest

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
American Redstart	AMRE	*Setophaga ruticilla*	Migrant	O
Arrow-Headed Warbler	**AHWA**	***Dendroica pharetra***	**Endemic**	**R**
Bananaquit	BANA	*Coereba flaveola*	Resident	O
Black and White Warbler	BAWW	*Mniotilta varia*	Migrant	O
Black-Throated Blue Warbler	BTBL	*Dendroica caerulescens*	Migrant	O
Black-Whiskered Vireo	BWVI	*Vireo altiloquus*	(Summer) Migrant	R
Caribbean Dove	CADO	*Leptotila jamaicensis*	Resident	R
Cattle Egret	CAEG	Bubulcus ibis	Resident	D
Common Ground Dove	COGD	*Columbina passerina*	Resident	O
Common Yellow throat	COYT	*Geothlypis trichas*	Migrant	O
Great Egret	GREG	Casmerodius albus	Resident / Migrant	R
Greater Antillean Grackle	GRAG	Quiscalus niger	Resident	D
Green-rumped Parrotlet	GRPA	*Forpus passerinus*	Resident	R
Jamaica Tody	**JATO**	***Todus todus***	**Endemic**	**R**
Jamaican Crow	**JACR**	***Corvus jamaicensis***	**Endemic**	**O**
Jamaican Elaenia	**JAEL**	***Myiopagis cotta***	**Endemic**	**R**
Jamaican Euphonia	**JAEU**	***Euphonia Jamaica***	**Endemic**	**O**
Jamaican Lizard Cuckoo	**JALC**	**Saurothera vetula**	**Endemic**	**R**
Jamaican Oriole	**JAOR**	**Icterus leucopteryx**	**Endemic**	**R**
Jamaican Pewee	**JAPE**	***Contopus pallidus***	**Endemic**	**R**
Jamaican Vireo	**JAVI**	***Vireo modestus***	**Resident**	**R**
Jamaican Woodpecker	**JAWO**	***Melanerpes radiolatus***	**Endemic**	**O**
Loggerhead Kingbird	LOKI	*Tyrannus caudifasciatus*	Resident	F
Northern Mockingbird	NOMO	*Mimus polyglottos*	Resident	A
Olive-throated Parakeet	**OTPA**	**Aratinga nana**	**Endemic**	**F**
Ovenbird	OVEN	*Seiurus aurocapillus*	Migrant	R
Palm Warbler	PAWA	*Dendroica palmarum*	Migrant	R
Prairie Warbler	PRAW	*Dendroica discolor*	Migrant	O
Red-Billed Streamertail	**RBST**	***Trochilus polytmus***	**Endemic**	**O**

Proper Name	Code Used	*Scientific Name*	Status	DAFOR
Sad Flycatcher	**SAFL**	***Myiarchus barbirostris***	**Endemic**	**R**
Smooth-billed Streamertail	SMBS	Crotophaga ani	Resident	D
Turkey Vulture	TUVU	*Carthartes aura*	Resident	O
Vervain Hummingbird	VEHU	*Mellisuga minima*	Resident	O
White Crowned Pigeon	WCPI	*Columba leucocephala*	Resident	R
White-Winged Dove	WWDO	*Zenaida asiatica*	Resident	R
Worm-eating Warbler	WEWA	*Helmitheros vemivorus*	Migrant	R
Yellow-billed Parrot	**YEBP**	***Amazona collaria***	**Endemic**	**O**
Yellow-faced Grassquit	YEFC	*Tiaris olivacea*	Resident	F
Yellow-shouldered Grassquit	**YSGR**	***Loxipasser anoxanthus***	**Endemic**	**O**
Yellow-throated Warbler	YETW	*Dendroica dominica*	Migrant	O
Zenaida Dove	ZEDO	*Zenaida aurita*	Resident	R

Appendix Table 16: The herpetofauna microhabitats found

Microhabitat	Open Pasture	Disturbed Forest
Base of large trees (>10m)		present
Grass piles	present	
High grass	present	
Large logs		present
large rock		present
Leaf litter		present
Log piles		present
Ponds / drinking holes	present	
Rock walls		present
Stone pile		present
Termite mounds		present
Trees below 5m	present	present
Trees between 10 - 15m		present
Trees between 5 - 10m		present
Trees taller than 15m		present

Appendix Table 17: Reptiles recorded at Holland Estate

Species	STATUS	DAFOR
Anolis garmani	E	F
Anolis grahami graham	E	D
Anolis lineatopus merope	E	D
Anolis lineatopus neckeri	E	O
Anolis sagrei	N	F
Anolis valencienni	E	R
Aristelliger praesignis	E	R
Celestus barbouri	E	R
Celestus crusculus crusculus	E	O
Celestus hewardi	E	R
Hemidactylus mabuya	I	O

Sphaerodactylus argus henriques	E	R
Sphaerodactylus goniorhynchus	E	F
Sphaerodactylus richardsoni richardsoni	E	O
Arrhyton callilaemus	E	R
Arrhyton funereum	E	R
Epicrates subflavus	E	R
Tropidophis stejnegeri	E	R
Typhlops jamaicensis	E	R
E= endemic, N= native, I = introduced		

Appendix Table 18: Amphibians recorded from Holland Estate

Genus	STATUS	DAFOR
Bufo marinus	I	R
Eleutherodactylus cundalli	E	R
Eleutherodactylus gossei gossei	E	O
Eleutherodactylus grabhami	E	R
Eleutherodactylus griphus	E	R
Eleutherodactylus johnstonei	E	R
Eleutherodactylus luteolus	E	O
Eleutherodactylus pantoni amiantus	E	O
Eleutherodactylus planirostris planirostris	N	R
Eleutherodactylus sisyphodemus	E	R
E = endemic, N = native, I = introduced		

Appendix VII: Impact Identification Definition and Significance of Impacts

In assessing the significance of potential impacts, various measures are used. These include the use of checklists/matrices, expert knowledge and a keen assessment of the project plans and details. Each parameter is evaluated according to the following:

- Potential impact - any change to the environment, whether adverse or beneficial, wholly or partially resulting from the proposed activities, products or services
- Activity – phase of development that action takes place in
- Environmental receptor - sensitive component of the ecosystem that reacts to or is influenced by environmental stressors
- Magnitude - A measure of how adverse or beneficial an effect may be
- Duration - the length of time needed to complete an activity
- Significance - A measure of importance of an effect
- Mitigation - Measures taken to reduce adverse impacts on the environment

Outlined below are the impacts on the various phases of the proposed development as they relate to key aspects of the project. Namely:

- Physical environment
- Biological environment
- Socio-economic environment
- Cumulative impact assessment

Mitigation measures are provided, where necessary, at the end of each subsection.

Impact Identification & Mitigation Method

A. Impact Identification

This section is undertaken to forecast the characteristics of the main potential impacts. Known as impact analysis, this stage can be broken down into three overlapping aspects:

- *identification* — to specify the impacts associated with each phase of the project and the activities undertaken;
- *prediction* — to forecast the nature, magnitude, extent and duration of the main impacts; and
- *evaluation* — to determine the significance of residual impacts i.e. after taking into account how mitigation will reduce a predicted impact

Impact identification and prediction are undertaken against an environmental baseline, such as:

- human health and safety;
- flora, fauna, ecosystems and biological diversity;
- soil, water, air, climate and landscape;

- use of land, natural resources and raw materials;
- protected areas and designated sites of scientific, historical and cultural significance;
- heritage, recreation and amenity assets; and
- livelihood, lifestyle and well being of those that may be affected by the proposed project

These requirements were identified in the Terms of Reference. The parameters to be taken into account in impact prediction and decision-making include:

- likelihood (probability, uncertainty or confidence in the prediction);
- nature (positive, negative, direct, indirect, cumulative);
- magnitude (severe, moderate, low);
- extent/location (area/volume covered, distribution);
- duration (short term, long term, intermittent, continuous);
- reversibility/irreversibility; and
- significance (local, regional, global)

A.1 Nature

The most obvious impacts are those that are directly related to the proposed project, and can be connected (in space and time) to the action that caused them. Typical examples of direct impacts as it relates to this project are: modifications of a surface runoff on and adjacent to the project site; loss of habitat caused by land clearance; any perceived changes/increases in air particulate emissions (temporary/permanent), etc.

Indirect or secondary impacts are changes that are usually less obvious, occurring later in time or further away from the impact source. Typical example of indirect impact as it relates to this project is: noise related stress caused by urban development.

Cumulative effects, typically, result from the incremental impact of an action when combined with impacts from projects and actions that have been undertaken recently or will be carried out in the near or foreseeable future. These impacts may be individually minor but collectively significant because of their spatial concentration or frequency in time. Cumulative effects can accumulate either incrementally (or additively) or interactively (synergistically), such that the overall effect is larger than the sum of the parts.

A.2 Magnitude (Intensity)

Estimating the magnitude of the impact is of primary importance. In this document it is expressed in terms of relative severity, such as major, moderate or low. Severity, will also take into account other aspects of impact magnitude, notably whether or not an impact is reversible.

- **Low**: negligible effect when component is slightly altered. For human population the effect is negligible when it slightly affects a component or its use or valuation by the community.

- **Moderate**: moderate effect when component is altered to a lesser extent but doesn't compromise its presence in the new environment. For human population the effect is less intense when it partially limits the use of the component or its valuation by the community.
- **Major**: major effect when component is completely destroyed or is altered significantly. For human population the effect is when it compromises or alters significantly the component or its use or valuation by the community.

A.3 Duration

Some impacts may be short-term, such as the noise arising from the operation of equipment during construction. Others may be long-term, such as noise arising from the operation of conveyor during operation. Certain impacts may be intermittent, whereas others may be continuous.

- **Short-term impacts**: when component will be affected for a limited period such as the pre-construction phase of the project, i.e., pre-construction and construction.
- **Intermittent impacts**: when component will have difficulty to adjust at first to the new environmental conditions but will eventually return to pre-project levels and the population will be able to use it eventually as before or even better.
- **Long-term impacts**: when component will be affected for the lifetime of the project enough to compromise the survival of a local species or use of a component by the population.

Impact magnitude and duration classifications will be cross-referenced; as necessary, for example, major but short term (less than one year).

A.4 Extent/Location

The spatial extent or zone of impact influence can be predicted for site-specific versus regional occurrences. Depending on the type of impact, where necessary, the variation in magnitude will be estimated.

- **Limited**: When impact occurs in relatively restricted areas such as the construction site facilities
- **Local**: Limited area when component is well represented in region (<1 km radius)
- **Regional**: When an impact exceeds local boundary and has the potential to affect a wide radius of communities such as a nearby town (1-10 km radius)
- **National**: When an impact has the potential to affect the entire island
- **International**: Impacts that may be considered as affecting the global population such as contributions to global warming

A.5 Significance

The evaluation of significance at this stage of EIA will depend on the characteristics of the predicted impact and its potential importance for decision-making. An impact may be categorized as negative if it adversely affects an environmental component and positive if it favourably affects an environmental component. For the purposes of this project:

- **Minor**: An impact of low significance is one that is short term and will have no long term cumulative effect on the environment and/or will affect a negligible portion of an environmental component.
- **Moderate**: An impact may be considered to be of moderate significance when the change is medium to long term and/or will result in changes that affect a considerable portion of the environmental component.
- **Major**: An impact of high significance will cause long term changes and/or will result in changes that affect a major percentage of the environmental component.

Significance may also be attributed in terms of an existing standard or criteria of permissible change.

B Impact Mitigation

The elimination of adverse environmental impacts or their reduction to an acceptable level is at the heart of the EIA process. By definition all EIA projects are likely to have significant environmental effects. In this case, the potential for mitigation will be considered at every stage of the proposed project. In determining the level of effectiveness of mitigation measures, the following will be taken into account:

A. **Prevent** - The most effective approach will be to prevent the creation of adverse environmental effects at source rather than trying to counteract their effects through specific mitigation measures. At source solutions may include:
    - specification of operational equipment- for example the use of an inherently quieter machine

B. **Reduce** - If the adverse effects cannot be prevented steps will be taken to reduce them. Methods to reduce adverse effects include: minimisation at source
    - use of low noise or vibration construction equipment
    - operating the site to minimise the production of leachate
    - abatement on site
        i. colour of buildings
        ii. screen planting and landscaping
        iii. noise attenuation measures
        iv. reduced hours of construction
    - abatement at receptor
        i. noise insulation for houses
        ii. relocating rare species

Quantification of impacts is a difficult technical aspect of an EIA. For some impacts the theoretical basis for computing the magnitude does not exist. Such impacts may have to be addressed in a qualitative way.

C. Summary of Impact Matrices

Summary matrices are included and give an overall picture of the potential pre-mitigation impacts and residual impacts.

C.1 Residual Impacts

Any potential residual impacts, ranked as moderate or major will be discussed in more detail in the subsequent text in the section addressed. The residual environmental impacts refer to the net environmental impacts after mitigation, taking into account the background environmental conditions and the impacts from existing, committed and planned projects.

The following table outlines the criteria used to assess environmental impacts in terms of minor, moderate, or major impact subsequent to mitigation measures being incorporated.

Table C: Level of Impact after Mitigation Measures

	Ecological Effects	Socio-economic Effects	Stakeholders	Consequence for Proponent
Major	Degradation to the quality or availability of habitats and/or fauna with recovery taking more than 2 years	Change to commercial activity leading to a loss of income or opportunity beyond normal business variability/risk Potential short term effect upon public health / well-being, real risk of injury	Concern leading to active campaigning locally or wider a field	Introduce measures to avoid these impacts wherever possible, closely monitor and control areas of residual impact
Moderate	Change in habitats or species beyond natural variability with recovery potential within 2 years	Change to commercial activity leading to a loss of income or opportunity within normal business variability/risk Possible but unlikely effect upon public health/well-being. Remote risk of injury	Widespread concern, some press coverage, no campaigning	Actively work to minimize scale of impacts
Minor	Change in habitats or species which can be seen and measured but is at same scale as natural variability	Possible nuisance to other activities and some minor influence on income or opportunity. Nuisance but no harm to public	Specific concern within a limited group	Be aware of potential impacts, manage operations to minimize interactions
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe	Noticed by but not a nuisance to other commercial activities. Noticed by but effects upon the health and well-being of the public	An awareness but no concerns	No positive intervention needed but ensure they do not escalate in importance
Positive	An enhancement of ecosystem or popular parameter	Benefits to local community	Benefits to stakeholder issues and interests	Actively work to maximize specific benefits