ENVIRONMENTAL IMPACT ASSESSMENT

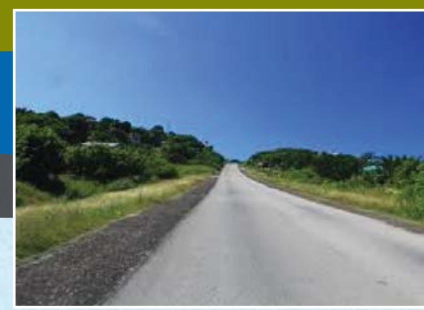
Draft Final Report

Southern Coastal Highway Improvement Project

Part B (ii) Works – Harbour View to Yallahs Bridge

Ministry of Economic Growth & Job Creation

October 2017



Stanley Consultants INC.

CL ENVIRONMENTAL

NWA NATIONAL WORKS AGENCY

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ROAD IMPROVEMENT PROJECT FROM HARBOUR VIEW, KINGSTON TO YALLAHS, ST. THOMAS (SECTION 1A OF THE SOUTHERN HIGHWAY IMPROVEMENT PROJECT)

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A	AADT	Annual average daily traffic
	ACGIH	American Conference of Industrial Hygienists
	AASHTO	American Association of State Highway and Transportation Officials
	AMC	Antecedent moisture conditions
	amsl	Above mean sea level
B	BA	Basal area
C	C	Celsius
	CH	Chainage
	CBD	Convention on Biological Diversity
	CCCL	Caribbean Cement Company Limited
	CDMP	Caribbean Disaster Mitigation Project
	CN	Curve number
	CO	Carbon Monoxide
	CO2	Carbon Dioxide
D	DAFOR	Dominant, Abundant, Frequent, Occasional, Rare
	dBA	A-weighted sound level (decibel)
	DBH	Diameter at breast height
	DCR	Design Concept Report
	DEM	Digital elevation model
	DO	Dissolved oxygen
E	E	East/ Easting
	EB	Eastbound
	EIRR	Economic Internal Rate of Return
	EAM	Environmental Assessment Memorandum
	EIA	Environmental Impact Assessment
	EMP	Environmental Monitoring Programme
	ESRI	Environmental Systems Research Institute
	FHA	Federal Highway Administration
	FOG	Fats Oil and Grease
F	ft.	Feet
G	g/l	Grams per litre
	GIS	Geographic information system
	GOJ	Government of Jamaica

	GPS	Global Positioning System
H	HA	Hectares
	hr	Hour
	Hz	Hertz
I	IPCC	Intergovernmental Panel on Climate Change
	IUCN	International Union for Conservation of Nature
J	JAD 2001	Jamaica Grid 2001
	JNHT	Jamaica National Heritage Trust
K	km	Kilometre
L	LDUC	Land Development and Utilization Commission
	Leq	Time-average sound level
	Lj	jth sound level
	LOS	Level of service
M	m	Metre
	m/s	Metres per second
	m3/sec	Cubic metres per second
	mg/l	Milligrams per litre
	mg/m^3	Milligrams per cubic metre
	min	Minute (s)
	mm	Millimetre
	mm/24 hr	Millimetres per 24 hour period
	mS/cm	milli Siemens per cm
	MSDS	Material Safety Data Sheets
	MCE	Multi criteria evaluation
N	N	North/ Northing
	NAAQS	National Ambient Air Quality Standards
	NEPA	National Environment and Planning Agency
	NMIA	Norman Manley International Airport
	NO2	Nitrogen Dioxide, Nitrite
	NO3	Nitrate
	NOx	Nitrogen Oxides
	NPV	Net present value
	NRCA	Natural Resources Conservation Act
	NSWMA	National Solid Waste Management Authority
	NTU	Nephelometric turbidity units
	NWA	National Works Agency
	NWC	National Water Commission
O	ODPEM	Office of Disaster Preparedness and Emergency Management
	OSHA	Occupational Safety and Health Administration
P	PCQ	Point-Centred Quarter
	PEL	Hearing Conservation and Permissible Exposure Limit
	PIF	Project Information Form

	PM10	Particulate matter smaller than 10 microns in diameter, respirable particulate matter
	PM2.5	Particulate matter smaller than 2.5 microns in diameter, fine particulate matter
	ppm	parts per million
	ppt	parts per thousand
	PSMP	(Jamaica) Public Sector Modernization Project
Q	QSP II	Quest suite Professional II
R	RADA	Rural Agriculture Development Agency
	ROW	Right of Way
S	s	Second
	SCHIP	Southern Coastal Highway Improvement Project
	SCS	US Soil Conservation Service
	SIA	Social Impact Area
	SO2	Sulfur Dioxide, sulfite
	SO4	Sulfate
	SOx	Sulfur Oxides
	STATIN	Statistical Institute of Jamaica
T	TCP Act	Town and Country Planning Act
	TDS	Total dissolved solids
	TSS	Total Suspended Solids
	TWSC	Two-way-stop-controlled
U	USEPA	United States Environmental Protection Agency
V	vpd	Vehicles per day
W	WHO	World Health Organization
	WRA	Water Resources Authority
	WB	Westbound
Y	yr.	Year

EXECUTIVE SUMMARY

INTRODUCTION

Overview and Objectives

Interregional connectivity is provided by existing major roadways along the south coast and these roadways, together with adjoining roads, constitute major elements of the surface transportation system in Jamaica. However, there is need for improvement along these major roadways based on a combination of safety, physical and functional deficiencies that exists, plus overall capacity needs. The Southern Coastal Highway Improvement Project (SCHIP) involves the development of highway alignments (upgrades or new alignment) along two corridors and specifically, Segment 1 (Port Antonio, Portland to Harbour View, St. Andrew, and Segment 2 (Negril, Westmoreland to Mandeville, Manchester).

Since the magnitude of the SCHIP is too large to complete under a single contract, a programme was developed that identified individual sections within each corridor for completion. Section 1A of Segment 1 is the first section of the Southern Coast Highway being constructed and this document therefore only refers to this section (Section 1A). Section 1A is approximately 17 km in length and involves road improvement works and new alignment between Harbour View, Kingston and Yallahs Bridge, St. Thomas. The Government of Jamaica (GOJ) has entered into a contract with China Harbour Engineering Company Ltd. (CHEC) to design and construct the project, which will be financed by the GOJ and a loan from the Export Import Bank of China.

Subsequent to the submittal of the Permit Application for the proposed project, it was decided that an Environmental Impact Assessment (EIA) was required. The specific tasks outlined in the approved TORs were executed by CL Environmental Co. Ltd. and this report serves to compile and present the findings of the EIA and ultimately provide a comprehensive evaluation of the proposed project.

Project Rationale

Specific to the selection of Section 1A as the first section for construction, there are a number of factors that influenced which section should be constructed initially (including socioeconomic ramifications, maintenance of traffic considerations, business impacts, Right-of-Way (ROW) acquisition, impact to traffic and safety, and various cost factors). Stanley Consultants in conjunction with the National Works Agency developed the project implementation priority and it was recommended to prioritize projects based on the Economic Internal Rate of Return (EIRR), as well as condition of existing facilities. Section 1A of Segment 1 had one of the three highest EIRRs, and was found to have the overall largest benefit, including subjective benefits for several reasons including:

- Existing road conditions are significantly worse than those sections with a higher EIRR.
- Significantly higher truck percentage due to quarry operations.
- Area east of Kingston is routinely cut off from services due to tropical storm and hurricanes.
- St. Thomas has land that can be developed as residential areas.

- Improvement of road will allow for future growth to the east of Morant Bay.

PROJECT DESCRIPTION

Overview

The proposed Section 1A highway consists of four lanes from 100+000 to 116+000 and two lanes from 116+000 to 117+400. The improvements to the existing roadway begins at 101+100 in Harbour View and continues to 106+700 in Bull Bay at the St. Andrew and St. Thomas parish boundary and from 109+500 in the vicinity of the Sun Coast Adventure Park (12 Mile) until the end of the section at the Yallahs River Bridge at 117+400. The new alignment begins at 106+700 where it diverts to the south of the existing roadway and continues until 109+500 in the vicinity of the Sun Coast Adventure Park in 12 Mile where it re-joins the existing roadway. The new alignment constitutes a total length of 2.8km. Improvements to the existing roadway includes road widening, curve flattening, installing sidewalks in urban areas, improved drainage infrastructure, etc. in order to correct deficiencies and improve the safety and traffic operating conditions.

Project Features

<u>Road Section</u>

The proposed typical sections indicate 2-lane roadway with one lane in either direction, as well as 4-lane roadway, where some of the project segments require additional travel lanes based upon traffic projections. Additionally, in urban areas it is expected that improvements to the existing road may include parking lanes to minimize disruption for the thru traffic. The rural typical section includes a utility corridor; in Segment 1, the utility corridor is on the right side of the road (the sea side).

<u>Drainage</u>

A wide range of works will be conducted ranging from maintenance of structures to replacing culverts in an attempt to alleviate flooding. There are 20 locations along the SCH Segment 1 Section 1A that require new or modified structures. Potential structure types range from multi-cell reinforced concrete box culverts (RCBC) to multi-span steel or concrete bridges (BR) and also include steel multi-plate pipe culverts (MPC) and high profile arches (MPA).

<u>Slope Stabilization</u>

Standard methods typically employed for highway cut and fill slopes are recommended along the majority of the proposed road alignment. Prior to grading, it is recommended that topsoil, vegetation and other objectionable material be stripped and clean topsoil stockpiled separate from other materials for reuse during the final stages of construction. Subgrades for both excavations and constructed fills should be proof-rolled and observed by a geotechnical engineer for any unsuitable materials. Areas where removal is unfeasible and cost-prohibitive, engineered products, such as geotextile and geogrid, can be used to improve stability.

Infrastructure

Along the proposed route, approximately 482 electricity poles, as well as 42 manholes and 11 service cabinets may have to be relocated. Additionally, there are potable water systems and sanitary sewer systems that are within close proximity to the proposed highway; some of these will have to be relocated.

An estimated 160,516.42 m3 of solid waste from site clearance and earthworks will be generated. Solid waste will be disposed of by CHEC in a manner approved by NWA and in accordance with all applicable government, county, parish, and local regulations.

Land Description and Ownership

Four communities, namely Bull Bay/ Seven Mile, Harbour View, Eleven Miles and Albion adjoin the proposed road works and 632 land parcels are completely or partially within the ROW for the project, covering a total land area of 893,802.41 sq. m (220.9 acres).

Project Schedule

- Design Phase (Land Acquisition and other similar activities) 10 months
- Construction Phase (Site preparation and general construction) 26 months
- Defects Liability Period (Any issues related to the defects etc.) 2 Years

IMPACTS AND MITIGATION

Site Preparation and Construction

ACTIVITY /IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
1. Physical															
Geotechnical		x		x	x				x			x			x
Excavation works and blasting		x		x	x			x				x		x	
Drainage and Hydrology															
- Drainage along alignment		x		x	x			x				x		x	
- sinkholes and wells		x	x		x			x			x		x		
Water Quality															
- Soil erosion and siltation		x		x	x			x				x		x	
- Raw Material Storage		x		x	x				x			x			x
Dewatering		x		x	x				x			x			x
Piling (noise and vibration)		x		x	x				x			x		x	
Noise		x		x	x			x				x		x	
Air quality		x		x	x			x				x		x	
Soil															
- Contamination		x	x			x		x				x		x	
- Soil erosion and siltation		x		x	x			x				x		x	
2. Biological															
Terrestrial Flora															
- Forested areas (removal)		x	x		x			x	x		x			x	x
- Habitat fragmentation		x	x		x				x			x		x	
- Soil erosion and siltation		x		x	x			x				x		x	
- Human and Invasive Species		x		x	x				x			x		x	
- Growth and Health		x		x					x			x		x	
- Human Encroachment and Urban Sprawl		x		x	x			x				x		x	
Terrestrial Fauna															

ACTIVITY /IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
- Fauna (degradation and removal of habitats)		x	x		x	x			x			x			x
- Fragmentation		x	x		x				x			x		x	
- Noise		x		x	x				x			x			x
3. Human and Social															
Traffic flow and Transportation		x		x	x			x				x			x
Raw Material spillage		x		x	x			x				x		x	
Traffic congestion, road wear		x		x	x			x				x			x
Dusting		x		x	x			x				x		x	
Increased Suspended solid runoff		x		x		x			x			x			x
Refuelling, storage and maintenance of vehicles and heavy equipment		x		x	x			x				x		x	
Land Use – Agricultural Land		x	x		x				x			x			x
Solid waste management		x		x	x				x			x			x
Sewage/wastewater generation		x		x	x				x			x			x
Water Demand and Supply		x		x	x				x		x				x
Health and safety															
- Occupational Health and Safety		x		x	x			x				x		x	
- Air Quality		x		x	x			x				x		x	
- Emergency Response		x		x	x			x				x	x		
Employment	x			x	x		x				x		x		
Health and Safety (Increased accident potential)		x		x	x			x				x		x	
Commercial activity															
Potential increases	x			x	x			x			x			x	
Potential reduction		x		x	x			x			x			x	
Recreational Facilities		x	x		x				x			x			x
Land Use															
- Agricultural Lands		x		x		x			x			x			x
Affected Structures		x	x		x		x				x			x	
Historic sites/artefacts		x	x		x				x			x	x		

Operation

ACTIVITY/ IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
1. Physical															
Water and Drainage															
- Drainage	x		x		x			x				x	x		
- Water resources (sinkholes and wells)		x	x		x			x			x		x		
Climate Change															
- Storm Surge and Sea Level Rise		x	x			x	x					x	x		
Air Quality															
- Increased pollutants in air shed		x	x			x		x				x			x
Noise															
- Increased noise pollution		x	x		x				x			x			x
Natural Hazards															
- Hurricane		x	x		x			x		x			x		
- Earthquake		x	x		x			x		x			x		
- Flooding		x	x		x			x		x				x	
2. Human/Social															
Transportation and Traffic															
- Improved road access and reliability and reduced travel time	x		x		x		x			x			x		
Housing	x		x			x		x		x				x	
Commercial Activity and Tourism	x		x			x		x		x			x		
Emergency Response															
- Potential for accidents		x	x			x	x				x			x	
- Emergency Access	x		x		x			x			x			x	
Aesthetics and Landscaping	x		x		x			x				x		x	

ENVIRONMENTAL MONITORING AND MANAGEMENT PLANS

Environmental Management System

As part of the Environmental Management System (EMS), it is recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but not limited to the following:

1. Noise
2. Dust
3. Traffic and Transportation
4. Water Quality
5. Solid Waste and Wastewater
6. Raw Material Storage and Transport
7. Health and Safety
8. Equipment Maintenance
9. Drainage

Other Related Studies and Plans

Risk Analysis Study

The first step in Risk Assessment is identifying the major hazards; that is, gathering and analysing data on meteorological, hydrological and geological hazards in terms of their nature, frequency and magnitude. Overall assessed risk levels result from a combination of low, medium and high severity of occurrence and probability of occurrence. The Risk Assessment was undertaken for natural and man-made hazards; priority hazards included: Flooding, Landslide, Earthquake, Accidents.

Emergency Response Plan

The Emergency Response Plan will be designed to describe the organizing, coordinating and directing of available resources in order to respond to various natural and man-made disasters and situations. These will include the following:

- Natural Disasters
- Civil Unrest and Riots
- Bomb Threats and Acts of Sabotage
- Acts of Terrorism and Armed Attacks
- Diesel and Hazardous Material Stockpiling
- Security and Safety Information
- Medical Emergency Information
- Technological Emergencies
- Occupational Health and Safety

Water Resources Risk Management Plan

A detailed assessment of the water resources along the final alignment and preparation of a Water Resource Risk Management Plan must be undertaken. This must be done in conjunction with Water Resources Authority's approval of the measures to mitigate against adverse effects during both the construction and operational phases. Reference must also be made to the drainage guidelines, "Guidelines for preparing hydrologic and hydraulic design reports for drainage systems of proposed developments", jointly developed by the NWA, ODPEM and the WRA.

Resettlement and Relocation Plan

All resettlement activities carried out by NWA will be sustainable in nature by providing sufficient resources or alternatives to those who are displaced. All persons affected will be consulted and given the opportunity to participate in the planning and implementation of their own resettlement. Assistance will be provided in helping individuals to restore their standard of living or to raise it, but no individual's standard of living should be lowered as a consequence of the project. The legal tenure of affected persons will determine the type of compensation and resettlement assistance to be received.

Restoration and Rehabilitation Plan

The rehabilitation will start with the restoration of the locations of the construction campsites and other cleared areas associated with the road works. This area will be backfilled with material removed during campsite construction and supplemented with layers of topsoil also removed during clearance activities. The surface will be stabilized according to an active planting program and a plant nursery will be setup to ensure that sufficient, suitable plant material is available to allow a timely re-vegetation of the site. The vegetation planted will be monitored over a minimum five-year period.

CONCLUSIONS

A multi-criteria approach was taken in order to select the final preferred SCHIP alignment and that section to be constructed initially (section 1A). The preferred alignment was chosen based on a number of weighted criteria; those ranking highest included impacts from flooding and storm surge; impacts to biological habitats (wetlands and springs) and archaeological sites; transportation and socioeconomic benefits gained as a result of reduction in average travel time, potential for development and improved level of service; as well as roadway costs and structure costs. The construction of Section 1A not only has one of the three highest EIRRs, but will bring about the overall largest benefit and encourage future development in eastern Jamaica.

The No Build Alternative of the proposed project assumes that no improvements will be made in the study area and that existing conditions will remain. The advantages of this option (no right-of-way acquisition, least impact to the environment, minor disruption to traffic during maintenance work and least costly alternative) do not outweigh those of the proposed project however, which would include less travel time, new improved roadway, reduced flooding and increased opportunity for economic development.

Implementation of recommend mitigation measures will assist in further reducing the environmental impact of the project.

1.0 INTRODUCTION

1.1 PROPOSED PROJECT AND RELEVANCE

The existing highways leading from Harbour View to Port Antonio along the southeast coast of Jamaica, and from Negril to Mandeville in the western portion of the island serve some of the most populated urban areas in the country (Figure 1-1). The roads also provide key routes for commercial and industrial interests, and is needed to support tourist activity and future development on the island. Interregional connectivity is provided by existing major roadways between the parishes of St. Andrew, St. Thomas, and Portland and Westmoreland, St. Elizabeth, and Manchester and these roadways, together with adjoining roads, constitute major elements of the surface transportation system in Jamaica. However, there is need for improvement along these major roadways based on a combination of safety, physical and functional deficiencies that exists, plus overall capacity needs within each corridor. The **Southern Coastal Highway Improvement Project (SCHIP)** involves the development of highway alignments (upgrades or new alignment) along these two corridors and specifically:

- **Segment 1** - Port Antonio, Portland to Harbour View, St. Andrew, approximately 110 km along the southern and eastern coast of the island, traversing the three parishes of St. Andrews, St. Thomas and Portland; and
- **Segment 2** - Negril, Westmoreland to Mandeville, Manchester, with a total length of approximately 130 km and located within the three parish boundaries of Westmoreland, St. Elizabeth, and Manchester.

Since the magnitude of the SCHIP (Segment 1 and Segment 2) is too large to complete under a single contract, a programme was developed that identified individual sections within each corridor for completion. Factors such as socioeconomic ramifications, maintenance of traffic considerations, business impacts, Right-of-Way acquisition, impact to traffic and safety, and cost were assessed and resulting from economic analyses undertaken during earlier phases of the SCHIP project, it was found that the largest benefit, including subjective benefits, comes from Section 1A due to the poor condition of the existing road and an opportunity to provide for development east of Kingston. The proposed project therefore refers only to this first section of the Southern Coast Highway being constructed, namely **Section 1A** of Segment 1.

Section 1A involves road improvement works and new alignment between Harbour View, Kingston and Yallahs Bridge, St. Thomas (Figure 1-2). The proposed configuration extends the four lanes at the Harbour View Roundabout through to Albion and deviates from the existing road just prior to Bull Bay River in a southeast direction towards the coastline before connecting to the existing road between Eleven Mile and Grants Pen (Figure 1-3). The road generally follows the existing alignment from Grants Pen to Yallahs Bridge with modifications to correct deficiencies and improve the safety and traffic operations. It should be noted that since the focus of this EIA is solely the first section for completion, namely Section 1A of Segment 1, minimal reference to Segment 2 will be made throughout this document.

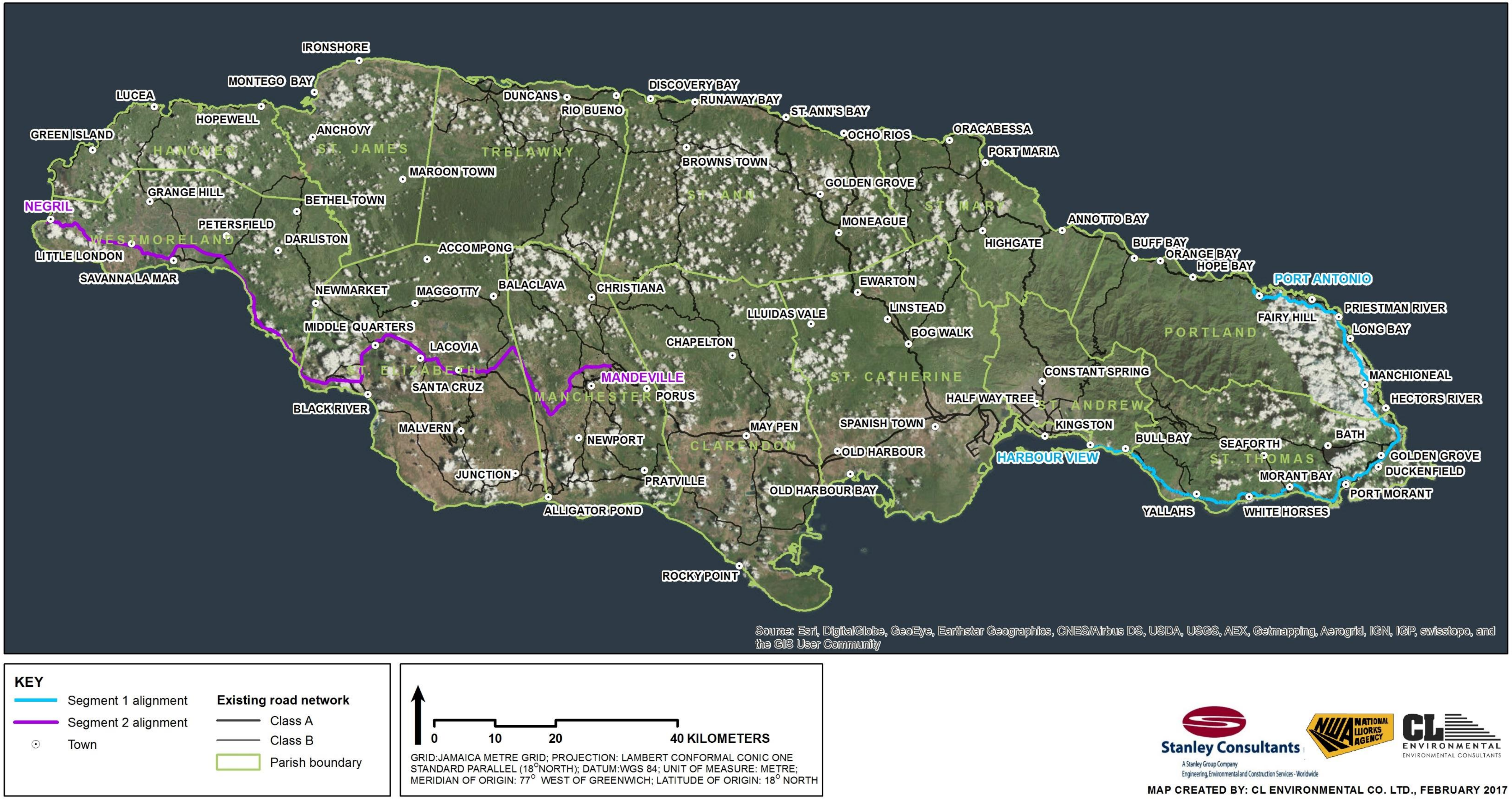


Figure 1-1 Location of SCHIP Segment 1 and Segment 2

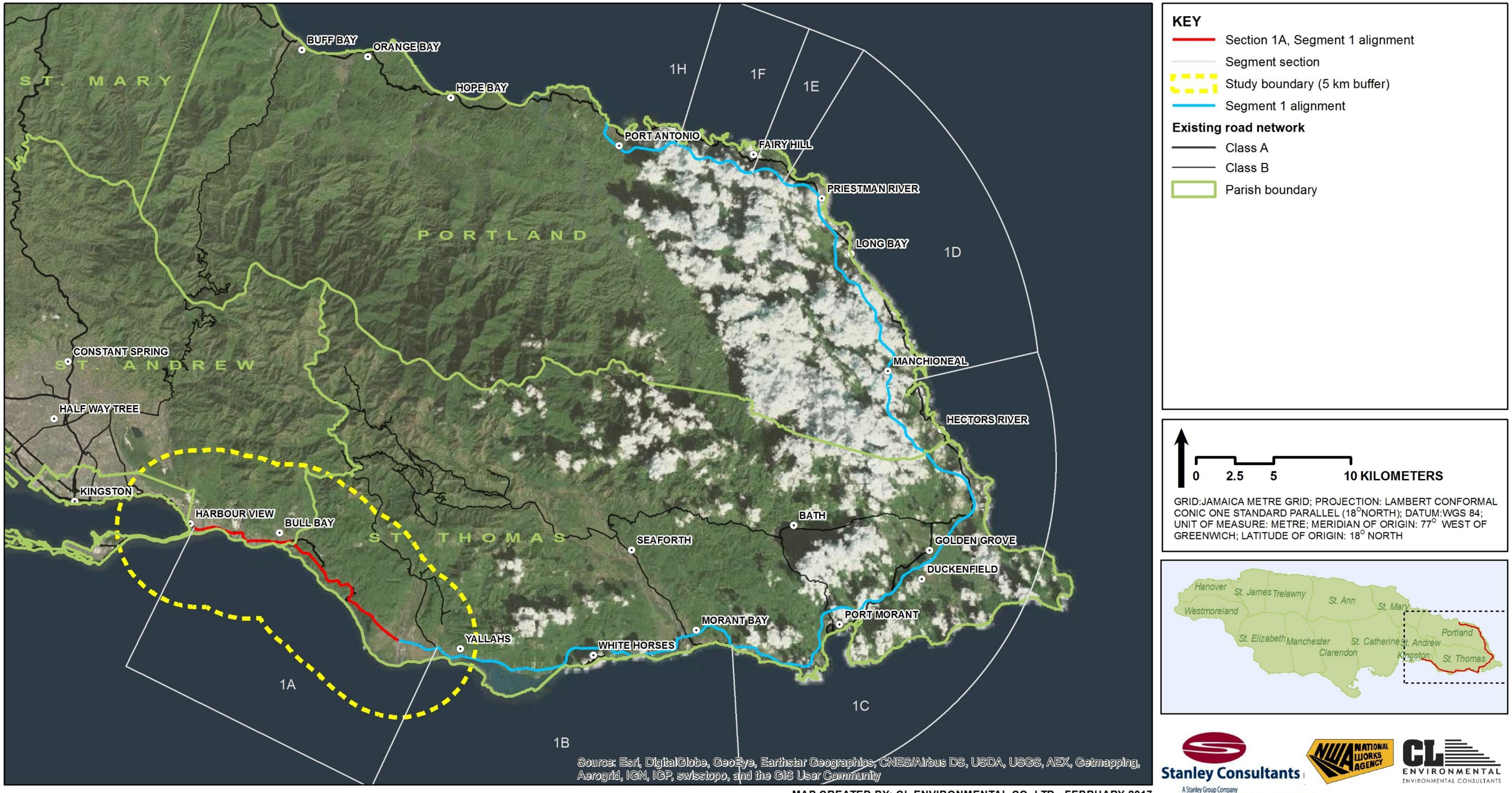


Figure 1-2 Location of SCHIP Segment 1, Section 1A

Figure 1-3 Existing roadway, proposed alignment and study area for Section 1A, Segment 1

1.2 PROJECT AREA

1.2.1 Project Location and Study Boundary

Segment 1 Section 1A is approximately 17 km in length and traverses the eastern parishes of St. Andrew from Harbour View and St. Thomas, ending at Yallahs Bridge (Figure 1-1, Figure 1-2 and Figure 1-3). Four communities adjoin the proposed road works, namely Bull Bay/ Seven Mile, Harbour View, Eleven Miles and Albion. The right-of-way (ROW) of the alignment covers a total land area of 912,443 sq. m (225.5 acres).

For the purposes of the EIA, the study boundary was defined as a 5-km buffer around the proposed roadway alignment (Figure 1-2 and Figure 1-3). With a total area of 241 km^2, the study area covers approximately 131 km^2 of land mass along and north of the proposed alignment in the parishes of Kingston, St. Andrew and St. Thomas, in addition to 110 km^2 of sea south of the proposed alignment.

1.2.2 Land Description and Ownership

1.2.2.1 Communities

A total of 26 communities in Kingston, St. Andrew and St. Thomas are either completely or partially within the study boundary of 5 kilometres (Table 1-1). However, only four of these communities, namely Bull Bay/ Seven Mile, Harbour View, Eleven Miles and Albion adjoin the proposed road works (Table 1-1).

Table 1-1 Communities located within the study boundary, with those adjoining Section 1A highlighted

Community	Parish
1) D'Aguilar Town/ Rennock Lodge	Kingston
2) Springfield	Kingston
3) Port Royal	Kingston
4) Bournemouth Gardens	Kingston
5) Johnson Town	Kingston
6) Norman Gardens	Kingston
7) Rollington Town	Kingston
8) Bloxborough	St. Andrew
9) Cane River	St. Andrew
10) Bito	St. Andrew
11) Hermitage	St. Andrew
12) Bull Bay/ Seven Mile	St. Andrew
13) Harbour View	St. Andrew
14) Constitution Hill	St. Andrew
15) Dallas	St. Andrew
16) August Town	St. Andrew
17) Ramble	St. Thomas
18) Easington	St. Thomas
19) Eleven Miles	St. Thomas
20) Llandewey	St. Thomas
21) Lloyds	St. Thomas
22) Albion	St. Thomas
23) Poormans Corner	St. Thomas

Community	Parish
24) Yallahs	St. Thomas
25) Pamphret	St. Thomas
26) Baptist	St. Thomas

Sections 4.4.1 and 5.2 provide greater detail regarding the communities within the study area.

1.2.2.2 Land Acquisition

According to land parcel data received for the project, 632 land parcels are completely or partially within the ROW for the project, covering a total land area of 893,802.41 sq. m (220.9 acres). Appendix 3 lists all parcels, along with respective volume and folio numbers, street address, scheme and parish.

Housing schemes along section 1A and within the right-of-way (ROW) of the alignment are as follows:

1. Albion
2. Albion Estate
3. Bay View
4. Biscayne Beach
5. Brooks Pen
6. Bull Bay
7. Bull bay H/E
8. Bull Bay Pen
9. Burns Run Albion Est
10. Camrose
11. Cane River
12. Cane River - Seven Miles
13. Cane River Pen
14. Copacabana
15. Eleven Miles
16. Grants Pen
17. Greenvale
18. Halberstadt
19. Harbour View
20. Henrys Run
21. James Cottage
22. Malibu Beach
23. Mar Bella Estate
24. Mezgar Gardens
25. Ocean Lake
26. Poormans corner
27. Rest Haven
28. Retreat
29. Retreat Pen
30. Roberts Pen
31. Seven & Eight Miles
32. Seven Miles
33. Seven Miles & Falltave
34. Shooters Hill Pen
35. South Albion
36. St Benedicts Heights
37. St Thomas Road
38. Sugar Loaf Mountain
39. West Albion
40. Wickie Wackie
41. Windsor Forest
42. Windsor Forest pen
43. Windsor Lodge

In addition, Dundas Development is a proposed new housing development located on the border of St Thomas to Grants Pen, north of the alignment and opposite Mezgar; it comprises 1,000 lots.

All land acquisition exercises will be conducted in accordance with the Land Acquisition Act.

Figure 1-4 Communities and land parcels located along SCHIP Segment 1, Section 1A

1.2.2.3 Impacted Structures

Resulting from an Impacted Structure Profile study undertaken in February 2017, it is estimated that approximately 391 structures will be impacted by the proposed project. The majority of these 391 structures mapped were houses (55.8%), followed by shops and stalls (26.9%), bus stops (5.6%) and other types including garages, stalls and notably a garden (11.8%). Please refer to Section 4.4.4 for further details.

1.2.2.4 Resettlement and Relocation

As a consequence of the construction of the highway it is inevitable that communities and individuals will be affected. All resettlement activities carried out by NWA will be sustainable in nature by providing sufficient resources or alternatives to those who are displaced. All persons affected will be consulted and given the opportunity to participate in the planning and implementation of their own resettlement. Assistance will be provided in helping individuals to restore their standard of living or to raise it, but no individual's standard of living should be lowered as a consequence of the project. The legal tenure of affected persons will determine the type of compensation and resettlement assistance to be received. Particular attention will be given to groups such as the elderly, unemployed, those living below the poverty line, women and children and those without land tenure.

Those persons, businesses and activities to be accommodated will include the following:

- Dwellings, businesses and other facilities (shops, stalls) that are directly in the highway's right of way.
- Dwellings, businesses, farms lands and other facilities where the access to the properties may be affected.
- Farm lands and recreational areas are affected.
- Person who suffer temporary or permanent income loss during construction.
- Persons whose community facilities may be affected.
- Public utilities whose assets are affected (power lines, telephone lines and optical fibre lines, water distribution networks, irrigation channels etc.

Displaced persons, and owners of businesses and activities will be informed of their rights and be given options. There will be consultations with them and economically viable resettlement alternatives will be offered. Compensation will be prompt, effective and at full replacement cost for losses such as lands, structures, crops, trees, businesses and incomes lost, at present open market values.

In accordance with the size of the lot, NWA will either acquire the total lot or compensate the owner for that portion of land and other assets that will be affected.

Where access to properties is affected NWA will seek to identify alternative access so as to ensure that there is no loss in value of the properties or impact on the businesses affected. Where no alternative access is possible then these individuals affected will be offered the same compensation packages and resettlement options provided for the dwellings and businesses located in the highway's right of way.

Stakeholder meetings will be held with the owners of the businesses and dwellings to determine what will be required to ensure their livelihood is restored. These meetings will be advertised via public media and other methods (newspaper, letters, flyers, libraries, post office, fire/police stations, town crier etc.). In addressing the farm lands and recreational areas that will be affected by the highway, NWA will compensate the farm owners for the portion of property affected along with crops being cultivated. This compensation will be at market values determined by a third party knowledgeable in land, structures, crops and plants/trees valuation.

In the instance where recreational fields (football fields, cricket pitches, walking/running tracks) are affected, NWA will seek to rebuild these recreational facilities in close proximity to the original facility.

For individuals temporarily affected, efforts will be made to provide an alternate route to their place of business. Signage informing the general public about changes in traffic flows and routings will be erected in visible locations. As indicated, compensation will also be made for the loss of income faced during their relocation activities.

For the individuals that will experience a permanent loss of income, an offer to introduce them to organisations involved with skills training or re-training will be made and financial support given to offset the associated expenses.

Please refer to Section 10.2.2 for a detailed description of the proposed Resettlement and Relocation Plan.

1.3 ORGANISATIONAL PROFILES

The proponent for this project, as well as the implementing organisation and environmental sub-consultant are listed in Table 1-2. Additional background information for each are given in subsequent sections.

Table 1-2 Contact information for the project proponent, implementing organisation and project consultants.

Company and Role	Address	Telephone	Website and Email
National Works Agency (NWA) *Proponent*	Corporate Office 140 Maxfield Avenue Kingston 10	Tel: 876.926.3210-9 Digicel: 876.618.ROAD(7623) Toll-free: 1.888.429.5692	http://www.nwa.gov.jm/
Ministry of Economic Growth and Job Creation (MEGJC) *Employer*	25 Dominica Drive Kingston 5	Tel: 876.926.1590 Fax: 876.926.4449	info@megjc.gov.jm http://www.mwh.gov/#!/
Stanley Consultants, Inc. *Implementing organisation*	Unit #27 Seymour Park 2 Seymour Avenue Kingston 6	Tel: 876.622.7398 Fax: 876.622.7411	http://www.stanleyconsultants.com/
C. L. Environmental Company Limited *Project consultant*	20 Windsor Avenue Kingston 5	Tel/Fax: 876.756.0338	info@clenvironmental.com http://www.clenvironmental.com/

1.3.1 The Proponent

The **Ministry of Economic Growth and Job Creation (MEGJC)** is considered the Employer of the proposed project. The MEGJC was created in March 2016, with the change of the political administration. The Ministry is charged with drafting the blueprint to drive economic growth and sustainable development in Jamaica. It has responsibility for seven (7) critical portfolio areas: Land, Environment, Climate Change, Investment, Water and Wastewater, Housing and Works. Under its portfolio areas, the Ministry has oversight for some 48 Agencies, Departments and Divisions, which are responsible for approximately 68 subject areas.

The Proponent of the project, the **National Works Agency (NWA)** is one the agencies over which the MEGJC has oversight. The NWA is the main government organisation directly responsible for Jamaica's main road network and bridges. The mission of the NWA is to "plan, build and maintain a reliable, safe and efficient main road network and flood control system, which: protect life and property; support the movement of people, goods and services; reduce the cost of transportation; promote economic growth and quality of life; and protect the environment."

The transportation network under the purview of the NWA consists of approximately 5,000 km of class A, B and C roads and 736 bridges; this transportation network forms 19% of the total road surface available to the nation. There are also parochial roads (14,895 km), farm roads (1,500 km) and community roads (4,200 km). In the case of the parochial and farm roads, these are the responsibility of the local authorities (Parish Councils), while the farm roads are the purview of the Ministry of Agriculture, through its agency, the Rural Agriculture Development Agency (RADA). Parochial, community and farm roads represent 81% of the total road surface in Jamaica.

The Government of Jamaica (GOJ), the International Bank for Reconstruction and Development, the British Department for International Development and the European Union jointly funded the Jamaica

Public Sector Modernization Project (PSMP). The PSMP focused on creating Executive Agencies that represented a new organisation format in the Jamaican Public Sector, and making core Ministries more policy driven. The Works Division of the Ministry of Transport and Works was one of the entities examined as part of the PSMP cluster groups and in October 1999 the GOJ endorsed the establishment of the National Works Agency (NWA), and accorded it Executive Agency status on April 1, 2001. The NWA's chief objectives were:

a) The promotion of improved maintenance of the main road network by use of modern management practices and cost–effective techniques.
b) The commercialization of the technical services of the Ministry of Transport and Works.

The main business lines were identified as follows:

- Road asset maintenance and development
- Road optimization and congestion improvement
- Road safety management
- Flood/sea damage control
- Efficiency and effectiveness

1.3.2 Implementing Organisation

Stanley Consultants Inc. serves clients globally, assisting with complex challenges in power, transportation, water and environmental for utility, industrial, higher education and local, state, federal and foreign government agencies. They are ranked #76 among ENR's Top 500 Design Firms and #129 among the Top 225 International Design Firms. Founded in 1913, Stanley Consultants has nearly 1,000 members in 30 offices worldwide and has worked in all 50 states and more than 100 countries around the world. Services provided include planning, design, permitting, environmental analysis, construction management, program management and alternative project delivery.

1.3.3 Project Consultant

C. L. Environmental Company Limited has been incorporated in Jamaica as a Limited Liability Company since August 2000. The Company provides consultancy services to both governmental and non-governmental agencies, local and overseas. The company comprises a range of professional skills and includes environmental scientists, marine ecologists, environmental engineers, waste management specialists, planners, industrial hygienists, environmental management systems specialists, environmental educators and quality Consultants. The team of Consultants and Scientists associated with C.L Environmental Company have over the years, worked on numerous environmental projects of which some were of national importance such as the Highway 2000 North South Link: Caymanas to Linstead and Moneague to Ocho Rios legs, National Programme of Action for Land Based Sources and Activities that Impact the Marine Environment, the Remediation of the American Airlines Flight 331 Accident Site at Norman Manley International Airport, the Ausjam Gold Mine Cyanide Spill in Clarendon, Environmental Assessment Road Rehabilitation Works for the Moneague Lake Flooding in St. Ann for Bouygues Travaux Publics and the Environmental Monitoring of the Falmouth Cruise Pier

Development in Falmouth, Trelawny for the National Environment and Planning Agency (NEPA) to name a few.

The environmental impact assessment capabilities of the company are built on a multidisciplinary group of professional associates who collectively have over eighty years of experience in environmental management. In addition, to their experience, the depth and diversity of the team provides us with strengths in policy development, organisational evaluation operational management, project management, noise modelling, water quality assessments, solid waste and medical waste management and waste treatment design and implementation. The combined inter disciplinary strength of this team and their regional and international experience, makes them highly suitable to undertake the proposed project.

1.4 SCOPE OF WORK

1.4.1 Purpose of EIA and Terms of Reference

Sections of the proposed alignment development fall under the category of “New Highways”, and specifically may be described as a roadway providing means of travel and transportation for passengers and goods. The proposed corridors will connect various destinations and is intended for motorised traffic. Environmental impacts from the construction and operation of the proposed highway will potentially arise and it was considered imperative to evaluate these likely impacts, recommend mitigation strategies and potentially viable alternatives to the proposed project.

The Permit Application for the proposed project, *the Environmental Impact Assessment for the Proposed Road Improvement Project from Harbour View, Kingston to Yallahs, St. Thomas (Section 1a of the Southern Highway Improvement Project)* was submitted on January 21, 2016. It was decided that an Environmental Impact Assessment (EIA) was required and the Terms of Reference (TORs) (Appendix 1) were established by the National Environment and Planning Agency (NEPA) in order to outline the various aspects of the EIA. The specific tasks outlined in the approved TORs were executed by CL Environmental Co. Ltd., a sub-consultant contracted by Stanley Consultants, Inc. The study team may be seen in Appendix 2. This report serves to compile and present the findings of the EIA and ultimately provide a comprehensive evaluation of the proposed project.

1.4.2 Standards and Litigation Matters

There are no known litigation pending nor any direction/order passed by any court against the proposed project. The proposed project will meet all relevant environmental and planning standards applicable for the project. Section 2.0 details the relevant legislation, whilst sections 7.0 and 9.3 outline the various recommended measures to ensure compliance.

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 ENVIRONMENTAL IMPACT ASSESSMENT FRAMEWORK

2.1.1 Rationale and Basis

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

- Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.
- It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytical method or technique, but uses many approaches as appropriate to the problem.
- It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.
- It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.
- EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus, it should be part of decision-making processes.
- The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.

2.1.2 Development Application and the EIA Process

2.1.2.1 General Procedures

The National Environment and Planning Agency (NEPA) [1] has been given responsibility for environmental management in Jamaica under the Natural Resources Conservation Authority Act (NRCA) Act of 1991. Since the promulgation of the NRCA Act, it has been strengthened by various

[1] NEPA represents a merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilization Commission (LDUC). Among the reasons for this merger was the streamlining of the planning application process in Jamaica.

supporting regulations that became effective in January 1997. The Environmental Permit and License System (P&L) is administered by NEPA through the Applications Section. It was introduced in 1997 to ensure that all developments meet required standards and negative environmental impacts are minimized. Under the NRCA Act of 1991, the NRCA has the authority to issue, suspend and revoke environmental permits and licenses, as well as the power to request EIAs for a permit or for any activity in a prescribed area (entire island of Jamaica) where it is of the opinion that the environment is likely to have adverse effects due to the activities.

The NRCA permit procedure is initiated by the submission of the Project Information Form (PIF) to the Authority. The PIF screening form is reviewed to determine whether an EIA is required and to begin determining areas of environmental significance, especially in waste discharge. Based on the review of the PIF, the NRCA advises if an EIA would be required for the proposed project and determines the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed using NRCA guidelines and are ultimately approved by the NRCA. NRCA gives the approved final TORs for the proposed project; Appendix 1 shows those specific to this project.

The NRCA requires that the EIA include the following:

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

The NRCA guidance on EIAs states that this process "should involve some level of stakeholder consultation in either focus groups or using structured questionnaires." A draft EIA is submitted to the developer to solicit the proponents' input into the description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply). Fourteen copies of the finalised draft are then submitted to NRCA, two to the client, and the consultant keeps one (17 in all are produced). The NRCA distributes these to various other public sector institutions who sit on the Technical Committee (e.g. Water Resources Authority (WRA), Environmental Control Division in the Ministry of Health (ECD), Jamaica National Heritage Trust (JNHT)) for their comments. Typically, this depends on the nature of the project.

As deemed necessary by the NRCA, Public Meeting(s) are then held (see Appendix 4 for the full guidelines on public participation in EIAs), following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged. The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report, but for incorporation into the development's design. The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Office of the Prime Minister.

2.1.2.2 Project-specific Progress

The Permit Application was submitted on January 21, 2016. It was decided that an EIA was required and for which the final TORs (Appendix 1) were used to guide the EIA approach. This document presents the initial findings of the EIA, which is currently underway.

2.2 NATIONAL LEGISLATION

2.2.1 Development Control

This section deals with planning and development issues that can affect the proposed road improvement along Section 1A of the SCHIP. Several development and planning related laws and regulations may affect the project; the applicability of these laws is dependent on the location of the development chosen, social and socio-economic issues, as well as the availability of land for acquisition. The following agencies are those that may be encountered for planning and development approvals:

- Parish Councils, otherwise referred to as Local Planning Authorities (LPA) – All development applications are made through the LPAs which include enquiries, planning, building and subdivision approvals.
- National Environment and Planning Agency (NEPA) - Applications reviewed by NEPA include enquiries, planning applications, and building and subdivision applications.
- National Works Agency (NWA) - Project proponent and main government organisation directly responsible for Jamaica's main road network and bridges.

2.2.1.1 Town and Country Planning Act (TCP Act), 1957 (Amended 1987)

The Town and Country Planning Act (TCP Act) 1957 (Amended 1987) provides the statutory requirements for the orderly development of land through planning, as well as guidelines for the preparation of Development Orders. A Development Order is a legal document which is used to guide development in the area to which it applies and the TCP Act is only applicable in an area where a Development Order exists. It constitutes land use zoning map/s, policy statements and standards relating to land use activities. Tree Preservation Areas and Conservation Areas (as specified areas the gazetted Development Orders) are two types of protected areas associated this Act. Matters addressed in the order include:

- Roads
- Buildings and other structures
- Community Planning
- Amenities
- Public Services
- Transportation and Communications
- Miscellaneous

The Town and Country Planning Act also establishes the Town and Country Planning Authority, which in conjunction with the Local Planning Authorities (LPAs), also referred to as Parish Councils, are responsible for land use zoning and planning regulations as described in their local Development Orders. The TCP Act is also administered by the National Environment and Planning Agency

As seen in Figure 2-1, the Development Orders relevant to this proposed project are as follows:

- Kingston Confirmed Development Order 1966
- St. Thomas Coast Confirmed Development Order 1965
- DRAFT St. Thomas Confirmed Development Order
    - Yallahs Local Planning Area Land Use Proposals (Inset No.2) (28-02-2017)

Though considered outdated, the Kingston Confirmed Development Order 1966 is the main piece of legislation used to guide the development within the parishes of Kingston and St. Andrew. Efforts were made to update this document; in 2010, the Local Area Planning Branch (NEPA) reported that the Draft Kingston and St. Andrew Development Order is intended to bring the entire parishes of Kingston and St. Andrew under Planning Law (The Local Area Planning Branch, NEPA, 2010). In addition, a Draft Kingston and St. Andrew Sustainable Development Plan (2005) exists (Kingston and St. Andrew Parish Corporation, 2012).

It should be noted that the St. Thomas Coast Confirmed Development Order 1965 preceded the DRAFT St. Thomas Confirmed Development Order, for which various Land Use Proposals have been created by NEPA in February/ March 2017. Western portions of the Yallahs Local Planning Area Land Use Proposals are relevant to this project. Section 4.4.3.3 and Figure 4-69 provide more detail pertaining to the proposed zoning according to these legal instruments and Section 6.0 and 7.0 for potential impacts mitigation measures recommended to ensure compliance with respective legislation.

The local planning authority for the development is the Kingston and St. Andrew Parish Corporation (KSAC). Its functions include granting permission to develop land (based on the Development Order and subject to approval by TCPA), maintaining a public register on land development applications, and enforcing planning controls. The Saint Thomas Parish Council, also known as the St. Thomas Municipal Corporation is the LPA for St. Thomas. Continued proactive communication with the Parish Council is recommended in order to keep them informed and in dialogue on the activity in their jurisdiction. This will also be the approach of the environmental consulting team in deliberating environmental aspects of the planning and approval process.

2.2.1.2 Parish Councils Act 1901 (Amended 2007)

Under the Parish Council Act, each LPA may revoke or alter regulations concerning the construction and restrictions as to the elevation, size and design of buildings built with the approval of the relevant Minister. It may also make regulations concerning the installation of sewers on premises. As mentioned previously, the Kingston and St. Andrew Parish Corporation (KSAC) and the Saint Thomas Parish Council/ St. Thomas Municipal Corporation are the local planning authorities with responsibility for development within the study area for the proposed project.

2.2.1.3 Land Development and Utilization Act 1966

This act specifies conditions pertaining to the development and utilization of land, dispossession of owners or occupiers and the Land Development and Utilization Commission as it pertains to agricultural and unused land. The Land Development and Utilisation Act is administered by the National Environment and Planning Agency.

2.2.1.4 Local Improvement Act 1944

The Local Improvements Act is the primary statute that controls the subdivision of land.

2.2.1.5 Registration of Titles Act 1989

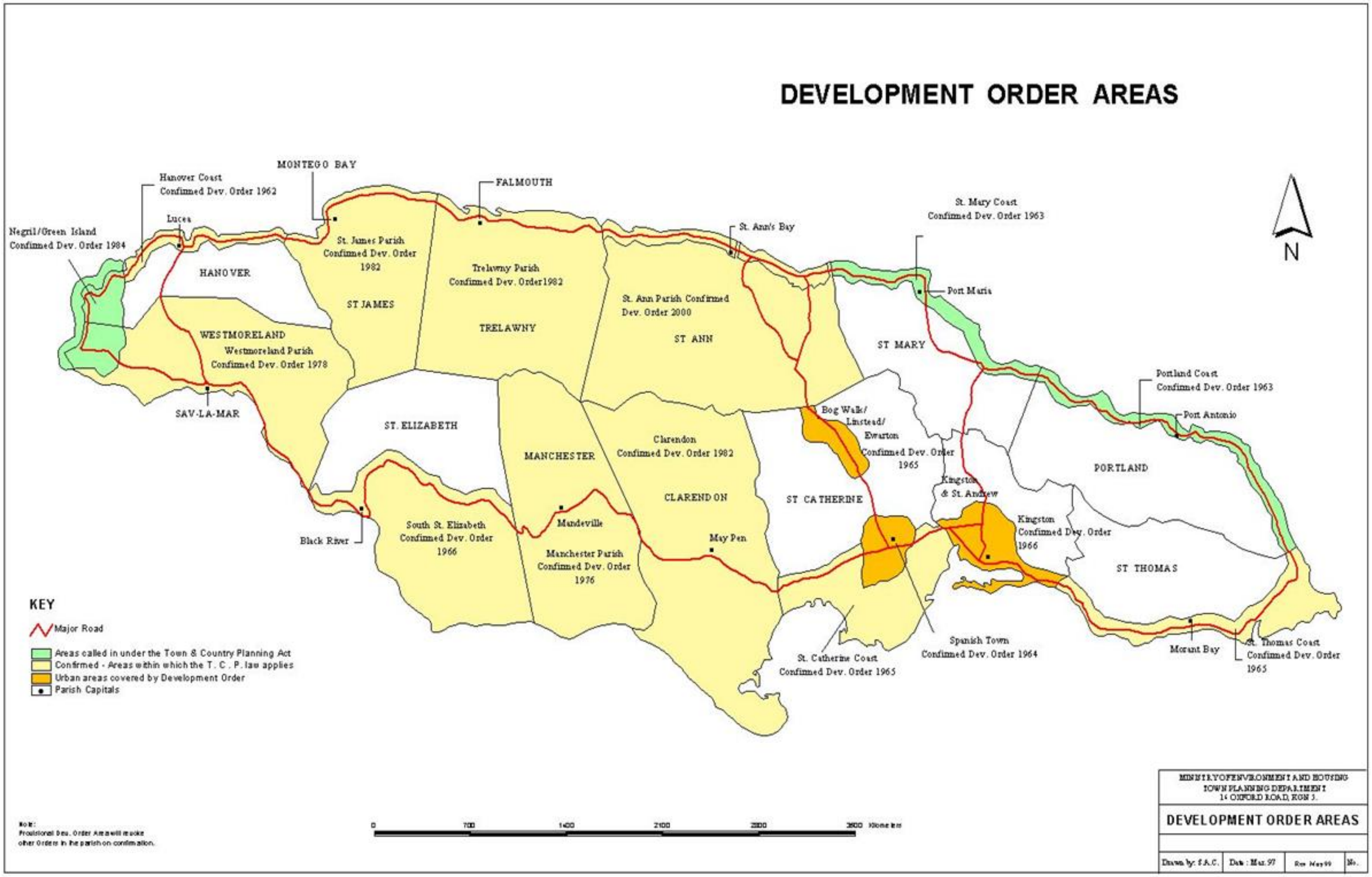
The Registration of Titles Act was passed in 1989 and speaks to the legalities associated with land registration in Jamaica.

2.2.1.6 Land Acquisition Act 1947

As stipulated under Section 3 of this Act, any officer authorized by the Minister may enter and survey land in any locality that may be needed for any public purpose. The Minister is authorized to make a public declaration under his signature if land is required for a public purpose, provided that the compensation to be awarded for the land is to be paid out of the Consolidated Fund or loan funds of the Government and funds of any Parish Council, the Kingston and St. Andrew Corporation or the National Water Commission.

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

Please see Section 1.2.2 for further detail regarding land descriptions and acquisition and Section 6.0 and 7.0 for potential impacts mitigation measures recommended to ensure compliance with respective legislation.



Source: National Environment and Planning Agency[2]

Figure 2-1 Development Order Areas in Jamaica

[2] http://www.nepa.gov.jm/symposia_03/Laws/Maps/Map_of_Development_Orders.htm

2.2.1.7 Main Roads Act 1932

The Main Roads Act of 1932 details the legal basis pertaining to main roads and specifically looks at management, laying out of roads, taking of lands, encroachments, offences, lights and carriages, power to arrest and other legalities. In section 5 of this Act, it states that the Minister has the power to declare other roads or parts thereof to be main roads and to also declare that a main road is no longer such. The Chief Technical Director (with permanent staff), under the directive of the Minister, is responsible for the laying out, making, repairing, widening, altering, deviating, maintaining, superintending and managing main roads, and controlling the expenditure of allotted moneys.

2.2.1.8 Beach Control Act 1956 and the Beach Control (Amendment) Act 2004

This Act was passed in 1956 to ensure the proper management of Jamaica's coastal and marine resources by means of a licensing system. This system regulates the use of the foreshore and the floor of the sea. In addition, the Act speaks to other issues including access to the shoreline, rights related to fishing and public recreation and establishment of marine protected areas. Under section 5 of this act, it is an offence to encroach on the foreshore or floor of the sea for a public or commercial purpose without a licence.

The Beach Control (Licensing) Regulations 1956 require a permit for any works on a beach, coastline or foreshore. Application for this permit must be made to NEPA. The requirements of the permit include a Notice of Application to be posted on the landward and seaward sides of the property and said Notice should be served on adjoining neighbours. Member of the Natural Resources Conservation Authority or any officer authorised by the Authority may conduct investigations to ensure compliance with licence and require information to be furnished.

It must also be noted that under this Act, the Port Royal Protected Area was declared on 8 May 1967. After this, the area was declared a protected area under the Natural Resources Conservation Authority (NRCA) Act on 18 September 1998.

2.2.1.9 Building Act 2016

The Building Act 2016 repeals the Kingston and St. Andrew Building Act and the Parish Councils Building Act and makes new provisions for the regulation of the building industry. It aims to facilitate the adoption and efficient application of national building standards (National Building Code of Jamaica) for ensuring safety in the built environment, enhancing amenities and promoting sustainable development. A "building" is described as a domestic building, a public building, a building of the warehouse class and any other physical structure, whether a temporary structure or not, any part of the structure, and any architectural or engineering product or work erected or constructed on, over or under land or the sea or other body of water.

For the purposes of this Act, the KSAC (for the parishes of Kingston and St. Andrew), the Parish Council (any other parish) and the Municipal Council (for the Municipality) is designated as the Local Building Authority for the respective area. In relation to this project, the KSAC and the Saint Thomas Parish

Council/ St. Thomas Municipal Corporation are the local planning authorities. A person who proposes to carry out building work must apply to the relevant Local Building Authority for the appropriate building permit. A person shall not carry out any building work unless the respective building permit has been issued; where applicable, a planning permit has been issued under the Town and Country Planning Act; and the work is carried out in accordance with the building permit, the provisions of this Act, the National Building Code, or of any other regulations made under this Act.

2.2.1.10 Vision 2030

Vision 2030 is a National Development Plan for Jamaica, promoting four National Goals as well as associated National Outcomes for each goal, to be achieved by 2030, with the objective of developing Jamaica into a country with a vibrant and sustainable economy, society and environment; a high level of human capital development; greater opportunities and access to these opportunities for the population; and a high level of human security. Of the aforementioned outcomes, one applies directly to the proposed project, namely National Outcome # 15: Sustainable Urban and Rural Development. Vision 2030 Jamaica creates a framework for urban and rural development that supports the economic and social development of all parishes to achieve their full potential, thereby creating sustainable communities. The Plan proposes a spatial arrangement of land use that facilitates social and economic development, respects the environment and satisfies the need for safety, efficiency, aesthetics and social justice. The development of new and progressive legislation to reflect the country's changing demands, and a modernized planning system, including clarification and strengthening of the roles of the various agencies involved in physical planning will be encouraged.

2.2.2 Environmental Conservation

2.2.2.1 Protected Areas System Master Plan: Jamaica 2013 – 2017

The Protected Areas System Master Plan (PASMP) sets out guidelines for establishing and managing a comprehensive system of protected areas that supports national development by contributing to long-term ecological viability; maintaining ecological processes and systems; and protecting the country's natural and cultural heritage (National Environment and Planning Agency, n.d.). The PASMP is consistent with several national policies and plans, including the Policy for Jamaica's System of Protected Areas 1997 (section 2.2.2.2), the National Strategy and Action Plan on Biological Diversity in Jamaica (2003) and Vision 2030 Jamaica: National Development Plan (2009) (section 2.2.1.10). It is also a requirement under the Convention for Biological Diversity's (CBD's) Programme of Work for Protected Areas (PoWPA).

Existing protected area categories in Jamaica are listed in Table 2-1, Table 2-2 and Table 2-3. The NRCA/NEPA is responsible for areas declared/designated under the acts it administers, including the Wild Life Protection and Natural Resources Conservation Authority Acts (sections 2.2.2.4 and 2.2.2.3 respectively). In addition, a number of other government entities (such as the Forestry Department, Fisheries Division and Jamaica National Heritage Trust), local management entities, non-governmental entities, private sector and individuals are outlined as important role players as well. Indeed, responsibility for protected area management has been a shared endeavour and this collaborative approach to protected area management will continue under the PASMP (National Environment and Planning Agency, n.d.).

Table 2-1 Existing categories of protected areas in Jamaica (January 2012) - protected area system categories

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	LAW
Protected Area	Forestry Department: Water, Land, Environment and Climate Change (MWLECC)	Forest Act, 1996 and Forest Regulations
	National Environment and Planning Agency: MWLECC	NRCA Act, 1991
	NEPA: MWLECC	Beach Control Act, 1956
National Park	NEPA: MWLECC	NRCA Act, 1991
Marine Park	NEPA: MWLECC	NRCA Act, 1991
Environmental Protection Area	NEPA: MWLECC	NRCA Act, 1996
Forest Reserve	Forestry Department: MWLECC	Forest Act, 1996 and Forest Regulations
Special Fishery Conservation Area	Fisheries Division: Ministry of Agriculture and Fisheries	Fishing Industry Act, 1976
National Monument	Jamaica National Heritage Trust(JNHT) Ministry of Youth and Culture (MYC)	JNHT Act, 1985
Protected National Heritage	JNHT: MYC	JNHT Act, 1985
Game Sanctuary	NEPA (NRCA): MWLECC	Wild Life Protection Act, 1945
Game Reserve	NEPA (NRCA): MWLECC	Wild Life Protection Act, 1945

Table 2-2 Existing categories of protected areas in Jamaica (as at 1 January 2012) - other designations not considered part of the system

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	LAW
Tree Order Preservation	Local Authority (Town and Country Planning Authority): MWLECC and Local Government Department, through Parish Councils	Town and Country Planning Act, 1958
Conservation Area	NEPA (Town and Country Planning Authority, parish councils): MWLECC	Town and Country Planning Act, 1958
Protected Watershed	NEPA (NRCA): MWLECC	Watershed Act, 1963 Protection

Table 2-3 Existing categories of protected areas in Jamaica (January 2012) - international designations

Source: (National Environment and Planning Agency, n.d.)

CATEGORY	RESPONSIBLE AGENCY	CONVENTION
Ramsar Site	NEPA (NRCA): MWLECC	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
World Heritage Site (no existing sites, however submissions have been made)	Jamaica National Heritage Trust: MYC	World Heritage Convention

The alignment for Section 1A does not traverse any protected area (Figure 2-2); however, those in proximity and thereby relevant to this project are as follows:

- **Palisadoes-Port Royal Protected Area (P-PRPA)** - declared as a protected area on 18 September 1998 under the Natural Resources Conservation Authority Act (NRCA) (1991) (section 2.2.2.3). Prior to this, it was declared as protected under the Beach Control Act on 8 May 1967 (section 2.2.1.8).
- **Port Royal and the Palisadoes, a Protected National Heritage** - Declared a Protected National Heritage on 22 July 1999 under the Jamaica National Heritage Trust Act (section 2.2.2.9).
- **Palisadoes-Port Royal Ramsar Site** - Designated a Wetland of International Importance (Ramsar Site) on 22 April 2005 under the Convention on Wetlands of International Importance (Ramsar).
- **Yallahs Salt Pond Protected Area (Proposed)**
- **Forest Reserves**
    - **Elleston Run (Dallas Mtn.)**
    - **Good Hope**
    - **Norris**
    - **Rockfort**
    - **Lloyds**

Please see section 4.4.3.2 for further detail regarding these protected areas, as well as Section 6.0 and 7.0 for potential impacts mitigation measures recommended to ensure compliance with respective legislation.

2.2.2.2 Policy for the National System of Protected Areas 1997

This legislative instrument is a White Paper and essentially proposes a comprehensive protected areas system for Jamaica. Six types of protected areas are proposed in order to encompass the diverse natural resources and landscape, and are comparable to those of the IUCN (International Union for Conservation of Nature) [3]:

1) National Nature Reserve/Wilderness Area (Equivalent to IUCN Category I)
2) National Park, Marine Park (Equivalent to IUCN Category II).
3) Natural Landmark/National Monument (Equivalent to IUCN Category III)
4) Habitat/Species Management Area (Equivalent to IUCN Category IV)
5) National Protected Landscape, or Seascape (Equivalent to IUCN Category V)
6) Managed Resource Protected Area (Equivalent to IUCN Category VI)

[3] It should be noted that since the publication of the Policy for Jamaica's System of Protected Areas 1997, the IUCN has revised the categories system and guidelines (http://cmsdata.iucn.org/downloads/guidelines_for_applying_protected_area_management_categories.pdf)

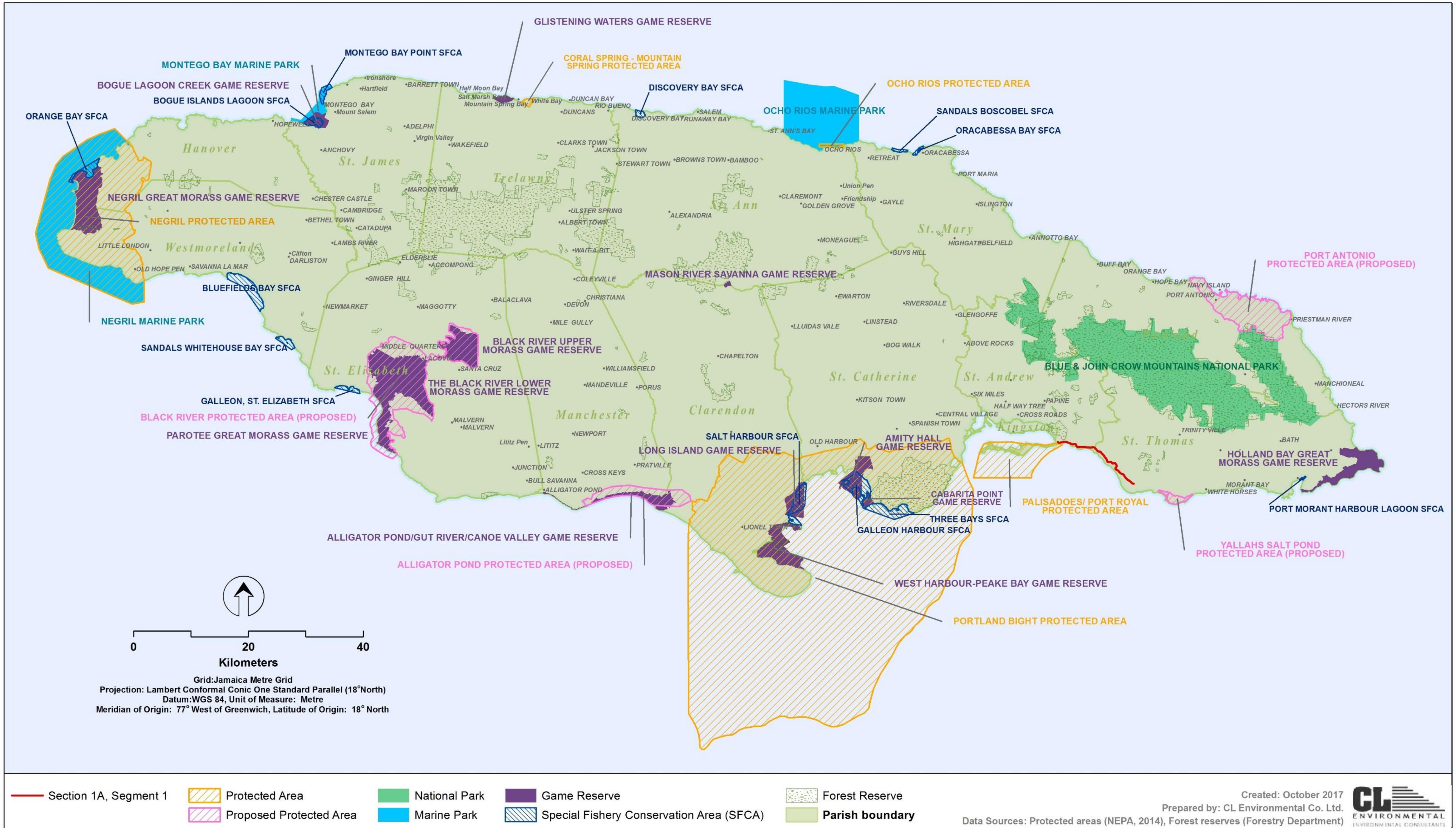


Figure 2-2 Protected areas system in Jamaica

2.2.2.3 Natural Resources Conservation Authority Act 1991

The Natural Resources Conservation Authority Act (NRCA) is considered Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation and protection of the natural resources of Jamaica. This Act was passed in the Jamaican Parliament in 1991 and subsequent to this, the Natural Resources Conservation Authority (NRCA) was established. The NRCA Act, under Sections 9 and 10 specifies that an Environmental Impact Assessment (EIA) is required from an applicant for a permit for undertaking any new construction, enterprise or development. It also speaks to the designation of national parks, protected areas etc.

The Act also gave power of enforcement of a number of environmental laws to the NRCA, namely the *Beach Control Act*, *Watershed Act* and the *Wild Life Protection Act*, as well as a number of regulations and orders including:

- *The Natural Resources (Permit and Licences) Regulations 1996 and* (Amendment) Regulations *2015;*
- *Natural Resources (National Parks) Regulations 1993 and (Amendment) Regulations 2003;*
- *The Natural Resources (Marine Parks) Regulations 1992, (Amendment) Regulations 2003,* and *(Amendment) Regulations, 2015;* and
- *The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996* and *(Amendment) Order 2015.*

The Natural Resources Conservation (Permit and Licences) Regulations 1996 and (Amendment) Regulations 2015

A permit and licencing system was established under these regulations in order to control the undertaking of any new construction or development of a prescribed nature in Jamaica and the handling of sewage or trade effluent and poisonous or harmful substances discharged into the environment.

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order 1996 and (Amendment) Order 2015

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996) and the Permits & Licensing Regulations was passed as a result of section 9 of the NRCA Act. Section 9 of the NRCA Act declare the entire island and the territorial sea as a 'prescribed area', in which specified activities require a permit, and for which activities an environmental impact assessment may be required. The major amendment made in 2015 was the substitution of the Categories of Enterprises, Construction and Development (Column A), which lists the various activities, by category, for which a permit is required. As discussed previously, an EIA was required for the proposed project and this report fulfils one component of the EIA process.

2.2.2.4 Wild Life Protection Act 1945 and Wild Life Protection (Amendment of Second and Third Schedules) Regulations 2016

The Wild Life Protection Act of 1945 is mainly concerned with the protection of specified faunal species and is the only statute in Jamaica specifically designated to this. This Act protects several rare and endangered faunal species and the Wild Life Protection (Amendment of Second and Third Schedules) Regulations 2016 provides substitutions for the Second and Third Schedules of the principal Act which lists these species. For these reasons, biological assessments were included as part of the biological surveys. As detailed further in section 4.3, four endemic species and one species of national importance were encountered during terrestrial flora surveys. Please see Sections 6.0 and 7.0 for further detail regarding potential impacts mitigation measures recommended to ensure compliance with respective legislation.

The establishment of two types of protected areas, namely Game Sanctuaries and Game Reserves is authorized under this Act. There are no game reserves or sanctuaries falling within the 5-km study boundary.

2.2.2.5 The Forest Act 1996

The 1996 Forest Act repealed the 1937 legislation and was the legal basis for the organisation and functioning of the Forestry Department. The Forestry Department is an independent entity established in 1942, subsequent to the Forest Division of the Department of Agriculture (1938) and the Forest Branch of the Lands Department (1937). The Forestry Department is the lead agency responsible for the management and conservation of the forest resources in Jamaica. The management of forests on a sustainable basis in an aim to maintain and increase the environmental services and economic benefits is the Forestry Department's main function. There are also a set of *Forest Regulations (2001)* which are administered by the Forestry Department as well.

A "Forest Reserve" is defined to be any area of land declared by or under this Act to be a forest reserve. In 1938, the Forest Branch gazetted some 78,800 hectares of Crown Lands as forest reserves, this making up more than 75% of the present-day forest reserves. Following this, these reserve areas were added to by purchase, lease and other arrangements. Relevant to this project, five forest reserves are found within the study boundary, either completely or partially, and totalling 9.44 sq. km in coverage. See section 4.4.3.2 for further details, as well as Sections 6.0 and 7.0 for potential impacts and mitigation measures recommended to ensure compliance with respective legislation.

Offences under this act include:

- Cut a tree in forest reserve without valid permit
- Fell, cut, girdle, mark, lop, tap, uproot, burn, damage, debark, strip/remove leaves of a tree
- Kindle, keep, carry lit material
- Clear or break up land
- Establish or carry on forest industry
- Remove soil, gravel or sand

- Unlawfully/illegally affix forest officer mark to any tree/timber
- Alter, deface/obliterate mark placed by forest officer on tree/timber
- Pasture/allow cattle trespass

2.2.2.6 The Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000 (Amended 2015)

The Endangered Species (Protection, Conservation and Regulation of Trade) Act was created in 2000 in order to ensure the codification of Jamaica's obligations under the Convention for the International Trade in Endangered Species of Wild Fauna and Flora. This Act governs international and domestic trade in endangered species in and from Jamaica. The regulations associated with this Act were amended in 2015, and include updated fees for the various permits and certificates granted through this legislation.

2.2.2.7 Water Resources Act 1995

The Water Resources Act (1995) established the Water Resources Authority (WRA), which is authorized to regulate, allocate, conserve and manage the water resources of the island. Section 25 advises that a proposed user will have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, under Section 21 it states that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

2.2.2.8 Draft Policy and Regulation for Mangrove & Coastal Wetlands Protection

As outlined in this draft policy, the Government of Jamaica has adopted the policy and regulation in order to promote the management of coastal wetlands. The policy seeks to:

- Provide protection against dredging, filling, and other development;
- Designate wetlands as protected areas;
- Protect wetlands from pollution particularly industrial effluent sewage, and sediment;
- Ensure that all developments planned for wetlands are subject to an Environmental Impact Assessment (EIA);
- Ensure that traditional uses of wetlands are maintained.

Wetlands are found in the study area; please see section 4.3 for descriptions of the wetland and Section 7.0 for mitigation measures recommended to ensure compliance with respective legislation.

2.2.2.9 The Jamaica National Heritage Trust Act 1985

The Jamaica National Heritage Trust Act established the Jamaica National Heritage Trust (JNHT) and has been in operation since 1985. The main goal is the preservation and protection of the country's national heritage. The Act states the following offences are liable to a fine and/or imprisonment:

- Wilfully defacing, damaging or destroying any national monument or protected national heritage;
- Wilfully defacing, destroying, concealing or removing any mark affixed or connected to a national monument or protected national heritage;
- Altering any national monument or marking without the written permission of the Trust;
- Removing any national monument or protected national heritage to a place outside of Jamaica.

JNHT was consulted for the SCHIP and section 4.4.2 details their findings. Sections 6.0 and 7.0 also describes potential impacts and recommended mitigation measures to ensure compliance with respective legislation.

2.2.3 Public Health & Waste Management

2.2.3.1 Water Quality Standards

The NRCA has primary responsibility for control of water pollution in Jamaica. National Standards for industrial and sewage discharge into rivers and streams, in addition to standards for ambient freshwater exist. For drinking water, World Health Organisation (WHO) Standards are utilized and these are regulated by the National Water Commission (NWC). Since 1996, Jamaica has had draft regulations governing the quality of the effluent discharged from facilities to public sewers and surface water systems. These draft guidelines require the facility to meet certain basic water quality standards for trade effluent including sewage (Table 2-4 and Table 2-5).

Further information regarding water quality may be found in sections 4.1.4.3. Section 6.0 and 7.0 also describes potential impacts and recommended mitigation measures to ensure compliance with respective legislation.

Table 2-4 Draft national ambient marine water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Phosphate,	P*	0.001-0.003	mg/L
Nitrate,	N**	0.007-0.014	mg/L
BOD_5	O	0.0-1.16	mg/L
pH		8.00-8.40	
Total Coliform		2-256	MPN/100mL
Faecal Coliform		<2-13	MPN/100mL

*Reactive phosphorus as P
**Nitrates as Nitrogen

Table 2-5 Draft national ambient freshwater water quality standards for Jamaica, 2009

Source: National Environment and Planning Agency (NEPA)

Parameter	Measured as	Standard Range	Unit
Calcium	(Ca)	40.0-101.0	mg/L
Chloride	(Cl^-)	5.0- 20.0	mg/L
Magnesium	(Mg^{2+})	3.6- 27.0	mg/L
Nitrate	(NO_3^-)	0.1- 7.5	mg/L
Phosphate	(PO_4^{3-})	0.01 - 0.8	mg/L
Potassium	(K^+)	0.74- 5.0	mg/L
Silica	(SiO_2)	5.0- 39.0	mg/L
Sodium	(Na^+)	4.5- 12.0	mg/L
Sulfate	(SO_4^{2-})	3.0- 10.0	mg/L
Hardness	($CaCO_3$)	127.0-381.0	mg/L (as $CaCO_3$
Biochemical Oxygen Demand	(O)	0.8- 1.7	mg/L
Total Dissolved Solids		120.0-300	mg/L
pH		7.00- 8.40	
Conductivity		150.0-600	µS/cm

2.2.3.2 Noise Abatement Act 1997

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specified equipment. This act has been said to address "some concerns but is too narrow in scope and relies on a subjective criterion" (McTavish). Given this, McTavish conducted a study to recommend wider and more objective criteria in accordance with international trends and standards, but tailored to Jamaica's conditions and culture.

National guidelines (NEPA) used for noise levels are shown in Table 2-6; values for commercial, industrial and residential areas are specified.

Table 2-6 NEPA guidelines for daytime and night time noise in various zones

ZONE	NEPA Daytime Guideline (dBA)	NEPA Night Time Guideline (dBA)
Commercial	65	60
Industrial	75	70
Residential	55	50

Noise surveys and modelling undertaken for this project are presented in sections 4.1.7 and 6.3.1.5. Mitigation measures recommended to comply with the existing standards are found in section 7.1.3.

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

Under section 38 of the NRCA Act, regulations pertaining to air quality in Jamaica are stipulated. The National standards, known as the National Ambient Air Quality Standards (NAAQS) are categorized into two groups. Part I of the NRCA Air Quality Regulations (2002) instructs on license requirements and indicates that every owner of a major or significant facility shall apply for an air pollutant discharge license. Part II makes reference to the stack emission targets, standards and guidelines.

According to the Natural Resources Conservation Authority (Air Quality) Regulations, 2006, a "significant air quality impact", means:

(a) the increment in the predicted average concentration of sulphur dioxide (SO_2), total suspended particulates (TSP), particulate matter less than ten microns (PM_{10}) or nitrogen dioxide (NO_2) is greater than an annual average of 20 µg/m^3 or a 24-hour average concentration of 80 µg/m^3; or
(b) the increment in the predicted average concentration of CO is greater than 500 µg/m^3 as an 8-hour average or 2000 µg/m^3 as a 1-hour average.

Table 2-7 summarizes the Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC).

Table 2-7 Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC) for air quality

Pollutant	Avg. Period	Significant Impact Concentration (µg/m^3)	Jamaican NAAQS or GC (µg/m^3)
PM_{10}	24-hr	80	150
	Annual	20	60
NO_2	1-hr	N/A	400
	24-hr	80	N/A
	Annual	20	100
SO_2	1-hr	N/A	700
	24-hr	80	280
	Annual	20	60
CO	1-hr	2000	40000
	8-hr	500	10000
1,3 Butadiene	1-hr	N/A	0.04
Acetaldehyde	1-hr	N/A	1250
	24-hr	N/A	500
Acrolein	1-hr	N/A	58.75
	24-hr	N/A	23.5
Benzene	Annual	N/A	1
Benzo (a) pyrene	1-hr	N/A	0.00275
	24-hr	N/A	0.0011
Carbon Tetrachloride	1-hr	N/A	6
	24-hr	N/A	2.4
Chloroform	1-hr	N/A	1250
	24-hr	N/A	500
Ethylene Dibromide	1-hr	N/A	7.5
	24-hr	N/A	3
Formaldehyde	1-hr	N/A	162.5
	24-hr	N/A	65

Pollutant	Avg. Period	Significant Impact Concentration (µg/m³)	Jamaican NAAQS or GC (µg/m³)
Methylene Chloride	1-hr	N/A	550
	24-hr	N/A	220
Styrene	1-hr	N/A	2500
	24-hr	N/A	1000
Xylenes	1-hr	N/A	5750
	24-hr	N/A	2300
Vinyl Chloride	24-hr	N/A	1
	Annual	N/A	0.2
Arsenic	1-hr	N/A	0.75
	24-hr	N/A	0.3
Beryllium	Annual	N/A	0.0013
Cadmium	1-hr	N/A	5
	24-hr	N/A	2
Chromium	1-hr	N/A	3.75
	24-hr	N/A	1.5
Cobalt	24-hr	N/A	0.12
Copper	1-hr	N/A	125
	24-hr	N/A	50
Lead	1-month	N/A	N/A
	3-month	N/A	2
Manganese	Annual	N/A	119
Mercury	1-hr	N/A	5
	24-hr	N/A	2
Nickel	1-hr	N/A	5
	24-hr	N/A	2
Selenium	24-hr	N/A	25
	Annual	N/A	10
Zinc	24-hr	N/A	12

In 1987, U.S. Environmental Protection Agency replaced TSP with PM_{10} as the indicator for both the annual and 24-hour health-related standards. The reason for this is because exposure to PM_{10} particles may cause serious health/respiratory related issues as these particles are retained deep in the lungs. The 24-hour NEPA standards for PM_{10} are shown in Table 1 4. However, the 24-hour US EPA standards are used for $PM_{2.5}$ and TSP:

- TSP = 150 µg/m³
- $PM_{2.5}$ = 35 µg/m³

Further information regarding air quality compliance may be found in sections 4.1.6 (existing environment), Sections 6.2.1.8, 6.3.1.4 and 7.1.5 (impacts and mitigation).

2.2.3.4 The Clean Air Act 1964

The Clean Air Act (1964) refers to premises on which there are industrial works, the operation of which is, in the opinion of an inspector, likely to result in the discharge of smoke, fumes, gases or dust in the air. An inspector may enter any affected premises to examine, make enquiries, conduct tests and take samples of any substance, smoke, fumes, gas or dust that may be considered necessary or proper for the performance of his/her duties.

2.2.3.5 Public Health Act 1985

The Public Health Act is administered by the Ministry of Health through Local Boards, namely the parish councils. *The Public Health (Nuisance) Regulations 1995* aims to, control reduce or prevent air, soil and water pollution in all forms. Under the regulations:

- No individual or organisation is allowed to emit, deposit, issue or discharge into the environment from any source;
- Whoever is responsible for the accidental presence in the environment of any contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay;
- Any person or organisation that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants; and
- No industrial waste should be discharged into any water body, which will result in the deterioration of the quality of the water.

2.2.3.6 The National Solid Waste Management Authority Act 2001

The National Solid Waste Management Authority Act of 2001 is "an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto". The National Solid Waste Management Authority (NSWMA) was established in April 2002 as a result of this Act to effectively manage and regulate the collection and disposal of solid waste in Jamaica.

Section 4.4.1.7 provides details regarding waste management in the study area. Section 6.0 and 7.0 describes potential impacts and recommended mitigation measures to ensure compliance with legislation.

2.2.3.7 The Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations 2003

These regulations seek to implement the *Basel Convention on the Transboundary Movement of Hazardous Waste* and control transboundary movement and prevent the illegal trafficking of certain hazardous wastes. It is an offence to unlawfully dump or otherwise dispose of hazardous waste in areas under the jurisdiction of Jamaica. Waste resulting from the proposed project should be properly disposed of, and special attention should be paid to those considered hazardous under these regulations and as listed above.

2.3 REGIONAL AND INTERNATIONAL LEGISLATIVE AND REGULATORY CONSIDERATIONS

2.3.1 United Nations Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promoting sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that "biological diversity is about more than plants, animals and microorganisms 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 became a party to the CBD on April 6, 1995. Jamaica's Green Paper Number 3/01, 'Towards a National Strategy and Action Plan on Biological Diversity in Jamaica', is evidence of Jamaica's continuing commitment to its obligations as a signatory to the Convention.

2.3.2 Convention on Wetlands of International Importance especially as Waterfowl Habitat, "Ramsar Convention" 1971

The Ramsar Convention is an intergovernmental treaty that focuses on maintaining ecological wetland systems and planning for sustainable use of their resources. It was adopted on 2 February 1971 in Ramsar, Iran. The mission of the Convention was adopted by the Parties in 1999 and revised in 2005 - "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under Article 2.2 it is stated:

> Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" and indicates that "in the first instance, wetlands of international importance to waterfowl at any season should be included.

Jamaica became a contracting party on 7 February 1998 and has 4 sites covering a combined total of 37,847 hectares (378.47 km^2).

2.3.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES generally seeks to protect endangered plants and animals and owing to the cross boundary nature of animals and plants. This protection requires international cooperation. It aims to ensure that international trade of wild animal and plant species does not threaten the survival of the species in the wild, and it accords varying degrees of protection to over 35,000 species.

This convention was drafted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN) and finalised in 1973. After being opened for signatures in 1973, CITES entered into force on 1 July 1975. Jamaica became a Party to CITES on June 22, 1997. In 2000, Jamaica enacted domestic legislation, the Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000 and Regulations to fulfil its obligations to CITES. The Management Authority for CITES in Jamaica is the Natural Resources Conservation Authority (NRCA). The Authority receives applications for permits and certificates to trade internationally in endangered species. The processing of applications is coordinated with the local Scientific Authority.

3.0 COMPREHENSIVE DESCRIPTION OF THE PROPOSED PROJECT

3.1 PROJECT HISTORY AND BACKGROUND

3.1.1 Project Development

In 2012, Stanley Consultants Inc. was contracted by the National Works Agency (NWA) to undertake the implementation of a feasibility study and preliminary design for the SCHIP. The Feasibility Study aimed to assess and develop alternatives, while also preparing documentation to support the preferred alternative and overall project development. As part of this, alignment alternatives within a 2-kilometre-wide corridor along existing road for both segments were evaluated in order to determine preferred alignments for each segment. The selection of the preferred alignments was conducted objectively and involved the identification of 27 measurable evaluation criteria (see section 9.2.1 fir listing of criteria) by a Steering Committee established for the SCHIP (see section 5.1 for details of members). Nine alignment alternative sections were identified in Segment 1 by the NWA and Stanley Consultants and eight in Segment 2. The design team developed alignment alternatives for each section and improvements to the existing road were considered as an alternative. Each alignment alternative developed by the design team was evaluated for each evaluation criterion. The alternative with the highest score was selected. The *Feasibility Study Report* presented all conceptual design plans for the preferred alternative, as well as an economic appraisal of the preferred alternative.

The results of the alignment alternative selection were carried forward into a design concept. A continuous alignment was developed for each segment that consisted of the alignment alternatives developed and minor improvements to the existing road connecting these alternatives. The design for each segment was further developed by a profile, the addition of climbing lanes and laybys. In addition, changes to climatic condition such as increases in rainfall intensity, sea level rise etc. were considered whilst developing the rationale of the project and during the design process. The need for better planned and designed roads with adequate drainage, bridges and road elevations were used to mitigate the impact from the potential onslaught of climate change. The *Design Concept Report* (DCR) showcases detailed engineering information that was used to guide the development of project alternatives and support the selection of a preferred alternative within each project segment.

Conceptual plans were developed for the preferred alternative within each segment of the SCHIP, and these included the centreline of the proposed alignment, roadway typical sections by chainage, location and design for major drainage structures, horizontal curve information and existing utilities and parcel lines. Wherever bypass/development roads are proposed, link road connections have been identified. Vertical geometry for the road was also designed for each of the segments and placed on profile sheets with the existing ground line. The *Preliminary Plans for the SCHIP* (365 plan sheets for Segment 1 and 441 sheets for Segment 2;) were submitted to the NWA in October 2014 (Stanley Consultants Inc., 2014).

As part of the concept development, two additional reports were prepared: *Drainage Report* and *Structures Report*. The Drainage Report identified the numerous watersheds that cross the preferred alignments and identified the required drainage facility for each watershed to convey the runoff under the South Coast Highway. The Structures Report identified the major structures required for each segment to convey large flows of runoff across the alignment or provide grade separation structures between two roadways.

3.1.2 Environmental Activities

As part of the Feasibility Study, three deliverables (Table 3-1) were the responsibility of the environmental team. The *Environmental Assessment Memorandum (EAM)* presented a reconnaissance of the proposed impact areas in order to determine the sensitive environmental receptors that may affect the design and construction of the project prior to the finalisation of the project plan. The *Environmental Report* included a characterization of the nature of the environment along the project corridor, the identification of environmental issues and impacts for consideration when developing the alignment alternatives and the requisite mitigation measures that must be taken.

The tasks carried out for the purposes of the *Environmental Report* did not constitute an Environmental Impact Assessment (EIA); therefore, a *Draft Terms of Reference (TOR) for an Environmental Impact Assessment (EIA)* was prepared. It should be noted however that the final approved TORs for this EIA for the proposed Section 1A of the SCHIP was established by NEPA (Appendix 1).

Table 3-1 Deliverables for all environmental activities for Phase 1 of the SCHIP

Deliverable	Status
Environmental Assessment Memorandum (EAM) *Environmental Assessment Memorandum for the Southern Coastal Highway Improvement Project, Feasibility Study and Preliminary Design - Segment 1: Port Antonio to Harbour View & Segment 2: Mandeville to Negril*	**COMPLETED** Final Report submitted 30 April 2013 by CL Environmental Co. Ltd. Considered as part of Initial Site Assessment Report.
Environmental Report *Environmental Report for the Southern Coastal Highway Improvement Project, Feasibility Study and Preliminary Design - Segment 1: Port Antonio to Harbour View & Segment 2: Mandeville to Negril*	**COMPLETED** Final Report submitted 26 November 2014 by CL Environmental Co. Ltd.
Draft Terms of Reference (TOR) for an Environmental Impact Assessment (EIA)	**COMPLETED**

3.1.3 Summary of Existing Reports

In addition to the environmental reports mentioned above, the following assessments and reports were prepared in support of the SCHIP and prior to the proposed project:

- Structures Report - Stanley Consultants Inc. – March 2014
- Design Concept Report - Stanley Consultants Inc. – July 2014
- Final Feasibility Study Report – Stanley Consultants Inc. – July 2014
- Traffic Report and Axle Road Survey - Stanley Consultants Inc. – July 2014
- Utility Assessment Report - Stanley Consultants Inc. – July 2014
- Economic Feasibility Study Report- Stanley Consultants Inc. – July 2014
- Roadway Site Assessment Report - Stanley Consultants Inc. – September 2014
- Drainage Report – September 2014
- Alignment Alternative Study Report - Stanley Consultants Inc. – September 2014
- Geotechnical Report – NHL Engineering – January 2015
- Updated Feasibility & Final Report – Stanley Consultants Inc. – February 2015
- Preliminary Plans - Stanley Consultants Inc. – February 2015

3.2 PROJECT IMPORTANCE AND RATIONALE

3.2.1 Rationale and Purpose

The SCHIP study corridors and specifically in Segment 1, provide interregional connectivity between the parishes of St. Andrew, St. Thomas, and Portland.[4] The main roadway, together with adjoining roadways, constitute major elements of the surface transportation system in Jamaica, which allows for the movement of goods and people between airports, seaports, major employment centres, residential areas and recreational areas. The road provides a key route for commercial and industrial interests, and is needed to support tourist activity and future development on the island.

The need for corridor improvements is based on a combination of safety, physical and functional deficiencies that exist, plus overall capacity needs within each corridor. Stanley Consultants and the NWA identified three objectives for the SCHIP: provide a safe and efficient highway; provide a highway not prone to flooding; and provide for future development. As part of the Feasibility Study requirements, a detailed assessment of the existing highway features was conducted for each segment and included roadway, drainage, structures, utilities environment and pavement condition. Flooding and storm surge, particularly in Segment 1, damages property and cuts off the supply of goods to residents and businesses along the corridor. In some cases, the existing road has been blocked in several locations, isolating the area between these blockages for days. Details for each site assessment were prepared and presented in a *Roadway Site Assessment Report*; the general results indicated that Segment 1 is in need of improvements that will allow the parishes to develop and improve the lifestyle of their citizens. This conclusion is supported by evaluation of the existing conditions and the recommendation for replacement of a high percentage of the facilities as shown in Table 3-2.

[4] Detailed information regarding Segment 2 is not included owing to the fact that the focus of this EIA is solely the first section for completion, namely Section 1A of Segment 1,

Table 3-2 Existing road deficiencies, Segment 1

Horizontal Curves	321 curves out of 681 curves do not sustain posted speed (47.1%)
Pavement Roughness (IRI)	Average 12.01 (equates to unpaved roads)
Structure Replacement	15 bridges out of 36 bridges (42%)
Culvert Replacement	239 culverts out of 358 culverts (67%)

The travel demand volumes, in annual average daily traffic (AADT), along the Segment 1 corridor for the year 2013, range from 1,200 vehicles per day (vpd) at the Fair Prospect to Boston link, to 13,100 vpd at the Harbour View Roundabout to Bull Bay. The corresponding level of service (LOS) is B. By the year 2035 the AADT will range from 1,700 vehicles per day (vpd) at the Fair Prospect to Boston link, to 18,300 vpd at the Harbour View Roundabout to Bull Bay, with corresponding level of service (LOS) remaining as B (traffic volumes, existing and projected, are contained in the *Traffic Report* and discussed further in section 4.4.1.8, 6.2.3.1 and 7.3.1). The Southern Coastal Highway is anticipated to serve as the main transportation facility that links residents of different cities and towns within the project limits. The proposed safety and operational improvements along the project corridor will therefore improve mobility and support the economic development of these communities as well as stimulate major construction activities that will contribute to economic growth within the area.

Further, the proposed project traverses through agricultural, open, residential, public and recreational land. There are several locations within the limits of the project where on-going development is occurring or is being planned; for example, the Dundas Development, a proposed housing development located on the border of St Thomas to Grants Pen. The SCHIP will support the infrastructure needs of existing land development projects, as well as enhance the potential for new growth to occur.

The project developed by Stanley Consultants for the SCHIP meets the project objectives; namely the development of a safe and efficient highway (according to the standards of the project detailed in section 3.3.1.2), that is not prone to flooding and that may provide for future development. The need for improvements on the corridors has been documented extensively in reports prepared to support the *Feasibility Study Report*. The safety, physical and functional deficiencies that exists, plus overall capacity needs within each corridor, but particularly Segment 1, is prohibiting growth and development in those sections of the country. The overall Economic Internal Rate of Return (EIRR) for the SCHIP from the *Feasibility Study Report* is 14.3%, above the discount rate of 12% used by the Ministry of Transport, Works and Housing to evaluate the worthiness of projects. The revised overall EIRR for the SCHIP based on the cost estimates from the preliminary plans is 13.0%, still above the discount rate of 12%. The SCHIP is a worthwhile investment in public infrastructure and would benefit the economy of Jamaica both in the short and long-term.

Specific to the selection of Section 1A as the first section for construction, there are a number of factors that influenced which section should be constructed initially. These factors include socioeconomic ramifications, maintenance of traffic considerations, business impacts, Right-of-Way acquisition, impact to traffic and safety, and various cost factors. Resulting from economic analyses undertaken, it was recommended to prioritize projects based on the rate of return, as well as condition of the existing facilities. Of the three highest EIRRs, one is located in Segment 1 and two in Segment 2, one at each end of the segment. While all are worthy projects, the largest benefit, including subjective benefits, was found to come from Section 1A due to the poor condition of the existing road and an opportunity to provide for development east of Kingston. Additionally, there are 4 main communities in St. Thomas and St. Andrew adjoining the road works, namely Bull Bay/ Seven Mile, Harbour View, Eleven Miles and Albion. As coastal communities, many of these settlements only have one access to the main road and all have no reasonable alternative to the main road for access to and delivery of health, educational and, social services and emergency support. Further, all communities east of Yallahs in St. Thomas use Section 1A as the main access to Kingston. Communities east of Kingston therefore depend on this segment (Section 1A) for access to health, education, social services and emergency support.

3.2.2 Economic Analysis

The methodology to prepare the construction cost estimate for the preferred alignments was to identify the major construction items that could be quantified with the conceptual level of design and increase the estimated cost by a percentage to account for items not estimated. For the right-of-way cost estimate, the right-of-way lines were determined by offsetting the slope lines by three meters and measuring the area. Cost factors for different types of land were provided by NWA and the National Land Agency; adjustments were made as necessary. For the construction cost estimate, the following quantities were determined from the design model for each segment:

- Clearing and Grubbing
- Bridge Demolition
- Regular Excavation
- Embankment (In Place)
- Borrow (Material and Haul Only)
- Waste
- Base Course
- Asphaltic Concrete (30mm) (Shoulder)
- Asphaltic Concrete (50mm) (Service Roads)
- Asphaltic Concrete (90mm) (Travel Lanes)
- Kerb & Gutter
- Sidewalk
- Fence (Barbed Wire)
- Guardrail
- Urban Storm Drain Pipe
- Catch Basins
- Cross Drainage Pipe
- Structures (Box culverts, bridges, multi-plate metal culverts and arches)
- Link Roads (connections between the SCH and the existing road)

Some items were estimated as a percentage of the total cost of the above items or a specific combination of these items. These included Erosion Control, Preliminary and General Items and Items Not Estimated.

3.2.2.1 Construction Program and Packages

The Ministry of Transport, Works and Housing selected the design-build project delivery method. Based on the initial conceptual cost estimates, and discussions with NWA, an attempt was made to identify potential construction packages. Feasible limits for construction contracts will be influenced based on the order of magnitude that is cost feasible and the extent that it is desirable to utilize local contractors. Since the desire is to attract international bidding, the construction value of each package must be large enough to attract these bidders. However, experience on the North Coast Highway showed that construction packages with a length longer than 30km to 40km create logistic issues for the contractors. Therefore, balancing the construction packages lengths and cost was a major consideration for the SCHIP.

For Segment 1, a total of 7 construction sections, 1A through to 1H were identified (Table 3-3, Table 3-4 and Figure 1-2). It should be noted that subsequent to the completion of the DCR, the South Coastal Highway alignment was revised to fit the actual field conditions once final aerial imagery was available. Consultants prepared new cost estimates for each construction section for these revised Preliminary Plans (Table 3-5). Construction costs increased from the DCR cost estimates to the cost estimates from the preliminary plans except for Section 1D, Segment 1, where the construction cost estimate showed a small reduction (Table 3-3).

Table 3-3 Segment 1 construction cost changes

Source: (Stanley Conulstants Inc., 2015)

Construction Section	DCR Construction Cost	Preliminary Plan Construction Cost	Percent Change
Section 1A	$105,182,700	$139,425,600	32.6%
Section 1B	$127,355,600	$182,899,600	43.6%
Section 1C	$193,273,200	$197,299,200	2.1%
Section 1D	$159,277,100	$154,205,700	-3.2%
Section 1E	$53,137,500	$60,608,300	14.1%
Section 1F	$156,149,000	$167,608,700	7.3%
Section 1H	$110,358,800	$174,627,800	58.2%
Totals	**$904,733,900**	**$1,076,674,900**	**19.0%**

Table 3-4 Construction Program DCR Costs (Segment 1), with construction packages relevant to this project highlighted

Construction Package	Sub-Section	Parish	Location	Length (km)	Construction Costs	Right-of-Way Costs	Total Costs
1A	1	St. Andrew	Harbour View to Bull Bay	6.6	$44,484,800	$20,764,400	$65,249,200
1A	2	St. Thomas	Bull Bay to Eleven Mile	3.1	$24,068,600	$26,210,200	$50,278,800
1A	3	St. Thomas	Eleven Mile to Grants Pen	3.6	$16,568,200	$7,992,600	$24,560,800
1A	4	St. Thomas	Grants Pen to Albion	2.7	$8,906,600	$5,224,800	$14,131,400
1A	5	St. Thomas	Albion to Poor Man's Corner	1.9	$4,894,000	$4,055,100	$8,949,100
1A	6	St. Thomas	Poor Man's Corner to Yallahs	2.0	$6,260,500	$4,288,200	$10,548,700
1A	**Totals**			**20.0**	**$105,182,700**	**$68,535,300**	**$173,718,000**
1B	1	St. Thomas	Yallahs to Prospect Pen	8.7	$26,105,400	$21,710,000	$47,815,400
1B	2	St. Thomas	Prospect Pen to Roselle	6.0	$63,801,100	$50,974,500	$114,775,600
1B	3	St. Thomas	Roselle to Morant Bay (West)	3.4	$8,077,900	$7,870,600	$15,948,500
1B	4	St. Thomas	Morant Bay (West) to Belfast	4.0	$29,371,200	$24,991,700	$54,362,900
1B	**Totals**			**22.2**	**$127,355,600**	**$105,546,800**	**$232,902,400**
1C	1	St. Thomas	Belfast to Leith Hall	6.3	$23,914,800	$4,667,300	$28,582,100
1C	2	St. Thomas	Leith Hall to Port Morant	3.1	$9.399,900	$14,393,400	$23,793,300
1C	3	St. Thomas	Port Morant to Arcadia Junction	3.1	$18,115,100	$14,439,400	$32,554,500
1C	4	St. Thomas	Arcadia Junction to Golden Grove	5.2	$18,785,300	$30,936,000	$49,721,300
1C	5	St. Thomas	Golden Grove to Amity Hall	3.6	$60,127,900	$22,230,000	$82,357,900
1C	6	St. Thomas	Amity Hall to Hector's River	6.5	$38,653,900	$20,940,800	$59,594,700
1C	7	Portland	Hector's River to Manchioneal	4.8	$24,276,300	$12,832,000	$37,108,300
1C	**Totals**			**32.6**	**$193,273,200**	**$120,438,900**	**$313,712,100**
1D	1	Portland	Manchioneal to Kensington	4.9	$90,572,200	$19,740,800	$110,313,000
1D	2	Portland	Kensington to Long Bay	2.8	$18,394,600	$8,912,000	$27,306,600
1D	3	Portland	Long bay to Fair Prospect	4.7	$30,498,300	$10,706,500	$41,204,800
1D	4	Portland	Fair Prospect to Boston	4.8	$19,812,000	$2,875,000	$22,687,000
1D	**Totals**			**17.2**	**$159,277,100**	**$42,234,300**	**$201,511,400**
1E	1	Portland	Boston to Fairy Hill	2.4	$53,137,500	$63,238,500	$116,376,000
1E	**Totals**			**2.4**	**$53,137,500**	**$63,238,500**	**$116,376,000**
1F	1	Portland	Fairy Hill to Frenchman's Cove	3.1	$74,715,000	$36,006,500	$110,721,500
1F	2	Portland	Frenchman's Cove to Williamsfield	2.6	$81,434,000	$29,572,400	$111,006,400
1F	**Totals**			**5.6**	**$156,149,000**	**$65,578,900**	**$221,727,900**
1H	1	Portland	Williamsfield to Port Antonio	2.8	$67,279,300	$36,549,000	$103,828,300
1H	2	Portland	Port Antonio to Bryan's Bay	3.6	$43,079,500	$47,579,200	$90,658,500
1H	**Totals**			**6.4**	**$110,358,800**	**$84,128,200**	**$194,486,800**
Segment 1 Totals				**106.3**	**$904,733,900**	**$549,700,900**	**$1,454,434,800**

Table 3-5 Segment 1 preliminary plans construction cost estimates by section

Source: (Stanley Conulstants Inc., 2015)

	Section 1A	Section 1B	Section 1C	Section 1D	Section 1E	Section 1F	Section 1H	Totals
BILL NO. GP - GENERAL AND PRELIMINARY ITEMS	$11,522,800	$15,115,700	$16,305,800	$12,744,300	$5,009,000	$13,852,000	$14,432,100	$88,981,700
BILL NO. 1 - MAINTENANCE AND PROTECTION OF TRAFFIC	$263,300	$292,200	$429,100	$226,500	$31,700	$73,800	$84,400	$1,401,000
BILL NO. 2 - SITE CLEARANCE AND REMOVALS	$997,400	$1,078,600	$1,466,600	$529,600	$127,100	$418,300	$461,800	$5,079,400
BILL NO. 3 - EARTHWORKS	$26,604,800	$35,940,500	$47,323,000	$34,757,300	$11,696,600	$54,159,000	$24,673,300	$235,154,500
BILL NO. 4 - REINFORCING STEEL	$0	$0	$0	$0	$0	$0	$0	$0
BILL NO. 5 - CONCRETE PIPE FOR STORM SEWERS	$7,524,800	$5,470,700	$2,946,300	$1,365,900	$0	$311,100	$2,444,700	$20,063,500
BILL NO. 6 - CONCRETE	$0	$0	$0	$0	$0	$0	$0	$0
BILL NO. 7 - CONCRETE STRUCTURES	$24,995,800	$15,707,200	$17,505,500	$7,804,800	$764,300	$1,819,700	$3,304,400	$71,901,700
BILL NO. 8 - ASPHALTIC CONCRETE PAVEMENT	$13,194,200	$11,581,800	$13,231,600	$6,939,900	$1,023,500	$2,064,300	$5,075,800	$53,111,100
BILL NO. 9 - CONCRETE SIDEWALKS, DRIVEWAYS AND KERB AND GUTTER	$2,316,900	$1,380,700	$1,042,500	$492,700	$0	$0	$297,000	$5,529,800
BILL NO. 10 - BRIDGE STRUCTURES	$19,569,100	$56,581,500	$65,769,400	$65,392,800	$33,555,200	$71,375,900	$92,687,100	$404,931,000
BILL NO. 11 - MANHOLES, CATCH BASINS AND AREA DRAINS	$530,200	$336,500	$173,500	$75,600	$0	$0	$97,200	$1,213,000
BILL NO. 12 - WATER LINES	$3,098,800	$5,781,800	$2,452,900	$1,381,500	$0	$127,700	$129,500	$12,972,200
BILL NO. 13 - TOPSOIL PLACING AND SEEDING	$213,900	$214,600	$499,900	$166,800	$32,600	$162,500	$110,200	$1,400,500
BILL NO. 14 - DUMPED STONE RIPRAP	$0	$687,100	$53,800	$26,200	$4,200	$27,200	$28,600	$827,100
BILL NO. 15 - WALLS AND FENCING	$304,100	$1,255,200	$944,600	$335,800	$24,100	$56,200	$3,955,700	$6,875,700
BILL NO. 16 - BARRIERS	$4,467,700	$2,868,900	$383,600	$0	$0	$0	$2,508,500	$10,228,700
BILL NO. 17 - ROAD MARKING AND ROAD FURNITURE	$166,800	$160,300	$211,700	$117,100	$21,500	$42,400	$84,200	$804,000
BILL NO. 18 - SIGNING	$34,600	$27,800	$43,700	$40,100	$3,700	$9,100	$11,000	$170,000
BILL NO. 19 - STRUCTURAL STEEL	$66,100	$38,800	$52,400	$22,800	$4,600	$2,300	$6,900	$193,900
BILL NO. 20 - ENVIRONMENTAL ASSESSMENT AND PROTECTION REQUIREMENTS	$858,800	$1,147,800	$1,271,500	$1,005,200	$389,900	$1,077,300	$1,121,000	$6,871,500
BILL NO. 21 - ITEMS NOT ESTIMATED	$5,260,400	$7,027,600	$4,420,500	$6,034,100	$2,382,400	$6,582,700	$6,854,100	$38,561,800
BILL NO. 22 - UTILITY POLE RELOCATIONS	$4,760,000	$3,577,000	$2,835,000	$728,000	$28,000	$210,000	$385,000	$12,523,000
ESTIMATED CONSTRUCTION COST	$126,750,500	$166,272,300	$179,362,900	$140,187,000	$55,098,400	$152,371,500	$158,752,500	$978,795,100
CONTINGENCY (10%)	$12,675,100	$16,627,300	$17,936,300	$14,018,700	$5,509,900	$15,237,200	$15,875,300	$97,879,800
TOTAL ESTIMATED PROBABLE CONSTRUCTION COST	$139,425,600	$182,899,600	$197,299,200	$154,205,700	$60,608,300	$167,608,700	$174,627,800	$1,076,674,900
FEASIBILITY REPORT CONSTRUCTION COST	$105,182,700	$127,355,600	$193,273,200	$159,277,100	$53,137,500	$156,149,000	$110,358,800	$904,733,900
CONSTRUCTION COST INCREASE FROM FEASIBILITY REPORT	32.6%	43.6%	2.1%	-3.2%	14.1%	7.3%	58.2%	19.0%

3.2.2.2 Economic Analysis and Project Implementation

The estimated costs allowed for the development of construction packages for the Economic Analysis. The *Economic Feasibility Study Report* is considered part of the detailed feasibility study and was prepared using the Highway Development and Management software (HDM-4). The EIRRs (DCR and Preliminary Plan) for each of the construction sections in Segment 1 is shown Table 3-6.

Table 3-6 Segment 1 EIRR changes

Source: (Stanley Conulstants Inc., 2015)

Construction Section	DCR EIRR	Preliminary Plan EIRR	Percent Change
Section 1A	26.5%	23.1%	-12.8%
Section 1B	14.6%	11.9%	-18.5%
Section 1C	6.5%	7.6%	16.9%
Section 1D	0.8%	2.7%	237.5%
Section 1E	-6.0%	-5.8%	3.3%
Section 1F	-4.6%	-4.4%	4.4%
Section 1H	10.7%	7.1%	-33.6%
Segment EIRR	**9.2%**	**8.4%**	**-8.7%**

Implementation of the construction packages should generally follow the EIRR for the projects, but be informed by a subjective evaluation of need and benefits. Stanley Consultants in conjunction with the NWA developed the project implementation priority shown in Table 3-7. Projects were prioritized based on rate of return, as well as condition of the existing facilities. For example, of the three highest EIRRs, one is located in Segment 1 and two in Segment 2, one at each end of the segment. While all are worthy projects, the largest benefit, including subjective benefits, may come from Section 1A and Section 1B due to the poor condition of the existing road and an opportunity to provide for development east of Kingston.

Table 3-7 Project implementation priority

Source: (Stanley Conulstants Inc., 2015)

Priority	Section No.	Project Limits	DCR Construction Cost	EIRR
1	1A	Harbour View to Yallahs	$105,182,700	26.8%
2	1B	Yallahs to Belfast	$127,355,600	14.5%
3	2E	Spur Tree to Williamsfield (W)	$45,635,000	32.7%
4	2A	Negril to Ferris Cross	$117,792,900	29.7%
5	2B	Ferris Cross to Crawford	$81,753,900	23.5%
6	2C	Crawford to Goshen	$101,279,300	21.2%
7	2D	Goshen to Spur Tree	$136,165,200	14.9%
8	1H	Williamsfield (E) to Port Antonio	$110,358,800	10.6%
9	1C	Belfast to Manchioneal	$193,273,200	7.7%
10	1D	Manchioneal to Boston	$159,277,100	2.6%
11	1F	Fairy Hill to Williamsfield (E)	$156,149,000	-4.2%
12	1E	Boston to Fairy Hill	$53,137,500	-5.5%

Note: *Williamsfield (E) is located between Port Antonio and Drapers*
Williamsfield (W) is located to the east of Mandeville

Section 1A was set at the highest priority even though the EIRR for was not the highest. This project was placed at the top of the list for several reasons:

- The existing road conditions in these two sections are significantly worse than those sections with a higher EIRR.
- There is a significantly higher truck percentage in these two sections due to quarry operations that provide better aggregates than other areas of the island.
- The area east of Kingston is routinely cut off from services due to tropical storm and hurricanes, stopping the transfer of goods and services to St. Thomas Parish.
- St. Thomas has land that can be developed as residential areas to support the economic growth of the Kingston metropolitan area.
- Improvement of these two sections of road will allow for future growth to the east of Morant Bay, improving the EIRR for those sections.
- The priority of the remaining construction sections is set based on the EIRR of the individual sections.

Further, while specific benefits are derived from the first two construction packages (1A and 1B) with the EIRR greater than the discount rate (Table 3-7), there is a larger overall benefit for developing the entire Segment 1. The EIRR for several of the construction packages for Segment 1 is below the discount rate of 12% and while this may indicate that the construction of these packages is not economically feasible at this time, a holistic approach to the construction of Segment 1 should be taken to realize the total benefit to St. Thomas and Portland parishes. Segment 1 provides access to a largely undeveloped section of Jamaica. St. Thomas and Portland have unique resources that can attract tourism, agriculture and other commercial business. These resources are currently untapped due to the poor access to the area as a result of a transportation infrastructure that hasn't been improved or maintained for many decades. As the construction packages for Segment 1 are implemented from Harbour View to Morant Bay, the improved access through the first two packages will spur development in the next package as access will be improved. The development will result in increased traffic volumes, which will drive up the EIRR for the adjacent package.

3.2.3 Development Plans and Policies

Local development plans are guided according to Development Orders; those of significance to Segment 1 Section 1A include the Kingston Confirmed Development Order 1966 and the DRAFT St. Thomas Confirmed Development Order (specifically Inset No.2, Yallahs Local Planning Area Land Use Proposals). It should be noted that the St. Thomas Coast Confirmed Development Order 1965 preceded the DRAFT St. Thomas Confirmed Development Order listed above.

Kingston Confirmed Development Order 1966 is the main piece of legislation used to guide development in the parishes of Kingston and St. Andrew. In these parishes, the proposed configuration extends the four lanes at the Old Harbour Roundabout. The existing main roadway and parts of the alignment on which improvements are proposed, are bounded by areas zoned as residential and industrial.

According to the 2017 Yallahs Local Planning Area Land Use Proposals, the proposed alignment follows the Class A road through Yallahs and does not cross into any area zoned for uses other than transport (National Environment and Planning Agency, 2017).

Vision 2030 is a National Development Plan for Jamaica, promoting four National Goals as well as associated National Outcomes for each goal, to be achieved by 2030, with the objective of developing Jamaica into a country with a vibrant and sustainable economy, society and environment; a high level of human capital development; greater opportunities and access to these opportunities for the population; and a high level of human security. Of the aforementioned outcomes, one applies directly to the proposed project, namely National Outcome # 15: Sustainable Urban and Rural Development. Vision 2030 Jamaica creates a framework for urban and rural development that supports the economic and social development of all parishes to achieve their full potential, thereby creating sustainable communities. The Plan proposes a spatial arrangement of land use that facilitates social and economic development, respects the environment and satisfies the need for safety, efficiency, aesthetics and social justice. The development of new and progressive legislation to reflect the country's changing demands, and a modernized planning system, including clarification and strengthening of the roles of the various agencies involved in physical planning will be encouraged.

3.3 PROJECT DESCRIPTION

3.3.1 Project Features

3.3.1.1 Summary of Proposed Improvements

Segment 1 Section 1A chainage (CH) begins at Harbour View roundabout (CH 100+000) in the parish of Kingston and is approximately 17.4 km in length (Table 3-8). Section 1A ends on the western edge of Yallahs River Bridge, St. Thomas at CH 117+400 approximately; the remainder of Segment 1 continues to Port Antonio, Portland (Figure 1-2). The proposed Southern Coastal Highway from the Harbour View Roundabout (CH100+000) to the Yallahs River Bridge (CH117+400) consist of improvements to the existing roadway, as well as new alignment (Figure 3-1). Improvements to the existing roadway includes road widening, curve flattening, installing sidewalks in urban areas, improved drainage infrastructure, etc. in order to correct deficiencies and improve the safety and traffic operating conditions. The proposed works along Section1A brings about a reduction in travelling distance of 2 km between Harbour View and Yallahs River Bridge, as well a reduction in travel time by approximately 4 minutes assuming no traffic or delays (Table 3-8).

Table 3-8 Total distance, speeds and estimated travelling times for existing roadway and conditions compared to that for the proposed alignment (modifications and new alignment)

	Proposed Section 1A			Existing Roadway		
Chainage	*Distance (km)*	*Speed*	*Time (mins)**	*Distance (km)*	*Speed*	*Time (mins)**
100+000 – 107+100	7.1	50	8.52	19.4	50	23.28
107+100 – 9+000	2.7	80	2.03			
109+800 – 113+400	3.6	50	4.32			
113+400 – 115+200	1.8	80	1.35			

	Proposed Section 1A			**Existing Roadway**		
Chainage	*Distance (km)*	*Speed*	*Time (mins)**	*Distance (km)*	*Speed*	*Time (mins)**
115+200 -117+400	2.2	50	2.64			
Total	**17.4**		**18.86**	**19.4**		**23.28**

**Time to travel assumes no traffic or delays. Taking into consideration delays, the time to complete the existing roadway at the posted speed is approximately 45 mins.*

The proposed highway consists of four lanes from 100+000 to 116+000 and two lanes from 116+000 to 117+400. The improvements to the existing roadway begins at 101+100 in Harbour View and continues to 106+700 in Bull Bay at the St. Andrew and St. Thomas parish boundary and from 109+500 in the vicinity of the Sun Coast Adventure Park (12 Mile) until the end of the section at the Yallahs River Bridge at 117+400. The new alignment begins at 106+700 where it diverts to the south of the existing roadway and continues until 109+500 in the vicinity of the Sun Coast Adventure Park in 12 Mile where it re-joins the existing roadway (Figure 3-1). The new alignment constitutes a total length of 2.8km (Table 3-9).

Table 3-9 Comparison of existing road modified with proposed improvements and new road along Segment 1, Section 1A

	Existing Road (modified with improvements)	*New Road*
Percentage of alignment on (%)	84	16
Distance (km)	14.5	2.8

Figure 3-1 Proposed SCHIP Segment 1 Section 1A alignment, showing chainage and section of new alignment

3.3.1.2 Project Design Criteria and Standards

The standards used to govern the development of proposed improvements for the Southern Coastal Highway are as shown in Table 3-10 in priority order. Additionally, Table 3-11 lists the project design controls that have been developed for the project.

Table 3-10 Governing project standards

PRIORITY	AGENCY	DOCUMENT
1	GOJ	Manual for Traffic Control Devices (MTW)
2	AASHTO	A Policy on Geometric Design of Highways and Streets
3	AASHTO	Roadside Design Guide
4	AASHTO	Standard Specifications for Highway Bridges, 16th Ed.
5	FHWA	Manual for Uniform Traffic Control Devices for Streets and Highways (2003 Edition) (MUTCD)
6	MTW	Standard Details

Table 3-11 South Coast Highway Design Controls

ELEMENT	VALUE	REFERENCE
Roadway Classification a. Type of Facility b. Area c. Highway System	 a. Arterial Roadway (Highway) b. Urban & Rural c. "A" Class Main Road	Terms of Reference
Design Vehicle	WB 15 (Turning Movements) Passenger Car (Sight Distance)	Terms of Reference
Level of Service	LOS C-Rural; LOS D-Urban	Traffic Report
Number of Travel Lanes	Minimum 2 Lanes – (1 in Each Direction) or based upon traffic demand or truck speed reduction	Terms of Reference
Design Traffic Volumes	To Be Determined	Traffic Report
Pedestrian & Bicycle Requirements	1.36m Sidewalks and Pedestrian Ramps in urban areas	Terms of Reference Typical sections

In conjunction with the NWA, Stanley Consultants established design criteria for both rural and urban areas (Table 3-12 and Table 3-13).

Table 3-12 Rural Roadway Design Criteria

ELEMENT	VALUE	REFERENCE
1) Design Speed	95 kilometers per hour	Terms of Reference
2) Lane Width	3.65 meters	Terms of Reference
3) Shoulder Width	2.7 meters (2.4m Paved)	Terms of Reference
4) Grades a. Level b. Rolling c. Mountainous	 a. 3.5% b. 4.5% c. 6.0%	AASHO Table 7-2 (2011 Edition)
5) Cross Slope a. Travel Lanes b. Shoulders	 a. 2% b. 4%	Terms of Reference; Typical Sections

ELEMENT	VALUE	REFERENCE
6) Horizontal Alignment a. Max. Super elevation (e) b. Min. Radius (e-max) c. Min. Radius (NC) d. Max. Deflection w/o curve	a. 6% b. 387 m curve c. 3195 m curve d. 0.95 Degrees	AASHTO Table 3-9 (2011 Edition)
7) Vertical Alignment a. K value – Crest VC b. K value – Sag VC c. Minimum length of curve d. Max. change in grade w/o vertical curve	a. K = 46 b. K = 42 c. 57m d. 0.4%	AASHTO Table 3-34 (Crest); Table 3-36 (Sag) (2011 Edition)
8) Minimum sight distance a. Stopping b. Passing	a. 173 meters b. 643 meters	AASHTO Table 7-1 (2011 Edition)
9) Horizontal Clearance (Recoverable Terrain)	9 meters	
10) Roadside Slopes a. Front Slope b. Back Slope c. Transverse Slopes	a. 1:4 Within Clear Zone b. 1:4 (1:3 w/Trap Ditch) c. 1:10 or Flatter	
11) Criteria for Grade Datum	0.6 meters clearance – Roadway Base above Seasonal High Water Table or ditch design flows	

Table 3-13 Urban Roadway Design Criteria

ELEMENT	VALUE	REFERENCE
1) Design Speed	65 kilometers per hour	Terms of Reference
2) Lane Width	3.65 meters	Terms of Reference
3) Shoulder Width Desirable / Minimum	Not Applicable (kerb)	Roadway Typical Sections
4) Grades a. Level b. Rolling c. Mountainous d. Minimum (kerb & gutter)	a. 6.0% b. 7.0% c. 9.0% d. 0.3%	AASHTO Table 7-4 (2011 Edition)
5) Cross Slope a. Travel Lanes b. Shoulders	a. 2% b. 4%	Terms of Reference; Roadway Typical Sections
6) Horizontal Alignment a. Max. Super elevation (e) b. Min. Radius (e-max) c. Min. Radius (NC) d. Max. Deflection w/o curve	a. 6% b. 154m curve c. 243m curve d. 2.0 Degrees	AASHTO Table 3-13a (2011 Edition) Low Speed Urban
7) Vertical Alignment a. K value - Crest VC b. K value - Sag VC c. Minimum length of curve d. Max. change in grade w/o vertical curve	a. K = 14 b. K = 21 c. 39m d. 0.8%	AASHTO Table 3-34 (Crest); Table 3-36 (Sag) (2011 Edition)
8) Minimum Sight Distance a. Stopping b. Passing	a. 95 meters b. 195 meters	AASHTO Table-7-1 (2011 Edition)

ELEMENT	VALUE	REFERENCE
9) Horizontal Clearance a. Poles & Above Ground Fixed objects b. Trees	a. 1.2m from face of kerb (minimum) b. 1.2m from face of kerb (minimum)	
10) Roadside Slopes	1:4 behind kerb	Roadway Typical Sections
11) Criteria for Grade Datum	0.3 meters' clearance – Roadway Base above Seasonal High Water Table	

3.3.1.3 Roadway Typical Sections

The proposed typical sections are consistent with the Terms of Reference and design criteria (Figure 3-2 through to Figure 3-5). These sections indicate 2-lane roadway with one lane in either direction, as well as 4-lane roadway, where some of the project segments require additional travel lanes based upon traffic projections. Additionally, in urban areas it is expected that improvements to the existing road may include parking lanes to minimize disruption for the thru traffic (Stanley Conulstants Inc., 2015). The rural typical section includes a utility corridor; in Segment 1, the utility corridor is on the right side of the road (the sea side).

For four-lane roadways, the NWA requested that a concrete median barrier be installed between opposing traffic. The concrete median barrier has a base width of 0.6m and a height of 0.8m. A 0.6m wide shoulder is provided on each side of the concrete median barrier on tangent sections. The right shoulder adjacent to the concrete median barrier must be widened for curves where the driver is turning to the right to provide adequate stopping sight distance.

The additional widening depends on the radius of the curve. The NWA was concerned that the additional widening would create additional right-of-way impacts, particularly in urban areas. The following procedure was established for the additional widening in rural areas.

- The appropriate median widening is used where there are no property constraints.
- Where there are property constraints, use the widening for an 80km/hr design speed. This provides the stopping sight distance for the posted speed.
- Do not lower the speed limit, but provide a 70km/hr advisory speed sign for that curve.
- The following procedure was established for urban areas.
- The appropriate median widening is used where there are no property constraints.
- Where we have used a 60km/hr design speed to reduce property impacts, use the additional widening required for 60km/hr design speed unless further reduction is necessary
- Where there are property constraints, use the widening for a 50km/hr design speed. This provides the stopping sight distance for the posted speed.
- Do not lower the speed limit, but provide a 40km/hr advisory speed sign if the 50km/hr design speed was used. No advisory sign would be required for a 60km/hr design speed

AASHTO recommends that for medians wider than 3m, the axis of rotation for the pavement is placed at the inside edges of the travel lane. This reduces the length of the super elevation transition and provides a better comfort factor for the motorists. Since the inside shoulder widening for the horizontal curves with concrete median barrier creates a median wider than 3m in many locations, the axis of rotation for all four-lane sections is placed at the inside edge of the inside travel lane, providing a consistency in the design of the four-lane roadway section. Where the pavement edges are at different elevations along the concrete median barrier, a stepped median barrier will be used. A detail for the stepped median barrier will be provided with the preliminary plans.

3.3.1.4 Design Traffic Conditions and Required Lanes

Based on the findings from projected traffic volumes and Level of Service analysis, the final recommendations for improvements on the South Coast Highway for Section 1A are listed in Table 3-14. The improvements presented in these tables represent roadway requirements based on projected travel demand to satisfy levels of service based on the Florida Department of Transportation's Quality/ Level of Service Manual. The results do not include climbing lanes that may be justified based on steep grades and high volumes of heavy vehicles. It should also be noted that the design period for the SCHIP was chosen as 20 years; however, the design team decided to push the design year to 2035 since it was unlikely that any improvement would be constructed before 2015.

In Segment 1 the first four sub-sections were identified to have travel demand projections, steep grades and high truck percentages that justify widening the roadway from two to four lanes. These sections are consecutive in St. Andrew Parish and St. Thomas Parish between Chainage (CH) 100+000 and CH 115+988 (within Section 1A).

Table 3-14 Segment 1 Design Year Traffic Volumes, LOS and Number of Lanes for Section 1A

Source: (Stanley Conulstants Inc., 2015)

	Location	Chainage***		Roadway Type	2013		2035 (Forecasted)		No. Lanes Required (2035)
		Begin	End		AADT	LOS	AADT	LOS	
St. Andrew	Harbour View Roundabout to Bull Bay	100+000	106+800	Urban	13100	B	18400	B	4**
	Bull Bay to Eleven Mile***	106+800	109+500	Transitioning	7000	B	9900	B	4*
St. Thomas	Eleven Mile to Grants Pen	109+500	113+290	Transitioning	7000	B	9900	B	4*
	Grants Pen to Albion	113+290	115+988	Rural Developed	5500	B	11400	B	4*
	Albion to Poorman's Corner	115+988	117+919	Rural Developed	8000	B	11400	C	2

**4 lanes required due to steep grades and high truck percentages*

*** Portion of the existing roadway is 4 lanes*

****Chainage is referenced to the Preferred Alignment*

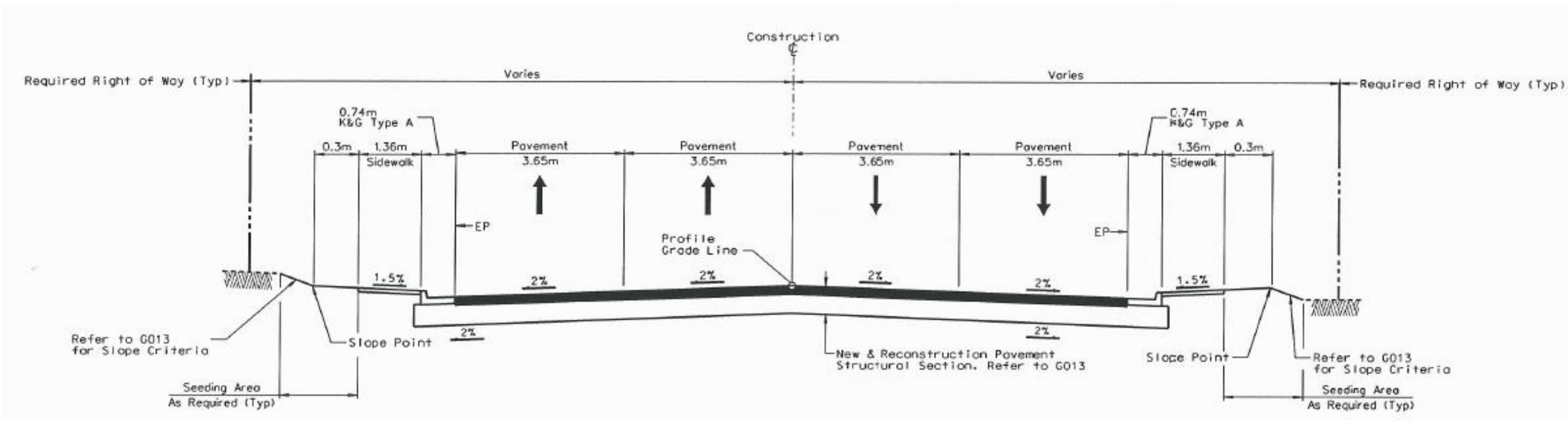


Figure 3-2 Typical road section between chainage 101+095 and 101+289, with a design speed 65 km/h

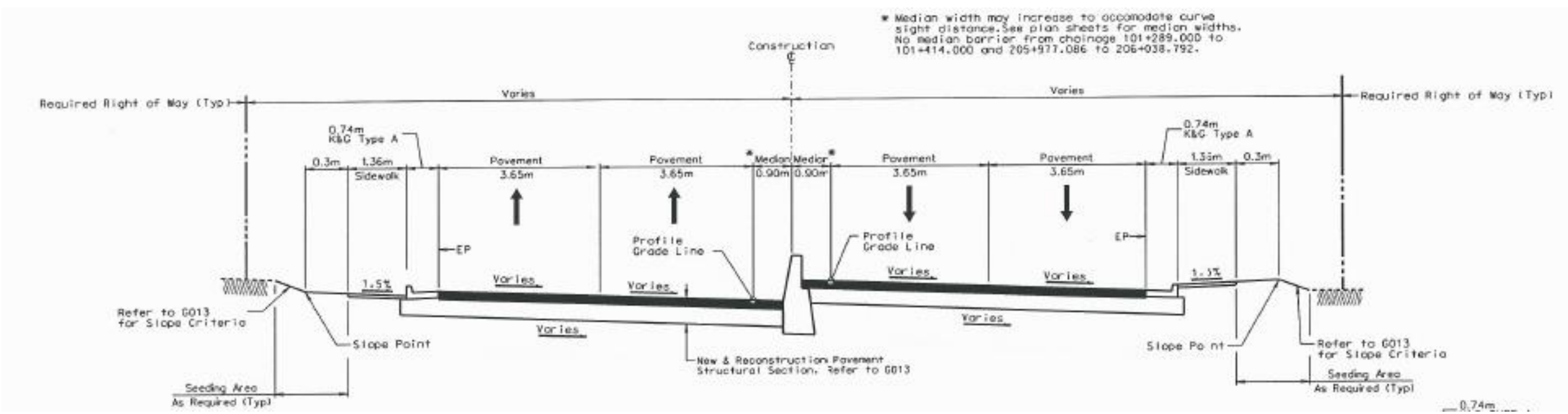


Figure 3-3 Typical road section along chainage 101+289 to 106+877 and 115+436 to 115+705, with design speed 65 km/h

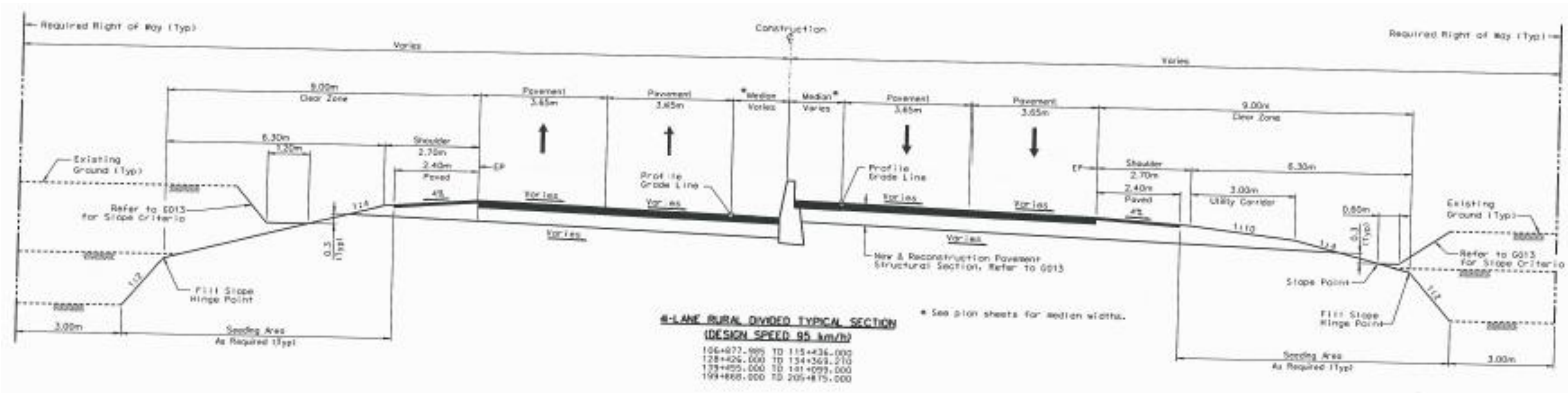


Figure 3-4 Typical road section between chainage 106+877 and 115+436, with design speed 95 km/h

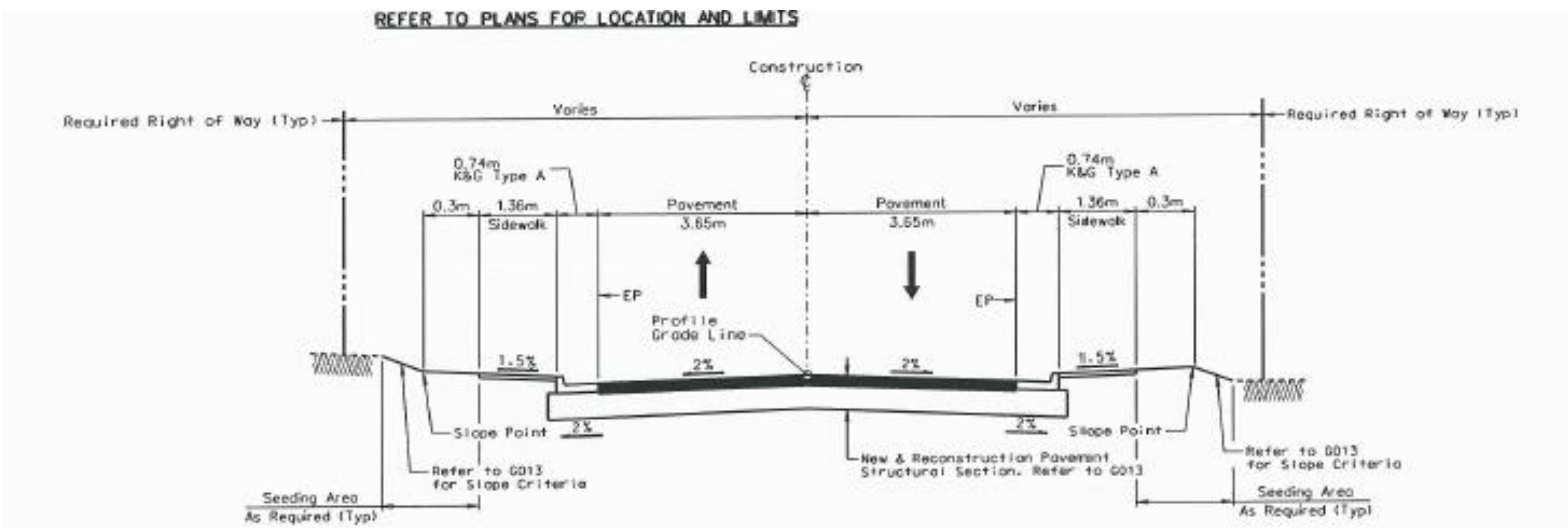


Figure 3-5 Typical road section between chainage 116+043 and 123+520, with design speed 65 km/h

3.3.1.5 Proposed Right Turn Lanes

Turning lanes improve the LOS of a roadway by removing turning traffic from the through traffic, and reducing potential conflicts; through traffic is not slowed down by the turning traffic. Turning lanes at side roads that have a significant turning volume are important to maintain an acceptable LOS and reduce the potential for accidents. As traffic volumes increase, the lack of right turn lanes will increase delay and reduce the LOS. The lack of right turn lanes may also increase accidents at intersections with minor arterial roads. The side roads along Segment 1 were reviewed for their significance in the transportation network; Table 3-15 indicates locations where right turn lanes are recommended.

Table 3-15 Proposed right turn lanes for Segment 1, Section 1A

Chainage	*Westbound*	*Eastbound*
113+170		X
115+983	X	X

3.3.1.6 Intersection Configurations

Table 3-16 provides a summary of the intersections that have turn lanes along Segment 1. The types of intersections include signalized intersections, two-way-stop-controlled (TWSC) intersections and U-turn intersection. The storage length for each turn lane is indicated. The minimum storage length used is 15m, which will accommodate two cars. For turn lanes at intersections without signals, there is an additional length for deceleration into the turn lane. The deceleration length for rural areas (95 km/hr design speed) is 130m. The deceleration length for urban areas (65 km/hr design speed) is 55m.

Table 3-16 Segment 1, Section 1A intersections with turn lanes and/or siganls

DCR Chainage	Intersection Type	WB Right Turn Storage Length	WB Left Turn Storage Length	EB Right Turn Storage Length	EB Left Turn Storage Length	NB Right Turn Storage Length	SB Right Turn Storage Length
105+865	TWSC	Shared	Shared	Shared	Shared	Shared	Shared
106+720	Signalized	Shared	---	---	30	---	30
113+170	TWSC	---	Shared	30	---	Shared	---
115+983	TWSC	30	Shared	30	Lane Drop	Shared	Shared

3.3.1.7 Climbing Lanes

American Association of State Highway and Transportation Officials (AASHTO) notes that freedom and safety of operation on two-lane highways, besides being influenced by the extent and frequency of passing sections, are adversely affected by heavily loaded vehicle traffic operating on grades of sufficient length to result in speeds that could impede following vehicles (Stanley Consultants Inc., 2014). Adding a climbing lane for an upgrade on a two-lane highway can offset the decline in traffic operations caused by the combined effects of the grade, traffic volume, and heavy vehicles. Climbing lanes are appropriate where the level of service or the speed of trucks is substantially less on an upgrade than on the approach to the upgrade. There are no locations for climbing lanes within Section 1A.

3.3.1.8 Intersections at Major Towns

New intersections will be added in the vicinity of towns where development roads are proposed to bypass the towns. If the existing alignment is used on either side of the town, a new intersection will be included to allow traffic to access the town and existing road from either end of the town. If the Southern Coastal Highway does not use the existing road on either side of the town, a link road will be identified for access to the town. A link road may be used even though access to the town is provided at either end.

3.3.1.9 Bus Laybys

The development of laybys for buses and taxis is important to keep a satisfactory level of service for the South Coast Highway as well as providing safety for passengers and other motorists. Table 3-17 provides a list that designates the initial locations for bus laybys located along Section 1A.

Table 3-17 Bus layby locations, Segment 1, Section 1A

Chainage	*Westbound*	*Eastbound*
101+080	X	X
102+649	X	X
103+660	X	X
104+590	X	X
105+865	X	X
106+800	X	X
109+500	X	X
111+000	X	X
111+800	X	X
112+283	X	X
113+170	X	X
115+983	X	X
116+784	X	X

3.3.1.10 Link Roads

Link roads connect the sections of the South Coast Highway that have been realigned with the existing main road. The locations of link roads were identified by Stanley Consultants and confirmed by NWA. There no link roads within Section 1A.

3.3.1.11 Drainage Structures

New or Modified Structures

Stanley Consultants prepared a *Structures Report* to identify and evaluate various structure alternatives along the proposed alignments of the South Coast Highway (SCH). Potential structure locations, types, sizes and estimated costs are based on the proposed SCH alignments and profiles for each segment. In-depth drainage analysis of the various watersheds within each corridor using open channel flow and culvert modelling was also used in determining required structure locations and sizes. Structures have also been identified at locations where the proposed SCH alignments intersect existing roadways and would eliminate connectivity across the new highway. Only those structures having a total length of at least 6.0 meters, when measured along the centreline of the roadway, are included in the *Structures Report*.

There are 20 locations along the SCH Segment 1 Section 1A that require new or modified structures (Table 3-18). Potential structure types range from multi-cell reinforced concrete box culverts (RCBC) to multi-span steel or concrete bridges (BR) and also include steel multi-plate pipe culverts (MPC) and high profile arches (MPA). The proposed structures in the *Structures Report* are based on roadway alignments and profiles in the early stages of development as presented in the *Design Concept* Report. As the roadway design evolves, the alignment and profile may change; these changes could affect the location, size and possibly the type of structure required at a specific location.

Table 3-18 Preferred Structure Alternatives and Estimated Costs, Segment 1, Section 1A

Chainage	Structure Name	Structure Type	Estimated Cost (US $)	Feature Name	Location
100+550	BR 1001	Existing Bridge - Perform Upgrades	$50,000	Hope River	Harbour View
101+404	RCBC 1001	RCBC - 2 Barrel 3.25m x 2.25m x 23 ± meters long	$235,000	Unknown	Harbour View
101+790	RCBC 1002	RCBC - 4 Barrel 3.0m x 2.5m x 23 ± meters long	$400,000	Unknown	Seven Mile
102+812	BR 1002	New Bridge - Six-span PC/PS concrete girder bridge,180 ± meter long	$14,600,000	Cane River	Seven Mile
103+410	RCBC 1003	RCBC - 4 Barrel 3.0m x 2.5m x 23 ± meters long	$400,000	Unknown	Seven Mile
104+530	RCBC 1004	RCBC - 2 Barrel 3.25m x 2.5m x 23 ± meters long	$245,000	Unknown	Wickie Wackie
104+740	RCBC 1005	RCBC - 2 Barrel 3.25m x 2.5m x 23 ± meters long	$245,000	Unknown	Wickie Wackie
104+970	RCBC 1006	RCBC - 2 Barrel 3.25m x 2.5m x 23 ± meters long	$255,000	Unknown	Nine Mile
106+000	BR 1003	Widen Existing Bridge	$1,320,000	Chalky River	Nine Mile
106+140	RCBC 1007	RCBC - 2 Barrel 3.75m x 2.75m x 23 ± meters long	$275,000	Unknown	Bull Bay
106+260	RCBC 1008	RCBC - 2 Barrel 3.25m x 2.75m x 23 ± meters long	$260,000	Unknown	Bull Bay
106+925	BR 1004	New Bridge - Four-span steel plate girder bridge, 132 ± meter long	$10,100,000	Bull Bay River	Ten Mile
109+820	RCBC 1009	RCBC - 2 Barrel 3.25m x 2.5m x 23 ± meters long	$245,000	Unknown	Four Mile Wood
111+206	RCBC 1010	RCBC - 2 Barrel 3.25m x 2.5m x 23 ± meters long	$245,000	Unknown	Four Mile Wood
112+125	RCBC 1011	RCBC - 4 Barrel 3.5m x 2.75m x 30 ± meters long	$562,000	Unknown	Grants Pen
112+880	RCBC 1012	RCBC - 2 Barrel 3.0m x 2.5m x 60 ± meters long	$575,000	Unknown	Grants Pen

Chainage	Structure Name	Structure Type	Estimated Cost (US $)	Feature Name	Location
113+620	RCBC 1013	RCBC - 2 Barrel 3.25m x 2.25m x 23 ± meters long	$234,000	Unknown	Grants Pen
114+955	RCBC 1014	RCBC - 3 Barrel 3.0m x 2.5m x 23 ± meters long	$316,000	Unknown	Albion
115+730	RCBC 1015	RCBC - 2 Barrel 3.75m x 2.5m x 14 ± meters long	$188,000	Unknown	Albion
116+238	RCBC 1016	RCBC - 3 Barrel 3.75m x 2.5m x 14 ± meters long	$255,000	Unknown	Albion

The bridge type selection process evaluates the structural, functional, and aesthetic requirements of a bridge, with respect to constructability, cost, and schedule constraints. The constraints are imposed by existing conditions and/or final conditions, which include, but are not limited to, cultural/environmental, drainage, geotechnical, right of way, roadway geometry, topography, traffic, utilities, and combinations thereof. The significance and influence of these parameters varies from location to location. The recommended alternative or bridge type of choice for a particular site is that which offers the best structural, functional, and cost-effective solution and satisfies all applicable constraints to the maximum practicable extent.

Several factors influence the evaluation of bridge type, span arrangement and appropriate span length for each bridge. Roadway geometrics, terrain, bridge location, embankment slopes within areas of cuts or fills, constructability related to existing conditions, aesthetics and economics all must be considered when determining the configuration of the bridge. The predominant bridge superstructure types considered for bridges are: composite precast pre-stressed concrete (PC/PS), composite steel girders and cast in place (CIP) concrete slab bridges. While still classified as bridges, at smaller crossings and where fill depths were less than 10 meters, cast-in-place reinforced concrete box culverts (RCBC) are typically the structure of choice. Although “standard” RCBC designs were assumed, special designs could be produced for culverts at locations where fill depths exceeded 10 meters.

The use of steel culverts and arches are limited to dry locations at the direction of the NWA. Where they have been designated for a stream crossing, the steel component of the structure has been raised on concrete abutments/walls above the high water line. Multi-plate steel culverts or arches may provide good alternatives to bridges in locations where the drainage opening is relatively small. Multi-plate steel culverts and arches are able to support deep fills as a result of their shapes, actually gaining strength from the soil surrounding them; this may make them more efficient and cost effective when compared to typical girder bridges.

Selection of abutment types is usually dependent upon the placement of the abutment in relation to the span arrangement and the span lengths. As a result, when a minimum bridge length is desired, full height retaining wall abutments are typically required. Conversely, utilizing longer spans and the use of embankment fore slopes allows for the use of less expensive short, stub abutments which are not required to resist large retaining wall design forces.

Piers can be comprised of single columns or multi-column bents depending upon the height and width of the superstructure. Columns can utilize a variety of shapes to accommodate stream flows, aesthetic details or space requirements. Girder bridges typically employ an exposed column cap beam or "drop cap" to support the girders at the piers.

Drilled shafts or driven piles are typically preferred in situations where scour is a concern, extensive excavation is prohibitive, embankment fill is high, or surface soils are soft, weak, or moisture sensitive. They can be constructed relatively quickly and easily within a relatively small disturbance area. Spread footings are typically more economical in situations where excavations are relatively small and shallow, and there are no local obstructions. They can be constructed quickly and easily with no specialized equipment or labour. The choice of foundation type for a structure is often determined by the anticipated scour and whether scour mitigation measures are provided.

The preferred structure alternatives and estimated costs for Section 1A are presented in Table 3-18.

Drainage Assessment

The hydrologic and hydraulic analyses were based on new drainage guidelines developed by Stanley Consultants and the NWA under the Comprehensive Drainage and Flood Control Scheme in 2011. These guidelines are set out in a Memo entitled "Jamaica Drainage Design Criteria", dated November 9, 2011. The hydrologic and hydraulic analyses were carried out along the proposed alignment to determine the design discharges, culvert sizes and required bridge openings for effective drainage and flood alleviation and control. The methodology used in the hydrologic analysis was closely coordinated with the NWA to ensure that their design requirements for an all-weather highway were satisfied. This methodology does not require a pre- and post-construction determination because the design guidelines which are outlined below took into consideration possible future development of the watersheds, climate change impacts, saturated conditions prior to the start of the storm event and other conditions relating to the size of the catchment. The specification for the design storm was also increased to the 25-year return period, where previously the requirement was a 10-year storm. These guidelines led to an upgrade of all the existing culverts and inadequate outfall channels to allow for sufficient capacity to convey the design discharges to the sea.

The approach used to calculate the design discharges for all hydraulic structures along the proposed highway is detailed in section 4.1.4.1, along with results pertaining to catchment area delineation and peak flow and design discharge calculations.

DRAINAGE DESIGN GUIDELINES

The following drainage design guidelines were used to determine the hydraulic capacity of the drainage structures.

- Bridges were designed to convey flows associated with the 100 year, 24-hour frequency storm.
- The minimum freeboard used was 1000 mm or 25% of the depth of flow, whichever is greater. For bridges, the freeboard was measured from the bottom chord of the girder to the 100-year

flow hydraulic grade line (water level). For channels lined with berms, the freeboard used was 1000 mm above the water level associated with the peak discharge of the 100-year, 24-hour frequency storm.

- Culverts with catchment areas greater than 500 acres (202 ha) were designed for the 50 year 24-hour frequency storm without surcharging.
- Culverts with catchment areas less than 500 acres were designed to convey the 25-year frequency storm using the 24-hour rainfall totals without surcharging.
- All culverts were designed to convey the 100 year, 24-hour frequency storm with a maximum surcharge of 1000 mm above the top of the culvert.
- Minimum culvert sizes were 900 mm diameter based on the NWA guidelines.
- All other stormwater drainage systems (roadside ditches, swales, storm sewers, catch basins, gutters, pavement) were designed for the 10 year, 24-hour frequency storm. The hydraulic grade line (water level) for roadside ditches and swales was designed to be below the roadway pavement structural section.

These guidelines were applied to minimize flooding along the entire corridor and adjacent properties and to ensure adequate drainage capacity for the life of the structures.

DRAINAGE STRUCTURES AND CONVEYANCE CAPACITIES

The sizing of the drainage structures was done in accordance with guidelines outlined in the previous section. The culverts were modelled using the Bentley Culvert Master Software which was developed specifically for modelling culverts. The culverts were sized to convey the design discharge without surcharge and the 100-year discharge with maximum surcharge of 1.0m. The culverts were modelled using a 300mm head difference between the culvert inlet and outlet.

A wide range of works will be conducted ranging from maintenance of structures to replacing culverts in an attempt to alleviate the existing flooding situations and to mitigate against potential flooding as a result of the proposed development. The structures to be impacted and the works to be conducted are listed in Table 3-19; in total, there are four (4) bridges and sixteen (16) culverts that that will be modified due to the proposed highway.

Table 3-19 List of bridges and culverts to be modified

NO.	CHAINAGE	CODE	LOCATION	TYPE	WORKS
1	100+550	BR 1001	Hope River - Harbour View – Kingston St. Andrews	Bridge	Existing Hope River Bridge. It is a relatively new bridge and is in very good condition. The bridge is a three-span steel plate girder bridge with spans of 43m+49m+43m. Joints be cleaned and the joint seals be replaced if required.
2	101+404	RCBC 1001	Unknown – Harbour View – Kingston St. Andrew	Culvert	Multi-cell RCBC; a two-cell 3.25m x 2.25m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
3	101+790	RCBC 1002	Unknown – Seven Mile – Kingston St. Andrew	Culvert	Multi-cell RCBC; a four-cell 3.0m x 2.5m box culvert. Estimated length of RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
4	102+812	BR 1002	Cane River – Seven Mile – Kingston St. Andrew	Bridge	Bridge length is approximately 180 meters. Standard precast prestressed (PC/PS) girders with six equal spans of 30 meters each. Bridge abutments are stub abutments supported on driven piles and each bridge pier consists of two or more cylindrical columns, also supported on driven piles with pile caps. Dumped rip-rap or sheet piling is used to provide scour protection at all substructure elements.
5	103+410	RCBC 1003	Unknown – Seven Mile – Kingston St. Andrew	Culvert	Multi-cell RCBC; a four-cell 3.0m x 2.5m box culvert. Estimated length of the RCBC is about 23 meters. 6Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
6	104+530	RCBC 1004	Unknown – Wickie Wackie – Kingston St. Andrew		Multi-cell RCBC; a two-cell 3.25m x 2.5m box culvert. Length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
7	104+740	RCBC 1005	Unknown – Wickie Wackie – Kingston St. Andrew	Culvert	Multi-cell RCBC; a two-cell 3.25m x 2.5m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
8	104+970	RCBC 1006	Unknown – Nine Mile – Kingston St. Andrew	Culvert	Multi-cell RCBC; a two-cell 3.25m x 2.5m box culvert. Estimated length of the RCBC is about 24 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
9	106+000	BR 1003	Chalky River - Nine Mile – Kingston St. Andrew	Bridge	Existing bridge a single span steel plate girder bridge. The bridge is approximately 31 meters long with an out-to-out width of about 11.7 meters. The bridge is in fair condition and there are utilities mounted at the back of railing on the north side. To accommodate the proposed four-lane urban roadway section and new bridge barriers the existing bridge can be widened in like kind approximately 10

NO.	CHAINAGE	CODE	LOCATION	TYPE	WORKS
					meters. Utilities mounted to the north side of the bridge must be relocated if the bridge is widened to the north. The proposed widening will require the addition of four girder lines and modifications to both abutments. As such widening should take place to one side if possible to provide streamlined abutment construction. The bridge widening should take place in conjunction with the Chalky River channel modifications to minimize throw away and so the channel modifications provide scour protection for the abutment foundations.
10	106+140	RCBC 1007	Unknown – Bull Bay – Kingston St. Andrew	Culvert	A multi-cell RCBC two-cell 3.75m x 2.75m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
11	106+260	RCBC 1008	Unknown – Bull bay – Kingston St. Andrew	Culvert	A multi-cell RCBC; a two-cell 3.25m x 2.75m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
12	Chainage 106+925	BR 1004	Bull Bay River – Ten Mile – Kingston St. Andrew	Bridge	A new bridge is needed at the Bull Bay River. A 132-meter-long, four-span steel plate girder bridge. The out-to-out width of the bridge will accommodate the four-lane roadway cross-section of about 22 meters with concrete bridge barriers. Bridge abutments are stub abutments on driven piles and bridge piers are founded on driven piles or drilled shafts with pile caps. Each bridge pier consists of two or more cylindrical columns and oriented parallel the river alignment. This will minimize flow obstructions and reduce the overall length of the bridge. Due to the proposed roadway grade, the bridge piers are approximately 11 to 14 meters tall. Dumped rip-rap or sheet piling will be used to provide scour protection at all substructure elements.
13	109+820	RCBC 1009	Unknown – Four Mile Wood – St. Thomas	Culvert	A multi-cell RCBC; a two-cell 3.25m x 2.5m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and vwingwalls will be used to accommodate the adjacent terrain. The RCBC floor provides scour protection.
14	111+206	RCBC 1010	Unknown – Four Mile Wood – St. Thomas	Culvert	A multi-cell RCBC; a two-cell 3.25m x 2.5m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
15	112+125	RCBC 1011	Unknown– Grants Pen – St. Thomas	Culvert	A multi-cell RCBC; a four-cell 3.5m x 2.75m culvert. Estimated length is about 30.0 meters. Inlet and outlet wingwalls will be constructed as necessary to keep the barrel length as short as possible and accommodate the grading of the adjacent terrain. The floor of the RCBC will provide scour protection.
16	112+880	RCBC 1012	Unknown – Grants Pen – St. Thomas	Culvert	A multi-cell RCBC; a two-cell 3.0m x 2.5m box culvert. Estimated length of the RCBC is about 60 meters. Tall inlet and outlet headwalls and wingwalls will be

NO.	CHAINAGE	CODE	LOCATION	TYPE	WORKS
					used to shorten the overall length of the culvert and accommodate the adjacent terrain.
17	113+620	RCBC 1013	Unknown – Grants Pen – St. Thomas	Culvert	A multi-cell RCBC; a two-cell 3.25m x 2.25m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
18	114+955	RCBC 1014	Unknown – Albion – St. Thomas	Culvert	A multi-cell RCBC; a three-cell 3.0m x 2.5m box culvert. Estimated length of the RCBC is about 23 meters. Inlet and outlet wingwalls will be necessary to accommodate the grading of the adjacent terrain.
19	115+730	RCBC 1015	Unknown – Albion – St. Thomas	Culvert	A multi-cell RCBC; a two-cell 3.75m x 2.5m box culvert. Estimated length of the RCBC is about 14 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.
20	116+238	RCBC 1016	Unknown – Albion – St. Thomas	Culvert	A multi-cell RCBC; a three-cell 3.75m x 2.5m box culvert. Estimated length of the RCBC is about 14 meters. Inlet and outlet headwalls and wingwalls will be used to accommodate the adjacent terrain.

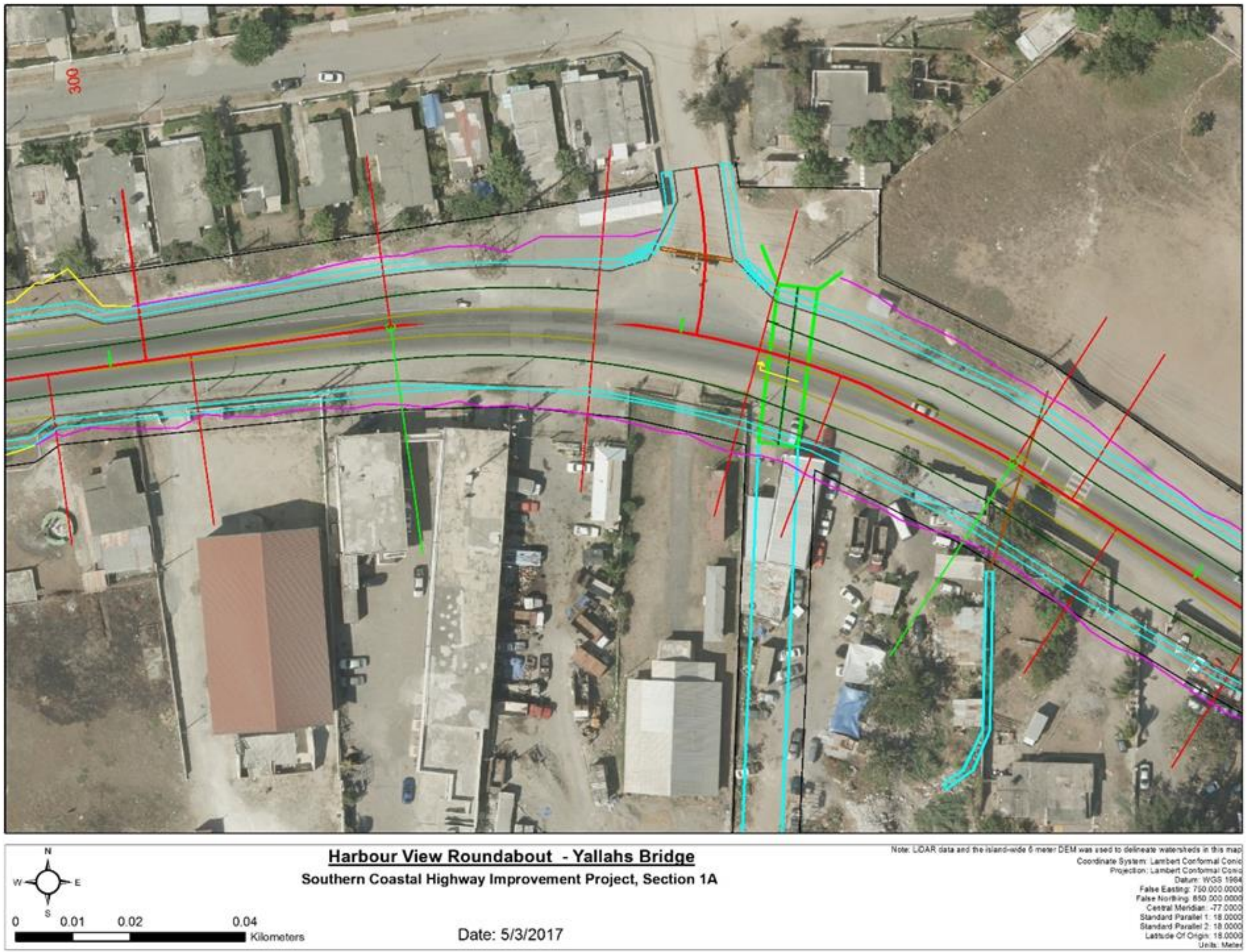
Flood and Sediment Erosion Control and Mitigation Plan

During the drainage assessment conducted by Stanley Consultants in 2012/2013, several locations along the existing roadway were identified as flood prone (Section 4.1.4.2). The design solution for these areas to mitigate the flooding are outlined below.

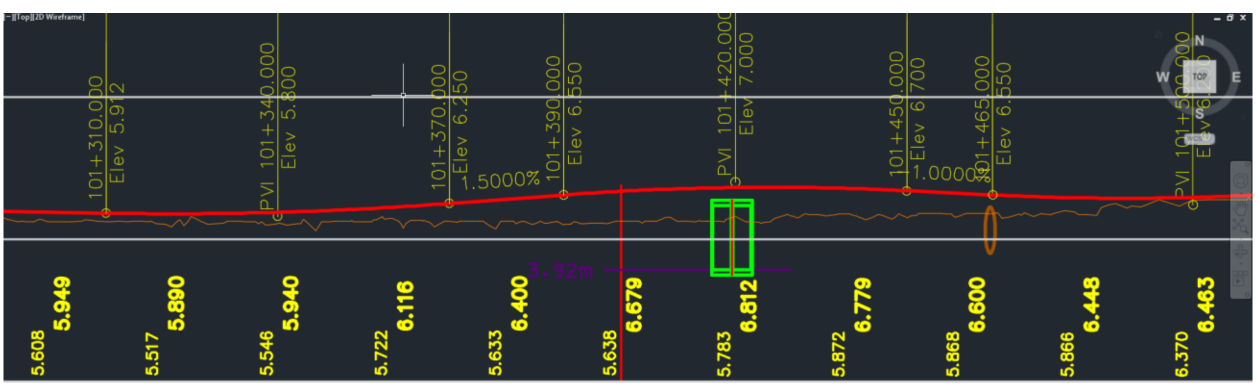
HARBOUR VIEW (100+100 TO 300+400)

This section of the roadway in Harbour View is said to experience severe flooding along the corridor. The area is currently drained by a 1.5m diameter culvert. This culvert has been upgraded in the drainage design to a 2-cell 3.25m x 2.25m box culvert at approximately 100+400 as shown in Figure 3-6a. the design also includes a lined outfall channel to ensure that the stormwater runoff will be effectively conveyed to the sea. During detailed designs, the side drains conveying water to the culvert would have to be appropriately sized to convey the design discharge.

The new roadway is also raised (Figure 3-6b) so that the water levels in the side drains do not rise above the pavement structural section as outlined in the design guidelines.



(a) Roadway plan showing proposed box culvert and lined outfall channel



(b) Alignment profile showing the proposed alignment raised above the existing roadway profile

Figure 3-6 Roadway plan and profile showing drainage design to mitigate flooding along the section of the corridor in Harbour View from 100+100 to 300+400

BULL BAY FOOTBALL CLUB PLAYFIELD (103+500 TO 103+700)

A natural pond exists next to the Bull Bay Club football field which is opposite to the Little Copa Club and Copacabana. A 600mm diameter pipe conveys water from the pond as well as from a drain that runs parallel to the existing road from the west. The outfall channel which was approximately 0.2m in width, was also blocked at the time of the visit. This combination of what appears to be an undersized pipe and an inadequate and blocked outfall channel was a recipe for constant flooding along this section of the road.

The design solution for this section had to take into consideration the functionality of the football field, improving the drainage and flood control and a roadway geometry that meets the AASHTO design specifications. This resulted in a solution that saw the drain running parallel to the existing road from the west being diverted north of the football field into the pond. The proposed highway, with some curve flattening, occupy the space of the existing drain and slightly impact the football field. Some reconstruction and orientation of the football field will be required to maintain the size of the field.

Based on the design flows, the 600mm diameter pipe was replaced with a 4-cell 3.0m x 2.5m box culvert. The outfall channel is also widened in the design to match the width of the box culvert and lined. Figure 3-7 show the plan view of the drainage design to mitigate the flooding problem at 103+500 to 103+700.

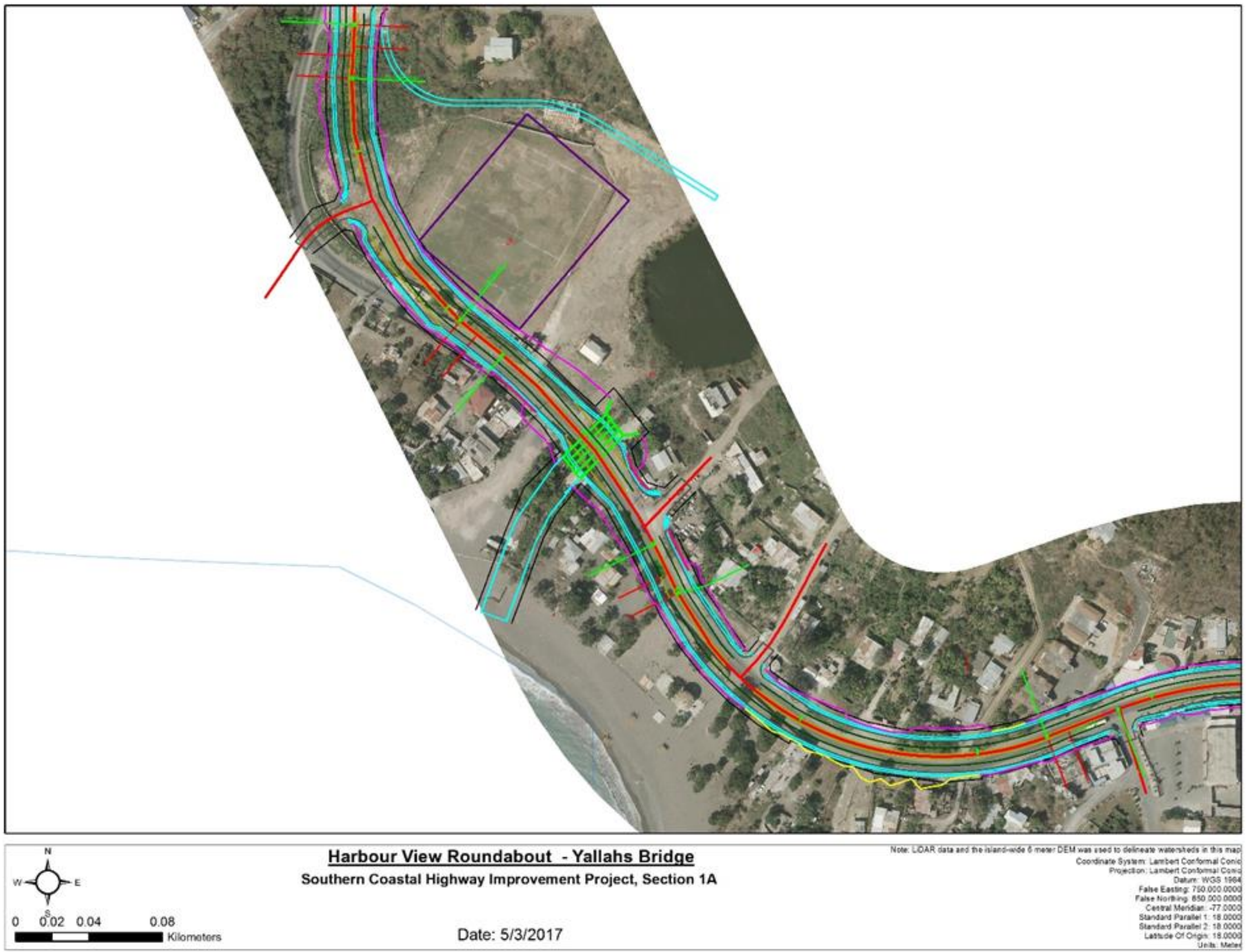


Figure 3-7 Roadway plan showing drainage design to mitigate flooding at 103+500 to 103+700

WICKIE WACKIE (104+080 TO 104+400)

The roadway in Wickie Wackie and the residential community located between the roadway and the sea experiences severe flooding during rainfall events. Stanley Consultants studied this area under the Comprehensive Drainage and Flood Control Scheme in 2012 and identified the following as contributing factors to the flooding:

- Most of the storm runoff that cause the flooding comes from the community north of the roadway which has a steep gradient towards the road.
- The cross-drain and culverts that intercept and convey runoff from the community on the north side of the road was totally blocked with silt and what appears to be construction material as well as material from erosion of the local road.
- Insufficient culvert sizes draining the upstream drainage area.

- Parts of the residential community to the south of the road and the section of the road at 104+100 were constructed in a low-lying area. Most of the water that cause the flooding comes from the community north of the road because the culvert to intercept the flows are blocked.
- There is a U-channel 7.4m x 2.0m which empties into the sea but does not extend all the way up to the road. The construction of this channel appears to have been incomplete and is underutilized.

The design solutions for mitigating the flooding of the roadway and sections of the community were developed under the Comprehensive Drainage and Flood Control Scheme the details of which are contained in the Comprehensive Drainage and Flood Control Scheme Report prepared by Stanley Consultants and dated January 2013. The main components are outlined below:

- Clean blocked drains and pipes that intercepts storm runoff from the community north of the roadway.
- Extend incomplete U-channel up to the roadway.
- Construct drainage channel and box culvert to convey intercepted flow from the community and other areas north of the roadway to the U-channel and 104+400. This will convey the runoff away from low lying section of the road and community where the major flooding and ponding of water occurs.
- At 104+100, where the road and the community is flooded, the inlet capacity of the existing drain should be increased to allow for more effective drainage.

The images in Figure 3-8 shows the roadway and drainage plans developed for the Wickie Wackie community.

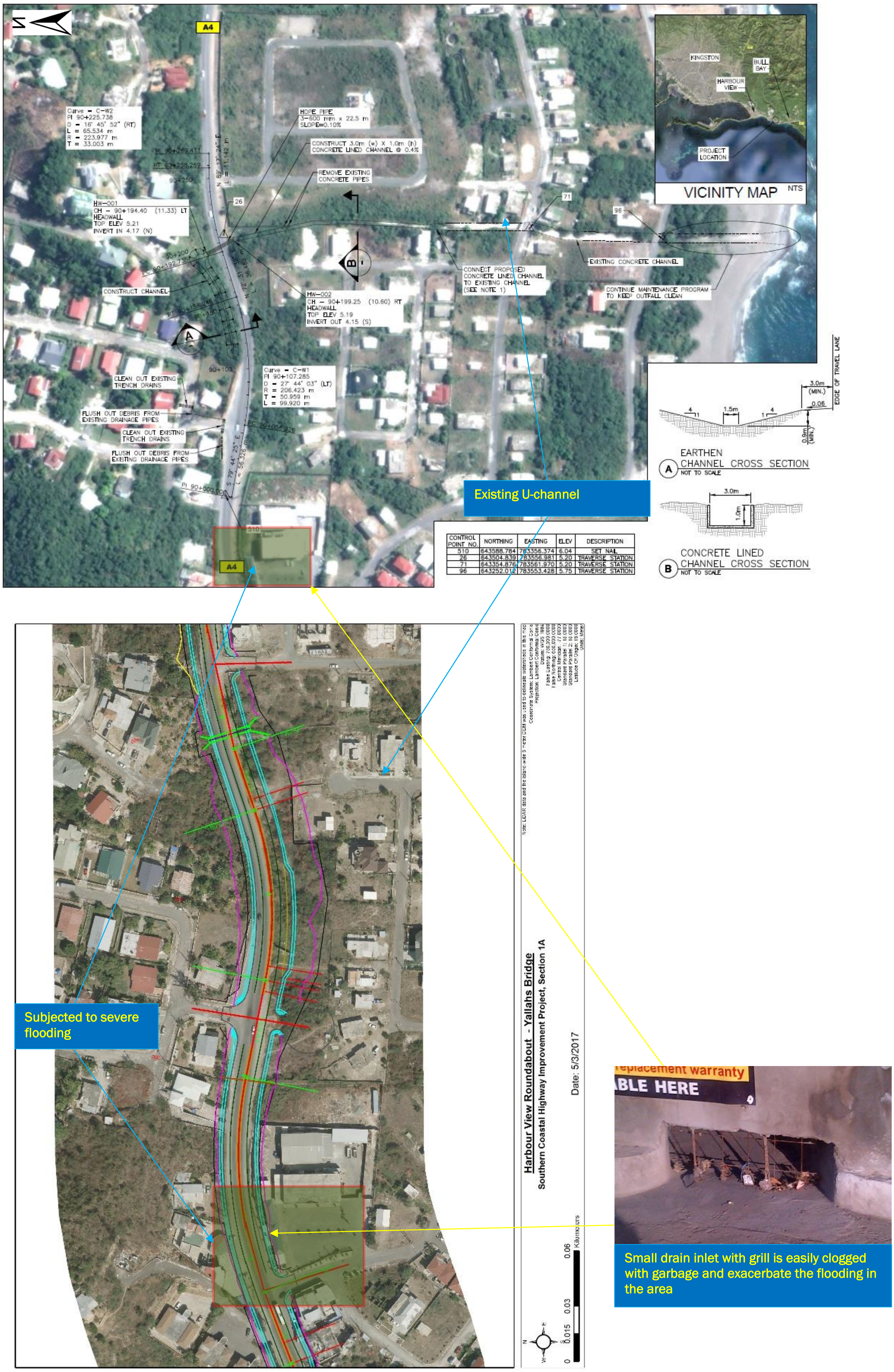


Figure 3-8 Design solution to mitigate flooding along the roadway and sections of the Wickie Wackie community. Top: *Proposed drainage solution (Comprehensive Drainage and Flood Control Scheme, 2012); Bottom: Proposed roadway improvements (SCHIP, 2014)*

POND SIDE CORNER (104+800)

The roadway at 104+800 floods and ponds water for long periods during storm events because of a lack of drainage infrastructure. There are no culvert or visible outfall channel present at the site. Heavy siltation was observed at the location during the drainage assessment in 2012/2013. The proposed solution is to install culverts and a lined U-channel to convey storm runoff across the road and to the sea (Figure 3-9). The culverts were sized to convey the design discharge. The drainage design could be modified to minimize the impact on the community.

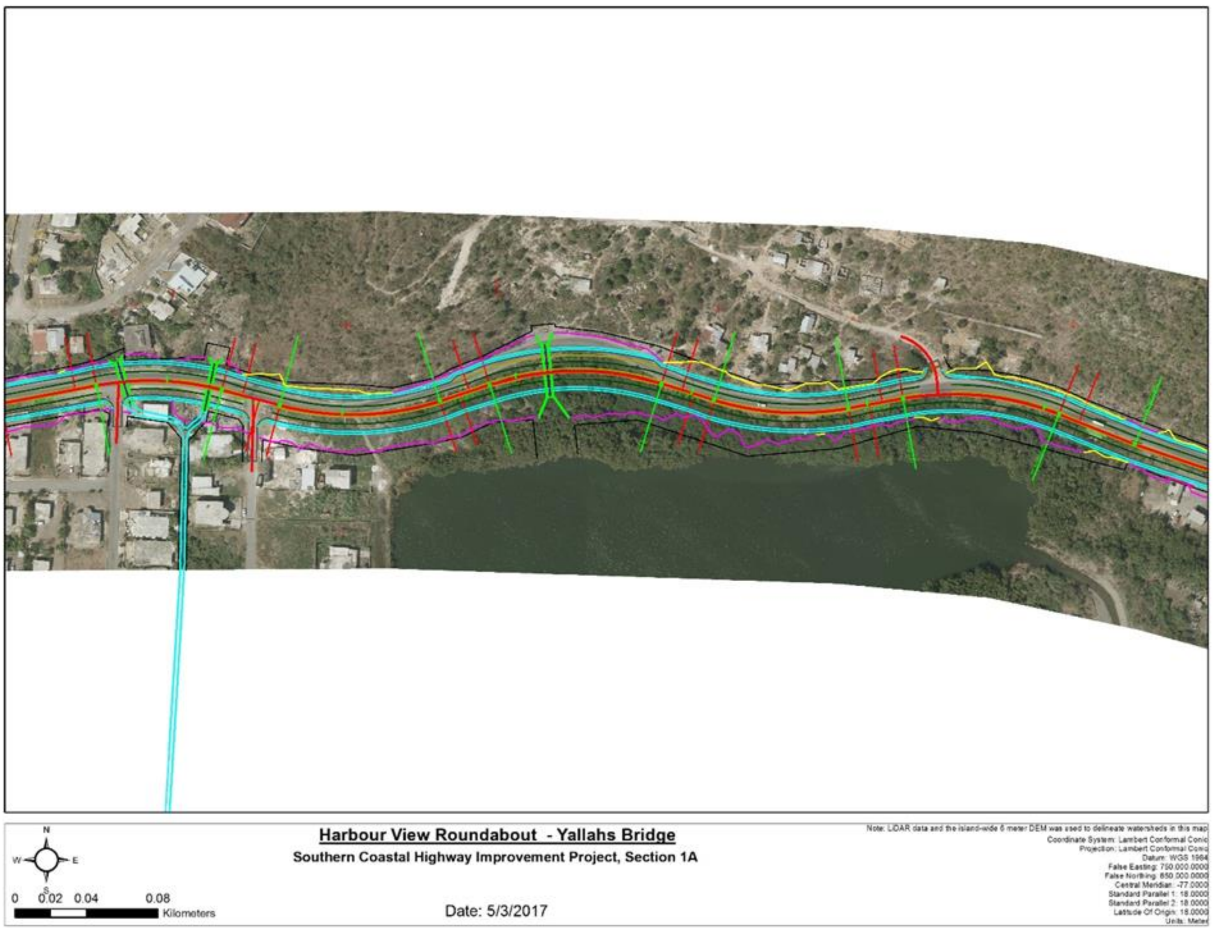
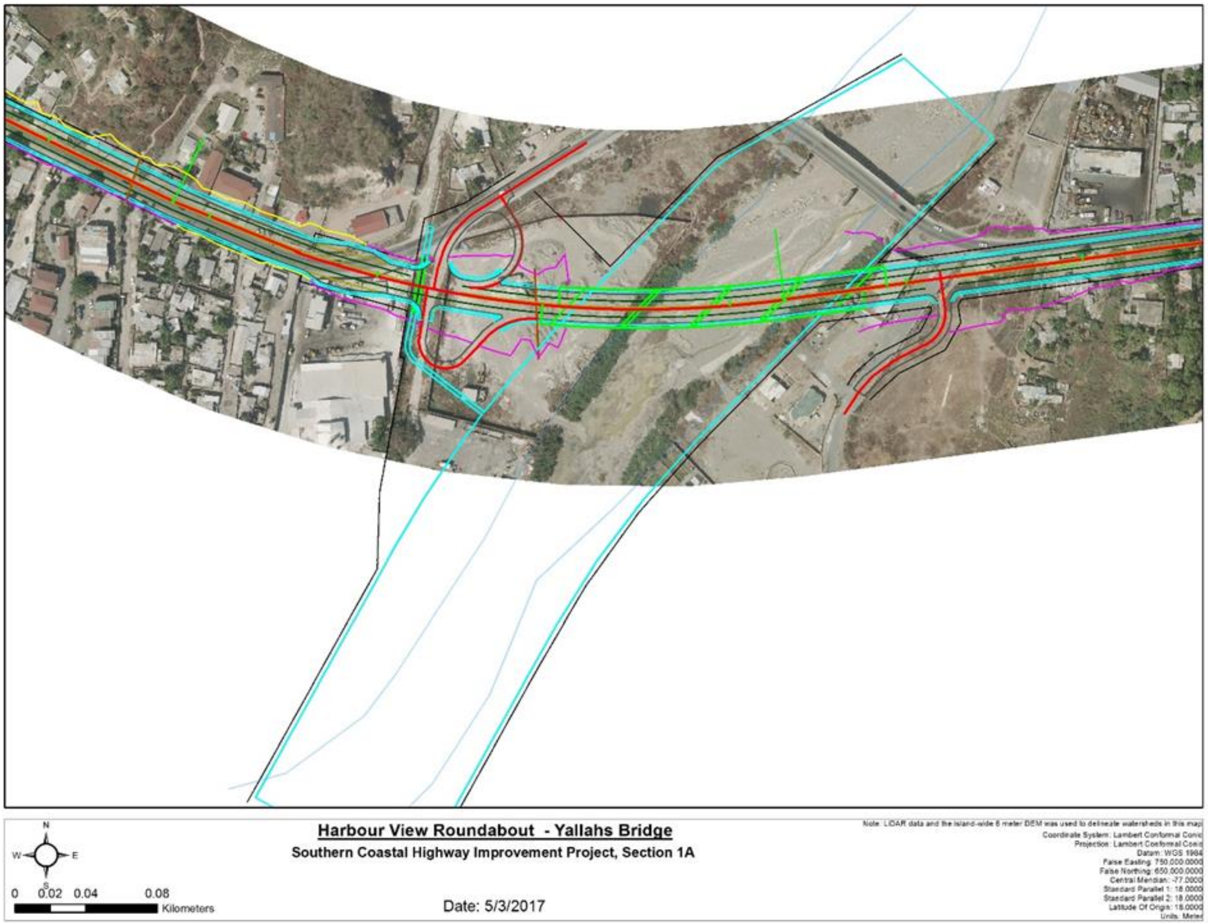


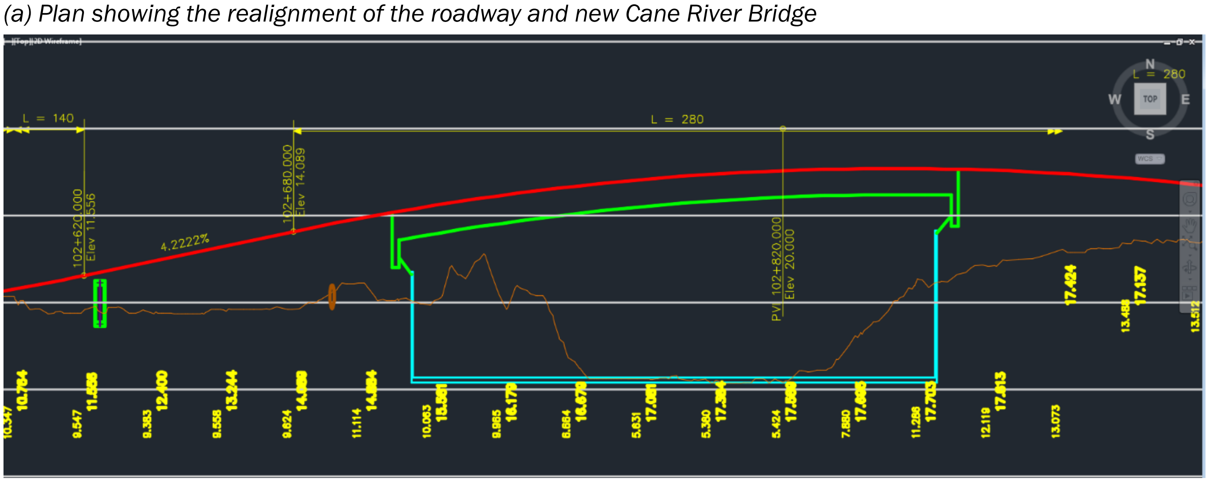
Figure 3-9 Proposed culverts and lined U-channel to mitigate flooding of the roadway at 104+800

THE CANE RIVER BRIDGE (102+800)

The Cane River carries a lot of sediment during storm events and requires periodic maintenance to remove the sediments and maintain its hydraulic capacity. A new 180 meters long bridge will be constructed at the Cane River crossing. The new bridge is required to meet design specifications and will be constructed approximately 100m downstream from the existing bridge. The bridge will be raised above the existing ground level which will increase its conveyance capacity and the bridge substructure elements are aligned parallel to the river to minimize flow obstructions. The new bridge will not exacerbate problems associated with flooding or debris flow associated with the Cane River. The roadway plan and profile are shown in Figure 3-10.



(a) Plan showing the realignment of the roadway and new Cane River Bridge



(b) Roadway profile showing the new Cane River Bridge

Figure 3-10 Roadway plan and profile showing the roadway realignment and Cane River Bridge

CHALKY RIVER BRIDGE (106+050)

The Chalky River carries a lot of sediments and in major storms sediment deposits can fill the channel to capacity and block the bridge openings as happened in 2002 (Figure 3-11a and b). This results in the flooding of the adjacent communities.

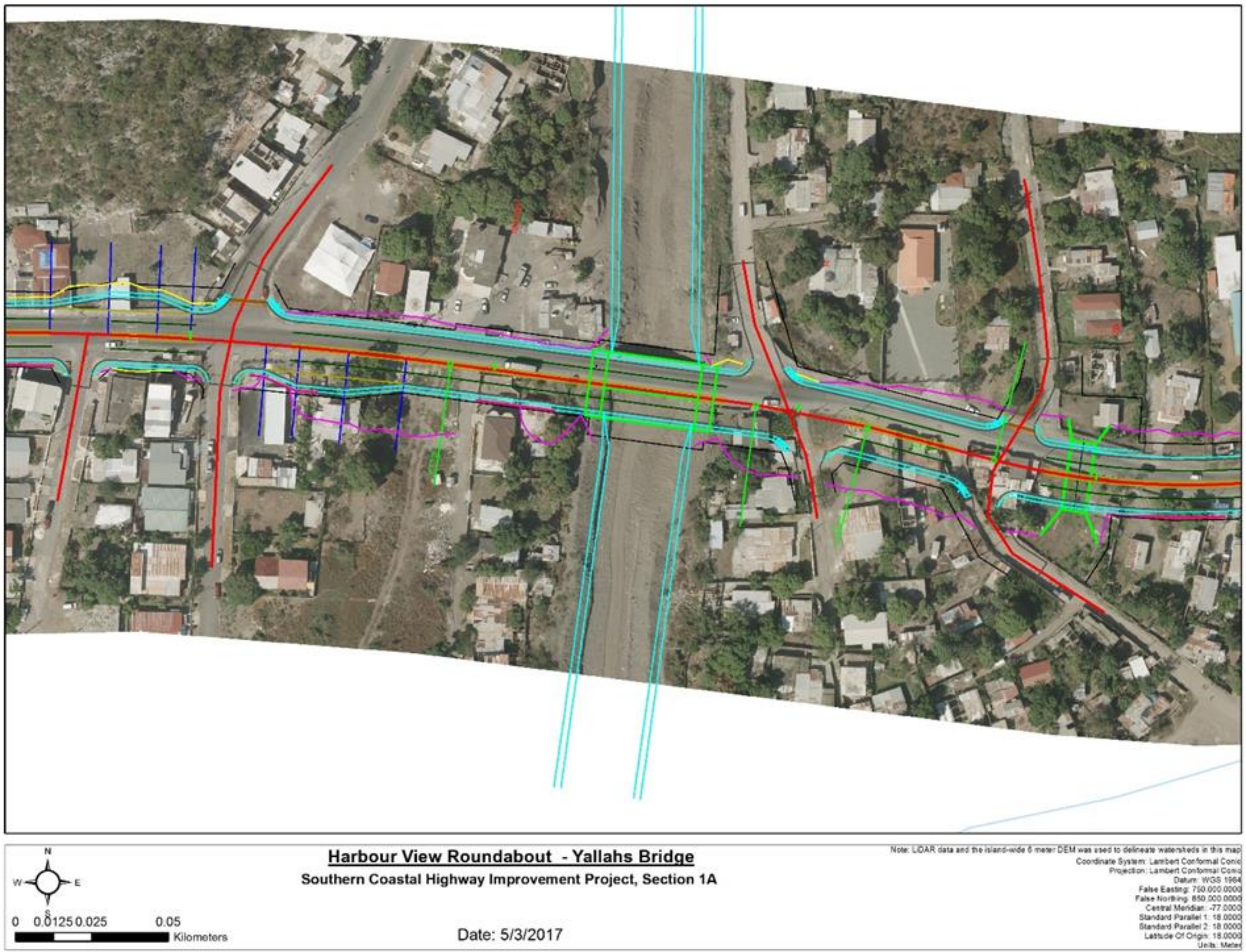
(a) Chalky River Bridge completely blocked by deposited sediments

b) Chalky River channel filled with deposited material

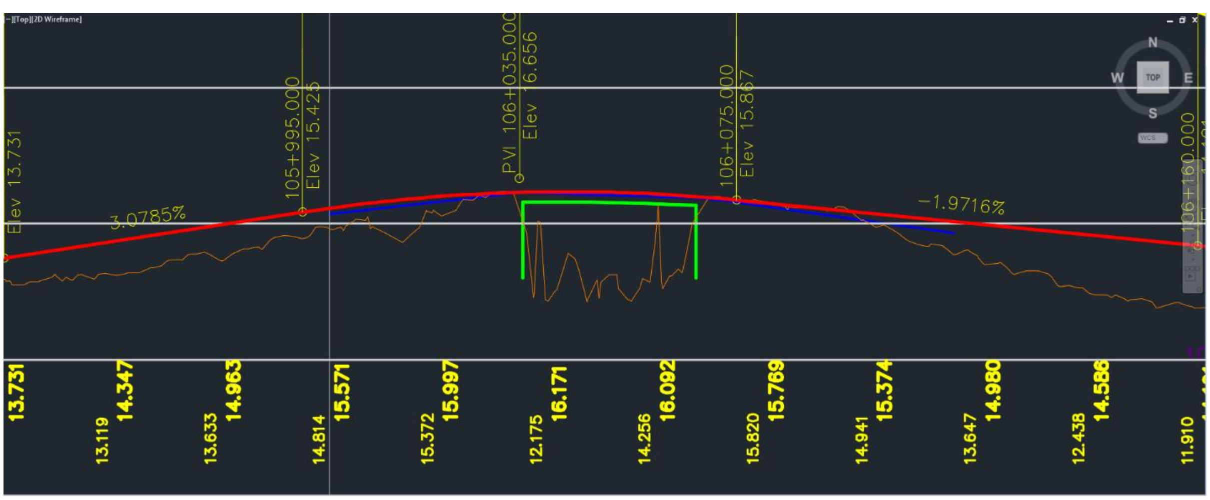
Figure 3-11 Deposited sediments completely block the Chalky River Bridge opening and fill the river channel during storm event in 2002 (Source: Jamaica Gleaner online)

The Chalky River Bridge was considered to be in fair condition based on site assessments carried out in 2012/2013 however concerns were raised regarding the lack of freeboard during high flows. The clearance during the assessment in 2012/2013, including freeboard, was 3.2m. Based on the hydraulic assessment under the SCHIP, the required hydraulic opening for the Chalky River Bridge, without channel modification, is 30 meters wide and 4.7 meters high (including freeboard). The design solution under the Comprehensive Drainage and Flood Control Scheme in 2012 was to construct a sediment basin in the upper reaches of the river and line the channel with concrete all the way to the sea. With the proposed modification to the channel, the existing 3.2m clearance would be adequate to pass the design flow, however, if the proposal to line the channel is not implemented, the 4.7m clearance to pass the design flow with the required free board will be required.

Based on the channel modification for the Chalky River under the Comprehensive Drainage and Flood Control Scheme, the proposal for the Chalky River Bridge was to keep the existing bridge and widen it to accommodate the additional lanes for the highway. The proposed plan and profile for the widening of the bridge is shown in Figure 3-12.



(a) Roadway plan showing proposed widening of the Chalky River Bridge



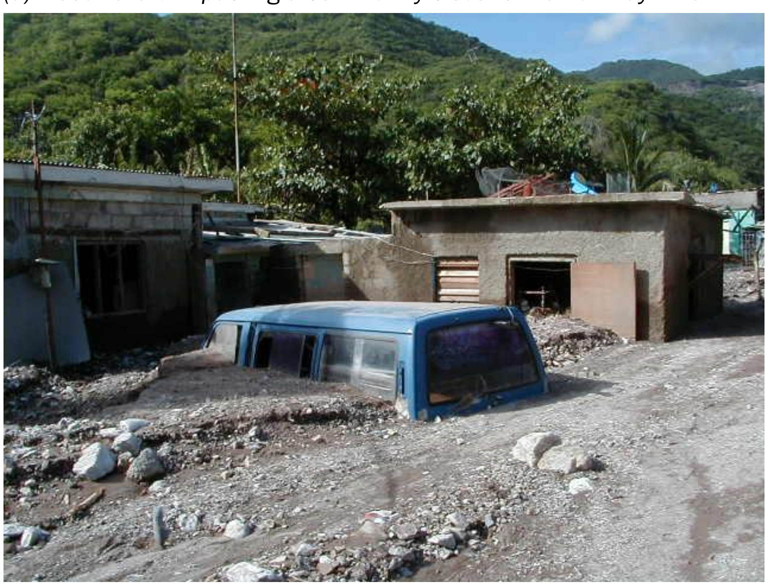
(b) Roadway profile showing the Chalky River Bridge

Figure 3-12 Roadway plan and profile showing the proposed widening of the Chalky River Bridge

BULL BAY RIVER BRIDGE (107+000)

During major storm events sections of the Bull Bay community are sometimes significantly impacted by severe flooding and debris flow as shown in Figure 3-13a and b. The flooding is normally exacerbated by the deposit of sediments within the river channel which reduce the capacity of the channel, especially at the existing bridge and culvert locations, and force the floodwater to overflow the channel banks and flow through the community.

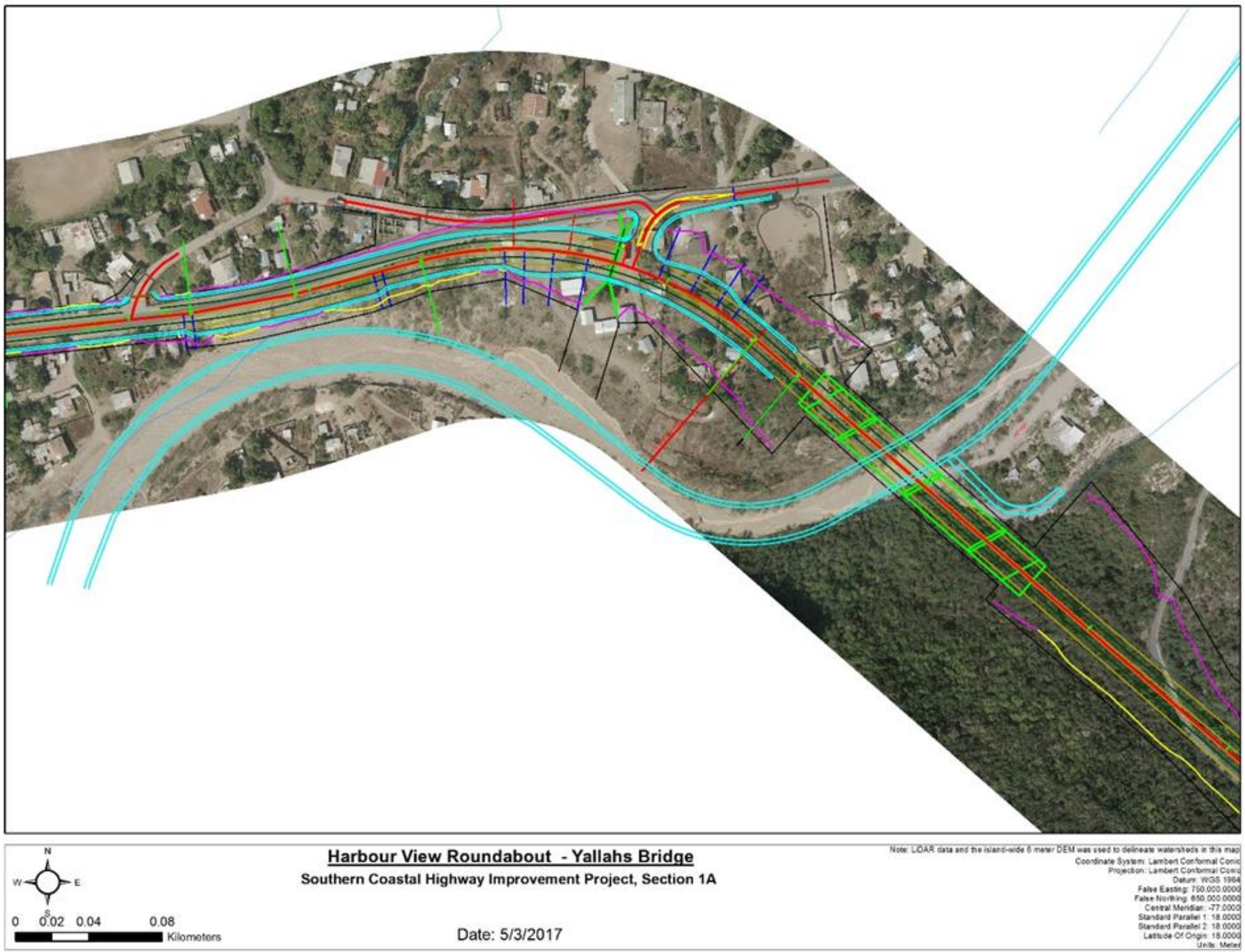
(a) Floodwaters impacting a community close to the Bull Bay River



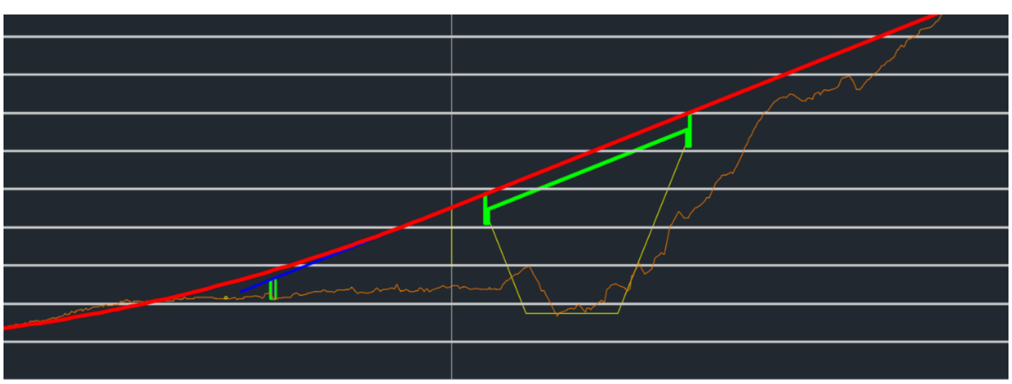
(b) Sediment deposits engulf house and van in the Bull Bay community.

Figure 3-13 Severe flooding and significant sediment deposits associated with the Bull Bay River in 2002 storm event (Source: Jamaica Gleaner online)

A new bridge will be constructed across the Bull Bay River approximately 230m south of the existing main road bridge. This new bridge will not exacerbate the flooding associated with the Bull Bay River during storm events as the bridge is designed with adequate capacity to allow floodwaters and debris flow to pass under the bridge with minimal obstruction. The new bridge is 132 meters long with bridge piers (clearance) approximately 11 to 14 meters tall. The difference in the height of the piers is due to the roadway grade being approximately 8%. The bridge piers are cylindrical columns and oriented parallel to the river alignment to minimize flow obstructions. Figure 3-14 shows the plan and profile view of the proposed new bridge.



(a) Plan showing the realignment of the roadway and the new Bull Bay River Bridge



(b) Roadway profile showing the new Bull Bay River Bridge

Figure 3-14 Roadway plan and profile showing the new Bull Bay River Bridge

BULL BAY TO TWELVE MILE – NEW ALIGNMENT (106+700 TO 109+500)

The new alignment has a total length of 2.8km as previously mentioned and falls within the Bull Bay River catchment. It begins at 106+700, approximately 350m west of the existing Bull Bay River Bridge. It diverts to the south of the existing roadway and crosses the Bull Bay River approximately 220m downstream from the existing Bull Bay River Bridge. A new Bridge is proposed for this location. The new alignment continues in a generally easterly direction until 109+500 where it rejoins the existing roadway in the vicinity of the Sun Coast Adventure Park at Twelve Mile. It is designed as a rural arterial road with a 95km/hr design speed to be posted at 80km/hr. The new alignment passes through hilly terrain with a maximum slope of 8%. Figure 3-15 shows the roadway plan superimposed on a 3D surface.

Natural drainage is mainly to the north towards the Bull Bay River. The highway cuts across two small sections that drain to the south. In all instances runoff from the highway flow in side drains along the road into existing channels namely; the Bull Bay River to the West at 107+000 and an existing culvert with increased capacity to the east at 109+860.

As a result of the runoff from the highway flowing along the road to existing culverts and drainage channels leading to the sea, there will be no negative impacts to local communities which are on the northern side towards the Bull Bay River or erosion of steep slopes due to higher flow velocities. Appropriate energy dissipator may be required at the culvert outfall at 109+500.

The internal drainage is “very rapid” based on available soil data maps (Figure 3-16). The very rapid internal drainage is evidenced by the lack of defined stream network in the area. With the construction of the new highway and the likely concentration of flows into lined drains and culverts, increased runoff and erosion due to the steep slopes and higher velocities could increase in the immediate vicinity of the highway and as the runoff flows down the slopes towards the Bull Bay River to the north and the sea to the south. To mitigate these impacts, retention ponds could be constructed to contain runoff from the highway where appropriate. The “very rapid” internal drainage of the soil would ensure effective vertical drainage of storm runoff collected in the ponds. The possible negative impact of increased and higher velocity runoff on the surface would have been mostly eliminated.

Overall, increase runoff resulting from the construction of the highway when compared to the Bull Bay River catchment will be insignificant as the highway footprint of the new alignment that is contribution to the Bull Bay River is approximately 0.67% (10.62ha) of the total catchment area.

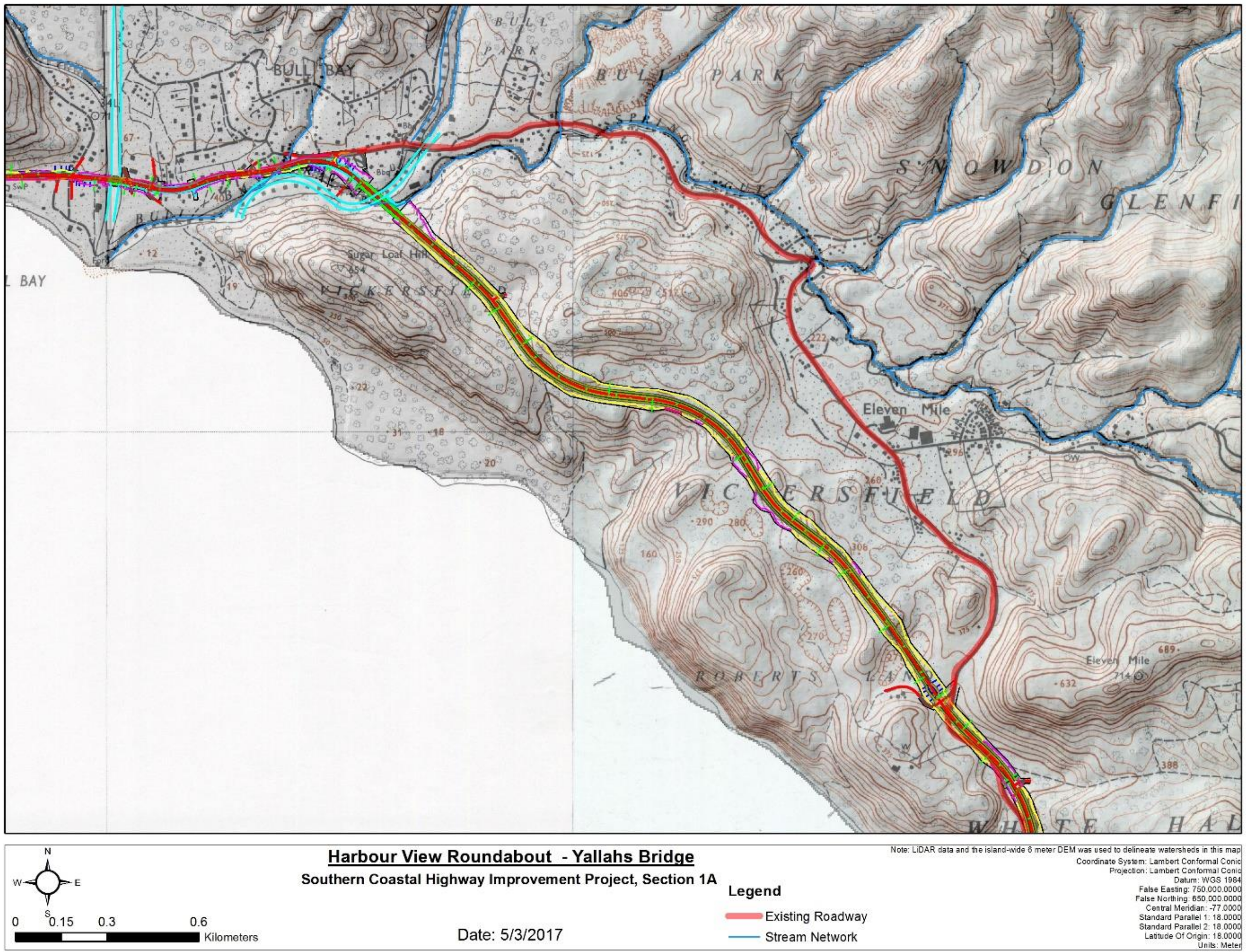


Figure 3-15 Roadway plan of new alignment superimposed on 3D image

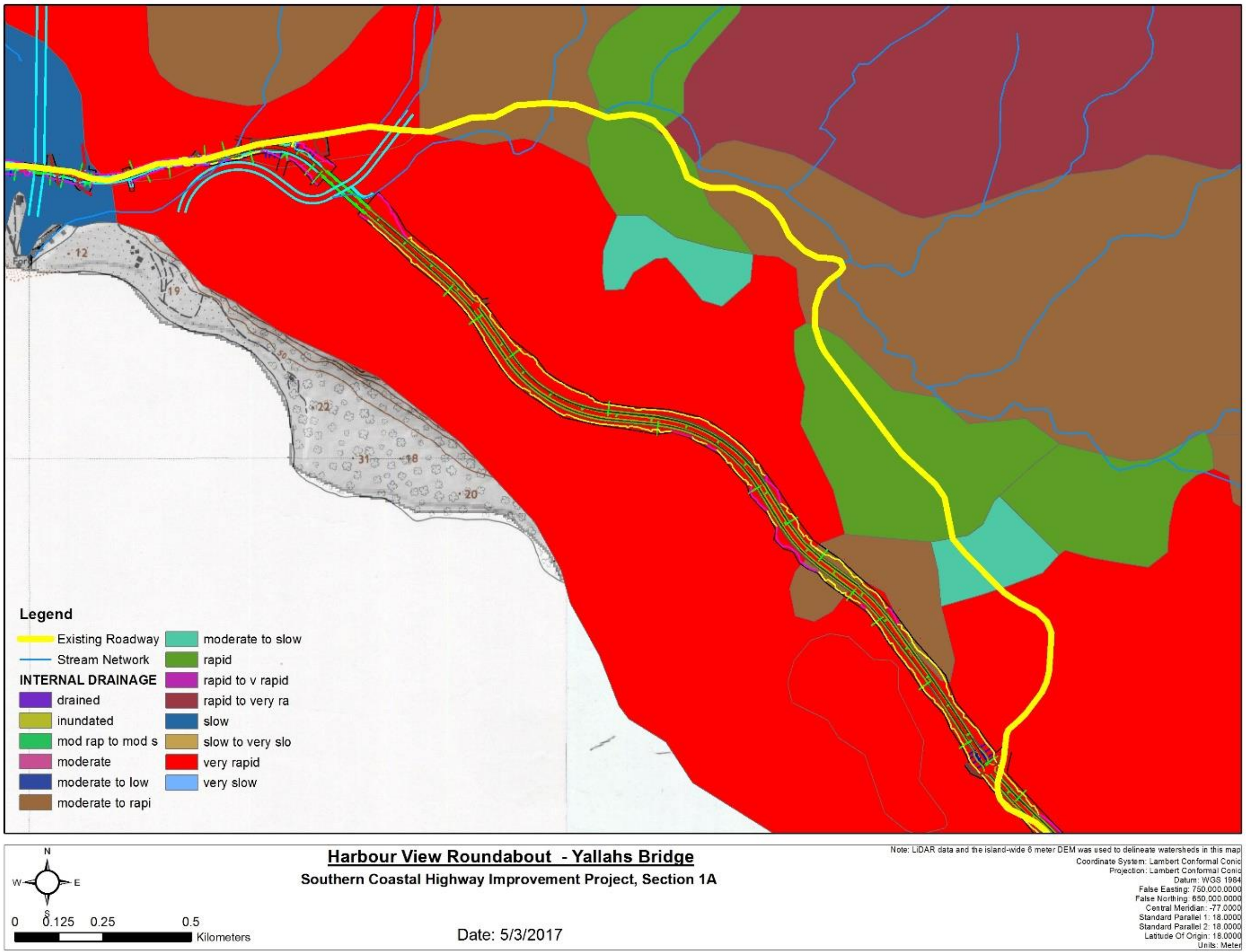


Figure 3-16 Map showing "very rapid" internal drainage characteristics of the soil for the New Alignment

The alignment shows significant cuts along its length with some fill sections (Figure 3-17). These cuts will result in the generation of sediments which must be controlled. Constructing retention ponds will mitigate the migration of sediments as a result of cut and fill operations. Silt fences and other erosion control measures could also be used.

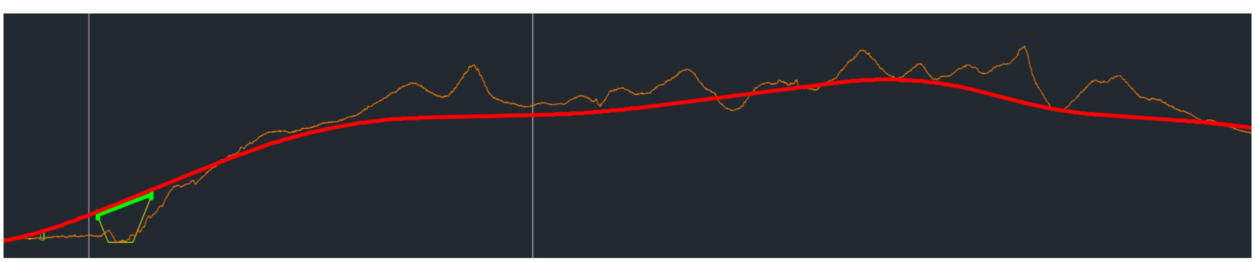
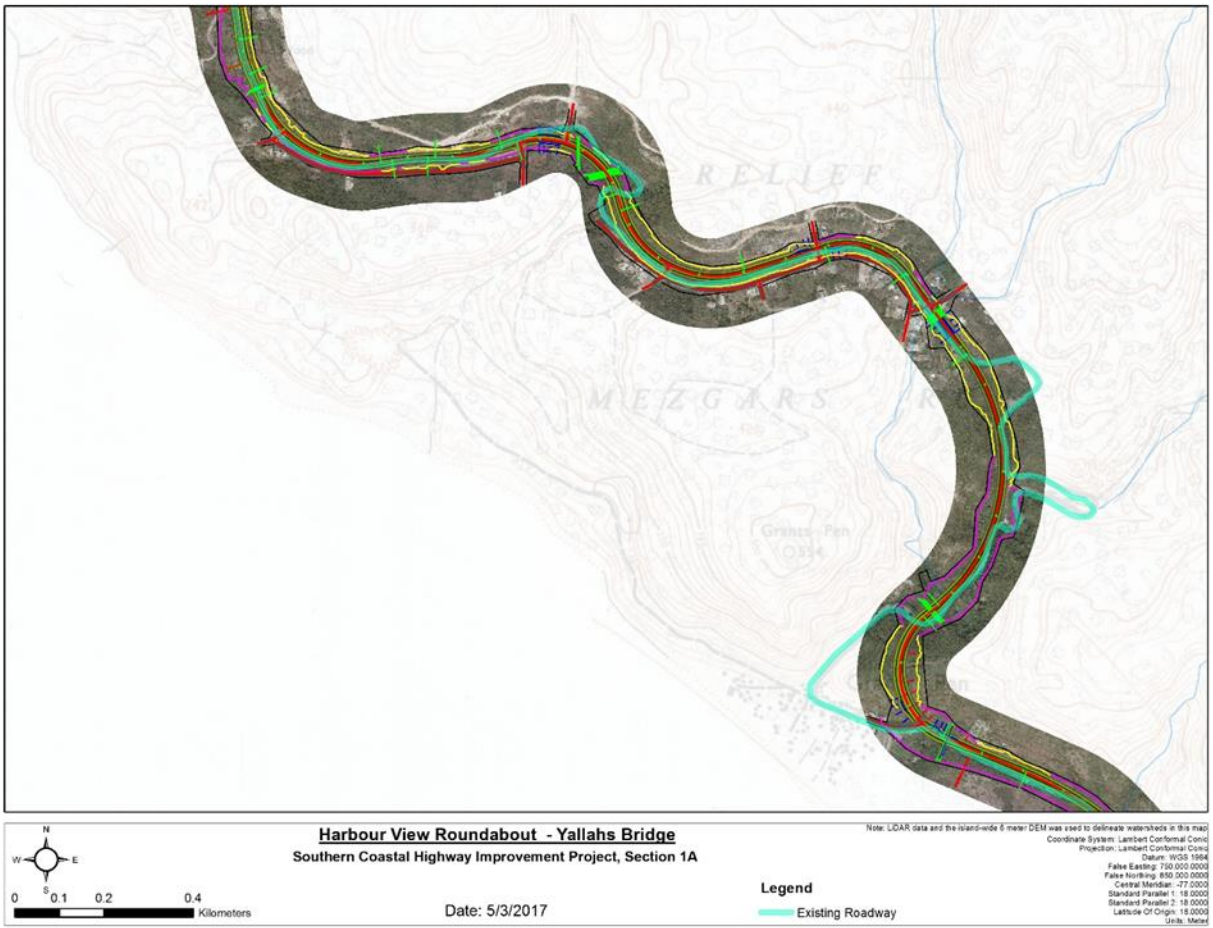


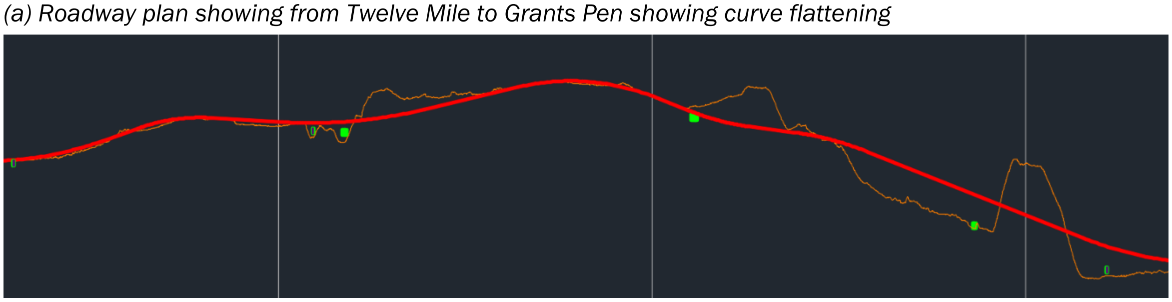
Figure 3-17 Roadway profile of the new alignment showing cut and fill sections

TWELVE MILE TO GRANTS PEN (109+500 TO 113+200)

The alignment from Twelve Mile to Grants Pen is along the existing roadway with curve flattening to meet the design specifications (Figure 3-18a). This section of the road also passes through hilly terrain with a maximum slope of 8% and with major cuts and fills in some sections (Figure 3-18b). The cuts and fills will generate sediment which will require measures to control the migration of these sediments. Drainage channels are also steep and energy dissipaters to reduce runoff velocity and scouring will be required.



(a) Roadway plan showing from Twelve Mile to Grants Pen showing curve flattening



(b) Roadway profile from Twelve Mile to Grants Pen showing cut and fill areas

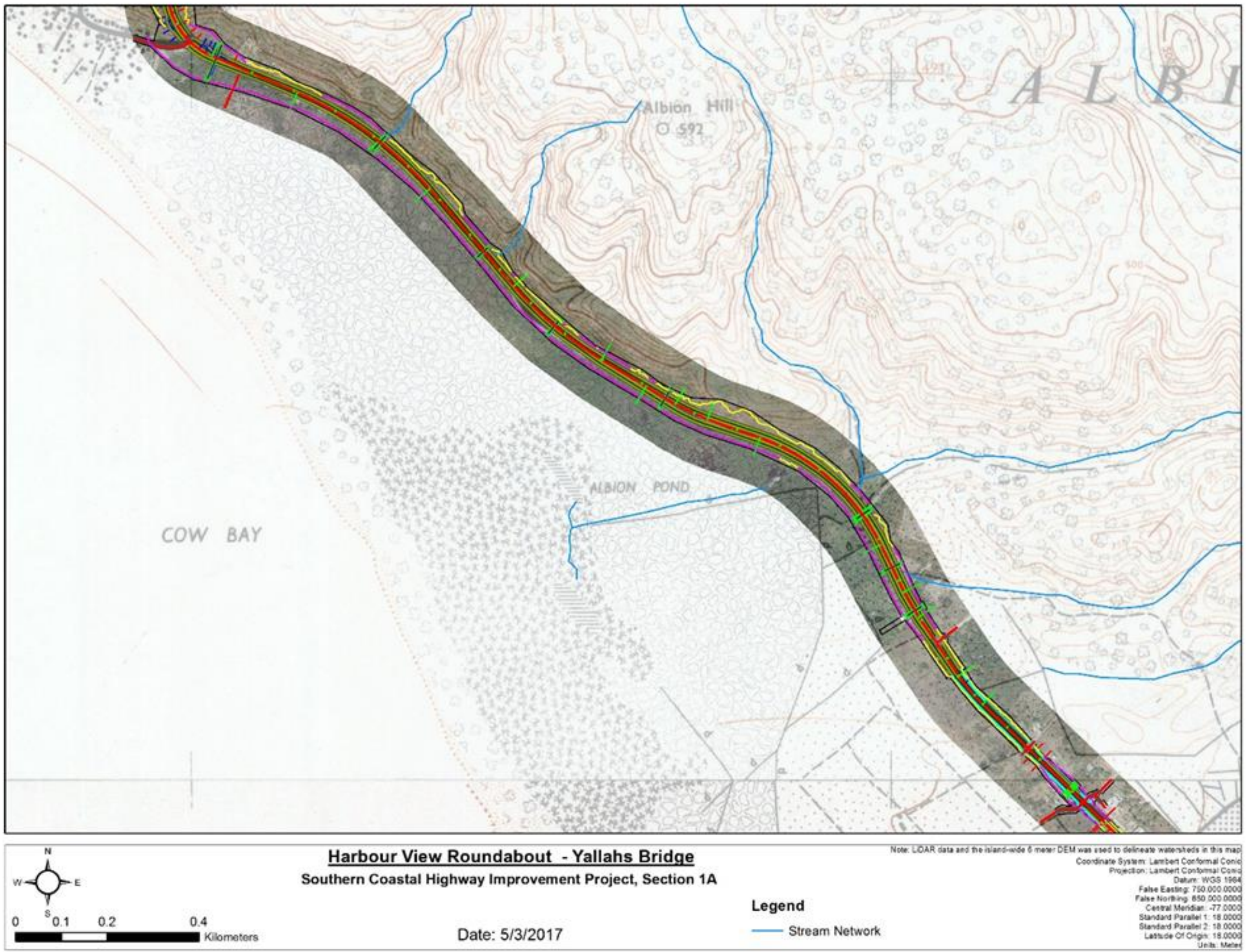
Figure 3-18 Roadway plan and profile from Twelve Mile to Grants Pen showing curve flattening and cut and fill sections

GRANTS PEN TO ALBION (114+000 TO 115+300)

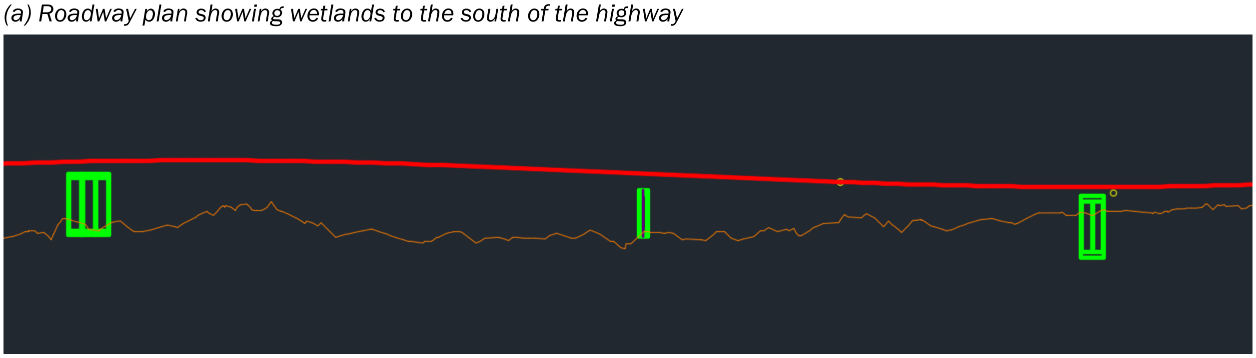
The alignment from Grants Pen to Albion between 114+000 and 115+300 runs at the toe of the hill to the north and borders a wetland to the south. The gradient in this area is very flat and makes effective drainage very challenging. It could also lead to clogging of the drainage systems due to slow flow velocities.

To mitigate this problem, the road is raised and the culvert sizes increased using box culverts instead of pipe culverts to allow for greater flow depth. This ensures that even if the culvert is partially blocked, flow through the culvert will still occur until maintenance work is carried out.

There will be some impact on the wetlands during construction however there is not expected to be any long-term damage. The roadway plan and profile are shown in Figure 3-19.



(a) Roadway plan showing wetlands to the south of the highway



(b) Roadway profile showing raised roadway with box culverts

Figure 3-19 Roadway plan and profile showing wetlands juxtaposing the highway and raised roadway and box culverts to mitigate flooding and aid drainage

3.3.1.12 Foundation Recommendations and Design

A geotechnical program was developed for the SCHIP in order to provide recommendations for embankment cut and fill slopes and initial bridge foundation design criteria. NHL Engineering Limited conducted boring investigations and material testing (borehole locations may be seen in Figure 4-10), the findings of which are documented in the *Geotechnical Report* and summarised in section 4.1.3.3. Stanley Consultants used the initial geotechnical report prepared by NHL Engineering to develop foundation recommendations for each structure that was drilled and to develop slope recommendations.

Alluvial deposits encountered at the borings were composed of silty to sandy clays with a significant portion of gravel and cobbles. These gravels and cobbles may impact pile installation and should be considered in the selection of construction methods. High plasticity clays containing varying amounts of sands and gravels are susceptible to long-term settlement and require significant design consideration. The sand and gravel deposits encountered were generally very compact with high relative densities and a component of plastic fines. These materials have low susceptibility to liquefaction under seismic loading. These deposits have high scour potential. Due to the settlement and scour concerns, deep foundations such as driven or drilled shaft piles are recommended at these locations. Design results specific to each borehole location are shown in Table 3-20.

Table 3-20 Design Considerations and Recommendations, Segment 1, Section 1A

Boring	Structure Chainage	Scour Potential	Liquefaction Potential	Settlement Potential	Recommended Foundation Type
BR1002	102+807	High	Low	Low	Driven or drilled shaft piles
BR1003	106+030	High	Low	Low	Driven or drilled shaft piles
BR1004	106+693	High	Low	Low	Driven or drilled shaft piles
R1-01	109+606	Low	Low	Low	Shallow mat/raft
R1-02	112+899	Low	Low	Low	Shallow mat/raft, driven or drilled shaft piles

Slope Stabilization

Standard methods typically employed for highway cut and fill slopes are recommended along the majority of the proposed road alignment. Prior to grading, it is recommended that topsoil, vegetation and other objectionable material be stripped from construction areas. Clean topsoil should be stockpiled separate from other materials for reuse during the final stages of construction. Topsoil should not be mixed with other excavated materials that will be reused for structural fill. Subgrades for both excavations and constructed fills should be proof-rolled and observed by a geotechnical engineer for any loose, soft, weak, friable, or otherwise unsuitable materials. Should such materials be encountered, additional excavation and compaction or replacement with suitable material is recommended. Areas where removal is unfeasible and cost-prohibitive, engineered products, such as geotextile and geogrid, can be used to improve stability.

Rock excavation is anticipated at numerous locations along the proposed alignment. Some softer, chalky rock encountered may be rippable while some areas may require blasting. On-site evaluation of rock qualities will be needed during construction to determine benching locations, cut face slopes, rock reinforcement, rockfall protection, and other requisite features. Blasted material should be crushed and sorted to provide embankment fill, structural fill, and aggregate base courses wherever feasible. Granular materials should be utilized as select fill for construction of bridge abutments and the top metre of embankments for roads.

Embankment material is expected to be sourced from excavated areas or from approved borrow sites along the proposed alignment. Borrow materials should be free from debris, roots, organic or other unstable or unsuitable material and should have a dry density of not less than 1525 kg/m^3 (AASHTO T99) and less than 10% organic content (AASHTO T194). Embankment materials should be placed and compacted within a controlled percentage (suggest 2-4%) of optimum moisture content (ASTM D698) to 98 percent of the standard proctor (ASTM D698), or 95% of modified proctor (ASTM D1557). Granular, free draining materials should be wetted thoroughly during or immediately prior to compaction. Materials too wet for placing should be spread and disked to reduce moisture content. Immediately prior to rain events it may be beneficial to lightly compact wet materials using a smooth drum roller to promote runoff and reduce absorption.

High plasticity clays encountered along the alignment are susceptible to long-term settlement and may also become unstable when loaded or placed rapidly without allowing the time necessary to dissipate pore water pressures. Fills utilizing materials with a plasticity index exceeding 15 should be avoided where feasible. Reduced placement rates and/or remediation techniques including soil mixing or addition of lime or fly ash may be needed at various locations.

Site-specific slope stability analyses will be required throughout the proposed alignment. NHL recommends:

> *a) Limiting the effective height of the embankment by using cutbacks and steps. This also minimizes the effects of stormwater erosion along slope face.*
>
> *b) Implementation of stormwater drainage elements to channel water in designated disposal facilities. Also, the use of slope protective vegetation to minimize stormwater erosion and surface infiltration.*
>
> *c) Remove pockets of areas identified as colluviums wherever they are exposed; these areas are susceptible to slope failure and erosion.*

NHL further recommends that, "the construction configuration criteria should limit the unsupported design slope angles to 30 degrees assuming measures for erosion protection are in place. Situations that dictate steeper slopes will require the use of supports such as geotextile reinforcements, anchored soil nails, mechanically stabilized earth (MSE) walls or Sierra Slope Retention Systems. Embankments or cuts with soil typical of the colluviums encountered are highly susceptible to erosion and slope failure. This material should be excavated and removed where encountered."

Selection of appropriate factors of safety for slope stability criteria along the roadway alignment should incorporate specific site conditions. Consequences of failure and potential impacts to people and property (i.e. loss of life, damage to property, economic loss due to roadway closure) should be weighed against construction cost. Also, uncertainty of material properties should weigh into the selection. NHL suggests the following guidelines for slope stability factor of safety:

- FS < 1 Unsafe
- 1.25 < FS < 1.5 Marginal (generally acceptable)
- 1.25 < FS < 1.4 Satisfactory for cuts and fills (not for dams etc.)
- FS > 1.4 Satisfactory for dams/levees

Foundation Design

Driven and drilled shaft piles are recommended for the majority of bridges along the proposed alignment. Variable weathered rock and zones of cobbles and boulders may make installation of driven piles impractical. Drilled shafts are the preferred piling method. Locales with shallow and competent bedrock formations will allow the use of mat/raft foundations to be economically constructed.

FACTORS OF SAFETY FOR AXIAL PILE CAPACITIES

Design factors of safety for pile capacity should be selected by the designer to incorporate local site conditions, uncertainties in material properties and loading conditions, as well as consequences of failure. Usual design conditions during normal operation and frequent floods require a factor of safety ranging from 2.0 to 3.0 based on verification of design parameters. A factor of safety of 3.0 will be used where theoretical or empirical predicted pile capacities are unverified during construction. A safety factor of 2.5 will be utilized where theoretical or empirical predicted capacities are verified by a suitable pile driving analyser. A factor of safety of 2.0 may be used where load testing is used to verify actual pile capacity.

Typically, if few piles are required the cost of load testing to verify pile capacity may not outweigh the additional cost to design to a higher factor of safety. The Southern Coastal Highway, however, will require numerous deep pile foundations along the proposed alignment. Table 3-21 should be used to design deep foundations on this Project.

Table 3-21 Axial Pile Capacity Recommendations from EM 1110-2-2906 [2]

Method of Determining Capacity	Loading Condition	Minimum Factor of Safety	
		Compression	Tension
Theoretical or empirical prediction to be verified by pile load test	Usual Unusual Extreme	2.0 1.5 1.15	2.0 1.5 1.15
Theoretical or empirical prediction to be verified by pile driving analyser…	Usual Unusual Extreme	2.5 1.9 1.4	3.0 2.25 1.7
Theoretical or empirical prediction not verified by load test	Usual Unusual Extreme	3.0 2.25 1.7	3.0 2.25 1.7

For load testing, piles should be statically loaded to at least 200% of their anticipated service load to verify theoretical capacity. It is recommended that the driven or drilled shaft piles tip utilize skin friction and tip within granular soils where possible. Piles founded in soft clays could experience excessive settlement due to lower end bearing capacity and long-term loading effects.

DOWNDRAG (NEGATIVE SKIN FRICTION)

Negative skin friction is defined as a downward shear force acting on piles due to downward movement of surrounding soil strata relative to the piles. For such a movement to occur, a segment of the pile must penetrate a compressible soils stratum that consolidates (due to placement of additional surface loads). This condition is expected to be particularly common in areas with thick alluvial deposits which were commonly encountered along the alignment during the subsurface investigation. It is recommended that negative skin friction be accounted for during the detailed design of deep foundations, but due to the preliminary nature of this memorandum these computations are omitted. The additional load due to downdrag should be added to the structural load when estimating the allowable capacity of a given foundation.

LOAD SETTLEMENT BEHAVIOR

The pile-load settlement curves of single driven or drilled shaft piles should be computed for detailed design based on the method of load transfer curves. The computations should be completed for both total stress (undrained) and effective stress (drained) conditions representing long term and short term loading respectively to determine which is controlling. All computations should also be completed assuming negative skin (downdrag) friction. Note that large numbers of piles in close proximity may have increased settlement due to pile group effects which may require additional analyses.

LATERAL PILE CAPACITY

Pile design should incorporate resistance to lateral loading from non-linear soil behaviour. Steel reinforcement may be needed at some locations to improve resistance to lateral loads. Pile arrays and groups may have reduced capacity due to pile group effects. It is recommended that pile groups be analysed using pile group analysis software to determine any reduction in lateral capacity due to these group effects.

Shallow Foundations

BRIDGE SUPPORT

Due to the soft/compressible upper soils encountered along portions of the proposed alignment, shallow foundations are generally not recommended. However, shallow foundations are recommended for areas with shallow surficial layers overlying strong bedrock. Shallow foundations should be a minimum of 1070mm below final grade. NHL recommends a bearing capacity factor of safety of 2.5.

BRIDGE ABUTMENT CONSIDERATIONS

The contractor should take care not to disturb the bottoms of excavations, and be prepared to extend excavations in the event that loose materials are encountered within shallow foundation areas. If unsuitable soils are encountered, it is recommended that the contractor extend the excavations 1 foot wider for every 1 foot deeper the excavations are extended. The excavations should be backfilled using acceptable structural fill, placed in loose lifts of approximately 200mm within 2 percent of their optimum moisture, and compacted to either 98 percent of the standard proctor (ASTM D698) or 95 percent of the modified proctor (ASTM D1557). Acceptable structural fill may consist of sand, silty sand, or clayey sand, having a plasticity index no greater than 15. Excessive post-construction settlement of clay and silty soils may otherwise occur.

Construction Considerations

The high plasticity clays (CH) encountered during the subsurface exploration are unsuitable for general fills and embankment fills. It is recommended that fine-grained backfill materials used for general fill and embankments be compacted to a minimum of either 95 percent of standard proctor density (per ASTM D698) or 93 percent of the modified proctor (ASTM D1557). Granular backfill materials should be compacted to a minimum of either 98 percent of standard proctor density (per ASTM D698) or 95 percent of the modified proctor density (ASTM D1557).

Working Platform Recommendations

In order to access and construct the driven or drilled shaft piles, a working platform may be required to provide a stable surface for construction equipment and operations. Assuming a wet, low strength clay subgrade having a very low bearing ratio, it is recommended that the platform consist of a minimum of 450mm of aggregate reinforced with a biaxial geogrid. Alternative subgrade stabilization would be mixing 5% lime into the upper 450mm of the subgrade soils. A test section for proposed stabilization measure is recommended prior to construction.

3.3.2 Ancillary Project Activities

3.3.2.1 Utilities

Jamaica Public Service Company Ltd. (JPSCo)

Along the proposed route, approximately 482 electricity poles will be relocated.

Lime

There are 42 manholes and 11 service cabinets along or within proximity of the proposed highway that will have to be relocated. There are sections of the road where the lines are placed on the JPS poles.

National Water Commission (NWC)

NWC facilities that are within close proximity to the proposed highway may have to be relocated:

- Potable Water - There are 23 system valves and 21 hydrants within close proximity of the proposed highway. In the vicinity of the Harbour View Roundabout there are 2 water treatment plants and an extensive pipeline covering the entire length of the Highway A4. Along the rest of the proposed highway there are 2 water treatment plants and pipelines.
- Sanitary Sewer - There is a wastewater facility and pipelines in the vicinity of the Harbour View Roundabout. The number of manholes along or within proximity to the main roadway is unknown.

3.3.2.2 Construction Camps and Infrastructure

The location of the construction camp/site(s) yard(s) have not yet been determined. It is anticipated, however, that the camp will be approximately 200m x 200m and will take into consideration storm water and surface water drainage requirements, location of interceptors, as well as wastewater and sewage requirements. All necessary approvals for the construction camp/site yard will be obtained prior to establishment of the site. The construction works will be implemented by the Contractor.

Although the exact location of the site construction camp has not been identified, the previous experience of the Highway 2000 projects should be taken into account, with regards to good housekeeping habits, conformance to permitting requirements, and adherence to audit procedures.

Water for the camp/site(s) yard(s) will be obtained either by connection to a NWC pipeline in proximity to the site or by water trucked to the site and stored in tanks. Wastewater generated from the camp/site(s) yard(s) will be collected and treated by plant. These will be designed to meet the NEPA sewage effluent and wastewater standards and the Ministry of Health requirements. Along the alignment of the highway construction, portable toilets will be strategically placed in the desired numbers. A guideline that should be used 1 portable toilet per 25 workers. Electricity for the campsite will be had either through connection to a JPSCo powerline or through the use of standby generators or a combination of both.

During this construction phase of the proposed project, solid waste generation may occur mainly from the construction campsite and from construction activities such as site clearance and excavation. In order to minimize the amount of solid waste on site, the following strategies should be employed:

i. Skips and bins should be strategically placed within the campsite and construction site.
ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iii. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
iv. Disposal of the contents of the skips and bins should be done at an approved disposal site.

3.3.2.3 Waste Management Plan

Construction

An estimated 160,516.42 m³ of solid waste from site clearance and earthworks will be generated.

Solid waste will be disposed of by CHEC in a manner approved by NWA. CHEC will dispose of all waste slurry off-site at an approved disposal site (Riverton Disposal Site in St. Catherine and/or Church Corner Disposal Site in Morant Bay). Removal and disposal of hazardous waste material shall be performed in accordance with all applicable government, county, parish, and local regulations. CHEC will be required to submit documentation attesting to the method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests. Test results from and accredited commercial laboratory verifying disinfection will also be submitted.

Efforts will be made to avoid and minimize spillage of fuels, lubricants, cleaners, solvents, or other hazardous substances which may potentially contaminate surface water bodies and groundwater bodies. Maintenance of vehicles and equipment will be conducted on hardstands in designated areas designed to contain incidental spills of hydraulic or other fluids.

Secondary containment for all bulk storage tanks or drums will be provided. Secondary containment shall be of adequate size to contain the entire contents of the tank plus sufficient freeboard to allow for precipitation. All secondary containments shall be constructed of impermeable materials to prevent infiltration of spilled or leaked tank contents onto the ground. Disposal of concrete residue and wash water, water from aggregate washing and other operations resulting in sedimentation will be treated by filtration, settling basins, or other means sufficient to reduce the sediment concentration to applicable limits established by NEPA.

The Project Manager and/or his designated representative will have the responsibility to implement and monitor the Plan. Project Manager and/or his designated representative will be supported by work team of monitors who will ensure waste is stored in the designated areas and assist in litter control. The team will also ensure burning of solid waste does not take place on the construction site. In addition, proper signage will be established to identify interim storage areas on site.

Litter control will be a key part of the solid waste plan. Forty-five gallon drums will be placed at strategic locations to collect litter. In addition, workmen will be given responsibility to control litter in their work area as part of monitoring programme.

The Site Manager will keep a log of the waste leaving the site. This will include; date, waste type, vehicle number, estimated quantity and disposal site. A ticketing system will be developed and both CHEC and the Solid Waste Haulers will keep records of disposal to ensure effective management of ‘cradle to grave’ and verification of disposal at the correct site. The logbook/ticketing system will be in place where upon departure the license number, time of departure and drivers name will be logged. An authorized CHEC agent before departure of each truck trip from the construction site will sign this ticket in triplicate.

The drivers of trucks entering the disposal site must have a valid identification card and the ticket must be given to the CHEC/NSWMA agent located at the site. The time of arrival must be entered and the ticket signed. The driver will receive a copy of the ticket as prove that the cargo he was carrying was delivered to the dumpsite. Monitoring of the transportation of solid waste from the construction site to the disposal site at will be done so as to ensure that no debris being transported is falling unto the roadway along the route. This will be done by a CHEC appointed agent. Spot checks should be conducted by NEPA and/or the Local Planning agencies.

Operation

The only expected solid waste to be generated during operations will come from littering by users of the roadway and/or accidental spillage of debris/material etc. from trucks transporting said items.

3.3.2.4 Site Rehabilitation

The rehabilitation will start with the restoration of the locations of the construction campsites and other cleared areas associated with the road works. This area will be backfilled with material removed during campsite construction and supplemented with layers of topsoil also removed during clearance activities. The surface will be stabilized according to an active planting program. The establishment of a ground cover is of priority (Table 10-3), after which, hardwood trees can/will be planted in the final rehabilitation phase. A plant nursery will be setup by the contactor to ensure that sufficient, suitable plant material is available to allow a timely re-vegetation of the site. Please see section 10.2.5 for further details.

3.3.3 Site Access

Access to the project site will be through controlled ingress and egress along the existing main road. Flagmen and warning signs with cones will be in place during active construction zones.

The access plans have not been finalized; however, upon finalization the plans will be shared with the relevant Regulatory Authorities for approvals. Special consideration will be given to all socially sensitive areas (e.g. residential areas, schools, etc.) and ecologically sensitive areas (e.g. primary forest, endemic species etc.). These will be avoided where possible.

3.4 PROJECT PHASES AND SCHEDULE

3.4.1 Project Schedule

The estimated timelines for each phase are given in Table 3-22 below.

Table 3-22 Table of proposed Project Timelines

Phase	Summary Description	Expected Time Line
Design Phase	Land Acquisition and other similar activities	10 months
Construction Phase	Site preparation and general construction	26 months
Defects Liability Period	Any issues related to the defects etc.	2 Years

3.4.2 Construction Activities

3.4.2.1 General Methodologies

The General construction methodologies are taken from the *North South Highway EIA Moneague to Ocho Rios*. It is anticipated that the entire construction period for the highway will last 26 months. The steps are broken down as per below. Road bed construction work will take approximately 18 months to complete and will follow the procedures outlined in Figure 3-20.

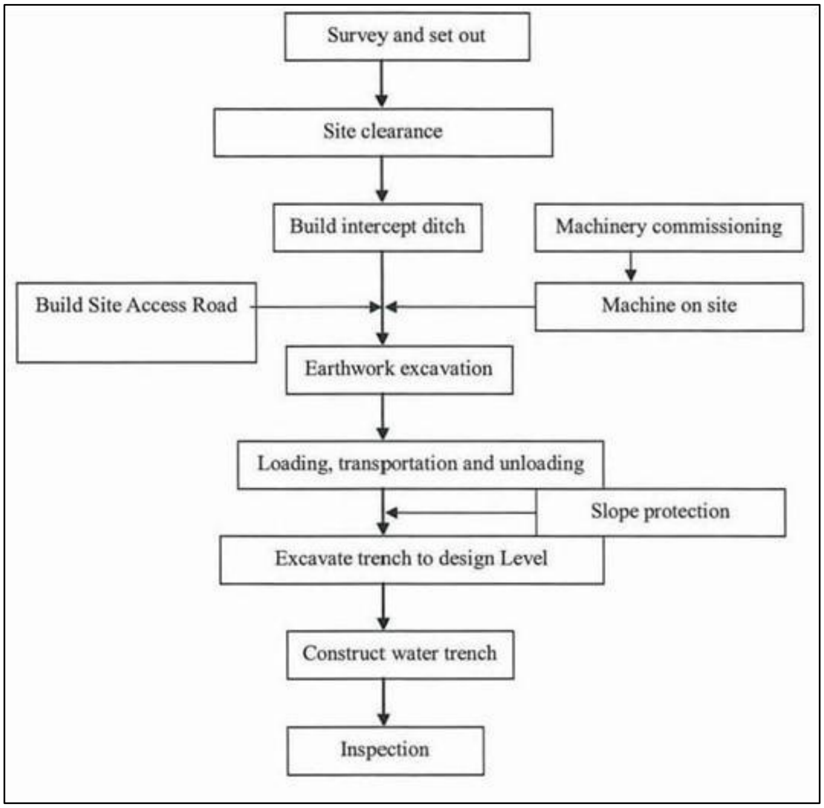


Figure 3-20 Roadbed construction procedure (source CHEC)

3.4.2.2 Construction Process of Excavation

Earthwork Excavation (Soft Material)

Excavation shall be done in layers from the top downwards (Figure 3-21).

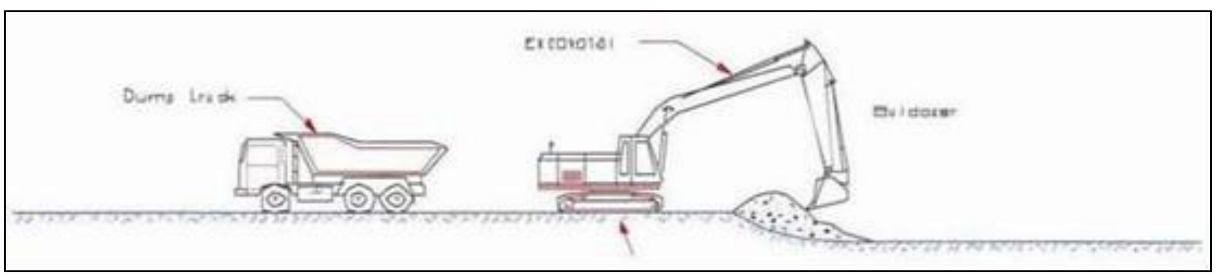


Figure 3-21 Earthwork excavation (source CHEC)

Earthwork Excavation (Hard Material)

Bulldozers and excavators with hydraulic breaker will be deployed to remove the rock.

Roadbed Filling

The flow chart below outlines the procedures that will be employed to do roadbed filling (Figure 3-22).

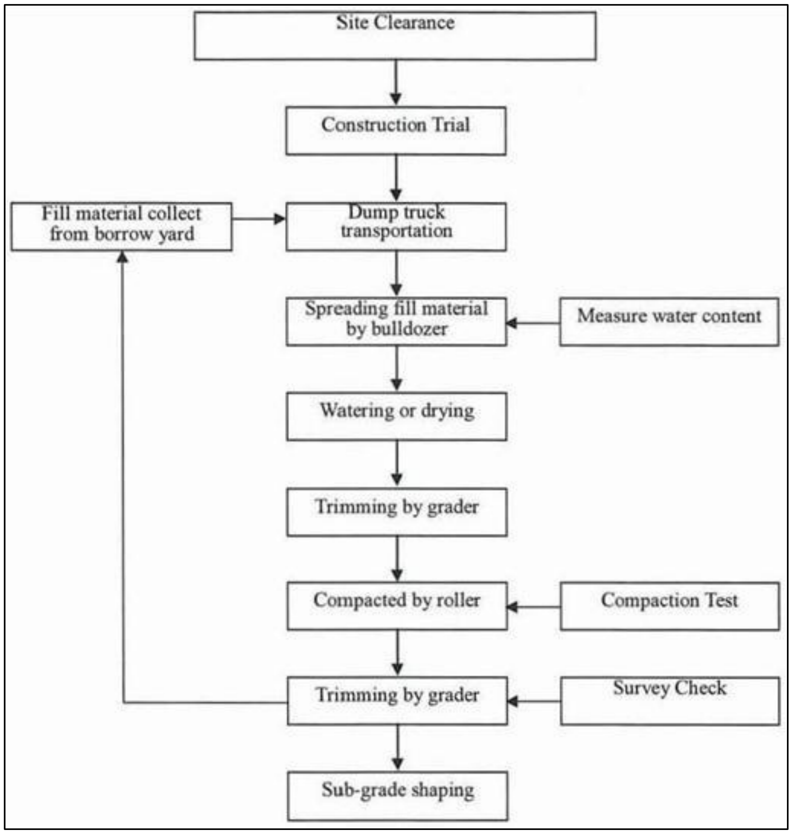


Figure 3-22 Construction procedure for roadbed filling (source CHEC)

The filling material will be transported to the construction site from the borrow area and dumped in the site, then spread by bulldozer and trimmed to control the design level. Then roller will be deployed to compact. Filling work will be started from bottom to top in layer by layer which is shown in the figure below. If uneven ground surface is found, filling and compaction will be applied on the existing ground, and then fill the layer according to requirements. In case of filling by sections and at different time, the first section shall be filled by bench method with gradient 1: 1.

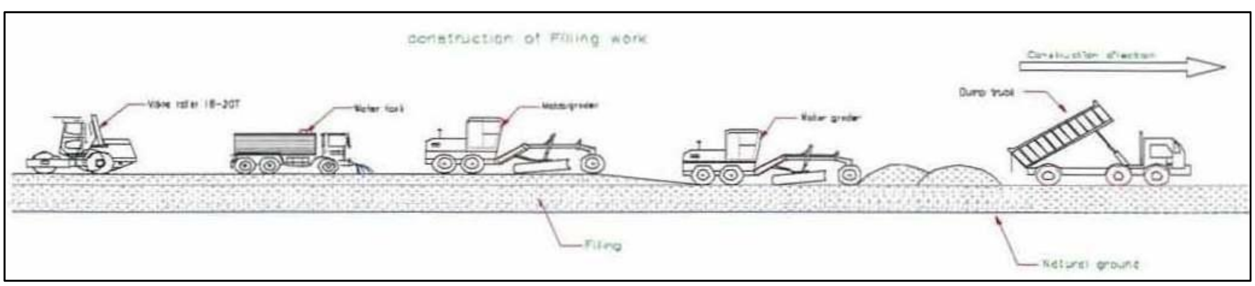


Figure 3-23 The steps for transporting, spreading and compacting fill material (source CHEC)

Material Quantities

Table 3-23 shows the quantities estimated for various construction related activities.

Table 3-23 Estimated quantities for various activities

Description of Activity	Quantity	Units
Site Clearance and Removals		
Site Clearance	60	Hectares
Removal of Topsoil	120,421.40	Cubic metres
Earthworks		
Excavation (rock)	802,283.68	Cubic metres
Roadway Excavation (soil)	200,225.24	Cubic metres
Embankment Filling	885,682.70	Cubic metres
Imported fill material from licenced quarry	50,000.00	Cubic metres
Recycled Excavation (Soil)	172,607.97	Cubic metres
Recycled Excavation (Rock)	713,074.73	Cubic metres
Transport Spoil to Approved Dump	160,516.42	Cubic metres
Grass Planting	251,405.00	Square metres
Topsoil	25,140.50	Cubic metres

3.4.2.3 Drainage and Retaining Wall Construction

Concrete Ditch

Forming the bedding with crushed stone after excavation, concreting to designed level.

Retaining Wall

The reinforced concrete retaining wall will be constructed by employing backhoe, steel-fixer, carpenter and concreter.

3.4.2.4 Pavement Construction

It will take approximately six months to finish the pavement. One set of 4000 asphalt batch mixer and three sets of paver will be deployed to execute the pavement works (Figure 3-24).

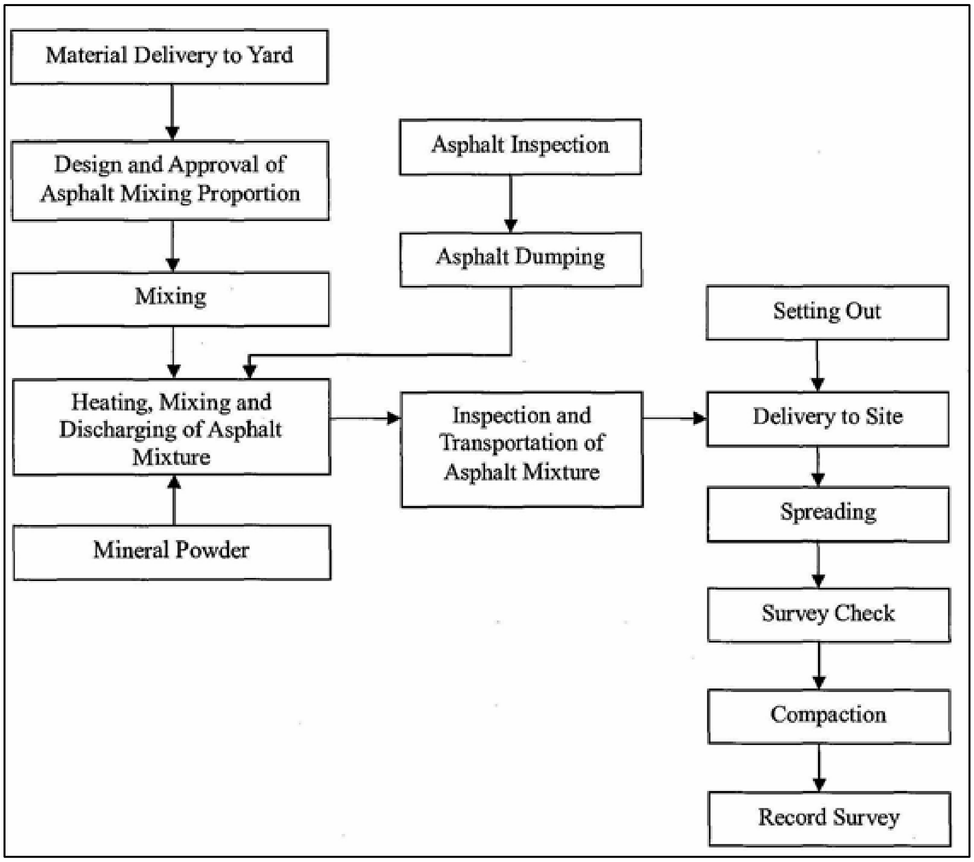


Figure 3-24 Pavement Construction Schematic (source CHEC)

Asphalt and Base Course Work

The thicknesses of the asphalt and base course are 90 mm and 430 mm respectively. The graded material will be graded by bulldozer, levelled and spread by a spreader and then compacted to required degree of compaction.

Prime Coat and Tack Coat Construction

Provide a layer of prime coat or slurry seal on base course and place a layer of tack coat between surface courses (Plate 3-1).

Plate 3-1 Asphalt Pavement Construction (Spraying) (source CHEC)

Asphalt Concrete Pavement

Asphalt concrete shall be transported by dump truck. In order to ensure consecutive spreading work, the dumping truck on site shall not be less than three during laying asphalt concrete (Plate 3-2).

Plate 3-2 Transportation of Asphalt Concrete (source CHEC)

The asphalt concrete will be spread by three ABG-type Pavers equipped with auto-adjusting thickness devices and auto-levelling device and initially-compacting device. The Paver will be adjusted to the best working condition to ensure the paving surface is even so as to reduce or to eliminate segregation. The elevation control method guided by steel wire shall be applied to spreading. The spreading speed will keep up with the step of material supply and compactors to ensure the consecutive and even spreading without interruption as much as possible (Plate 3-3).

Plate 3-3 Asphalt Concrete Spreading (source CHEC)

Compaction of Asphalt Concrete

Asphalt concrete shall be immediately compacted after spreading. The concrete shall be compacted by 10t dual-drum vibration roller immediately after the paving (Plate 3-4).

Plate 3-4 Spreading and Compacting Asphalt Mixture (source CHEC)

3.4.2.5 Bridge Construction

Bridge construction will be constructed concurrently with road construction and will take approximately 15 months to complete.

a) Total station method will be applied to surveying.
b) Spread foundation construction

Foundation will be excavated by excavator with the assistance of manpower. After the excavation is finished, the concreting work will be carried out. Five centimetre (5cm) thick concrete blinding will be poured before fixing reinforcements steel. When steel reinforcements transported to the site and fixed, embed pier and abutment and connect with reinforcements.

Construction of Pier and U-shaped Abutment

Rough surface will be formed as the construction joints for the pier and abutment. Prefabricated hollow concrete slab/beam and pre-stressed concrete T beam will be adopted for bridge. Prestressed ducts of T beam are formed by using corrugated pipe. Concrete will be transported to site by concrete truck and poker vibrator will be applied to compact the concrete.

Post-tensioning of Pre-Stressed Concrete T Beam

The tensioning equipment will meet relevant working requirements. Equipment will be frequently checked to ensure the proper operation. Steel strands will be cut in accordance with design drawing. The pre- stressed steel stainless strands shall not be damaged and have no rust. Strands passing through the beam will be carried out by winch with the assistance of manpower.

When the concrete beam achieves the design strength, positive bending moment strands shall be tensioned at both ends in symmetrical way. During tensioning, records will be properly kept and after tensioning, temporary protection treatment will be applied to anchor devices.

Jacking to Position

When pre-stressed completed, an Employer's Representative will check the tensioning records. Once approved by Employer's Representative, the surplus tendon can be cut and be ready for jacking. After jacking into position, cement mortar shall be applied to grout to seal the holes.

Precast Beam Storage

When the specified strength is achieved, the T beam can be transported to the storage area.

Beam Installation

Erect supporting frame between two abutments, then place longitudinal sliding track and put girder on track. A winch is set at the other abutment end to pull the beam onto the support frame. The beam is installed on the abutment by using jack to place the first beam on the edge. Similarly, repeat to place the remaining beams.

Set the transverse sliding track on erected two pieces of beam, then pull the next beam onto erected two beams in longitudinal direction and move it in a transverse direction adjacent to the second beam and finally place it on the abutment by using a jack. In similar way, the rest of beam shall be placed on abutment one by one.

3.4.2.6 Culvert Construction

The construction procedure is set out in Figure 3-25.

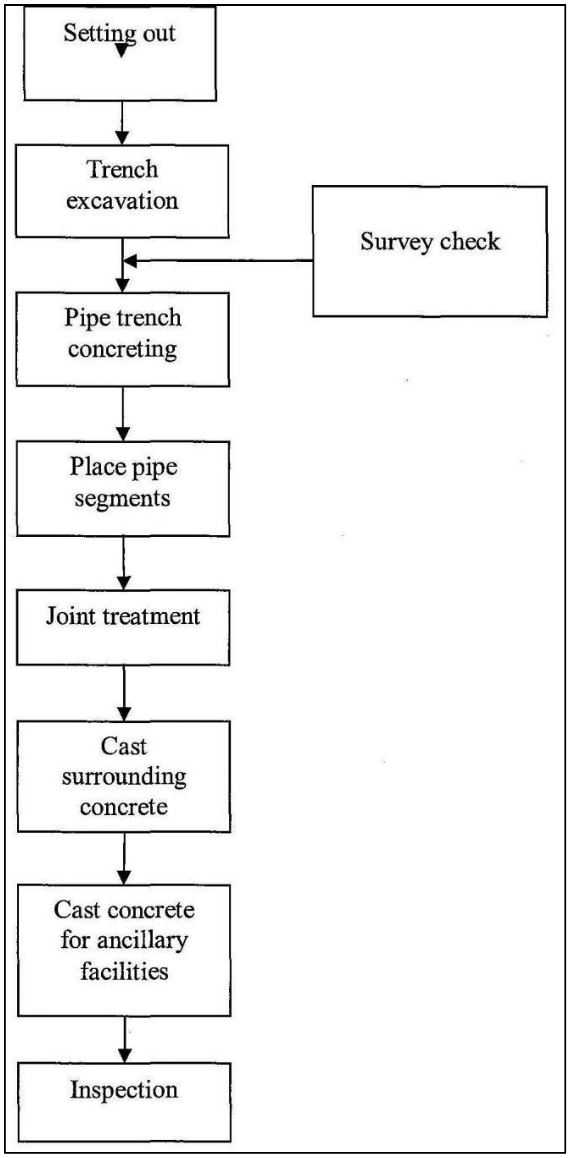


Figure 3-25 Culvert Construction Procedure (source CHEC)

Foundation and Abutment

The foundation will be excavated by an excavator. During the casting of the abutment, observation of the form will be done in case there is any transformation.

Concrete Slab

Concrete slabs will be prefabricated on site, and then transported to the position. The strength of prefabricated slab must achieve 90% design strength before being hoisted.

3.4.2.7 Traffic Signs

Traffic signs in this project include milestones, guide signage and warning sign etc. These signs shall be purchased in Jamaica and erected by Ministry of Transport and Mining (MTW).

3.4.2.8 Transportation Requirements

All motorized vehicles within the site, excluding those on public roads, shall be restricted to maximum speed of 20 km per hour (in site yard) and 50 km per hour (on the alignment). Speed limit signs will be erected as appropriate. Haulage and delivery vehicles will be confined to designated roadways inside the site. The production team will ensure that vehicles transporting earth materials and fines are fitted with side and tailboards. Materials transported by vehicles shall be covered, with the cover properly secured and extended over the edges of the side and tailboards. Dusty materials will be dampened before transportation

3.4.2.9 Potential Road Diversions

Potential road diversions will be discussed and agreed upon by the proponent and relevant authorities and subsequently announced to the public.

3.4.2.10 Decommissioning and Abandonment of Works

Prior to the end of the project, a detailed decommissioning plan will be submitted to the relevant agencies. This will include but not limited to the following project features: batching plant, camp site (dormitories, sewage, canteen etc.) and fuelling and repairs stations.

3.4.2.11 Raw Materials

Twelve quarries are located within 5 km of the proposed alignment; limestone, shales, sand, gravel and gypsum are the primary material types (Table 3-24 and Figure 3-26). The project developers will source relevant material from nearby quarries; lab tests will be conducted on the material to determine quality and suitability for construction.

Table 3-24 Quarries located within the study area

Source: Mines and Geology Division

Type of Material	Quarry License	Name
Limestone	QL 0004	L.C. Mc Kenzie
Shales	QL 1252	Caribbean Cement
Sand & Gravel	QL 1053	Jamaica Pre Mix
Sand	QL 1225 QL 1207	Eartherane Haulage
Sand	QL 1442	Alvin Merrick Nicholas
Limestone	QL 1116	Michael Black
Sand	QL 1181	Jamaica Pre Mix
Gypsum	QL 1287	Jamaica Gypsum Quarry
Sand	QL 1530	Ludlow Ronnicks
Sand	QL 1444	Jamaica Pre Mix
Sand	QL 1592	Pre-Mix
Gypsum	QL 1125	Gypsum

3.4.2.12 Equipment and Machinery

Table 3-25 lists the various types of equipment and plants, and associated numbers anticipated for the construction phase.

Table 3-25 List of equipment expected to be used during the construction phase of the proposed project

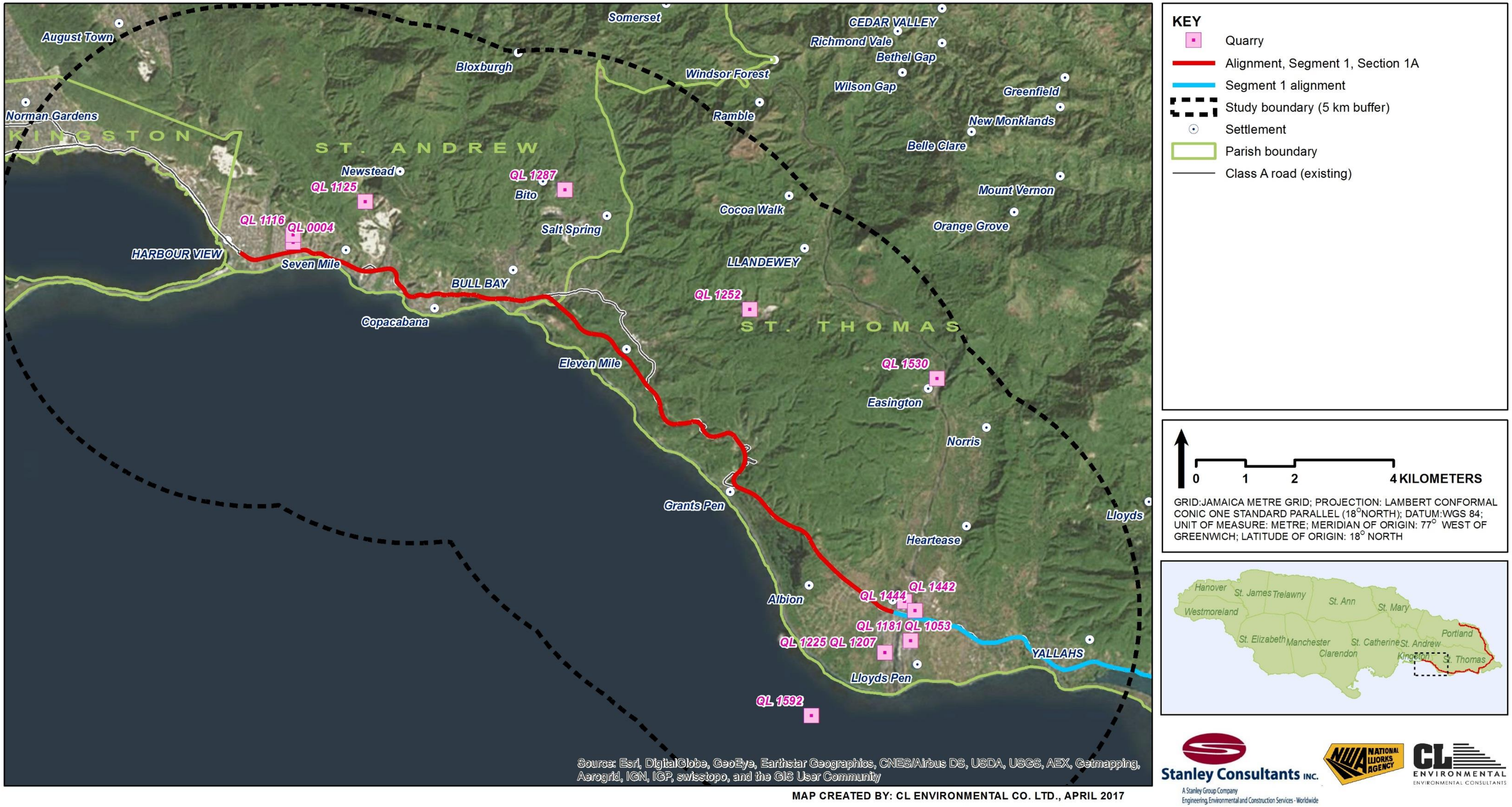
No.	Description
2	Bulldozer
4	Backhoe
1	Asphalt Paver
20	Dump Truck
3	Frontend Loader
2	Water Truck
2	Crane
5	Roller
3	Excavator
3	Grader
1	Concrete Batching Plant
1	Asphalt Batching Plant
4	Concrete Mixer Truck
1	Aggregate Crushing Plant

3.4.2.13 Employment

The proposed project is expected to employ 350 workers during construction.

3.4.3 Implementation

The Government of Jamaica (GOJ) has entered into a contract with China Harbour Engineering Company Ltd. (CHEC) to design and construct the project, which will be financed by the GOJ and a loan from the Export Import Bank of China.



Source: Mines and Geology Division

Figure 3-26 Quarries located within the study area

4.0 DESCRIPTION OF THE ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

4.1.1.1 National Meteorological Service

Climate data (temperature, relative humidity and wind speed and direction) were obtained from the National Meteorological Service for the period December 1st, 2016 to March 13th, 2017; and rainfall data for the period December 1st, 2016 to February 28th, 2017. This data was obtained for the following areas: Norman Manley International Airport (NMIA), East Albion and Yallahs.

Norman Manley International Airport

Average temperature over the period was 27.04 °C and ranged from a low of 21.9 °C which occurred on March 22nd at 8:50pm, to a high of 32.7 °C which occurred on December 18th at 6:50pm and December 25th at 6:10pm.

Average relative humidity over the period was 64.6% and ranged from a low of 30.18% which occurred on January 12th at 5:40pm, to a high of 88.53% which occurred on March 18th at 5:00am.

Average rainfall over the period measured 0.12 mm and ranged from a low of 0 mm to a high of 3.7 mm which occurred on February 23rd.

Average wind speed over the period was 7.88 m/s and ranged from a low of 1.3 m/s which occurred on December 22nd at 3:00am, to a high of 26.9 m/s which occurred on December 27th, at 5:50pm. Dominant wind direction was 32° (northeast) (Figure 4-1).

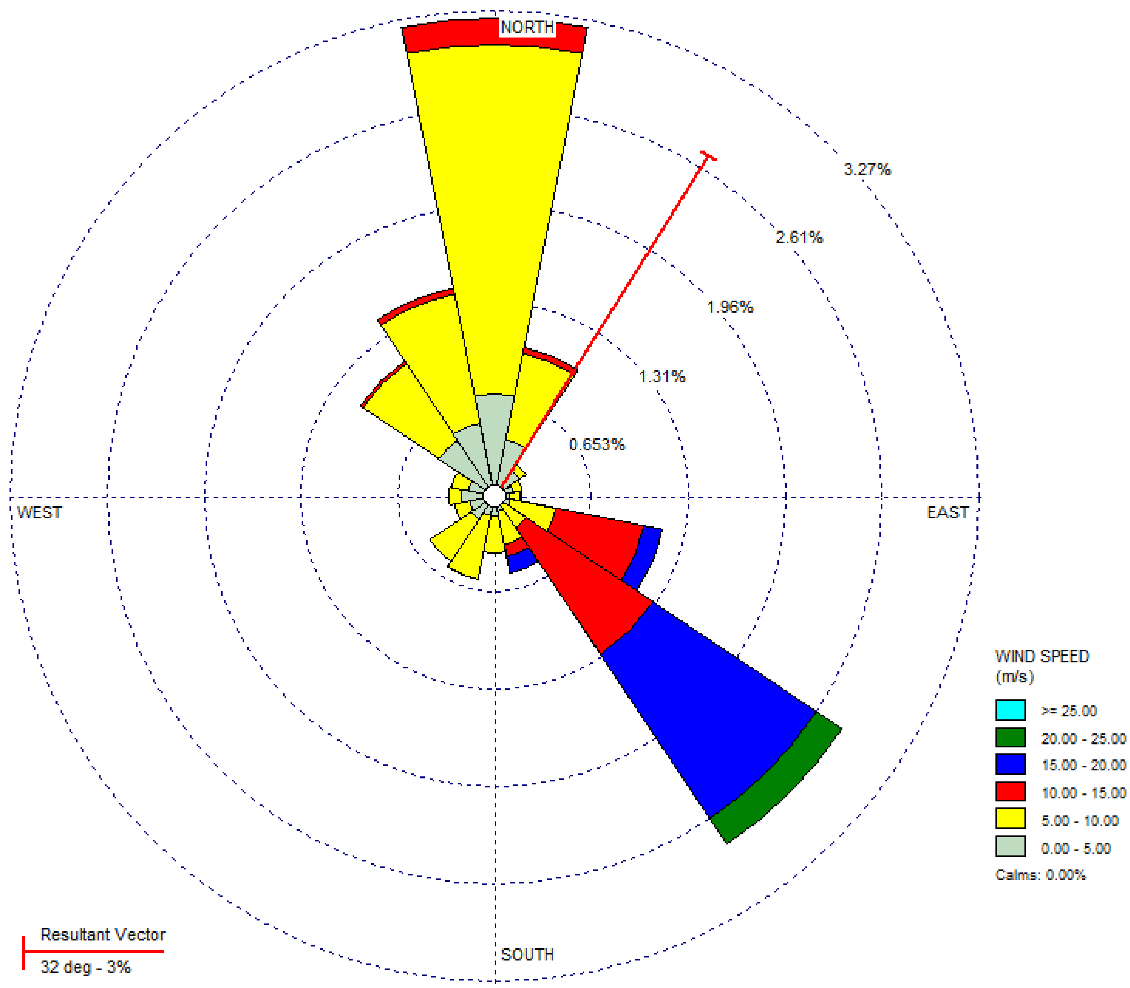


Figure 4-1 Wind Rose for NMIA

East Albion

Average temperature over the period was 26.18 °C and ranged from a low of 20.1 °C which occurred on January 11th at 6:00am, to a high of 33.6 °C which occurred on December 24th at 2:00pm.

Average relative humidity over the period was 67.8% and ranged from a low of 31% which occurred on January 28th at 2:00pm, to a high of 94% which occurred on March 13th at 2:00am.

Average rainfall over the period measured 0.25 mm and ranged from a low of 0 mm to a high of 4.4 mm which occurred on December 18th.

Average wind speed over the period was 3.0 m/s and ranged from a low of 0 m/s to a high of 10.4 m/s which occurred on February 1st, 15th, 18th and 26th. Dominant wind direction was 73° (east northeast) (Figure 4-2).

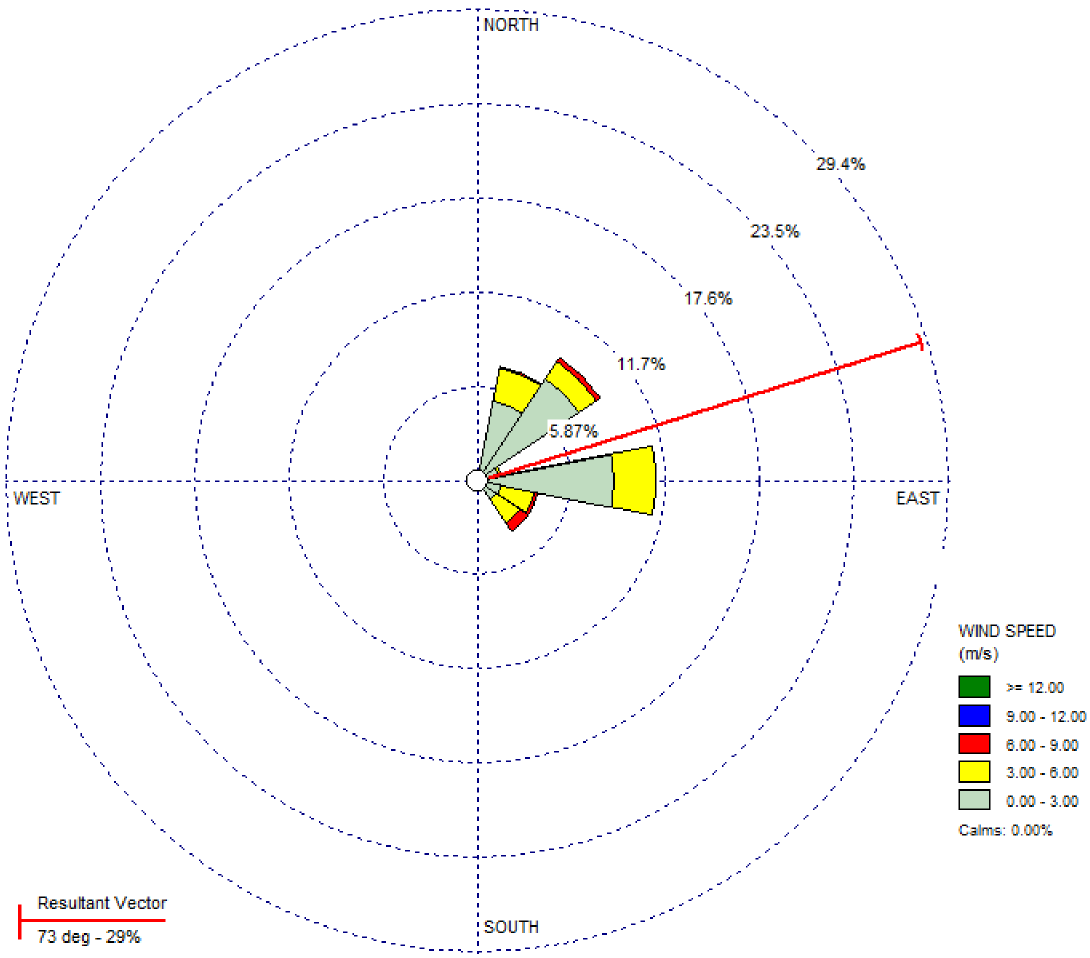


Figure 4-2 Wind Rose for East Albion

Yallahs

Average temperature over the period was 26.19 °C and ranged from a low of 19.8 °C which occurred on January 11th at 2:00am, to a high of 32.8 °C which occurred on March 3rd at 2:00pm.

Average relative humidity over the period was 70.5% and ranged from a low of 36% which occurred on January 28th at 3:00pm, to a high of 94% which occurred on January 24th at 9:00am and on March 13th at 12:00am.

Average rainfall over the period measured 0.41 mm and ranged from a low of 0 mm to a high of 4.4 mm which occurred on February 12th.

Average wind speed over the period was 6.14 m/s and ranged from a low of 0.9 m/s to a high of 16.5 m/s which occurred on February 27th and March 1st. Dominant wind direction was 67° (east northeast) (Figure 4-3).

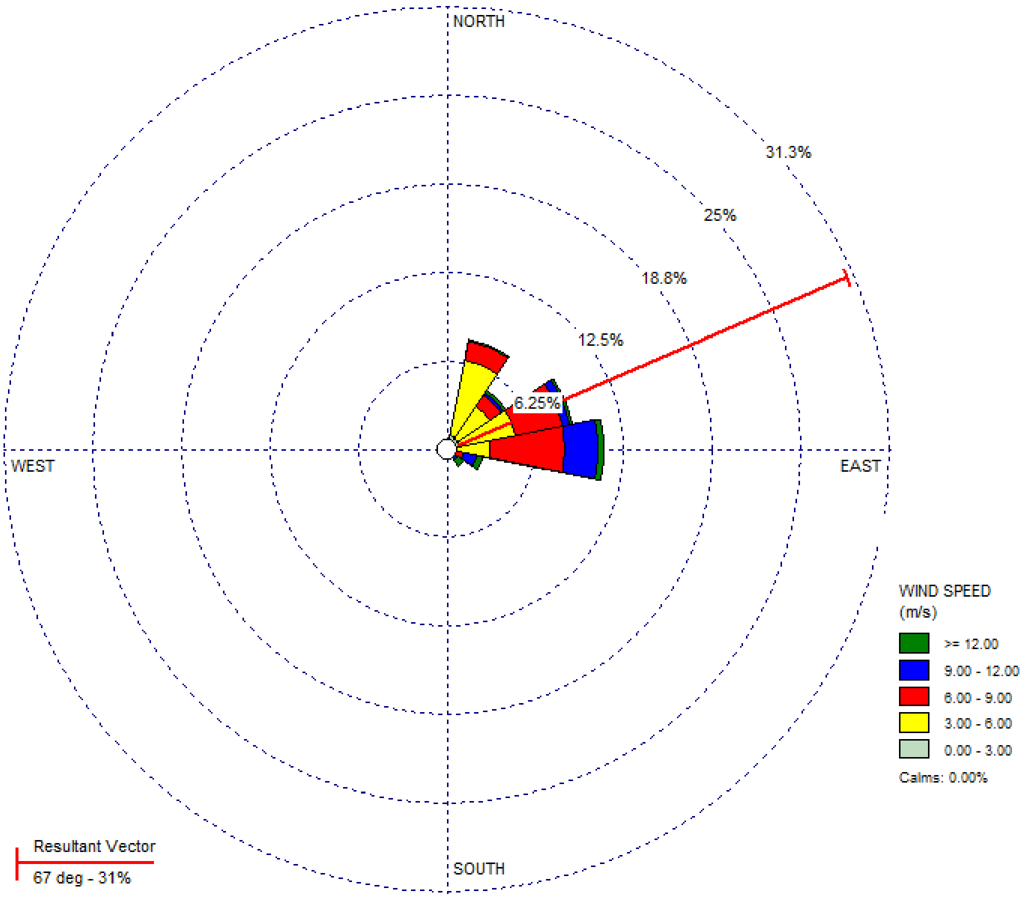


Figure 4-3 Wind Rose for Yallahs

4.1.1.2 Extreme Rainfall

The island-wide analysis indicated that there has been an overall increase ranging from 11.7% (for the 2-year Return Period Event) to 1.5% (for the 100-year Return Period event) for all stations considered across the island. This increase has occurred over a time frame of 21 years (1988 to 2009) and equates to 0.7% to 5.6% increase per decade for the entire island (Table 4-1 and Figure 4-4).

Table 4-1 Overall increase in 24-hours rainfall intensity across the island (1988 – 2009)

	Return Period (yr.)					
	2	5	10	25	50	100
Number of stations considered	117	117	117	117	117	116
Average increase (mm)	14.0	10.0	5.6	5.9	6.3	5.3
Average rainfall depth (mm) 1930 to 1988	119.8	175.0	217.7	268.2	307.8	345.7
Overall increase	11.7%	5.7%	2.6%	2.2%	2.1%	1.5%
Increase per decade	5.6%	2.7%	1.2%	1.0%	1.0%	0.7%

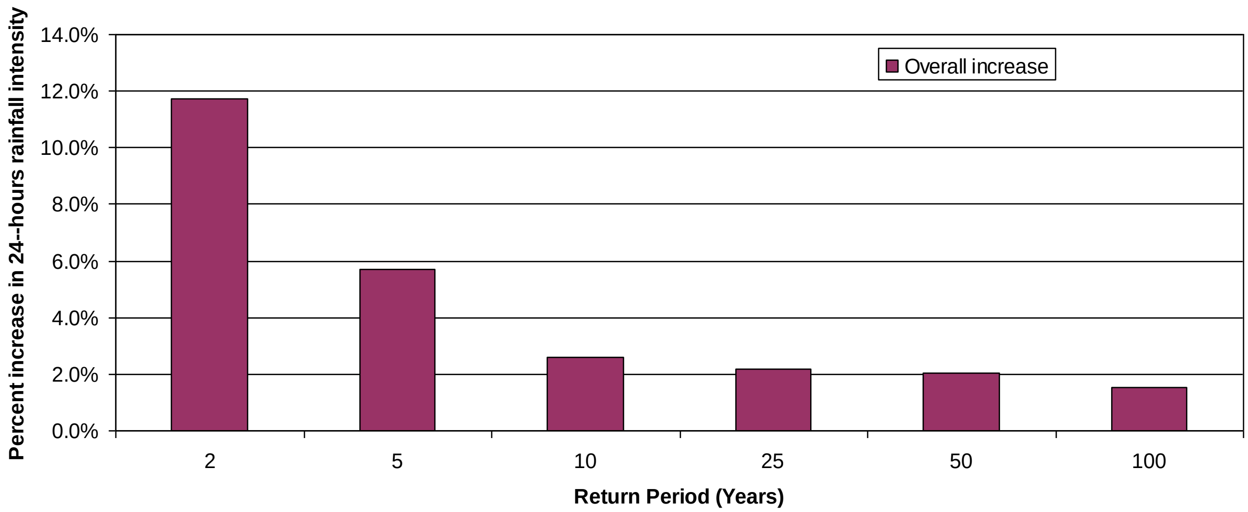


Figure 4-4 Bar graph showing 0verall increase in 24-hours rainfall intensity across the island for the period between 1988 and 2009

Figure 4-5 and Figure 4-6 depict the spatial rainfall changes estimated for the 50year and 100year 24-hour extreme rainfall across the island. In the eastern parishes in proximity of Segment 1, Section 1A alignment, a negative difference between the 1930-1988 and 1992 to 2008 24-hours extreme rainfall intensities for both the 50 year and 100 year return periods are observed.

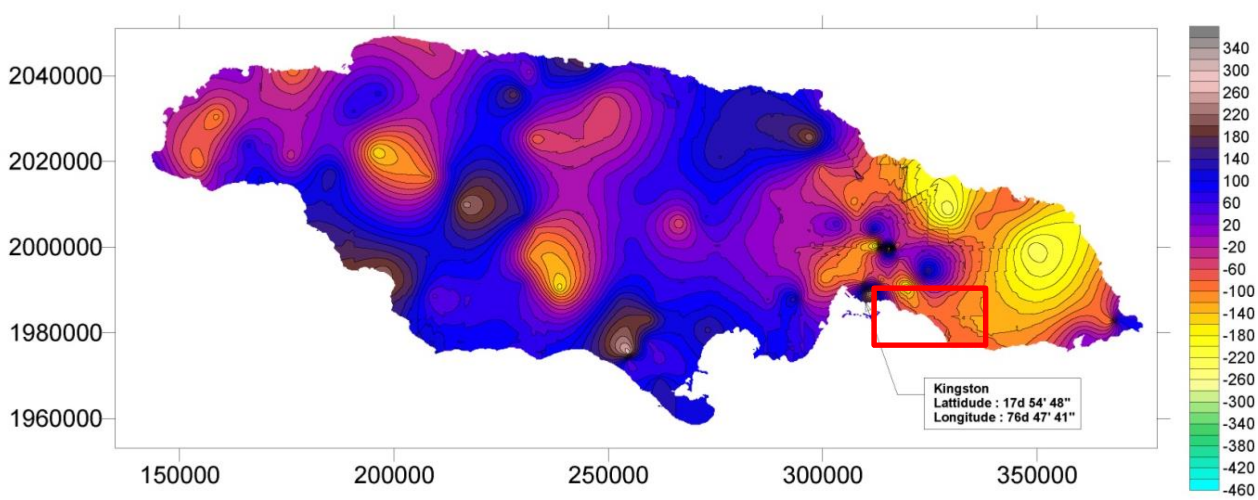


Figure 4-5 Difference (mm) between the 1930-1988 and 1992 to 2008 24-hours Extreme rainfall intensities for the 50 Year Return Period Event, general study area outlined by red box

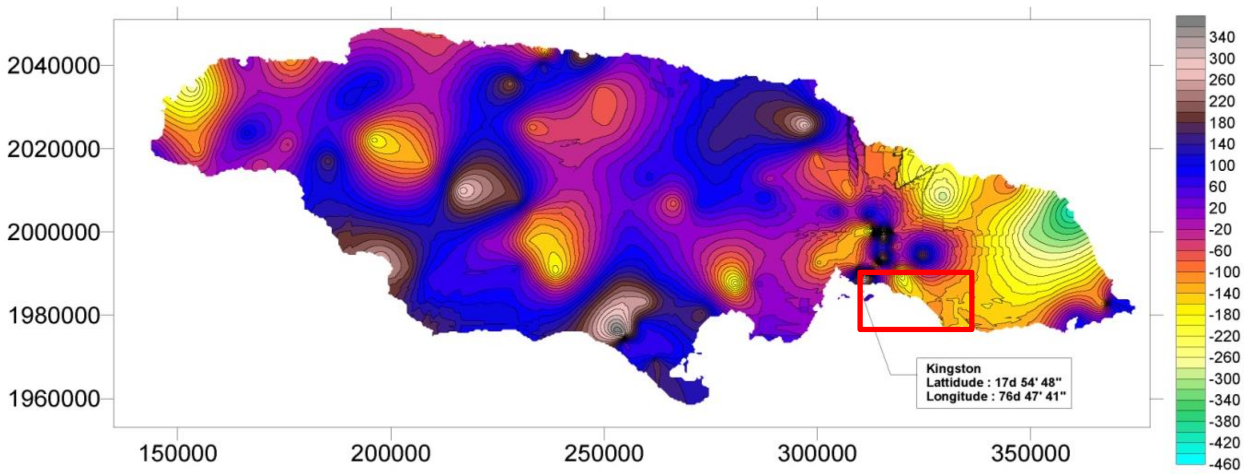


Figure 4-6 Difference (mm) between the 1930-1988 and 1992 to 2008 24-hours Extreme rainfall intensities for the 100 Year Return Period Event, general study area outlined by red box

4.1.2 Topography

Elevation, slope and aspect within the study area may be seen in Figure 4-7, Figure 4-8 and Figure 4-9 respectively. Along the proposed alignment, the existing roadway from Harbour View to Bull Bay consists of generally flat to gently sloping terrain with a maximum slope of 3.7% on the approach to the Chalky River Bridge at 106+000. Generally, slopes were less than 2%. The existing alignment from the Sun Coast Adventure Park (109+500) to Grants Pen (113+350) is very hilly terrain with maximum slopes of 8%. The existing roadway from Grants Pen to the end of the section at the Yallahs River Bridge is flat with slopes generally less than 1%. The new alignment cuts through hilly terrain with a maximum slope of 8% and a new 132m long, four span steel plate girder bridge at 106+925 where it crosses the Bull Bay River.

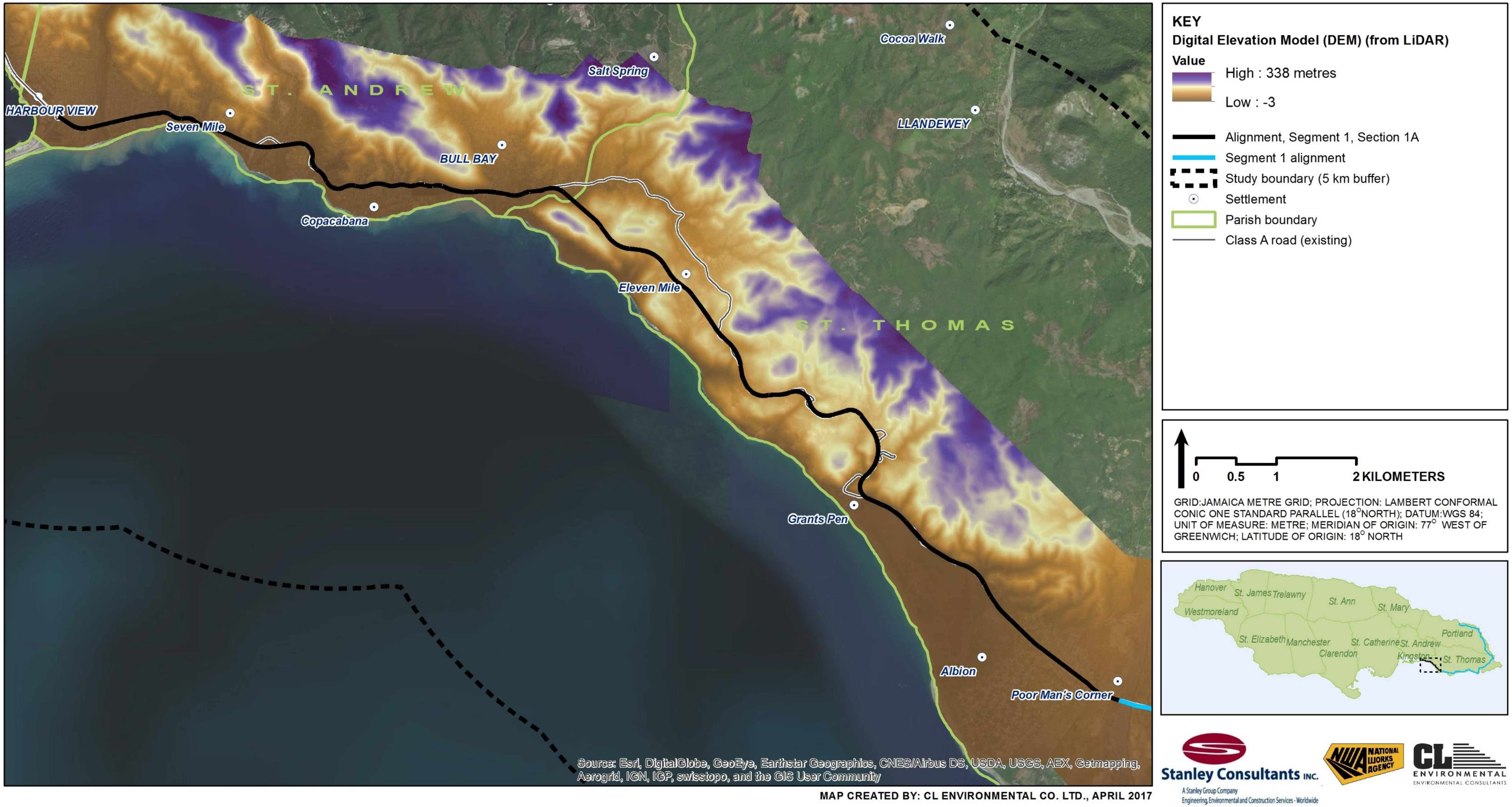


Figure 4-7 Digital elevation model for the study area, Segment 1, Section 1A

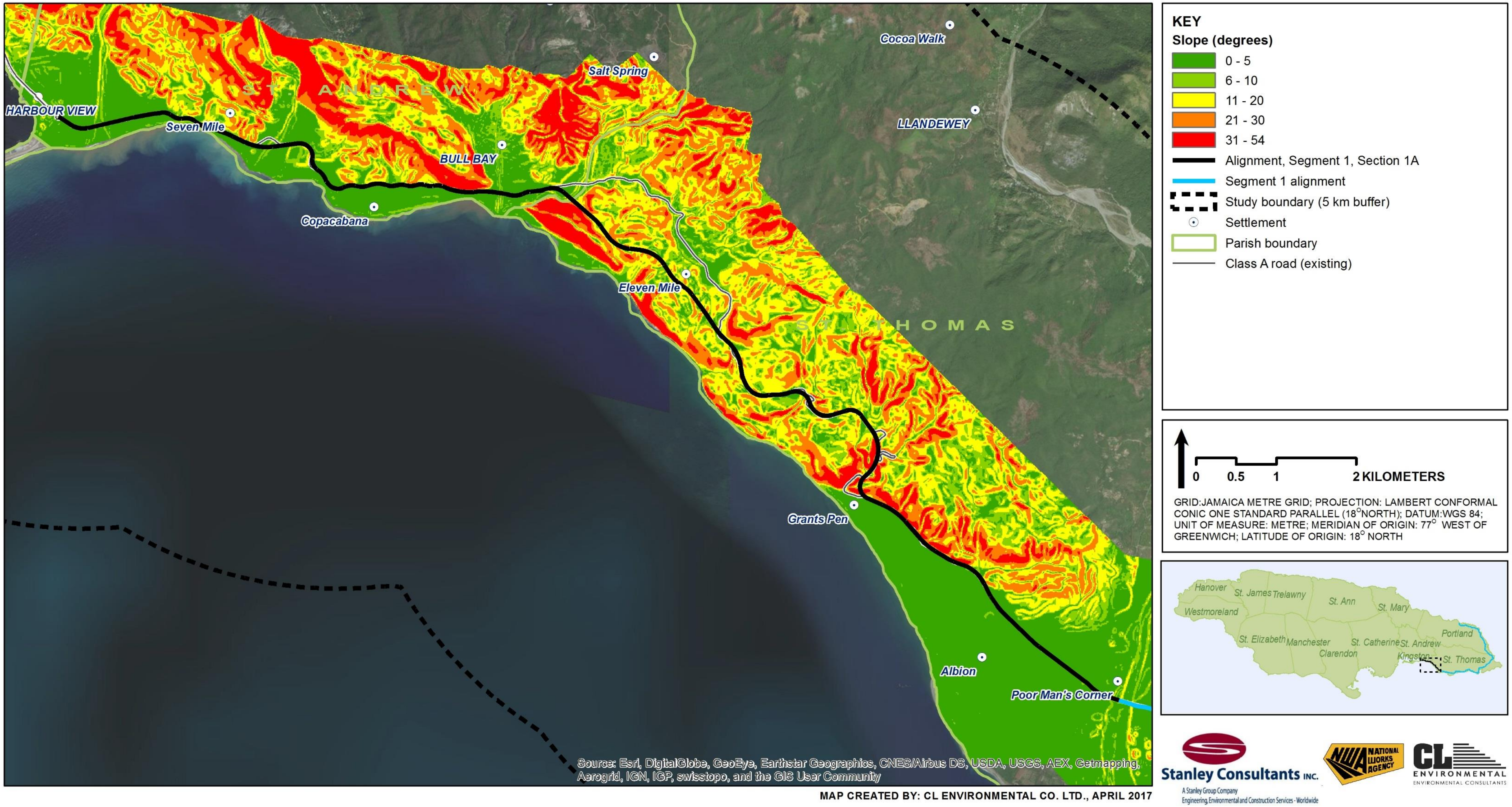


Figure 4-8 Slope, Segment 1, Section 1A

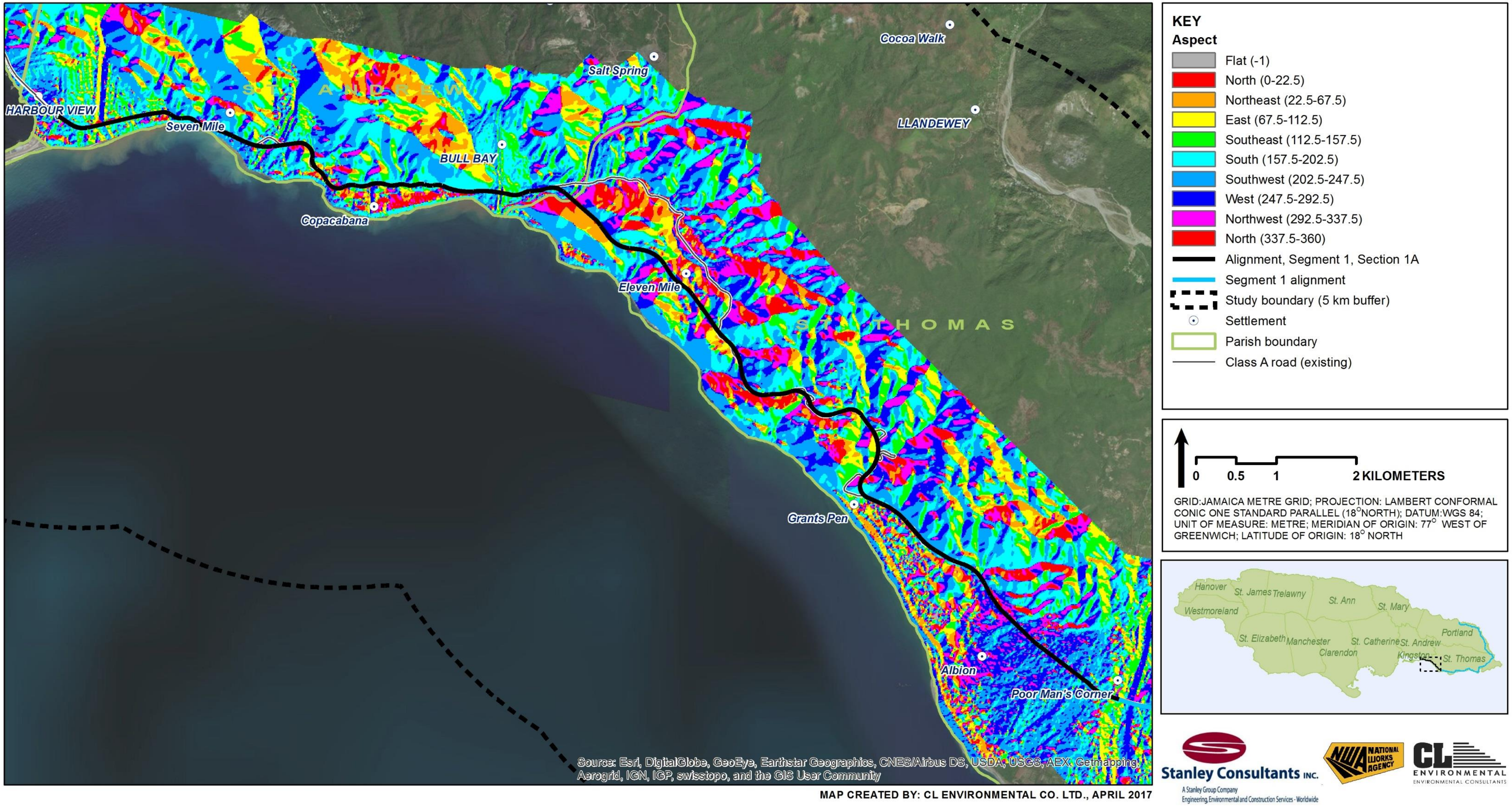


Figure 4-9 Aspect, Segment 1, Section 1A

4.1.3 Geotechnical

4.1.3.1 Geological Formations

Geological formations depicted in Figure 4-10 and found along the proposed alignment include:

- Bellvue Formation (Kgh)
- Coastal Group
- Gibraltar - Bonny Gate Form
- Marshland
- Montpelier Formation

4.1.3.2 Soils

Eleven (11) soil types are found along the alignment for Section 1A, with erosion potential ranging from slight to high (Table 4-2, Figure 4-11).

Table 4-2 Soils through which Segment 1 alignment traverses

Source: Rural Physical Planning Division

Name	Texture	Erosion Potential
Bonnygate	Stony loam	High
BS		Without Rating
Carron Hall	Clay	Moderate
Heartease	Gravelly loam	Slight
Killancholly	Clay	Moderate to high
M		Without Rating
MA		Without Rating
RW		Without Rating
Shrewsbury Ball	Clay	Slight
U		Without Rating
Yallahs	Stony loam	Slight
Yallahs	Loam	Slight

4.1.3.3 Geotechnical Studies

Purpose

A geotechnical program was developed for the SCHIP in order to provide recommendations for embankment cut and fill slopes and initial bridge foundation design criteria. NHL Engineering Limited conducted boring investigations, material testing and reporting for each bore hole. Detailed findings from the field investigation are documented in the *Geotechnical Report*; a summary of this report is presented here.

Field Investigation and Laboratory Testing

Field investigation and laboratory testing services were completed by NHL Engineering Limited. Thirty-one standard penetration (SPT) structure borings and three SPT roadway borings were performed in total for the SCHIP; of these, a total of five locations were found along Section 1A (Figure 4-10). Following the collection of samples for the penetration borings, a laboratory testing program was completed to determine soil properties needed for foundation analysis and design. The testing program included:

- moisture content and density
- Atterberg limits
- sieve (grain size) analysis

Geotechnical Results

Table 4-3 provides a summary of spatial location and geological siting of each structure boring completed within Segment 1 along Section 1A, as of December 31, 2014. Alluvium (Qa) is the main geological formation found at borehole locations along Section 1A. The island of Jamaica is primarily composed of mid-Eocene to Miocene Limestone and Miocene to recent coastal group Quaternary Alluvium that has been eroded by weathering, alluvial processes, and wave action and has undergone regular disruption by earthquakes. Typical alluvial deposits encountered at the borings were composed of silty to sandy clays with a significant portion of gravel and cobbles. The sand and gravel deposits encountered were generally very compact with high relative densities and a component of plastic fines. These materials have low susceptibility to liquefaction under seismic loading. These deposits have high scour potential.

Table 4-3 Location of Geotechnical Bore Holes along section 1A

Structure Boring	Latitude*	Longitude*	Location Description	Seismic Class	Geologic Formation
BR1002	17.94691°N	76.69499°W	7 Miles Bridge - Bull Bay	C: Very dense soil and soft rock	Alluvium (Qa)
BR1003	17.94088°N	76.66802°W	9 Miles Bridge - Bull Bay	C: Very dense soil and soft rock	Alluvium (Qa)
BR1004	17.94036°N	76.65938°W	11Miles Bridge - Bull Bay	D: Stiff soil	Alluvium (Qa)
R1-01	17.92473°N	76.64199°W	12 Miles Bull Bay – St. Thomas	C: Very dense soil and soft rock	Alluvium (Qa)
R1-02	17.90903°N	76.62548°W	Grants Pen – St. Thomas	C: Very dense soil and soft rock	Alluvium (Qa)

**approximate coordinates converted to decimal degrees*

The underlying geology varies along Section 1A alignment. The proposed alignment traverses areas classified as Montpelier Formation, Coastal Group, Marshland and Gibraltar - Bonny Gate Form (Figure 4-10). The geological fault system has been described as a strike slip restraining and releasing bend (Cunningham & Mann, 2007) with an east to west trending fault zone along the north and south coasts. Segment 1 of the Southern Coastal Highway is impacted by two of Jamaica's major fault zones which are linked to Haiti's active fault system. The Wagwater fault zone trends north northwest and is located in the vicinity of Harbour View through Grants Pen (chainage 100+000 through 113+000). The Plantain Garden fault zone affects the eastern portion of the alignment as it travels through St. Thomas Parish.

NHL reported that an, "available seismic risk map for Jamaica indicates that the spectral acceleration for short periods/two second periods with 5% damped acceleration response spectrum for the maximum considered earthquake with a 2% probability of exceedance in 50 years, was deduced as S_1 = 0.3g.". Results from standard penetration resistance and laboratory testing were used to determine seismic soil classifications that are shown in Table 4-3. Table 4-4 shows additional information relating to groundwater resulting from borehole investigations.

Table 4-4 Boring Location, Depth and Groundwater Encountered along section 1A

Boring	Date Completed	Structure Chainage	Northing	Easting	Elev.	Depth (m)	Water Depth (m)
BR1002	17 Nov, 2013	102+807	644138.0	782311.5	12.729	30.5	*
BR1003	20 Nov, 2013	106+030	643487.9	785170.2	15.833	30.5	*
BR1004	27 Nov, 2013	106+693	643432.1	786085.9	21.817	30.5	*
R1-01	27 Jan, 2014	109+606	641705.2	787931.6	78.663	13.1	*
R1-02	1 Dec, 2013	112+899	639971.6	789683.9	26.856	30.5	*

** water not encountered or detected during boring*

.

Figure 4-10 Geological formation and borehole locations along SCHIP Segment 1, Section 1A

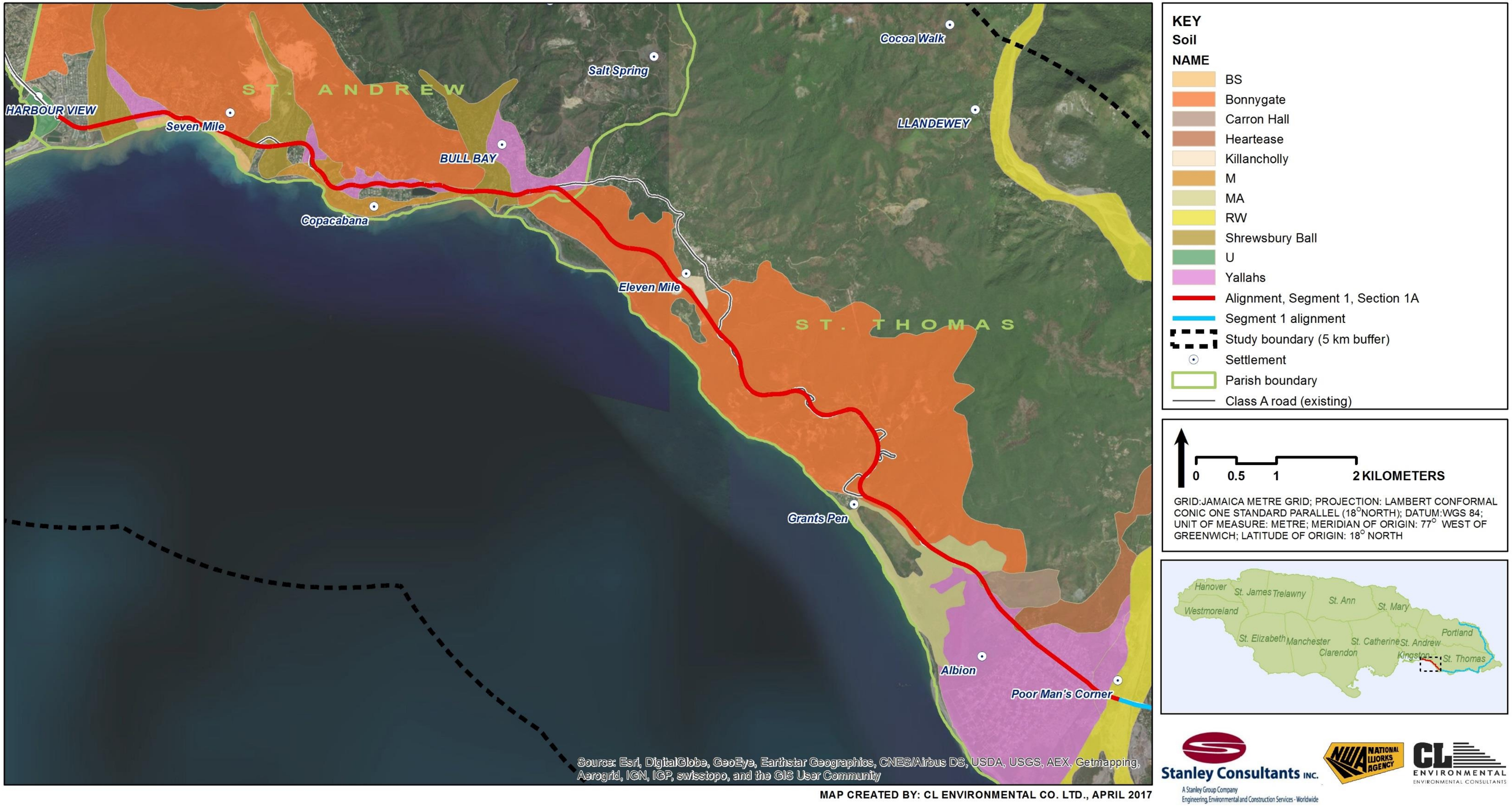


Figure 4-11 Soils along SCHIP Segment 1, Section 1A

4.1.4 Hydrology and Drainage

4.1.4.1 Hydrologic and Hydraulic Analyses

Approach

The following guidelines were used to calculate the design discharges for all hydraulic structures along the proposed highway (see section3.3.2.2 for further details regarding drainage works).

a) Catchment areas were delineated using the ArcHydro tool in ArcGIS, the Watershed Modelling System (WMS) software and manually based on LiDAR Mapping, 1: 12,500 scale topographic maps and Google Earth images where the natural drainage channel was altered by human intervention.

b) The Rational Method was used to compute the peak flows for watersheds with catchment areas less than or equal to 250 acres (101 ha). A runoff coefficient of 0.75 was used across watersheds to represent higher runoffs due to saturated soils and possible future urbanization of the watersheds. The Rational Equation used is as follows:

Rational Equation: $\mathbf{Q = 0.0028ciA}$

Where: Q = Peak discharge (m³/s)
c = Rational method runoff coefficient
i = Rainfall intensity (mm/hour)
A = Drainage area (hectare)

The Velocity Method was used to estimate the time of concentration used in the Rational Method. Given the significant number of drainage basins (55) the time of concentration was calculated assuming shallow concentrated flow conditions. The velocity was estimated based on the TR-55 velocity versus slope for shallow concentrated flow diagram (Appendix A) and that runoff is conveyed above ground in unpaved/grassed waterways. This was done to facilitate quick approximations of the design discharge for the basins where the Rational Method was used. A more robust estimation of the time of concentration would have considered sheet flow, shallow concentrated flow and open channel flow conditions as appropriate. The time of concentration should therefore be reviewed during detailed design applying a more robust estimation technique.

c) The regression equations (Table 4-5)developed by Mr. Ruddy Harrison, formerly of the NWA, were used to determine the rainfall intensities. These regression equations allow for the IDF curves to be used with localised 24-hour rainfall totals. A minimum Time of Concentration of 10 minutes was used to determine rainfall intensity.

Table 4-5 Rainfall IDF relationships at the Norman Manley International Airport developed by Mr. Ruddy Harrison in 2009

Return Period (years)	Rainfall Intensity in i.p.h. or mm/hr	
	$t < 60$ min	$t > 60$ min
2	$i = 2.6125 \ P \times t^{-0.4814}$	$i = 5.9487 \ P \times t^{-0.6822}$
5	$i = 2.5444 \ P \times t^{-0.5119}$	$i = 4.2020 \ P \times t^{-0.6344}$
10	$i = 2.4944 \ P \times t^{-0.5218}$	$i = 3.6597 \ P \times t^{-0.6154}$
25	$i = 2.4556 \ P \times t^{-0.5300}$	$i = 3.2696 \ P \times t^{-0.5999}$
50	$i = 2.4377 \ P \times t^{-0.5343}$	$i = 3.0870 \ P \times t^{-0.5920}$
100	$i = 2.4230 \ P \times t^{-0.5375}$	$i = 2.9552 \ P \times t^{-0.5860}$

i = Rainfall intensity in inches per hour (inch/hour) or millimeters per hour (mm/hr)
P = 24-hour rainfall in inches or mm
t = rainfall duration in minutes

d) The Jamaica 2 Method was used to determine the design flows for catchment areas greater than 250 acres (101.2 ha). The Jamaica 2 Method of hydrologic calculations is recommended and used by the NWA for drainage calculations in Jamaica. A sample of the Jamaica 2 Method calculations is presented in Appendix B. The rainfall depths presented in Table 4-6 were used in the peak flow calculations for all structures falling within the Water Resources Authority (WRA) defined boundaries of the corresponding watersheds. Maps showing the WRA watershed boundaries and spatial distribution of the rainfall stations for Section 1A are presented in Figure 4-12.

e) Design discharges were computed on the assumption that Antecedent Moisture Condition (AMC) III or saturated conditions exists at the start of the storm event. For this reason, a uniform CN value of 85 which represents AMC III conditions was applied across the watersheds to determine runoff hydrographs.

f) A surcharge of 10% was added to the calculated peak discharges to arrive at the design discharge based on NWA guidelines. This guideline was developed to account for climate change impact, uncertainties in the rainfall data resulting from the loss of approximately 30 years of data by the Met Office and potential urbanization of sections of the watersheds.

Table 4-6 Rainfall Data for Peak Flow Calculations for Section 1A

Watershed	IDF curve	Rainfall Station	24-hour Rainfall totals (mm)			
			10yr	25yr	50yr	100yr
Hope River	Kingston	Gordon Town	315	402	467	532
Cane River	Kingston	Gordon Town	315	402	467	532
Chalky River	Kingston	Mavis Bank	313	400	465	529
Bull Bay River	Kingston	Mavis Bank	313	400	465	529
Yallahs River	Kingston	Mavis Bank	313	400	465	529

Catchment Area Delineation

The catchments were delineated using the ArcHydro tool and ArcGIS. There were 55 catchments delineated. The LiDAR data and island wide DEM of Jamaica were used in the delineation of the watershed boundaries. The catchments were grouped into three categories (Table 4-7) based on the design criteria and method of computation. Detailed delineation of the watershed boundaries is presented in Appendix C.

Table 4-7 Catchments Areas, Design Criteria and Method of Computation – Section 1A

Categories	Quantity	Design Criteria*	Method
≥ 202 ha (500 acres)	6	50 year	Jamaica 2
≥ 101 < 202 ha (≥250 < 500 acres)	3	25 year	Jamaica 2
< 101 ha (250 acres)	46	25 year	Rational

** Bridges were designed for the 100-year storm irrespective of the size of the catchment.*

Peak Flow and Design Discharge Calculations

A summary of the watershed characteristics and design discharges are presented Figure 4-13 through to Figure 4-16and Table 4-8.

4.1.4.2 Drainage Issues along Alignment

Most of the drainage issues along the existing roadway were identified during a detailed assessment and mapping of the drainage structures which was conducted as part of a comprehensive drainage assessment along the existing roadway. The complete findings of the drainage assessment are presented in the "*Drainage Assessment Report*" prepared by Stanley Consultants and dated June 2013.

The following drainage issues were identified along the existing roadway from Harbour View to the Yallahs River Bridge:

- Flooding along the corridor occurs at the following locations during storm events:
  - Harbour View (100+100 to 300+400)
  - Bull Bay Football Club Playfield (103+500 to 103+700)
  - Wickie Wackie (104+080 to 104+400)
  - Pond Side Corner (104+800)
  - Bull Bay River Bridge (107+000)
- Most of the culverts were in disrepair and needed to be changed
- Scour was observed at several culvert outlets
- Many of the culverts were completely or significantly blocked
- The Cane River (102+800) and Chalky River (106+050) carries a lot of sediment during storm events and sediment deposition at the bridge reduces the capacity of the bridge openings.

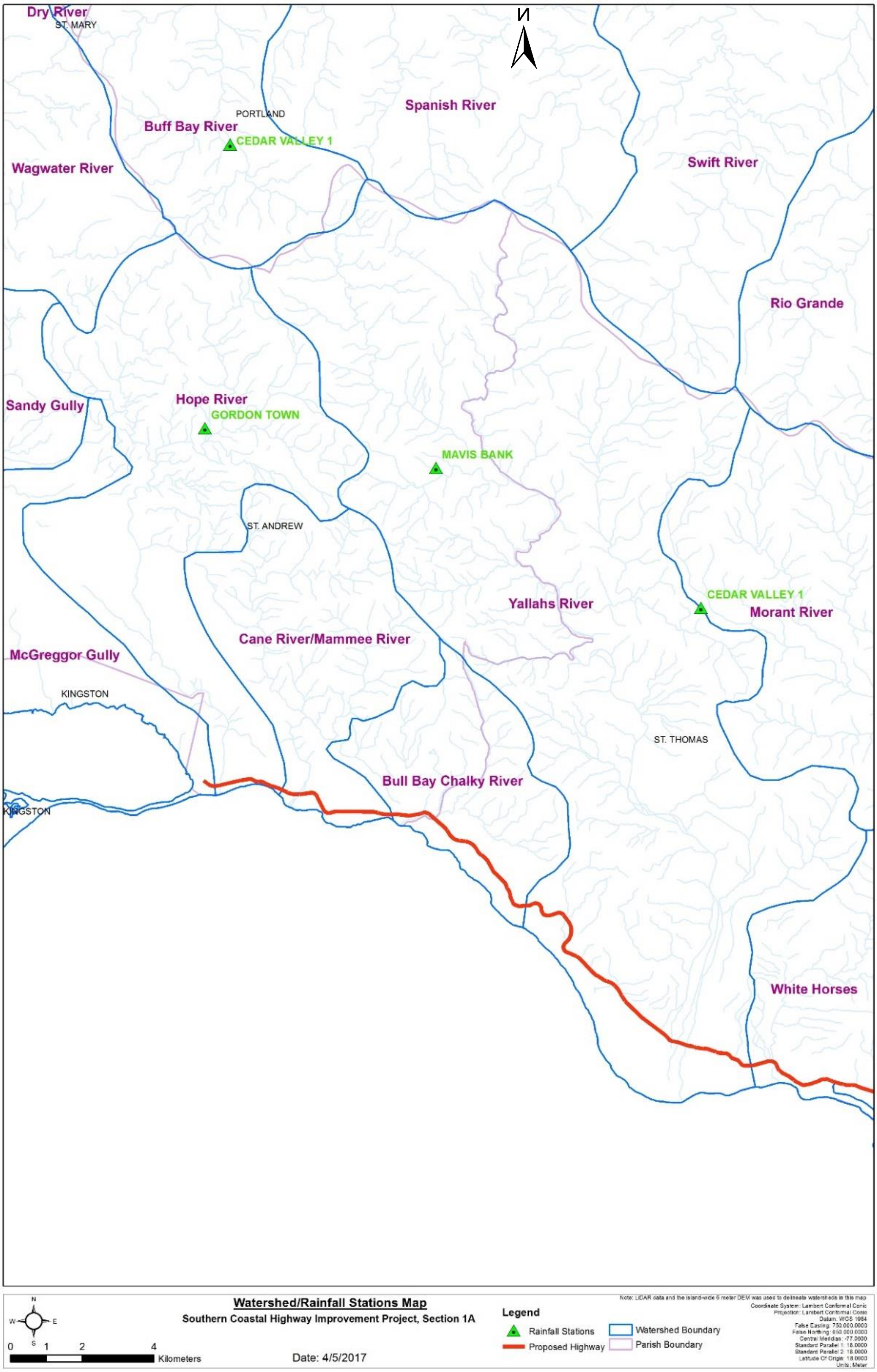


Figure 4-12 Hydrologic Boundaries and Spatial Distribution of the Rainfall Stations for Section 1A

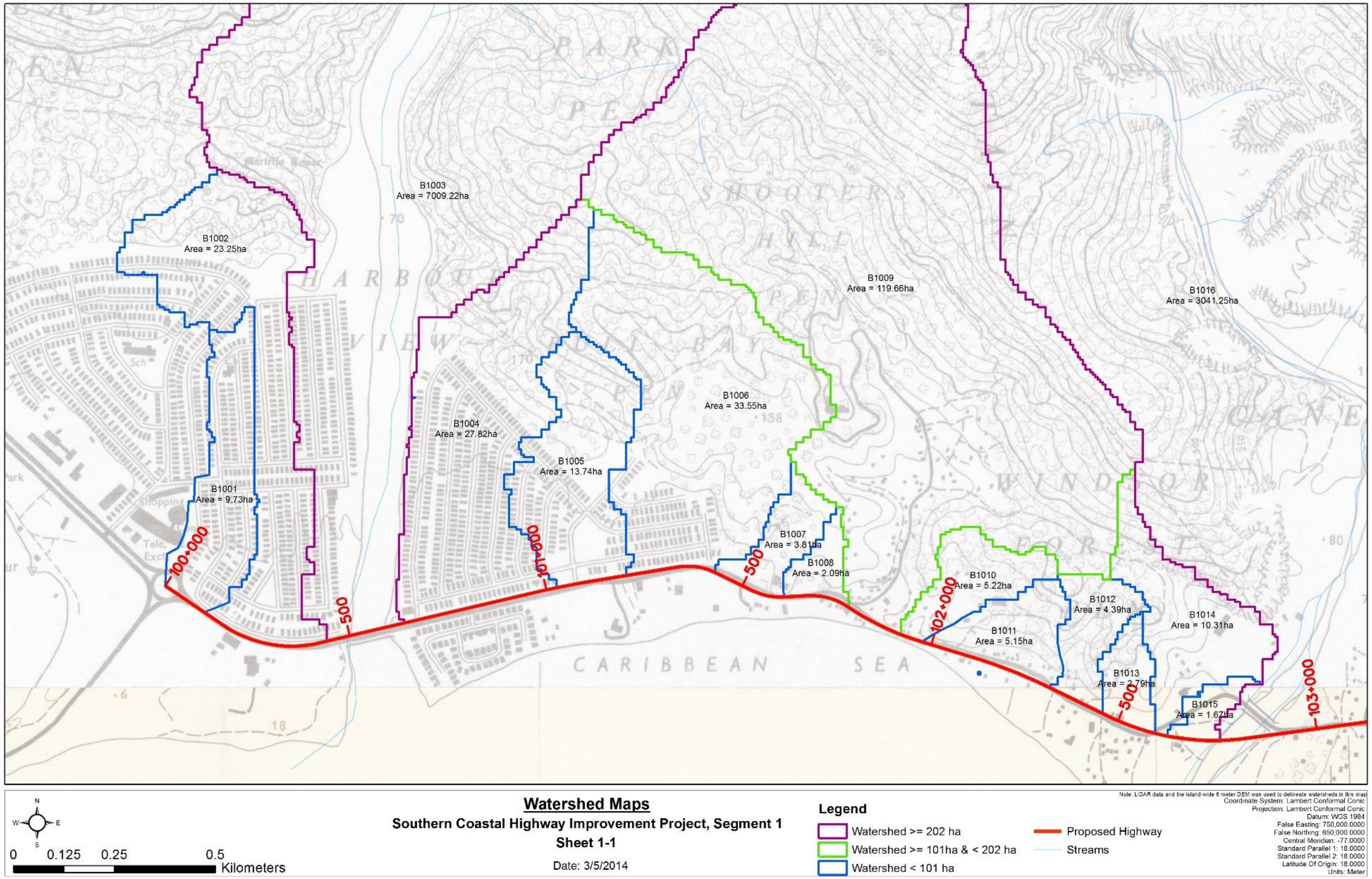


Figure 4-13 Delineated catchment areas, 100+000 to 130+000

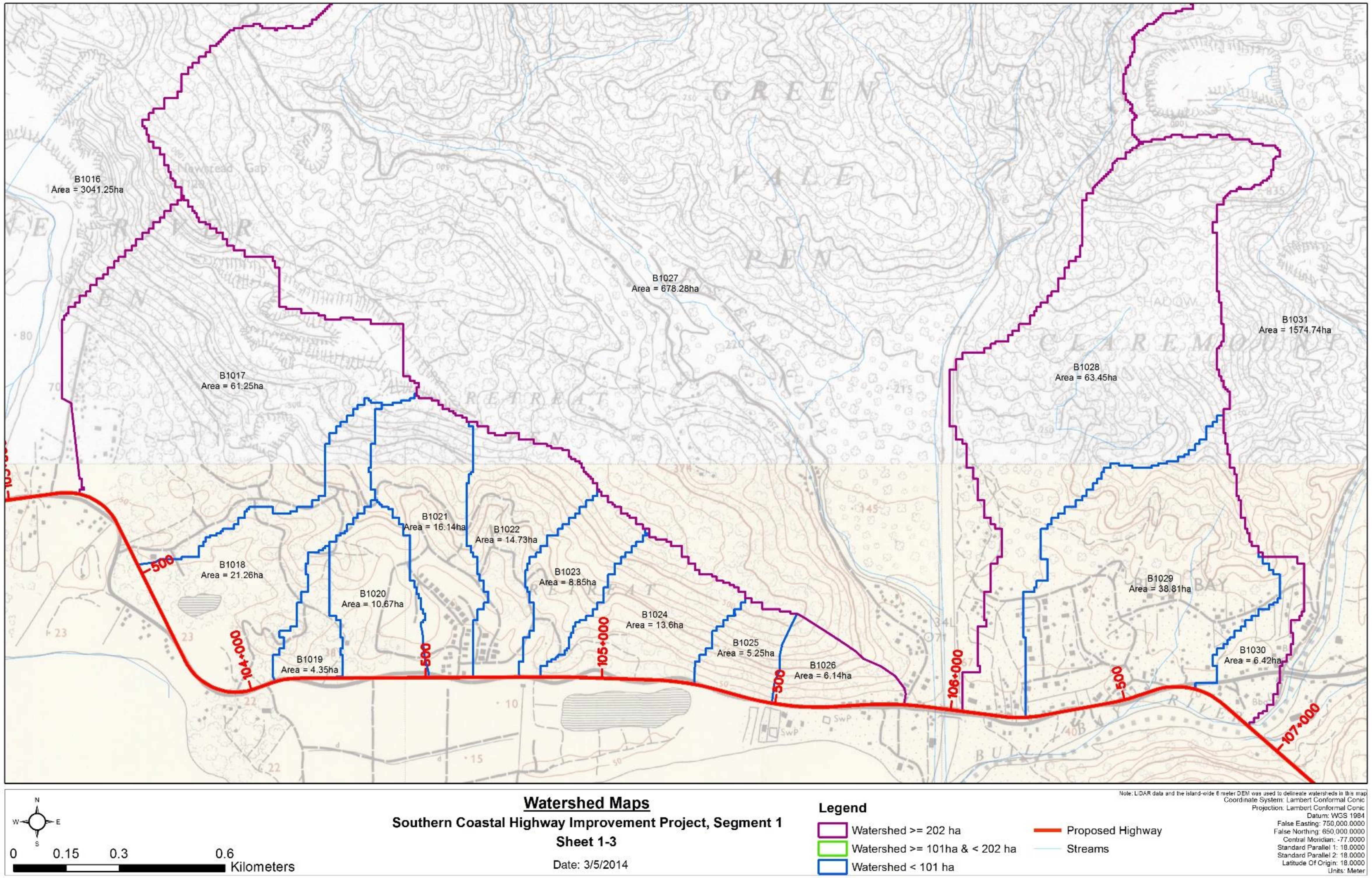


Figure 4-14 Delineated catchment areas, 130+000 to 107+000

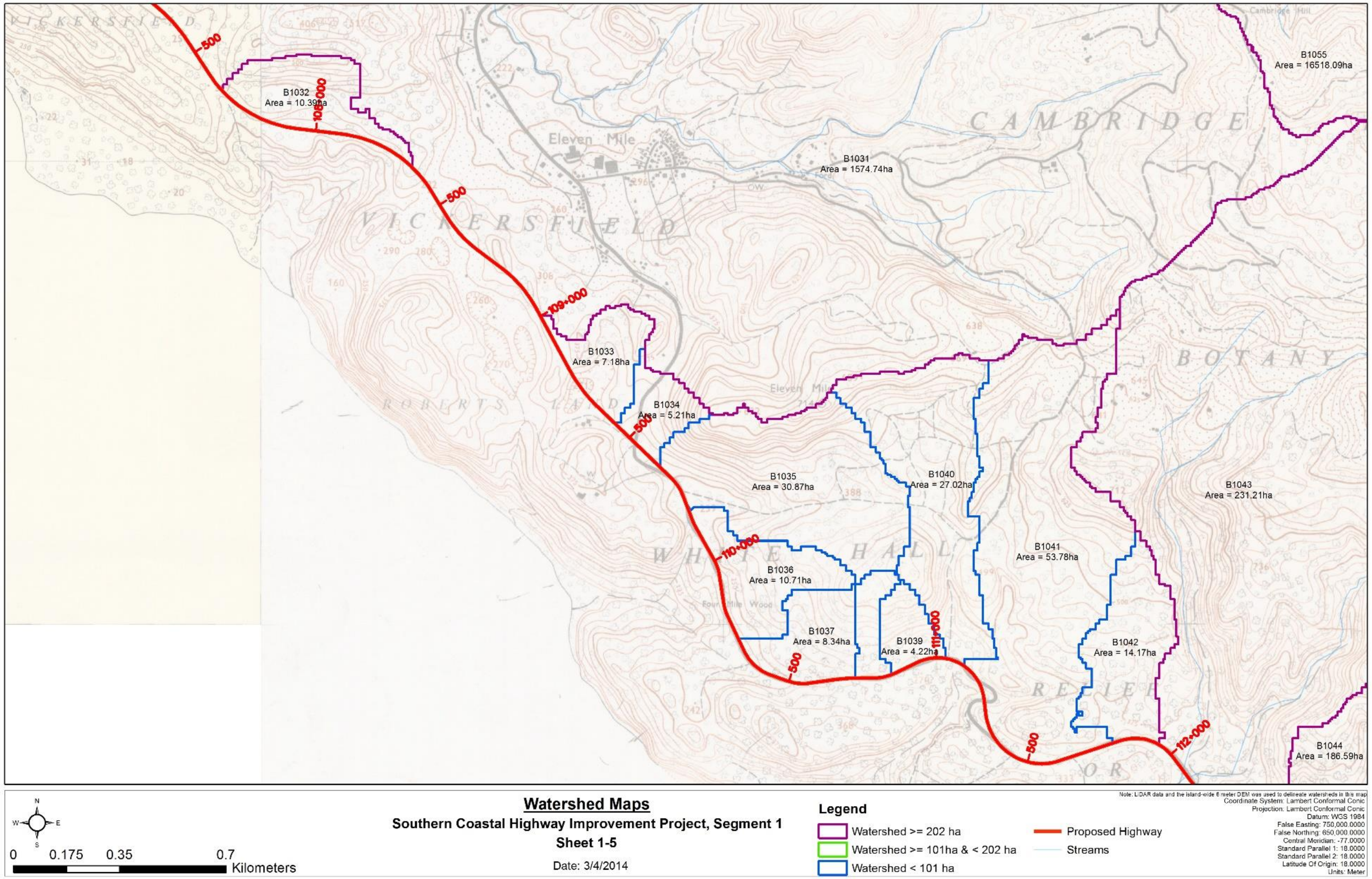


Figure 4-15 Delineated catchment areas, 107+000 to 112+000

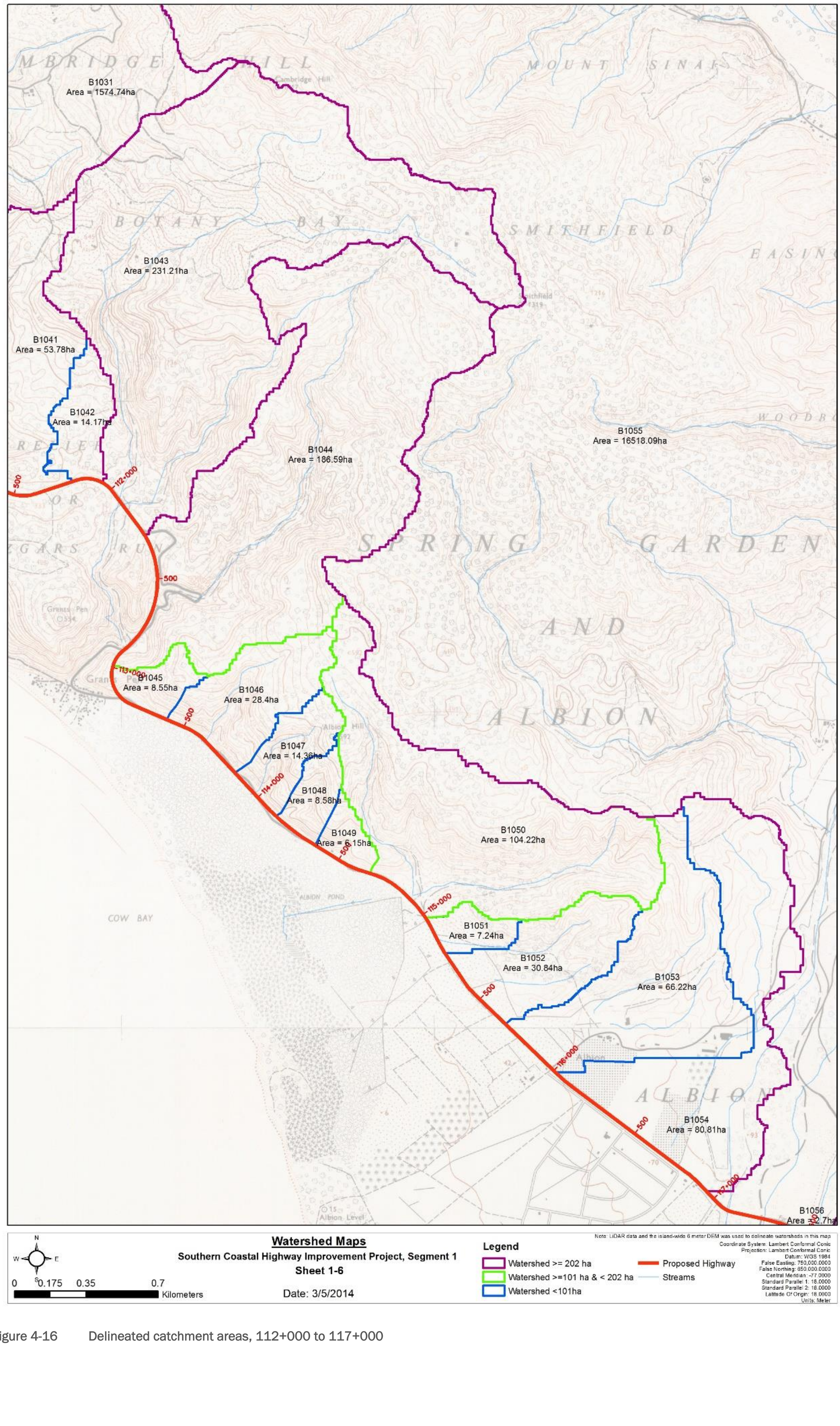


Figure 4-16 Delineated catchment areas, 112+000 to 117+000

Table 4-8 Summary of Watershed Characteristics and Design Discharge Calculations – Section 1A

Southern Coastal Highway Improvement Project – design discharge calculations (Segment 1)													
Basin ID	Chainage	River / Stream	Drainage Area	Watercourse Length	Runoff Coeff.[1]		T_c[2]	24-hour Rainfall	Return Period	Peak Discharge (Q_P)	Design Discharge[3] (Q_D)	100yr 24-hour Rainfall	100yr Design Discharge[3] (Q_{D100yr})
			(ha)	(m)	CN	C	(min)	(mm)	(year)	(m^3/s)	(m^3/s)	(mm)	(m^3/s)
B1001	100+077	Unknown	9.73	987		0.75	25.7	402	25yr	3.6	4.0	532	5.1
B1002	100+320	Unknown	23.25	1816		0.75	32.9	402	25yr	7.6	8.4	532	10.6
B1003	100+550	**Hope River**	7,009.22	23422	85		200.7	532	100yr	1463.0	1609.3	532	1609.3
B1004	100+870	Unknown	27.82	1445		0.75	14.7	402	25yr	13.9	15.3	532	19.6
B1005	101+083	Unknown	13.74	1070		0.75	13.1	402	25yr	7.3	8.0	532	10.2
B1006	101+404	Unknown	33.55	1419		0.75	14.5	402	25yr	16.9	18.6	532	23.8
B1007	101+459	Unknown	3.81	430		0.75	4.3	402	25yr	2.3	2.5	532	3.3
B1008	101+685	Unknown	2.09	333		0.75	3.3	402	25yr	1.3	1.4	532	1.8
B1009	101+790	Unknown	119.66	2615	85		55.6	402	25yr	39.3	43.2	532	61.1
B1010	101+944	Unknown	5.22	511		0.75	4.5	402	25yr	3.2	3.5	532	4.5
B1011	102+150	Unknown	5.15	373		0.75	2.8	402	25yr	3.2	3.5	532	4.4
B1012	102+365	Unknown	4.39	450		0.75	3.7	402	25yr	2.7	3.0	532	3.7
B1013	102+470	Unknown	2.79	347		0.75	2.8	402	25yr	1.7	1.9	532	2.4
B1014	102+625	Unknown	10.31	989		0.75	8.7	402	25yr	6.3	6.9	532	8.9
B1015	102+713	Unknown	1.67	389		0.75	11.6	402	25yr	0.9	1.0	532	1.3
B1016	102+812	**Cane River**	3,041.25	14474	85		142.9	532	100yr	785.3	863.8	532	863.8
B1017	103+410	Unknown	61.25	1280		0.75	10.2	402	25yr	37.2	40.9	532	52.5
B1018	103+682	Unknown	21.26	1102		0.75	8.6	402	25yr	13.0	14.3	532	18.4
B1019	104+214	Unknown	4.35	452		0.75	5.3	402	25yr	2.7	3.0	532	3.7
B1020	104+360	Unknown	10.67	688		0.75	6.3	402	25yr	6.5	7.2	532	9.2
B1021	104+530	Unknown	16.14	969		0.75	7.0	402	25yr	9.9	10.9	532	14.0
B1022	104+740	Unknown	14.73	944		0.75	6.8	402	25yr	9.0	9.9	532	12.8
B1023	104+786	Unknown	8.85	716		0.75	4.7	402	25yr	5.4	5.9	532	7.6
B1024	104+970	Unknown	13.60	640		0.75	4.0	402	25yr	8.3	9.1	532	11.8
B1025	105+410	Unknown	5.25	293		0.75	1.4	402	25yr	3.2	3.5	532	4.5
B1026	105+610	Unknown	6.14	293		0.75	1.4	402	25yr	3.8	4.2	532	5.3
B1027	106+000	Chalky River	678.28	4781	85		72.9	529	100yr	255.4	280.9	529	280.9
B1028	106+140	Unknown	63.45	2252		0.75	21.8	400	25yr	25.5	28.1	529	35.9
B1029	106+260	Unknown	38.81	1419		0.75	11.9	400	25yr	21.6	23.8	529	30.4
B1030	106+722	Unknown	6.42	812		0.75	9.5	400	25yr	3.9	4.3	529	5.5
B1031	106+925	**Bull Bay River**	1,574.74	9468	85		147.7	529	100yr	394.8	434.3	529	434.3
B1032	108+000	Unknown	10.39	499		0.75	4.9	400	25yr	6.3	6.9	529	8.9
B1033	109+271	Unknown	7.18	476		0.75	4.9	400	25yr	4.4	4.8	529	6.2
B1034	109+635	Unknown	5.21	609		0.75	4.8	400	25yr	3.2	3.5	529	4.5
B1035	109+820	Unknown	30.87	994		0.75	8.9	400	25yr	18.8	20.7	529	26.5
B1036	110+090	Unknown	10.71	570		0.75	4.6	400	25yr	6.5	7.2	529	9.2
B1037	110+500	Unknown	8.34	703		0.75	6.7	400	25yr	5.1	5.6	529	7.2
B1038	110+824	Unknown	3.29	447		0.75	3.2	400	25yr	2.0	2.2	529	2.9
B1039	110+934	Unknown	4.22	333		0.75	2.1	400	25yr	2.6	2.9	529	3.6
B1040	111+059	Unknown	27.02	1383		0.75	15.8	400	25yr	12.9	14.2	529	18.2
B1041	111+206	Unknown	53.78	2113		0.75	25.9	400	25yr	19.8	21.8	529	27.7
B1042	111+830	Unknown	14.17	981		0.75	11.5	400	25yr	8.0	8.8	529	11.3
B1043	112+125	Unknown	231.21	3789	85		77.8	465	50yr	74.8	82.3	529	96.4
B1044	112+880	Unknown	186.59	3538	85		75.0	400	25yr	51.1	56.2	529	79.4
B1045	113+225	Unknown	8.55	495		0.75	3.4	400	25yr	5.2	5.7	529	7.4
B1046	113+620	Unknown	28.40	1033		0.75	8.2	400	25yr	17.3	19.0	529	24.4
B1047	113+970	Unknown	14.36	732		0.75	5.0	400	25yr	8.7	9.6	529	12.3

Southern Coastal Highway Improvement Project – design discharge calculations (Segment 1)													
Basin ID	Chainage	River / Stream	Drainage Area	Watercourse Length	Runoff Coeff.[1]		Tc[2]	24-hour Rainfall	Return Period	Peak Discharge (Q_P)	Design Discharge[3] (Q_D)	100yr 24-hour Rainfall	100yr Design Discharge[3] (Q_{D100yr})
			(ha)	(m)	CN	C	(min)	(mm)	(year)	(m³/s)	(m³/s)	(mm)	(m³/s)
B1048	114+185	Unknown	8.58	618		0.75	3.9	400	25yr	5.2	5.7	529	7.4
B1049	114+465	Unknown	6.15	424		0.75	2.5	400	25yr	3.7	4.1	529	5.3
B1050	114+955	Unknown	104.22	2013	85		54.3	400	25yr	34.5	38.0	529	53.5
B1051	115+107	Unknown	7.24	549		0.75	5.2	400	25yr	4.4	4.8	529	6.3
B1052	115+214	Unknown	30.84	1212		0.75	14.4	400	25yr	15.5	17.1	529	21.8
B1053	115+730	Unknown	66.22	1929		0.75	23.8	400	25yr	25.4	27.9	529	35.6
B1054	116+238	Unknown	80.81	1553		0.75	17.0	400	25yr	37.1	40.8	529	52.1
B1055	117+225	Yallahs River	16,518.09	41993	85		279.6	529	100yr	2814.5	3096.0	529	3096.0

1The Runoff Coefficient assumes possible future developments within the watersheds

2The minimum Time of Concentration used 10 minutes.

3Design Discharge is adjusted by a factor ranging from 0.1 to 1.1 times the peak discharge

4.1.4.3 Groundwater

Section 4.4.1.7 details all wells and water resources which fall within 5km of the proposed alignment. Further, Table 4-4 shows information relating to groundwater resulting from borehole investigations.

4.1.5 Water Quality

Whole water samples were collected at various stations during the 2014 Environmental Study and analysed for Fats, Oil and Grease (FOG), Total Suspended Solids (TSS), phosphates, nitrates and faecal coliform. Temperature, conductivity, salinity, pH, turbidity, were measured *in situ* using a Hach Hydrolab DataSonde-5 multi probe water quality meter.

The only two water bodies that exist along the Section 1A alignment were the Hope River and Cane River well. At the time of sampling, the Hope River was dry and the Cane River well was inaccessible.

4.1.6 Air Quality (Ambient Particulates)

4.1.6.1 Definitions

Coarse particles are airborne pollutants that fall between 2.5 and 10 micrometres in diameter. Fine particle are airborne pollutants that fall below 2.5 micrometres in diameter. Sources of coarse particles include crushing or grinding operations, and dust stirred up by vehicles traveling on roads. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

4.1.6.2 Methodology

PM10 and PM2.5 particulate sampling exercises were conducted at the six (6) locations (where noise monitoring was conducted) for 24 hours each using Airmetrics Minivol Tactical Air Samplers. The locations are listed in Table 4-11 and illustrated in Figure 4-17. The PM10 sampling exercise was conducted from 12:00am – 12:00am on February 9th – 10th, 12th – 13th, 2017 and March 15th – 16th, 2017, whilst the PM2.5 sampling exercises were conducted from 12:00am – 12:00am on February 11th – 12th, 2017, March 14th – 15th and 16th – 17th, 2017.

4.1.6.3 Results

PM10

The results of the PM10 sampling run is shown in Table 4-9 below. All locations had average particulate PM10 values compliant with the 24-hour NEPA standard of 150μg/m^3. The proximity of the monitoring stations to the existing roadway will result in the stirring up of particulates from vehicles traversing the road. Station 6 had the highest average PM10 value as well as one incidence of non-compliance on February 12th, 2017 (163.47 μg/m^3).

Table 4-9 PM 10 Results

STATION	AVERAGE PM10 RESULT (µg/m³)	RANGE (µg/m³)	NEPA/US EPA STD. (µg/m³)
STN 1	**22.36**	4.58 – 46.67	150
STN 2	**49.03**	28.06 – 61.67	150
STN 3	**44.95**	25.14 – 79.72	150
STN 4	**25.63**	24.58 – 26.67	150
STN 5	**20.37**	8.89 – 33.47	150
STN 6	**79.82**	27.92 – 163.47	150

Values in red are non-compliant with NEPA standards

PM2.5

The results of the PM2.5 sampling run is shown in Table 4-10. All locations had average particulate PM2.5 values non-compliant with the 24-hour NEPA PM2.5 standard of 35µg/m³. The elevated PM2.5 values along the existing roadway may be because of exhaust emissions from motor vehicles or from residential burning of fires.

Table 4-10 PM 2.5 Results

STATION	AVERAGE PM2.5 RESULT (µg/m³)	RANGE (µg/m³)	NEPA/US EPA STD. (µg/m³)
STN 1	**127.96**	30.42 – 185.28	35
STN 2	**94.58**	47.64 – 138.19	35
STN 3	**228.98**	174.85 – 306.25	35
STN 4	**191.79**	158.44 – 249.72	35
STN 5	**64.35**	17.08 – 90.28	35
STN 6	**128.42**	97.64 – 185.56	35

Values in red are non-compliant with NEPA standards

4.1.7 Noise

4.1.7.1 Methodology

Noise level readings were taken from 7:00am Thursday February 9th, 2017 to 7:00am Saturday February 11th, 2017, by using Quest Technologies SoundPro DL Type 1 hand held sound level meters with real time frequency analyser setup in an outdoor monitoring kit. The octave band analysis was conducted concurrently with the noise level measurements. Measurements were taken in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz (low, medium and high frequency bands).

The noise meters were calibrated pre and post noise assessment by using a Quest QC - 10 sound calibrator. The meters were programmed using the Quest Suite Professional II (QSP II) software to collect third octave, average sound level (Leq) over the period, Lmin (The lowest level measured during the assessment) and Lmax (The highest level measured during the assessment) every ten seconds.

Average noise levels over the period were calculated within the QSP II software using the formula;

$$\textit{Average dBA} = 20 \log 1/N \quad \sum_{j=1}^{N} 10^{(Lj/20)}$$

where N = number of measurements, L_j = the jth sound level and j = 1, 2, 3 .... N.

Six (6) noise meters with outdoor monitoring kits were set up. These meters were left for the entire seventy-two (72) hour assessment period in an outdoor measuring system and programmed to collect data every 10 seconds. Table 4-11 and Figure 4-17 lists and shows the locations of the noise monitoring stations. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphone of the meters was at a height of approximately 1.5m above ground and had an unobstructed view of the roadway (>135°). There were no vertical reflecting surfaces within 3 m (10 feet) of the microphone.

Noise statistics (L_{10} and L_{90}) were also calculated at each location.

Table 4-11 Noise and dust monitoring location coordinates

STATION #	LOCATION (JAD2001)	
	NORTHINGS (m)	EASTINGS (m)
N1P1	780059.1	644278.5
N2P2	782683.6	644137.5
N3P3	784925.2	643523.3
N4P4	786010.9	643505.5
N5P5	789677.2	640681.6
N6P6	792316.1	637495.2

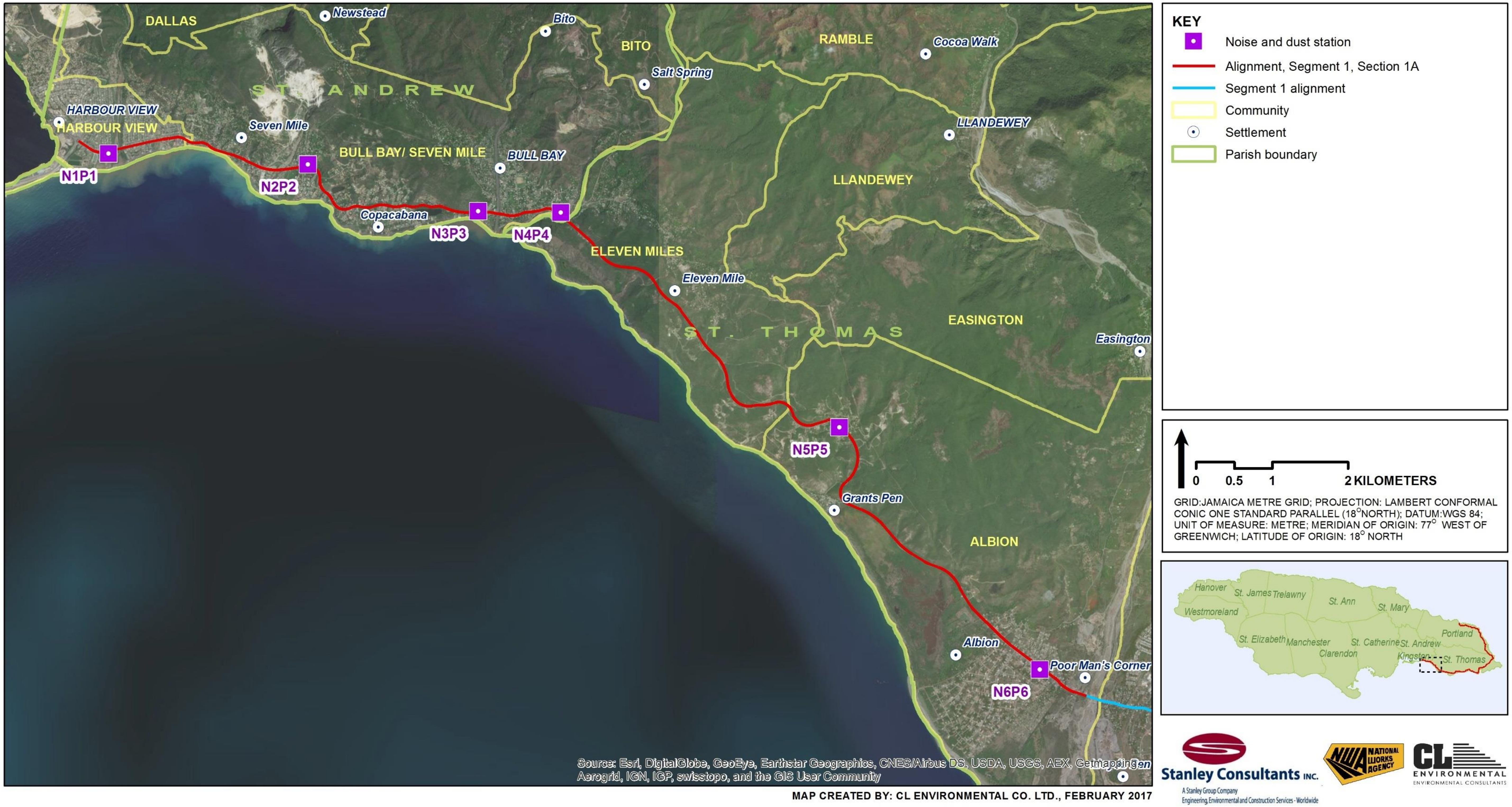


Figure 4-17 Location of noise and particulate monitoring stations

4.1.7.2 Results

Table 4-12 shows the minimum, maximum and average noise levels over the 72-hour assessment period, as well as the geometric mean centre frequencies obtained at each station. The noise meter at Station N5 did not run due to equipment malfunction.

Table 4-12 Ambient Noise data at all stations

Stn.#	Average Leq (72 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	60.7	40.5	92.9	12.5	11 - 14
N2	70.6	33.3	98.1	80	71 - 90
N3	68.9	38.4	98.1	63	56 - 71
N4	81.4	31.2	101.7	800	713 - 898
N5	N/A	N/A	N/A	N/A	N/A
N6	59.9	27.1	92.4	63	56 - 71

** Meter at Station 5 did not run due to malfunction*

Station 1

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 40.5 dBA to a high (Lmax) of 92.9 dBA. Average noise level for this period was 60.7 L_{Aeq} (72h). The fluctuation in noise levels over the 72 hour period is depicted in Figure 4-18.

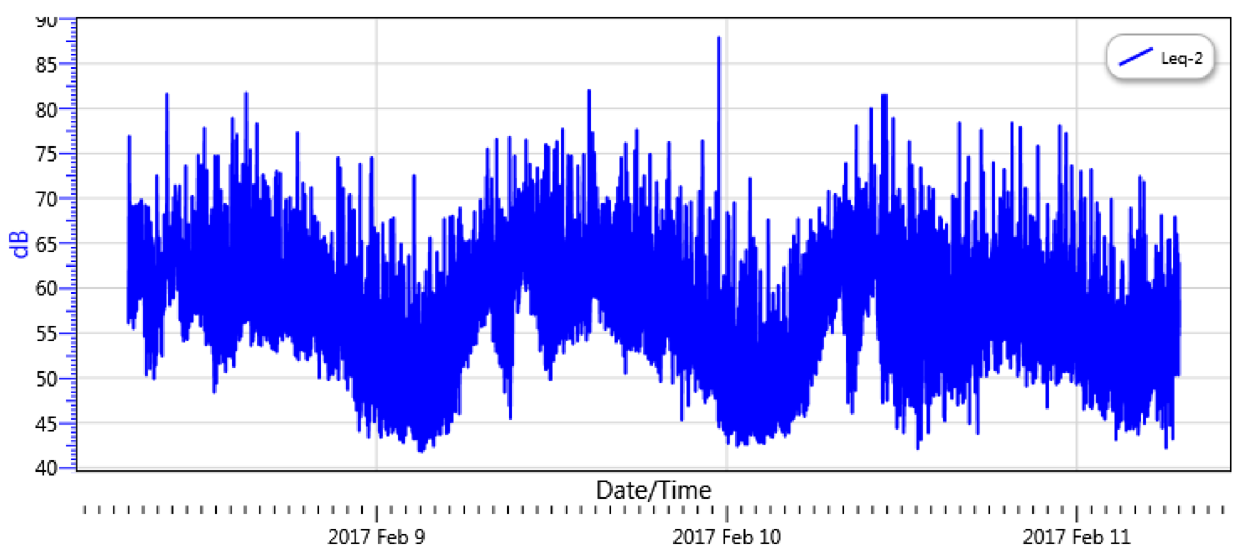


Figure 4-18 Noise fluctuation (Leq) over 72 hours at Station 1

OCTAVE BAND ANALYSIS AT STATION 1

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 12.5 Hz. (octave frequency range is 11 - 14 Hz) (Figure 4-19).

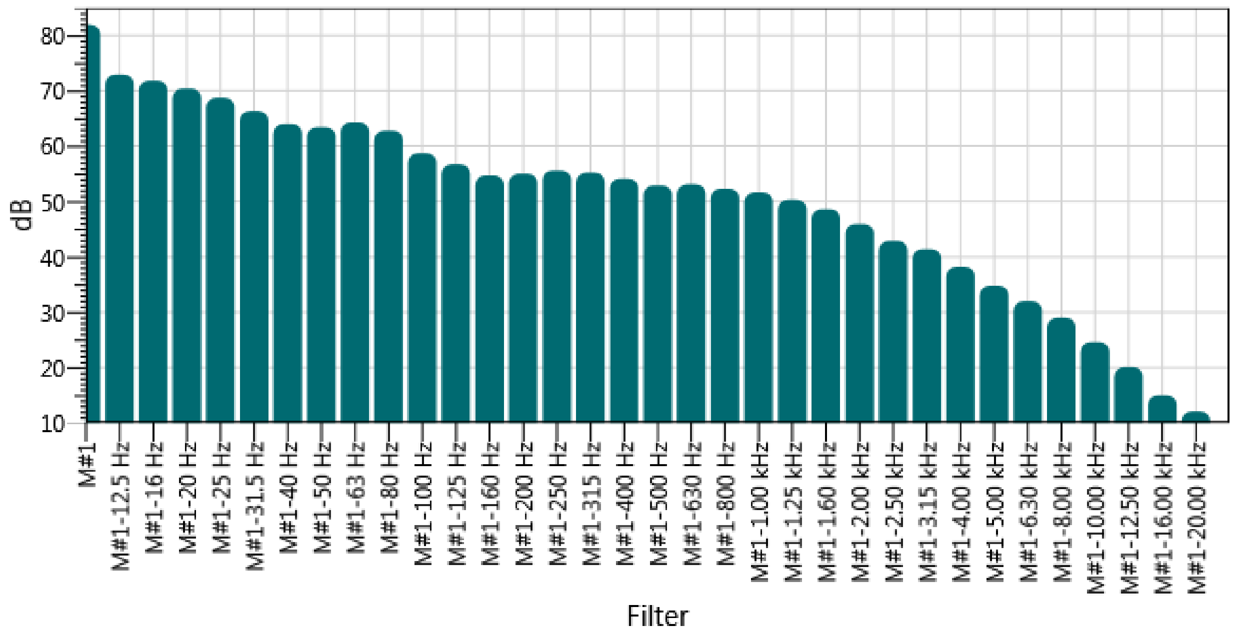


Figure 4-19 Octave band spectrum of noise at Station 1

L10 AND L90

The two most common L_n values used are L_{10} and L_{90} and these are sometimes called the 'annoyance level' and 'background level' respectively. L_{10} is almost the only statistical value used for the descriptor of the higher levels, but L_{90}, is widely used to describe the ambient or background level. L10-L90 is often used to give a quantitative measure as to the spread or "how choppy" the sound was.

L10 is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic. L90 is the noise level exceeded for 90% of the time of the measurement duration. The difference between L10 and L90 gives an indication of the noise climate. When the difference is < 5 dBA then it is considered that there are no significant fluctuations in the noise climate, moderate fluctuations 5-15 dBA and large fluctuations >15 dBA.

Figure 4-20 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈100 % of the time) in the noise climate at this station. The overall L10 and L 90 at this station for the time assessed were 63.6 dBA and 48.6 dBA respectively.

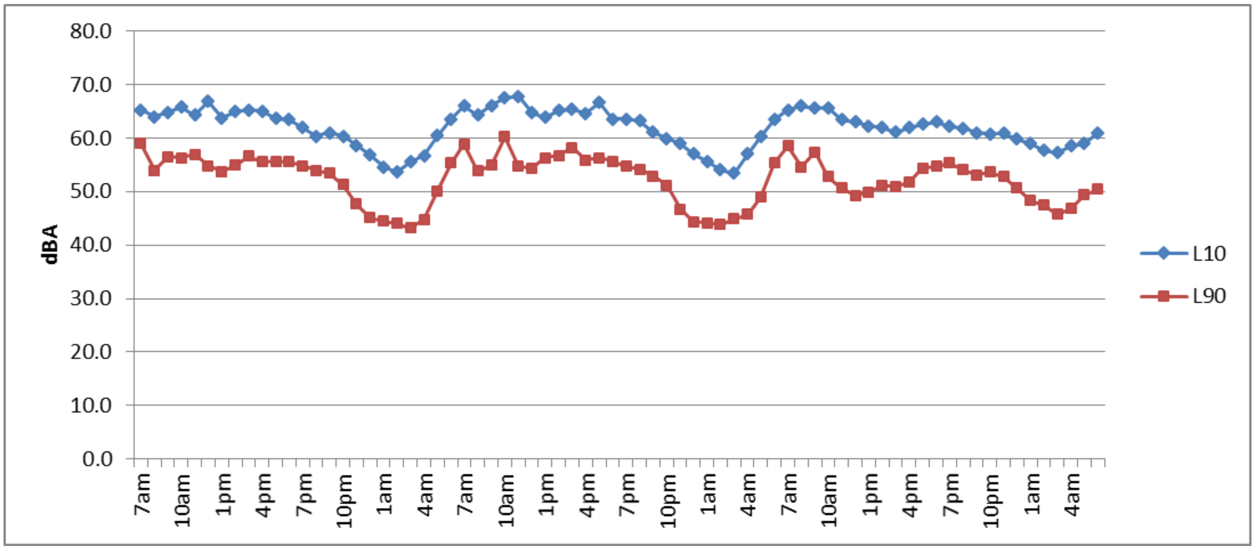


Figure 4-20 L10 and L90 for Station 1

Station 2

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 33.3 dBA to a high (Lmax) of 98.1 dBA. Average noise level for this period was 70.6 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 4-21.

There are reports of consistent noise from trucks using engine breaks at this location.

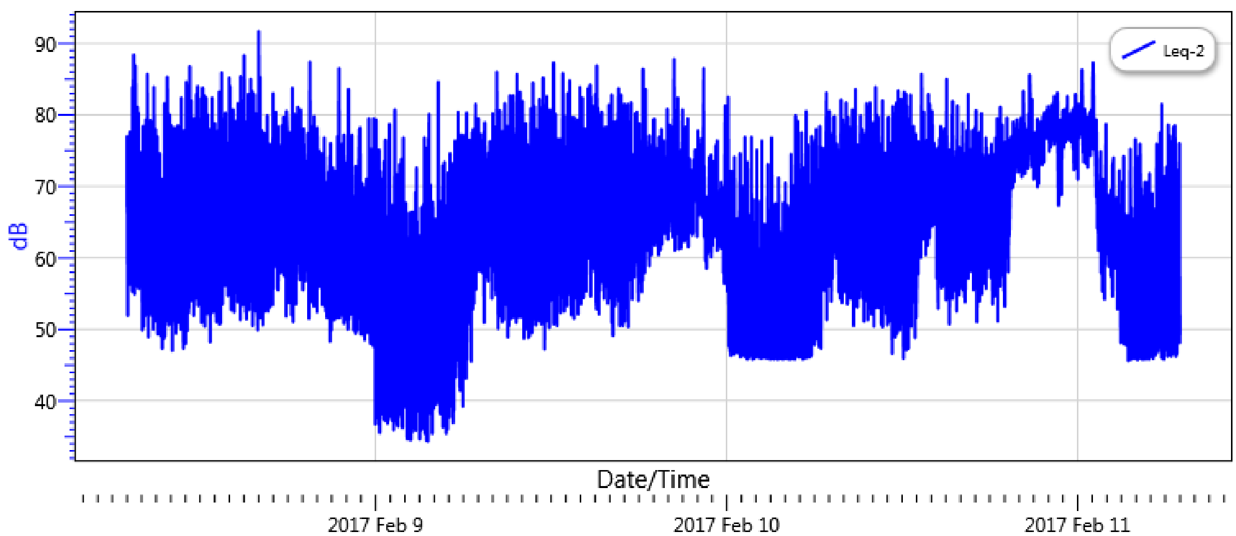


Figure 4-21 Noise fluctuation (Leq) over 72 hours at Station 2

OCTAVE BAND ANALYSIS AT STATION 2

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 80 Hz. (octave frequency range is 71 - 90 Hz) (Figure 4-22).

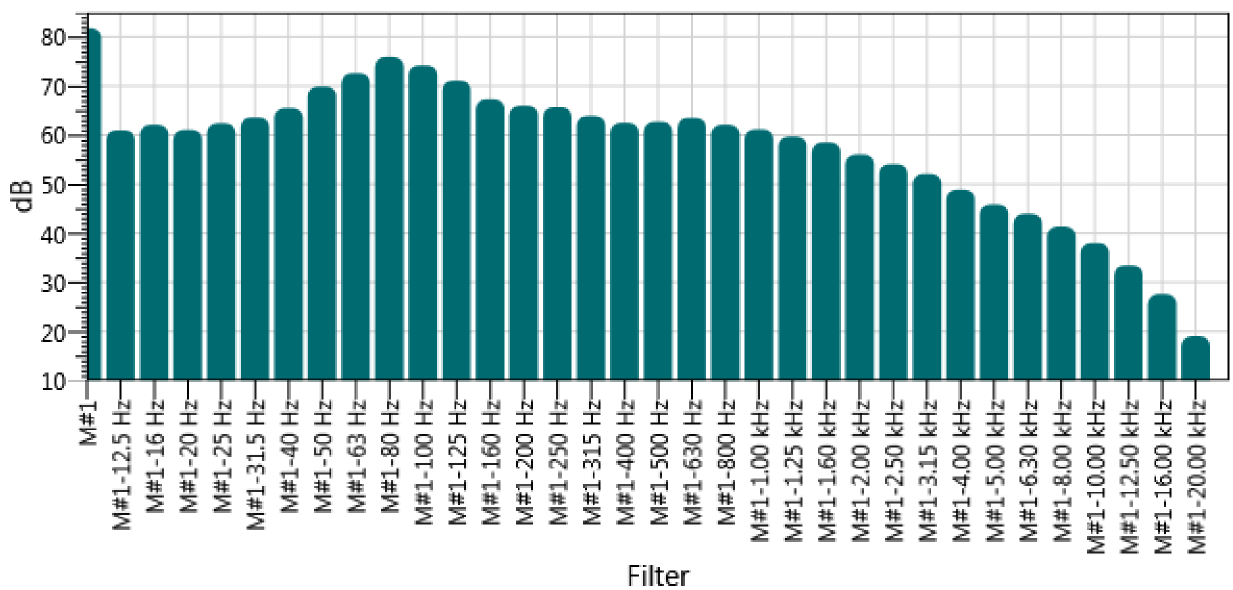


Figure 4-22 Octave band spectrum of noise at Station 2

L10 AND L90

Figure 4-23 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈44.4% of the time), no significant fluctuations (L10 – L90) (≈4.2% of the time) and large fluctuations (L10 – L90) (≈51.4% of the time) in the noise climate at this station.

The overall L10 and L 90 at this station for the time assessed were 75.4 dBA and 49 dBA respectively.

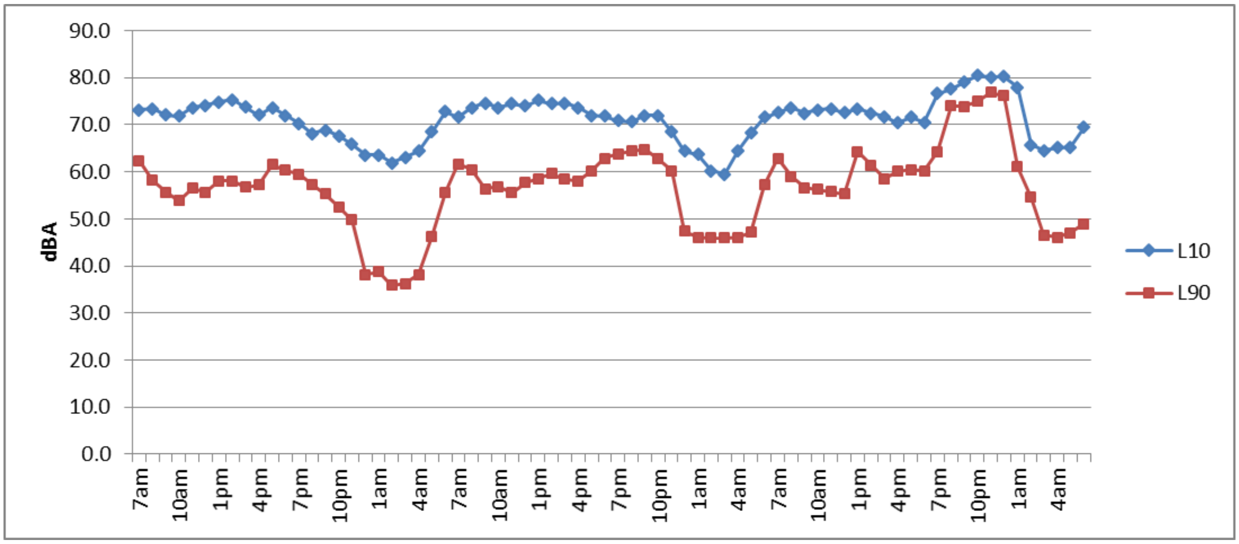


Figure 4-23 L10 and L90 for Station 2

Station 3

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 38.4 dBA to a high (Lmax) of 98.1 dBA. Average noise level for this period was 68.9 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 4-24.

There are reports of consistent noise from trucks using engine breaks at this location.

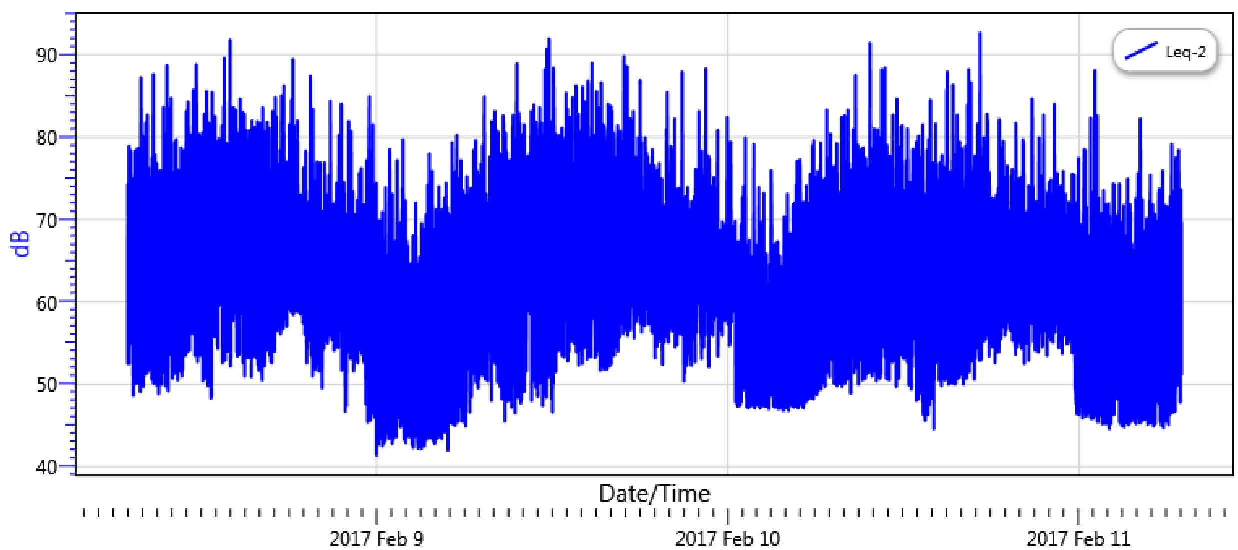


Figure 4-24 Noise fluctuation (Leq) over 72 hours at Station 3

OCTAVE BAND ANALYSIS AT STATION 3

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 63 Hz. (octave frequency range is 56 - 71 Hz) (Figure 4-25).

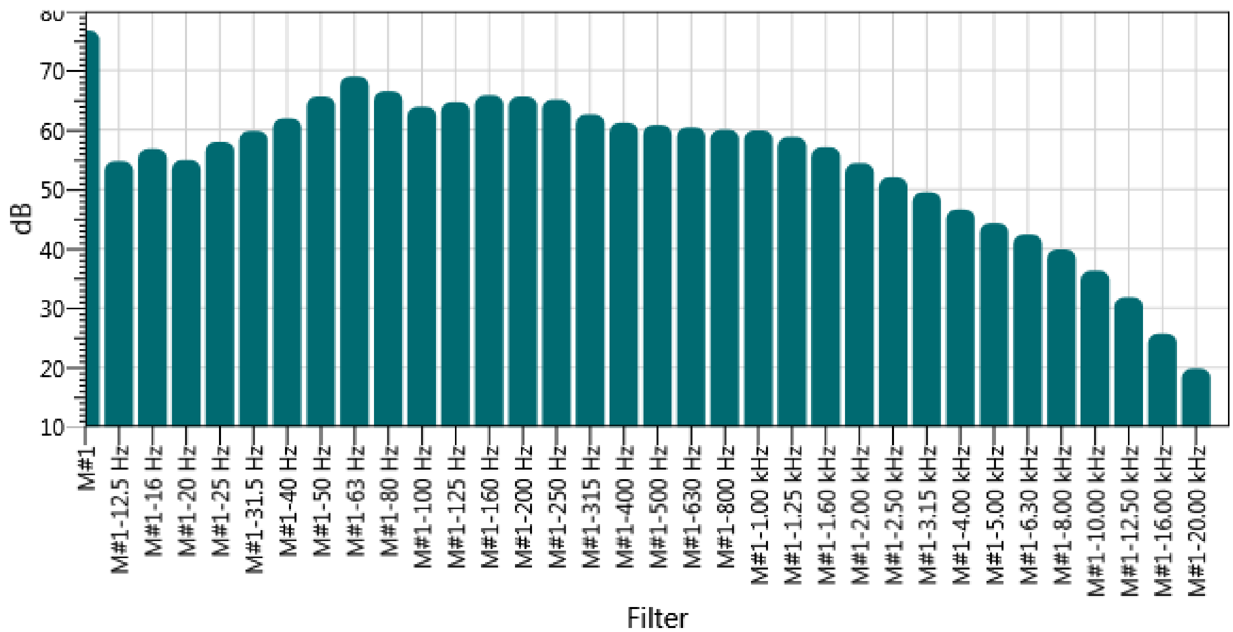


Figure 4-25 Octave band spectrum of noise at Station 3

L10 AND L90

Figure 4-26 depicts the hourly L10 and L90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈32% of the time) and large fluctuations (L10 – L90) (≈68% of the time) in the noise climate at this station.

The overall L10 and L 90 at this station for the time assessed were 71.2 dBA and 48.28 dBA respectively.

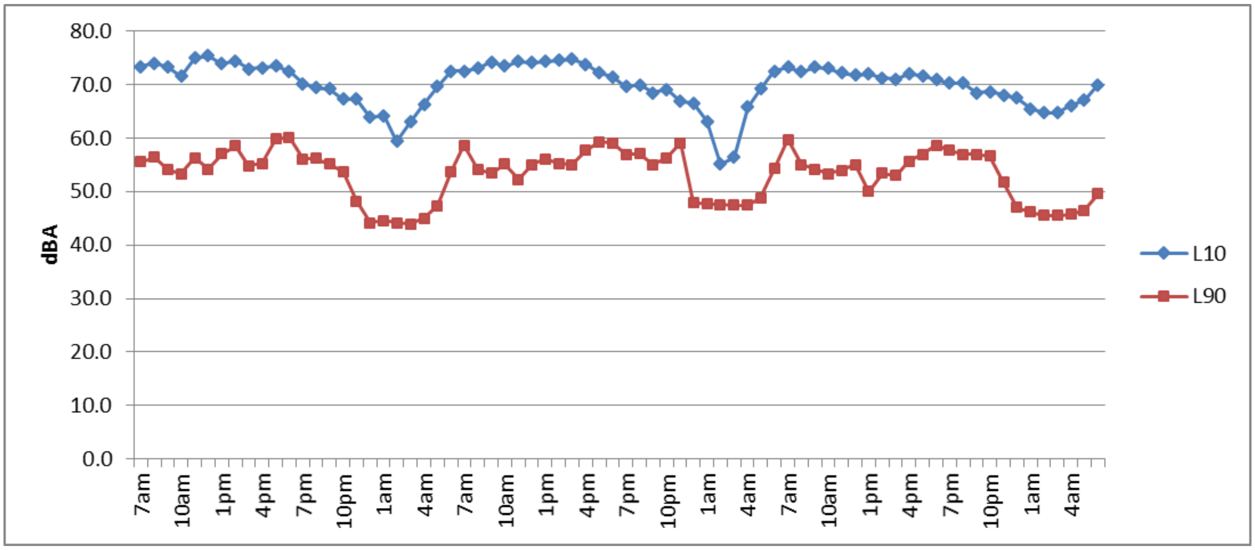


Figure 4-26 L10 and L90 for Station 3

Station 4

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 31.2 dBA to a high (Lmax) of 101.7 dBA. Average noise level for this period was 81.4 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 4-27.

The spike in noise levels shown in the graph below is due to loud music being played in close proximity to the noise meter on Friday February 10th, between the hours of 12:00pm – 7:00pm.

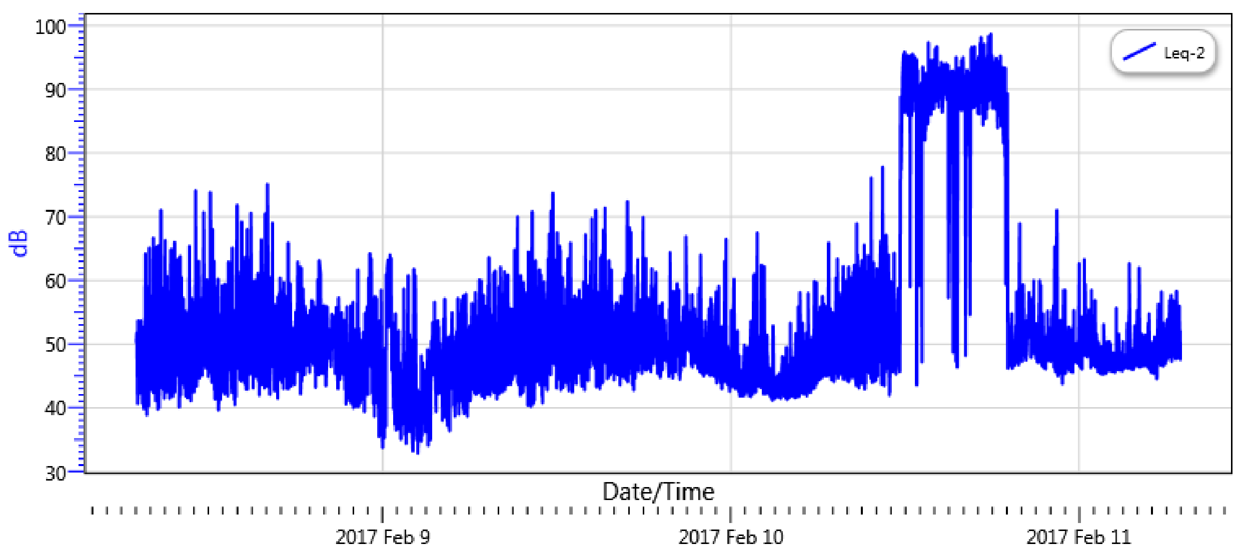


Figure 4-27 Noise fluctuation (Leq) over 72 hours at Station 4

OCTAVE BAND ANALYSIS AT STATION 4

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 800 Hz. (octave frequency range is 713 - 898 Hz) (Figure 4-28).

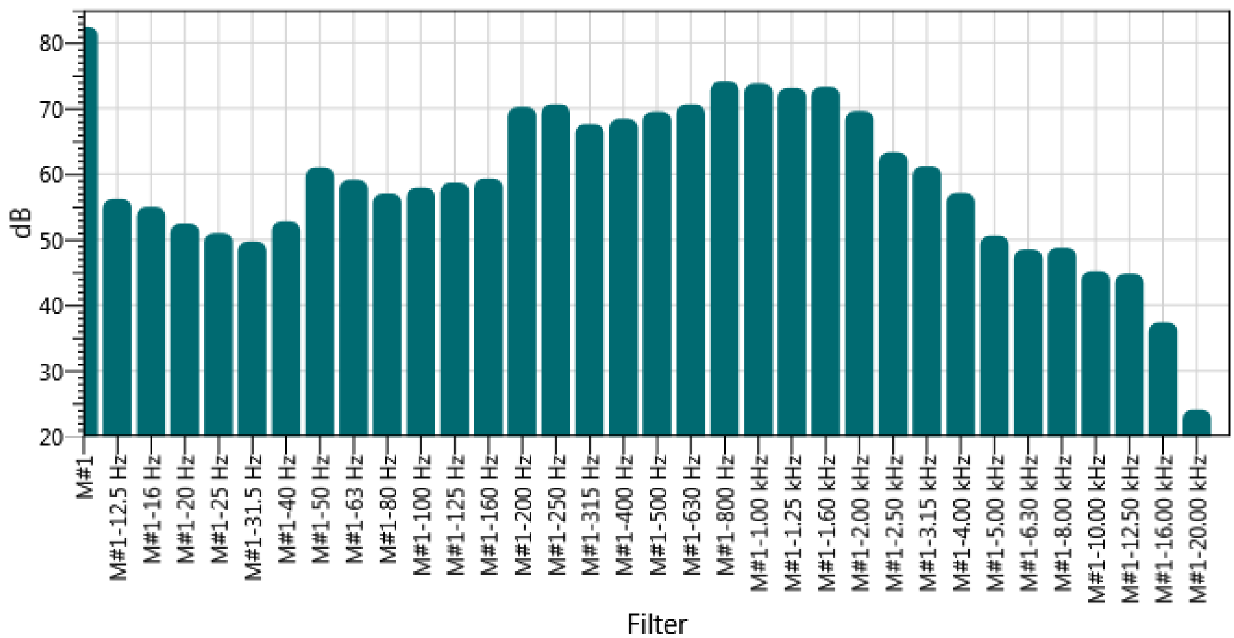


Figure 4-28 Octave band spectrum of noise at Station 4

L10 AND L90

Figure 4-29 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈75% of the time), no significant fluctuations (L10 – L90) (≈16.7% of the time) and large fluctuations (L10 – L90) (≈8.3% of the time), in the noise climate at this station.

The overall L10 and L 90 at this station for the time assessed were 72.3 dBA and 43.6 dBA respectively.

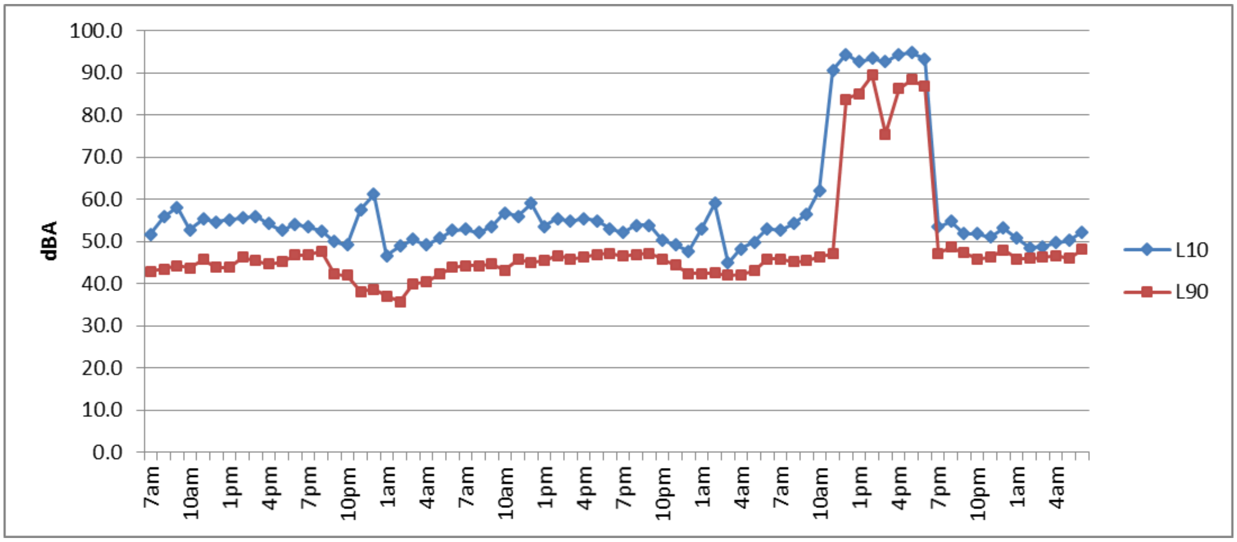


Figure 4-29 L10 and L90 for Station 4

Station 6

During the 72-hour period, noise levels at this station ranged from a low (Lmin) of 27.1 dBA to a high (Lmax) of 92.4 dBA. Average noise level for this period was 59.9 L_{Aeq} (72h). The fluctuation in noise levels over the 72-hour period is depicted in Figure 4-30.

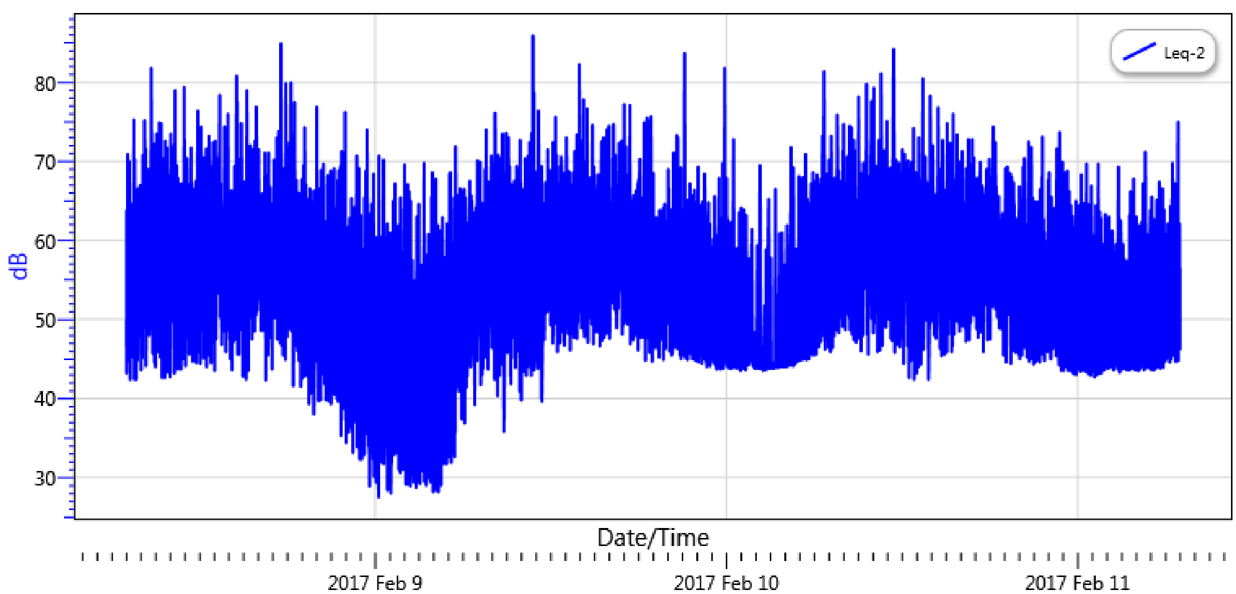


Figure 4-30 Noise fluctuation (Leq) over 72 hours at Station 6

OCTAVE BAND ANALYSIS AT STATION 6

The noise at this station during the 72-hour period was in the low frequency band centred around the geometric mean frequency of 63 Hz (octave frequency range is 56 - 71 Hz) (Figure 4-31).

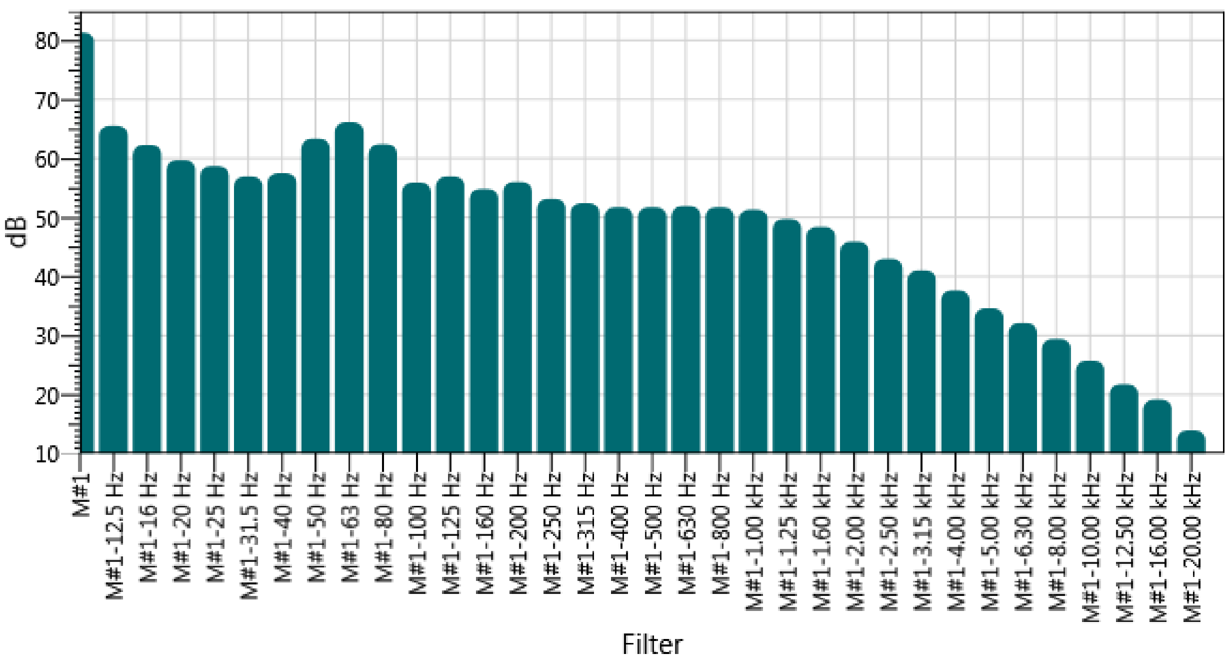


Figure 4-31 Octave band spectrum of noise at Station 6

L10 AND L90

Figure 4-32 depicts the hourly L10 and L 90 statistics for this station over the noise assessment period. The data shows moderate fluctuations (L10 – L90) (≈65.3% of the time), no significant fluctuations (L10 – L90) (≈2.8% of the time) and large fluctuations (L10 – L90) (≈31.9% of the time) in the noise climate at this station.

The overall L10 and L 90 at this station for the time assessed were 62.3 dBA and 43.9 dBA respectively.

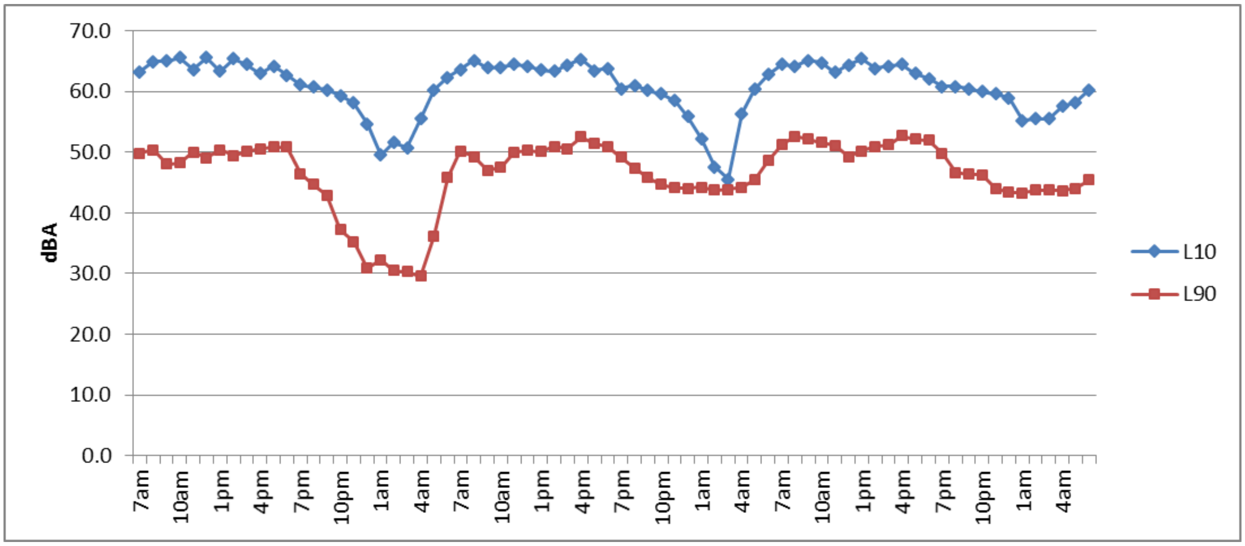


Figure 4-32 L10 and L90 for Station 6

Comparisons of Ambient Noise Levels with NEPA Daytime and Night Time Guidelines

Comparison of the ambient noise levels in the study area with the National Environmental and Planning Agency (NEPA) guidelines are shown in Table 4-13. During the daytime, noise levels at Stations 1, 2 and 3 were non-compliant with NEPA daytime standards, while during night time, noise levels at all stations except Station 6, were non-compliant with NEPA night time standards.

Table 4-13 Comparison of daytime and night time noise levels at the stations with the NEPA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	*NEPA Guideline (dBA)*	10 pm. - 7 am (dBA)	*NEPA Guideline (dBA)*
1	Residential	62.4	*55*	56.1	*50*
2	Residential	70.2	*55*	64.3	*50*
3	Residential	70.6	*55*	64.8	*50*
4	Residential	52.6	*55*	50.5	*50*
5	Residential	N/A	*55*	N/A	*50*
6	Commercial/ Residential	61.6	*65*	54.8	*60*

NB. Numbers in red are non-compliant with the standard/guideline

Federal Highway Administration Standards

Noise standards issued by the Federal Highway Administration (FHA) of the United States Department of Transportation for use by state and Federal highway agencies in the planning and design of highways, are depicted below in Table 4-14.

Table 4-14 FHA noise standards for use by state and Federal highway agencies for planning and design of highways

Land Use Category	Design Noise Level-L10	Description of Land Use Category
A	60dBA (Exterior)	Tracts of lands in which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheatres, particular parks or portions of parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70dBA (Exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas, and parks.
C	75dBA (Exterior)	Developed lands, properties or activities not included in categories A and B above.
D	-	For requirements on undeveloped lands see paragraphs 5a (5) and (6), this PPM.
E	55dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Based on the land use categories listed above, **Category B** is the most apt to describe the land use within the study area of the noise assessment.

Comparisons with the FHA standard (Category B) has indicated that of the 72 hours, the L10 noise levels at Stations 1 and 6 were in full compliance with the FHA standard. Station 4 was also in full compliance with the FHA standard except for the time period in which loud music was being played in close proximity to the noise meter on Friday February 10th, between the hours of 12:00pm – 7:00pm. L10 noise levels exceeded the FHA standard at select time periods (mostly morning to evening) throughout the 72 hours at Stations 2 and 3 (Figure 4-33 - Figure 4-37).

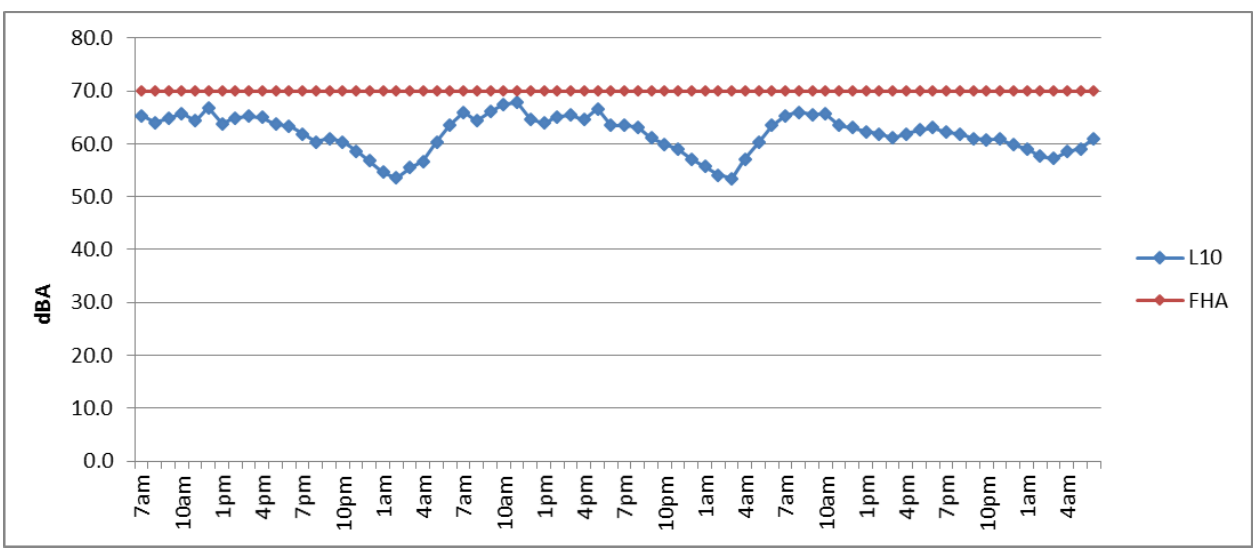


Figure 4-33 Comparison of L10 at Station 1 with FHA standard

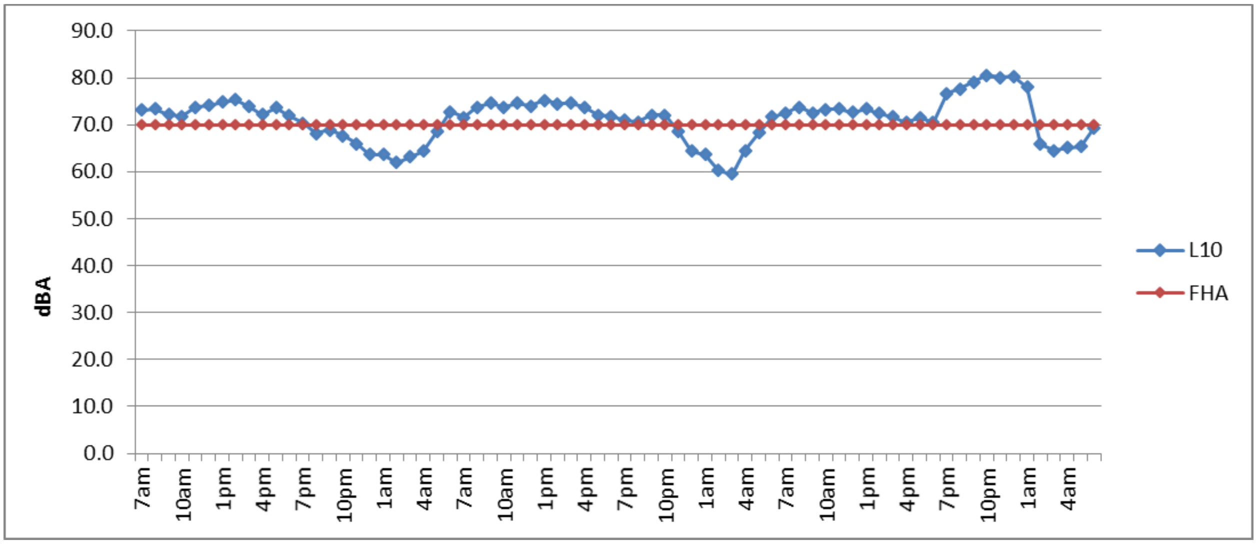


Figure 4-34 Comparison of L10 at Station 2 with FHA standard

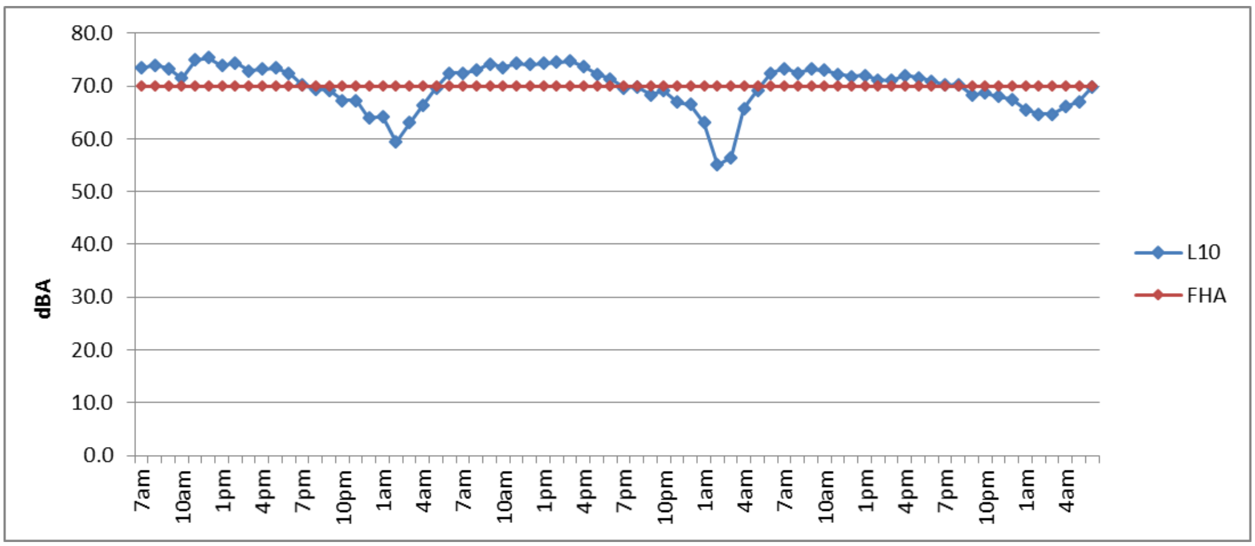


Figure 4-35 Comparison of L10 at Station 3 with FHA standard

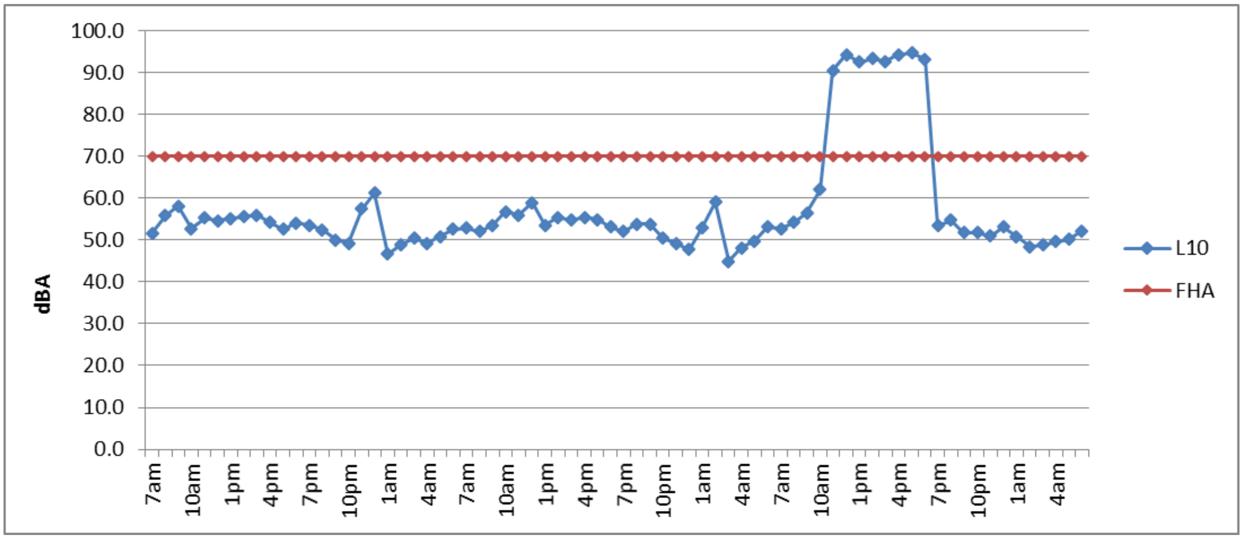


Figure 4-36 Comparison of L10 at Station 4 with FHA standard

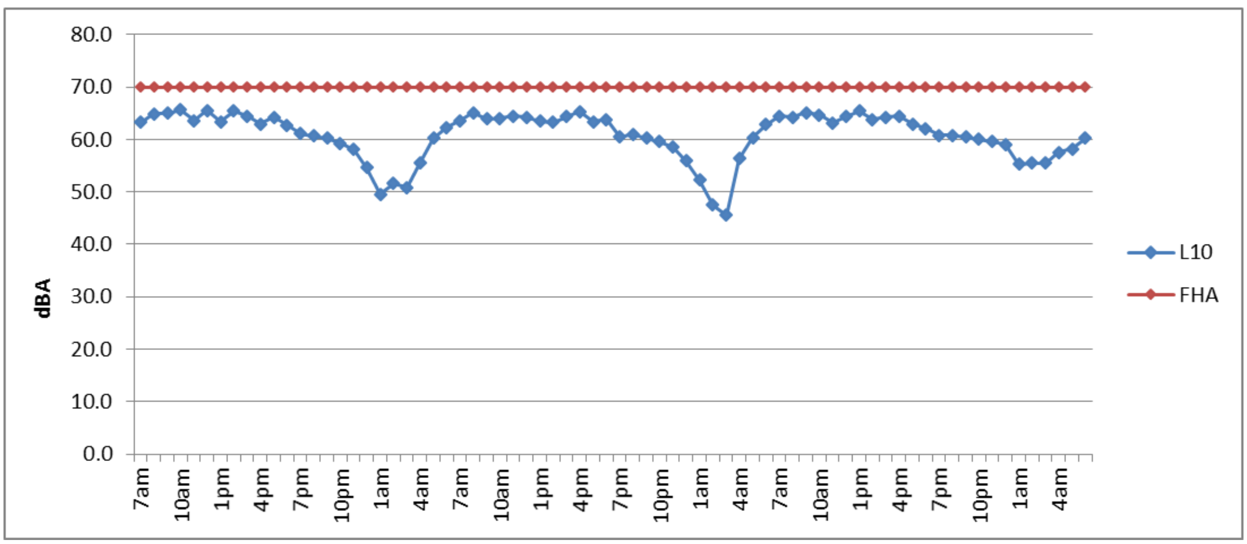


Figure 4-37 Comparison of L10 at Station 6 with FHA standard

4.1.8 Sources of Pollution

Pollution sources include sedimentation from rivers such as the Hope River, Cane River and Yallahs River as well as various drains and gullies which traverse the project area. Other forms include indiscriminate solid waste disposal, air pollution from charcoal burning, field preparation, noise pollution from truck engine brakes and honking of horns and domestic sewage disposal (e.g. pit latrine).

4.2 NATURAL HAZARDS

4.2.1 Earthquakes and Seismicity

Jamaica is characterized by medium-high seismic hazards due to the location of the Island on the Gonavave microplate bounded by the Oriente Fracture Zone to the North, the Cayman Spreading Center to the west, the Enriquillo Plantain Garden and the Walton Fault zones to the south (Salazar, et al 2013). All along the north coast the rocks forming the limestone terrace in the coastal plain are faulted to varying degrees, indicative of seismic activity continuing to the present day (Horsfield, 1972). This terrace was formed only about 120,000 years ago, so that the region as a whole must be considered as still seismically active. Faulting affecting more recent unconsolidated or semi-consolidated sediments is difficult to identify, but the continued occurrence of earthquakes is well documented (Shepherd & Aspinall, 1980).

Earthquake hazard zoning for Jamaica over the period from 1692 to the present shows that Section 1A lies within a zone of low probability of high intensity earthquakes in Jamaica (5-9 per century) (Figure 4-38). Figure 4-39 shows the location of the epicentres and the magnitude of recent earthquake events in and around Jamaica for the period of 1977 to 2014; it illustrates that earthquake activity is relatively high inland of the eastern parishes. From historical earthquake epicentre data available, twenty-nine (29) earthquake epicentres are found within the study area (Figure 4-40). Further, it should be noted that a number of faults cross the alignment and study area at various locations.

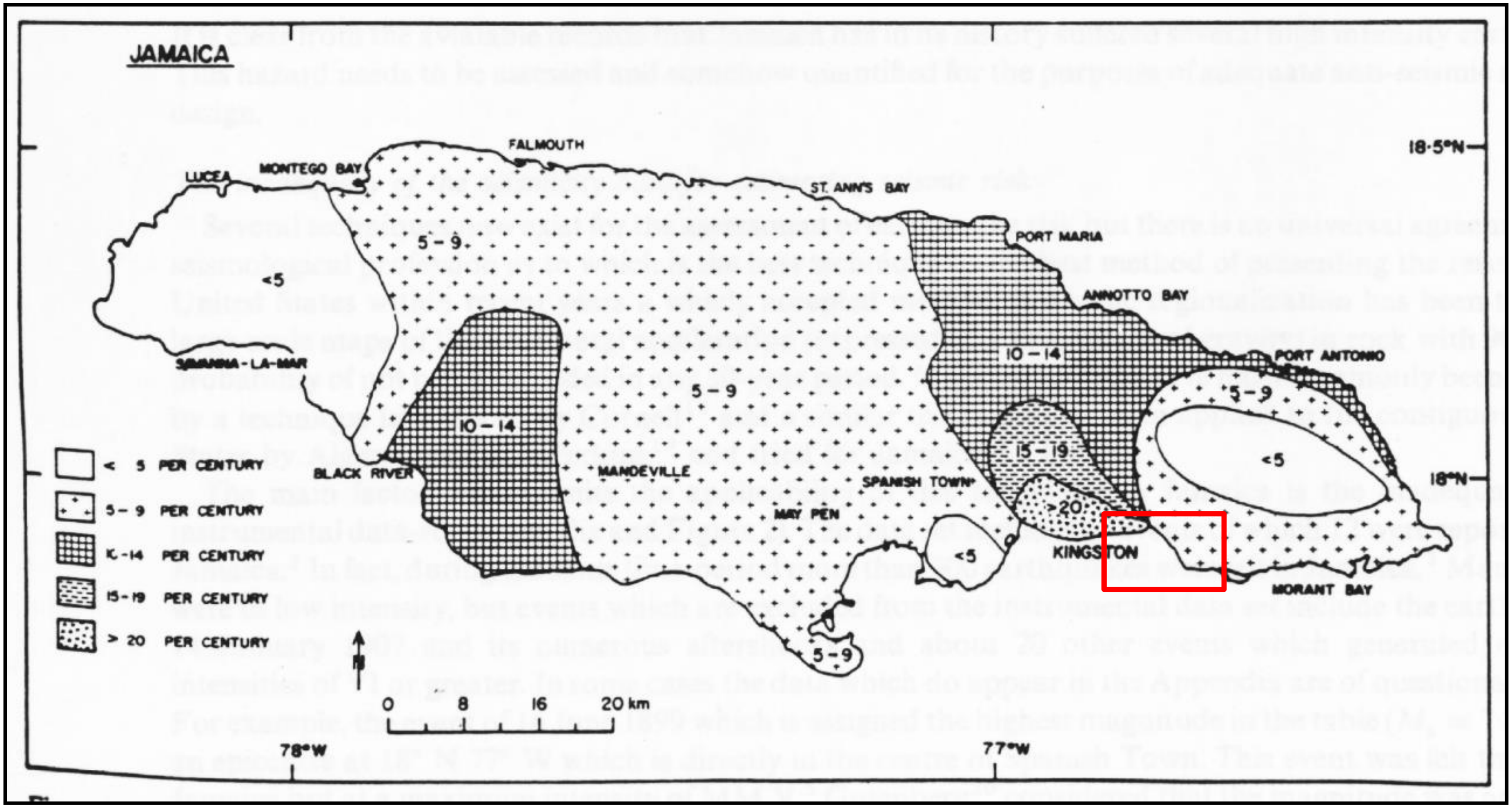
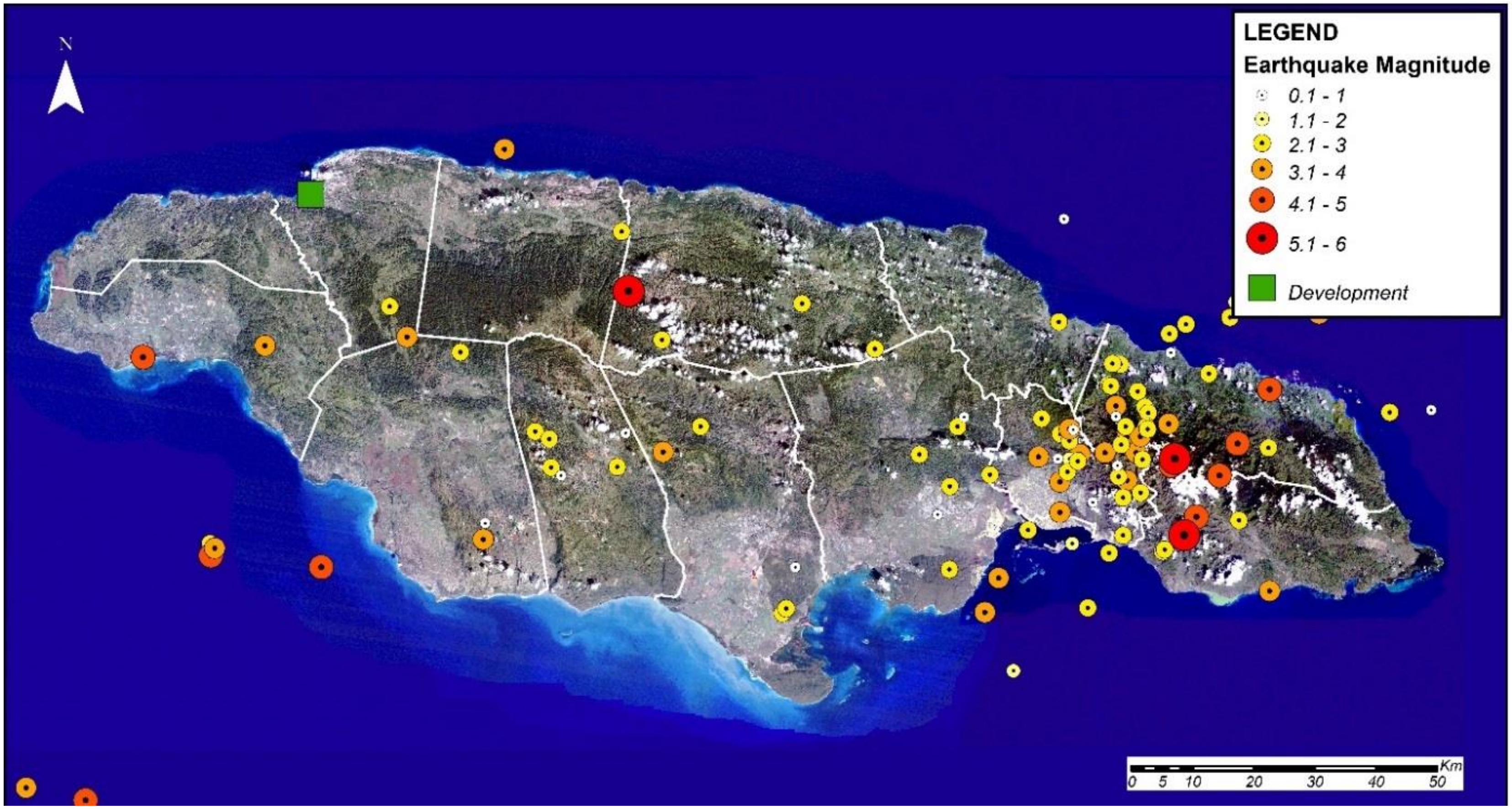


Figure 4-38 Map showing number of times per century that intensities of MM VI or greater have been reported, 1880-1960 (from Shepherd & Aspinall, 1980), with general study area outlined in red



Source: earthquake.usgs.gov Earthquake Archive

Figure 4-39 Earthquakes in Jamaica 1977-2014

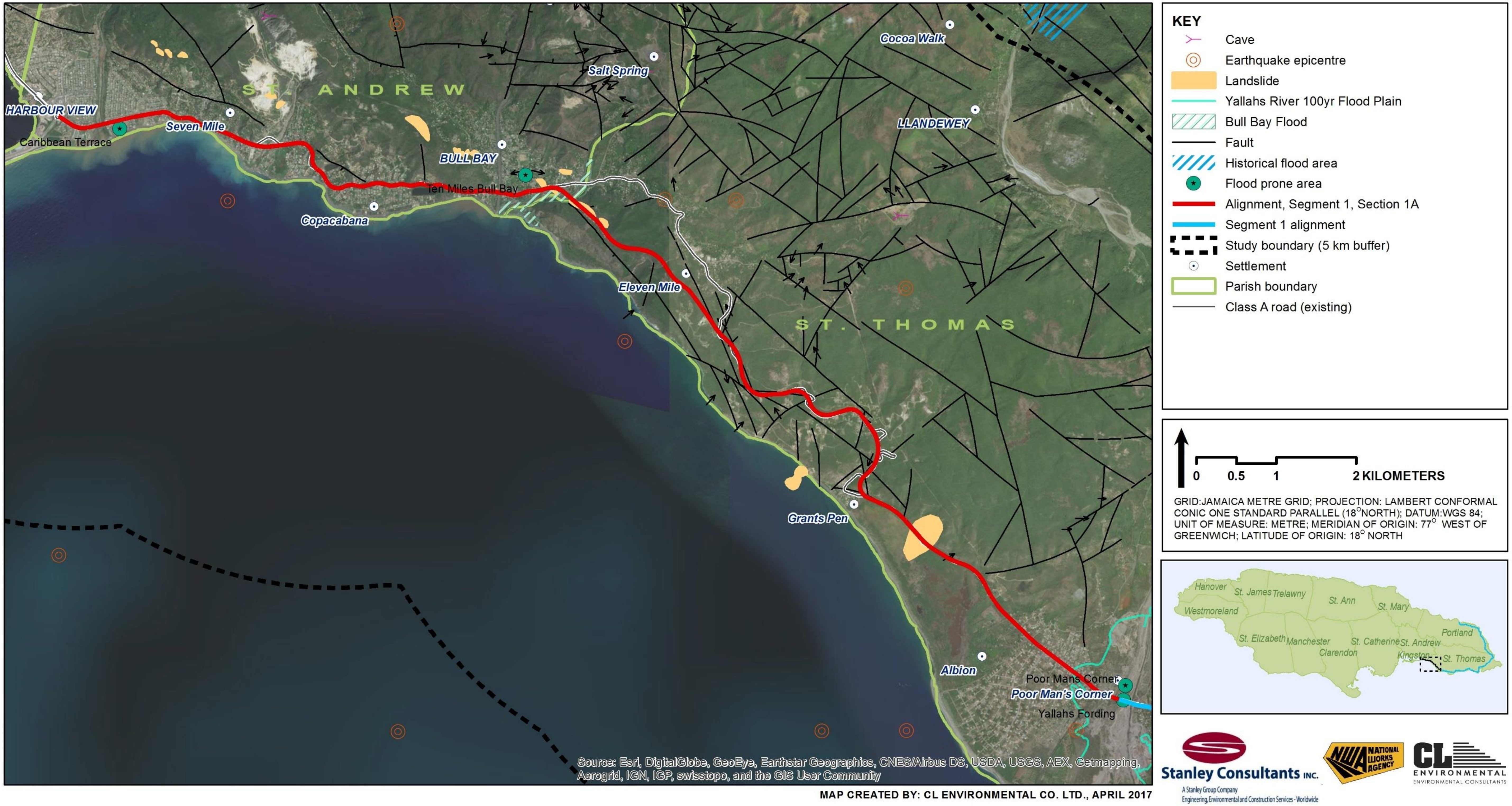


Figure 4-40 Earthquake epicentres, caves, landslides and flooding within the study area for Segment 1, Section 1A

4.2.2 Hurricanes

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation at the proposed location. The high velocity winds can cause structural damage. Jamaica lies within the Caribbean hurricane belt and has been directly affected by numerous hurricanes. Hurricanes and tropical storms are frequently accompanied by heavy rainfall. It has also been widely suggested that the Atlantic-Caribbean region is moving, and has already started to move, into a cycle of wetter and more severe tropical disturbances (IPCC, 2001).

During the hurricane season (June to November) these low-pressure systems form in the mid-Atlantic off the African west coast between latitudes 5 to 25 N, and move north-westerly into the Caribbean basin. Detailed storm data are available from the US National Hurricane Centre archives for the years 1851 to 2012 (Figure 4-41). The analysis was conducted on storms passing within 200 km of the proposed alignment. During that period, notable hurricanes include Charlie (August 1951), Allen (August 1980), Gilbert (September 1988), Ivan (September 2004), Dean (August 2007), Gustav (August 2008) and Sandy (October 2012).

4.2.3 Flooding

Flood prone areas within the study area include (Figure 4-40): Caribbean Terrace, Ten Miles Bull Bay, Yallahs Fording and Poor Man's Corner. The 100 year return period floodplain of the Yallahs River is known to affect Poor Man's Corner and Albion. Flooding has also occurred in the Bull Bay 10 Miles area and has the potential of affecting approximately 79m of the proposed alignment.

4.2.4 Landslides

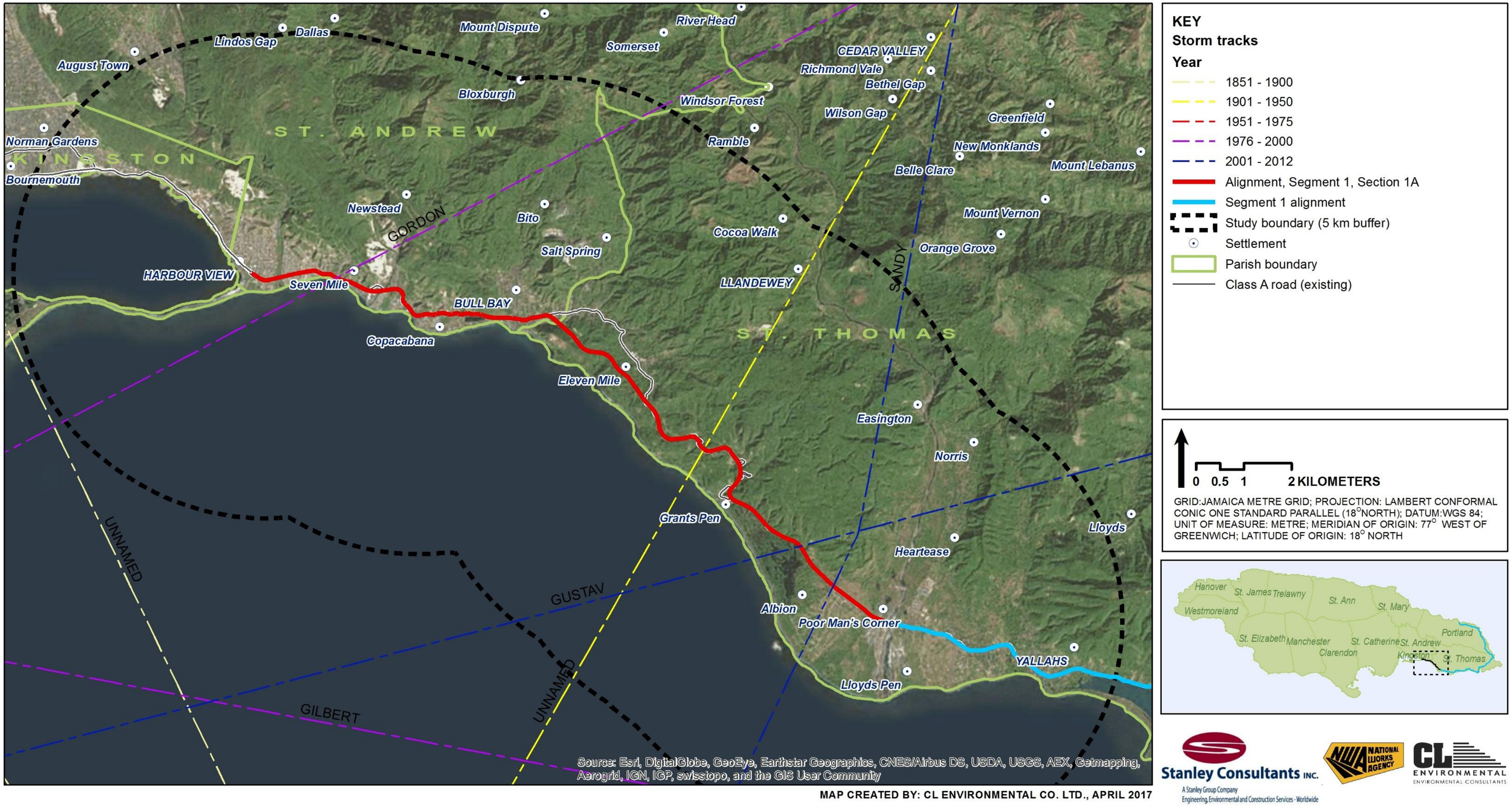
Twenty landslides were identified within the study area, with three located across the proposed Section 1A alignment. Those crossing the alignment are described as inactive or probable scarps.

4.2.5 Subsidence/ Cave-ins/ Sinkholes

Eight caves are located within the study area (Table 4-15, Figure 4-40). In addition to caves, another potential cause of subsidence/cave-ins in road construction is the presence of sink holes. Jamaica is Karstic in nature which results in sinkhole formation.

Table 4-15 Caves within Section 1A study area

Name	Type	Depth (m)	Length (m)
Cambride Hill Cave	Chamber cave		0
Grandby Bush Caves	Dry passage		107
Hope River Sink	Inpenetratable sink		0
Rockfort Cave	Chamber cave	15	15
Salt Spring Cave	Dry passage		37
Threefingers Jack's Ca			0
Bloxburgh Cave		0	0
Dallas Castle Caves	Shelter caves	0	21



Storm track data from the US National Hurricane Centre

Figure 4-41 Storm tracks for the years 1851 to 2012, Segment 1, Section 1A

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Terrestrial Flora

4.3.1.1 Introduction and Methodology

In January and February 2014, a rapid ecological study was undertaken in order to identify the commonly occurring terrestrial plant species and to characterise the flora occurring in those areas where activities pertaining to the SCHIP would be conducted. Included in that initial study was the segment of focus for this EIA, between Harbour View (St. Andrew) and the Yallahs Bridge (St. Thomas).

An important part of any vegetation survey is determining the most efficient way to effectively sample the plant community. From carefully chosen samples one may extrapolate the sample information to describe the entire community. Key factors that affect any environmental impact assessment/study include the dynamics of the study area itself as well as the man-made constraints of the individual project (e.g. scope and timeline for completion). As such, the implementation of methodologies that balance accuracy and efficiency is important to the rapid floristic survey.

The scope of the study called for a rapid ecological assessment (REA) of the vegetation to be traversed by the proposed development. As such, the main sampling methods employed included the use of window surveys and walk-throughs to assess the flora and state of the communities within which they occurred. The existing road networks were utilised in an attempt to access the proposed footprint of the development at regular intervals. Where the exact footprint was inaccessible, the available areas closest to the alignment were used as an estimate. This process was assisted by the use of a Trimble GeoExplorer™ 6000 Series GeoXT™ handheld GPS unit.

Virtually all plant species encountered during the field surveys were identified in-situ or samples collected and taken to the University of the West Indies Herbarium for later identification.

An additional vegetation survey was conducted on March 8, 2017 and focused on an area of elevated limestone vegetation, which was identified in the initial 2014 report for further investigation. This was located between the Ten Mile Bridge and Grants Pen. It is intended, therefore, to use the information and data resulting from both 2014 and 2017 assessments.

4.3.1.2 Findings and Discussion

Ten Mile Bridge to Grants Pen

The vegetation here occupied an area of rugged, coastal hills with substrate that consisted of a thin, gravelly soil layer and some limestone outcroppings (Plate 4-1). Northern facing slopes tended to be relatively gentle and more accessible than the southern sections, which presented steep-faced coastal bluffs (Plate 4-2).

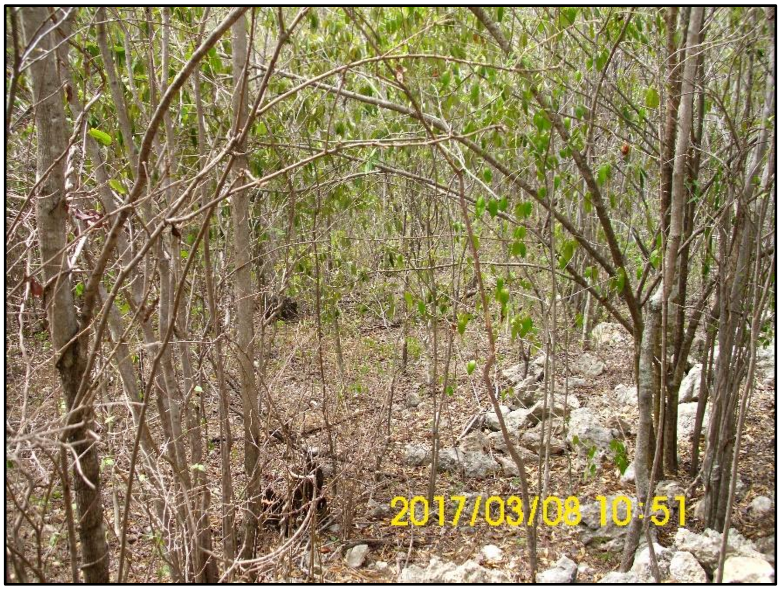


Plate 4-1 Section of vegetation exhibiting stony soil (Location: "10-Miles" area, 17.938650, 76.656194 WGS 84).

Plate 4-2 View from atop south-facing coastal bluff (Location: Hills near "11-Miles", 17.938650, 76.656194 WGS 84)

Anthropogenic disturbance was evidenced by noticeable land clearances through large sections of the vegetation. These appeared to have been carried out via logging and/or burning (Plate 4-3), as well as from the establishment of dwellings and recreational spaces (Plate 4-4) serviced by paved and dirt roadways.

Plate 4-3 Section of study area cleared by fire (Location: hills near "11-Miles", 17.932399, 76.651936 WGS 84).

Plate 4-4 Recreational facility near eastern half of study area (Location: "Three-Finger-Jack Hotel", recreational grounds, 17.927652, -76.645297 WGS 84).

Rainfall and drainage tend to be important factors in such locales. The mean rainfall recorded for this area (March 2016-2017) was a mere 1.1 mm (Weather Underground 2017). This, coupled with substrate conditions that typically lead to poor water retention and/or infiltration, portends an arid ecosystem, predisposed to xerophytic vegetation.

Caespitose, deciduous and sclerophyllous phanerophytes dominated; many of which had reduced leaves (some reduced to spines). This gave the flora a characteristically "scrubby" appearance (Plate

4-5). Thus, the overall community could be described as a Dry Limestone Thicket exhibiting various levels of disturbance (Plate 4-6). The most common trees possessed well developed root systems capable of maximising anchorage. However, average canopy height ranged from 2 to 4.3 m in areas adjacent to disturbances, where their stature was thin-boled (3-5 cm mean DBH) and more shrub-like in appearance (Plate 4-5 & Plate 4-8). Similar physiognomies were observed in southern areas affected by wind-cropping. In locales with less disturbance (typically at higher elevations) canopy heights averaged 8-10 m with *Bursera simaruba* (Red Birch) and *Tabebuia riparia* being conspicuous emergents (with the latter being an infrequent constituent – encountered only on western slopes). Trees in these areas had trunk diameters ranging between 10 cm and 15 cm; with *B. simaruba* trees exceeding 20 cm in a few cases.

Plate 4-5 Section of vegetation showing deciduous phanerophyte vegetation, occurring in thickets (background), as well as three individuals of Agave sp. upon the substrate (near-foreground). (Location: Hills near "10-Miles", 17.935480, -76.655043 WGS 84).

The aromatic tree *Capparis ferruginea* (Mustard Shrub) dominated most of the vegetation. Other common constituents of the canopy layer included *Acacia tortuosa* (Wild Poponax), *Canella winterana* (Wild Cinnamon), the National Flower *Guiacum officinale* (Lignum Vitae), *Gymnanthes lucida* (Crab Wood) and the ubiquitous *Leucaena leococehphala* (Lead Tree).

Three endemic trees were encountered. The aforementioned *T. riparia* was an occasional, yet conspicuous constituent (Plate 4-7), while *Bourreria baccata* occurred frequently in patches throughout the flora. However, only a single individual of *Trichilia reticulata* was encountered.

Plate 4-6 General view of the flora near Eleven Miles area (Location: 17.935480, 76.655043 WGS 84).

Plate 4-7 The endemic tree Tabebuia riparia with white blooms at centre (Location: near cellular tower – "10-Miles", 17.939082, -76.656491 WGS 84).

Tecoma stans and *Schaefferia frutescens* were commonly occurring shrubs. The former was in bloom at the time of this survey and their yellow inflorescences were quite noticeable. Unfortunately, the several *Agave* sp. encountered were not flowering, which made identification to species level difficult. A few cacti species were also observed, of which *Opuntia spinosissima* (Prickly Pear Tree) and *Stenocereus hystrix* (Dildo Pear) were rare yet conspicuous constituents (Plate 4-8 and Plate 4-9).

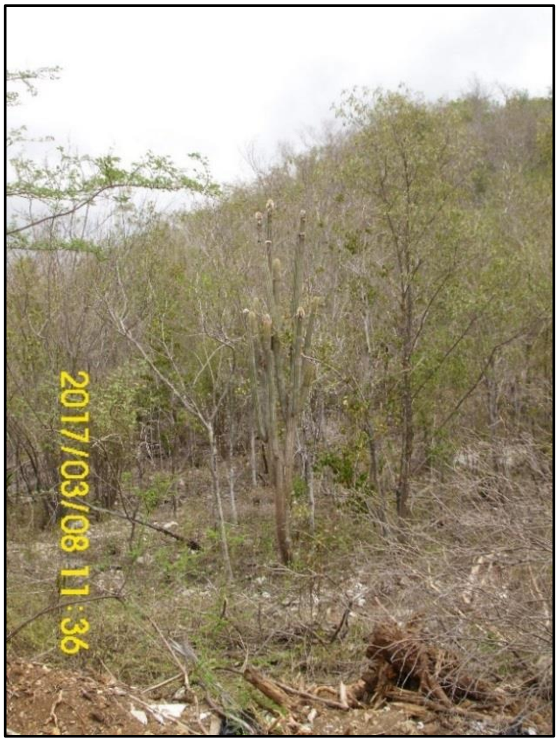


Plate 4-8 Scrub vegetation with the "Dildo Cactus" (Stenocereus hystrix) conspicuous at centre (Location: hills near "10-miles" – lower slopes,17.935816, -76.654981 WGS 84).

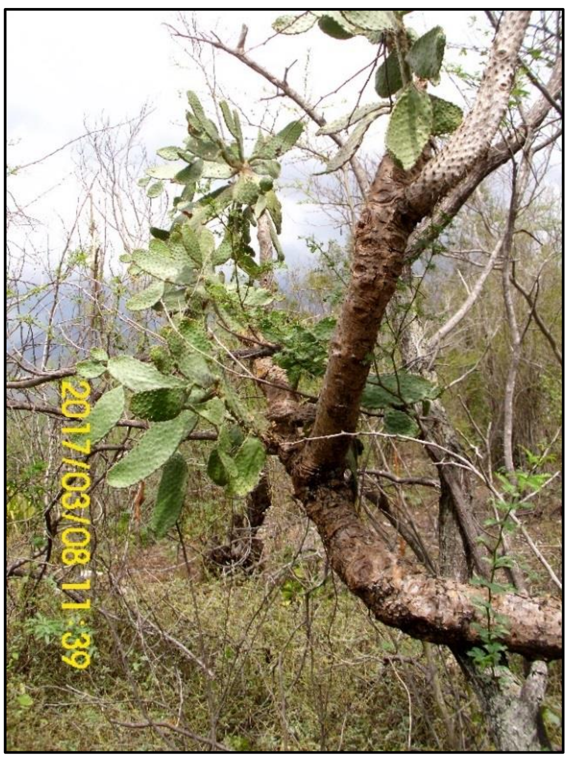


Plate 4-9 Prickly Pear cactus (Opuntia spinosissima) (Location: hills near "10-miles" – lower slopes, 17.935816, -76.654981 WGS 84)

The herbaceous component was quite sparse, as was expected. Having woody or sclerophyllous tissues and pubescence are beneficial xeromorphic characteristics. Shrubby herbs such as *Urena lobata* (Ballard Bush) and *Abutilon hirtum* were the most commonly occurring herbs. These species were well suited for their habitat, focusing on the development of non-living tissue (to lower water requirements and avert the advent of wilting) and hairs on their leaves (so as to reduce transpiration). In fact, the majority of herbs encountered possessed one or both these traits; examples include *Alternanthera ficoidea* (Crab Withe), *Mimosa pudica* (Shame Weed) and *Sida* spp.

Epiphytes were rare and included the parasite *Phoradendron piperoides* (Mistletoe), the poisonous vine *Urechites lutea* (Nightshade) and the endemic cactus *Hyolocereus triangularis* (God Okra).

In total 57 plant species were encountered, consisting of 27 trees, 10 shrubs and 14 xerophytic herbs. These species are listed in Appendix 5.

Other Areas along Section 1A

Other areas along the planned roadway development were highly developed with several residential and commercial areas along the existing main road. Bananas (*Musa* sp.) and Coconuts (*Cocus nicifera*) tended to be the most frequently occurring subsistence crops in some areas. In more residential areas fruit trees such as *Mangifera indica* (Mango), *Blighia sapida* (Ackee) and *Artocarpus altilis* (Breadfruit) (some escaping to fallow lands) were common.

4.3.2 Terrestrial Fauna

4.3.2.1 Approach

A survey of the entire proposed road alignment was conducted in 2014. Some areas were identified as requiring special attention, i.e. were habitats/fauna considered above average ecological significance; these are shown in Figure 4-42. The results in the following sections present summaries for these areas of special ecological significance. Other areas are generally highly developed residential of agricultural sites.

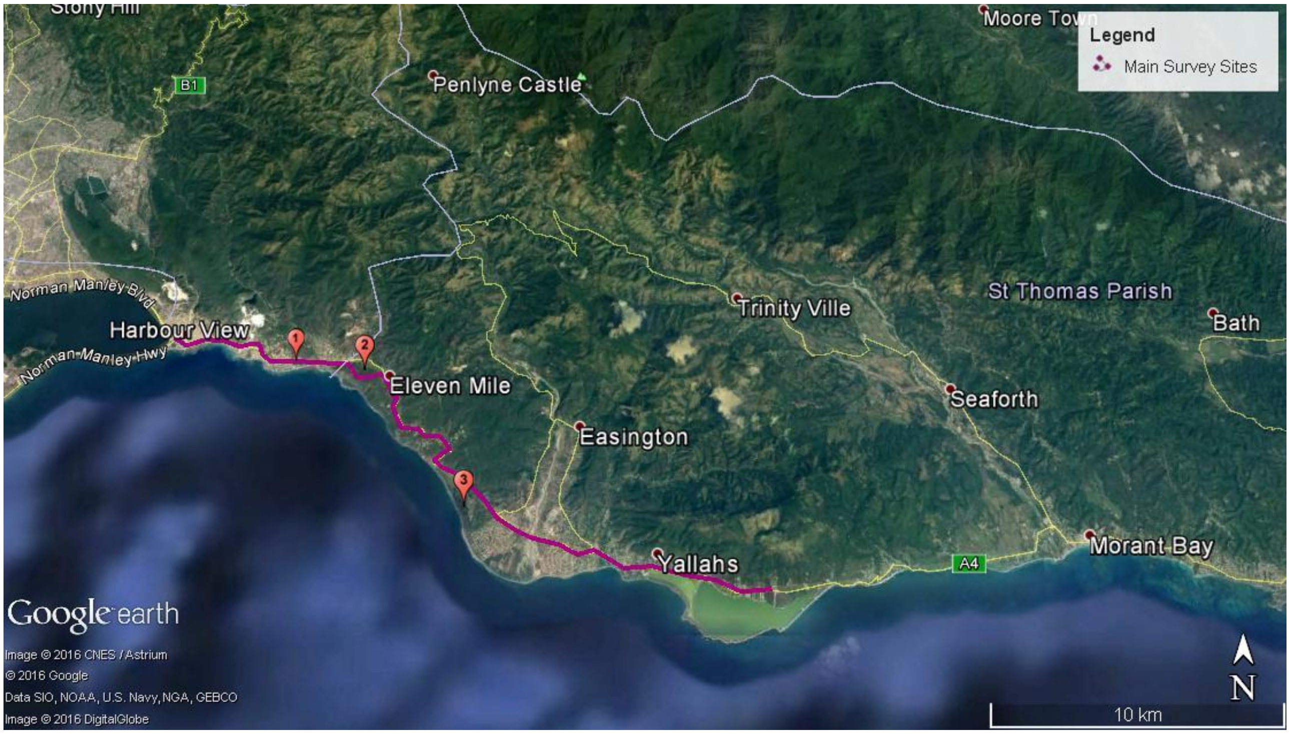


Figure 4-42 Main study sites for faunal study: 1. Ocean Lake; 2. Bull Bay dry forest; 3. Grants Pen wet lands

4.3.2.2 Results

Ocean Lake

Approximate location (WGS 1984): 17°56'30.32"N, 76°40'37.85"W

Ocean Lake is a rectangular lake approximately 30,000 m^2, on the southern side of the road (and proposed alignment) and draining into the sea (Figure 4-43). Several dwellings are located in proximity/at edge of lake. The present road, and the proposed alignment runs along the foot of the hill at the edge of the pond. Abundant animal life was recorded and included birds (e.g. common egret, common Morhen, Table 4-16), insects (e.g. dragon flies and mud wasps) and an abundant snail and fish population (Table 4-17).

Table 4-16 List of terrestrial bird species recorded from various sites of the proposed alignment

Common Name	*Scientific Name*
Black-faced Grassquit	*Tiaris bicolor*
Cattle Egret	*Bubulcus ibis*
Common Ground Dove	*Columbina passerina*
Greater Antillean Grackle	*Quiscalis niger*
Jamaican Euphonia - e	*Euphonia jamaica*
Jamaican Mango - e	*Anthracothorax mango*
Jamaican Oriole	*Icterus leucopteryx*
Jamaican Tody - e	*Todus todus*

Common Name	*Scientific Name*
Jamaican Woodpecker - e	*Melanerpes radiolatus*
Loggerhead Kingbird	*Saurothera vetula*
Northern Mockingbird	*Zenaida macroura*
Orangequit - e	*Mimus polyglottos*
Streamertail - e	*Aratinga nana*
Smooth-billed Ani	*Crotophaga anis*
Turkey Vulture	*Cathartes aura*

e – endemic species

Table 4-17 Families of terrestrial invertebrate fauna recorded from various sites of the proposed alignment

ORDER	FAMILY
Coleoptera (Beetles)	Lycidae
	Coccinellidae
	Scolytidae
	Chrysomelidae
	Cerambycidae
	Scarabaeidae
Hemiptera (Bugs)	Pentatomidae
	Scutelleridae
	Coreidae
	Pyrrhocoridae
	Reduviidae
Homoptera (Plant bugs)	Cicadellidae
	Membracidae
	Fulgoridae
Lepidoptera (Butterflies & Moths)	Heliconiidae
	Hesperiidae
	Nymphalidae
	Lycaenidae
	Satyridae
	Pieridae
	Papilionidae
	Danaiidae
	Arctiidae
Orthoptera (Grasshopper & Crickets)	Gryllidae
	Acrididae
Hymenoptera (Ants, Wasps & Bees)	Formicidae
	Ichneumonidae
	Chalcidae
	Apidae
	Megachilidae
	Sphecidae
	Vespidae
	Eumenidae
Odonata (Dragonflies & Damselflies)	Anisoptera
Diptera (Flies)	Asilidae
	Culicidae
	Syrphidae
	Muscidae
ISOPTERA (Termites)	

Figure 4-43 Map showing ocean lake, with road running at the edge of the pond and at the base of the steep hill with human settlement.

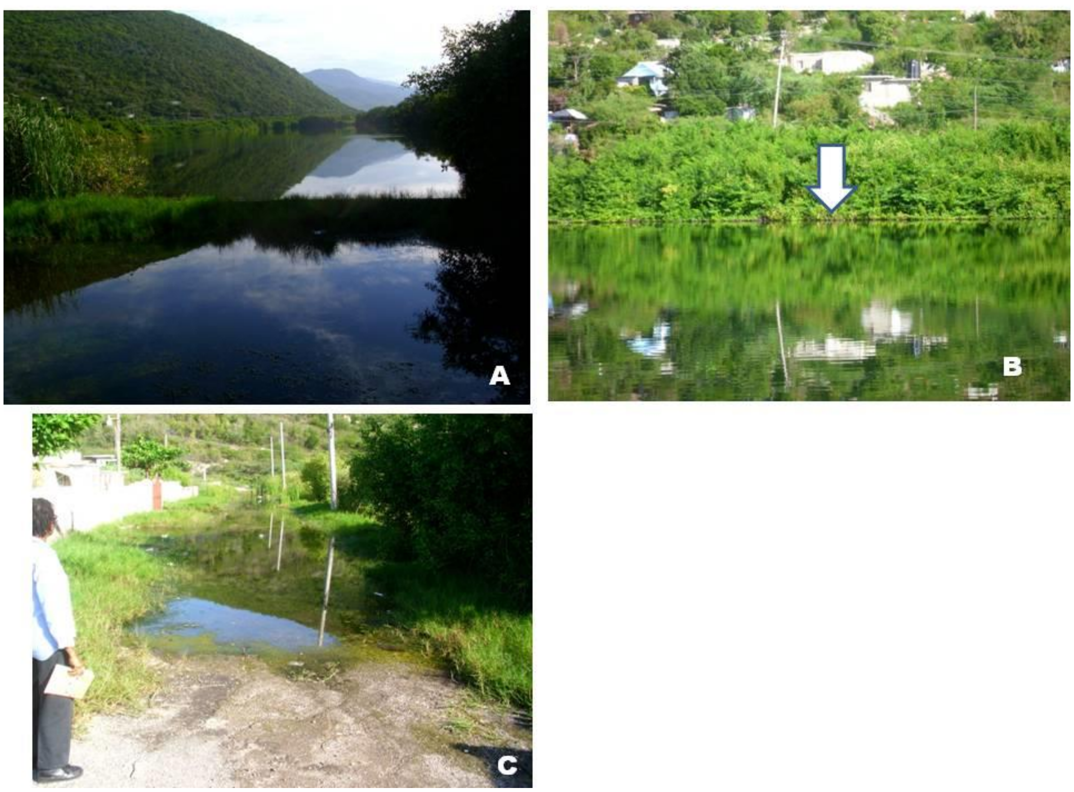


Plate 4-10 Views of Ocean Lake: A: view of lake looking easterly; B: the edge of the lake is demarked for development and infrastructure already installed; C: the road (arrow) runs at the edge of the lake

Seven Mile Bull Bay Dry Forest

Approximate location (WGS 1984): N17°56'18", W76°39'45".

A dry limestone forest, approximately 2 km long and 1 km wide, bordered by the sea to the south and to the north by Bull Bay and the main road ad proposed Section 1A alignment (Figure 4-44). The forest shows signs of significant human activity and there are a few houses on the slopes. There are still significant areas of well-developed forest, although they may be secondary (Plate 4-11). There is a well-established access road to a cell tower, and numerous tracks throughout. The fauna observed was typical of dry limestone forest. No species requiring specific conservation attention were recorded.

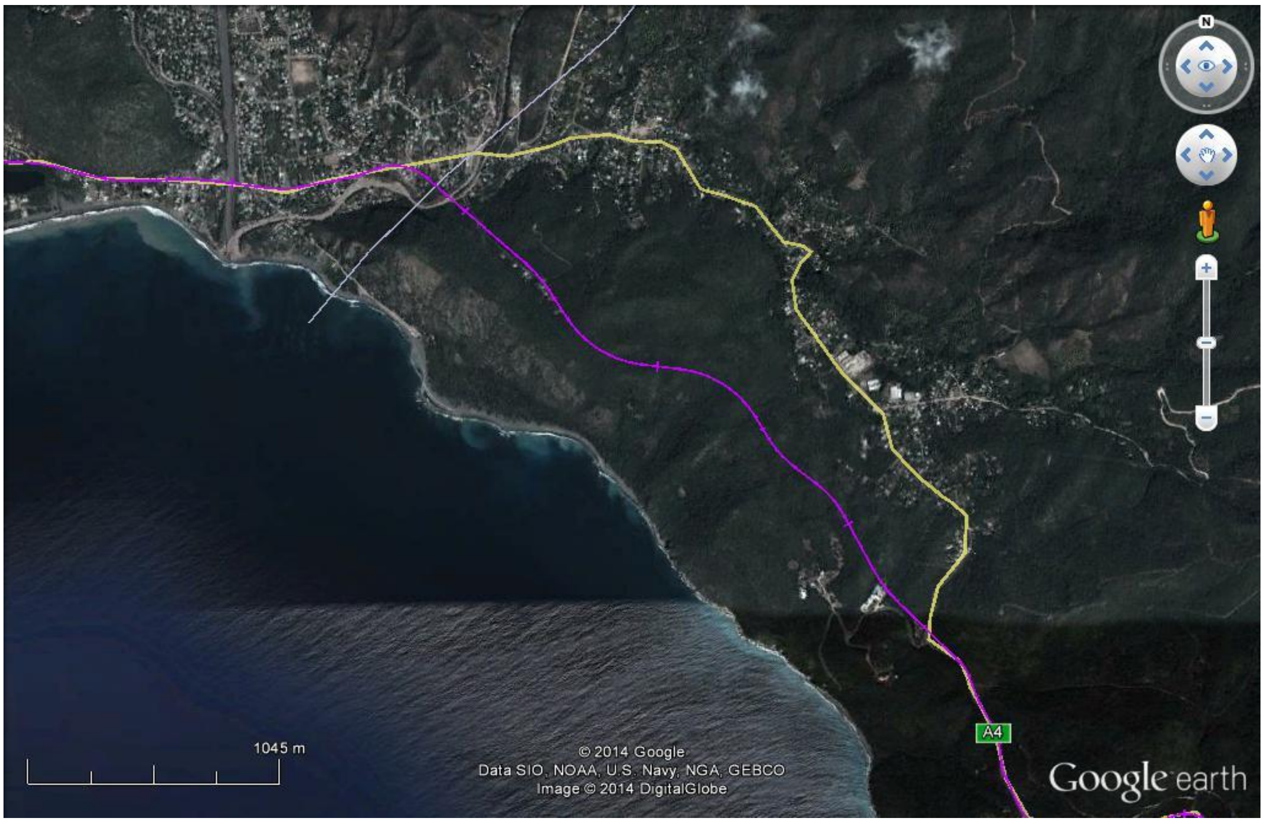


Figure 4-44 Map showing the Bull Bay dry forest

Plate 4-11 Bull Bay forest showing secondary forest (upper left) and human disturbance in other areas.

Grants Pen Wetland

Approximate location (WGS 1984): N17°53'70", W 76°36'76"

Grants Pen wetland is a large wetland extending from Grants Pen to Albion and the coast; the alignment passes at the edge. This is a complex wetland of open water and swampy areas with diverse fauna. This area is a well-documented crocodile habitat and has been monitored by NEPA for several years. A four-meter-long crocodile was found dead on the road during this study; it had been run over by a truck earlier that morning (Plate 4-12). Anecdotal evidence from local folk indicate that crocodiles sometimes venture onto the roadway. This area is home to a significant population of crocodiles which is a protected species.

We were unable to find any data or report which shows the presence of the West Indian Whistling Duck in this area, however the area contains habitat suitable for these ducks. It is therefore possible that ducks use these areas. No ducks were seen during the survey.

Plate 4-12 Crocodile from Grants Pen wet lands; killed while crossing road, December 2013

4.4 SOCIO-ECONOMIC ENVIRONMENT

4.4.1 Demography, Services and Infrastructure

4.4.1.1 Approach

Social Impact Area

In order to assess the various social elements of the proposed project, a Social Impact Area (SIA) is established. An SIA may be described as the estimated spatial extent of the proposed project's effect on the surrounding communities. Demographic analyses are carried out utilising this SIA demarcation, and social services, infrastructure and industrial facilities are described in relation to this area as well.

For the purposes of this project, the SIA is similar to the study boundary and encompasses a five (5) kilometre buffer around the proposed roadway alignment (Figure 4-45). The SIA is located within the following communities in the parishes of Kingston, St. Andrew and St. Thomas.

- D'Aguilar Town/ Rennock Lodge, Kingston
- Springfield, Kingston
- Port Royal, Kingston
- Bournemouth Gardens, Kingston
- Johnson Town, Kingston
- Norman Gardens, Kingston
- Rollington Town, Kingston
- Bloxborough, St. Andrew
- Cane River, St. Andrew
- Bito, St. Andrew
- Hermitage, St. Andrew
- Bull Bay/ Seven Mile, St. Andrew
- Harbour View, St. Andrew
- Constitution Hill, St. Andrew

- Dallas, St. Andrew
- August Town, St. Andrew
- Ramble, St. Thomas
- Easington, St. Thomas
- Eleven Miles, St. Thomas
- Llandewey, St. Thomas
- Lloyds, St. Thomas
- Albion, St. Thomas
- Poormans Corner, St. Thomas
- Yallahs, St. Thomas
- Pamphret, St. Thomas
- Baptist, St. Thomas

Demographic Analyses and Census Database

Population data were extracted from the Statistical Institute of Jamaica (STATIN) 2011 Population Census database for the SIA by enumeration district (ED). This was undertaken using Geographic Information Systems (GIS) methodologies, which were also used to derive visual representations of the data. It should be noted that all Census data relates to the resident population and does not take into consideration persons working in or visiting the ED.

In order to derive information from the census data the following computations were made:

- ***Population growth*** - was calculated using the formula [$P_n = P_o\ (1 + r)^t$]; where P_o is the population at the beginning of a period, t is the period of time in years, r is the annual rate of increase, and P_n is the population at the end of the period (United Nations, 1952).
- ***Population density*** – was derived by dividing the population by the land area. This is useful for determining the locations of greater concentrations of population.
- ***Dependency ratio*** – was calculated using the formula [child population + aged population /working population X 100], where the child population is between ages 0-14, the aged population is 65 & over and the working population is between ages 15-64 years. This ratio is useful for understanding the economic burden being borne by the working population.
- ***Male sex ratio*** – was calculated by using the formula [male population / female population X 100]. This in effect denotes the number of males there are to every 100 females and is useful for determining the predominant gender in a particular area.
- ***Domestic water consumption*** - was calculated based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption. Water consumption for workers in Jamaica is calculated at 19 litres/capita/day and sewage generation at 100% water consumption.
- ***Domestic garbage generation*** - was calculated at 4.11 kg/household/day (National Solid Waste Management Authority).

Other GIS Data and Information Sources

Geospatial data for various services and infrastructure, including schools, health centres, hospitals, police stations, fire stations and post offices were obtained from the Mona GeoInformatics Institute. Other data sources are stated throughout and include organizations such as the Forestry Department, the Planning Institute of Jamaica (PIOJ), Water Resources Authority (WRA) and the National

Environmental Planning Agency (NEPA). Additional data were also gleaned from the 1984 national topographic maps (metric series) and satellite imagery available for the project.

Where applicable, information garnered from Summary Profiles resulting from a socio-economic survey conducted by the Social Development Commission in 2009 are included (Social Development Commission, 2009). Specifically, profiles for the following communities were available:

- Harbour View, St. Andrew
- Cane River, St. Andrew
- Bito, St. Andrew
- Yallahs, St. Thomas

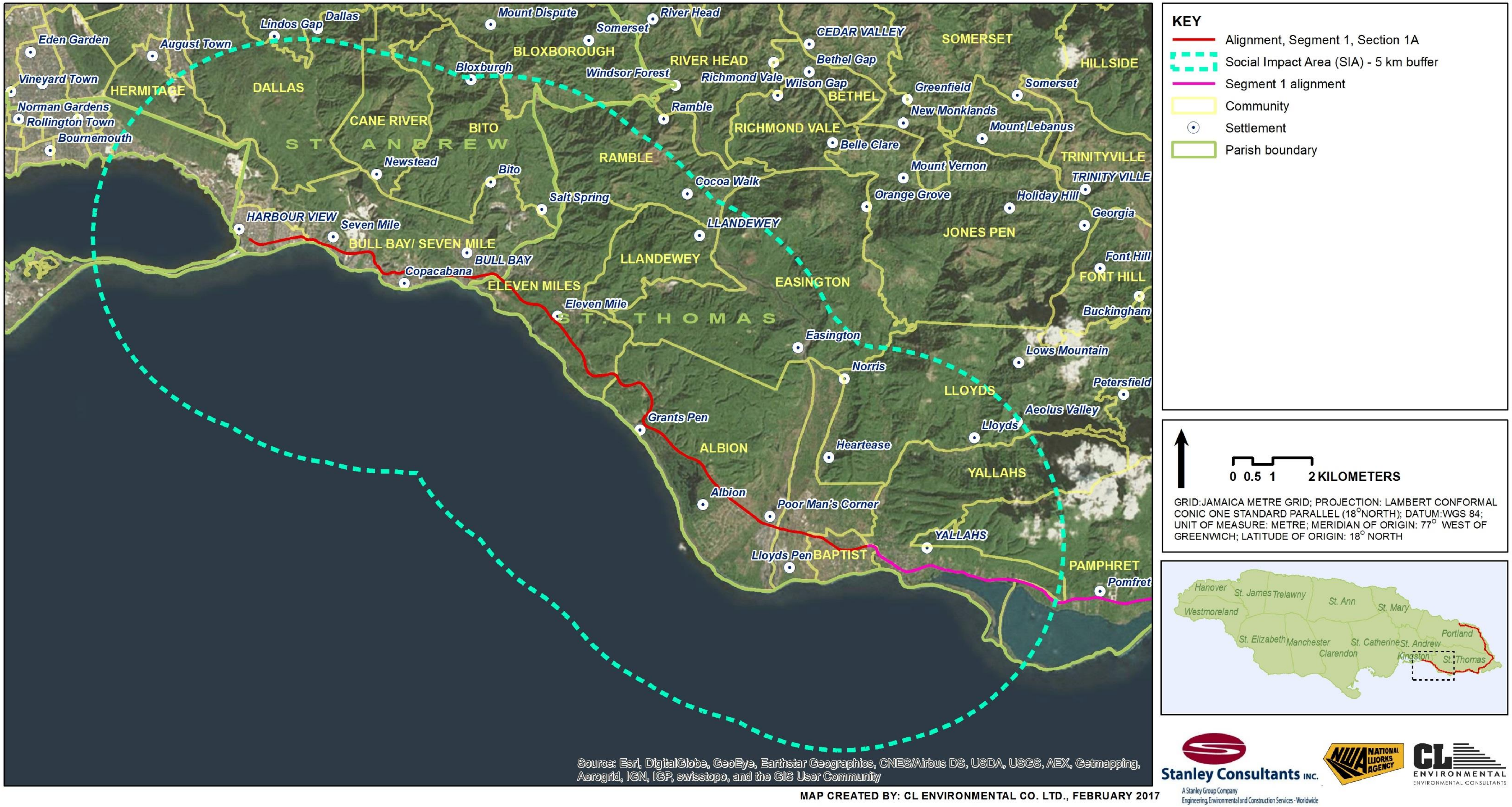


Figure 4-45 Map showing the Social Impact Area (SIA) for Segment 1, Section 1A of the SCHIP

4.4.1.2 Demography

Population Growth

The total population within the SIA in 2011 was approximately 64,610 persons (STATIN 2011 Population Census). Examination of the 2001 population data showed that there were approximately 63,996 persons within the SIA in 2001. From this population, and that calculated for the year 2011 (64,610 persons), it was estimated that the actual growth within the SIA between 2001 and 2011 was approximately 0.10% per annum. Based on this growth rate, at the time of this study (2017), the population was approximately 64,981 persons and is expected to reach 66,550 persons over the next twenty-five years if the current population growth rate remains the same.

The annual growth rate for the SIA (0.10%) differs from than that for the parishes pf Kingston (-0.08%), St. Andrew (0.33%)and St. Thomas (0.26%), as well as the island (0.36%) between 2001 and 2011 (STATIN, 2011). Using the regional rates for Kingston, St. Andrew and St. Thomas, the population in 2017 is estimated to range between 61,570 to 65,900 persons, and in 2042, between 50,369 and 71,558 persons.

Figure 4-46 depicts the population within each enumeration district (ED) for the years 2001 and 2011. As seen here, obvious increases in the ED population occurred in Grants Pen, Albion, Harbour View and Bull Bay.

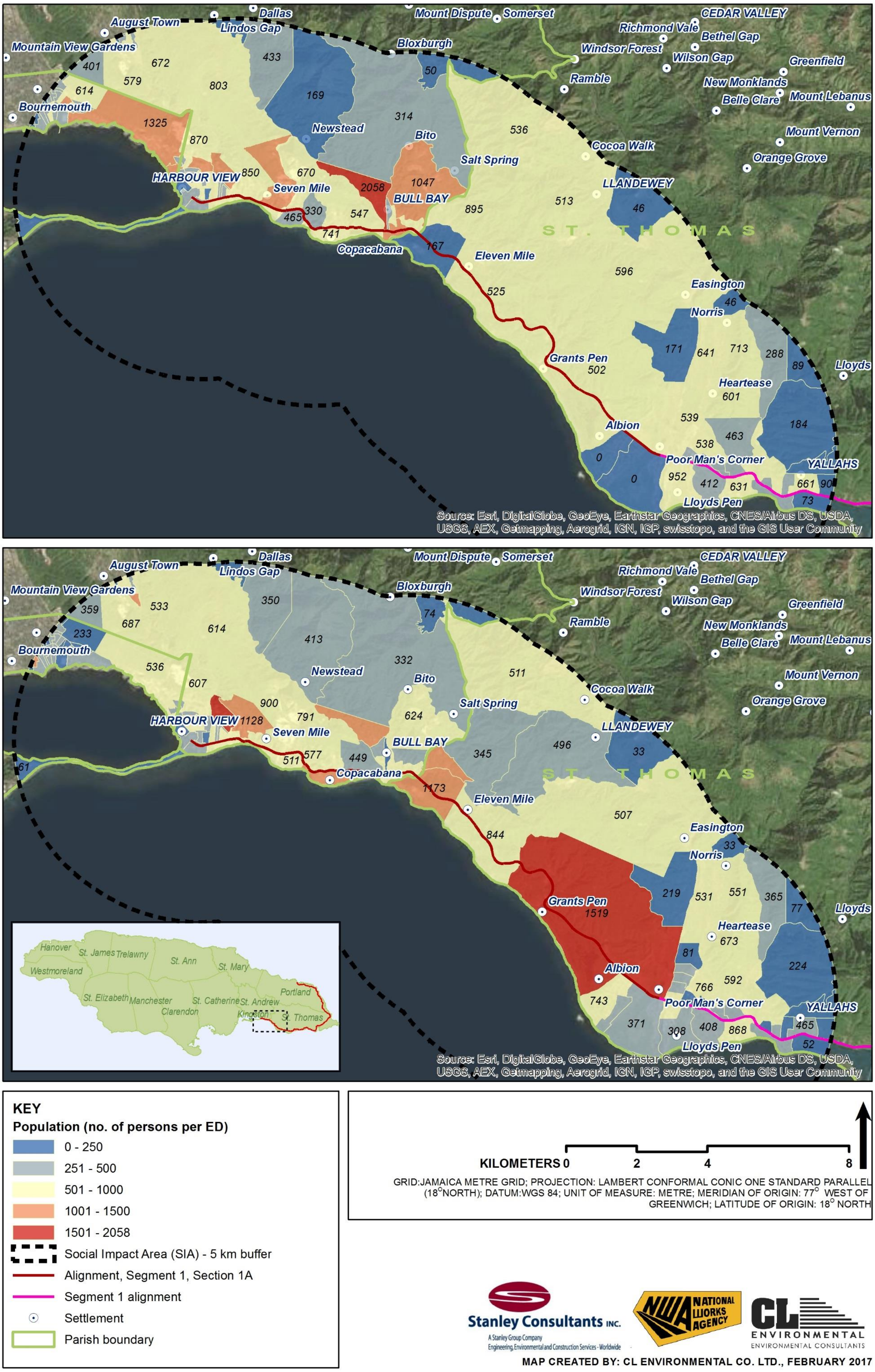
Population Density

The land area within the SIA was calculated to be approximately 131.2 km^2. With a population of 64,610 persons, the overall population density was calculated to be 492 persons/km^2. This population density is higher than the national level (245 persons/km^2) and the St. Thomas regional density of 127 persons/km^2 respectively (Table 4-18). However, when compared to the regional densities for Kingston and St. Andrew, the SIA population density is drastically lower.

Table 4-18 Comparison of population densities for the year 2011

Source: STATIN Population Census 2011

Category	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
Land Area (km^2)	10,991.0	22.7	433.9	742.2	131.2
Population	2,697,983	89,057	573,369	93,902	64,610
Population Density	245	3,921	1,321	127	492



Data source: STATIN Population Census 2011 and 2001

Figure 4-46 SIA 2001 (top) and 2011 (bottom) population data represented in enumeration districts

Age & Sex Ratio

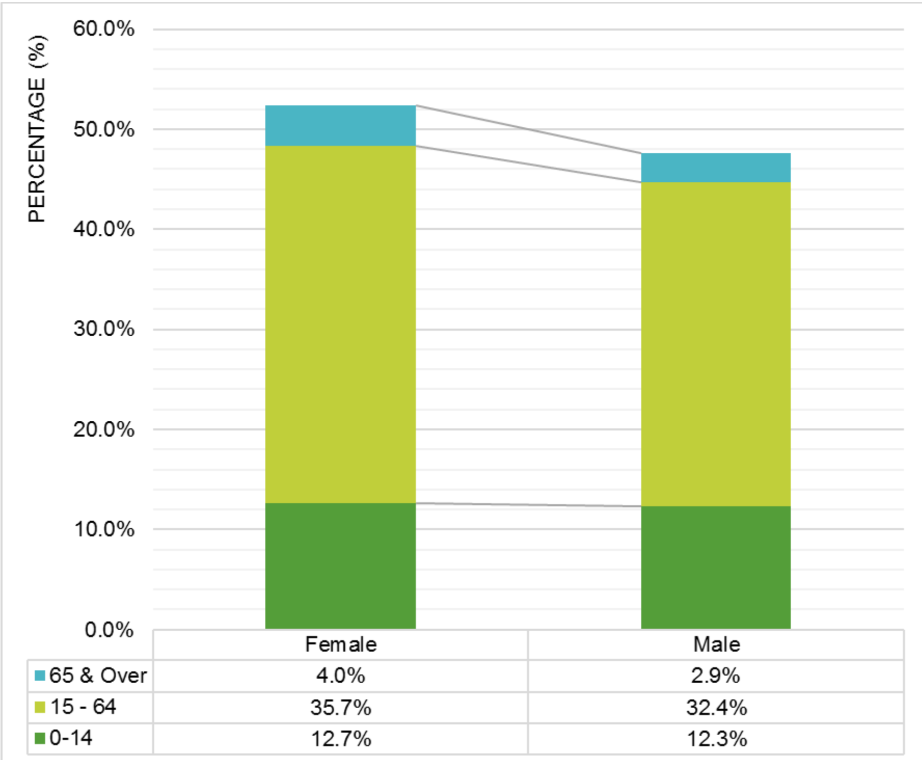
The segment of a population that is considered more vulnerable are the young (children less than five years old) and the elderly (65 years and over). In the SIA population, 7.3% comprised the vulnerable young category, and a comparable 7.0% comprised the elderly. Table 4-19 shows the percentage composition of each age category of the population. This is compared on a national, regional and local (SIA) level. Percentage age distribution in the SIA for the 0-14 years' age cohort (28.5%) is slightly greater than the parish and island figure (26.1%). As mentioned preciously, elderly persons aged 65 years and greater make up 5.6% of the SIA population; and this value is lower than other extents investigated. Within the SIA, the 15-64 years' age category accounted for 65.9% and can therefore be considered a working age population, similar to that for the nation (65.9%) (Table 4-19).

Table 4-19 Age categories as percentage of the population for the year 2011

Source: STATIN Population Census 2011

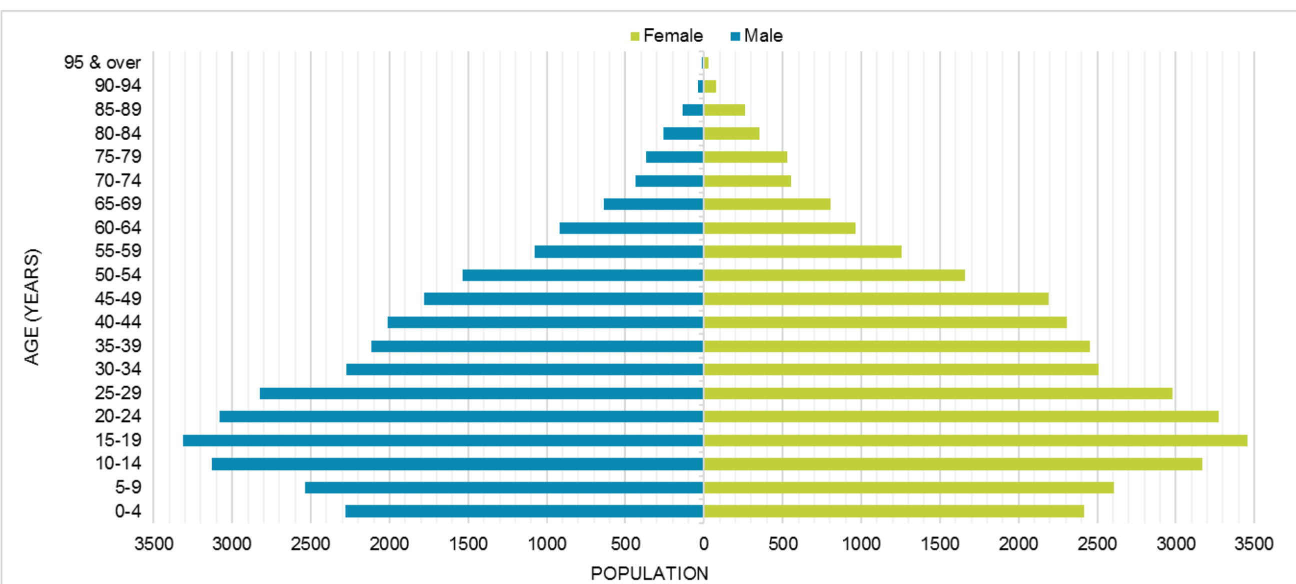
Age Categories	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
0-14	26.1%	27.9%	22.6%	27.0%	25.0%
15 - 64	65.9%	66.0%	69.9%	64.1%	68.1%
65 & Over	8.1%	6.1%	7.5%	8.9%	7.0%

As seen in Figure 4-47 Census 2011 data indicated that there were more females within each age cohort when compared to males. A higher portion of females is also seen when these age groupings are further divided using a population pyramid (Figure 4-48). Sex ratio for all age cohorts within the SIA was calculated to be 90.9 males per one hundred females; this ratio however varies spatially across the SIA, with ratios in Kingston and southern St. Andrew EDs being noticeably high (Figure 4-49).



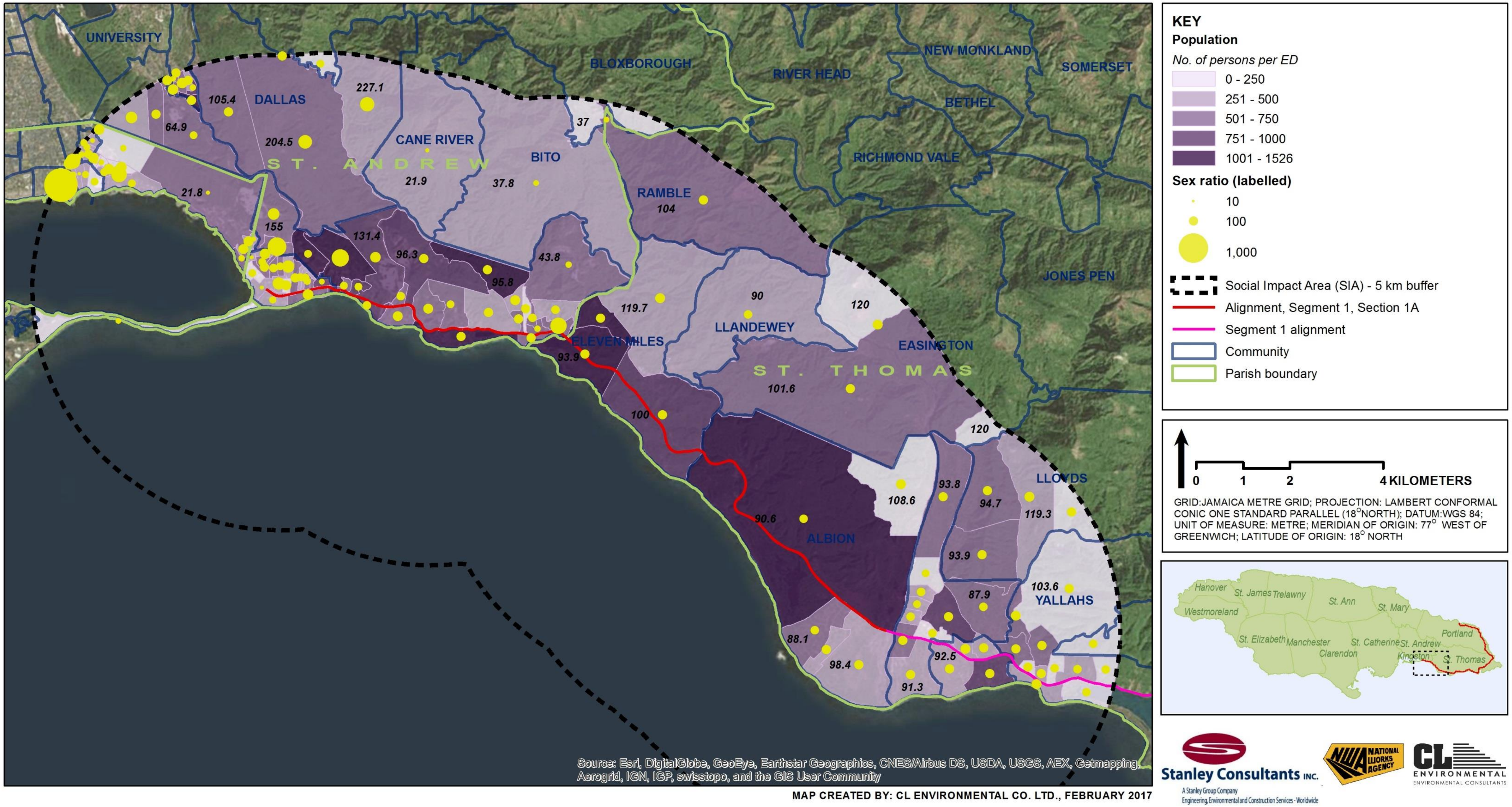
Source data: STATIN Population Census 2011

Figure 4-47 Male and female percentage population by age category in 2011 for the SIA for Segment 1, Section 1A of the SCHIP



Source data: STATIN Population Census 2011

Figure 4-48 Population pyramid in 2011 for the SIA for Segment 1, Section 1A of the SCHIP

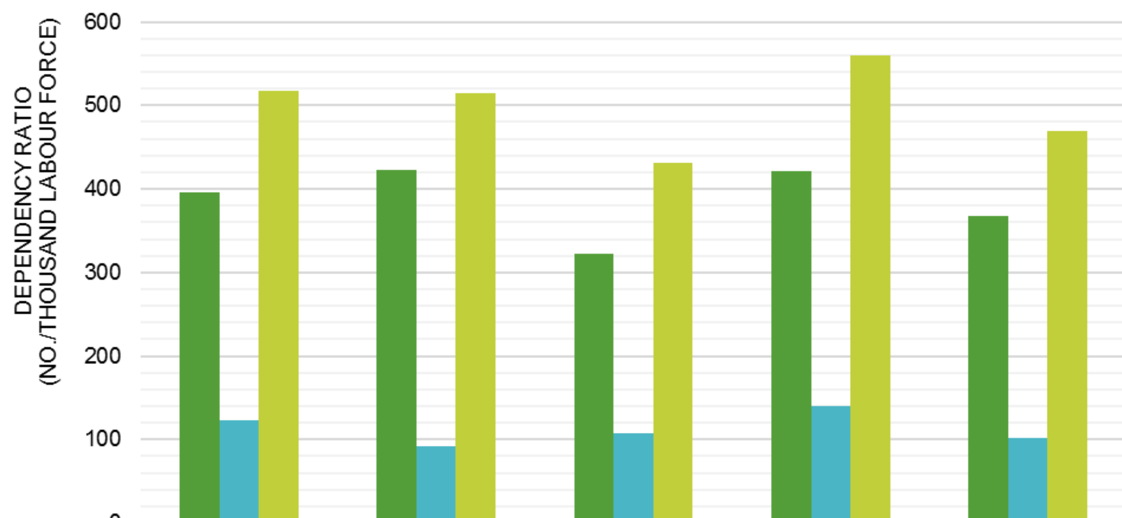


Source data: STATIN Population Census 2011

Figure 4-49 Sex ratio by ED within the SIA for Segment 1, Section 1A of the SCHIP

Dependency Ratios

The child dependency ratio for the SIA in 2011 was 367.0 per 1000 persons of labour force age; old age dependency ratio stood at 102.4 per 1000 persons of labour force age; and societal dependency ratio of 469.4 per 1000 persons of labour force. This indicates that the youth (child dependency) are far more dependent on the labour force for support when compared with the elderly in the SIA. The SIA child dependency is lower than the figures for the parishes of Kingston and St. Thomas and the island (Figure 4-50), whilst societal age dependency is lower in the SIA when compared to the nation and these parish extents. When compared to the parish of St. Andrew however; SIA child and societal dependencies are both higher than the parish figures. Comparing old age dependency to other extents, it is seen that SIA old age dependency is lower than all extents, with the exception of Kingston.



	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
Child Dependency	395.4	423.0	323.0	420.7	367.0
Old Age Dependency	122.4	92.2	108.0	139.5	102.4
Societal Dependency	517.8	515.2	431.0	560.1	469.4

Source: STATIN Population Census 2011

Figure 4-50 Comparison of dependency ratios for the year 2011

4.4.1.3 Education

For 2011, the highest level of educational attainment for the national, regional and SIA extents are represented in Table 4-20. When the highest level of educational attainment within the SIA is calculated as a percentage, it becomes evident that there is a propensity towards the attainment of primary and secondary education. Fifty percent (50.1%) of the SIA population attained a secondary school education as the highest level, followed by 28.5% attaining primary education. Differences between the regional secondary educational attainment are not great when compared with SIA, ranging between 49.1% (St. Thomas) and 52.8% (Kingston). Tertiary education attainment (university and other) as the highest level of education is higher in the SIA (10.4%) when compared to Kingston and St. Thomas parishes (6.1% and 6.4% respectively), yet lower than that for St. Andrew (15.4).

According to the SDC community profiles, percentage households headed without academic qualification ranged from 36% (Harbour View) to 90% (Bito). Of interest as well, is "high levels of high school drop out" being a major concern in the community of Yallahs, as well as low skill levels in Cane River and Harbour View.

Table 4-20 Population 3 years old and over by highest level of educational attainment as a percentage for the year 2011

Source: STATIN Population Census 2001

	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
No Schooling	0.7%	0.5%	0.4%	0.7%	0.5%
Pre Primary	4.8%	5.8%	4.0%	4.8%	4.6%
Primary	34.4%	28.6%	27.1%	34.8%	28.5%
Secondary	45.7%	52.8%	46.8%	49.1%	50.1%
University	4.7%	2.3%	9.6%	2.5%	4.5%
Other Tertiary	5.2%	3.8%	5.8%	3.9%	5.9%
Other	0.5%	0.5%	0.7%	0.3%	0.7%
Not Stated	0.0%	5.7%	5.6%	3.9%	5.3%

The relatively high proportion of the population in proximity to the project location attaining a secondary education, as well as tertiary education suggests that the labour pool is relatively educated, and as such, there should be no problem in obtaining non-technical workers from the community. Figure 4-51 depicts secondary education attainment within the SIA and the location of schools in proximity to the proposed development. Of the ten (10) schools located within the demarcated SIA, five are All-Age schools, 4 primary and one secondary (Table 4-21).

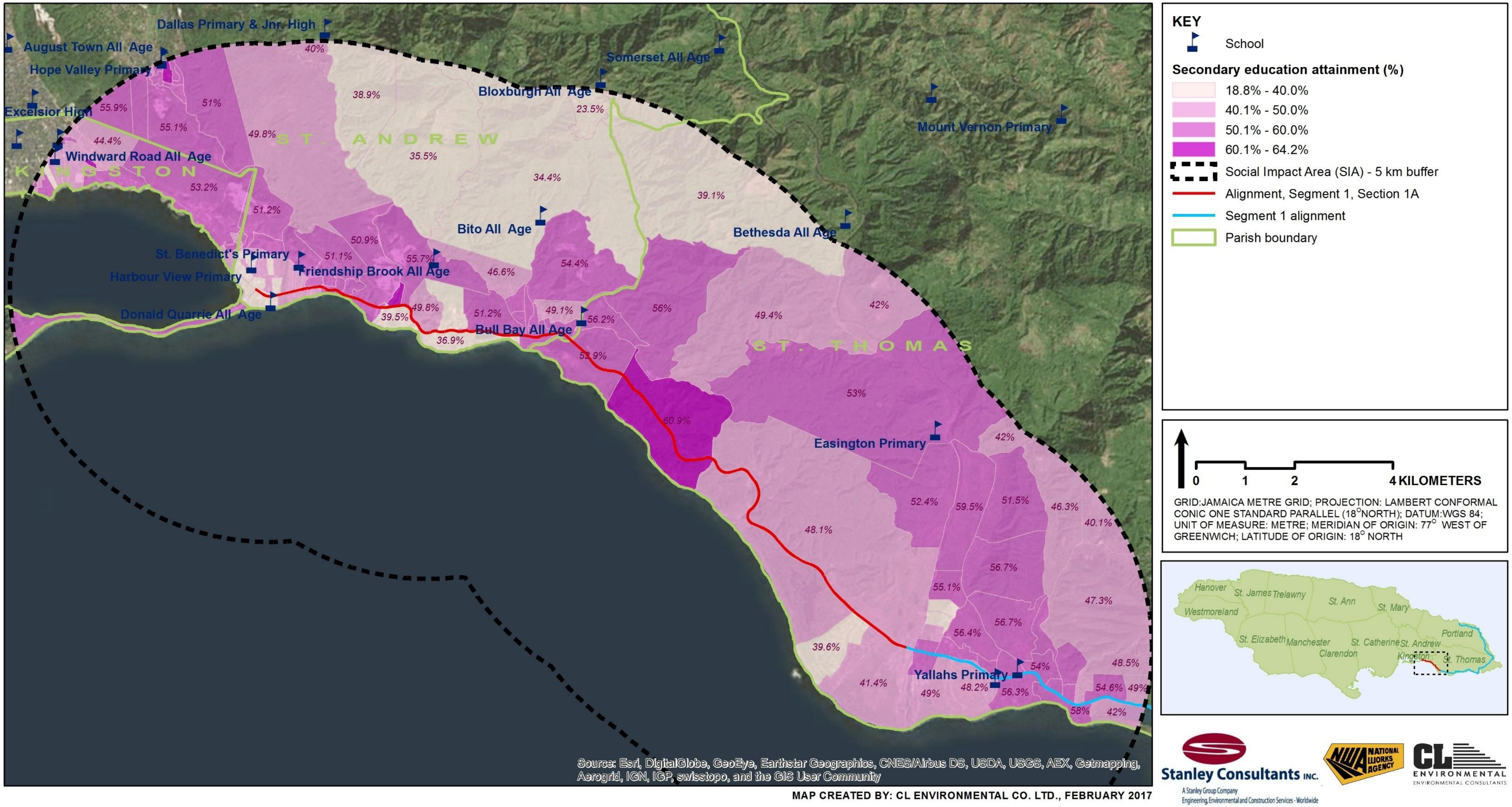
Table 4-21 Schools found with the 5km project SIA for Segment 1, Section 1A of the SCHIP

Source: Mona GeoInformatics Institute

Name	Type	Parish	Gender	Capacity	Teachers
Yallahs Primary	Primary	St. Thomas	Co-ed	950	48
Yallahs Comprehensive High	Comprehensive High	St. Thomas			
Easington Primary	Primary	St. Thomas	Co-ed	220	8
Bull Bay All Age	All Age	St. Thomas	Co-ed	330	11
Bito All Age	All Age	St. Andrew	Co-ed	145	3
St. Benedict's Primary	Primary	St. Andrew	Co-ed	915	19
Friendship Brook All Age	All Age	St. Andrew	Co-ed	85	3
Harbour View Primary	Primary	St. Andrew	Co-ed	655	31
Donald Quarrie All Age	All Age	St. Andrew	Co-ed	720	73
Windward Road All Age	All Age	Kingston	Co-ed	1000	58

4.4.1.4 Employment

Approximately 26.0% of households in Cane River are headed by unemployed persons, whilst larger percentages were recorded for Bito (45.0%), Harbour View (40.5%) and Yallahs (32.9%). Indeed, high levels of unemployment amongst the youth and adults, as well as limited or no opportunities for training and employment are major concerns in these communities (Social Development Commission, 2009).



Source: Education (STATIN Population Census 2011), Schools (MGI)

Figure 4-51 Percentage population attaining a secondary education within the SIA for Segment 1, Section 1A of the SCHIP

4.4.1.5 Poverty

The poverty GIS dataset developed by the Planning Institute of Jamaica (PIOJ) (with contributions from STATIN, Social Development Commission (SDC) and the University of Technology), primarily identifies areas of poverty by community. As described by PIOJ, for the 2002 poverty map:

> The indicators utilized were those that best predicted per capita consumption levels in households based on data from the Jamaica Survey of Living Conditions (JSLC) 2002. Relevant variables that were common to this survey and the Population Census 2001 were selected and tested for similarity. The satisfactory variables were then applied to the census data to obtain estimates of the consumption levels of the households that had consumption levels island wide. Members of households that had consumption levels below the poverty line for the region in which their household was located were deemed to be in poverty. The proportion of persons in poverty in each community was used to rank the 829 communities.

As seen in Figure 4-53, the poverty level along the alignment varies. The SIA population has poverty levels ranging between 5.28% and 44.1% of persons living in poverty.

4.4.1.6 Housing

Housing Units, Dwellings and Households

For the purposes of this study, the definition of housing unit, dwelling and household are those used in the population census conducted by the Statistical Institute of Jamaica (STATIN). The definition states that:

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

There were 17,281 housing units, 20,299 dwellings and 21,250 households within the SIA in 2011. The average number of dwellings in each housing unit was 1.2 and the average household to each dwelling was 1.0 (Table 4-22). The average household size in the SIA was 3.0 persons/ household; however, this varied spatially by ED with a minimum size of 1 person/ household to a maximum of 24.5 persons/ household, both extremes located in Kingston (Figure 4-54). When compared to the available SDC community profiles, household size ranges as well, from 2.1 persons/ household in Bito, to 3.8 in Yallahs, with both Harbour View and Cane River having 3.4 persons per household (Social Development Commission, 2009).

Comparisons of the SIA with national and regional ratios indicate that the SIA had comparable household/dwelling and average household size; however, the SIA dwelling/ housing unit ratio (1.2) was drastically lower than that for Kingston (2.0), yet comparable to that for Jamaica and St. Thomas (1.2 and 1.1 respectively).

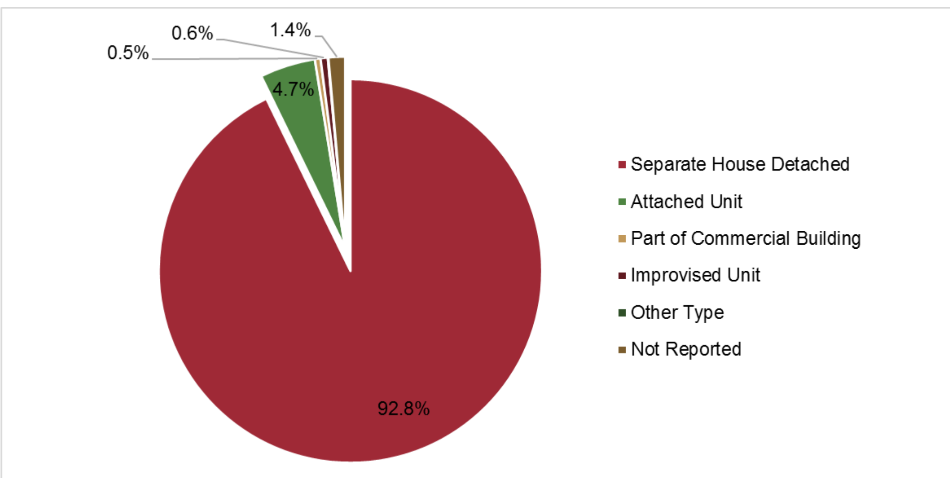
Table 4-22 Comparison of national, regional and SIA housing ratios for 2011

Source: STATIN Population Census 2001

	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
Dwelling/Housing Unit	1.2	2.0	1.5	1.1	1.2
Household/Dwelling	1.0	1.0	1.0	1.1	1.0
Average Household Size	3.1	3.0	3.0	2.9	3.0

Housing Unit Type

Approximately 89.5% of the housing units in the SIA were of the separate detached type, 7.0% were attached, 2.3% improvised unit, 0.7% part of a commercial building, 0.5% not reported (Figure 4-52).



Source: STATIN Population Census 2011

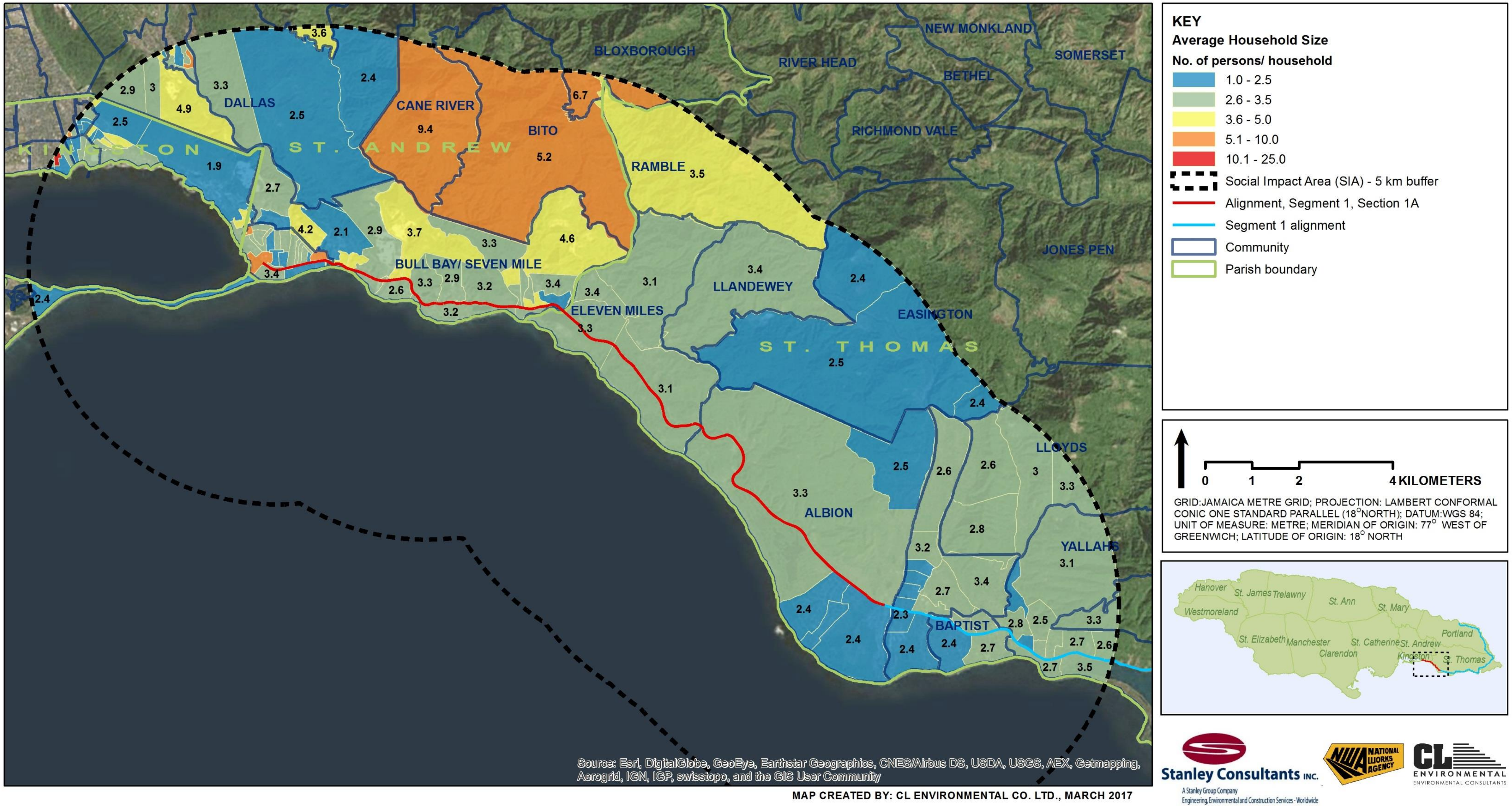
Figure 4-52 Percentage of housing units by type within the SIA for Segment 1, Section 1A of the SCHIP

Household Headship

According to the SDC profiles, Bito had the highest percentage of households headed by males (78%), compared to Cane River (48%), Harbour View (43%) and Yallahs (41.8%) (Social Development Commission, 2009).

Data source: PIOJ (with contributions from STATIN, SDC and the University of Technology

Figure 4-53 Proportion of persons in poverty in each community within the SIA for Segment 1, Section 1A of the SCHIP



Source: Education (STATIN Population Census 2011), Schools (MGI)

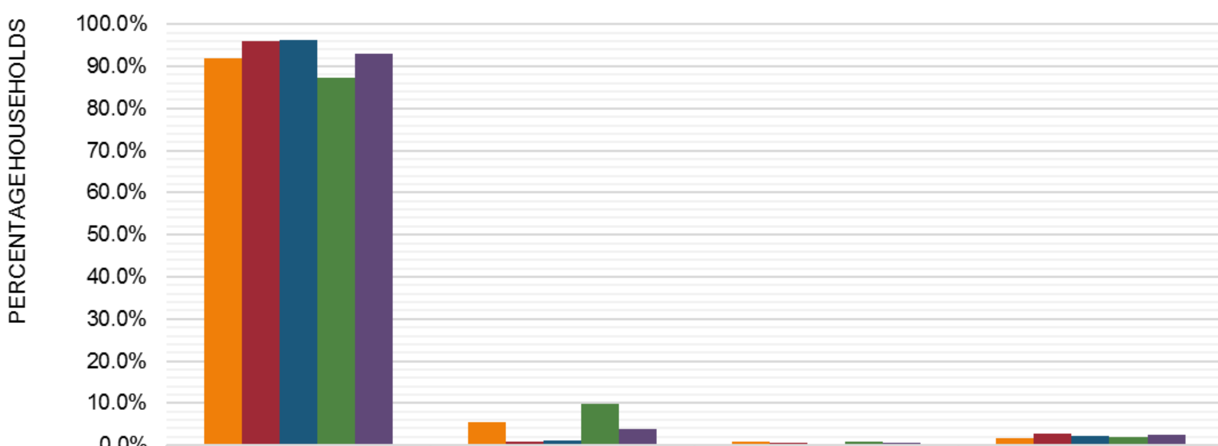
Figure 4-54 Household size by ED for 2011 within the SIA for Segment 1, Section 1A of the SCHIP

4.4.1.7 Utilities

Lighting

Figure 4-55 details the percentage of households using a particular category of lighting. Data for all extents (SIA, parish and national) reveal that the majority of the population utilises electricity as their main source of lighting. Approximately ninety-three percent (93.1%) of households within the SIA use electricity, this is lower than the percentages for the Kingston and St. Andrew figures (95.9% and 96.3% respectively), but higher than those for the island (91.6%) and St. Thomas (87.4%). From the SDC profiles, 96% Harbour View residents used electricity for lighting, 90% in Yallahs, 83% in Cane River and 64.5% in Bito.

The use of electricity is not consistent throughout the SIA (Figure 4-56); in EDs where electricity usage is less than 80%, kerosene is used more than electricity as a source of lighting within the ED, or the source is not reported. Overall however, the percentage of households using kerosene as their main means of lighting in the SIA (3.8%) was lower than that for St. Thomas (9.7%) and Jamaica (5.5%), but higher than Kington and St. Andrew (0.9% and 1.1% respectively).



	Electricity	Kerosene	Other	Not Reported
Jamaica	91.9%	5.5%	0.8%	1.8%
Kingston	95.9%	0.9%	0.5%	2.7%
St. Andrew	96.3%	1.1%	0.3%	2.2%
St. Thomas	87.4%	9.7%	1.0%	1.9%
SIA	93.1%	3.8%	0.7%	2.5%

Source: STATIN Population Census 2011

Figure 4-55 Percentage households by source of lighting

As part of the *Feasibility Study* requirements, assessment of the existing utilities was conducted for each of the SCHIP segments. GIS information on the utilities within the corridor limits was provided by the Jamaica Public Service (JPS), National Water Commission (NWC) and LIME. Critical utility features contained in the GIS information were verified and features identified in the field that were not contained in the GIS information were mapped and documented. With respect to JPS utilities, 69kV transmission lines primarily provide electricity to the study area (Table 4-23). Similar to the existing main road, transmission lines run more or less parallel to the coastline, but further north than the roadway (Figure 4-56).

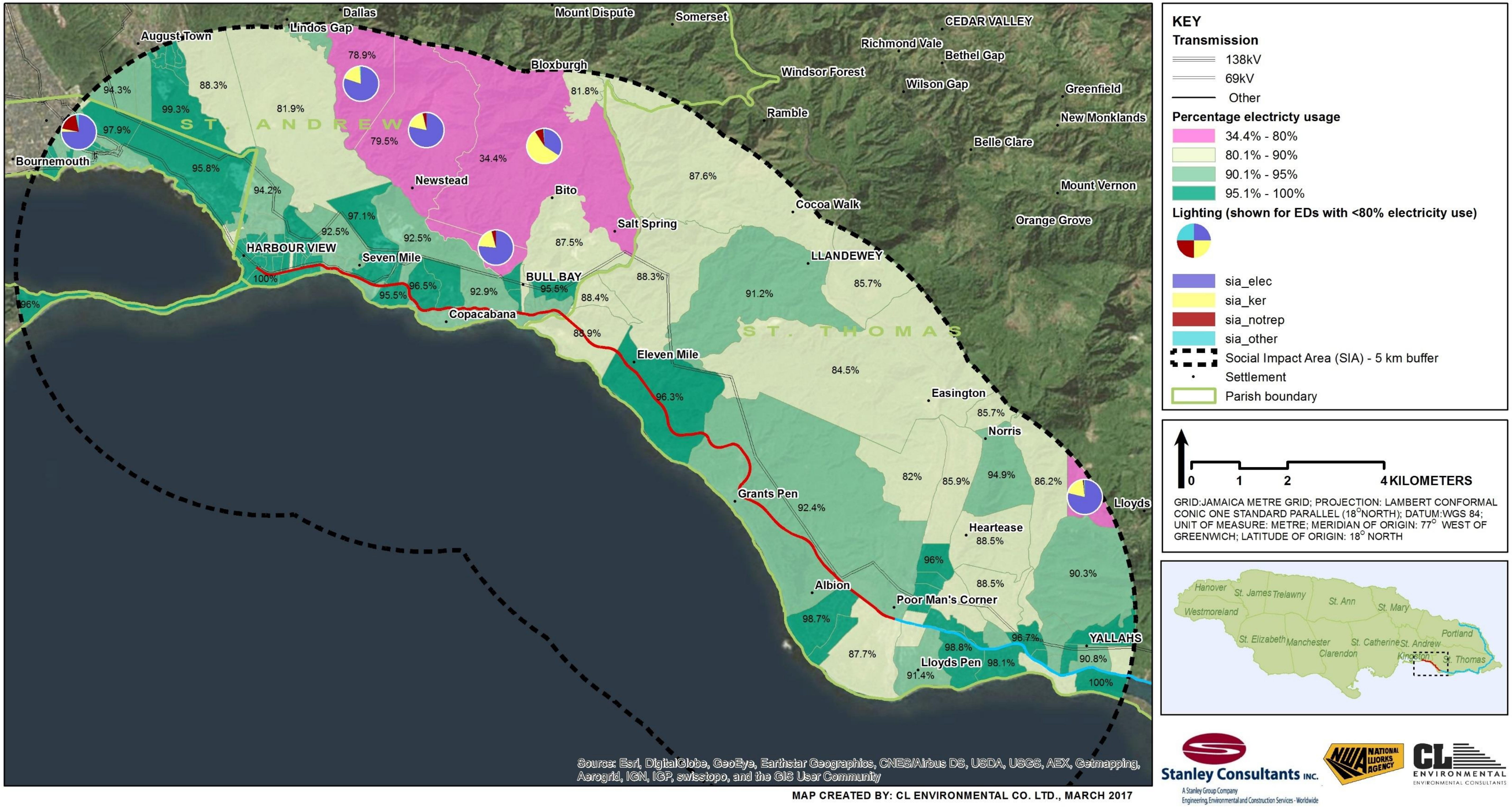
Table 4-23 Summary of utilities along existing main road, Segment 1, Section 1A

Source: (Stanley Conulstants Inc., 2015)

Sub-Segment	JPS	NWC	LIME
Harbour View to Bull Bay	214 poles 69KV transmission line north of road	18 valves 11 hydrants Sewer lines near Harbour View roundabout	37 manholes 8 service cabinets Overhead lines
Bull Bay to Grants Pen	160 poles 69KV transmission line north of road	0 valves 1 hydrant No sewer facilities	No manholes No service cabinets Overhead lines
Grants Pen to Poor Man's Corner	118 poles 69KV transmission line north of road	5 valves 7 hydrants Sewer facilities north of road	6 manholes 1 service cabinet Overhead lines
Yallahs	178 poles 69KV transmission line north of road	26 valves 7 hydrants No sewer facilities	17 manholes 6 service cabinets Overhead lines

Telecommunication

The parishes of Kingston, St. Andrew and St. Thomas, and thereby the study area as well, are served with landlines provided by Flow Jamaica Limited (formerly LIME Jamaica Limited). As seen in Table 4-23, a number of LIME service cabinets and overhead lines exists along the main roadway. Wireless (mobile) communication is provided by Digicel Jamaica Limited and Flow; a network to support internet connectivity is also provided by Flow. In Harbour View, telephone services utilized by 99% of residents and in Cane River and Bito, 97% of the population utilised mobile services. In Yallahs, 96% had telephone services, 82% mobile phones and 17% had both cellular and land line phones (Social Development Commission, 2009).



Source: STATIN Population Census 2011

Figure 4-56 Percentage electricity usage for the year 2011 and location of transmission lines within the SIA for Segment 1, Section 1A of the SCHIP

Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SIA (85.7%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 4-24). This is also comparable to SDC survey data for Harbour View, where it was found that 62% of residents received water publicly from NWC (public water piped into dwelling). In Yallahs, this percentage from public water piped is lower (28.8%), with a higher percentage of the population receiving private water piped into dwelling (43.2%). In Cane River, 30% of residents received water from a standpipe and 16% from private catchments, whilst in Bito, the major water source was from springs, rivers or streams (56.3%).

Table 4-24 Percentage of households by water supply for the year 2011

Source: STATIN Population Census 2011

	Category	Jamaica	Kingston	St. Andrew	St. Thomas	SIA
Public Source	Piped in Dwelling	49.7%	51.2%	70.9%	40.4%	59.3%
	Piped in Yard	16.5%	40.1%	18.0%	23.1%	18.6%
	Stand Pipe	7.1%	1.5%	2.5%	14.6%	6.0%
	Catchment	2.2%	0.8%	0.6%	1.2%	1.8%
Private Source	Into Dwelling	6.4%	2.2%	2.9%	6.5%	3.5%
	Catchment	9.8%	0.5%	1.1%	1.8%	4.0%
	Spring/ River	3.0%	0.0%	1.2%	5.8%	0.7%
	Trucked Water/Water Truck	2.1%	0.3%	0.5%	1.8%	2.0%
	Other	1.8%	1.1%	0.9%	3.1%	2.2%
	Not Reported	1.3%	2.3%	1.5%	1.8%	1.9%

NWC facilities and pipelines that support the provision of water form public sources and that are located within the SIA are shown in Figure 4-57 and listed in Table 4-25. There are 57 wells located within the SIA, those owned by NWC are listed in Table 4-26. Also shown in Figure 4-57 are the natural water sources (e.g. springs and rivers); six springs are found within the SIA – two in St. Andrew (Friend Brook and Rosey River) and four in St. Thomas (Broke-away Spring, Alluvial Spring, Albion Spring and Easington Spring). Major river systems include Bull Park Pen River, Cane River, Chalky River, Hope River, Mammee River, Mandicot River and Yallahs River. Portions of the water management units (WMUs) for two of these rivers, namely Hope River and Yallahs River, as well as that for Morant River are located in the SIA (Figure 4-57). The number of NWC valves and hydrants along the main roadway may be seen in Table 4-23.

Table 4-25 NWC potable water facilities within the SIA for Segment 1, Section 1A of the SCHIP

Name	Type	Administration	Status
Shooters Hill Relift Station	Relift Station	KSA	Operational
Rest Haven Production Well	Production Well	KSA	Operational
Rest Haven Storage Tank	Storage Tank	KSA	Operational
South Haven Production Well	Production Well	St. Thomas	Operational
Montpelier Pump Station	Pump Station	St. Thomas	Operational

Name	Type	Administration	Status
Albion Estate Pump Station	Pump Station	St. Thomas	Operational
East Albion Production Well	Production Well	St. Thomas	Operational

Water demand for the SIA in 2017 is estimated to be 14,758,521.4 litres/day (~3,898,789.6 gals/day) and is expected to increase to 15,114,871.6 litres/day (~3,992,927.4 gals/day) over the next twenty-five years based on population growth rates calculated previously.

Table 4-26 Wells located within the project SIA for Segment 1, Section 1A of the SCHIP

No.	Location	Parish	Owner	Depth (m)
1	Rock Spring	Kingston	National Water Commission	
2	Plant #2 (Rockfort)	Kingston	Carib Cement Company	
3	Plant #3 (Rockfort)	Kingston	Carib Cement Company	
4	Rockfort CH#2	Kingston	Jamaica Private Power Company	60.66
5	Long Mountain	Kingston	National Water Commission	24.38
6	Rockfort (JPPC)	Kingston	Jamaica Private Power Company	72.24
7	Tropicana - Rockfort	Kingston	Tropicana International Limited	15.85
8	Rennock Lodge	Kingston	National Water Commission	30.48
9	Rockfort Power Plant #1	Kingston	Auxini SA	16.76
10	Rockfort Power Plant #2	Kingston	Auxini SA	16.76
11	Plant #1 (Rockfort)	Kingston	Carib Cement Company	10.67
12	August Town - Berry	St. Andrew	National Water Commission	
13	Cane River	St. Andrew	Black's Block Factory	11.58
14	Resthaven 1 (old)	St. Andrew	National Water Commission	
15	Resthaven 2 (new)	St. Andrew	National Water Commission	28.35
16	Albion 2	St. Thomas	Mr. Black	
17	Poorman's Corner Y6 CH	St. Thomas	National Water Commission	
18	Montpelier #1	St. Thomas		6.71
19	Albion 1 CH	St. Thomas	Water Resources Authority	9.14
20	Albion 1	St. Thomas	Mr. Cowan	
21	West Albion (South) - Y5 CH	St. Thomas	National Water Commission	
22	Heartease (South) - Y4 CH	St. Thomas	National Water Commission	
23	Heartease (North) - Y3 CH	St. Thomas	National Water Commission	
24	Woodburn - Easington #2 CH	St. Thomas	Water Resources Authority	45.72
25	Easington	St. Thomas	National Water Commission	
26	Gutterhead - Norris Y1 CH	St. Thomas	National Water Commission	
27	West Albion (North) - Y2 CH	St. Thomas	National Water Commission	
28	Easington CH	St. Thomas	National Water Commission	14.33
29	Norris	St. Thomas	YVLA	15.24
30	Hampstead	St. Thomas	Mr. Aaron	
31	Yallahs - Highgate Expl. #1	St. Thomas	W. K. Newman	15.24
32	London Piece - Albion	St. Thomas	Ministry of Agriculture	16.15
33	Albion 3 CH	St. Thomas	M. C. Halliburton	16.76
34	Yallahs (Highgate #1)	St. Thomas	Aston Tai	13.11
35	Yallahs	St. Thomas	Mr. Aston Tai	182.88
36	Yallahs Market	St. Thomas	St. Thomas P.C.	
37	Easington replacement	St. Thomas	National Water Commission	21.34
38	Albion 4 (Yallahs Bay)	St. Thomas	Water Resources Authority	21.34
39	Montpelier (Yallahs - Henry Walk 1)	St. Thomas	National Water Commission	30.48
40	Albion 2 CH	St. Thomas	Water Resources Authority	22.86
41	Lloyds Pen - Borehole H H-5	St. Thomas	National Water Commission	30.48

No.	Location	Parish	Owner	Depth (m)
42	Heartease - Borehole H H-4	St. Thomas	National Water Commission	45.72
43	Albion Estates (Supply)	St. Thomas	National Water Commission	30.48
44	Albion 3	St. Thomas	Caribbean Aggregates Limited	38.1
45	Albion - Borehole H H-OB	St. Thomas	National Water Commission	30.48
46	Phillipsfield	St. Thomas	National Irrigation Commission	50.29
47	Albion 3R (replacement)	St. Thomas	Caribbean Aggregates Limited	36.58
48	Yallahs	St. Thomas	Jamaica Premix Limited	35.05
49	Yallahs - Easington EB #1	St. Thomas	National Irrigation Commission	42.67
50	Yallahs (Tropiculture 2)	St. Thomas	Tropiculture Limited	30.48
51	Lloyds Pen (Yallahs) - Southaven	St. Thomas	National Water Commission	37.34
52	Woodburn - Easington	St. Thomas	Mr. A. Wong	45.72
53	Albion - Borehole HH-I	St. Thomas	National Water Commission	60.96
54	Norris - Borehole H H-3	St. Thomas	National Water Commission	45.11
55	East Albion – Poorman's Corner	St. Thomas	National Water Commission	48.77
56	Yallahs - Norris EB#2	St. Thomas	National Irrigation Commission	40.23
57	Woodburn - Easington #1 CH	St. Thomas	St. Thomas Aggregates	57.91

Table 4-27 NWC potable water facilities within the SIA for Segment 1, Section 1A of the SCHIP

Name	Type	Administration	Status
Yallahs	WW Treatment Plant	St. Thomas	Operational
Harbour View East	WW Pump Station	KSA	Operational
Harbour View	WW Treatment Plant	KSA	Operational

Wastewater Generation and Disposal

It is estimated that approximately 11,806,817.1 litres/day (~3,119,031.7 gals/day) of wastewater is generated within the study area (for 2017) and is expected to decrease to 12,091,897.2 litres/day (~3,194,341.9 gals/day) over the next twenty-five years based on calculated growth rates.

Census 2011 data for wastewater disposal methods was not available. However, according to the SDC 2009 survey, wastewater disposal methods varied amongst the communities for which data was available (Social Development Commission, 2009):

- Harbour View: 62% of households utilized water closets linked to sewer, 22% used soak away and 31% shared toilet facilities with other households.
- Cane River: 65% of households utilized pit latrines, 47% also used water closets not linked to a sewer.
- Bito: 75% of households utilized pit latrines, 12.5% used soak away.
- Yallahs: 39.8% had flush toilets not linked to a sewer, 28.8% had flush toilets linked to a sewer and 25.2% of households used pit latrine.

Wastewater (WW) infrastructure shown in Figure 4-57 include pipelines, in addition to the Yallahs WW Treatment Plant in St. Thomas and Harbour View East WW Pump Station and Harbour View WW Treatment Plant in St. Andrew; all three facilities are operational. Along the main roadway, sewer lines exist near Harbour View roundabout, and facilities north of the road between Grants Pen to Poor Man's Corner.

Solid Waste Generation and Disposal

It is estimated that at the time of this study (2017), approximately 87,840.75 kg (~87.8 tonnes) of solid waste was being generated.

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, MPM Waste Management Ltd. covers the parishes of St. Andrew, Kingston and St. Thomas. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area. The waste is transported to the Riverton Waste Disposal Site (landfill) located in southeast St. Catherine. Riverton Waste Disposal Site is approximately 1.19 m^2 (119 hectares) and receives approximately 60% of the island's waste. Solid waste collection for commercial and industrial facilities is done by arrangements by these entities with private contractors. Solid waste at the site will be collected on as needed basis by a private company.

Data from the SDC profiles revealed that the common method of household garbage disposal was by pick-up (NSWMA) in Harbour View (83%) and Yallahs (84%). Burning was the predominant method in Cane River (94%) and Bito (93.8%), and also practiced in Harbour View (24%) and Yallahs (46.8%). Burying garbage was also reported by approximately 9% of households in Bito and Cane River (Social Development Commission, 2009).

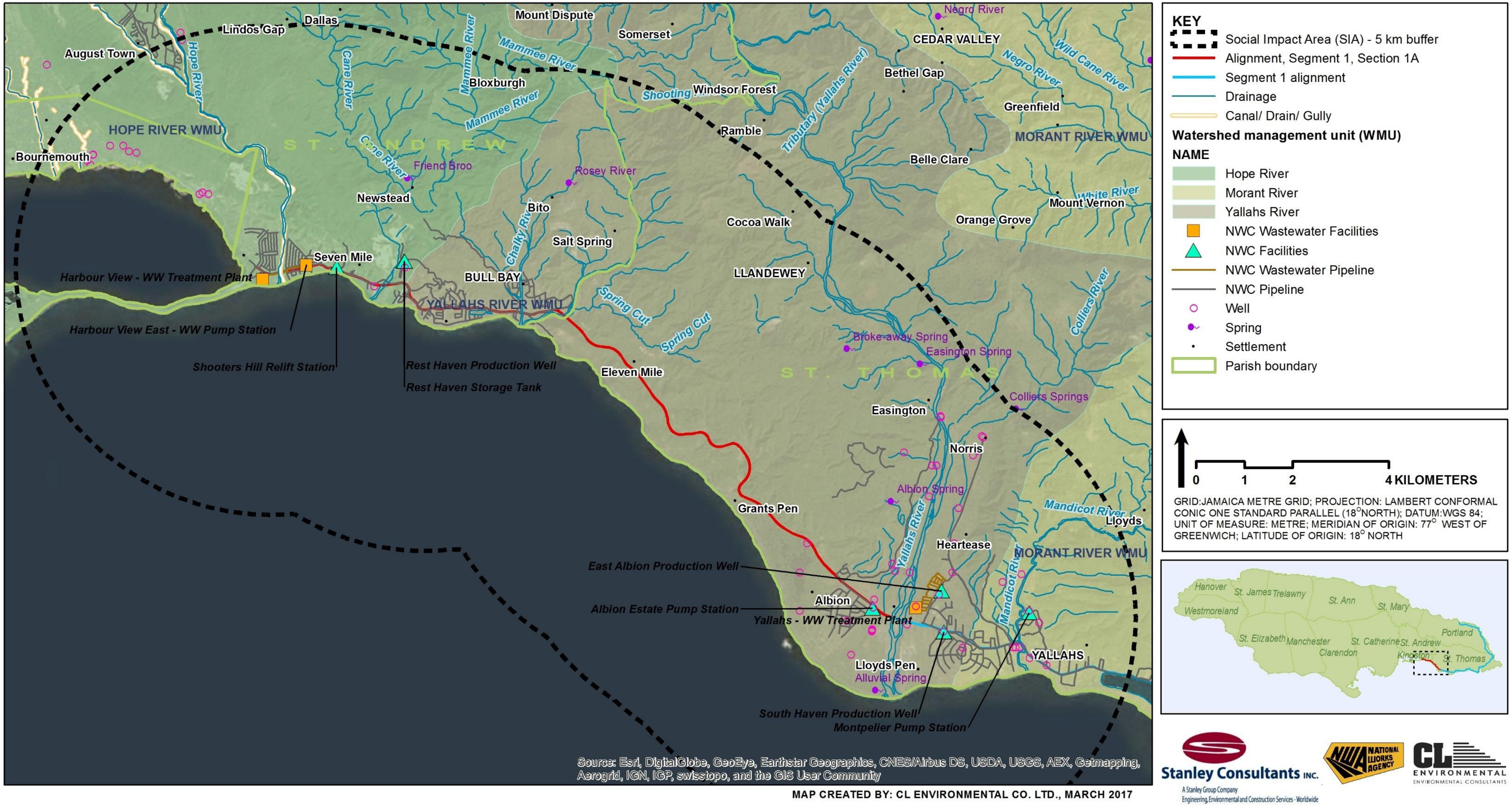


Figure 4-57 Water management units, natural water features, as well as NWC infrastructure located in the SIA for Segment 1, Section 1A of the SCHIP

4.4.1.8 Transportation

Road Network

ROAD CONDITON

The existing road network within and surrounding the SIA is depicted in Figure 4-58. As part of the SCHIP *Feasibility Study* requirements, a detailed assessment of the existing highway features was conducted in 2012 for each of the project segments. The information provided in this section was taken from the respective report.

As shown in Table 4-28, the Right-of-Way width along the main roadway between Harbour View and Yallahs ranges between 15 and 25 m and safety concerns such as absence of sidewalks, minimal clear zones and shoulders exist. Existing pavement assessment revealed that as many as 12 potholes were recorded per kilometre in some areas, with cracked areas ranging from 8 to 35%. (Table 4-29). The generally poor or marginal conditions of the roadway is also revealed by the SDC 2009 survey, in which poor roads are considered a priority issue in the communities of Harbour View, Cane River and Bito (St. Andrew) (Social Development Commission, 2009).

Table 4-28 Summary of existing roadway features for Segment 1, Section 1A sub-segments

Source: (Stanley Conulstants Inc., 2015)

Sub-Segment	Typical Section	Posted Speed	Right-of-Way Width	Pavement Condition	Sight Distance	Roadside Safety
Harbour View to Bull Bay	4 Lanes for 1 km; 2 lanes; Minimal shoulders	50 km/hr.	15m to 25m	Good to Fair	Adequate; Poor east of Seven Mile; Few opportunities for passing	No sidewalks in urban areas; fixed objects within clear zone
Bull Bay to Grants Pen	2 lanes; Lanes narrow; No shoulders	50 km/hr.	15m to 25m	Fair with rutting	Poor due to sharp horizontal curves; Few opportunities for passing	Narrow roadway; No shoulders
Grants Pen to Poor Man's Corner	2 Lanes with narrow shoulders	80 km/hr. to Albion; 50 km/hr. to Poor Man's Corner	15m to 25 m	Marginal with patching; Large cracks	Generally good with some opportunities to pass slow vehicles	Obstacles within clear zone; No steep drop off
Yallahs	2 Lanes with no shoulders	50 km/hr.	15m	Marginal with patching and potholes	Generally adequate with some areas to pass slow vehicles	Roadside is congested with businesses; Minimal clear zone

Table 4-29 Summary of existing pavement conditions along Segment 1, Section 1A sub-segments

Source: (Stanley Conulstants Inc., 2015)

Sub-Section	Potholes (per km)	Area Cracked (%)	Edge Break Area (m^2 per km)	Ravelled Area (%)	International Roughness Index (m per km) *
Harbour View to Bull Bay	12.4	12	200	10	8.172
Bull Bay to Eleven Mile	12.5	35	400	15	12.381
Eleven Mile to Grants Pen	6.2	30	400	15	9.698

Sub-Section	Potholes (per km)	Area Cracked (%)	Edge Break Area (m^2 per km)	Ravelled Area (%)	International Roughness Index (m per km) *
Grants Pen to Albion	10.9	25	400	15	8.293
Albion to Poor Man's Corner	1.6	8	400	10	3.552
Poor Man's Corner to Yallahs	3.4	10	400	10	4.894

** The International Roughness Index is a measure of the roughness of a pavement, which induces vibration into a vehicle's ride. Range: 0 -16 m/km.*

Culvert and drainage channel conditions range from fair to poor for the most part with scoured channels, structural damage and high vegetation (Table 4-30). Flooding is a cause for concern at the beginning of Section 1A between Harbour View to Bull Bay, as well as in Yallahs.

Table 4-30 Summary of existing drainage features along Segment 1, Section 1A sub-segments

Source: (Stanley Conulstants Inc., 2015)

Sub-Segment	Type*	Size	Material	Blockage	Culvert and Channel Condition	Flooding and Storm Surge
Harbour View to Bull Bay	PC - 16; BC – 2;	600mm to 1500mm; 500mm x 700mm; 1100mm x 700mm	All concrete except 1 HDPE	100% – 4 50% to 100% - 8 0% to 20% – 6	Fair to Poor; Scoured channels; Structural damage Replace 13	Flood prone areas – 1; Storm surge areas - 1
Bull Bay to Grants Pen	PC - 9; BC – 5	600mm to 1200mm; 800mm x 800mm to 4500mm x 2000mm	All concrete except 1 unspecified material	80% to 100% – 6 0% to 40% – 14 0% - 4	Fair to Poor; Scoured channels; Structural damage; High vegetation Replace 6	None
Grants Pen to Poor Man's Corner	PC - 9	450mm to 1500mm	Concrete – 7; HDPE – 1; Cast Iron - 1	100% – 2 0% to 20% – 5 0% - 2	Fair to Poor; Structural damage; High vegetation Replace 3	None
Yallahs	PC - 9; BC – 1	300mm to 600mm; 800mm x 600mm	All concrete	50% to 100% – 5 0% to 20% – 2 0% - 3	Poor to good; Scoured channels; Structural damage; Undefined channel Replace 7	Flooding at road to Poor Man's Corner; No storm surge

** PC - Pipe Culvert, BC - Box Culvert*

BRIDGES

Of a total of 37 structures identified and investigated within Segment 1 from Port Antonio to Harbour View, 6 are found within Section 1A (Table 4-31). The existing structures along Segment 1 range in age from approximately 70 years old to only a few years old. Age can be a major contributing factor to the poor condition of many of the existing bridges and although there are numerous newer bridges, there are also a number of bridges that are nearing the end of their design life. During inspection of many bridges it was noticed that heavily loaded aggregate trucks routinely use the existing bridges without regard to the maximum design load of the bridge. Lack of enforcement of overweight loads can subject bridge components to forces that exceed their design capacity. As such bridge decks, girders and columns are forced to "work" harder than intended. This results in fatigue of bridge components which in turn can cause them to breakdown faster than they would under normal use.

Table 4-31 Summary of existing bridges along Segment 1, Section 1A

Source: (Stanley Conulstants Inc., 2015)

No.	Road Section	Bridge	Feature/Name	Structure Type	Action
St. Andrew Parish					
1	Harbour View to Bull Bay	AK	Hope River	3 span steel plate girder	Refurbish
2	Harbour View to Bull Bay	AJ	Cane River	2 span steel plate girder	Widen
3	Harbour View to Bull Bay	AI	Chalky River	1 span steel plate girder	Replace
St. Thomas Parish					
1	Bull Bay to Grants Pen	AH	Bull bay River	2 span steel plate girder	Replace
2	Bull Bay to Grants Pen	AG	Spring Gut	2 cell RCBC	Widen
3	Bull Bay to Grants Pen	AF	Spring Gut	2 cell RCBC	Widen

EXISTING LEVEL-OF-SERVICE

The existing Level-of-Service (LOS) along the corridor was analysed by Stanley Consultants and presented in the *Traffic Report* and Axle Load Survey (July 2014). Based on this analysis using the FDOT generalized level of service (LOS) tables, the LOS along this corridor is B, with the exception of a segment between the Old Harbour Roundabout and Bull Bay as shown in Table 4-32. Volumes range from 5,500 to 17,400 vehicles per day. Although this analysis is from 2013, traffic conditions are not expected to be significantly different in 2017. St. Thomas vehicular traffic is expected to grow by less than 2% per year based on an analysis of the population and vehicle registration growth from the 2014 Traffic Report.

Table 4-32 Existing Corridor Level-of-Service

Source: (Stanley Consultants Inc., 2014)

Parish	Location	Roadway Type	2013	
			AADT	*LOS*
St. Andrew	Harbour View Roundabout to Bull Bay	Transitioning	17,400	D
	Bull Bay to Grants Pen	Transitioning	7,000	B
St. Thomas	Bull Bay to Albion	Rural Developed	5,500	B
	Grants Pen to Pomphret at Poor Man's Corner	Rural Developed	8,000	B
	Grants Pen to Pomphret at Yallahs High School	Urban	8,200	B

TRUCK TRAFFIC

St. Thomas has a large aggregate hauling industry with several active quarries within the parish. Based on data from Mines and Geology Division of the Ministry of Transport and Mining, there are 38 quarries in St. Thomas, 17 of which have current licenses to operate. The main road therefore has significant truck traffic that is vital to the economy of the parish and infrastructure development in the country. Table 4-33 shows the percentage of heavy vehicles between Harbour View and Yallahs recorded in the 2014 Traffic Report and Axle Load Survey.

Table 4-33 Percentage of Heavy Vehicles

Source: (Stanley Consultants Inc., 2014)

Section	Percent Heavy Vehicles
Harbour View to Bull Bay	12.80%
Bull Bay to Eleven Mile	11.10%
Eleven Mile to Grants Pen	15.20%
Grants Pen to Albion	15.20%
Albion to Poor Man's Corner	9.70%
Poor Man's Corner to Yallahs	9.10%

Airfields, Aerodromes and Airports

Air transport facilities do not exist within the SIA. The Norman Manley International Airport (NMIA) is situated approximately 2 km west of the SIA. NMIA Airports Limited is a wholly owned subsidiary of Airports Authority of Jamaica (AAJ) which was incorporated in 2003. The Airport is operated under a 30-year Concession Agreement with AAJ. The NMIA is the primary airport for business travel to and from Jamaica and for the movement of air cargo. There are 13 scheduled airlines serving many international destinations and average daily aircraft movement is 67. In 2013, total passenger movements were approximately 1.37M and freight (cargo/mail) was 11,503 metric tonnes. The NMIA generates over 13,000 direct and indirect jobs. Located airside, are 13 aircraft gates and 2 remote stands and 9 passenger loading bridges (PLB). The runway is 12/30, with a length of 2,716m (8,910 ft.) and elevation of 3 m (10 ft.). One parallel taxiway with four linked taxiways, including one high-speed exit exists.

Ports, Docks and Marinas

A dock is located at the Caribbean Cement Company at Rockfort in Kingston, in the western section of the SIA.

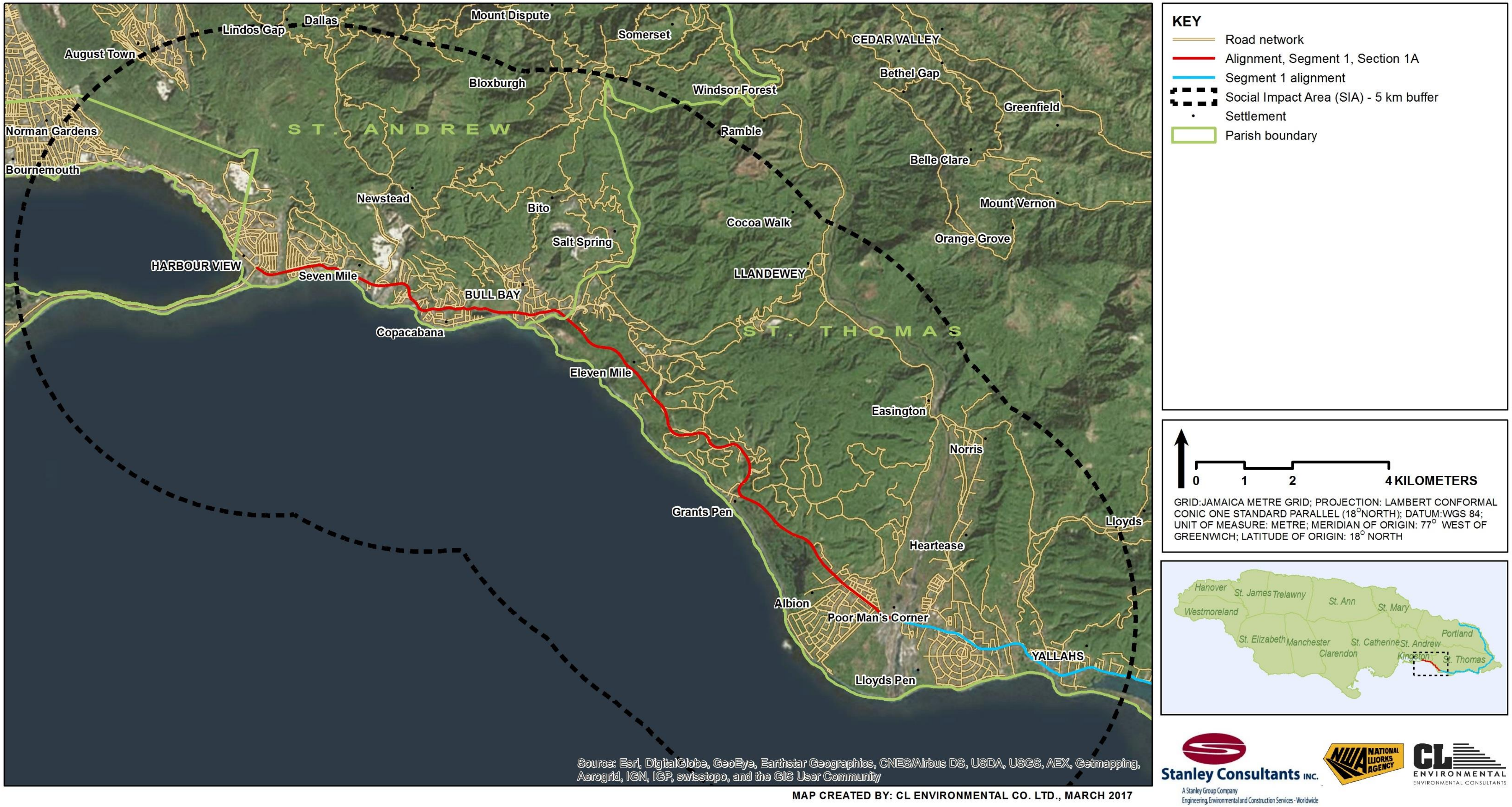


Figure 4-58 Road network and post offices located in the SIA for Segment 1, Section 1A of the SCHIP

4.4.1.9 Social, Health and Emergency Services

Post Offices

As seen in Figure 4-59, there are four post offices found within the demarcated SIA at the following locations: Bull Bay, Ten Miles; Shop 9, Harbour View Shopping Centre; Llandewey; and Yallahs. That at Bull Bay Ten Miles is found directly along Section 1A alignment (Figure 4-59).

Health Centres

Four public health centres exist within the SIA (Table 4-34); all four fall under the responsibility of the Southeast Regional Health Authority (SERHA). Those located at Llandewey and Bull Bay are Type II Health Centres; it is serviced by a visiting Doctor and Nurse Practitioner and serves a population of about 12,000 persons. Family health (including antenatal, postnatal, child health, nutrition, family planning & immunization); curative, dental, environmental health, Sexually Transmitted Infections (STIs) treatment, counselling & contact investigation; child guidance, mental health and pharmacy are the services provided (Southeast Regional Health Authority (SERHA), n.d.). The remaining two at Yallahs and Harbour View are Type III Health Centres; Family Health services, including antenatal, postnatal, child health, nutrition, family planning & immunization are offered (Southeast Regional Health Authority (SERHA), n.d.).

Table 4-34 Health centres located within the project SIA for Segment 1, Section 1A of the SCHIP

Location	Parish	Health Region	Type	Ownership
Yallahs	St. Thomas	SE Health Region	Type 3 Health Centre	Public
Llandewey	St. Thomas	SE Health Region	Type 2 Health Centre	Public
Bull Bay	Kingston and St. Andrew	SE Health Region	Type 2 Health Centre	Public
Harbour View	Kingston and St. Andrew	SE Health Region	Type 3 Health Centre	Public

Hospitals

There are currently no public or private hospitals within the SIA; those closest to the SIA include Princess Margaret Hospital in Morant Bay. St Thomas, 19 km east of the eastern end of Section 1A, as well as those located in Kingston and St. Andrew between 6 and 11 km northwest of the start of Section 1A:

- Victoria Jubilee Hospital (Type S Specialist, Public)
- National Chest Hospital (Type S Specialist, Private)
- Bustamante Hospital (Type S Specialist, Public)
- Kingston (Public) Hospital (Type A, Public)
- University Hospital (Type A, Public)
- Sir John Golding Hospital (Type S Specialist, Public)
- Hope Institute (Type S Specialist Hospital, Public)
- Bellevue (Type S Specialist Hospital, Public)
- Andrews Memorial Hospital (Private)

- Maxfeild Medical Hospital (Private)
- Medical Associates Hospital (Private)
- Nuttal Memorial Hospital (Private)

Ambulance

Ambulance services operating within the parishes of Kingston and St. Andrew include:

- Ambucare - Network of life sustaining units on call 24 hours a day. Services include radio dispatched vehicles, pre-hospital medical response, air ambulance link (overseas) and standby for events and functions.
- Deluxe - Service team consists of specially trained emergency drivers and EMTs. Services include emergency and non-emergency transfers, hospitals and nursing homes, individual companies, stand-by at public events, ground transportation for air ambulance link-up, pre-arranged transport to & from clinics, treatment facilities and laboratories.
- St. Johns - Home nursing and first aid training to individuals and organisations as well as providing health services at sporting events, parties, corporate events and other events.

Fire Stations

South Haven, Yallahs Fire Station is the only fire station located within the SIA; however, 6 km northwest of the start of Section 1A, Fire Boat Fire Station New Port East, Kingston is located (Figure 4-59). These stations fall under Area I and would likely respond to any events along Section 1A.

Fire stations island-wide are served by a fleet of 91 operational firefighting and rescue vehicles and 58 utility vehicles. There are also 3 fire boats, one each assigned to the harbours in Kingston, Montego Bay and Ocho Rios. The Fire Prevention and Public Relations Division and the Emergency Medical Service (EMS) provide fire prevention services and emergency medical rescue/ paramedic services (Jamaica Fire Brigade , 2012).

Police Stations

As seen in Table 4-35, four police station exist within the SIA. One of these stations would likely respond to any events along Section 1A.

Table 4-35 Police Stations falling within the SIA for Segment 1, Section 1A of the SCHIP

Name	Parish	Area	Region
Bull Bay	Kingston and St. Andrew	4	Kingston Eastern
Yallahs	St. Thomas	5	St. Thomas
Rockfort	Kingston and St. Andrew	4	Kingston Eastern
Harbour View	Kingston and St. Andrew	4	Kingston Eastern

Data source: Mona GeoInformatics Institute

Figure 4-59 Social, health and emergency services located in and around the SIA for Segment 1, Section 1A of the SCHIP

4.4.1.10 Recreation

Traditionally, beach use is a recreational experience for many Jamaicans and visitors alike. Recreational beaches found within Segment 1 Section 1A SIA or in proximity are as follows:

- KINGSTON
  - 52B - Gunboat
- ST. ANDREW
  - 51B - Copacabana
  - 16C - Brookes Pen
- ST. THOMAS
  - 50B - Mezgars Run

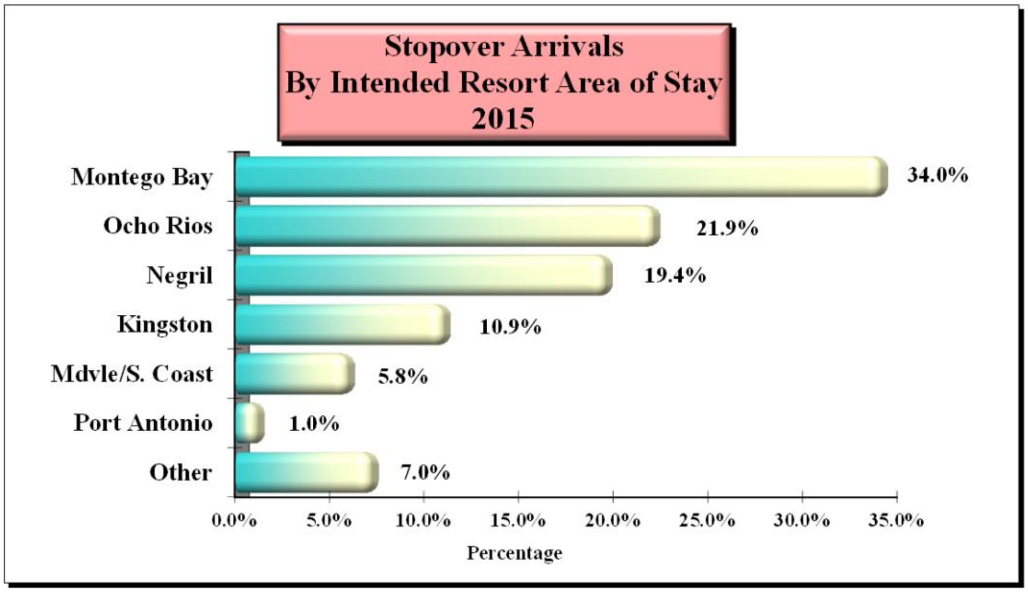
Gunboat Beach was popular until the 1980s at which point in time the quality of bathing waters decreased as a result of the pollution in the Kingston Harbour. Even though polluted waters and degraded facilities are known to exist at this beach, it is still reported more than 200 persons utilise Gunboat beach on public holidays (Environmental Management Consultants (Caribbean) Ltd., 2007). Environmental Management Consultants (Caribbean) Ltd. (2007) reported that only approximately ten (10) persons were seen swimming at Gunboat beach on Sunday, December 3, 2006 between 1.00 pm and 2.00 pm

It should also be noted that various beach locations along the St. Andrew and St. Thomas southern coastline are visited primarily by residents for recreational activities. The Palisadoes strip, located in the western section of the SIA is popular for running, walking, recreational fishing and sightseeing.

4.4.1.11 Industry and Economy

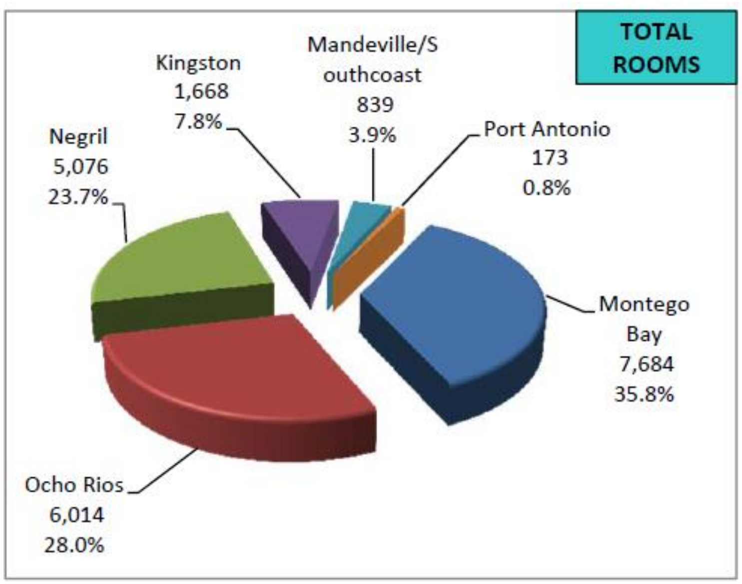
Tourism

Towards the eastern section of the island, and of interest to Segment 1, Kingston and Port Antonio account for 11.9% of stopover arrivals (Jamaica Tourist Board, 2016) (Figure 4-60), and collectively have 1,841 rooms, 8.6% of national total (Figure 4-61). An increase in tourism is evident in these parishes; between 2013 and 2014 there was a positive percent change in stopover arrivals of 4.0% and 9.5% in Kingston and Port Antonio (Jamaica Tourist Board, 2015) and between 2014 and 2015, there was an increase in stopover arrivals by 3.7% and 5.6% respectively for Kingston and Port Antonio (Jamaica Tourist Board, 2016).



Source: (Jamaica Tourist Board, 2016)

Figure 4-60 Stopover arrivals by intended resort areas of stay, 2015



Source: (Jamaica Tourist Board, 2016)

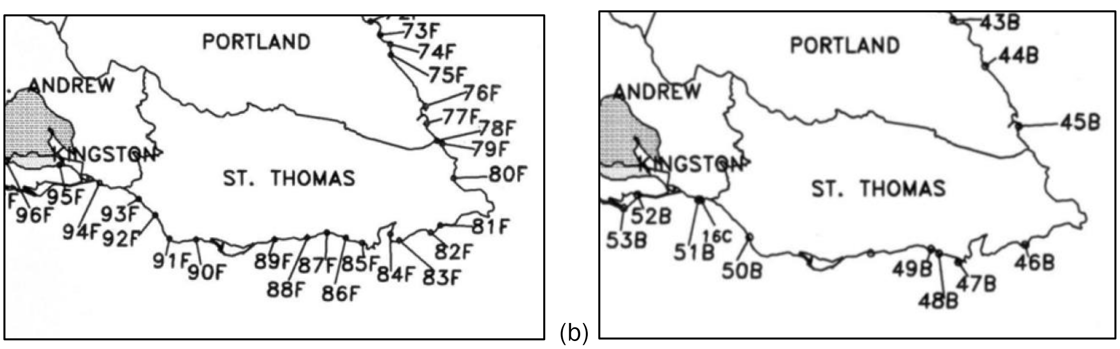
Figure 4-61 Hotel rooms by resort regions, 2015

In 2015, Kingston and Port Antonio collectively accounted for 8.0% of employment in the accommodation sector. In addition to direct employment with the tourism industry, there are also a number of indirect (also called inter-industry linkages such as car manufacturing, publishing, furnishing services etc.) and induced jobs (impacts of incomes earned directly and indirectly as they are spent in the local economy, such as wholesalers, food and beverage suppliers, computers etc.). For every $1 million in Travel & Tourism spending, 99 jobs are supported - 30 direct, 50 indirect, and 19 induced (World Travel & Tourism Council, 2013). The World Travel & Tourism Council states that for every direct job in the tourism sector, an additional two jobs are created either indirectly or on an induced basis.

Fisheries

Fishing is an important economic activity in the study area; approximately 26% of registered vessels[5] and 27% of registered fishers[6] in Jamaica were collectively located in the parishes of Kingston and St. Andrew in 2008 (Ministry of Agriculture and Fisheries). Fishing beaches exist within the project SIA and those of interest include (Figure 4-62):

- ST. ANDREW
  - 95F - Rae Town
  - 94F - Seven Miles
- ST. THOMAS
  - 90F - Yallahs
  - 91F - Grant's Pen
  - 92F – Cow Bay
  - 93F – Nine Miles



(a) (b)

Source: (Natural Resources Conservation Authority, 2000)

Figure 4-62 Fishing (a) and public bathing (b) beaches located in south-eastern Jamaica

Manufacturing

The Caribbean Cement Company at Rockfort, as well as a quarries in St. Andrew and St. Thomas are located within the SIA (Figure 4-63). The Caribbean Cement Company Limited (CCCL), recently purchased by Cemex, has been producing a consistently high quality of Portland cement for

5 http://www.moa.gov.jm/Fisheries/data/Number%20and%20percentage%20of%20registered%20vessels%20by%20parish%202008.pdf

6 http://www.moa.gov.jm/Fisheries/data/Number%20and%20percentage%20of%20registered%20fishers%20by%20parish%202008.pdf

approximately 60 years. One of CCCL's subsidiary companies, namely Jamaica Gypsum and Quarries Limited (JGQ), supplies the Company with the gypsum used in the manufacture of its cement. The Company exports its surplus gypsum to countries such as Colombia, Venezuela, Trinidad and Barbados, whilst a smaller amount is used locally by CCCL in the final stage of cement processing. CCCL is a major contributor to the Jamaican economy and employs over 300 persons. Over 90% of structures present in Jamaica today were built using Carib Cement, as it is commonly known. In 2009, the plant produced 742,208 tonnes of clinker and 736,560 tonnes of cement. The current clinker manufacturing capacity is 1.3 million tonnes and cement manufacturing capacity is 2 million tonnes per annum.

Quarrying

Established quarry zones within the boundaries of the SIA exist in Bito, Albion and Yallahs (Figure 4-63). As defined by the Mines and Geology Division (MGD), quarry zoning is the "designation of specific areas wherein quarrying and related activities may take place." (Mines & Geology Division, n.d.) The MGD is guided by the Quarries Control Act (1983) and has established quarry zones based on proximity to developing centres, major townships and ports. The JGQ has been mining in the Bito area since 1949.

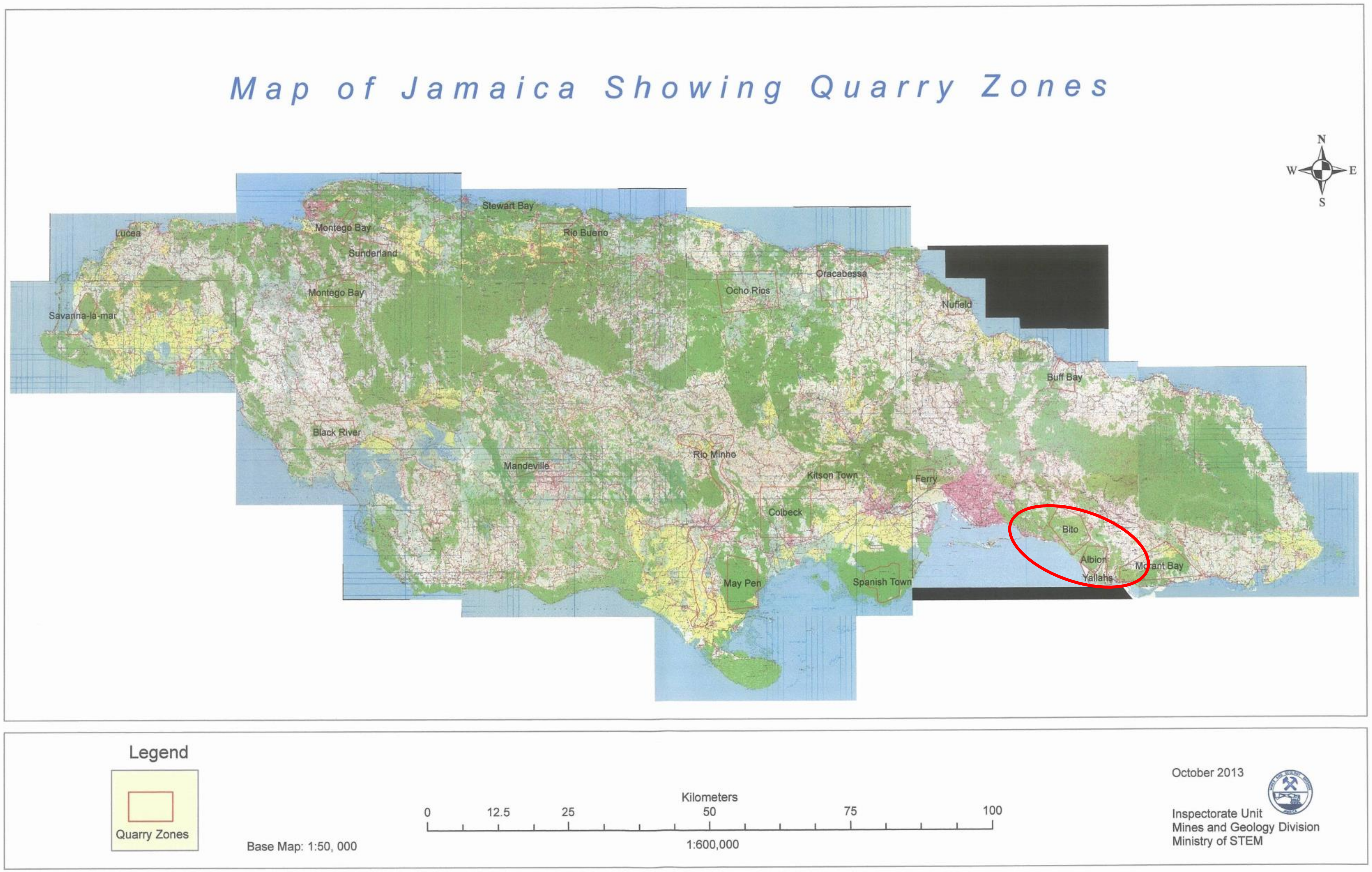


Figure 4-63 Map of Jamaica showing quarry zones across the island

4.4.2 Cultural Resources and Heritage

Eleven sites along Section 1A were deemed important historically and/or culturally by the Jamaica National Heritage Trust (JNHT):

1) Harbour View United Church
2) St. Benedict's Primary and Catholic Church
3) Enrique Fault Line
4) Hope Hill Baptist Church
5) Lime Kiln
6) Wickie Wackie Pond
7) Sugar Loaf Hill (Historic Bridle Road)
8) Three Finger Jack Monument
9) 4 Mile Pump House
10) Site of Jew's House
11) Grant's Pen Water Supply (Pump House)

Figure 4-64 shows the locations of these sites, with the exception of one, namely Grant's Pen Water Supply Pump House (owing to incorrect coordinate data). Photographs of some of these locations may be seen in Plate 4-13 though to Plate 4-20.

Plate 4-13 St. Benedict's Primary and Catholic Church

Plate 4-14 Enrique Fault Line

Plate 4-15 Lime Kiln

Plate 4-16 Wickie Wackie Pond

Plate 4-17 Hope Hill Baptist Church

Plate 4-18 Sugar Loaf Hill (Historic Bridle Road)

Plate 4-19 Three Finger Jack Monument

Plate 4-20 Modern house built in environs of historic Jew House at Fourteen Mile

Figure 4-64 JNHT sites, Segment 1 Section 1A

4.4.3 Land Use and Zoning

4.4.3.1 Land Use

Historical

The exact origin of the Palisadoes is unknown; however historical records show that Port Royal was once an isolated island and it is possible that Port Royal and other cays were connected to the mainland by a series of spits in order to form what is now known as the Palisadoes (Robinson & Rowe, 2005). Important historical milestones occurring within the SIA that have influenced the land use along the Palisadoes include:

- 1600s and 1700s - Rockfort was fortified as protection against the possibility of a French invasion in 1694 and properly protected in the 1700s.
- 1959 - Gunboat beach was developed as a public bathing beach and patrons enjoyed the facilities up until the mid-1980s, at which time recreational activity such as swimming, picnicking and water skiing declined owing to the pollution within the Kingston Harbour (Environmental Management Consultants (Caribbean) Ltd., 2007).
- 1959-1960 - Housing development of 1,865 houses was established by the West Indies Home Contractors, named Harbour View.

Existing Land Use

The proposed project alignment follows the existing main road except for at 106+700 where it diverts to the south of the existing roadway and continues until 109+500 in the vicinity of the Sun Coast Adventure Park in 12 Mile where it re-joins the existing roadway.

In 1998, general land cover within the SIA comprised buildings and other infrastructure, disturbed broadleaf, open dry forest, secondary forest, wetlands, fields and bare rock. (Figure 4-68) (Forestry Department, 1998). As showcased in previous sections, existing land use within the SIA is mixed. Buildings and other infrastructure (Figure 4-68) are associated with the following uses:

- Residential;
- Industrial;
- Civic (including social, educational and utilities); and
- Transportation;

Agricultural, commercial, recreational and natural (land cover) uses are also found within the SIA. Commercially, the study area has restaurants, bars and shops and quarries. Recreationally, there is a football field at Bull Bay, beaches and the Suncoast Adventure Park at Three Finger Jack.

Future Land Use

There are at least two proposed housing developments at Content and Dundas Development a 630 acres subdivision north of the alignment in the Four Wood Mile/ Whitehall area. The proposed SCHIP alignment will pass through the Content Development (Figure 4-65).

Figure 4-65 Map showing the locations of approved housing subdivisions along the proposed Section 1A of Segment 1 of the South Coast Highway

4.4.3.2 Protected Areas

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area; these include fish sanctuaries or Special Fishery Conservation Areas (SFCAs), protected areas (declared and proposed), national parks, forest reserves, marine parks, game reserves and national heritage and monuments. Specific to this project, the alignment for Section 1A does not traverse any protected area; however, portions of the general Palisadoes Port Royal Area and specifically the Palisadoes-Port Royal Protected Area, Palisadoes-Port Royal Ramsar Site and Port Royal and the Palisadoes, a Protected National Heritage (protected under three different legislative declarations) and the proposed Yallahs Salt Pond Protected Area are within the boundaries of the SIA. In addition, five forest reserves are found within the SIA, either completely or partially, and totalling 9.44 sq. km in coverage. Figure 4-68 shows the location of these protected areas in relation to Section 1A and the project SIA.

Palisadoes-Port Royal Protected Area (P-PRPA)

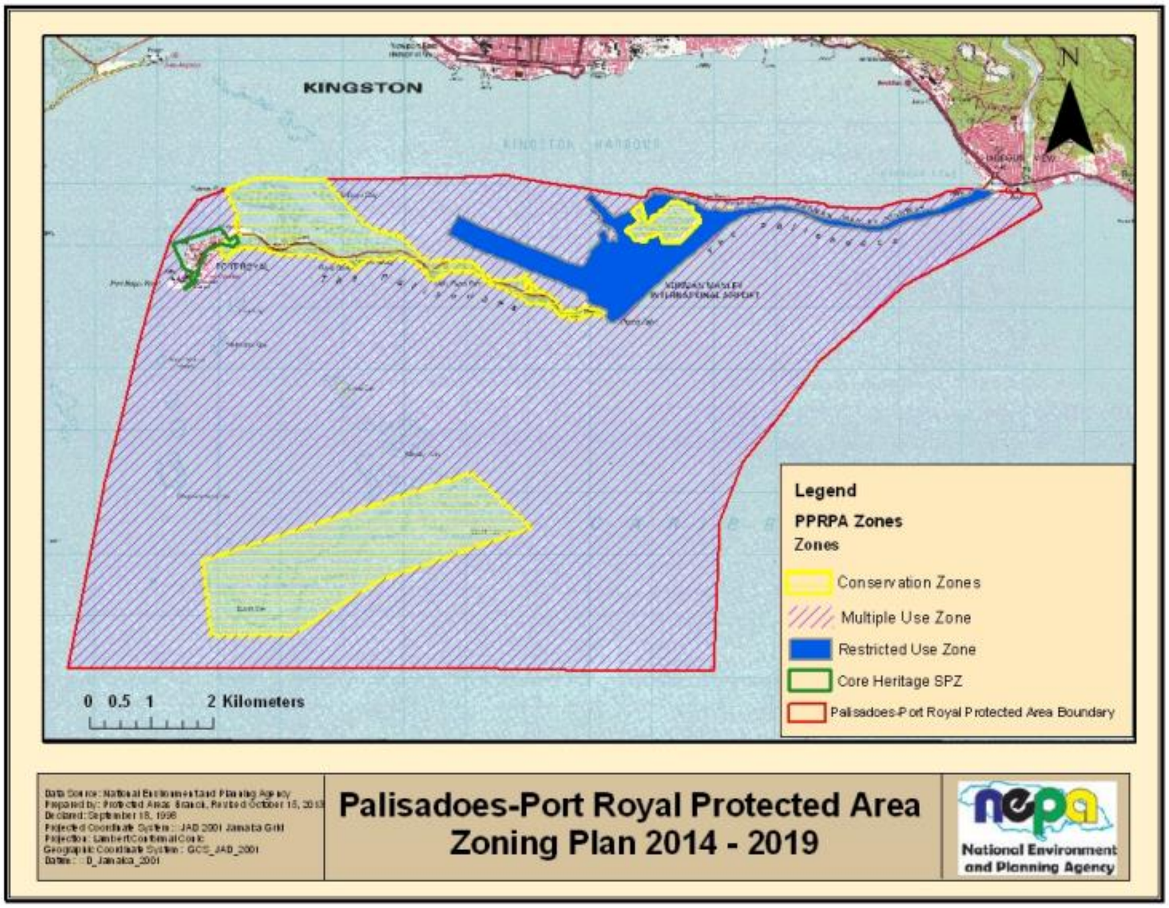
Palisadoes-Port Royal Protected Area (P-PRPA) was declared as a protected area on September 18, 1998 and is one of nine (9) protected areas declared under the Natural Resources Conservation Authority Act (NRCA) (1991). As mentioned previously, it was first declared as protected under the Beach Control Act on 8 May 1967.

The P-PRPA is approximately 7,523 hectares (75.23 km^2) (The Protected Areas Branch, The National Environment and Planning Agency , 2013) and comprises the tombolo (Palisadoes), offshore cays, reefs and mangroves. The area was given protected status owing to historic and archaeological sites of educational and cultural significance; spiritual values; natural resources as a basis for the livelihood for residents and other communities; unique ecosystem (sand/ dune, coral reef, lagoon, seagrass beds); nesting sites for sea turtles, birds and fish; offers protection and a shelter for small vessels/ boats during storms and hurricanes; and acts as major gateway i.e. by sea (sea ports) and air (airports).

Four zones are distinguished (The Protected Areas Branch, The National Environment and Planning Agency , 2013):

1. Restricted Use Zone
2. Conservation Zone
3. Multiple-use Zone
4. Core Heritage Special Purpose Zone(SPZ)

The Palisadoes entrance is in proximity of the start of Section 1A and the P-PRPA stretches south and southwest of Section 1A. The land portion of the P-PRPA at the Palisadoes entrance has been zoned as a “Restrictive Use Zone” (Figure 4-66). The Restrictive Use Zone begins at the Harbour View Round-about and extends along the Palisadoes tombolo approximately 7.5 km (4.6 miles) inclusive of lands housing the Norman Manley International Airport and its associated facilities, and ends at a point adjacent to the Plumb Point Lighthouse. The objective of this Zone is to allow for the operation and expansion of existing facilities and other activities which can be undertaken in a manner that will not negatively impact surrounding zones.



Source: The Protected Areas Branch, The National Environment and Planning Agency (2013)

Figure 4-66 Zones of the Palisadoes-Port Royal Protected Area (2014-2019)

The marine areas southwest of Section 1A are zoned as "Multiple-use Zone" (Figure 4-66). The Multiple-use Zone includes all the areas outside the boundaries of the Restricted Use and Conservation Zones and the Core Heritage Special Purpose Zone. The Multiple-use Zone will allow for a range of uses such as fishing as well as recreational boating. Activities which are not to be permitted as indicated in the "Final Draft Palisadoes-Port Royal Protected Area Management Plan 2015-2020" include the following:

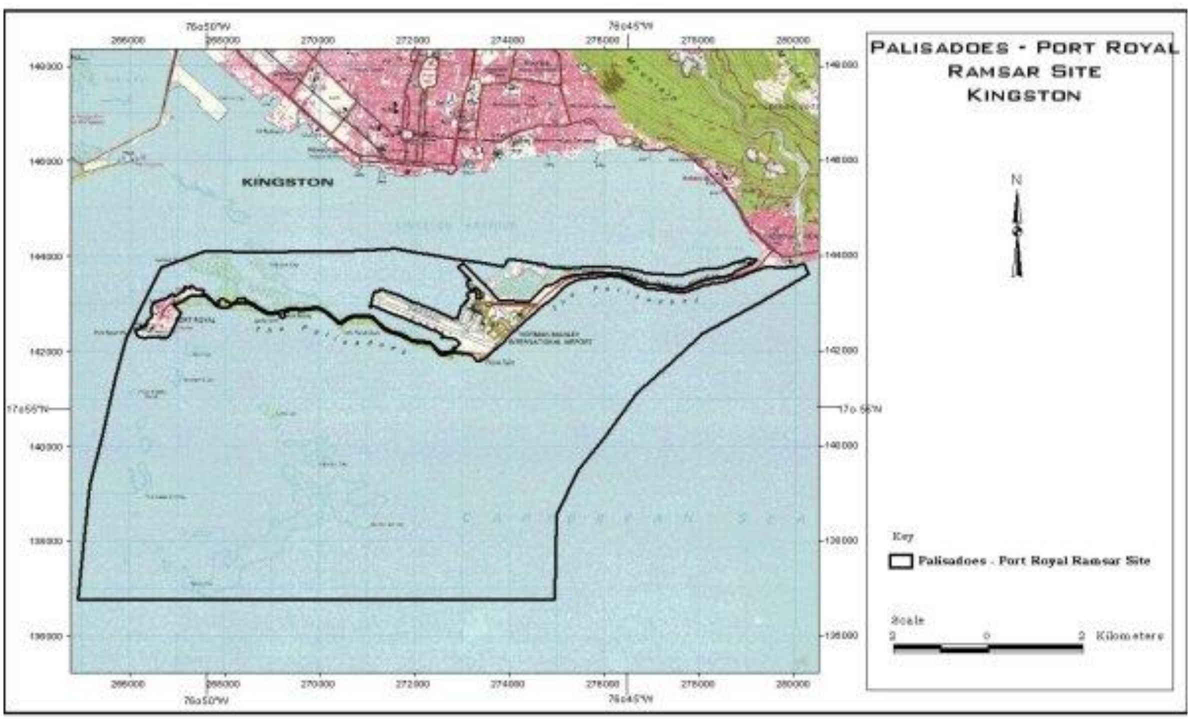
- "Activities with environmental footprint that will adversely impact archaeological/heritage resources and the functionality of the area's ecosystems and that of adjacent zones".
- "Removal or disturbance of physical or biological features/specimens or habitats, e.g. dune, sand, reef, rock, artifacts, flora, fauna, except when dredging is permitted in the shipping channel".

Palisadoes-Port Royal Ramsar Site

On 22 April 2005, the Palisadoes Port Royal area was designated a Wetland of International Importance (Ramsar Site) under the Convention on Wetlands of International Importance (Ramsar).

The site is located on the southeast coast of Jamaica and covers approximately 7523.08 hectares including the cays, shoals, mangrove lagoons, mangrove islands, coral reefs, seagrass beds and surrounding shallow water, excluding the urban centres on the Tombolo (the town of Port Royal and the Airport complex) (Webber, et al., 2005) (Figure 4-67).

The historic and cultural value of the area is very high as it includes forts on the dunes and a portion of the city of Port Royal. The site includes three categories of wetlands classified as underrepresented by the seventh Conference of Parties (1999): coral reefs, mangroves and sea-grass beds, all significant in biodiversity and in ecologically sensitive areas which are essential to the maintenance of waterfowl and fish populations. The Tombolo and the associated mangrove areas form the southern boundary of the site and the seaward boundary of the Kingston Harbour, reported to be the seventh largest natural harbour in the world. (Webber, et al., 2005). Important species found within this Ramsar site include the American Crocodile (*Crocodylus acutus*), the Reid Seahorse (*Hippocampus reidi*), the Hawksbill turtle (*Eretmochelys imbricata*), the Brown Pelican (*Pelecanus occidentalis*), the West Indian Manatee (*Trichechus manatus manatus*), the Bottlenose Dolphin (*Tursiops truncatus*), the Red Mangrove (*Rhizophora mangle*), the Black Mangrove (*Avicennia germinans*) and the White Mangrove (*Laguncularia racemosa*). (National Environment and Planning Agency , n.d.).



Source: (The Ramsar Convention Secretariat, 2005)

Figure 4-67 Palisadoes-Port Royal Ramsar Site, Kingston

Port Royal and the Palisadoes, a Protected National Heritage

On 22 July 1999, the Port Royal area was declared as protected under the Jamaica National Heritage Trust Act. Although Port Royal is perhaps the focus of this site with its rich history and numerous heritage sites, the complete heritage site encompasses the land and structures as part of Harbour Head Pen, the Palisadoes (situated in the western section of the project SIA) and Port Royal, and the adjoining sea and cays.

Yallahs Salt Pond Protected Area (Proposed)

The Yallahs Salt Ponds were once a key source of salt for the region. A popular theory for their creation is that during the 1962 earthquake, the land below what are now the ponds sank, leaving pockets of seawater almost completely enclosed by land. Due to evaporation, the water in the pond is extremely saline, at times recorded as being 15 times saltier than the seawater (Visit Jamaica, n.d.).

Forest Reserves

Forest Estates collectively encompass three descriptive types:

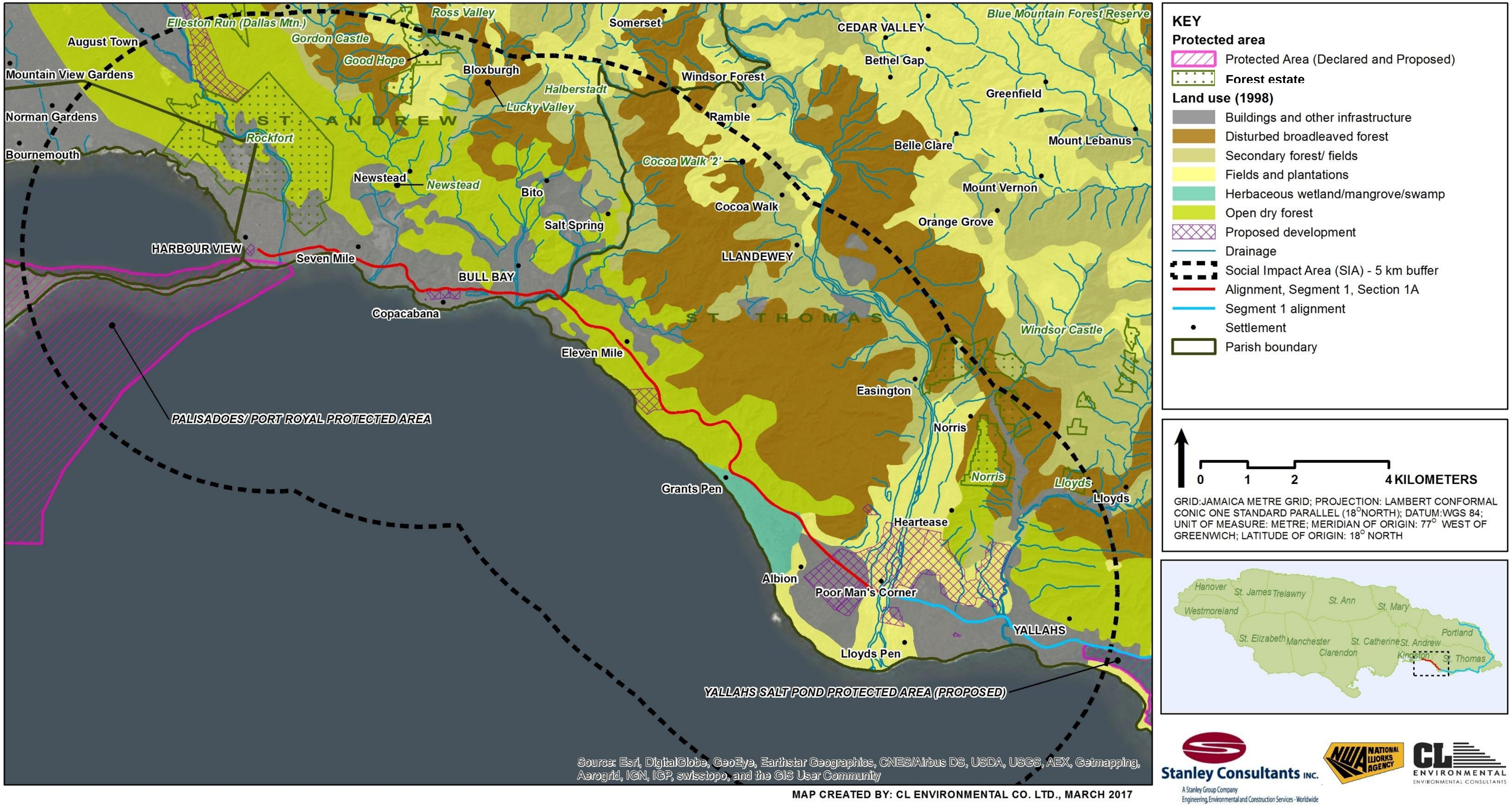
1) Forest reserves – Government and privately-owned lands that have been gazetted as Forest Reserves;
2) Forest Management Areas - Probate lands co-managed by the Forestry Department and gazetted as Forest Management Areas); and
3) Crown Lands - Lands transferred to the Forestry Department for management by the Commission of Lands).

All forest estates falling completely or partially within the SIA are shown in Table 4-36 and Figure 4-68 and are owned by the Government of Jamaica (Forestry Department, 2011). Of particular interest are Forest Reserves, which are considered protected areas. Five forest reserves are located within the project SIA and are listed in red in Table 4-36 (Elleston Run, Good Hope, Norris, Rockfort and Lloyds). The total area of forest reserves falling within the SIA is 9.44 sq. km.

Table 4-36 Forest estates, inclusive of forest reserves (in red), management areas and crown lands located within the SIA for Segment 1, Section 1A of the SCHIP

Source (Forestry Department, 2011)

Name	Description	Gazette date	Total estate area (sq. km)	Area within SIA (sq. km)	Total area by description (sq. km)
Elleston Run (Dallas Mtn.)	Forest reserve	1/12/1950	0.428	0.147	9.44
Good Hope	Forest reserve	4/18/1963	0.925	0.798	
Norris	Forest reserve	1/12/1950	2.453	1.865	
Rockfort	Forest reserve	12/1/1950	6.453	6.453	
Lloyds	Forest reserve	1/12/1950	0.603	0.172	
Lucky Valley	Crown land		3.607	2.755	6.89
Halberstadt	Crown land		4.525	3.673	
Cocoa Walk '2'	Crown land		0.59	0.464	
Newstead	National Water Commission*		4.264	4.264	4.31
Gordon Castle	National Water Commission*		0.043	0.043	
				TOTAL:	20.63



Data sources: Land use (Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 4-68 Land use, protected areas and forest estates within the SIA for Segment 1, Section 1A of the SCHIP

4.4.3.3 Zoning

Development orders of significance to Segment 1 Section 1A include (Figure 4-69):

- Kingston Confirmed Development Order 1966
- DRAFT St. Thomas Confirmed Development Order
    - Yallahs Local Planning Area Land Use Proposals (Inset No.2) (28-02-2017)

As mentioned previously, though the Kingston Confirmed Development Order 1966 is considered outdated, this is the main piece of legislation used to guide development in the parishes of Kingston and St. Andrew. As seen in Figure 4-69, the existing roadway is adjacent to areas zoned as residential and industrial.

It should be noted that the St. Thomas Coast Confirmed Development Order 1965 preceded the DRAFT St. Thomas Confirmed Development Order listed above. As seen in the 2017 Yallahs Local Planning Area Land Use Proposals (Figure 4-69), the proposed alignment follows the Class A road through Yallahs and does not cross into any area zoned for uses other than transport (National Environment and Planning Agency, 2017).

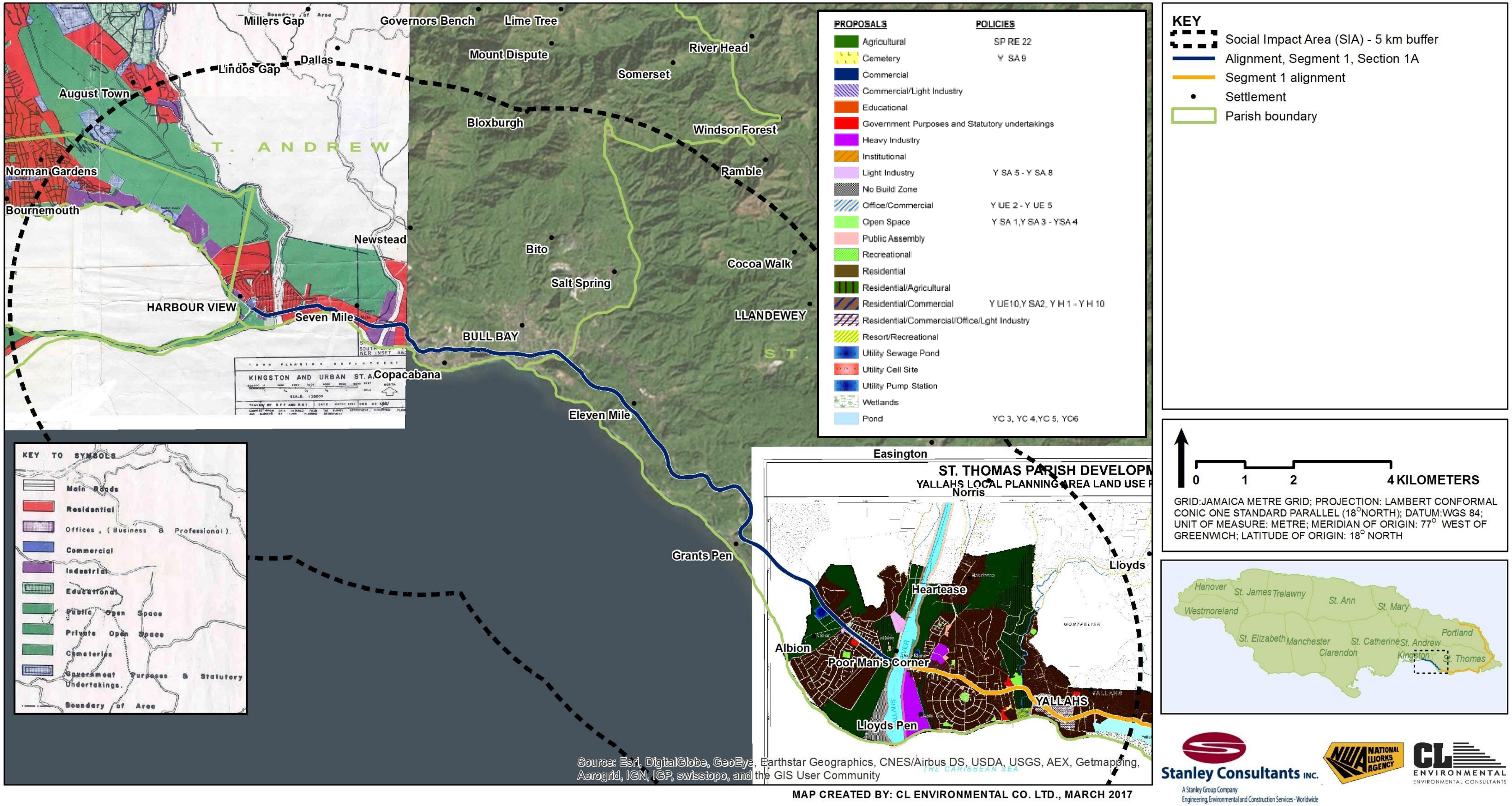


Figure 4-69 Development Orders within the SIA for Segment 1, Section 1A of the SCHIP

4.4.4 Impacted Structures

4.4.4.1 Objectives and Approach

An Impacted Structure Profile study was undertaken in February 2017. The overall aim of this study was to identify and characterise the structures to be impacted by the proposed roadway improvement within Section 1A. The specific objectives were as follows:

- Create a geospatial database inclusive of impacted structures and associated attribute information such as building type, materials and condition; number of occupants and building and lot use.
- Acquire photographs of each impacted structure.
- Prepare an analytical report showcasing statistical analyses and spatial mapping.

Geographic Information Systems (GIS) and Global Positioning Systems (GPS) technologies were considered paramount to the exercise. The recording of coordinates for each structure via GPS formed the basis of the geospatial database, to which all associated non-spatial attribute information was linked in a GIS. It should be noted that for the purposes of this study, a structure was defined to be a physical built entity, with the main distinction being between houses and shops/stalls. Often smaller structures such as bus stops, fowl coups, farms, pig pens or sports fields exist in association with another structure or independently, and these structures were also noted and categorised.

4.4.4.2 Results

A total of 391 structures were mapped and deemed as impacted during the survey. The majority of these 391 structures mapped were houses (55.8%), followed by shops and stalls (26.9%), bus stops (5.6%) and other types including garages, stalls and notably a garden (11.8%) (Figure 4-70).

Figure 4-70 Location of impacted structures by building type along Segment 1, Section 1A

5.0 PUBLIC PARTICIPATION

5.1 STAKEHOLDER CONSULTATION

Stakeholder involvement was paramount during the Feasibility Study. In order to facilitate the participation of various stakeholders, a Project Steering Committee was established and comprised of the following agencies and their nominated representatives:

- Ministry of Transport, Works and Housing (MTWH) – Mr. Courtney Laidlaw
- Ministry of Finance (MOF) – Mr. Steve Reid
- Planning Institute of Jamaica (PIOJ) – Ms. Alicia Dunn
- National Environment and Planning Agency (NEPA) – Mr. Alan Hamilton
- National Works Agency (NWA)- Mr. Patrick Rose (Chairman)
- National Works Agency (NWA) – Mr. Alfonso Marshall
- National Land Agency (NLA) – Mrs. Lois Edwards Bourne
- Stanley Consultants, Inc. – Mr. Andrew Evans

The Project Steering Committee was also supported by the Permanent Secretary, MTWH, Ms. Audrey Sewell, and the Chief Executive Officer, NWA, Mr. E. G. Hunter.

Coordination meetings and informational meetings were held with project stakeholders (Table 5-1), in order to comprehensively discuss alignment alternatives. In addition, several other one-on-one meetings were conducted with property owners during filed visits.

Table 5-1 SCHIP project stakeholders

1	Project Steering Committee
2	Parish Councils (Portland, St. Thomas, Westmoreland, St. Elizabeth, Manchester)
3	Kingston and St. Andrew Corporation (KSAC)
4	National Works Agency (NWA)
5	National Environmental and Planning Agency (NEPA)
6	Planning Institute of Jamaica (PIOJ)
7	Water Resources Authority (WRA)
8	National Land Agency (NLA)
9	Housing Agency of Jamaica (HAJ)
10	Jamaica National Heritage Trust (JNHT)
11	National Housing Trust (NHT)
12	Office if Disaster Preparedness and Emergency Management (ODPEM)
13	National Road Operating and Constructing Company (NROCC)
14	SEPROD Limited
15	Sugar Transformation Unit (STU)
16	Tourism Product Development Company (TPDCo)
17	St. Thomas Parish Council Infrastructure Team
18	Forestry Department
19	Flynn Property Management

5.2 PERCEPTION SURVEY

5.2.1 Introduction

A two-kilometre buffer around the proposed Section 1A (Harbour View to Yallahs Bridge) was utilised as the geographic extent for the perception survey. Within this two-kilometre buffer, the approximate total population is 44,028 persons; for the purpose of the survey, a sample size of two hundred and nine (209) persons was used.

On March 30, 31 and April 1, 2017, community questionnaires were administered to 209 persons within the two-kilometre buffer (see Appendix 7 for questionnaire). Fourteen main communities were visited whilst administering the 209 questionnaires - Harbour View, Albion, St. Benedict's, Yallahs, Heartease, Poorman's Corner, Grants Pen, Seven Miles Bull Bay, Eight Miles Bull Bay, Nine Miles Bull Bay, Ten Miles Bull Bay, Eleven Miles Bull Bay, Twelve Miles, Bull Bay and Fourteen Miles Bull Bay. The sample size within each community may be seen in Table 5-2.

Table 5-2 Perception survey sample size by community

	Community	Number of interviewees	Percentage (%)
1	Harbour View	46	22.0
2	St. Benedict's	10	4.8
3	7 Miles Bull Bay	10	4.8
4	8 Miles Bull Bay	13	6.2
5	9 Miles Bull Bay	17	8.1
6	10 Miles Bull Bay	12	5.7
7	11 Miles Bull Bay	10	4.8
8	12 Miles Bull Bay	9	4.3
9	14 Miles Bull Bay	7	3.3
10	Grant's Pen	6	2.9
11	Albion	16	7.7
12	Heartease	4	1.9
13	Poorman's Corner	19	9.1
14	Yallahs	30	14.4
	TOTAL:	**209**	**100**

5.2.2 Results and Findings

It should be noted that percentages presented are for the total number of persons offering responses; in instances where respondents did not offer an answer to a question, they were not considered part of the analyses.

5.2.2.1 Summary (All Communities)

Approximately forty-nine percent (49.3%) of respondents were female and 50.7% were male. Age cohort distribution was as follows; 16.7% were age 18-25 years, 18.2% were age 26-33 years, 20.1 % were age 34-41 years, 19.1% were age 42 – 50 years, 12.9% were age 51-60 years and 25.5% were older than sixty years of age.

Of those persons interviewed (all communities) who offered a response, 63% indicated that they were the heads of their households. Regarding respondents' employment status 65.4% of respondents were employed, 27.4% unemployed and 7.2% of respondents were retired. Of the approximately 65% percent of employed individuals, 58.8% stated that they were self-employed while 41.2% indicated that they had an employer.

Respondents in general were reluctant to disclose information pertaining to income. Of those interviewed 83.7% of respondents offered an answer for their weekly household income. 0.6% indicated that income was less than $500.00; 1.7% indicated $1,001.00 - $1,500.00 and $1,501.00 - $2,000.00 respectively; 2.3% indicated income of $2,001.00 - $3,000.00; 6.9% indicated income of $3,001.00 - $4,000.00; 9.7% indicated income of $4,001.00 - $5,000.00; 6.9% indicated income of $5,001.00 - $6,000.00; 7.4% indicated income of $6,001.00 - $7,000.00 and 62.9% indicated weekly household income was in excess of $7,000.00.

On the issue of respondents' awareness of the National Works Agency (NWA) and the South Coast Highway Project (SCHIP) approximately 98% of those interviewed offered a response. Seventy-three percent (73.0%) of interviewees stated that they had heard of the National Works Agency while 63.1% stated that they heard of the South Coast Highway Project. When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 57.6% indicated that they were aware. However, while not able to be statistically represented, it was realised that respondents while being aware of the project, we were unaware of the relationship between the NWA and the SCHIP.

In general respondents indicated that they were made aware of the NWA, SCHIP and the highway project through the media (40% - 47%), and/or "word of mouth" (6.0%, 26.9% & 26.3% respectively).

On the issues of dependency on the location for business 44.5% of interviewees indicated that they depended on the location. Responses included personal businesses and places of employment being along the location, commuting and transportation of goods into communities, and businesses patronised being located along the area.

As it related to whether or not respondents had any concerns pertaining to the project, 63.3% of interviewees indicated that they did not have any concern while 36.7% indicated that they had project concerns. Concerns highlighted pertained to relocation (20.8%), loss of property (20.8%), pedestrian hazards (6.9%), the actual road footprint (6.9%), delays during road construction (5.6%), community flooding (1.4%) and the possibility of an employment opportunity (5.6%).

On the issue of how the project would affect interviewees, 50.5% of respondents indicated that the project would not affect their life in any way, while 37.5% anticipated a positive impact and 12.0% anticipated a negative impact.

Regarding respondents' perception about how their commute may be affected, 46.5% of respondents indicated that their commute would not be affected, while 51.9% anticipated an easier commute and 1.6% anticipated a more difficult commute.

On the issue of housing and social services, 40.3% of respondents indicated they owned their home, 4.6% leased, 20.9% rented the home they occupied; 3.6% were squatters, 30.1% lived in family owned homes and 0.5% lived in the home of their spouse. When asked about the land on which dwellings were located 23.2% of respondents indicated that they owned the land, 18.4% leased, 14.7% squatted, 31.1% had their homes on family land, 2.1% stated their homes were on government lands and 10.5% stated other. Those indicating "other" were mostly respondents who stated that they rented the house they live in.

Approximately eighty-three percent (82.8%) of those interviewed indicated that their homes were of concrete and blocks and 17.25% indicated their homes were wood structures. Approximately fifty-eight percent (57.6%) of respondents indicated that their roofs were metal/zinc sheeting while 41.9% stated concrete as the roof type and 0.5% indicated that their roof was wood. Both water closets and pit latrines were in the study area. Approximately eighty-nine percent (89.3%) of interviewees indicated that their toilet facility was a water closet while 10.7% stated that they had pit latrines.

Approximately ninety-eight percent (97.5%) of respondents stated that they used electricity for household lighting, 2.0% indicated kerosene and 0.5% indicated other; solar was specifically stated. 90.1% of respondents stated gas as the main fuel for cooking while 9.9% stated coal.

Regarding water supply, 80.9% of interviewees stated that their household domestic water supply was public piped water into their dwelling, 3.9% stated private tank, 3.4% stated community tank, 2.5% stated government water truck, 7.4% indicated the public standpipe; 1.5% indicated private water truck and 0.5% stated that their water supply is from an adjacent residence. Regarding problems with the domestic water supply 46.0% of respondents indicated that they had an issue; 70.7% indicating irregular water supply and 13.0% indicating low water pressure. Approximately eighty-six percent (86.3%) of interviewees stated that there were no issues with flooding, while 96.1% indicated that there were no issues with frequent fires.

5.2.2.2 Harbour View

Approximately twenty-two percent (22.0%) of respondents were interviewed in the Harbour View area. Approximately thirty-nine percent (39.1%) of respondents were female and 60.9% were male. Age cohort distribution was as follows; 17.4% were age 18-25 years, 10.9% were age 26-33 years, 21.7 % were age 34-41 years, 19.6% were age 42 – 50 years, 8.7% were age 51-60 years and 21.7% were older than sixty years of age.

Of those persons interviewed who offered a response, 56.5% indicated that they were the heads of their households. Regarding respondents' employment status 71.1% were employed, 13.3% unemployed and 15.6% were retired. Of the approximately 71% percent of employed individuals, 36.4% stated that they were self-employed while 63.6% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 86.7% stated that they knew of the NWA. When asked about what they knew, 87.2% of interviewees indicated that the Agency was responsible for road construction and maintenance, 2.6% respectively indicated the NWA had a

Summer Employment and a work recruitment programme. Approximately eight percent (7.7%) while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (30.8%), word of mouth (7.7%), both word of mouth and media (7.7%). Approximately fifty-four percent (53.8%) of those interviewed did not state the means through which they were made aware of the NWA.

Regarding the South Coast Highway Project (SCHIP) approximately 97.8% of those interviewed in Harbour View offered a response. Approximately seventy-three percent (73.3%) of interviewees stated that they heard of the South Coast Highway Project. In response to what they knew about the SCHIP 51.5% of respondents did not offer a response while 42.4% indicated that they were aware that the project was to be implemented and 6.1% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (60.6%), word of mouth (15.2%), both word of mouth and media (3.0%). Approximately twenty-one percent (21.2%) of those interviewed did not state the means through which they were made aware of the SCHIP.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 68.9% indicated that they were aware and 31.1% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (64.5%), word of mouth (16.1%), both word of mouth and media (19.4%).

On the issues of dependency on the location for business 35.7% of interviewees indicated that they depended on the location. Of this 35.7% of respondents, approximately 60.0% indicated a financial dependence on the area; as a means of income (33.3%), personal business along location (6.7%), customers along location (13.3%) and financial benefit (6.7%). The remaining 40% indicated commuting (26.7%) and businesses patronised being along the location (13.3%).

As it related to whether or not respondents had any concerns pertaining to the project, 66.7% of interviewees indicated that they did not have any concern while 33.3% indicated that they had project concerns. Concerns highlighted pertained to pedestrian hazard (6.7%), whether the road would be a toll road (13.3%), the possibility of an employment opportunity (20.2%), loss of property (13.3%), when the project would begin and its duration (6.7%), environmental impact, specifically dust (6.7%), the actual footprint of the road (13.3%) and delays during road construction (13.3%). 6.7% while indicating concern did not state what the concerns were.

On the issue of how the project would affect interviewees, 57.8% of respondents indicated that the project would not affect their life in any way, while 42.2% anticipated a positive impact and 0.0% anticipated a negative impact. Anticipated positives were an increase in customers (5.2%), improved roads (15.8%), community development (15.8%), improved travel time (21.1%) and a more relaxing commute (36.8%). 5.3% of respondents did not specify what positive impact they anticipated.

Regarding respondents' perception about how their commute may be affected, 44.2% of respondents indicated that their commute would not be affected, while 55.8% anticipated an easier commute. Respondents from Harbour View did not anticipate a more difficult commute. Of those anticipating an easier commute 37.5% attributed this to improved roads, 16.7% indicated more comfortable travel; 33.3% expected a shorter travel time and 4.2% anticipated reduced congestion. The remaining 8.3% of those interviewed while expecting an easier commute did not indicate how their commute would be made easier.

On the issue of housing and social services, 46.7% of respondents indicated they owned their home, 33.3% rented the home they occupied and 20.0% lived in family owned homes. When asked about the land on which dwellings were located 40.0% of respondents indicated that they owned the land, 4.4% squatted, 24.4% had their homes on family land; 2.2% stated their homes were on government lands and 28.9% stated other.

Approximately ninety-six percent (95.6%) of those interviewed indicated that their homes were of concrete and blocks and 4.4% indicated their homes were wood structures. 11.1% of respondents indicated that their roofs were metal/zinc sheeting while 88.9% stated concrete as the roof type. 100.0% of interviewees indicated that their toilet facility was a water closet.

All of respondents stated that they used electricity for household lighting. 97.8% of respondents stated gas as the main fuel for cooking while 2.2% stated coal. Regarding water supply, 97.8% of interviewees stated that their water was public piped water into their dwelling and 2.2% stated government water truck.

On the issue of problems with the domestic water supply 18.6% of respondents indicated that they had an issue while 81.4% of Harbour View residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 62.5% stated irregular water supply and 25.0% indicated low water pressure, 12.5% stated other reasons. Approximately thirty-eight percent (37.5%) of those having water problems buy water, 12.5% are supplied by water truck; 12.5% stated other means of coping with the problem, while 37.5% did not state specifically how they coped with the problem. Of the respondents indicating that they stored water, 37.5% use drums, 50.5% use aboveground tanks and 12.5% did not state how they stored water.

Approximately ninety-three percent (93.3%) of interviewees stated that there were no issues with flooding. Of the 6.7% stating that there were issues with flooding, 33.3% indicated that flooding occurred every time it rains, 33.4% indicated flooding only during times of heavy rains, and 33.3% stated that there was flooding only during a hurricane. Approximately thirty-three percent (33.3%) of individuals did not state the specific area/areas flooded. Approximately sixty-seven percent (66.7%) identified Harbour Drive and Caribbean Terrace and further indicated that water level ranged between one and five feet. All of respondents indicated that there were no issues with frequent fires in Harbour View.

5.2.2.3 St. Benedict's

Approximately five percent (4.8%) of respondents were interviewed in the St Benedict's community. Seventy percent (70.0%) of respondents were female and 30.0% were male. Age cohort distribution was as follows; 20.0% were age 18-25 years, 20.0% were age 26-33 years, 30.0% were age 34-41 years, 20.0% were age 42 – 50 years, 10.0% were age 51-60 years and 0.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 60.0% indicated that they were the heads of their households while 40.0% were not household heads. Regarding respondents' employment status 70.0% of respondents were employed and 30.0% unemployed. Of the 70% percent of employed individuals, 50.0% stated that they were self-employed while 50.0% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 66.7% stated that they knew of the NWA. When asked about what they knew, 83.3% indicated that the Agency was responsible for road construction and maintenance and 16.7% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (83.3%) and word of mouth (16.7%).

Regarding the South Coast Highway Project (SCHIP) all interviewees in St Benedict's offered a response. Sixty percent (60.0%) of interviewees stated that they heard of the South Coast Highway Improvement Project while 40.0% stated they were unaware. In response to what they knew about the SCHIP 33.3% did not offer a response while 50.0% indicated that they were aware that the project was to be implemented and 16.7% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via word of mouth (66.7%) and both word of mouth and media, to include print, television and radio (33.3%).

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 60.0% indicated that they were aware and 40.0% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio. (33.3%), word of mouth (33.3%), both word of mouth and media (16.7%). The remaining 16.7% while indicating awareness did not offer a response regarding how they were made aware.

On the issues of dependency on the location for business 66.7% of interviewees indicated that they depended on the location. Of this approximately 67% of respondents, 66.7% stated that their personal business was along the location, 16.7% indicated businesses which they patronise being along the location. 16.6% indicated that their church was located along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 80.0% of interviewees indicated that they did not have any concern while 20.0% indicated that they had project concerns. Concerns highlighted pertained to loss of property (50.0%) and relocation and compensation and family disruption as a result of relocation (50.0%).

On the issue of how the project would affect interviewees, 50.0% of respondents indicated that the project would not affect their life in any way, while 40.0% anticipated a positive impact and 10.0% anticipated a negative impact. Anticipated positives were, work opportunity (50.0%) and a more relaxing commute (50.0%). Regarding negative effects, all respondents expressed that they would be negatively impacted as their businesses would have to be relocated.

Regarding respondents' perception about how their commute may be affected, 77.8% of respondents indicated that their commute would not be affected, while 22.0% anticipated an easier commute. Respondents from St Benedict's (0.0%) did not anticipate a more difficult commute. Of those anticipating an easier commute all respondents (100%) expected a shorter travel time.

On the issue of housing and social services, 70.0% of respondents indicated they owned their home, 10.0% rented the home they occupied, 10.0% lived in family owned homes and 10.0% stated other. When asked about the land on which dwellings were located 25.0% of respondents indicated that they owned the land, 25.0% leased, 25.0% squatted, and 25% stated other.

Ninety percent (90.0%) of those interviewed indicated that their homes were of concrete and blocks and 10.0% indicated their homes were wood structures. Fifty percent (50.0%) of respondents indicated that their roofs were metal/zinc sheeting while 50.0% stated concrete as the roof type. Only water closets were in the study area. All of interviewees indicated that their toilet facility was a water closet.

All of respondents stated that they used electricity for household lighting. 90.0% of respondents stated gas as the main fuel for cooking while 10.0% stated coal. Regarding water supply, 100.0% of interviewees stated that their water was public piped water into their dwelling.

On the issue of problems with the domestic water supply 20.0% of respondents indicated that they had an issue while 80.0% of St. Benedict's residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 100.0% indicated low water pressure. 50.0% of those having problems buy water and 50.0% stated that they depended on the water truck to supply water. Of the respondents indicating that they stored water all persons indicated that they stored water in drums.

Ninety percent (90.0%) of interviewees stated that there were no issues with flooding. Of the 10.0% stating that there were issues with flooding, all indicated flooding only during times of heavy rains and at approximately a once per six-month interval. Respondents also identified the entire community as the flooded area and further indicated that water level ranged between one and five feet. All respondents indicated that there were no issues with frequent fires in St. Benedict's.

5.2.2.4 7 Miles Bull Bay

Approximately five percent (4.8%) of respondents were interviewed in the 7 Miles Bull Bay community. 60.0% of respondents were female and 40.0% were male. Age cohort distribution was as follows; 20.0% were age 18-25 years, 10.0% were age 26-33 years, 10.0% were age 34-41 years, 20.0% were age 42 – 50 years, 30.0% were age 51-60 years and 10.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 60.0% indicated that they were the heads of their households while 40.0% were not household heads. Regarding respondents' employment status 50.0% of respondents were employed and 40.0% unemployed and 10.0% retired. Of the 50.0% percent of employed individuals all stated that they were self-employed.

On the issue of respondents' awareness of the National Works Agency (NWA), 66.7% stated that they knew of the NWA. When asked about what they knew, 83.3% indicated that the Agency was responsible for road construction and maintenance and 16.7% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (33.3%) and word of mouth (16.7%). 50.0% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Project (SCHIP) all respondents in 7 Miles Bull Bay offered a response. 80.0% of interviewees stated that they heard of the South Coast Highway Project while 20.0% stated they were unaware. In response to what they knew about the SCHIP 12.5% did not offer a response while 62.5% indicated that they were aware that the project was to be implemented and 25.0% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (12.5%), word of mouth (12.5%) while 75.0% did not offer a response regarding how they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 50.0% indicated that they were aware and 50.0% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio. (20.0%) while 80.0% did not offer a response.

On the issues of dependency on the location for business 57.1% of interviewees indicated that they depended on the location. Of this approximately 58.0% of respondents, 75.0% indicated a financial dependence on the area; personal business along location (25.0%), place of employment being along location (25.0%) and customers located along location (25.0%). The remaining 25.0% indicated businesses patronised being along the location (25.0%).

As it related to whether or not respondents had any concerns pertaining to the project, 66.7% of interviewees indicated that they did not have any concern while 33.3% indicated that they had project concerns. Concerns highlighted pertained to loss of property (33.3%), relocation and compensation and family disruption as a result of relocation (33.3%) the effect of the project on business (33.4%).

On the issue of how the project would affect interviewees, 77.8% of respondents indicated that the project would not affect their life in any way, while 11.1% anticipated a positive impact and 11.1% anticipated a negative impact. Anticipated positives were, work opportunity (100.0%). Regarding negative effects, all of respondents expressed that they would be negatively impacted due to loss or reduction in business.

Regarding respondents' perception about how their commute may be affected, 62.5% of respondents indicated that their commute would not be affected, while 37.5% anticipated an easier commute. Of those anticipating an easier commute 33.3% expected fewer accidents. 66.7% of respondents expecting an easier commute, did not indicate how their commute would be made easier.

On the issue of housing and social services, 55.6% of respondents indicated they owned their home, 22.2% rented the home they occupied and 22.2% lived in family owned homes. When asked about the land on which dwellings were located 40.0% of respondents indicated that they owned the land, 10.0% leased, 10.0% squatted and 40.0% indicated their homes were on family owned land.

Seventy percent (70.0%) of those interviewed indicated that their homes were of concrete and blocks and 30.0% indicated their homes were wood structures. 50.0% of respondents indicated that their roofs were metal/zinc sheeting while 40.0% stated concrete as the roof type and 10% stated wood as the roof type. Both water closets and pit latrines were in the study area. Eighty percent (80.0%) of interviewees indicated that their toilet facility was a water closet and 20.0% stated pit latrine.

All of respondents stated that they used electricity for household lighting and that gas was the main fuel for cooking. Regarding water supply, all interviews interviewees stated that their domestic water supply was public piped water into their dwelling. All residents of 7 Miles Bull Bay indicated that there was no issue with their domestic water supply.

Ninety percent (90.0%) of interviewees stated that there were no issues with flooding while 10.0% stated that there were issues with flooding; however, no responses were given regarding the frequency of flood events, severity of flooding and areas affected by flooding

All respondents of 7 Miles Bull Bay indicated that there were no issues with frequent fires. Corner.

5.2.2.5 8 Miles Bull Bay

Approximately six percent (6.2%) of respondents were interviewed in the 8 Miles Bull Bay community. 46.2% of respondents were female and 53.8% were male. Age cohort distribution was as follows; 15.4% were age 18-25 years, 38.5% were age 26-33 years, 7.7% were age 34-41 years, 0.0% were age 42 – 50 years, 23.1% were age 51-60 years and 15.4% were older than sixty years of age.

Of those persons interviewed who offered a response, 61.5% indicated that they were the heads of their households while 38.5% were not household heads. Regarding respondents' employment status 53.8% of respondents were employed and 46.2% unemployed. Of the approximately 54% percent of employed individuals, 57.1% stated that they were self-employed while 42.9% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 76.9% stated that they knew of the NWA. When asked about what they knew, 60.0% indicated that the Agency was responsible for road construction and maintenance, 10.0% stated that the Agency had a work recruitment programme, 10.0% stated that the agency did not like to pay workers and 10.0% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (40.0%). 60.0% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Project (SCHIP) all respondents in 8 Miles Bull Bay offered a response. 53.8% of interviewees stated that they heard of the South Coast Highway Project while 42.6% stated they were unaware. In response to what they knew about the SCHIP, 57.1% did not offer a response while 42.9% indicated that they were aware that the project was to be implemented. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (47.1%) and word of mouth (28.6%) while 14.3% did not offer a response regarding how they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 61.5% indicated that they were aware and 38.5% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio. (50.0%), word of mouth (37.5%) and both word of mouth and media (12.5%).

On the issues of dependency on the location for business 33.3% of interviewees indicated that they depended on the location. Of this approximately 33% of respondents, 50% indicated a financial dependence on the area specifically place of employment along location. The remaining 50% indicated that businesses patronised being along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 33.3% of interviewees indicated that they did not have any concern while 66.7% indicated that they had project concerns. Concerns highlighted pertained to the footprint of the roadway (12.5%) and relocation and compensation and family disruption as a result of relocation (62.5%), the effect the highway will have on business (12.5%) and loss of employment (12.5%).

On the issue of how the project would affect interviewees, 27.3% of respondents indicated that the project would not affect their life in any way, while 18.2% anticipated a positive impact and 54.5% anticipated a negative impact. Anticipated positives were work opportunity (100.0%). Regarding negative effects, 50.0% respondents expressed that they would be negatively impacted due to a loss or reduction in business, 16.7% job loss and 33.3% loss of their homes.

Regarding respondents' perception about how their commute may be affected, 75.0% of respondents indicated that their commute would not be affected, while 25.0% anticipated an easier commute. Of those anticipating an easier commute, 66.7% anticipated improved roads and 33.3% anticipated a shorter travel time.

On the issue of housing and social services, 8.3% of respondents indicated they owned their home, 8.3% lease, 16.7% rented the home they occupied; 16.7% squat and 50.0% lived in family owned homes. When asked about the land on which dwellings were located 0.0% of respondents indicated that they owned the land, 38.5% leased, 15.4% squatted, 38.5% indicated their homes were on family owned land and 7.6% stated other.

Approximately ninety-two percent (92.3%) of those interviewed indicated that their homes were of concrete and blocks and 7.7% indicated their homes were wood structures. Approximately sixty two percent (61.5%) of respondents indicated that their roofs were metal/zinc sheeting while 38.5% stated concrete as the roof type. Both water closets and pit latrines were in the study area. Approximately ninety-two percent (92.3%) of interviewees indicated that their toilet facility was a water closet and 7.7% stated pit latrine.

All of respondents stated that they used electricity for household lighting and that gas was the main fuel for cooking. Regarding water supply, 76.9% of interviewees stated that their water was public piped water into their dwelling, 15.4% private tank, 7.7% private water truck.

On the issue of problems with the domestic water supply 25.0% of respondents indicated that they had an issue while 75.0% of 8 Mile Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 66.7% indicated low water pressure; the remaining 33.3% did not offer a response. Approximately thirty-three percent (33.3%) of those having problems indicate that the water truck supplies water while 33.3% of respondents stated other and 33.4% of interviewees did not state how they cope with water problems. Of the respondents indicating that they stored water, 66.7% indicated drums, 19.0% and 33.3% of respondents offered no response.

Approximately eighty-three percent (83.3%) of interviewees stated that there were no issues with flooding. Of the 16.7% stating that there were issues with flooding all respondents indicated flooding only during times of heavy rains. Regarding how often flood events occurred, 50.0% stated once per year, and 50.0% of respondents did not offer a response. 50.0% respectively stated the affected area as being close to the gully and the swamp. Fifty percent (50.0%) stated that water level ranged between one and five feet and 50.0% indicated that water level rose above five feet. Approximately ninety-two percent (91.7%) of respondents indicated that there were no issues with frequent fires in 8 Miles Bull Bay.

5.2.2.6 9 Miles Bull Bay

Approximately eight percent (8.1%) of respondents were interviewed in the 9 Miles Bull Bay community. 58.8% of respondents were female and 41.2% were male. Age cohort distribution was as follows; 5.9% were age 18-25 years, 35.3% were age 26-33 years, 5.9% were age 34-41 years, 17.6% were age 42 – 50 years, 11.8% were age 51-60 years and 23.5% were older than sixty years of age.

Of those persons interviewed who offered a response, 76.5% indicated that they were the heads of their households while 23.5% were not household heads. Regarding respondents' employment status 70.6% of respondents were employed and 23.5% unemployed and 5.9% were retired. Of the approximately 71% percent of employed individuals, 69.2% stated that they were self-employed while 30.8% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 58.8% stated that they knew of the NWA. When asked about what they knew, all interviewees indicated that the Agency was responsible for road construction and maintenance. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (50.0%), word of mouth (10.0%) and both media and word of mouth (10.0%). 30.0% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Improvement Project (SCHIP) all respondents in 9 Miles Bull Bay offered a response. Approximately thirty-five percent (35.3%) of interviewees stated that they heard of the South Coast Highway Improvement Project while 64.7% stated they were unaware. In response to what they knew about the SCHIP 16.7% did not offer a response while 83.3% indicated that they were aware that the project was to be implemented. Respondents indicated that they were made aware of the South Coast Highway Improvement Project via media, to include print, television and radio (16.7%) and word of mouth (50.0%) while 33.3% did not offer a response regarding how they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 64.7% indicated that they were aware and 35.3% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (18.2%), word of mouth (54.5%), community meeting (18.2%) and both word of mouth and media (9.1%).

On the issue of dependency on the location for business 56.3% of interviewees indicated that they depended on the location. Of this approximately 56% of respondents, 77.8% indicated a financial dependence on the area, specifically personal business along location (22.2%), having customers along location (55.6%) specifically place of employment along location. The remaining 22.2% indicated that businesses patronised being along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 56.2% of interviewees indicated that they did not have any concern while 43.8% indicated that they had project concerns. Concerns highlighted at 14.3% respectively pertained to job opportunity, loss of property, when the project would begin and its duration, relocation and compensation and family disruption as a result of relocation, the effect the highway will have on business, loss of employment. Approximately fourteen percent (14.2%) of respondents expressed concern about the personal benefit to be derived from the highway project.

On the issue of how the project would affect interviewees, 53.3% of respondents indicated that the project would not affect their life in any way, while 26.7% anticipated a positive impact and 20.0% anticipated a negative impact. Anticipated positives were improved road condition (50.0%), community development (25.0%) and work opportunity (25.0%). Regarding negative effects, 33.3% respondents expressed that they would be negatively impacted due to loss of their homes and speeding on the roads respectively. 33.4% indicated that they would be negatively affected as they anticipated losing their recreational space.

Regarding respondents' perception about how their commute may be affected, 56.2% of respondents indicated that their commute would not be affected, while 43.8% anticipated an easier commute. Of those anticipating an easier commute, 28.6% respectively anticipated improved roads, easier travel and a shorter travel time while 14.2% expected reduced congestion.

On the issue of housing and social services, 33.3% of respondents indicated they owned their home, 13.3% lease, 13.3% rented the home they occupied and 40.1% lived in family owned homes. When asked about the land on which dwellings were located 20.0% of respondents indicated that they owned the land, 33.3% leased, 40.0% indicated their homes were on family owned land and 6.7% indicated their homes were on government owned lands.

Approximately ninety-three percent (93.3%) of those interviewed indicated that their homes were of concrete and blocks and 3.7% indicated their homes were wood structures. Approximately eighty-seven percent (86.7%) of respondents indicated that their roofs were metal/zinc sheeting while 13.3% stated concrete as the roof type. Both water closets and pit latrines were in the study area. Seventy-five percent (75.0%) of interviewees indicated that their toilet facility was a water closet and 25.0% stated pit latrine.

All of the respondents stated that they used electricity for household lighting. Approximately eighty-eight percent (87.5%) of interviewees stated that gas was the main fuel for cooking and 12.5% stated coal as the main fuel type. Regarding water supply, 93.8% of interviewees stated that their water was public piped water into their dwelling and 6.2% private tank.

On the issue of problems with the domestic water supply 25.0% of respondents indicated that they had an issue while 75.0% of 9 Mile Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 75% indicated irregular water supply; the remaining 33.3% did not offer a response. Twenty-five percent 25.0% of those having problems indicate that they buy water, 25.0% get water from the community standpipe and 50.0% of respondents stated other. All respondents indicating that they stored water, indicated drums as the means of storage.

Approximately sixty-three percent (62.5%) of interviewees stated that there were no issues with flooding. Of the 37.5% stating that there were issues with flooding, 66.7% stated that flooding occurred every time it rained and 33.3% indicated flooding occurred during times of heavy rainfall. Regarding how often flood events occurred, 33.3% stated less than once per year, and 66.7% of respondents did not offer a response. Approximately thirty-three percent (33.3%) did not indicate any particular area affected by flood water, while 66.7% stated the main road, Taylor Land, Nine Mile Square and Windsor Heights. Approximately seventeen percent (16.7%) indicated that water level was less than one foot, 16.7% also stated that water level ranged between one and five feet and 16.6% indicated that water level rose above five feet. Fifty percent (50.0%) of respondents offered no response. All respondents indicated that there were no issues with frequent fires in 9 Miles Bull Bay.

5.2.2.7 10 Miles Bull Bay

Approximately six percent (5.7%) of respondents were interviewed in the 10 Miles Bull Bay area. Twenty-five percent (25.0%) of respondents were female and 75.0% were male. Age cohort distribution was as follows; 16.7% were age 18-25 years, 16.7% were age 26-33 years, 16.7 % were age 34-41 years, 16.7% were age 42 – 50 years, 8.2% were age 51-60 years and 25.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 66.7% indicated that they were the heads of their households. Regarding respondents' employment status 66.7% of respondents were employed, 25.0% unemployed and 8.3% of respondents were retired. Of the approximately 67% percent of employed individuals, 62.5% stated that they were self-employed while 37.5% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 83.8% stated that they knew of the NWA. When asked about what they knew, 90.0% indicated that the Agency was responsible for road construction and maintenance. Ten percent (10.0%) while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio, (60.0%), both word of mouth and media (10.0%). Thirty percent (30.0%) of those interviewed did not state the means through which they were made aware of the NWA.

Regarding the South Coast Highway Project (SCHIP) approximately all interviewees in 10 Miles Bull Bay offered a response. Approximately sixty-seven percent (66.7%) of interviewees stated that they heard of the South Coast Highway Project. In response to what they knew about the SCHIP 37.5% did not offer a response while 37.5% indicated that they were aware that the project was to be implemented and 25.0% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio. (12.5%) and both word of mouth and media (62.5%). Twenty-five percent (25.0%) of those interviewed did not state the means through which they were made aware of the SCHIP.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 58.3% indicated that they were aware and 41.7% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio, (57.1%), word of mouth (14.3%), both word of mouth and media (14.1%) and 14.3% of those interviewed did not offer a response.

On the issues of dependency on the location for business 22.2% of interviewees indicated that they depended on the location. All respondents indicated a financial dependence on the area; as a means of income (50.0%), and customers along location (50.0%).

As it related to whether or not respondents had any concerns pertaining to the project, 60.0% of interviewees indicated that they did not have any concern while 40.0% indicated that they had project concerns. Concerns highlighted pertained to pedestrian hazard (25.0%), relocation and compensation and family disruption as a result of relocation (25.0%), the effect on business (25.0%), when the project would begin and its duration (25.0%).

On the issue of how the project would affect interviewees, 60.0% of respondents indicated that the project would not affect their life in any way, while 30.0% anticipated a positive impact and 10.0% anticipated a negative impact. Anticipated positives were an increase in customers (33.4%), improved roads (33.3%) and community development (33.3%). Regarding negative effects, all respondents (100.0%) expressed that they would be negatively impacted due to a loss or reduction in business.

Regarding respondents' perception about how their commute may be affected, 50.0% of respondents indicated that their commute would not be affected, while 50.0% anticipated an easier commute. All respondents from 10 Miles Bull Bay did not anticipate a more difficult commute. Of those anticipating an easier commute, 60.0% indicated more comfortable travel; 20.0% expected a shorter travel time. The remaining 20.0% of those interviewed while expecting an easier commute did not indicate how their commute would be made easier.

On the issue of housing and social services, 40.0% of respondents indicated they owned their home, 10.0% leased, 10.0% rented the home they occupied and 40.0% lived in family owned homes. When asked about the land on which dwellings were located 10.0% of respondents indicated that they owned the land, 30.0% leased, 20.0% squatted and 40.0% had their homes on family land.

Approximately ninety-one percent (90.9%) of those interviewed indicated that their homes were of concrete and blocks and 9.1% indicated their homes were wood structures. Approximately twenty-seven percent (27.3%) of respondents indicated that their roofs were metal/zinc sheeting while 72.7% stated concrete as the roof type. All of the interviewees indicated that their toilet facility was a water closet.

Approximately ninety-one percent (90.9%) of respondents stated that they used electricity for household lighting and 9.1% stated that kerosene was used for household lighting. Approximately seventy-three percent (72.7%) of respondents stated gas as the main fuel for cooking while 27.3% stated coal. Regarding water supply, 90.9% of interviewees stated that their water was public piped water into their dwelling and 9.1% stated private water truck.

On the issue of problems with the domestic water supply 60.0% of respondents indicated that they had an issue while 40.0% of 10 Miles Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 83.3% stated irregular water supply. The remaining 16.7% did not state what their specific issue was. Approximately thirty-three percent (33.3%) of those having water problems buy water, 33.3% are supplied by water truck; 16.7% use the community stand pipe and 16.7% stated other means of coping with the problem. Of the respondents indicating that they stored water, 50.0% use drums and 50.0% use aboveground tanks.

Approximately sixty-four percent (63.6%) of interviewees stated that there were no issues with flooding. Of the 36.4% stating that there were issues with flooding, 75.0% indicated that flooding occurred every time it rains while 25.0% did not offer an answer. Seventy-five percent (75.0%) of those interviewed also stated that flooding occurred less than once per year and 25.0% also did not offer a response. All respondents identified the main road, Bull Park River, and 10 Mile Bridge as flooded areas and further indicated that water level exceeded five feet. All of the respondents indicated that there were no issues with frequent fires in 10 Miles Bull Bay.

5.2.2.8 11 Miles Bull Bay

Approximately five percent (4.8%) of respondents were interviewed in the 11 Miles Bull Bay area. 40.0% of respondents were female and 60.0% were male. Age cohort distribution was as follows; 50.0% were age 18-25 years, 10.0% were age 26-33 years, 10.0 % were age 34-41 years, 20.0% were age 42 – 50 years, 0.0% were age 51-60 years and 10.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 60.0% indicated that they were the heads of their households. Regarding respondents' employment status 60.0% of respondents were employed and 40.0% unemployed. Of the 60.0% percent of employed individuals, 66.7% stated that they were self-employed while 33.3% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 50.0% stated that they knew of the NWA. When asked about what they knew, 60.0% indicated that the Agency was responsible for road construction and maintenance. Forty percent (40.0%) while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (60.0%). Forty percent (40.0%) of those interviewed did not state the means through which they were made aware of the NWA.

Regarding the South Coast Highway Project (SCHIP) approximately all interviewees in 10 Miles Bull Bay offered a response. Seventy percent (70.0%) of interviewees stated that they heard of the South Coast Highway Project. In response to what they knew about the SCHIP 42.9% did not offer a response while 42.9% indicated that they were aware that the project was to be implemented and 14.2.0% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio. (14.3%) and word of mouth (85.7%).

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 20.0% indicated that they were aware and 80.0% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (50.0%) and word of mouth (50.0%).

On the issues of dependency on the location for business 40.0% of interviewees indicated that they depended on the location. All respondents indicated a financial dependence on the area; as a means of income (25.0%), place of employment along location (25.0%) and personal business along location (50.0%).

As it related to whether or not respondents had any concerns pertaining to the project, 90.0% of interviewees indicated that they did not have any concern while 10.0% indicated that they had project concerns. All (100.0%) concerns highlighted pertained to the personal benefit to be derived from the highway project.

On the issue of how the project would affect interviewees, 66.7% of respondents indicated that the project would not affect their life in any way, while 33.3% anticipated a positive impact. Anticipated positives were an increase in customers (33.3%), improved travel time (33.3%) and work opportunity (33.4%).

Regarding respondents' perception about how their commute may be affected, 77.8% of respondents indicated that their commute would not be affected, while 22.2% anticipated an easier commute. Respondents from 11 Miles Bull Bay (0.0%) did not anticipate a more difficult commute. Of those anticipating an easier commute, all respondents (100.0%) expected a shorter travel time.

On the issue of housing and social services, 30.0% of respondents indicated they owned their home, 20.0% leased and 50.0% lived in family owned homes. When asked about the land on which dwellings were located, 22.2% leased, 33.4% squatted and 44.4% had their homes on family land.

Approximately sixty-seven percent (66.7%) of those interviewed indicated that their homes were of concrete and blocks and 33.3% indicated their homes were wood structures. Approximately eighty-nine percent (88.9%) of respondents indicated that their roofs were metal/zinc sheeting while 11.1% stated concrete as the roof type. Both water closets and pit latrines were in the study area. Ninety percent (90.0%) of interviewees indicated that their toilet facility was a water closet and 10.0% stated pit latrine.

All of the respondents stated that they used electricity for household lighting and also stated gas as the main fuel for cooking. Regarding water supply, 30.0% of interviewees stated that their water was public piped water into their dwelling, 10.0% community tank, and 9.1% stated that they used the stand pipe.

On the issue of problems with the domestic water supply 90.0% of respondents indicated that they had an issue while 10.0% of 11 Miles Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 33.3% stated that no pipes were run in the area while 66.7% stated irregular water supply. Approximately eleven percent (11.1%) of those having water problems collect rain water and 88.9% use the community standpipe. Of the respondents indicating that they stored water all individuals indicated that they use drums.

Regarding the occurrence of frequent flooding and frequent fires all respondents indicated that there were no issues in 11 Miles Bull Bay.

5.2.2.9 12 Miles Bull Bay

Approximately four percent (4.3%) of respondents were interviewed in the 12 Miles Bull Bay area. 44.4% of respondents were female and 55.6% were male. Age cohort distribution was as follows; 0.0% were age 18-25 years, 33.3% were age 26-33 years, 22.2 % were age 34-41 years, 11.1% were age 42 – 50 years, 11.1% were age 51-60 years and 22.3% were older than sixty years of age.

Of those persons interviewed who offered a response, 55.6% indicated that they were the heads of their households. Regarding respondents' employment status 77.8% of respondents were employed and

11.1% unemployed and 11.1% retired. Of the approximately 78% percent of employed individuals, 42.9% stated that they were self-employed while 57.1% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 66.7% stated that they knew of the NWA. When asked about what they knew, 50.0% indicated that the Agency was responsible for road construction and maintenance. 50.0% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio. (83.3%) and word of mouth (16.7%).

Regarding the South Coast Highway Improvement Project (SCHIP) all interviewees in 12 Miles Bull Bay offered a response. Approximately seventy-eight percent (77.8%) of interviewees stated that they heard of the South Coast Highway Project. In response to what they knew about the SCHIP 71.4% did not offer a response while 28.6% indicated that they were aware that the project was to be implemented. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio. (42.8%), word of mouth (28.6%) and both word of mouth and media (14.3%). Approximately fourteen percent (14.3%) of respondents did not offer a response regarding the means through which they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 50.0% indicated that they were aware and 50.0% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio. (50.0%), word of mouth (25.0%) and both word of mouth and media (25.0%).

On the issues of dependency on the location for business 28.6% of interviewees indicated that they depended on the location. All respondents indicated a financial dependence on the area; as a means of income (50.0%) and personal business along location (50.0%).

As it related to whether or not respondents had any concerns pertaining to the project, 33.3% of interviewees indicated that they did not have any concern while 66.7% indicated that they had project concerns. Concerns highlighted pertained to loss of property (16.7%), the actual footprint of the road (16.7%), relocation and compensation and family disruption as a result of relocation (50.0%) and the effect the highway would have on business (16.6%).

On the issue of how the project would affect interviewees, 28.6% of respondents indicated that the project would not affect their life in any way, while 57.1% anticipated a positive impact and 14.3% anticipated a negative effect. Anticipated positives were improved roads (50.0%) and community development (25.0%). 25.0% of interviewees did not specify what positive impact they anticipated. Regarding negative effect, all respondents expected a negative impact as their business would have to be relocated.

Regarding respondents' perception about how their commute may be affected, 42.9% of respondents indicated that their commute would not be affected, while 42.9% anticipated an easier commute. 14.2%

of respondents from 12 Miles Bull Bay anticipated a more difficult commute. Of those anticipating an easier commute, 33.3% respectively expected a shorter travel time and a fewer accidents. The remaining 33.4% of those interviewed while expecting an easier commute did not indicate how their commute would be made easier. Regarding negative effects all respondents indicated that their living environment would be impacted.

On the issue of housing and social services, 37.5% of respondents indicated they owned their home, and 62.5% lived in family owned homes. When asked about the land on which dwellings were located, 25.0% leased, 37.5% squatted and 37.5% had their homes on family land.

Approximately sixty-seven percent (66.7%) of those interviewed indicated that their homes were of concrete and blocks and 33.3% indicated their homes were wood structures. 55.6% of respondents indicated that their roofs were metal/zinc sheeting while 44.4% stated concrete as the roof type. Both water closets and pit latrines were in the study area. Approximately seventy-eight percent (77.8%) of interviewees indicated that their toilet facility was a water closet and 22.2% stated pit latrine.

All of the respondents stated that they used electricity for household lighting. 55.6% of respondents stated gas as the main fuel for cooking and 44.4% coal. Regarding water supply, 55.6% of interviewees stated that their water was public piped water into their dwelling, 22.2% private tank, 11.1% government water truck and 11.1% stated private water truck.

On the issue of problems with the domestic water supply 77.8% of respondents indicated that they had an issue while 22.2% of 12 Miles Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue all individuals (100.0%) stated irregular water supply. 28.6% of those having water problems collect rain water, 28.6% indicated that the water truck supplies water and 42.8% use the community standpipe. Of the respondents indicating that they stored water, 71.4% individuals indicated that they use drums, 14.3% aboveground tank and 14.3% stated other means.

Regarding the occurrence of frequent flooding and frequent fires all respondents indicated that there were no issues in 12 Miles Bull Bay.

5.2.2.10 14 Miles Bull Bay

Approximately three percent (3.3%) of respondents were interviewed in the 14 Miles Bull Bay area. Approximately fifty-seven percent (57.1%) of respondents were female and 42.9% were male. Age cohort distribution was as follows; 57.1% were age 18-25 years, 14.3% were age 26-33 years, 14.3 % were age 34-41 years, 0.0% were age 42 – 50 years, 14.3% were age 51-60 years and no one was older than sixty years of age.

Of those persons interviewed who offered a response, 42.9% indicated that they were the heads of their households. Regarding respondents' employment status 57.1% of respondents were employed and 28.6% unemployed and 14.3% retired. Of the approximately 57% percent of employed individuals, 25.0% stated that they were self-employed while 75.0% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 42.9% stated that they knew of the NWA. When asked about what they knew, 66.7% indicated that the Agency was responsible for road construction and maintenance. Approximately thirty-three percent (33.3%) while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (33.3%) and 66.7% did not stated the means through which they were made aware of the NWA.

Regarding the South Coast Highway Project (SCHIP) all interviewees in 14 Miles Bull Bay offered a response. Approximately fifty-seven percent (57.1%) of interviewees stated that they heard of the South Coast Highway Project. In response to what they knew about the SCHIP 50.0% did not offer a response while 50.0% indicated that they were aware that the project was to be implemented. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (25.0%) and word of mouth (75.0%).

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 28.6% indicated that they were aware and 71.4% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (50.0%) and word of mouth (50.0%).

On the issues of dependency on the location for business all (100.0%) of interviewees indicated that they depended on the location. All respondents indicated a financial dependence on the area; place of employment along location (50.0%) and personal business along location (50.0%).

As it related to whether or not respondents had any concerns pertaining to the project, 40.0% of interviewees indicated that they did not have any concern while 60.0% indicated that they had project concerns. Concerns highlighted pertained to loss of property (33.3%) and the quality of the finished road (33.3%) and 33.4% while indicating concerns did not specify the concern.

On the issue of how the project would affect interviewees, 71.4% of respondents indicated that the project would not affect their life in any way, while 28.6% anticipated a positive impact. Anticipated positives were improved roads (50.0%) and shorter travel time (50.0%).

Regarding respondents' perception about how their commute may be affected, 20.0% of respondents indicated that their commute would not be affected, while 80.0% anticipated an easier commute. Of those anticipating an easier commute, 25.0% respectively expected, improved roads, reduced travel time and a fewer accidents. The remaining 25.0% of those interviewed while expecting an easier commute did not indicate how their commute would be made easier.

On the issue of housing and social services, 42.9% of respondents indicated they owned their home, 28.6% rent and 28.5% lived in family owned homes. When asked about the land on which dwellings were located, 16.7% owned, 16.7% leased, 50.0% squatted and 16.6% had their homes on family land.

71.4% of those interviewed indicated that their homes were of concrete and blocks and 28.6% indicated their homes were wood structures. 71.4% of respondents indicated that their roofs were metal/zinc sheeting while 28.6% stated concrete as the roof type. All (100.0%) interviewees indicated that their toilet facility was a water closet.

All of the respondents stated that they used electricity for household lighting and gas was the main fuel for cooking. Regarding water supply, 85.7% of interviewees stated that their water was public piped water into their dwelling and 14.3% stated the public standpipe.

On the issue of problems with the domestic water supply 28.6% of respondents indicated that they had an issue while 71.4% of 14 Miles Bull Bay residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue 50.0% of individuals stated that no pipes were run in the area and 50.0% stated irregular water supply. Fifty percent (50.0%) of those having water problems use the community standpipe while 50.0% did not state specifically how they coped with the problem. Of the respondents indicating that they stored water, 50.0% individuals indicated that they use drums and 50.0% did not offer a response.

Regarding the occurrence of frequent flooding and frequent fires all respondents indicated that there were no issues in 14 Miles Bull Bay.

5.2.2.11 Grant's Pen

Approximately three percent (2.9%) of respondents were interviewed in the Grant's Pen community. 66.7% of respondents were female and 33.3% were male. Age cohort distribution was as follows; 0.0% were age 18-25 years, 33.3% were age 26-33 years, 33.3% were age 34-41 years, 33.4% were age 42 – 50 years, 0.0% were age 51-60 years and 0.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 83.3% indicated that they were the heads of their households while 16.7% were not household heads. Regarding respondents' employment status 66.7% of respondents were employed and 33.3% unemployed. Of the approximately 67% percent of employed individuals, 80.0% stated that they were self-employed while 20.0% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 66.7% stated that they knew of the NWA. When asked about what they knew, all respondents indicated that the Agency was responsible for road construction and maintenance. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (25.0%). Seventy-five percent (75.0%) did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Improvement Project (SCHIP) all respondents in Grant's Pen offered a response. Approximately thirty-three percent (33.3%) of interviewees stated that they heard of the South Coast Highway Project while 66.7% stated they were unaware. In response to what they knew about the SCHIP all interviewees indicated that they were aware that the project was to be implemented and all individuals further indicated that they were made aware of the South Coast Highway Project via word of mouth.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 16.7% indicated that they were aware and 83.3% indicated that they were unaware. All persons indicating an awareness stated that they were made aware of this project via word of mouth.

On the issues of dependency on the location for business 25.0% of interviewees indicated that they depended on the location. These respondents all stated that businesses patronised were along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 50.0% of interviewees indicated that they did not have any concern while 50.0% indicated that they had project concerns. Concerns highlighted pertained to loss of property (66.7%) and 33.3% anticipated an increase in income taxes and bus fares (33.4%).

On the issue of how the project would affect interviewees, 33.4% of respondents indicated that the project would not affect their life in any way, while 33.3% anticipated a positive impact and 33.3% anticipated a negative impact. Anticipated positives were, improved travel time (50.0%). The remaining 50.0% did not offer a specific answer regarding how they expected to be positively affected. Regarding negative effects, 50.0% loss of their home and 50.0% anticipated a reduction in income as a result of increased taxes.

Regarding respondents' perception about how their commute may be affected, 50.0% of respondents indicated that their commute would not be affected, while 50.0% anticipated an easier commute. Of those anticipating an easier commute 50.0% anticipated a more comfortable travel experience. 50.0% of respondents expecting an easier commute, did not indicate how their commute would be made easier.

On the issue of housing and social services, 16.7% of respondents indicated they owned their home, 16.7% leased, 16.7% rented the home they occupied, 16.7% squatted and 33.2% lived in family owned homes. When asked about the land on which dwellings were located none of respondents indicated that they owned the land, 20.0% leased, 40.0% squatted and 40.0% indicated their homes were on family owned land.

None of those interviewed indicated that their homes were of concrete and blocks and 100.0% indicated their homes were wood structures and further stated that their roofs were metal/zinc sheeting. Both water closets and pit latrines were in the study area. Fifty percent (50.0%) of interviewees indicated that their toilet facility was a water closet and 50.0% stated pit latrine.

All of respondents stated that they used electricity for household lighting. Approximately sixty-seven percent (66.7%) of respondents stated gas as the main fuel for cooking while 33.3% stated coal. Regarding water supply, all respondents stated that the main source of domestic water was the standpipe.

On the issue of problems with the domestic water supply 66.7% of respondents indicated that they had an issue while 33.3% of Grant's Pen residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 50.0% stated no pipes run in the area, while 25.0% indicated irregular water supply and 25.0% indicated low water pressure. All of those having problems use the community standpipe and also stored water in drums.

All interviewees stated that there were no issues with frequent flooding or frequent fires.

5.2.2.12 Albion

Approximately eight percent (7.7%) of respondents were interviewed in the Albion area. 31.2% of respondents were female and 68.8% were male. Age cohort distribution was as follows; 12.5% were age 18-25 years, 18.8% were age 26-33 years, 31.3% were age 34-41 years, 25.0% were age 42 – 50 years, 12.5% were age 51-60 years and 0.0% were older than sixty years of age.

Of those persons interviewed who offered a response, all indicated that they were the heads of their households. Regarding respondents' employment status 68.8% of respondents were employed and 31.2% unemployed. Of the approximately 70% percent of employed individuals, 72.7% stated that they were self-employed while 27.3% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 56.3% stated that they knew of the NWA. When asked about what they knew, 55.6% indicated that the Agency was responsible for road construction and maintenance and 44.4% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio. (33.4%), word of mouth (11.1%) a Community Meeting (11.1%). Approximately forty-four percent (44.4%) of those interviewed did not state the means through which they were made aware of the NWA.

Regarding the South Coast Highway Improvement Project (SCHIP) all interviewees in Albion offered a response. 56.3% of interviewees stated that they heard of the South Coast Highway Improvement Project while 43.8% stated they were unaware. In response to what they knew about the SCHIP 33.3% did not offer a response while 22.3% indicated that they were aware that the project was to be implemented and 44.4% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio. (22.2%) and word of mouth (22.2%). Approximately fifty-six percent (55.6%) of those interviewed did not state the means through which they were made aware of the SCHIP.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 43.8% indicated that they were aware and 56.2% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (57.1%), word of mouth (14.3%), both word of mouth and media (14.3%). The remaining 14.3% while indicating awareness did not offer a response regarding how they were made aware.

On the issues of dependency on the location for business 50.0% of interviewees indicated that they depended on the location. Of this 50.0% of respondents, approximately 25.0% indicated a financial dependence on the area; as a means of income (12.5%) and customers being along location (12.5%). The remaining 75.0% indicated businesses patronised being along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 73.3% of interviewees indicated that they did not have any concern while 26.7% indicated that they had project concerns. Concerns highlighted pertained to pedestrian hazard (25.0%) and when the project would begin and its duration (25.0%). The remaining 50.0% of interviewees expressed concerns about relocation and compensation and family disruption as a result of relocation.

On the issue of how the project would affect interviewees, 60.0% of respondents indicated that the project would not affect their life in any way, while 26.7% anticipated a positive impact and 13.3% anticipated a negative impact. Anticipated positives were, improved roads (50.0%) and improved travel time (25.0%). 25.0% of respondents did not specify what positive impact they anticipated. Regarding negative effects, 50.0% respectively anticipated a loss or reduction in business and a loss of income.

Regarding respondents' perception about how their commute may be affected, 62.5% of respondents indicated that their commute would not be affected, while 37.5% anticipated an easier commute. Respondents from Albion (0.0%) did not anticipate a more difficult commute. Of those anticipating an easier commute 16.7% attributed this to improved roads, 33.3% indicated more comfortable travel and 33.3% expected a shorter travel time. The remaining 16.7% of those interviewed while expecting an easier commute did not indicate how their commute would be made easier.

On the issue of housing and social services, 37.5% of respondents indicated they owned their home, 18.8% rented the home they occupied, 12.5% squatted and 31.2% lived in family owned homes. When asked about the land on which dwellings were located 15.4% of respondents indicated that they owned the land, 30.7% leased, 23.1% squatted, 23.1% had their homes on family land and 7.7% stated their homes were on government lands.

Approximately sixty-three percent (62.5%) of those interviewed indicated that their homes were of concrete and blocks and 37.5% indicated their homes were wood structures. Approximately sixty-three percent (62.5%) of respondents indicated that their roofs were metal/zinc sheeting while 37.5% stated concrete as the roof type. Both water closets and pit latrines were in the study area. 81.2% of interviewees indicated that their toilet facility was a water closet while 18.8% stated that they had pit latrines.

Approximately ninety-four percent (93.7%) of respondents stated that they used electricity for household lighting while 6.3% indicated other and stated solar as the means for household lighting. 93.7% of respondents stated gas as the main fuel for cooking while 6.3% stated coal. Regarding water supply, 68.7% of interviewees stated that their water was public piped water into their dwelling and 31.3% stated community tank.

On the issue of problems with the domestic water supply 75.0% of respondents indicated that they had an issue while 25.0% of Albion residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 91.7% stated irregular water supply and 8.3%

indicated low water pressure. 33.4% of those having water problems collect rain water, 8.3% buy water; 8.3 collect water from a spring or river, 25.0% use the community stand pipe and 25.0% stated other means. Of the respondents indicating that they stored water, 58.3% use drums, 33.3% use aboveground tanks and 8.4% did not state how they stored water.

Approximately ninety-four percent (93.8%) of interviewees stated that there were no issues with flooding. Of the 6.2% stating that there were issues with flooding, 100.0% indicated flooding only during times of heavy rains and one time per month. Respondents also identified the main roadway as the flooded area and further indicated that water level ranged between one and five feet. Approximately ninety-four percent (93.7%) of respondents indicated that there were no issues with frequent fires in Albion, while 6.3% indicated that there was an issue with frequent fires.

5.2.2.13 Heartease

Approximately two percent (1.9%) of respondents were interviewed in the Heartease community. Seventy-five percent (75.0%) of respondents were female and 25.0% were male. Age cohort distribution was as follows; 0.0% were age 18-25 years, 50.0% were age 26-33 years, 25.0% were age 34-41 years, 25.0% were age 42 – 50 years, 0.0% were age 51-60 years and 0.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 50.0% indicated that they were the heads of their households while 50.0% were not household heads. Regarding respondents' employment status 75.0% of respondents were employed, 25.0% unemployed and 0.0% retired. Of the approximately 75% percent of employed individuals, all stated that they were self-employed.

On the issue of respondents' awareness of the National Works Agency (NWA), 100.0% stated that they knew of the NWA and further stated that the Agency was responsible for road construction and maintenance. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (50.0%) and both media and word of mouth 25.0% and 25.0% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Project (SCHIP) all interviewees in Heartease offered a response. Fifty percent (50.0%) of interviewees stated that they heard of the South Coast Highway Improvement Project while 50.0% stated they were unaware. In response to what they knew about the SCHIP all respondents indicated that they were aware that the project was to be. All respondents further indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 50.0% indicated that they were aware and 50.0% indicated that they were unaware. All respondents indicated that they were made aware of this project via media, to include print, television and radio. On the issues of dependency on the location for business 50.0% of interviewees indicated that they depended on the location. Fifty percent (50.0%) respectively indicated commuting and businesses patronised being along the location.

As it related to whether or not respondents had any concerns pertaining to the project, 75.0% of interviewees indicated that they did not have any concern while 25.0% indicated that they had project concerns. Concerns highlighted pertained to loss of property (100.0%). On the issue of how the project would affect interviewees, 66.7% anticipated a positive impact and 33.3% anticipated a negative impact. Anticipated positives were, improved travel time (50.0%) and work opportunity (50.0%). Regarding negative effects, all respondents expressed that they would be negatively impacted due to a loss or reduction in business.

Regarding respondents' perception about how their commute may be affected, all respondents indicated that they anticipated an easier commute. 33.3% expected improved roads and 66.7% anticipated a shorter travel time. On the issue of housing and social services, 50.0% of respondents indicated they owned their home, 25.0% leased, and 25.0% rented the home they occupied. When asked about the land on which dwellings were located 50.0% of respondents respectively indicated that they owned the land and leased the land.

All persons interviewed indicated that their homes were of concrete and blocks and further stated that their roofs were metal/zinc sheeting. Both water closets and pit latrines were in the study area. Fifty percent (50.0%) of interviewees indicated that their toilet facility was a water closet and 50.0% stated pit latrine.

All of the respondents stated that they used electricity for household lighting and gas as the main fuel for cooking. Regarding water supply, 50.0% of interviewees stated that their water was public piped water into their dwelling, 50.0% indicated private tank. On the issue of problems with the domestic water supply 75.0% of respondents indicated that they had an issue while 25.0% of Heartease residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 66.7% indicated irregular water supply and 33.3% indicated low water pressure.

Approximately thirty-three percent (33.3%) of those having problems collect rain water, and 66.7% indicate that the water truck supplies water. Of the respondents indicating that they stored water, 66.7% indicated drums and 33.3% stated aboveground storage tanks. Regarding problems with frequent flooding and frequent fires, all respondents of Heartease indicated that there are no problems.

5.2.2.14 Poorman's Corner

Approximately nine percent (9.1%) of respondents were interviewed in the Poorman's Corner community. Of this, 47.4% of respondents were female and 52.6% were male. Age cohort distribution was as follows; 26.3% were age 18-25 years, 15.8% were age 26-33 years, 15.8% were age 34-41 years, 26.3% were age 42 – 50 years, 10.5% were age 51-60 years and 5.3% were older than sixty years of age.

Of those persons interviewed who offered a response, 68.4% indicated that they were the heads of their households while 31.6% were not household heads. Regarding respondents' employment status 73.7% of respondents were employed and 26.3% unemployed. Of the approximately 74% percent of employed individuals, 66.7% stated that they were self-employed while 33.3% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 68.4% stated that they knew of the NWA. When asked about what they knew, 46.2% indicated that the Agency was responsible for road construction and maintenance and 53.8% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (76.9%) and both media and word of mouth (7.7%), 15.4% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Improvement Project (SCHIP) all respondents in Poorman's Corner offered a response. Approximately sixty-three percent (63.2%) of interviewees stated that they heard of the South Coast Highway Improvement Project while 36.8% stated they were unaware. In response to what they knew about the SCHIP 33.3% did not offer a response while 58.3% indicated that they were aware that the project was to be implemented and 8.4% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (91.7%) while 8.3% did not offer a response regarding how they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 52.6% indicated that they were aware and 47.4% indicated that they were unaware. Respondents indicated that they were made aware of this project via media, to include print, television and radio (50.0%), word of mouth (20.0%) and both word of mouth and media (30.0%).

On the issues of dependency on the location for business 64.7% of interviewees indicated that they depended on the location. Of this approximately 65.0% of respondents, 72.7% indicated a financial dependence on the area; as a means of income (18.2%), personal business along location (27.3%), place of employment being along location (18.2%) and work opportunity (9.0%). The remaining 27.3% indicated transportation of goods into communities (9.1%) and businesses patronised being along the location (18.2%).

As it related to whether or not respondents had any concerns pertaining to the project, 83.3% of interviewees indicated that they did not have any concern while 16.7% indicated that they had project concerns. Concerns highlighted pertained to loss of property (33.3%), relocation and compensation and family disruption as a result of relocation (33.3%) the anticipated increase in income taxes and bus fares (33.4%).

On the issue of how the project would affect interviewees, 33.3% of respondents indicated that the project would not affect their life in any way, while 50.0% anticipated a positive impact and 16.7% anticipated a negative impact. Anticipated positives were, community development and improved travel time, 33.3% respectively and work opportunity (33.4%). Regarding negative effects, 33.3% of respondents expressed that they would be negatively impacted due to loss of their job, 33.4% loss of their home and 33.3% anticipated a bus fare increase.

Regarding respondents' perception about how their commute may be affected, 16.7% of respondents indicated that their commute would not be affected, while 83.3% anticipated an easier commute. Of those anticipating an easier commute, 20.0% anticipated improved roads and 13.3% expected travelling to be easier, 33.4% anticipated a shorter travel time, 13.3% expected fewer accidents. 20.0% of respondents which expecting an easier commute, did not indicate how their commute would be made easier.

On the issue of housing and social services, 33.3% of respondents indicated they owned their home, 6.7% leased, 26.7% rented the home they occupied, 13.3% squatted and 20.0% lived in family owned homes. When asked about the land on which dwellings were located 11.1% of respondents indicated that they owned the land, 27.8% leased, 22.2% squatted, 33.3% indicated their homes were on family owned land and 5.6% had their homes on government land.

Approximately ninety percent (89.5%) of those interviewed indicated that their homes were of concrete and blocks and 10.5% indicated their homes were wood structures. Approximately eighty-four percent (84.2%) of respondents indicated that their roofs were metal/zinc sheeting while 15.8% stated concrete as the roof type. Both water closets and pit latrines were in the study area. 84.2% of interviewees indicated that their toilet facility was a water closet and 15.8% stated pit latrine.

Approximately ninety percent (89.5%) of respondents stated that they used electricity for household lighting while 10.5% stated that kerosene was used. 88.9% of respondents stated gas as the main fuel for cooking while 11.1% stated coal. Regarding water supply, 72.2% of interviewees stated that their water was public piped water into their dwelling, 5.6% respectively stated private tank and community tank and indicated water was supplied by government water trucks. Eleven (11.0%) of respondents stated that the main source of domestic water was the standpipe.

On the issue of problems with the domestic water supply 57.9% of respondents indicated that they had an issue while 42.1% of Poorman's Corner residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 9.1% indicated they had no water, 18.2% no pipes run in the area, while 45.5% indicated irregular water supply and 18.2% indicated low water pressure. 9.0% of respondents stating there was a problem with the water supply did not indicate what the specific issue was.

Approximately nine percent (9.1%) of those having problems collect rain water, 9.1% buy water, 18.2% indicate that the water truck supplies water while 36.4% use the community standpipe. 27.2% of respondents stated other. Of the respondents indicating that they stored water, 72.7% indicated drums, 9.1% respectively stated aboveground storage tanks and other while 9.1% of respondents offered no response.

Approximately sixty-three percent (63.2%) of interviewees stated that there were no issues with flooding. Of the 36.8% stating that there were issues with flooding, 57.1% stated that flooding occurred every time it rained and 14.3% indicated flooding only during times of heavy rains while 28.6% offered no response. Regarding how often flood events occurred none of the interviewees offered a response.

71.4% indicated that the Poorman's Corner main road flooded, 28.6% did not indicate any specific area affected by flood water, 85.7% stated that water level ranged between one and five feet and 14.3% did not offer a response. Approximately ninety-five percent (94.7%) of respondents indicated that there were no issues with frequent fires in Poorman's Corner.

5.2.2.15 Yallahs

Approximately fourteen percent (14.4%) of respondents were interviewed in the Yallahs community. Approximately sixty-seven percent (66.7%) of respondents were female and 33.3% were male. Age cohort distribution was as follows; 6.7% were age 18-25 years, 6.7% were age 26-33 years, 30.0% were age 34-41 years, 23.3% were age 42 – 50 years, 23.3% were age 51-60 years and 10.0% were older than sixty years of age.

Of those persons interviewed who offered a response, 75.9% indicated that they were the heads of their households while 24.1% were not household heads. Regarding respondents' employment status 53.3% of respondents were employed, 36.7% unemployed and 10.0% retired. Of the approximately 76% percent of employed individuals, 75.0% stated that they were self-employed while 25.0% indicated that they had an employer.

On the issue of respondents' awareness of the National Works Agency (NWA), 85.7% stated that they knew of the NWA. When asked about what they knew, 70.8% indicated that the Agency was responsible for road construction and maintenance, 4.2% stated that the Agency had a work recruitment programme, 4.2% stated that the agency had good community relations and 20.8% while indicating knowledge of the NWA did not offer any specific response as to what they knew. Respondents indicated that they were made aware of the National Works Agency via media, to include print, television and radio (45.8%), word of mouth (4.2%), both media and word of mouth 12.5% and 37.5% did not state the means through which they heard of the NWA.

Regarding the South Coast Highway Improvement Project (SCHIP), 93.3% of respondents in Yallahs offered a response. Approximately sixty-eight (67.9%) of interviewees stated that they heard of the South Coast Highway Improvement Project while 32.1% stated they were unaware. In response to what they knew about the SCHIP, 26.3% did not offer a response while 68.4% indicated that they were aware that the project was to be implemented and 5.3% stated that they were aware only of the proposal to undertake the project. Respondents indicated that they were made aware of the South Coast Highway Project via media, to include print, television and radio (36.8%), word of mouth (26.3%) and both word of mouth and media (5.3%) and 36.1% did not offer a response regarding how they were made aware.

When interviewees were asked if they knew that the NWA under the SCHIP was proposing to construct a highway from Harbour View to Portland 78.6% indicated that they were aware and 21.4% indicated that they were unaware, while 6.7% did not offer a response. Respondents indicated that they were made aware of this project via media, to include print, television and radio. (27.3%), word of mouth (31.8%), community meeting (9.1%) and both word of mouth and media (31.8%).

On the issues of dependency on the location for business 40.7% of interviewees indicated that they depended on the location. Of this approximately 41% of respondents, 45.5% indicated a financial dependence on the area; as a means of income (9.1%), personal business along location (9.1%) and customers along location (27.3%). The remaining 54.5% indicated commuting (27.3%), transportation of goods into communities (18.2%) and businesses patronised being along the location (9.1%).

As it related to whether or not respondents had any concerns pertaining to the project, 55.6% of interviewees indicated that they did not have any concern while 44.4% indicated that they had project concerns. Concerns highlighted pertained to pedestrian hazards (16.7%), loss of property (33.3%), the footprint of the roadway (8.3%) and relocation, increased reckless driving (8.3%), the effect the highway will have on business (8.3%), the risk of flooding due to the highway (8.3%) and delays during road construction (16.7%).

On the issue of how the project would affect interviewees, 44.4% of respondents indicated that the project would not affect their life in any way, while 48.2% anticipated a positive impact and 7.4% anticipated a negative impact. Anticipated positives were, increased customers (7.7%), improved roads (38.5%); improved travel time (38.5%) and work opportunity (7.6%), more relaxing commute (7.7%). Regarding negative effects, all respondents expressed that they would be negatively impacted due to a loss or reduction in business.

Regarding respondents' perception about how their commute may be affected, 25.9% of respondents indicated that their commute would not be affected, while 66.7% anticipated an easier commute. 7.4% of respondents from Yallahs anticipated a more difficult commute. Of those anticipating an easier commute 50.0% anticipated more comfortable travel and 27.8% anticipated a shorter travel time. 5.6% respectively anticipated reduced congestion, fewer accidents and less damage to motor vehicles. 5.6% of respondents which expecting an easier commute, did not indicate how their commute would be made easier. Respondents anticipating a more difficult commute stated an increase in accidents (50.0%) and objection to the highway (50.0%).

On the issue of housing and social services, 44.8% of respondents indicated they owned their home, 24.2% rented the home they occupied and 31.0% lived in family owned homes. When asked about the land on which dwellings were located 34.6% of respondents indicated that they owned the land, 7.7% leased, 3.8% squatted, 38.8% indicated their homes were on family owned land and 15.4% stated other.

Approximately eighty-six percent (86.2%) of those interviewed indicated that their homes were of concrete and blocks and 13.8% indicated their homes were wood structures. 82.8% of respondents indicated that their roofs were metal/zinc sheeting while 17.2% stated concrete as the roof type. Both water closets and pit latrines were in the study area, 96.6% of interviewees indicated that their toilet facility was a water closet and 3.4% stated pit latrine.

Approximately ninety-seven percent (96.6%) of respondents stated that they used electricity for household lighting while 3.6% stated that kerosene was used. Approximately eighty-six percent (86.2%) of respondents stated gas as the main fuel for cooking while 13.8% stated coal. Regarding water supply, 89.7% of interviewees stated that their water was public piped water into their dwelling, 6.9% indicated water was supplied by government water trucks and 3.4% stated other.

On the issue of problems with the domestic water supply 72.4% of respondents indicated that they had an issue while 27.3% of Yallahs residents indicated that there was no issue with their domestic water supply. Of those respondents indicating an issue, 4.8% indicated they had no water, while 90.4% indicated irregular water supply and 4.7% indicated low water pressure. Approximately five percent (4.8%) of those having problems collect rain water, 19.0% buy water, 14.3% indicate that the water truck supplies water while 4.8% use the community standpipe, 42.9% of respondents stated other and 14.2% of interviewees did not state how they coped with water problems. Of the respondents indicating that they stored water, 71.5% indicated drums, 19.0% stated aboveground storage tanks and 9.5% of respondents offered no response.

Approximately ninety percent (89.7%) of interviewees stated that there were no issues with flooding. Of the 10.3% stating that there were issues with flooding, 66.7% stated that flooding occurred every time it rained and 33.3% indicated flooding only during times of heavy rains. Regarding how often flood events occurred, 33.3% stated once per year, and 66.7% of respondents did not offer a response. Approximately thirty-three percent (33.3%) respectively indicated that the Yallahs main road and Yallahs Housing Scheme flood, 33.4% did not indicate any specific area affected by flood water. Approximately thirty-three percent (33.3%) indicated that water level was less than one foot and 66.7% stated that water level ranged between one and five feet. 82.8% of respondents indicated that there were no issues with frequent fires in Yallahs.

6.0 IDENTIFICATION AND ASSESSMENT OF POTENTIAL IMPACTS

6.1 IMPACT MATRICES

Impact matrices for construction/ site preparation and operation phases are presented in Table 6-1 and Table 6-2. These list project activities and potential impacts and were rated based on the following criteria[7]:

- **Magnitude of Impact:** This is defined by the severity of each potential impact and indicates whether the impact is irreversible or reversible with the estimated potential rate of recovery. The magnitude of an impact cannot be considered high if a major adverse impact can be mitigated.
- **Extent of Impact:** The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific or limited to the project area; a locally occurring impact within the locality of the proposed project; a regional impact that may extend beyond the local area and a national impact affecting resources on a national scale and sometimes trans-boundary impacts, which might be international.
- **Duration of Impact:** Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered.
- **Significance of the Impact:** This refers to the value or amount of the impact. Once an impact has been predicted, its significance must be evaluated using an appropriate choice of criteria. The most important forms of criterion are:
  - Specific legal requirements e.g. national laws, standards, international agreements and conventions, relevant policies, etc.
  - Public views and complaints
  - Threat to sensitive ecosystems and resources, e.g., can lead to extinction of species and depletion of resources, which can result into conflicts.
  - Geographical extent of the impact, e.g., has trans- boundary implications.
  - Cost of mitigation
  - Duration (time period over which they will occur)
  - Likelihood or probability of occurrence (very likely, unlikely, etc.)
  - Reversibility of impact (natural recovery or aided by human intervention)
  - Number (and characteristics) of people likely to be affected and their locations
  - Cumulative impacts, e.g., adding more impacts to existing ones.
  - Uncertainty in prediction due to lack of accurate data or complex systems. Precautionary principle is advocated in this scenario.

[7] Taken from - Ogola, P. F. A. 2007. Environmental Impact Assessment General Procedures, presented at Short Course II on Surface Exploration for Geothermal Resources, organized by UNU-GTP and KenGen, at Lake Naivasha, Kenya, 2-17 November, 2007

Table 6-1 Environmental impact matrix for site preparation and construction phase

ACTIVITY /IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
1. Physical															
Geotechnical		x		x	x				x			x			x
Excavation works and blasting		x		x	x			x				x		x	
Drainage and Hydrology															
- Drainage along alignment		x		x	x			x				x		x	
- sinkholes and wells		x	x		x			x			x		x		
Water Quality															
- Soil erosion and siltation		x		x	x			x				x		x	
- Raw Material Storage		x		x	x				x			x			x
Dewatering		x		x	x				x			x			x
Piling (noise and vibration)		x		x	x				x			x		x	
Noise		x		x	x			x				x		x	
Air quality		x		x	x			x				x		x	
Soil															
- Contamination		x	x			x		x				x		x	
- Soil erosion and siltation		x		x	x			x				x		x	
2. Biological															
Terrestrial Flora															
- Forested areas (removal)		x	x		x			x	x		x			x	x
- Habitat fragmentation		x	x		x				x			x		x	
- Soil erosion and siltation		x		x	x			x				x		x	
- Human and Invasive Species		x		x	x				x			x		x	
- Growth and Health		x		x					x			x		x	
- Human Encroachment and Urban Sprawl		x		x	x			x				x		x	
Terrestrial Fauna															
- Fauna (degradation and removal of habitats)		x	x		x	x			x			x			x
- Fragmentation		x	x		x				x			x		x	
- Noise		x		x	x				x			x			x
3. Human and Social															
Traffic flow and Transportation		x		x	x			x				x			x
Raw Material spillage		x		x	x			x				x		x	
Traffic congestion, road wear		x		x	x			x				x			x
Dusting		x		x	x			x				x		x	
Increased Suspended solid runoff		x		x		x			x			x			x
Refuelling, storage and maintenance of vehicles and heavy equipment		x		x	x			x				x		x	
Land Use – Agricultural Land		x	x		x				x			x			x
Solid waste management		x		x	x				x			x			x
Sewage/wastewater generation		x		x	x				x			x			x
Water Demand and Supply		x		x	x				x		x				x
Health and safety															
- Occupational Health and Safety		x		x	x			x				x		x	
- Air Quality		x		x	x			x				x		x	
- Emergency Response		x		x	x			x				x	x		
Employment	x			x	x		x				x		x		
Health and Safety (Increased accident potential)		x		x	x			x				x		x	
Commercial activity															
Potential increases	x			x	x			x			x			x	
Potential reduction		x		x	x			x			x			x	

ACTIVITY /IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
Recreational Facilities		x	x		x				x			x			x
Land Use															
- Agricultural Lands		x		x		x			x			x			x
Affected Structures		x	x		x		x				x			x	
Historic sites/artefacts		x	x		x				x			x	x		

Table 6-2 Environmental impact matrix for operation phase

ACTIVITY/ IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE			EXTENT			SIGNIFICANCE		
	Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
1. Physical															
Water and Drainage															
- Drainage	x		x		x			x				x	x		
- Water resources (sinkholes and wells)		x	x		x			x			x		x		
Climate Change															
- Storm Surge and Sea Level Rise		x	x			x	x					x	x		
Air Quality															
- Increased pollutants in air shed		x	x			x		x				x			x
Noise															
- Increased noise pollution		x	x		x				x			x			x
Natural Hazards															
- Hurricane		x	x		x			x		x			x		
- Earthquake		x	x		x			x		x			x		
- Flooding		x	x		x			x		x				x	
2. Human/Social															
Transportation and Traffic															
- Improved road access and reliability and reduced travel time	x		x		x		x			x			x		
Housing	x		x			x		x		x				x	
Commercial Activity and Tourism	x		x			x		x		x			x		
Emergency Response															
- Potential for accidents		x	x			x	x				x			x	
- Emergency Access	x		x		x			x			x			x	
Aesthetics and Landscaping	x		x		x			x				x		x	

6.2 SITE CLEARANCE/ CONSTRUCTION

6.2.1 Physical

6.2.1.1 Geotechnical Considerations

Alluvium (Qa) is the main geological formation found at borehole locations along Section 1A. Typical alluvial deposits encountered at the borings were composed of silty to sandy clays with a significant portion of gravel and cobbles. The sand and gravel deposits encountered were generally very compact with high relative densities and a component of plastic fines. These materials have low susceptibility to liquefaction under seismic loading. These deposits have high scour potential.

6.2.1.2 Excavation Works and Blasting

Excavation works will entail digging, loading and removal of material by trucks. This exercise has the potential to create a dust nuisance.

Blasting is expected to be concentrated in the mountainous areas. The main concerns are:

- Fragments of rocks will be propelled into the air by explosions. These rocks create hazards if and when they are propelled into nearby settlements causing harm or even death. Fumes, both toxic and non-toxic, are released into the atmosphere as a result of using explosives for blasting. Settlements may be affected by dust and fumes within 100 metres. Deposited dust may give rise to complaints from locals as cars, windows or any surface expected to remain free from dust may have noticeable deposition.
- A second concern is vibrations caused by blasting will impact on structures within close proximity to the blast sites.

6.2.1.3 Drainage and Hydrology

Drainage along Alignment

Section 3.3.2.2 details the possible drainage impacts along the proposed highway. In summary, flooding along the corridor is a potential impact at the following locations:

- Harbour View (100+100 - 300+400)
- Bull Bay Football Club Playfield (103+500 - 103+700)
- Wickie Wackie (104+080 - 104+400)
- Grants Pen to Albion (114+000 - 115+300)

Flooding, along with ponding along the corridor at Pond Side Corner (104+800) is also likely, whilst flooding and debris flow at the following locations is possible:

- The Cane River Bridge (102+800)
- Chalky River Bridge (106+050)

- Bull Bay River Bridge (107+000)

Finally, concentrated storm runoff, erosion, sediment migration from construction site and sediment transport during storm events are potential impacts at two locations along Section 1A:

- Bull Bay to 12 Mile – New Alignment (106+700 - 109+500)
- Twelve Mile to Grants Pen (109+500 - 113+200)

Sinkholes and Wells

Water resources include sinkholes and wells. Sinkholes are natural holes in the ground caused by the erosion of water, usually occurring in regions of limestone formation, which facilitates in the recharging of aquifers through which surface runoff. Throughout the length of the proposed alignment, the topography includes various depressions in which sinkholes may occur. The construction of the South Coast Highway has the potential to destroy, cover-up, or block these water resources affecting drainage and water supply.

Soil Erosion and Siltation

The potential for land slippage is greatly increased as a result of vegetation removal. A plant's roots act as a mesh within the substrate increasing its cohesiveness and improving drainage. Areas where bare ground is exposed tend to erode faster than areas inhabited by plants as they help percolate rainwater into the substrate below and into underground aquifers. The substrate of the elevated areas comprising mainly of limestone rock, readily succumbs to weathering over time by rainfall and flowing water.

6.2.1.4 Storage of Raw Material and Equipment

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

6.2.1.5 Dewatering

Groundwater may be encountered during construction of the highway base and drainage structures. To enable working in these areas dewatering of the base will have to be carried out.

6.2.1.6 Piling

Inserting the piles with a pile driver will result in repeated clanging sounds which may be audible and a nuisance to surrounding businesses and communities. Pile driving also creates vibrations which may damage property.

6.2.1.7 Noise

Site clearance for the proposed highway project necessitates the use of heavy equipment to carry out the job, including bulldozers, backhoes, jackhammers, etc. Additionally, there is a possibility that blasting may be carried out. These activities and required equipment possess the potential to have a direct negative impact on the noise climate.

Construction noise on a highway project can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently. To gain a general insight into potential construction noise impacts that may result from the project, the typical noise levels associated with various types of construction equipment are identified in Table 6-3. The noisiest periods of highway construction are typically the ground clearing and earthwork phases.

Table 6-3 Typical construction equipment noise levels

Type of Equipment	Typical Sound Level at 50 ft. (dBA Leq.)
Dump Truck	88
Portable Air Compressor	81
Concrete Mixer (Truck)	85
Jackhammer	88
Scraper	88
Bulldozer	87
Paver	89
Generator	76
Piledriver	101
Rock Drill	98
Pump	76
Pneumatic Tools	85
Backhoe	85

Adapted from - Route 101A Widening and Improvements, City of Nashua Hillsborough County, New Hampshire; McFarland-Johnson, Inc. May 30, 2007

6.2.1.8 Air Quality

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

6.2.1.9 Soil

Contamination

Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils, etc. and thereby have the potential to contaminate the soil.

Soil Erosion and Siltation

The potential for land slippage is greatly increased as a result of vegetation removal. A plant's roots act as a mesh within the substrate increasing its cohesiveness and improving drainage. Areas where bare ground is exposed tend to erode faster than areas inhabited by plants as they help percolate rainwater into the substrate below and into underground aquifers. The substrate of the elevated areas comprising mainly of limestone rock, readily succumbs to weathering over time by rainfall and flowing water. Therefore, there could also be a resulting shift in the level of the water table as a result of plant removal.

6.2.2 Biological

6.2.2.1 Terrestrial Flora

The direct environmental impact from a highway development is linear and extends along its length. This is realised mainly during the preparation and construction phases of most highway projects where the existing vegetation is typically removed to accommodate the rights-of-way for the roadway. Therefore, the loss of biomass and species (invasive, local or endemic) are likely.

Habitat Fragmentation

Habitat fragmentation is the process whereby a large, continuous area of habitat is both reduced in area and divided into two or more fragments by roads, fields, towns and many other human constructs (Primack, 2006). These fragments are often isolated from each other by a highly modified or degraded landscape and their edges experience an altered set of microclimate conditions called “edge-effect”. Edge effect refers to the variation in the observed microenvironment at the fragment edge. Differences in microclimate factors such as light, temperature, wind and humidity may each significantly impact species composition and vigour within the fragment.

Fragmentation normally occurs during circumstances of severe habitat loss where (for example) large areas of natural vegetation may be cleared for agricultural or residential developments. However, it may also occur when the area of disturbance is reduced to a minor degree: such as roadway developments similar to this project. Comparatively, the clearance needed for a roadway is much less than that needed for agriculture; nonetheless, the thoroughfare may induce the following habitat destructive issues:

- Roadways may act as physical barriers to the passive movement of spores and seeds across a landscape.
- Highways may also restrict the movement of animal species that often act as pollen and seed vectors for many plants
- Roadways help to divide once continuous populations into smaller, more isolated, contiguous populations due to restrictions on the movement of spores and seeds. This may precipitate further population decline due to inbreeding depression, genetic drift and other issues common to small population size.
- Fragments may also experience the increased incidence of fire due primarily to the increased penetration of wind, reduced humidity, higher temperatures and the accumulation of drying wood from dying or dead trees expected at fragment-edges (Primack, 2006). Commuters along highways may also dispose of flammable debris along the corridor, further contributing to this risk.

Fragmentation may also lead to increased vulnerability of the fragment to invasion by exotic and native pest species as well as diseases.

Accidental or Intentional Removal of Important Plant Species

Over 50 plant species were encountered, including four endemic species (and one species of national importance). Therefore, although disturbed, the areas surveyed are considered species rich with an indigenous component – important to the local environment and the natural history of the country.

Increased Soil/Substrate Erosion

The potential for land slippage is greatly increased as a result of vegetation removal. This is especially so for the hillside communities. A plant's roots act as a mesh within the substrate increasing its cohesiveness and improving drainage. Areas where bare ground is exposed tend to erode faster than areas inhabited by plants as they help percolate rainwater into the substrate below and into underground aquifers. The substrate of the elevated areas was comprised mainly of limestone rock, which readily succumbs to weathering over time by rainfall and flowing water. Therefore, there could also be a resulting shift in the level of the water table as a result of plant removal.

Increased Human and Invasive Species Access

As in any development, the clearing of natural vegetation allows the intrusion of invasive plant and animal species into the development site and more importantly into the surrounded protected area.

Plant Growth and Health

Plant growth and health can be significantly affected by dust, grime and toxic emissions. Leaching from storage areas can disturb the pH balance in the soil and result in plant loss.

Human Encroachment, Urban Sprawl and Control of Invasive Species

The study site, although disturbed, is species rich and possesses a relatively high tree density in the highland areas. Therefore, minimising the impact on the flora during the construction phase of the development is important. This impact may continue also into the operation phase of the project. Furthermore, as in any land modification project, the clearing of natural vegetation allows the intrusion of invasive plant and animal species into the development site and more importantly into the surrounded protected area.

6.2.2.2 Terrestrial Fauna

Fragmentation of the Ecosystem

Fragmentation will affect some wildlife species which have to negotiate, tolerate or cope with the natural barriers (Southerland, 1994). In this project the wildlife which could be affected include reptiles (snakes, lizards), amphibians, mammal and invertebrates (land snails and insects). The following are potential effects related to fragmentation:

- Erode genetic diversity and increase inbreeding.
- Loss of interior or area-sensitive species.

- Increase abundance of weed species.
- Increase mortality of animals who try to cross the highway.

Degradation of Natural Habitat

The following are potential fauna impacts related to the degradation of natural habitats:

- Excessive vegetation removal for the construction of the road.
- Natural characteristics of the land are eliminated within the paved area and adjacent roadsides.
- The replacement of forest trees with grasses and shrubs have negative impacts on forest specialist species.
- Reducing the habitat for forest specialist species including eliminating nesting.
- Introduction of exotic species as a result of the construction of the highway.
- Create habitat for non-forest specialist species. For example, roadway with the grass or shrub vegetation provide habitat for these species.
- The highway including service roads used in the construction have created easy access to pristine areas which will lead to habitat degradation.
- Cumulative impacts where the highway development is provided as a stimulus to secondary development and ultimately local economic enhancement. This will cause an indirect loss of the natural habitat.

Noise

Noise from the construction of the road has the potential to scare away birds. Birds and other wildlife that communicate by auditory signals may be at a disadvantage near roads. However, there are no studies definitively identifying traffic noise as the critical variable affecting birds with regard to stress and physiological effects near roadways and highways (Robert and Arthur, 2007).

Locational Impacts

Specific to each location studied:

- Ocean Lake: The present road, and the proposed alignment runs along the foot of the hill at the edge of the pond. The new road will result in negligible reduction in the size of the lake. There is a potential problem of increase sedimentation from the construction process as well as modified rain water runoff. The pond is presently subjected to tremendous human influence; while the species observed have been able to tolerate this to date, small changes might push environmental conditions beyond the critical point.
- Seven Mile Bull Bay Dry Forest: No species needing special conservation status was recorded. However, the fauna observed was typical of dry limestone forest.
- Grants Pen Wetland: While the road will occupy only a negligible portion of the wetland, attention must be made to minimise modification of rain water runoff and general water circulation. Crocodiles are present in the area and potential impacts; such as harm particularly during road crossings will likely continue.

6.2.3 Human/ Social

6.2.3.1 Traffic Flow and Transportation

Any works along the main road will have some impact on the commuting traffic and adjoining communities since there is no alternate route. Between Bull Bay and Yallahs, daily volumes are moderate and can therefore accommodate some amount of disruptions before the level-of service drops below an acceptable level with the exception of the segment between Harbour View and Bull Bay where traffic volumes are the heaviest.

Specific potential impacts as a result of site preparation and construction activities include:

- Reduced lane capacity or side friction along the main road will impact on traffic flow in the localized areas that works are taking place, and can cause backlogs in traffic in adjoining communities and areas.
- Complete road closures may be necessary for bridge and culvert works.
- Detour routes may add travel time and costs. The significant truck traffic in particular can create additional impacts for commuters on detours since trucks require wider swept paths, move slower on gradients and increase side friction on narrow detours.
- Project traffic and delivery of materials may cause delays to commuting traffic.
- Detour routes may cut through small communities and subdivisions.
- Weight of heavy vehicles, both for the project and external industrial activity can contribute to the deterioration of the existing roads. Local detour routes can be especially susceptible to rapid deterioration by an increase in truck traffic.
- Construction activities, particularly detours can affect public transport. The Jamaica Urban Transport Company (JUTC) operates bus routes from Kingston to the community of Eleven Miles, while various taxis and small public transport sub-franchises provide coverage of this route and extended routes.
- Increased traffic associated with accommodations for construction workers.
- Increased risk of accidents or damage to vehicles caused by objects falling from construction vehicles.
- Roads and access points along the corridor will be directly impacted by the construction.

6.2.3.2 Transportation of Raw Material and Equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along local roads and result in road wear and tear. There is also the potential for spillage onto the roadway which may in turn cause accidents and increased dusting of ambient environment. Ground and surface water quality may be prone to increased suspended solids from run-off from road construction activities.

6.2.3.3 Refuelling, Storage and Maintenance of Equipment

Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils, etc. and thereby have the potential to contaminate the soil as well as groundwater quality.

6.2.3.4 Land Use and Acquisition

Communities and Land Parcels

Bull Bay/ Seven Mile, Harbour View, Eleven Miles and Albion adjoin the proposed road works. Within these communities, a minimum of 632 land parcels and 893,802.41 sq. m (220.9 acres) of land are located within the ROW and are therefore likely to be impacted. Housing schemes within the right-of-way (ROW) total 43, in addition to the proposed Dundas Development located on the border of St Thomas to Grants Pen and comprising 1,000 lots.

Community Fragmentation

Along the alignment, there exist a number of access points including road intersections, vehicular accesses and pedestrian accesses. The alignments currently go through communities on the existing road and new alignments are primarily routed around communities. Nonetheless, the proposed alignment has the potential to negatively impact movement across the corridor owing to increased road width and travel speed.

6.2.3.5 Construction Crew

Solid Waste Generation

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

i. From the construction campsite.
ii. From construction activities such as site clearance and excavation.

Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with showers and sanitary conveniences. The disposal of the wastewater generated at the construction campsite has the potential to have a minor negative impact on groundwater.

Water Demand and Supply

Construction activities will require additional water resources. Suitable sources will be determined based on demand and location.

Health and Safety

OCCUPATIONAL HEALTH AND SAFETY

Construction of the highway and its infrastructure may entail workers being suspended in the process. This has the potential for increase construction accidents. Additionally, there may be some blasting in preparing the site for the construction along sections of the highway segments.

AIR QUALITY

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

EMERGENCY RESPONSE

Construction of the proposed highway has the potential for accidental injury. There may be either minor or major accidents.

6.2.3.6 Employment

Potential job opportunities will directly arise from site clearance/ construction phases. The proposed project is expected to employ 350 workers during this phase.

In addition to this potential direct employment, based on data from the U.S. Department of Transportation and the Federal Highway Administration there are approximately 2.5 indirect jobs and 1.8 induced jobs created for every direct job created. The project will therefore generate a total of 875 indirect jobs and 630 induced jobs. Indirect jobs are those held by workers in industries that supply highway construction manufacturers with materials and by offsite construction industry workers such as administrative, clerical, and managerial workers. Supplying industry jobs include those supported in stone and clay mining and quarrying, petroleum refining, lumber, steel, concrete, and cement products, as well as in miscellaneous professional services. Induced jobs are jobs supported throughout the economy when highway construction industry employees spend their wages. Expenditures by these workers on various goods and services stimulate demand for additional employees in these industries, resulting in jobs being supported throughout the general economy.

6.2.3.7 Workers Safety

Construction of the highway and its infrastructure may entail:

- Workers being suspended above ground in the process.
- Blasting for site preparation.
- Trenching for site preparation and to install pipes and drains.

These activities increase accident potential to workers.

6.2.3.8 Commercial Activity

There is the potential for an increase as well as a decrease in commercial activity in the project area. A potential increase in commercial activity would be represented in the form of increased sales from food and beverages to construction crew while a potential decrease would be represented in the form of decreased access by the public to certain areas due to construction activities.

6.2.3.9 Recreational Facilities

The Bull Bay Football field will be directly impacted by proposed alignment and will therefore most likely have to be relocated elsewhere. This will result in temporary loss of recreational activities occurring on this field.

6.2.3.10 Land Use

Agricultural Land

The proposed highway section does not traverse any major agricultural lands, however smaller subsistence farming activities as identified during the Impacted Structure Survey.

Protected Areas

The proposed highway section does not traverse any protected areas (Palisadoes Port Royal Protected Area (P-PRPA) or the proposed Yallahs Salt Ponds protected area).

6.2.3.11 Affected Structures

It is estimated that 391 structures will be impacted by the proposed project, including houses (55.8%), shops and stalls (26.9%), bus stops (5.6%) and other types including garages, stalls and notably a garden (11.8%).

6.2.3.12 Cultural/ Historic Sites

A total of 11 sites along Section 1A were identified by JNHT to be of historical and cultural significance. The impact footprint of road works may encompass these sites and hence there are possible foreseen direct impacts.

6.3 OPERATION

6.3.1 Physical

6.3.1.1 Water and Drainage

All of the proposed highway is along the existing roadway except for the 2.8km of new alignment between Bull Bay and Twelve Mile. The drainage impact of the proposed highway along the existing roadway is negligible given that the proposed highway is mostly improving the existing roadway. A pre- and post-development analysis of the runoff for the proposed improvements along the existing roadway is therefore not necessary. Rather, emphasis has been placed on identifying the areas that have inadequate drainage and are vulnerable to flooding (Section 4.1.4.2) and develop solutions for these areas as part of the project.

For the 2.8km of new alignment, a pre- and post-development runoff analysis is also not necessary as all the runoff generated by the highway will flow in side channels along the highway to the Bull Bay River to the west at 107+000 and to an existing culvert with increased capacity to the east at 109+860. This is because the alignment passes through mostly cut areas preventing very little opportunity for cross drains along this section of the highway. More details are presented in Section 3.3.2.2.

6.3.1.2 Sinkholes and Wells

Impacts of the highway alignments implementation may include:

- Possible sinkholes within close proximity to the alignments may become plugged. This will result in the recharge area for the aquifers to decrease in size, affecting the productivity of any wells located nearby.
- Recharge paths for surface run-off may be traversed by the alignment, decreasing the volume of run-off reaching the sinkholes.
- Surface run-off may become contaminated due to fuel/oil/chemical spills.

6.3.1.3 Climate Change

The climate change impacts identified within the context of the highway segments include increase runoffs as a result of increased storm intensity and frequency. The IPCC AR5 notes that evidence suggests a certain increase in the frequency and intensity of the strongest hurricanes in the Atlantic since the 1970s. The AR4 concluded that a range of modelling studies project a likely increase in peak wind intensity and near storm precipitation in future tropical hurricanes. Simulations consistently found that greenhouse warming causes tropical hurricane intensity to shift towards stronger storms by the end of the 21st century (2 to 11% increase in mean maximum wind globally).

Storm surge and sea level rise may also affect sections of the proposed alignments (Caribbean Terrace in Harbour View). In Jamaica, and the surrounding region, the sea level rise is approximately the global average (IPCC 2013) of 3.2 mm/yr. (± 0.4). Projected increases in global and Caribbean mean sea level by 2100 relative to the 1980-1999 is 0.37m (IPCC 2007) (± 0.5 m relative to global mean) and this is equivalent to 3.7 mm/yr. It is proposed that road profiles be raised in most areas to account for storm surge and sea level rise.

6.3.1.4 Air Quality

The potential for vehicular emissions from this project negatively affecting air quality to an extent where human respiratory health may also be negatively impacted, is low.

It should be noted that vehicular emissions are highest at the time of vehicle start up in the morning (cold start). This is due to the fact that the first few minutes of driving generate higher emissions because the emissions-control equipment has not yet reached its optimal operating temperature (U.S. Environmental Protection Agency). Also, emission rates are higher during stop-and-go, congested traffic conditions than free flow conditions operating at the same average speed.

6.3.1.5 Noise Pollution

Noise Modelling

SoundPlan 7.4 was used to conduct the noise modelling for this study. Within SoundPlan, the Road Traffic Noise Model – FHWA; 2004 (TNM 2.5) was used to conduct the predictions. The first step was to select the standards that were going to be used to run the model. Within the standard, temperature was set at 28.6 °C, the relative humidity at 80 % and air pressure 1013.3 mbar.

MODEL CALIBRATION

The noise model was calibrated for Section 1A of Segment 1. Calibration was done using the following assumptions. The traffic and traffic composition was assumed to be the 2013 traffic count and an average speed of 50 km h^{-1}. The results were then compared to the measured data at the locations. A difference of 3 dBA was considered adequate to accept the model as being accurate (calibrated).

The noise station used for Section 1A was Station N2. This station was close to the existing roadway. The results indicated good agreement; therefore, the model can be accepted as calibrated (Table 6-4).

MODELLED DATA

The traffic data used in the model for Section 1A are listed in to Table 6-6. The tables outlined the location of measurements, the Annual Average Daily Traffic (AADT), traffic direction, the traffic composition, percentage of anticipated day and night traffic and the speed limits for each section.

Table 6-4 Noise model calibration results for Section 1A of Segment 1 using 2013 traffic data and average speed limit of 50 km h^{-1}

STATION	MEASURED (dBA)			PREDICTED (dBA)			DIFFERENCE (dBA)		
	72 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	72 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	48 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
N2	70.6	70.2	64.3	67.7	69.4	61.6	-2.9	-0.8	-2.7

Table 6-5 2013 traffic data for Section 1A of Segment 1

Parish	Location	Chainage***		Roadway Type	2013	EAST BOUND	WEST BOUND	% EAST BOUND			% WEST BOUND			EAST BOUND - DAY TIME (90% OF TRAFFIC)	EAST BOUND - NIGHT TIME (10% OF TRAFFIC)	WEST BOUND - DAY TIME (90% OF TRAFFIC)	WEST BOUND - NIGHT TIME (10% OF TRAFFIC)	SPEED LIMIT (KM/H)
		Begin	End		AADT			CARS	MEDIUM TRUCKS	HEAVY TRUCKS	CARS	MEDIUM TRUCKS	HEAVY TRUCKS					
St. Andrew	Harbour View Roundabout to Bull Bay	100+000	105+863	Urban	13100	6550	6550	84.7	13.5	1.8	90.2	9.1	0.7	5895	655	5895	655	65
	Bull Bay to Eleven Mile***	105+863	109+694	Rural Developed	7000	3500	3500	88.8	9.5	1.7	89.2	10	0.8	3150	350	3150	350	95
	Eleven Mile to Grants Pen	109+694	113+500	Rural Undeveloped	7000	3500	3500	84.9	13.1	2	84.9	13.1	2	3150	350	3150	350	65
	Grants Pen to Albion	113+500	115+988	Rural Undeveloped	5500	2750	2750	84.9	13.1	2	84.9	13.1	2	2475	275	2475	275	65
	Albion to Poor Man's Corner	115+988	117+919	Rural Developed	8000	4000	4000	91.8	7.5	0.6	91	8.1	0.9	3600	400	3600	400	65
	Poor Man's Corner to Yallahs	117+919	119+961	Rural Developed	8200	4100	4100	91.8	7.6	0.6	90.2	9.1	0.6	3690	410	3690	410	65

Table 6-6 2035 traffic data for Section 1A of Segment 1

Parish	Location	Chainage***		Roadway Type	2035	EAST BOUND	WEST BOUND	% EAST BOUND			% WEST BOUND			EAST BOUND - DAY TIME (90% OF TRAFFIC)	EAST BOUND - NIGHT TIME (10% OF TRAFFIC)	WEST BOUND - DAY TIME (90% OF TRAFFIC)	WEST BOUND - NIGHT TIME (10% OF TRAFFIC)	SPEED LIMIT (KM/H)
		Begin	End		AADT			CARS	MEDIUM TRUCKS	HEAVY TRUCKS	CARS	MEDIUM TRUCKS	HEAVY TRUCKS					
St. Andrew	Harbour View Roundabout to Bull Bay	100+000	105+863	Urban	18400	9200	9200	84.7	13.5	1.8	90.2	9.1	0.7	8280	920	8280	920	65
	Bull Bay to Eleven Mile***	105+863	109+694	Rural Developed	9900	4950	4950	88.8	9.5	1.7	89.2	10	0.8	4455	495	4455	495	95
	Eleven Mile to Grants Pen	109+694	113+500	Rural Undevelope	9900	4950	4950	84.9	13.1	2	84.9	13.1	2	4455	495	4455	495	65
	Grants Pen to Albion	113+500	115+988	Rural Undevelope	11400	5700	5700	84.9	13.1	2	84.9	13.1	2	5130	570	5130	570	65
	Albion to Poor Man's Corner	115+988	117+919	Rural Developed	11400	5700	5700	91.8	7.5	0.6	91	8.1	0.9	5130	570	5130	570	65
	Poor Man's Corner to Yallahs	117+919	119+961	Rural Developed	11600	5800	5800	91.8	7.6	0.6	90.2	9.1	0.6	5220	580	5220	580	65

MODELLED NOISE RESULTS

Results from the model have indicated that for Section 1A, Stations N2, N3 and N4 in 2013 had noise levels non-compliant with the NEPA standard for both day and night time from traffic operating along the proposed highway. For 2035, the same stations were non-compliant for day and night times, with the addition of Stations N5 day time (Table 6-7 and Table 6-8 and Figure 6-1 and Figure 6-2).

Table 6-7 Predicted noise levels for Section 1A of Segment 1 for 2013

STATION	PREDICTED (dBA)			NEPA STANDARD (dBA)	
	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	Day	Night
N1	33.4	34.9	27.6	45	40
N2	71.1	72.7	65.4	65	60
N3	69.8	71.3	64.0	55	50
N4	64.5	66.1	58.8	55	50
N5	53.1	54.7	47.4	55	50
N6	57.7	59.3	52.0	65	60

NB: Values highlighted in red are non-compliant with the NEPA Standard

Table 6-8 Predicted noise levels for Section 1A of Segment 1 for 2035

STATION	PREDICTED (dBA)			NEPA STANDARD (dBA)	
	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	Day	Night
N1	34.7	36.3	28.9	45	40
N2	72.4	74.0	66.6	65	60
N3	71.1	72.7	65.3	55	50
N4	65.3	66.9	59.6	55	50
N5	54.2	55.8	48.4	55	50
N6	59.3	60.9	53.5	65	60

NB: Values highlighted in red are non-compliant with the NEPA Standard

It should be noted that Stations N2 and N3 are within the eastbound lanes of the Proposed Highway and as a result would have elevated noise levels when modelled.

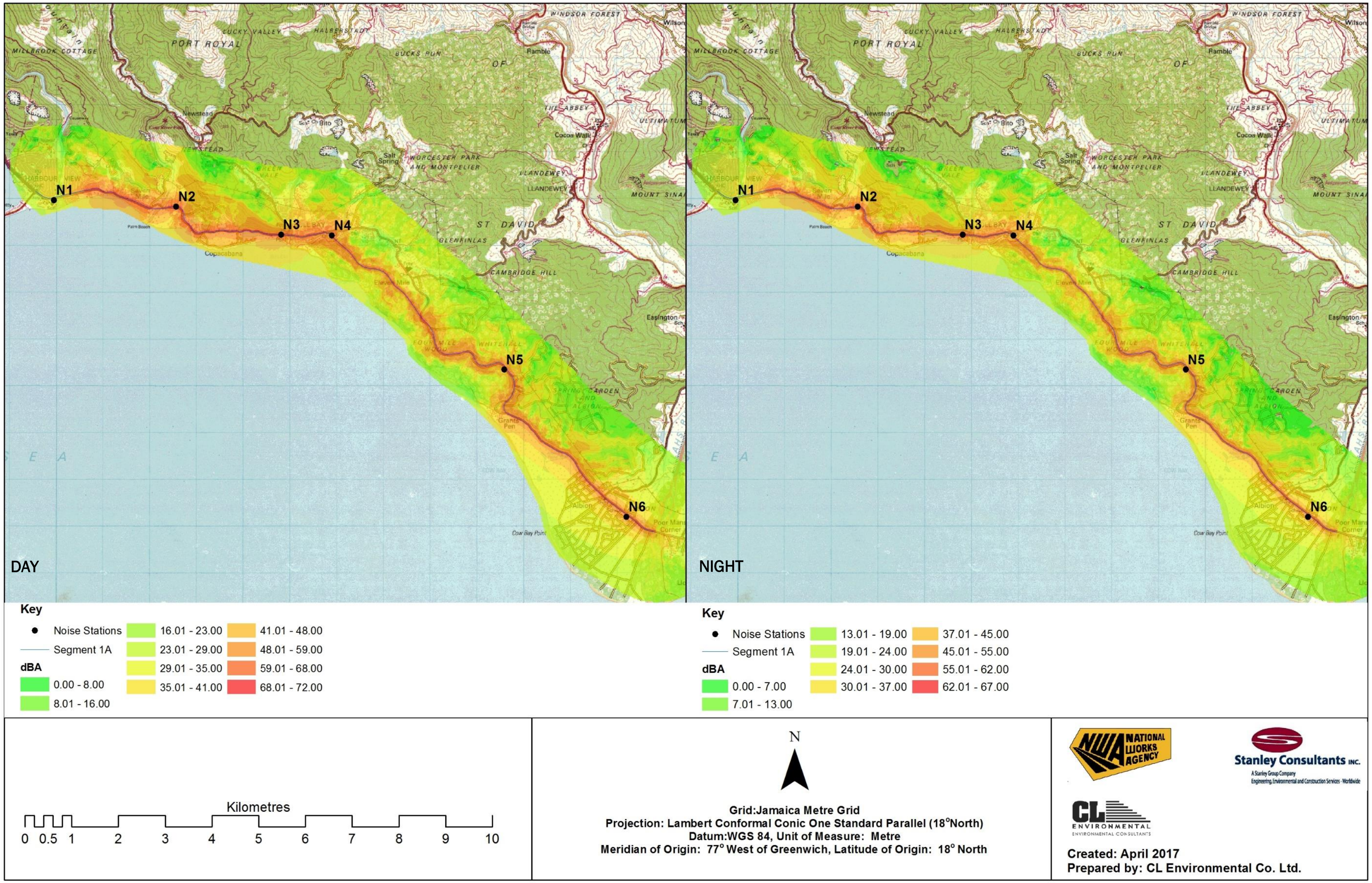


Figure 6-1 Section 1A of Segment 1 - 2013 day and night time noise levels

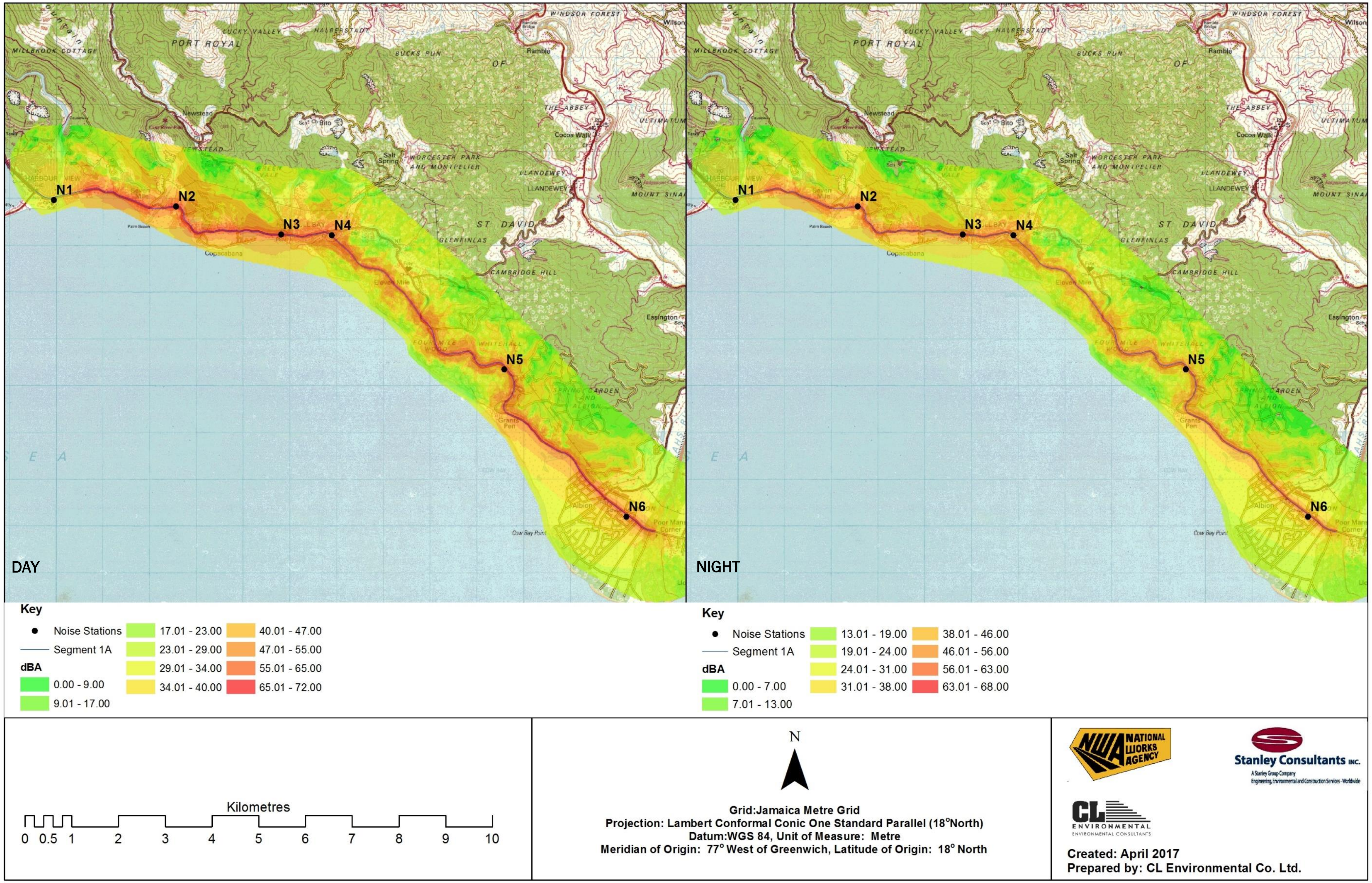


Figure 6-2 Section 1A of Segment 1 2035 day and night time noise levels

SENSITIVE RECEPTORS

A total of 6 sensitive receptors along Section 1A of Segment 1 were assessed for noise impact from the proposed alignment. The sensitive receptors investigated were schools and health centres and hospitals. There were however no hospitals within Section 1A of Segment 1.

Schools

Four (4) schools were assessed in Section 1A of Segment 1. The results indicated that only St Benedict's Primary School would have noise levels from the traffic (2013 and 2035) using the highway above the NEPA day time noise standard (Table 6-9). The day time standard was used as it is not anticipated that schools will be opened for teaching at nights.

Table 6-9 Noise levels (day time) for schools assessed in Section 1A of Segment 1 for 2013 and 2035 traffic

RECEIVERS	NOISE LEVELS – 2013 (dBA)	NOISE LEVELS – 2035 (dBA)	NEPA DAY TIME STANDARD (dBA)
Bull Bay All Age	40.6	41.3	45
Donald Quarrie All Age	31.0	32.1	45
Harbour View Primary School	27.9	29.0	45
St. Benedict's Primary School	57.8	59.0	45

NB: Values highlighted in red are non-compliant with the NEPA Standard

Health Centres and Hospitals

A total of 2 health centres and no hospitals were assessed for noise impact from the traffic along the proposed Section 1A of Segment 1 highway using the 2013 and 2035 traffic. During the days, the Bull Bay health centre and has noise levels non-compliant with the NEPA day time standard for both the 2013 and 2035 traffic (Table 6-10). During nights, the Bull Bay Health Centre (2013 and 2035) had noise levels exceeding the NEPA night time noise standard (Table 6-11).

Table 6-10 Noise levels (day time) at health centres and hospitals assessed in Section 1A of Segment 1 for 2013 and 2035 traffic

RECEIVERS	NOISE LEVELS – 2013 (dBA)	NOISE LEVELS – 2035 (dBA)	NEPA DAY TIME STANDARD (dBA)
Bull Bay Health Centre	59.4	60.4	55
Harbour View Health Centre	25.9	27.1	55

NB: Values highlighted in red are non-compliant with the NEPA Standard

Table 6-11 Noise levels (night time) at health centres and hospitals assessed in Section 1A of Segment 1 for 2013 and 2035 traffic

RECEIVERS	NOISE LEVELS – 2013 (dBA)	NOISE LEVELS – 2035 (dBA)	NEPA NIGHT TIME STANDARD (dBA)
Bull Bay Health Centre	52.0	53.0	50
Harbour View Health Centre	18.6	19.8	50

NB: Values highlighted in red are non-compliant with the NEPA Standard

6.3.1.6 Natural Hazards

Natural hazards such as flooding, hurricane and earthquake have the potential to impact negatively on the structural integrity of the highway and its furniture.

Earthquakes

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

Segment 1 of the South Coast Highway project lies within the zone where the probability of exceedance of accelerations between 245 and 295 gals in a fifty-year period is 10%.

Hurricanes

The project is potentially affected by hurricanes, which typically occur during the hurricane season (June to November). Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation at the proposed location. It has also been widely suggested that the Atlantic-Caribbean region is moving, and has already started to move, into a cycle of wetter and more severe tropical disturbances (IPCC, 2001).

Landslides

Twenty landslides were identified within the study area, with three located across the proposed Section 1A alignment. Those crossing the alignment are described as inactive or probable scarps.

Flooding

Areas in proximity to the alignment currently experience flooding. The 100 year return period floodplain of the Yallahs River is known to affect Poor Man's Corner and Albion. Flooding has also occurred in the Bull Bay 10 Miles area and has the potential of affecting approximately 79m of the proposed alignment.

6.3.2 Human/ Social

6.3.2.1 Transportation and Traffic

Upon completion, the improved road will likely cause an increase in vehicular speeds. The increase in speeds will decrease the travel time, increase capacity and increase efficiency of the road network, however it may also result in an increase in traffic crashes.

The operations at roads and access points along the corridor may be permanently altered after construction. With the implementation of a 4-lane divided roadway, some full access intersections and driveways may become left-in, left-out operations. The four-lane divided cross-section impacts pedestrian access and movements. Crossing a four-lane divided highway takes more time and is inherently more dangerous for pedestrians.

Overall, on completion, the numerous potential positive impacts of the proposed highway to transportation include:

- Reduction in congestion during peaks hours
- Improved access
- Increased capacity especially during rain events where the existing road is prone to severe flooding
- Increase in reliability of the road network
- More predictable travel times
- Reduced vehicle operating costs
- Reduced travel time
- Improved pedestrian facilities

6.3.2.2 Housing

The proposed highway alignments have the potential to open up new areas for residential development. The resultant improved roadway and reduced travel times will make areas attractive to persons who do not want to live in major towns (for example Kingston, Mandeville) but instead prefer to commute to work or do business.

6.3.2.3 Commercial Activity and Tourism

With the improvement to the road network and reduced travel time by the proposed highway, there will be a potential increase in commercial activities. Upgraded transportation infrastructure can improve access of both commercial and residential populations, and ease delivery and receipt of goods and raw materials. Likewise, ease of travel may also encourage residents and visitors to visit tourist attractions.

6.3.2.4 Emergency Response and Accident Potential

Potential Hazards

There is a potential for the highway to be impacted by natural or man-made disasters such as earthquakes, floods, fires and accidents. Other miscellaneous hazards that may result in potential accidents include; stray animals, dead animals, fallen tree limbs, accumulation of dirt, gravel or other granular materials, oil spills, pavement/surface defects (potholes, deformations, edge drops), missing or damaged safety barrier/guard rail/fencing at a critical location and abandoned/damaged vehicles.

Emergency Access Points

Medians will be constructed at the following chainages; 101+289 to 106+877, 115+436 to 115+705 and 106+877 to 115+436 which will prevent crossing from one side of the road to the other. As a result, provisions need to be made for emergency access points for vehicles using the highway.

6.3.2.5 Aesthetics and Landscaping

Grass planting will be conducted over a total of 251,405.00 m^2 upon project completion. Section 10.2.5 outlines a proposed Restoration and Rehabilitation Plan.

6.4 CUMULATIVE IMPACTS

6.4.1 Air Quality

It is expected that vehicular traffic along the proposed new alignments will increase the level of particulate, NO_x and SO_2. However, the impact is expected to be minor.

It is also important to note that emissions are highest at the time of vehicle start up in the morning (cold start). This is due to the fact that the first few minutes of driving generate higher emissions because the emissions-control equipment has not yet reached its optimal operating temperature (U.S. Environmental Protection Agency). This effect would be largely reduced in rural areas where there is a low concentration of local traffic. Also, emission rates are higher during stop-and-go, congested traffic conditions than free flow conditions operating at the same average speed.

Given the above explanations, the potential for vehicular emissions from this project negatively affecting air quality to an extent where human respiratory health may also be negatively impacted is low.

6.4.2 Storm Water Runoff

The effect of off-site drainage, which is that drainage generated by runoff outside the footprint of the roadway, was modelled by Stanley Consultants Inc. The existing structures (pipes, box culverts and bridges) were investigated for adequate capacity using the new drainage criteria developed by the NWA and Stanley Consultants. As part of the preliminary plans, each drainage basin was modelled and the minimum structure size determined. These are summarised in section 3.3.2.2 of this report.

If the existing drainage structures are undersized, it is anticipated that they will be replaced as part of the project. Where the outfall channels are poorly defined or under-capacity, concrete–lined U-channels from the road to a satisfactory discharge point (usually the sea if the road is close enough) are shown. For those sections with new alignment, the offsite drainage has been modelled to determine the structure size required to pass the design flow. The additional amount of runoff from the road footprint has not been established; however, it is typically small compared with offsite flows. In addition, the time of concentration for the roadway drainage will be much shorter that the off-site drainage flows, meaning the roadway drainage flows will pass before the offsite flows peak at that location.

A performance specification will be included in the tender documents that provide the drainage requirements for urban areas. The performance specification will establish the maximum ponding in the gutter section to allow traffic to continue to pass safely. It is anticipated that catch basins will be constructed at a maximum spacing of 65m on both sides of the urban section and discharged into a pipe system that will outlet into a channel. The design-build team will design the urban drainage system to meet with the performance requirements that will be part of the tender documents.

Therefore, it is not expected that there will be significant cumulative effect from drainage. Structures are designed such that they will reduce flooding along the road. A requirement will be included in the performance specification that requires the design-build team to check the outfall channel downstream for sufficient capacity and improve any channel that could cause flooding downstream due to the fact that the structures upstream allow addition flows to pass.

6.4.3 Noise

The cumulative noise levels (existing noise level plus the predicted noise level) were assessed for the six locations where noise measurements were done. Stations N1- N4 were non-compliant with both NEPA's day and night time noise standards for 2013 traffic (Table 6-12). For the 2035 traffic, Stations N1 – N4, were non-compliant for both day and night NEPA standards (Table 6-13). Note that no cumulative noise levels were calculated for Station N5 as no baseline noise data were collected due to the malfunction of the noise meter.

Further investigations indicate that the changes in existing noise levels with the proposed highway will only be noticeable (+ 3dBA) at Stations N2, N3 and N4 for both day and night time with both the 2013 and 2035 traffic.

Table 6-12 Cumulative noise levels for selected locations along Section 1A of Segment 1 using 2013 traffic

STATION	MEASURED (dBA)			PREDICTED (dBA)			CUMULATIVE NOISE (dBA)			NEPA STANDARDS	
	72 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	Day	Night
N1	60.7	62.4	56.1	33.4	34.9	27.6	60.7	62.4	56.1	45	40
N2	70.6	70.2	64.3	71.1	72.7	65.4	73.9	74.6	67.9	65	60
N3	68.9	70.6	64.8	69.8	71.3	64.0	72.4	74.0	67.4	55	50
N4	81.4	52.6	50.5	64.5	66.1	58.8	81.5	66.3	59.4	55	50
N5	N/A	N/A	N/A	53.1	54.7	47.4				55	50
N6	59.9	61.6	54.8	57.7	59.3	52.0	61.9	63.6	56.6	65	60

NB: Values highlighted in red are non-compliant with the NEPA Standard

Table 6-13 Cumulative noise levels for selected locations along Section 1A of Segment 1 using 2035 traffic

STATION	MEASURED (dBA)			PREDICTED (dBA)			CUMULATIVE NOISE (dBA)			NEPA STANDARDS	
	72 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	24 Hours	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	Day	Night
N1	60.7	62.4	56.1	34.7	36.3	28.9	60.7	62.4	56.1	45	40
N2	70.6	70.2	64.3	72.4	74.0	66.6	74.6	75.5	68.6	65	60
N3	68.9	70.6	64.8	71.1	72.7	65.3	73.1	74.8	68.1	55	50
N4	81.4	52.6	50.5	65.3	66.9	59.6	81.5	67.1	60.1	55	50
N5	N/A	N/A	N/A	54.2	55.8	48.4				55	50
N6	59.9	61.6	54.8	59.3	60.9	53.5	62.6	64.3	57.2	65	60

NB: Values highlighted in red are non-compliant with the NEPA Standard

7.0 MITIGATION

7.1 PHYSICAL

7.1.1 Geotechnical Considerations

Available seismic risk map for Jamaica indicates that the spectral acceleration for short periods/two second periods with 5% damped acceleration response spectrum for the maximum considered earthquake with a 2% probability of exceedance in 50 years, was deduced as $S_1 = 0.3g$. Results from standard penetration resistance and laboratory testing were used to determine seismic soil classifications, as follows:

- A: Hard rock
- B: Rock
- C: Very dense soil and soft rock
- D: Stiff soil
- E: Soft clay soil
- F: Soil requires site response analysis

Additional seismic analysis is recommended for foundations with soils classified as seismic types D and E.

Selection of appropriate factors of safety for slope stability criteria along the roadway alignment should incorporate specific site conditions. Consequences of failure and potential impacts to people and property (i.e. loss of life, damage to property, economic loss due to roadway closure) should be weighed against construction cost. Also, uncertainty of material properties should weigh into the selection. EM 1110-2-1902 [3] states that, "typical minimum acceptable values of factor of safety are about 1.3 for end of construction and multistage loading, 1.5 for normal long-term loading conditions. This is consistent with FHWA publication FHWA-NHI-01-026 *Soil Slope and Embankment Design*." NHL suggests in their Report [1] the following guidelines for slope stability factor of safety:

- $FS < 1$ Unsafe
- $1.25 < FS < 1.5$ Marginal (generally acceptable)
- $1.25 < FS < 1.4$ Satisfactory for cuts and fills (not for dams etc.)
- $FS > 1.4$ Satisfactory for dams/levees

Due to the soft/compressible upper soils encountered along portions of the proposed alignment, shallow foundations are generally not recommended. However, shallow foundations are recommended for areas with shallow surficial layers overlying strong bedrock. Shallow foundations should be a minimum of 1070mm below final grade. NHL recommends a bearing capacity factor of safety of 2.5.

The contractor should take care not to disturb the bottoms of excavations, and be prepared to extend excavations in the event that loose materials are encountered within shallow foundation areas. If unsuitable soils are encountered, it is recommended that the contractor extend the excavations 1 foot wider for every 1 foot deeper the excavations are extended. The excavations should be backfilled using acceptable structural fill, placed in loose lifts of approximately 200mm within 2 percent of their optimum moisture, and compacted to either 98 percent of the standard proctor (ASTM D698) or 95 percent of the modified proctor (ASTM D1557). Acceptable structural fill may consist of sand, silty sand, or clayey sand, having a plasticity index no greater than 15. Excessive post-construction settlement of clay and silty soils may otherwise occur.

The high plasticity clays (CH) encountered during the subsurface exploration are unsuitable for general fills and embankment fills. It is recommended that fine-grained backfill materials used for general fill and embankments be compacted to a minimum of either 95 percent of standard proctor density (per ASTM D698) or 93 percent of the modified proctor (ASTM D1557). Granular backfill materials should be compacted to a minimum of either 98 percent of standard proctor density (per ASTM D698) or 95 percent of the modified proctor density (ASTM D1557).

In order to access and construct the driven or drilled shaft piles, a working platform may be required to provide a stable surface for construction equipment and operations. Assuming a wet, low strength clay subgrade having a very low bearing ratio, it is recommended that the platform consist of a minimum of 450mm of aggregate reinforced with a biaxial geogrid. Alternative subgrade stabilization would be mixing 5% lime into the upper 450mm of the subgrade soils. A test section for proposed stabilization measure is recommended prior to construction.

7.1.2 Drainage and Hydrology

7.1.2.1 Cuts and Fills

Significant cuts and fills will occur along the new alignment and on the existing road between Twelve Mile and Grants Pen. A combination of measures must be employed in these areas to minimize erosion and scour such as retention ponds, energy dissipaters, check dams, silt traps etc. If implemented, these or other appropriate measures will ensure that the community and other downstream receptors are not negatively impacted by increased runoff, erosion or sedimentation associated with the construction of the highway.

7.1.2.2 Sink Holes and Wells

Construction

Sinkholes and wells work as an underground water network. To ensure this network does not become contaminated or destroyed, special mitigation steps may be taken:

i. Specifically, a Water Resources Risk Management Plan should be created. This must be done in conjunction with Water Resources Authority's approval of the measures to mitigate against adverse impacts during both the construction and operational phases. In keeping with the recommendation for a Water Resource Risk Management Plan, a dedicated mapping exercise should be undertaken to identify all vulnerable sinkholes and other water resources. This detailed assessment of the water resources along the final alignment and preparation of a Risk Management Plan must be undertaken. Please see section 10.2.3 for further detail.
ii. A drainage and vegetated buffer area should be installed around and within the sinkhole drainage area to improve runoff water quality by filtration and adsorption of contaminants before direct discharge to sinkholes.
iii. Culverts and proper drainage should be implemented wherever the alignment crosses the surface run-off paths for the sinkholes to ensure the recharge area is not disturbed.
iv. The developers should consider installing a combination of wetland detention basins, oil separators or interceptor within the drainage system which will facilitate the filtering of the local water system from toxic contaminants.
v. No sinkhole within established 50m and 100m buffer zones be blocked or covered with earth preventing or significantly altering the surface/sub-surface drainage pattern.
vi. The NWA should assess the designs of the detention area and the holding pond to ensure capacity of the detention pond(s) is adequate to detain storm water runoff and the adequacy of the holding pond to contain both storm water discharges.
vii. A geotechnical survey should be conducted along the alignment of the highway to confirm whether or not there are caverns and caves in the sub-surface that may affect construction or pose a possible risk of collapse. This geotechnical survey should be done before any excavation or mitigation activities on the possible sinkholes take place.

Operations

i. Sinkholes in proximity to the alignment should be checked and cleaned periodically to ensure they are not blocked.

7.1.2.3 Drainage Design and Works

One of the main objectives of SCHIP was to design an all-weather highway that remains accessible during or after major storm events. The drainage design for Section 1A was therefore based on new design guidelines developed by Stanley Consultants and the NWA under the Comprehensive Drainage and Flood Control Scheme in 2011.

Drainage assessments carried out under both the Comprehensive Drainage and Flood Control Scheme and the SCHIP identified several drainage issues along the existing roadway including flooding, erosion and sedimentation, inadequate drainage capacity, etc. Design solutions for these drainage issues were developed and are to be incorporated in the implementation of the SCHIP where possible. The designs were developed to resolve the current issues with minimal impact to the community and on the environment.

Section 3.3.2.2 details the proposed drainage works and Table 7-1 summarises the recommended mitigation measures for the possible drainage impacts outlined previously. The mitigation measures are not meant to be an exhaustive list.

Table 7-1 Summary of drainage impacts and mitigation measures

Location	Chainage	Impact	Possible Mitigation Measures
Harbour View	100+100 - 300+400	Flooding along corridor	Increase culvert size, line outfall channel, raise road level
Bull Bay Football Club Playfield	103+500 - 103+700	Flooding along corridor	Divert flow into natural pond, increase culvert size, increase outfall channel size and line channel
Wickie Wackie	104+080 - 104+400	Flooding along corridor	Clean blocked drains and pipe culverts that intercepts storm runoff from the community north of the roadway and direct same to the existing U-channel, extend incomplete U-channel up to the roadway, construct swale and box culvert to convey flow from the community and other areas north of the roadway to the U-channel, at 104+100, the inlet capacity of the existing drain should be increased for more effective drainage
Pond Side Corner	104+800	Flooding and ponding along corridor	Install culvert to convey water across road, construct lined outfall channel to convey water to the sea
The Cane River Bridge	102+800	Flooding and debris flow	New bridge is to be constructed with increased hydraulic capacity, channel could be lined to increase flow capacity
Chalky River Bridge	106+050	Flooding and debris flow	Bridge is to be widened, channel to be lined to increase flow capacity
Bull Bay River Bridge	107+000	Flooding and debris flow	The new bridge to be constructed across the Bull Bay River will not exacerbate the flooding and debris flow experienced during major storm events at this location
Bull Bay to 12 Mile – New Alignment	106+700 - 109+500	Concentrated storm runoff, erosion, sediment migration from construction site, sediment transport during storm events	Retention ponds, silt fences, benching, energy dissipators
Twelve Mile to Grants Pen	109+500 - 113+200	Concentrated storm runoff, erosion, sediment migration from construction site, sediment transport during storm events	Detention ponds, silt fences, benching, energy dissipators, check dams
Grants Pen to Albion	114+000 - 115+300	Flooding along corridor	Raise road level, increase culvert size, use box culverts instead of pipe culverts to increase flow depth

7.1.3 Storage of Raw Material and Equipment

7.1.3.1 Construction

i. A central area should be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment.
ii. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
iii. Fine grained materials (sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away.
iv. Raw material should be placed on hardstands surrounded by berms.
v. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
vi. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
vii. In terms of transporting equipment, the paths of the planned roadways should be used, rather than creating temporary pathways just for equipment access.

7.1.3.2 Operation

No mitigation is required.

7.1.4 Noise Pollution

7.1.4.1 Construction

i. Use equipment that has low noise emissions as stated by the manufacturers.
ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
iii. Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

7.1.4.2 Operation

Two main noise mitigation strategies are recommended:

i. Conduct annual noise assessment to determine if the traffic from the highway is having a negative impact on the environment.

ii. Where necessary, noise mitigative structures should be put in place, such as noise barriers, etc. In the same regard, adequate provision should be made to implement noise barriers for both existing developments and approved subdivisions.

The exceedances of NEPA's noise level standards at sensitive receptors from traffic noise necessitate noise mitigation. One mitigation strategy is to build noise walls to shield the affected facility from the noise source (traffic). Preliminary noise walls were designed and optimized using SoundPlan 7.4 and the resultant noise levels are reported in Table 7-2 with the dimensions of the noise walls detailed in Table 7-3. In an effort to look at a long-term mitigation strategy the predicted noise levels from the 2035 traffic was used in the design of the walls.

Table 7-2 Predicted noise levels (dBA) at St. Benedicts Primary School along Section 1A of Segment 1 before and after the installation of noise walls compared to NEPA standards

LOCATION	WITHOUT NOISE WALLS (dBA)	WITH NOISE WALLS (dBA)	NEPA DAY TIME STANDARD (dBA)
St. Benedicts Primary – Bldg. #1	69.3	39.9	45.0
St. Benedicts Primary – Bldg. #2	56.1	45.0	45.0
St. Benedicts Primary – Bldg. #3	53.8	43.8	45.0

**NEPA Night time standard*

Table 7-3 Section 1A of Segment 1 preliminary noise walls stationing, ground elevation (base height), wall heights and wall lengths at St. Benedicts Primary School

LOCATION	STATIONING (km)	BASE HEIGHT (m)	WALL HEIGHT (m)	WALL LENGTH (m)
St Benedicts Primary School	101+430	6.35	18.50	31.77
	101+462	6.63	20.00	13.72
	101+476	6.91	14.00	29.29
	101+514	6.87	12.00	1.73
	101+516	6.76	13.00	2.43
	101+518	6.64	14.00	2.57
	101+543	6.57	14.00	25.26
	101+554	6.96	13.50	11.59
	101+559	7.20	13.00	5.26
	101+571	7.32	13.50	12.06
	101+589	7.52	13.50	17.85
	101+616	7.73	10.00	27.34
	101+626	7.71	11.50	10.20
	101+648	11.62	12.50	22.10
	101+665	13.33	20.00	17.42

The dimensioned walls have resulted in the compliance of NEPA's noise standards. Another mitigative strategy is to do noise insulation of the affected buildings (e.g. reducing gaps in doors, windows, walls or installing double pane windows) where possible. These strategies might have to be used to achieve compliance as some of the designed walls have wall heights that are considered unrealistic (e.g. >7m).

It is important to note that the noise walls discussed here are preliminary as two critical factors need to be defined for any finalization of the designs. The first is the as built road elevation and the second, the baseline noise climate at the locations. It is common knowledge that Jamaica is a noisy country and although there are established zonal noise standards rarely if at any time are these standards met. It is therefore recommended that the + 3dBA above ambient noise climate guideline be used to design the noise walls. This will help in refining the noise wall heights and lengths. The proposed guideline is in keeping with the fact that a person with average hearing will not perceived an increase in noise of 3 dBA or less. This is supported by the IFC and World Bank 3 dBA rule in which it states that a noise from a source should not result in an increase in baseline noise levels by more than 3 dBA at the nearest receptor from the source.

An illustration of the noise walls is depicted in Figure 7-1. It should be noted that the walls should be built as close to the road verges as is practical to be effective. Also note that there is an existing perimeter wall at St. Benedicts Primary School that may (depending on the structure) be able to be upgraded.

Imagery: October 2013

Figure 7-1 Noise wall at St. Benedicts Primary

7.1.5 Air Quality

7.1.5.1 Construction

i. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
ii. Minimize cleared areas to those that are needed to be used.
iii. Cover or wet construction materials such as marl to prevent a dust nuisance.
iv. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

7.1.5.2 Operation

No mitigation is required.

7.2 BIOLOGICAL

7.2.1 Habitat Fragmentation

7.2.1.1 Construction

i. Limit rights-of-passage to areas already showing noticeable signs of habitat degradation. For example, areas with open fields, pastureland, low endemism and areas of agricultural or isolated residential development.
ii. Incorporate at regular intervals engineering solutions that would help minimise habitat fragmentation such as tunnels and/or bridges especially at higher elevations. These structures would help reduce population isolation by providing links between potentially fragmented habitats (Primack, 2006; Smith & Smith, 2006). They would also minimise the impact of vegetation removal. Comparatively, highway developments that do not incorporate these features may result in higher incidences of population isolation; complete vegetation removal within the swath of the rights-of-way; as well as further habitat degradation from engineered land modifications, designed to suitably grade the highway.

7.2.1.2 Operation

i. Ensure that the pathways are easily accessible and clear.

7.2.2 Terrestrial Flora

7.2.2.1 Construction

Accidental or Intentional Removal of Important Plant Species

i. The removal of the endemic species will be avoided.

ii. If removal is necessary, a nursery will be established for the maintenance and propagation of these and other naturally occurring plants. These plants may later be reintroduced into the forest or used for landscaping and other aesthetic purposes.

Human Encroachment, Urban Sprawl and Control of Invasive Species

i. A proper plan should be developed concerning transportation routes and storage for equipment and material.
ii. The proposed post construction or operation road network should be kept simple as well as be used throughout the preparation and construction phases of the project.
iii. A buffer area should be established and maintained.
iv. Proper planning regarding access points to the construction site should be established.
v. Further planning will be required for the establishment of development zones within nearby lands, villages and towns. This should direct controlled or prohibited development of nearby areas.

Increased Soil/Substrate Erosion

i. Where possible, trees with trunks of DBH 18 cm and greater should be left intact.
ii. Remove trees only as necessary. Hence a proper procedure should be developed as to site preparation prior to project initiation.

7.2.2.2 Operation

i. Ensure that the plant nursery is maintained.
ii. Planning/zoning laws must be enforced.

7.2.3 Terrestrial Fauna

Dry forests are among the most important ecosystems in Jamaica (Kapos, 1986) and thus special care must be taken to reduce general modifications of the environment. Anecdotal evidence from local residents, points to the need to consider barriers at key points to reduce the chance of crocodiles crossing the road; this will be important to protect both the crocodiles and the road users.

7.2.3.1 Construction

i. Protect rare, endemic and other ecological important species. A monitoring programme and mitigative measures should be put in place to identify sensitive habitats if encountered during the construction phase (vegetation removal, earth moving and road building) of the project.
ii. Construct bridges or other access features to ensure that communities with access to either other areas or within the community are not impeded. Various crossing features can be utilised to facilitate any natural migration/ movement processes within the area.
iii. Erect barriers at key areas to reduce the incidence of road kill of migrating species (crocodiles).

7.2.3.2 Operation

i. Planning/zoning laws must be enforced.

ii. Ensure that access features are easily accessible and clear.

7.3 HUMAN/ SOCIAL

7.3.1 Transportation and Traffic

7.3.1.1 Construction

The draft contract for the proposed works includes a detailed section on the maintenance of traffic, with specific requirement for Traffic Management Plans (TMP) and Maintenance of Traffic (MOT) plans. These draft employee requirements include the following that provide mitigation for traffic impacts:

- Maintain and provide access to property by owners, customers, visitors, and emergency vehicles, except as otherwise Approved by the Employer's Representative.
- Maintain the current pedestrian accommodations within the Project limits during construction.
- All existing Safe Routes to school must be maintained throughout the duration of construction.
- The Design-Builder must submit for Approval a Pedestrian Access Plan that provides for safe pedestrian routing and includes a safe route for school children to cross the Project.
- Provide Project Notification Signs on both sides of each arterial cross-street approaching the Main Road and on the Main Road approaching the Project limits.
- Provide a Traffic Operations Manager and Traffic Control Maintainer(s) who will coordinate all construction traffic impacts with the Employer's Representative.
- Provide a courtesy patrol service consisting of a truck and driver equipped with adequate resources to assist motorists stalled along the highway. The courtesy patrol truck shall be equipped with a push bar. Provide courtesy patrol service 24 hours per day, seven days per week.
- Coordinate and hold regular meetings with Incident Management Partners.
- Correct all traffic control deficiencies upon notification or observance of the deficiency within 1 hour of notice or observation.

Additionally, Table 7-4 presents the potential traffic impacts and the proposed mitigation measures for the construction phase that can be included in the Contractor's traffic management plan.

Table 7-4 Traffic Impact Mitigation, Construction Phase

Traffic Impact	Mitigation
Site preparation and construction activities that reduce lane capacity or cause side friction along the main road will impact on traffic flow in the localized areas that works are taking place, and can cause backlogs in traffic in adjoining communities and areas.	Construction activities should be scheduled with peak traffic flows and directions in mind. Where possible, hoarding can be used to mitigate against rubber-necking. Side friction can be reduced with adequate buffer between work areas and travel lanes where the space is available.
Complete road closures may be necessary for bridge and culvert works.	Where a complete closure of the A4 main road is required a detour must be in place. Under the terms of the contract, Contractors will be required to prepare traffic management

Traffic Impact	Mitigation
	plans in compliance with the National Works Agency (NWA) requirements.
Detour routes may add travel time and costs. The significant truck traffic in particular can create additional impacts for commuters on detours since trucks require wider swept paths, move slower on gradients and increase side friction on narrow detours.	Detour routes must be optimized to reduce travel time and cost by choosing the shortest route possible with adequate tapers and widths to accommodate high truck traffic. Adequate and appropriate construction warning signs must be in place for commuters to efficiently use the detours. Adequate notice of the pending road works and detours are a part of the employer's requirements. This will allow the commuters to use the road more efficiently.
Project traffic and delivery of materials may cause delays to commuting traffic.	Schedule deliveries to the site during off-peak times and store materials in locations that reduce localize traffic within the construction zone. The employer's requirements as part of the contract includes specified MOT off-peak periods.
Detour routes may cut through small communities and subdivisions.	Attention needs to be placed on the local users of the subdivision/local roads that may be used as detours to adequately mitigate against the effects of increased traffic in these areas. Mitigation can include: • Providing verge/sidewalks as appropriate to separate pedestrians from vehicles • Providing additional flaggers and signage in the vicinity of schools and civic centres that generate significant pedestrian traffic.
Weight of heavy vehicles, both for the project and external industrial activity can contribute to the deterioration of the existing roads. Local detour routes can be especially susceptible to rapid deterioration by an increase in truck traffic.	A scale should be placed on site to ensure the trucks transporting material for the project are within the appropriate weight limits. A maintenance plan must be put in place to address the deterioration of local roads that are used as detours.
Construction activities, particularly detours can affect public transport. The Jamaica Urban Transport Company (JUTC) operates bus routes from Kingston to the community of Eleven Miles, while various taxis and small public transport sub-franchises provide coverage of this route and extended routes.	Where appropriate and available, detours and partial road closures should provide temporary bus bays and bus stops.
Increased traffic associated with accommodations for construction workers.	The project is expected to take advantage of local labourers which would therefore decrease the need for additional accommodation for construction workers and minimize traffic from the increase in activity. However, where accommodation is provided for workers, it is not anticipated to cause a significant impact on the existing traffic.
Increased risk of accidents or damage to vehicles caused by objects falling from construction vehicles.	Ensure vehicles are covered and not overloaded.
Roads and access points along the corridor will be directly impacted by the construction.	Maintenance of traffic plans for all existing roads and driveways must be detailed in the Traffic Management Plan (TMP).

7.3.1.2 Operation

Table 7-5 presents the potential traffic impacts and the proposed mitigation measures for the operation phase that can be included in the Contractor's traffic management plan.

Table 7-5 Traffic Impact Mitigation, Operation Phase

Traffic Impact	Mitigation
Upon completion, the improved road will likely cause an increase in vehicular speeds. The increase in speeds will decrease the travel time, increase capacity and increase efficiency of the road network, however it may also result in an increase in traffic crashes.	Mitigation against an increase in crashes from an increase in vehicular speeds can be addressed with design elements such as rumble strips, adequate marking and signage, and a continued police presence and surveillance. Traffic signal warrants should be conducted taking into consideration increased vehicle speeds and the speed differentials on the side roads. Several traffic calming techniques can also be considered at intersections to improve safety including rumble strips, roundabouts, surface texture, turning movement diverters, and chicanes.
The operations at roads and access points along the corridor may be permanently altered after construction. With the implementation of a 4-lane divided roadway, some full access intersections and driveways may become left-in, left-out operations.	Access management, intersection geometry and safety must be considered in the planning and detailed design of the corridor. Where access points and roads will be restricted to left-in, left-out operations, adequate provisions must be made for U-turns and/or routes to full-access intersections. Where full access intersections are proposed, consideration must be given for safety features. The 2014 Traffic Report analysed the intersections at major towns and developed recommendations to improve the geometries and operations.
The four-lane divided cross-section impacts pedestrian access and movements. Crossing a four-lane divided highway takes more time and is inherently more dangerous for pedestrians.	Pedestrian access must be addressed in the planning and design. Midblock pedestrian signals need to be considered where crossing volumes are high and no alternatives exist. Adequate street lighting is also essential to improve the driver's ability to see pedestrians at night. Adding textured pavement to the functional area of the intersection can encourage drivers to slow down in the vicinity of pedestrian crossings.

7.3.2 Transportation of Raw Material and Equipment

7.3.2.1 Construction

i. Paths of the planned roadways should be used, rather than creating temporary pathways just for equipment access.
ii. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example, reduced speed near the construction site.
iii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
iv. The trucks should be parked on the proposed site until they are off loaded.
v. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.
vi. The use of flagmen should be employed to regulate traffic flow.
vii.

7.3.2.2 Operation

No mitigation required.

7.3.3 Refuelling, Fuel Storage and Maintenance of Vehicles and Heavy Equipment

7.3.3.1 Construction

Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.

7.3.3.2 Operation

With the exception of emergencies, no refuelling and or maintenance of vehicles or heavy equipment should be conducted along the highway. In emergency circumstances, refuelling and or repairs should be conducted on the soft shoulders and not on the roadway or vegetated areas.

7.3.4 Solid Waste Generation

7.3.4.1 Construction

i. Skips and bins should be strategically placed within the campsite and construction site.
ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iii. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
iv. Disposal of the contents of the skips and bins should be done at an approved disposal site.

7.3.4.2 Operation

No mitigation is required.

7.3.5 Wastewater Generation and Disposal

7.3.5.1 Construction

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

7.3.5.2 Operation

No mitigation is required.

7.3.6 Workers Safety

7.3.6.1 Construction

i. The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary)
ii. Adequate communication with workers and signage should be put in place to alert/inform workers of the time, location of such blasting and instructions
iii. Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.)
iv. There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site
v. Make prior arrangements with local health care facilities such as health centres or the hospitals to accommodate any eventualities
vi. Material Safety Data Sheets (MSDS) should be stored onsite.
vii. Trench Excavation
    - A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals
    - Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil)
    - Spoil should be placed so that the channels rainwater and other runoff water away from the excavation
    - Take precautions regarding Tension Cracks
        - Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench
        - Sliding or sloughing may occur as a result of tension cracks

Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

7.3.6.2 Operation

No mitigation required.

7.3.7 Land Use

Measures should be taken to ensure that during the land acquisition phases, land parcels along the highway and or in proximity are not land locked.

The developers should also be aware of all planning zones and protected area boundaries. Further, it should be ensured that construction workers and activities are sensitive to the natural and man-made systems existing within the zones and protected areas.

7.3.8 Recreational Activities

Relocation of the Bull Bay Football field should be a part of the overall Resettlement/Relocation Plan as outlined in Section 10.2.2.

7.3.9 Emergency Response

7.3.9.1 Construction

i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
ii. The construction management team should have onsite first aid kits and arrange for a local nurse and/or doctor to be on call for the construction site.
iii. Make prior arrangements with local health care facilities such as health centres or the hospitals to accommodate any eventualities.
iv. Material Safety Data Sheets (MSDS) should be store onsite.

7.3.9.2 Operation

i. Alternate route or routes should be identified beforehand.
ii. Adequate and clearly defined signs should be erected and public announcements will be made if there is a need to use the alternate route(s).
iii. On-call emergency highway operators to attend to any situation that may result in potential accidents (dead animals, fallen tree limbs, gravel, sand, oil spill etc)

7.3.10 Cultural and Historical

7.3.10.1 Construction

i. Further archaeological evaluations should be undertaken in order to ascertain the magnitude of archaeological sites, if any.
ii. The recording of impacted structures should be undertaken prior to destruction.
iii. Monitoring should be conducted during clearing and excavation stages in areas where historic artefacts were discovered.
iv. Ensure the preservation of the historic and cultural sites.

7.3.10.2 Operation

No mitigation is required.

8.0 RESIDUAL IMPACTS

Sections 6.0 and 7.0 (Identification and Assessment of Potential Direct and Indirect Impacts and Recommended Mitigation) described the potential impacts that would occur as a result of different phases of the project and how the proposed mitigation measures would contribute to minimising or eliminating the impacts. Not all impacts can be fully mitigated and therefore residual impacts will be experienced by the environmental and social receptors affected by the project.

8.1 NOISE

The proposed project has the potential to be a noise nuisance during both the construction and the operational phases. Even with the proper mitigative steps, short-term impacts of varying duration such as truck engines, truck engine brakes and loud horn honking will be a nuisance to nearby residential communities.

8.2 AIR QUALITY

Fugitive dust and exhaust emissions from motor vehicles have the potential to affect the health of the resident population. PM2.5 particulates specifically, which showed high concentrations prior to commencement of project, may continue to be high or even higher due to increased vehicle usage of new highway. Fine PM2.5 particles are airborne pollutants that fall below 2.5 micrometres in diameter. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. In this case, any residential burning or motor vehicle exhaust emissions would contribute to elevated PM2.5 particulate concentrations.

8.3 HERITAGE AND CULTURAL

Sections of proposed project area have dense vegetation cover. When this vegetation is removed from the proposed site, there is a high probability of finding prehistoric and historic cultural material. However, there is the possibility that they may be destroyed by heavy machinery and equipment during the site clearance process.

9.0 IDENTIFICATION AND ANALYSIS OF ALTERNATIVES

9.1 NO PROJECT ALTERNATIVE ("NO-BUILD")

The No Build Alternative assumes that no improvements will be made in the study area and that existing conditions will remain. This alternative is often used to compare the costs and benefits of implementing proposed improvements versus the alternative of continuing to use the existing facility. For this study, the No Build Alternative would mean that both segments of the Southern Coastal Highway system remain as 2-lane facilities without any improvements beyond the usual maintenance activities. None of the land in the study area is impacted under the No Build scenario.

The No Build Alternative was considered an option throughout the *Feasibility Study*. The advantages of the No Build Alternative include:

- No right-of-way acquisition
- Least impact to the environment
- No utility impacts or relocation
- Minor disruption to traffic during maintenance work
- Least costly alternative

The disadvantages of the No Build Alternative include:

- The purpose and needs of the project not satisfied
- No improvement to traffic operations and safety
- Not consistent with local transportation plans and goals of the local government
- Reduced level of service (below LOS D) and increased congestion and accidents
- No reduction of flooding

9.2 ALTERNATIVES DEVELOPMENT AND ANALYSIS

Project alternatives considered during the SCHIP included alternate corridor options as well as addressing the deficiencies along the existing road. Up to three alternative corridors were evaluated within any section of the road segments (Figure 9-1). The limits of the study were generally along a 2 kilometre bandwidth around the existing road with some exceptions due to topography and impacts to development. The corridor analysis conducted for alignments off of the existing road considered the need to accommodate traffic demands while making safety and traffic operations the main priority. All alternatives were evaluated in terms of engineering, environmental, and socioeconomic impacts.

Figure 9-1 Design Concept Report (DCR) alignments, Segment 1, Section 1A

Other areas of the study included identifying construction segments, right-of-way costs, bridge replacement considerations and drainage assessment.

The alternatives evaluated for the study were initially identified as part of the process to define the scope of work for the project, the first step of which listed several locations for potential realignments of the existing main road. For Segment 1 Section 1A area, Bull Bay to Grants Pen and Albion to Yallahs were considered.

During the initial site assessment field visits, Stanley Consultants and National Works Agency staff identified challenges associated with the initial realignment options such as difficult terrain and existing commercial and residential development. This information was later used to help optimize the design for the realignment alternatives. Where realignment alternatives were not feasible, the existing corridor conditions were analysed for upgrades to meet the project design standards.

Based on the information obtained from field reviews and existing conditions analysis, the design team established alignment alternatives that included an alternative along the existing road with modifications as necessary to meet project design criteria. The various alignment alternatives were developed with horizontal geometry of the proposed roadway centreline on aerial imagery that Stanley Consultants assembled in-house to complete the feasibility study. To supplement the data collection, coordination meetings with agencies were held to solicit available information that could impact the development of the alternatives. Project stakeholder meetings were conducted with those entities listed in Table 5-1.

GIS data obtained through coordination efforts included utilities, agricultural land use, wetlands (including springs), caves, archaeological, protected areas, and parcel information. This data was incorporated into the project mapping and survey files so that it could be evaluated as part of the design process to optimize the alignment alternatives.

Within Segment 1, there were nine sections identified for alternative alignments. The horizontal and vertical geometry were developed for each alternative and limits of impacts / right-of-way reservation lines determined. This information was superimposed onto the aerial imagery and parcel lines to estimate the impacts for parcels located along the alignment, as well as to residential and commercial buildings. Additionally, link road connections were identified for each of the bypass/development roads to connect back to the existing road as needed to better accommodate local traffic. The details for each of the study alternative alignments are contained within *The Alignment Alternatives Report.*

9.2.1 Evaluation Criteria

Stanley Consultants in conjunction with the NWA and the delegated project Steering Committee identified criteria that would be used to evaluate each alignment alternative. The Steering Committee also established the weighting for each evaluation criterion by comparing each criterion against each other and noting which was more important in this one-on-one comparison. The evaluation criteria and ranking of the criteria resulting from this process is shown in Table 9-1.

Table 9-1 Evaluation criteria ranking

Source: (Stanley Conulstants Inc., 2015)

Rank	Criteria	Score	Weight
1	Flooding & Storm Surge Impacts	329	10.0
2	Wetland Impacts	272	8.3
3	Average Travel Time	264	8.0
4	Impact to Springs	264	8.0
5	Potential for Development	262	8.0
6	Biological & Wildlife Habitat Impacts	258	7.8
7	Roadway Costs	246	7.5
8	Level of Service	244	7.4
9	Structure Costs	242	7.4
10	Archaeological Impacts	239	7.3
11	Drainage Costs	236	7.2
12	Number of Residential Relocations	231	7.0
13	Right-of-Way Costs	215	6.5
14	Business & Commercial Impacts	210	6.4
15	Design Speed Variance	207	6.3
16	Impact to Wells	198	6.0
17	Cost of Road Maintenance	176	5.3
18	Agricultural Impacts	175	5.3
19	Utility Impacts (Power Transmission Poles)	166	5.0
20	Number of Parcels Impacted	160	4.9
21	Utility Impacts (Power Distribution Poles)	159	4.8
22	Access Management Opportunities	154	4.7
23	Utility Impacts (Sewer)	147	4.5
24	Utility Impacts (Water Lines)	146	4.4
25	Noise Impacts	131	4.0
26	Utility Impacts (Underground Comm. Facilities)	118	3.6
27	Utility Impacts (Above ground Comm Facilities)	116	3.5

9.2.2 Evaluation Matrix

Once the criteria weighting had been established, the scoring values for each criterion, for each alignment alternative in each section was determined by the engineering team and entered in the evaluation matrix (Figure 9-2). This process involved quantifying values for each criterion for each alignment alternative. Based on the degree of impacts and costs, a corresponding score was assigned for each criterion in the evaluation matrix. The alignment alternative for that section with the highest score would be identified as the alternative that best met the evaluation criteria (Figure 9-2).

9.2.3 Preferred Alternatives

Based on evaluation matrix scoring, a preferred alignment alternative was identified for each section of the project. The preferred alternatives were presented to The Minister of Transport, Works and Housing on January 30, 2013. No objections for the preferred alignments were raised by the Ministry during that presentation. At the request of the Minister of Transport, Works and Housing, the preferred alignments were presented to the Jamaican Cabinet and Prime Minister on February 18, 2013. At this meeting there were no objections raised concerning the preferred alignments or the study methodology.

			Alternative Designation									
			A		B		C		D		E	
			Score	Length (m)	Score	Length (m)	Score	Length (m)	Score	Length (m)	Score	Length (m
Segment 1												
	Section 1	Bull Bay to 12 Mile	**1566.3**	3147	1296.9	3550						
	Section 2	12 Mile to Yallahs	1245.4	10163	1119.2	11032	1229.2	9855	**1332.1**	14600		
	Section 3	White Horses	**1478.8**	5579	1156.6	5100						
	Section 4	Morany Bay	1360.9	5013	**1465.3**	4084	1197.6	3200				
	Section 5	Port Morant	**1573.6**	7777	1232.2	7800						
	Section 6	Golden Grove	**1398.8**	9400	1383.2	10595	1228.6	10700				
	Section 7	Amity Hall to Long Bay	**1456.3**	44426	1058.5	45150	1066.5	44600	1097.1	31126	1177.5	3110
	Section 8	Boston to Drapers	**1576.5**	9500	1174.5	10000						
	Section 9	Drapers to Port Antonio	**1456.9**	6500	1281.3	6710						

Notes: Cell color matches alignment alternative color.

Green indicates existing road with improvements

Bold text indicates highest score for alternative alignments

For Segment 2, Section 6, Alternative A is Option 1; Alternative B is Option 2

Figure 9-2 Evaluation matrix, highlighting sections corresponding to Section 1A (red box)

9.3 PRELIMINARY ENVIRONMENTAL VULNERABILITY ASSESSMENT

During the Feasibility Study for the SCHIP, a reconnaissance of the proposed impact areas was undertaken in order to determine the sensitive environmental receptors that may affect the design and construction of the project prior to the finalisation of the project plan. It was believed that a useful means of analysing the various impacts and identifying the most environmentally sensitive areas would be by means of multi criteria evaluation (MCE), in a GIS.

9.3.1 Approach and Methodology

9.3.1.1 Environmental Feature Impacts

The first objective was to identify all environmental features that could be potentially impacted by road realignment and/or widening within the study area (otherwise referred to as the corridor) for both highway segments. In order to create a comprehensive database, spatial information inclusive of natural environmental features, as well as cultural, social, civic and economic data were collated. Over 50 features were input to the identification exercise.

Detailed analysis of all potential impacts was not feasible for the preliminary spatial exercise owing to the unavailability of some GIS ready data. The preliminary environmental feature matrix listed the potential effects/impacts of the preferred alignment on specific environmental features for which data was available (Appendix 8). In addition, it should be noted that some collated data were not up-to-date.

9.3.1.2 Input Layers and Vulnerability Scoring

Impacts identified by means of the impact matrices were used to guide the establishment of input layers. It should be noted that only negative impacts were incorporated in the vulnerability assessment. Zones of decreasing sensitivity were created away from each feature dataset by assigning vulnerability scores ranging from 1 to 100. This vulnerability scoring was based on distances (in metres) away from each feature, given that sensitivity will typically decrease away from each feature. For example, for the ‘rivers’ input layer (E1), a buffer of 0-300 metres away from rivers was considered to be the most environmental sensitive and cells within this buffer were given a value of “1”, whilst distances > 600 metres away from rivers were considered to be least sensitive and assigned the highest vulnerability score of “100”. Thus, resulting from the scoring exercise, the most sensitive/ vulnerable locations are denoted by a value of “1”, and higher values up to a maximum “100” reflect the least vulnerable areas (Table 9-2). In addition to the vulnerability scoring of each input layer, a layer weight was assigned to each input layer. The flow of steps undertaken for the vulnerability assessment is showcased in Figure 9-3.

Table 9-2 Environmental vulnerability/sensitivity classes

Total Score	*Vulnerability Class*
75 - 100	Least vulnerable/sensitive
50 - 75	Moderately vulnerable/ sensitive
1 - 50	Vulnerable/ sensitive

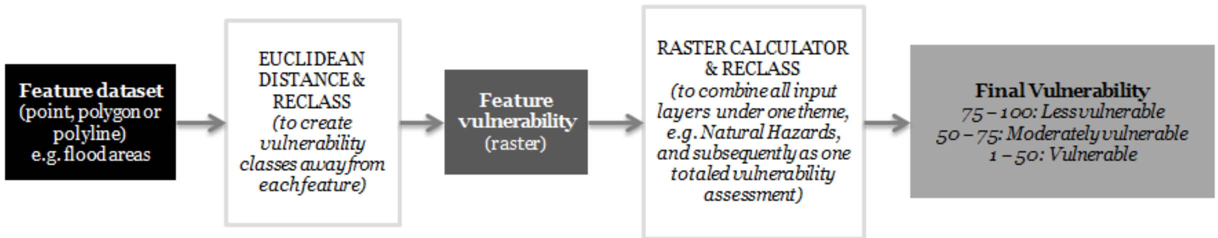


Figure 9-3 Flow chart outlining GIS methodology undertaken for vulnerability assessment

When applying MCE, expertise in various fields is required in order to establish sound criteria, respective scores and weighting. During the evaluation carried out by Stanley Consultants during Phase 1 (Feasibility Study), relevant stakeholders were consulted in order to arrive at appropriate weightings for each criterion (see section 9.2). The results of this evaluation were taken into consideration when assigning weights and scores to each input layer. In addition, experience within the EIA field, as well as specific comments received from NEPA were also taken into account during the establishment of scores for reclassification and weights.

9.3.1.3 Themes

Each input feature was grouped under the following main themes:

1) Ecology (E)
2) Natural Hazards (H)
3) Social/Cultural Quality & Services (S)
4) Infrastructure & Utilities (U)
5) Industry and Economy (I)

Each input layer was weighted by simple map algebra in order to produce maps for each of the five themes. The weights assigned were established based on the magnitude of the impact, expertise considerations and the outcomes of the stakeholder consultations carried out by Stanley Consultants (section 9.2). For example, in the case of the Social/Cultural Quality & Services theme, a higher weighting of 10% was assigned to schools, health centres and hospitals than that of post offices and agencies (2%), given that the impacts to the "sensitive" populations may be more detrimental than to the postal service if the road were to be constructed. Once the weights were assigned to each layer, the weighted maps were combined in order to arrive at one thematic map per theme using Equation 9-1.

Equation 9-1 Weighted total for each theme being considered

$$t_{total} = \sum_{i=1}^{n} w_i \, . \, c_i$$

Where t_{otal} is the weighted total for the theme being considered
n is the number of impacts being considered for each theme
i is the input layer
w_i is the percentage weight of input layer i
c_i is the score for input layer i

9.3.1.4 Combined Vision

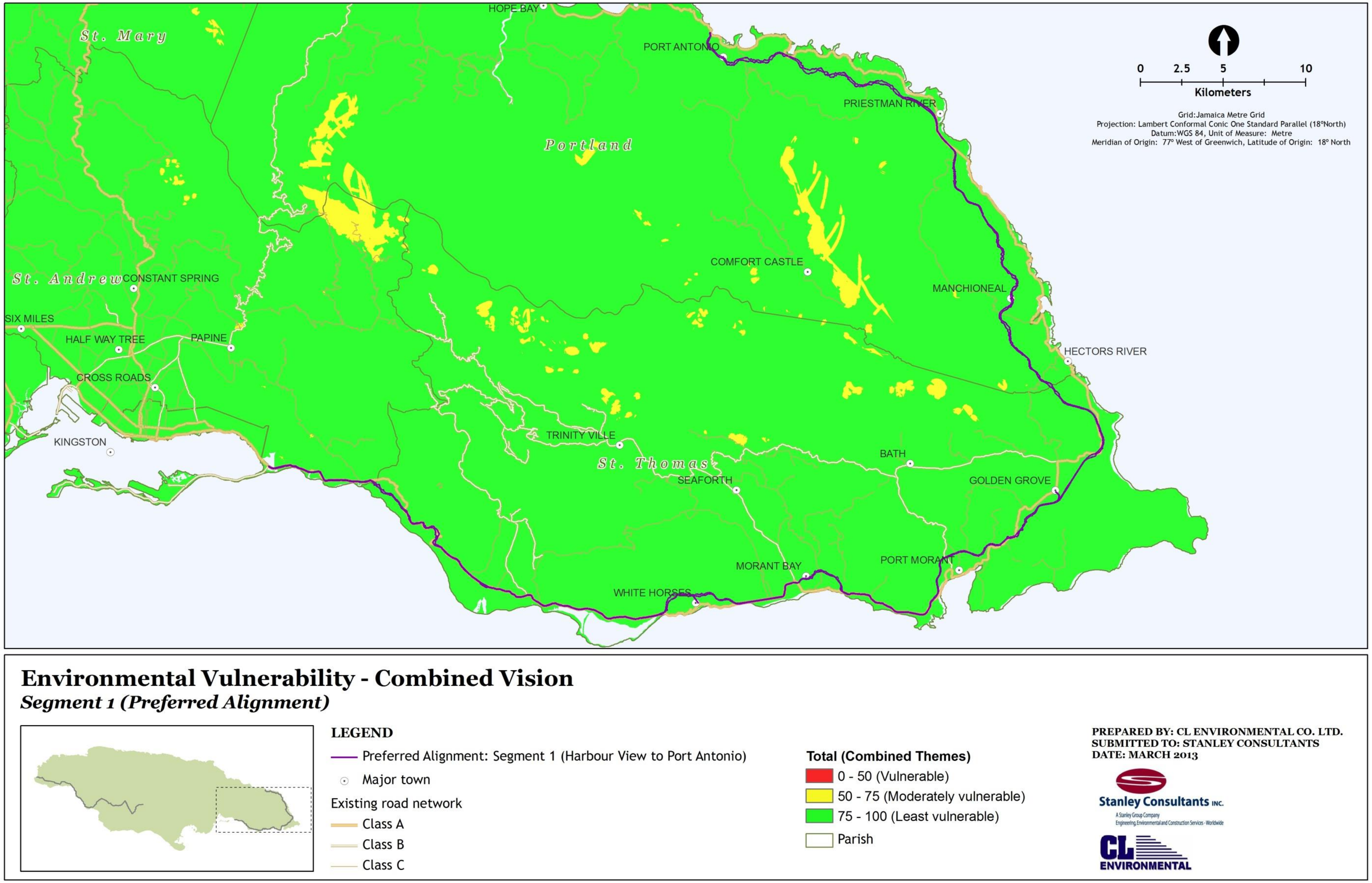
By means of MCE and utilising map algebra on raster layers in the GIS, different weights were assigned to each theme map created in order to examine a combined vision. Weights were assigned to each theme in order to arrive at a final vulnerability map (Table 9-3).

Table 9-3 Theme weightings for combined vulnerability vision

Theme	Weighting
Ecology	35%
Social/Cultural Quality & Services	15%
Infrastructure & Utilities	10%
Industry and Economy	10%
Natural Hazards	30%
Total Percentage	**100%**

9.3.2 Results

The combined visions unite all environmental themes (Ecology; Natural Hazards; Social/Cultural Quality & Services; Infrastructure & Utilities; and Industry and Economy) into one overall vision, weighted according to the values in Table 9-3. The mapped output of the combined vision for Segment 1 may be seen in Figure 9-4. As seen in this figure, when all categories of the "environment" are combined, vulnerability is seen to be low along the entire preferred alignment for Segment 1 (including Section 1A).



Source: (CL Environmental Co. Ltd., 2014)

Figure 9-4 Environmental vulnerability for the combined vision of all themes – Segment 1

10.0 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

10.1 ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) is an important tool which can be used to assist operations managers in meeting current and future environmental requirements and challenges. It can be used to measure a company's operations against environmental performance indicators, thereby helping the company to reach its environmental targets. A good management system will integrate environmental management into a company's daily operations, long-term planning and other quality assurance systems.

It is therefore recommended that several parameters be monitored before, during and after the project implementation to record any negative construction impacts and to propose corrective or mitigation measures. The suggested parameters include but not limited to the following:

1. Noise
2. Dust
3. Traffic and Transportation
4. Water Quality
5. Solid Waste and Wastewater
6. Raw Material Storage and Transport
7. Health and Safety
8. Equipment Maintenance
9. Drainage

10.1.1 Site Preparation and Construction Phase

- Daily inspection of site clearance activities to ensure that they are following the proposed plan and to ensure that site drainage system is not impacting on any waterways. Check and balance can be provided by NEPA and the Parish Council.

  Person(s) appointed by NWA may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake monthly water quality monitoring or a frequency agreed to with NEPA to ensure that the construction works are not negatively impacting on water quality. The parameters that should be monitored are salinity, dissolved oxygen, nitrates, phosphates, turbidity, total suspended solids, faecal coliform. Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

This is estimated to cost approximately J$ 105,000 per monitoring exercise.

- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition to noise, environmental noise monitoring should be undertaken to determine workers exposure and construction equipment noise emission. Noise monitoring to be conducted monthly at the site and settlements near to site.

  Client project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed.

  The monitoring of the construction work hours is not expected to incur any costs. The noise survey is estimated to cost approximately J$270,000.

- Daily monitoring to ensure that fugitive dust from cleared areas, access roads and raw materials are not being entrained in the wind and creating a dust nuisance. Particulate measurements should be conducted monthly. Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. Client project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that this stipulation is being followed. In addition, any Citizens Association within the area can be used to provide additional surveillance.

  It is anticipated that the particulate measurements will cost approximately J$185,000.

- Undertake daily inspections of trucks carrying raw material to ensure that they are not over laden as this will damage the public thoroughfare and onsite lead to soil compaction.

  Person(s) appointed by the Client or NWA may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that trucks carrying raw materials and heavy equipment are parked at the designated areas so as to prevent traffic congestion along existing roads.

  Person(s) appointed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that flagmen where necessary are in place and that adequate signs are posted along the roadways where heavy equipment interact with existing roads. This is to ensure that traffic have adequate warnings and direction.

  Person(s) employed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. Additionally, solid waste generation and disposal at the campsite should also be monitored.

  Person(s) appointed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

- Weekly assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.

  Person(s) appointed by the Client or Ministry of Health may perform this exercise.

  No additional cost is anticipated for this exercise.

- Monitor and approve the suppliers and sources of local materials. Inspection of the quarry should be conducted to ensure that they are legal. Copies of these licences should be kept on file.

  Person(s) appointed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

- Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of soil contamination from spills. Spot checks should be conducted by NEPA.

  Person(s) appointed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

  Traffic should be monitored during construction to ensure approved traffic management plans at critical areas are being followed. Person(s) appointed by the Client may perform this exercise. NEPA and the Client should perform spot checks to ensure compliance. Monitoring should be conducted daily to ensure major disruption to the public transport is avoided.

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.

  Person(s) appointed by the Client may perform this exercise.

  No additional cost is anticipated for this exercise.

10.1.2 Operational Phase

- The integrity of the road structures should be conducted every two (2) years.

  This should be done by a qualified person. NWA or their appointed person should conduct these inspections. No additional cost is anticipated for this exercise.

- An Annual noise survey should be conducted at the same locations as during the EIA construction phases for purposes of comparison. Any organization with the capability and equipment to conduct noise monitoring should be used to perform this exercise. The noise survey is estimated to cost approximately J$270,000.

10.2 OTHER RELATED STUDIES AND PLANS

10.2.1 Risk Analysis Study

The first step in Risk Assessment is identifying the major hazards; that is, gathering and analysing data on meteorological, hydrological and geological hazards in terms of their nature, frequency and magnitude. These hazards can be natural or man-made or a combination of both. Assessing and characterising each by triggering factors, degree of severity, spatial occurrence, duration of the event and their relationship is what gives rise to the risk assessment.

The risk assessment matrix used to characterize the overall risk is given in Table 10-1. Overall assessed risk levels result from a combination of low, medium and high severity of occurrence and probability of occurrence. Resulting risk considered as “HIGH” is denoted by a red box, “MEDIUM” risk by yellow and “LOW” risk by green. The Risk Assessment undertaken for all natural and man-made hazards is given in Table 10-2. It should be noted that priority hazards include: Flooding, Landslide, Earthquake, Accidents.

Table 10-1 Risk Assessment matrix for combined low, medium and high probability of occurrence and severity of consequences

Severity of Consequences	Probability of Occurrence: *Low*	*Medium*	*High*
High	MEDIUM RISK	HIGH RISK	HIGH RISK
Medium	LOW RISK	MEDIUM RISK	HIGH RISK
Low	LOW RISK	LOW RISK	MEDIUM RISK

** Overall assessed risk levels include HIGH (red), MEDIUM (yellow) and LOW risk (green).*

Table 10-2 Risk Assessment

HAZARD	RISK RATING	PROBABILITY	SEVERITY	COMMENTS
HURRICANES	**HIGH**	Seasonally June- November	May seriously damage infrastructure, property and individuals	Hurricanes and storms are expected to increase in severity over time
LANDSLIDES	**MEDIUM**	Sections along the alignment are prone to landslides	May cause result in property damage and harm to individuals	20 landslides were identified - 3 in Section 1A. Those crossing the alignment are described as inactive or probable scarps.
SINKHOLES	**MEDIUM**	Caves and other features increase the probability of landslides along the alignment	May result in loss of use and or damage, to roadway, property and individuals	9 caves Identified along the alignment with varying risks of sinkhole formation; Cambridge Hill Cave, Grandby Bush Caves, Hope River Sink, Rockfort Cave, Salt Spring Cave, Three-finger Jack's Cave, Bloxburgh Cave, Dallas Castle Caves, Granby Bush Caves
EARTHQUAKES	**LOW**	Section 1A lies within the zone of low probability of high intensity earthquakes	May result in loss of use and or damage, to roadway, property and individuals	29 epicentres can be found in the study area with a number of faults along Section 1A
FLOODING	**LOW**	Likely to occur during heavy event. Heavy rain events may occur more than once a year	Flood prone areas the route; Caribbean Terrace, Ten Miles Bull Bay, Yallahs Fording and Poor Man's Corner.	Project features are designed to reduce flooding
ACCIDENTS	**MEDIUM**	Improved drainage and infrastructure from the road works should reduce the probability of vehicular accidents	Road accidents range from sever to mild. Accidents may result in loss of use, property damage and loss of life	Improved road quality should reduce the accident potential
SPILLS	**HIGH**	This is will be the main roadway for quarry material transport. Trucks have a high probability of spillage of material. Oil and other material spills are less likely	May result in loss of use and or damage, to roadway, disruptions in flow, accidents and other blockages	The main quarries for the island area. The risk of spillage from trucks is therefore expected to be higher in this area
OBSTRUCTIONS	**MEDIUM**	Obstructions along the roadway are likely to be common	May cause result in property damage, loss of use and harm to individuals	Stray animals, Pavement or Surface Defects (potholes), Missing or damaged safety barriers, guard rails and/or fencing at a critical location are examples of common obstructions
FIRES	**LOW**	There is low probability of fires along the roadway	Fires may result in mild to severe damage	The cause and extent of the fire along with the response time of emergency services will dictate the severity of the impacts of the fire.

10.2.2 Emergency Response Plan

The Emergency Response Plan will be designed to describe the organizing, coordinating and directing of available resources in order to respond to various natural and man-made disasters and situations. The risk analysis study described in section 10.2.1, as well as related impacts and mitigation (sections 6.0 and 7.0) should be used as a reference in the preparation of the Emergency Response Plan. Hazards to be considered include the following:

- Natural Disasters
    - Hurricane
    - Earthquake
    - Flooding
    - Fire
    - Landslide
- Civil Unrest and Riots
- Bomb Threats and Acts of Sabotage
- Acts of Terrorism and Armed Attacks
- Diesel and Hazardous Material Stockpiling
- Security and Safety Information
- Medical Emergency Information
- Technological Emergencies
- Occupational Health and Safety

A detailed plan will be submitted as a separate document by the Contractor, CHEC. The Emergency Response Plan is to be approved by the Office of Disaster Preparedness and Emergency Management (ODPEM) and the Fire Department.

10.2.3 Water Resources Risk Management Plan

As stipulated in section 7.1.2.2, a detailed assessment of the water resources along the final alignment and preparation of a Water Resource Risk Management Plan must be undertaken. This must be done in conjunction with Water Resources Authority's approval of the measures to mitigate against adverse effects during both the construction and operational phases. In keeping with this recommendation, a dedicated mapping exercise should be undertaken to identify all vulnerable sinkholes.

Reference must be made to the drainage guidelines, “Guidelines for preparing hydrologic and hydraulic design reports for drainage systems of proposed developments”, jointly developed by the NWA, ODPEM and the WRA (The Ministry of Transport, Works and Housing, National Works Agency, Ministry of Local Government and Community Development, 2015). This guide outlines a set of procedures and makes reference to a number of standards and/or requirements that are relevant and applicable to the subdivision and development of land across the island. It sets out the minimum information to be included in the preparation of hydrologic and hydraulic design reports on drainage systems for proposed sub-divisions. It is expected that these guidelines will advance the mainstreaming of Disaster Risk Reduction considerations into the project planning phase to reduce future impacts from hazards and economic losses from disasters; contributing to the achievement of goals under the Vision 2030 National Development Plan. It should be noted that these guidelines were adopted by the Internal Review Committee (IRC) at the NWA and Sub-committee and Technical Review Committee at the NEPA.

10.2.4 Resettlement and Relocation Plan

10.2.4.1 Introduction

As a consequence of the construction of the highway it is inevitable that communities and individuals will be affected. However, where it will be necessary to relocate persons, NWA will involve the affected persons in the process from the start so as to make the transition a comfortable and easier one. These impacted structures were previously described in Section 4.4.4.

10.2.4.2 Resettlement Criteria

All resettlement activities carried out by NWA will be sustainable in nature by providing sufficient resources or alternatives to those who are displaced. All persons affected will be consulted and given the opportunity to participate in the planning and implementation of their own resettlement. Assistance will be provided in helping individuals to restore their standard of living or to raise it, but no individual's standard of living should be lowered as a consequence of the project. The legal tenure of affected persons will determine the type of compensation and resettlement assistance to be received. Particular attention will be given to groups such as the elderly, unemployed, those living below the poverty line, women and children and those without land tenure.

Those persons, businesses and activities to be accommodated in the Resettlement Plan will include the following:

- Dwellings, businesses and other facilities (shops, stalls) that are directly in the highway's right of way.
- Dwellings, businesses, farms lands and other facilities where the access to the properties may be affected.
- Farm lands and recreational areas are affected.
- Person who suffer temporary or permanent income loss during construction.
- Persons whose community facilities may be affected.
- Public utilities whose assets are affected (power lines, telephone lines and optical fibre lines, water distribution networks, irrigation channels etc.

Displaced persons, and owners of businesses and activities will be informed of their rights and be given options. There will be consultations with them and economically viable resettlement alternatives will be offered. Compensation will be prompt, effective and at full replacement cost for losses such as lands, structures, crops, trees, businesses and incomes lost, at present open market values.

In accordance with the size of the lot, NWA will either acquire the total lot or compensate the owner for that portion of land and other assets that will be affected. Where access to properties is affected NWA will seek to identify alternative access so as to ensure that there is no loss in value of the properties or impact on the businesses affected. Where no alternative access is possible then these individuals affected will be offered the same compensation packages and resettlement options provided for the dwellings and businesses located in the highway's right of way.

Stakeholder meetings will be held with the owners of the businesses and dwellings to determine what will be required to ensure their livelihood is restored. These meetings will be advertised via public media and other methods (newspaper, letters, flyers, libraries, post office, fire/police stations, town crier etc.). In addressing the farm lands and recreational areas that will be affected by the highway, NWA will compensate the farm owners for the portion of property affected along with crops being cultivated. This compensation will be at market values determined by a third party knowledgeable in land, structures, crops and plants/trees valuation. In the instance where recreational fields (football fields, cricket pitches, walking/running tracks) are affected, NWA will seek to rebuild these recreational facilities in close proximity to the original facility.

For individuals temporarily affected, efforts will be made to provide an alternate route to their place of business. Signage informing the general public about changes in traffic flows and routings will be erected in visible locations. As indicated, compensation will also be made for the loss of income faced during their relocation activities. For the individuals that will experience a permanent loss of income, an offer to introduce them to organisations involved with skills training or re-training will be made and financial support given to offset the associated expenses.

10.2.4.3 Resettlement Options

Recognizing the importance of the individual's right to choose and make the best decisions for themselves, the resettlement options will be explained and the person/s being relocated will be given advice in understanding the implications of each option. The two options are: Self-Relocation and Relocation by NWA.

Self-Relocation

Persons can be compensated for the following; structures, lands and crops; they can then use the compensation to conduct their own relocation. These persons will also benefit from other forms of assistance such as a transportation grant, temporary rental assistance of up to six months and transitional grants to cover some transitional costs such as loss of income.

Relocation by NWA

NWA will seek to acquire houses and house lots with the intention to relocate persons who choose this mode of compensation, or because of varying reasons, such as age, gender, unemployment, and legal rights to the land, may not be able to access the open property market. Persons will be taken to visit the proposed relocation units or sites and these will be agreed with the persons prior to relocation.

10.2.4.4 Compensation Options

The following types of compensation options are listed below:

- Cash for structures and/ or crops/trees only
- Cash for structures and land
- Cash for land, structure, crops/trees
- Cash for land only
- Cash for crops/trees only
- An exchange of lands and/or buildings; NWA purchasing house lots or houses, which by agreement with the affected person, is exchanged for possession of the lands/structures they occupy.
- Relocation Grant
- Restoration or cash compensation for restorative works to fences, adjustments to buildings or rebuilding
- Transportation assistance in relocation
- Alternative accommodation where the person wishes to be relocated.
- Temporary rental income

In most cases, compensated persons will be able to salvage all the movable objects on the land, such as all crops, buildings and fixtures, for use elsewhere. In some cases, affected persons will receive more than one type of compensation. Compensation cheques are delivered mainly through the attorneys representing vendors where the assets are registered under the Registration of Titles Act or by the Negotiators. Any and all fees to conduct land surveys, crop assessments and land assessments will be borne by NWA.

Eligibility for Compensation

All compensation for lands, structures and crops will be based on the current open market values determined by the preparation of a valuation report. Valuations will be prepared by an independent company registered with the Real Estate Board of Jamaica and comprising chartered land surveyors. The valuation report for lands will assess the entire land, the area to be taken by the highway and the replacement costs of all structures. These valuations will also take account of modifications to fence and utilities if these are required.

In addition, provision exists for compensation to be made where there are losses of incomes while the replacements of structures are being undertaken and such assessments are also addressed by the valuations. NWA also provides additional cash compensation to assist in relocation, temporary rental, transportation, etc. A separate valuation will be prepared for crops and the rates will be based on the current market rates being used by the Rural Agricultural Development Agency (RADA). Depending on the type of mature crops assessed, compensation will be made for an average period of 3-5 years.

The land acquisition strategy has been developed based on experience and reflects the various classes of ownership and title status. The following are the broad categories of classes of ownership and the options available to persons who wish to do their own relocation.

- Informal Settler/Squatter – Person in possession does not claim ownership or rights to the property. In this scenario, an independent assessment of the value of the structures based on current replacement costs is developed, as well as current market value of crops. These valuations are then agreed with the persons who are in possession of the lands.
- Informal Purchaser/Family Lands – Person in possession of the land claims to have purchased the land or have inherited the property, however, no formal receipts or title exist to confirm this. The initial treatment of this person is similar to the previous scenario with an independent market valuation and a relocation grant being paid initially to the person in possession.
- Registered Owner – Owner has a registered title in their name. Valuations of the lands and crops have been conducted. Payments made for the lands and crops in exchange for title.
- Tenants – person in possession by short term rental agreement or long-term lease. For these tenants, valuation of any structures identified to be owned by tenant as well as any crops grown by them is conducted. The valuations are then agreed with the tenant and the money paid as compensation in keeping with the previous scenarios. Similar to the previous instances these persons are also allowed to reap any crops and salvage any existing structures owned by them.

Documentation Required

Where ownership of lands is in dispute or unknown, this information is sent to the Commissioner of Lands who will arrange for hearings to be held and a ruling made as to who should be compensated for the lands. Certified copies of the following documents are required from persons claiming interest to lands:

- Valid Identification such as passport, driver license, national ID etc.
- Taxpayer Registration Number (TRN)
- Survey diagram (preferably prepared in affected person's name)
- Will (preferably probated)
- Registered Title or Common Law Title
- Sales Agreement and or Purchase Receipts
- Current and past Tax Receipts
- Subdivision Plans or titles to adjoining lands showing their occupation

Valuation of Property/Assets

The valuations will consider the following:

- Buildings only – The full replacement costs of the buildings including designs, fees, etc.
- Commercial enterprises – In addition to the facilities themselves owners will also be compensated for loss of income during the period of relocation of these facilities.

- Properties (Lands with or without Buildings) – The current market value of the property based on what similar properties are being sold for in the same vicinity. This will also include any modifications to fences and utilities which may be required.
- Crops – The current market value of the crops and trees taking into account their age and expected life.
- Farm Lands – Current value of similar lands taking into account the type of soils, costs to prepare the soil, irrigation, fencing, utility modifications and other facilities available.

In those instances, where only a portion of the lands is to be acquired depending on the size of the lot NWA will either acquire the total lot or compensate the owner for that portion of land that will be affected. The following guidelines are applicable to determine whether the entire property will be acquired.

- Farm lands - when the remaining lands are smaller than 5 acres (20,234 sq. m) or where there is no access to the remaining lands
- Residential Lots - when the remaining lands are less than 6000 sq. ft. (557 sq. m)

Where access to properties is impossible, NWA will seek to identify alternative access so as to ensure that there is no loss in value of the properties or impact on the businesses affected. Where there is no alternative access possible, the entire property will be acquired. These individuals will be offered the same compensation packages and resettlement options provided for the lands, dwellings and businesses located in the highway's right of way. In all instances transfer taxes, registration fees, etc. for these transactions, will be borne by NWA.

10.2.4.5 Organizational Responsibilities

Apart from the responsibility for the acquisition of the lands needed to construct the highway, NWA has the responsibility for the relocation of utilities and graves (if any) affected.

Utilities

Where utilities such as water and electrical infrastructures are affected as a result of the proposed highway construction, NWA will notify the relevant authorities in charge of the affected utilities to carry out the necessary works to relocate them at NWA's cost. Approval will also have to be sought from the utility companies, for NWA to provide the basic physical infrastructures of road, electricity and water to any new subdivision (if any) needed to conduct resettlement activities. The respective utility companies are:

- National Water Commission – in charge of water and sewerage systems
- Jamaica Public Service – in charge of electricity
- National Works Agency and Parish Councils – in charge of main roads and parochial roads respectively
- National Irrigation Commission – in charge of the provision of irrigation channels and related infrastructures for farmlands (if applicable).
- Local Cable Companies – provides cable services

Graves (if any)

Special attention will be given to graves, which have sentimental, emotional and cultural values attached to them. All graves will be interred by licensed undertakers contracted by NWA. Re-internment will be in an approved family plot or cemetery. Approval for the re-internment of graves will be sought from the Municipal Councils and Health Department within the parish.

10.2.4.6 Grievance Mechanism

Wherever individuals affected by the proposed highway are dissatisfied with any aspect of the resettlement process, these persons may address their issues. These issues can be raised orally or in writing to: NWAs' Land Acquisition Coordinator or Manager, NWAs' Chief Executive Office or his Designate, Commissioner of Lands, or the Court. A log will be created to keep track of these issues and to ensure that these are responded to. It is the objective of NWA to respond to all issues raised within a reasonable timeframe.

10.2.4.7 Monitoring

Once NWA has entered into an agreement to acquire lands and the affected persons have been relocated, there will be continued dialogue and communication. In the event where the affected persons will carry out self-relocation, NWA will meet with each person as frequently as required to keep abreast of the progress being made to either find housing or to carry out construction activities.

Any works to be carried out by NWA for resettlement will also be inspected weekly and a report done on the progress being made. Weekly meetings will be held to review the progress being made and to find solutions to arising issues which may originate.

Some monitoring indicators used for relocated persons' standard of living include:

- Household/land size (i.e. area and number of rooms)
- Land productivity (small farmers)
- Building materials (wood, blocks)
- Land tenure status (without legal titles/security of tenure)
- Public services (potable water, electricity, transportation, etc.)
- Social services (distance from school, health care facilities, etc.)
- Income (where possible)

10.2.5 Restoration and Rehabilitation Plan

The rehabilitation will start with the restoration of the locations of the construction campsites and other cleared areas associated with the road works. This area will be backfilled with material removed during campsite construction and supplemented with layers of topsoil also removed during clearance activities. It is estimated that approximately 25,140.50 m^3 of topsoil will be removed. The final slope angle of the area will be determined based on the geotechnical characteristic of the material used.

Fast growing herbs and runners (Table 10-3) will be planted in the various pre-cleared areas. These plants will be obtained from a pre-established nursery within which the species necessary for rehabilitation will be housed.

Table 10-3 Plants to be used for rehabilitation currently growing within the project area

Plant Species	Common Name	Growth Form	Status
Alternanthera ficoidea	Crab Withe	**Herbs**	
Leonotis nepetifolia	Christmas Candlestick	**Herbs**	
Panicum maximum	Guinea Grass	**Herbs**	
Hyolocereus triangularis	God Okra	**Runner/Climber**	Endemic
Agave sp.		**Shrubs**	
Bursera simarouba	Red Birch	**Tree**	
Guiacum officinale	Lignum Vitae	**Tree**	National Flower
Leucaena leococehphala	Lead Tree	**Tree**	
Simaruba glauca	Bitter Damson	**Tree**	

The surface will be stabilized according to an active planting program. The establishment of a ground cover is of priority and would include planting the herbs and runners listed in Table 10-3. Their progress will be assisted with the deployment of erosion control blankets and appropriate mulch as necessary. After the ground cover is established, hardwood trees, such as *Bursera simaruba* (Red Birch), *Simarouba glauca* (Bitter Damson), *Guiacum officinale* (Lignum vitae) and *Leucaena leococehphala* (Lead tree) can/will be planted in the final rehabilitation phase. An estimated 251,405 m^2 will be rehabilitated. The vegetation planted will be monitored over a minimum five-year period.

A plant nursery will be setup by the contactor to ensure that sufficient, suitable plant material is available to allow a timely re-vegetation of the site. The nursery will primarily facilitate the care of commonly occurring, native, and endemic plants currently found in the area. The locations and responsibility of this nursery will be determined by the relevant Regulatory Authorities prior to the rehabilitation.

Table 10-4 shows a list of activities and estimated time frames for the Rehabilitation Plan detailed above.

Table 10-4 Activities and estimated timeframes for Rehabilitation Plan

Activity	Timeframe
Backfilling	1 - 2 months
Levelling and Grading	2 - 3 weeks
Planting of grass, herbs, runners and shrubs and deployment of erosion control blankets and mulch	2 - 3 weeks
Planting of hardwood trees	2 - 4 days
Monitoring	Minimum 5 years

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12.0 APPENDICES

Appendix 1 – Terms of Reference

TERMS OF REFERENCE
for an
ENVIRONMENTAL IMPACT ASSESSMENT

for a

Proposed Road Improvement Project

from

Harbour View, Kingston to
Yallahs, St. Thomas
(Section 1A of the Southern Coastal Highway Improvement Project)

by

The National Works Agency (NWA)

Date: 10 November 2016
Prepared by: The National Environment and Planning Agency

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Foreword

The purpose of this document is to establish the Terms of Reference (TOR) for the Environmental Impact Assessment (EIA). The TOR outlines the aspects of an EIA which when thoroughly addressed, will provide a comprehensive evaluation of the proposed site, in terms of predicted environmental impacts, required mitigation strategies and potentially viable alternatives to the proposed project.

The EIA report must be produced in accordance with the approved TOR.

Where the need arises to modify the TOR, the required amendments/modifications are to be made and submitted to the National Environment and Planning Agency (NEPA). Approval for the TOR must be obtained from the NEPA, in writing, prior to the commencement of the EIA study.

The NEPA and the Natural Resources Conservation Authority (NRCA) reserves the right to reproduce, transfer and disclose any and all contents contained in the submitted EIA report without the written consent of the proponent, consultants and/or its agents.

The TOR to conduct the EIA is as follows:

1. Executive Summary

Provide a brief statement on the content of the EIA report condensed to a maximum of ten pages. The executive summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project, etc. In addition, it should include relevant background information, project description, and provide a summary of the main findings, including but not limited to, main impacts and mitigation measures, analyses, important aspects of the environmental monitoring and management plans and the conclusions of the report.

2. Introduction

The Introduction should give a background; explain the need for and the context of the project. The introduction should include, but not be limited to the following:

- Purpose of the project, project proponent, brief description of the project including the name, nature, size, and location of the project; and its importance to the surrounding communities and country
- Land description – land parcels – including where available volume and folio or valuation number, street or scheme address, and parish – and total acreage of land required for the project
- Details of land acquisition inclusive of relocation of infrastructure and residences, where necessary
- Details of existing communities/settlements
- Profile of the project proponent, implementing organization, and/or project consultants, including contact information for each to include, but not limited to name, contact address, telephone number, and e-mail address
- Confirm that the project meets the approved TOR and environmental and planning standards applicable for the project
- The proponent should declare any litigation pending against the proposed project and/or any direction/order passed by any court of law against the project, and if so, details thereof

3. Legislation and Regulatory Consideration

Outline the pertinent regulations, standards, government policies and legislation governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, and land use control at the national and local levels. The examination of the legislation should include at minimum, legislation such as the Natural Resources Conservation Authority Act, Land Acquisition Act, Wild Life Protection Act, Land Development and Utilization Act, Public Health Act, Main Roads Act, Town and Country Planning Act, Building Act, codes and standards and any regulations promulgated under any of the previously mentioned Acts, Development Orders and Plans and all appropriate international convention/protocol/treaty, where applicable. This section should also describe traditional land uses and any prescriptive and/or public access rights.

4. Project Description

The description should include a comprehensive overview of the project, noting areas to be reserved for construction and verges. The description of the project should give the total length and width of the alignment, the width of the right-of-way, width of verges, drainage requirements, bridges and crossings and the location of ancillary buildings and facilities. This will also include a description of all activities and features, which will introduce risks or generate impacts (negative and positive) on the environment. These activities may be associated with secondary facilities such as fuel dispensing sites, concrete and asphalt batching plants, camp sites and site offices, and material and spoil storage sites. This will 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. For projects to be done on a phased basis it is expected that all phases be clearly defined, the relevant time schedules provided, and phased maps, diagrams and appropriate visual aids included.

In light of the above, a comprehensive and detailed description of the proposed project should be provided. This section will provide information on the proposed project and should include but not be limited to:

- History and background of the project
- Name and address of land owners, accompanying title/deed of conveyance as well as land tenure and use of immediately adjacent lands (plan required), where available
- Relevance of the project in light of the existing local and national development plans and policies
- Detailed description of the proposed alignment, right-of-ways, and easements
- Description of the general construction methodologies
- Details of any modification of the current road network adjacent to the project and any required, permanent or temporary road diversions
- Modification of existing infrastructure including but not limited to natural (eg. rivers, gullies, waterfalls, etc.) and man-made drainage features, bridges, pipelines, utilities, etc.
- Details of off-site facilities such as construction camps and infrastructure services
- Details for the decommissioning and abandonment of works and/or facilities
- Possible source of suitable material for road fill and details of any proposed quarry operation
- A detailed restoration plan for all areas modified as part of the construction highlighting grading and proposed changes in topography, as well as proposed landscaping.
- Details of proposed accesses to the project sites (road and ancillaries) to be used for pre-construction, construction and operational phases. This description should detail all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to deforestation, soil erosion and sedimentation, slope stability, impact to biodiversity.
- All phases of the project should be clearly defined, the relevant time schedules provided and phased maps, diagrams and appropriate visual aids included
- Details of infrastructure development including design plans for all components of the development including any proposed wastewater/sewage treatment system and disposal of treated effluent must be clearly outlined.

- A comprehensive description of all on and off site drainage works. This plan should consider existing natural drainage channels, proposed man-made drainage/water features or any proposed changes in topography. Potential issues of increased surface runoff and sediment loading must also be addressed. Special emphasis should also be placed on the storm water run-off, drainage patterns, characteristics of the aquifer, including the level and status of the groundwater.
- Plans for providing utilities, particularly details relating to the source of potable water and electricity generation, roads and other services should be clearly stated
- Methods and location of construction waste storage and disposal
- A Waste Management Plan which clearly outlines expected quantities of construction waste during the construction phase, general waste arising from material consumption of the workforce, as well as, all expected waste during the operational phase should be completed. Details should also be provided for any central disposal area(s) being considered to serve the proposed development
- Details of equipment and machinery to be involved, how these will be mobilized and areas to be used for storage of machinery and material should be clearly indicated.
- Methods for long term slope stabilization, methods and strategies for site rehabilitation, re-vegetation plan, list of species to be used in proposed rehabilitation, top soil cover to be used, monitoring and management for rehabilitated areas, including potential use of the rehabilitated area.
- Timelines for all ancillary project activities to be clearly defined.

Essential maps to be provided with EIA should include but not be limited to:

- A location map at a scale of 1:12,500 (or an appropriate scale) showing regional setting
- Site maps illustrating extent of road alignment, areas to be mined or quarried, buffers and areas to be preserved in their natural and existing state. It should clearly demarcate the exact location of the proposed project and should clearly identify the areas which will be used for road construction and those which will be used for the storage and stockpiling of material and spoils.
- A site layout plan showing the various components and design elements of the proposed development as well as the spatial allotments for the various design elements of the project.
- A map of project area and 5 km area from proposed road alignment, delineating protected areas (special fishery conservation areas, national parks, game reserves, forest reserves, heritage site)/ sensitive ecosystems areas / parish and county boundaries
- Land use map of the study area at a scale of 1: 12,500 based on recent satellite imagery of the project area and 5 km from the proposed project boundary delineating, forest area and built-up areas, water bodies, human settlement, agricultural lands, coastal features, and other surface features such as railway tracks, ports, fishing beach, aquaculture facilities, roads, major industries, etc.
- Site layout plan of the proposed development shall be submitted to a scale of 1:5000, clearly marking the road alignment, ancillary operations, batching and/or crushing plants, silos, conveyors, roads, railway tracks, administrative and operational buildings, utilities, towns, etc.

- Area drainage and contour maps of the project area and 5 km from the proposed. In case of any proposed diversion of gully/river/natural drainage features, same shall also be shown in the map.

5. Description of the Environment

This section involves the generation of baseline data which is used to describe the study area as follows:

i) Physical environment
ii) Biological environment
iii) Socio-economic and cultural environment

The study area should be clearly identified and referenced. Taking into account the types of resources located in the area and the magnitude of the associated impacts, the study area should be large enough to include all valued resources that might be significantly affected by the project. The methodologies employed to obtain baseline and other data should be clearly detailed in the EIA. All assessments should be conducted for both the wet and dry seasons. Where existing data is presented it should be not more than five years old. This information will form the basis upon which impacts of the project will be assessed.

The following aspects should be described in this section:

i. Physical Environment

- General description of a project site including the topography of the site, ground and surface water features, etc.
- Detailed geotechnical studies of the areas outside of the existing road alignment and propose recommendation to address any of issues identified
- Geological faults within 5km of the proposed alignment, in addition to any other geological structure(s) vis-à-vis fracture plains and orientation of bedding
- Identification of old landslides on or in close proximity to the highway route
- Proposed future development of lands with special emphasis on storm water run-off, drainage patterns and any possible slope stability issues
- Water quality of ground and surface water features/resources including coastal waters, rivers, ponds, streams, wells in the vicinity of the development, with special emphasis on those to be crossed by the proposed alignment and in the vicinity of camp sites, and quarrying, crushing and batching operations. Quality indicators should include but not necessarily be limited to suspended solids, turbidity, oil and grease, pH, dissolved solids, BOD, DO, and coliform bacteria.
- Climatic conditions in the area of influence inclusive of wind speed and direction, precipitation, relative humidity and ambient temperatures
- Air quality in the area of influence including air emissions (e.g. TSP, PM10, NOx, SOx) from stationary or mobile sources. *A review of the Natural Resources Conservation Authority Air Quality Regulations and the implications of the regulations on the proposed project should be conducted and ascertained.*
- Noise levels of the undeveloped site and the ambient noise in the area of influence
- Sources of pollution existing and extent of contamination

- Include a section called "Issues of Natural Hazard and Geotechnical Stability".
- Proximity of raw material to haulage route and stockpile area

ii. ***Drainage and Storm Water Management***

An assessment of storm water drainage should be conducted and proposed drainage features should be designed and calculated to accommodate the volume and velocity of storm water post construction and not cause flooding of the highway or any adjacent lands or communities. This should cover but not be limited to:

- Drainage for the site during construction and operation to include mitigation for erosion and sediment control
- Drainage control for crossings of rivers and/or gullies, to include impacts that drainage control features could have on aesthetics, water quality and sedimentation
- Assessment of the impact of draining the site on adjacent communities and on future developments including mitigation measures
- Assessment of drainage channels for debris flow associated with up gradient land use as well as impacts related to climate change
- Assess the use of detention ponds to regulate peak flow
- Identify and clearly map locations of sinkholes, to ensure that where necessary, these are not traversed by the proposed alignment
- Identify other effects of storm water run-off such as the input of oil and grease into the aquatic (marine and freshwater) environment
- Identify avenues for the collection and reuse of storm water

iii. ***Natural Hazards and Climate Change***

Vulnerability assessment of the development in relation to the following must be undertaken and should take in account climate change projections:-

- Climate change
- Hurricanes and earthquakes

iv. ***Biological Environment***

Present a detailed description of the flora and fauna of the project area, with special emphasis on migratory, rare, endemic, protected or endangered species. In this section the emphasis is on a description of habitats, flora and fauna and should include species list, commentary on the ecological health, function and value in the project area, threats and conservation significance. There may be the need to incorporate micro-organisms to obtain an accurate baseline assessment.

This should include:

- A detailed qualitative and quantitative assessment of the habitats in and around the proposed project area and the areas of impact
- Flora and fauna surveys and resulting species lists
- Species dependence, niche specificity, community structure, population dynamics, species richness and evenness (a measure of diversity)

- Different ecosystem types including cave and sinkholes and their species, if present
- Nocturnal species within the project site. Attention should be paid to the species of tree dwelling bats inhabiting areas in close proximity to the proposed alignment.
- Biological diversity importance of the area
- Identification and description of invasive and economically important species

The field data collected should include, but not be limited to:

- Vegetation profiles
- Species lists for each community
- A habitat and species distribution map of the project area

v. ***Heritage***

The historical importance of the area should also be examined, augmented by consultation with the Jamaica National Heritage Trust (JNHT). An assessment of artifacts, archaeological, geological and paleontological features of the site must also be conducted in collaboration with the JNHT.

vi. ***Socio-economic Environment***

Demography, regional setting, location assessment and current and potential land-use patterns (of neighbouring properties); description of existing infrastructure such as transportation, electricity, water, telecommunications, public health and safety; cultural peculiarities, aspirations and attitudes should be explored; and other material assets of the area should also be examined. A socio-economic survey to determine public perception of the project should also be completed and this should include but not be limited to potential impacts on social, aesthetic and historical/cultural values. This assessment should include but not be limited to:

- Present employment and livelihood, sources of employment and income of populations in the vicinity of the project
- Awareness of the population about the proposed project
- Major economic activities in the vicinity of the project

The following must also be identified:

i. Existing land development, communities and settlements
ii. Demography of surrounding areas
iii. Private land acquisition needs
iv. Tenure issues identified during pre-application consultations and how they will be addressed
v. Local economic costs and benefits of the project (overall and on an individual community basis)
vi. Implications of the project for traffic flow from adjoining communities, resident commuter travel and travel times; accommodation for construction workers; access to and delivery of health, educational and, social services and emergency support to local communities

vii. Economic impact of the construction phase (road closures, delays and detours) on the local economy and adjacent communities
viii. Proximity of alignment to established residential settlements
ix. Availability of solid waste disposal facilities
x. Availability of public sanitary facilities (rest stops) along the corridor

vii. ***Risk Analysis Study***

The objective of the Risk Analysis Study is to identify potential credible hazards arising out of the road construction works, to mitigate severity and to aid in preparing effective emergency response procedures by delineating an emergency response plan to handle on-site and offsite emergencies.

viii. ***Emergency Response Plan***

An Emergency Response Plan (ERP) should be prepared to effectively deal with all potential hazards and ensure that the developer is in a state of preparedness to respond to such events and their effects to the population including workers. The ERP should cater to worst disaster scenarios with reference to specific cases like hurricanes, landslides, floods, oil/chemical spills, fire, explosion, toxic dispersion, etc. The plan should include details of systems for the early detection of emergencies, details on the command and co-ordination of response agencies, list of trained personnel, list of available appropriate resources for handling emergencies, emergency response actions, methods of notification, and details of communication facilities and training for personnel. Where applicable, the plan should propose mitigation measures for specific emergency situations and methods of containment, remediation, and rehabilitation. Infrastructure requirement for on-site emergency controls and mechanism for integration of protocols of operation with the Office of Disaster Preparedness Emergency Management shall be prepared.

ix. ***Resettlement and Relocation Plan***

This plan should detail the procedures to be followed and the actions to be taken to properly resettle and compensate people and communities that will be adversely impacted by the proposed project. The plan must identify the full range of people and communities to be affected by the project and justify their displacement after consideration of alternatives that would minimize or avoid displacement.

x. ***Restoration and Rehabilitation Plan***

This plan should be prepared in a tabular form indicating the extent and quantitative coverage of the area to be rehabilitated. The plan should also include proposed plant species and timeframe for rehabilitation/restoration.

6. Public Participation

Describe the public participation methods, timing, type of information provided and collected from the public and stakeholder target groups meetings. The instrument used to collect the information must be included in the appendix. It may be useful and necessary to hold stakeholder meetings to inform the public of the proposed development and the possible impacts. This will also gauge the feeling/response of the public toward the development.

The issues identified during the public participation process should be summarized and public input that has been incorporated or addressed in the EIA should be outlined.

Public Meetings should be held in accordance with the Guidelines for Conducting Public Presentation at a time and location signed off by the NEPA. A public meeting will be required to be held to present the findings of the EIA once completed and approved by the NEPA. All relevant documents are required to be made available to the public. In addition, any material change to the design of the project, subsequent to the public meeting, will require a further public meeting to be undertaken by the developer and all changes made to the project clearly outlined to the public.

7. Impact Identification and Assessment/ Analysis of Potential Impacts

A detailed analysis of the project components should be done in order to identify the major potential environmental and public health impacts. This section of the report should detail:

- Positive and negative impacts
- Distinguish between the level and significance of impacts (a ranking from major to minor/significant to insignificant should be developed)
- Duration (long term, short term or immediate) of impacts
- Distinguish between direct and indirect, reversible and irreversible or avoidable and unavoidable impacts

Cumulative impacts should also be evaluated taking into account previous developments, additional phases being considered and any proposed development immediately adjacent to the project.

The identified impacts should be profiled to assess their magnitude. The major environmental and public health impacts should be noted and the relative importance of the associated aspect to the design of the project and the intended activities indicated. The extent and quality of the available data should be characterized, explaining significant information deficiencies and any uncertainties associated with the predictions of impacts. A major environmental impact is determined after examining the impact (positive or negative) on the environment and having the negative impact significantly outweigh the positive. It is also determined by the number and magnitude of mitigation strategies which need to be employed to reduce the risk(s) introduced to the environment. Project activities and impacts should then be ranked as major, moderate and minor and presented in separate matrices for all the phases of the project (i.e. pre-construction, construction, operational and decommissioning/closure). The potential impacts may be subdivided into physical, biological, socio-economic and cultural impacts. All impacts should be assessed, listed, and ranked.

The impacts to be assessed will include but not be limited to the following:

i. Flooding potential and change in drainage pattern
ii. Pollution of wells, potable, surface or ground water
iii. Blasting, noise, vibration and other such impacts on residents and communities
iv. Impacts of excavation and construction on the existing landscape
v. Loss of and damage to geological and palaeontological features

vi. Cultural impacts including changes in the historic landscape, architecture and archaeology of the site
vii. Socio-economic impacts including impact on residences; private, public and commercial property; recreational facilities; and burial sites
viii. Slope stability and landslides
ix. Loss of biodiversity, ecosystem functions and natural features
x. Habitat loss and/or fragmentation
xi. Air pollution
xii. Maintenance of any alternative routes identified
xiii. Natural hazards including hurricanes, earthquakes, torrential rain, etc.
xiv. Hazardous material storage
xv. Solid waste generation
xvi. Land clearance and change in land use
xvii. Impacts on existing infrastructure including utilities

8. Impact Mitigation

The mitigation measures should endeavour to avoid, reduce and remedy the potential negative effects, while enhancing the positive impacts projected. Mitigation and abatement measures should be developed for each potential negative impact identified. Each proposed measure should be quantifies and assigned financial and economic value. Recommendations for the enhancing beneficial impacts should also be included. The use of green technology should be examined and strategies for the conservation of energy and water must be outlined.

The assessment of impacts must be accompanied by guidelines for avoiding, as far as possible, (e.g. restoration and remediation) any adverse impacts due to proposed use of the corridor and utilization of existing environmental attributes for optimum development. These guidelines should also include the issues of restoration and rehabilitation.

9. Residual Impacts

This section should identify any residual negative impacts that potentially have no solution for mitigation, for example, change in aesthetics, habitat loss, etc.

10. Analysis of Alternatives

Alternatives to the proposed project including the no-action alternative should be examined. These should be assessed according to the physical, ecological, climatic variability, and socio-economic parameters of the site. The assessment of alternatives should also consider the potential impacts of climate change on the site. This examination of alternatives should incorporate the use of the history of the overall area in which the site is located and previous uses of the site itself. Alternatives should also address specific aspects of the project such as methods, locations, layouts, costs and technologies proposed in the execution of the project that have been identified as being causes of major impacts. This section of the report should include a description of each alternative considered, summary of adverse impacts of each alternative, and the rationale for the selected project alternative.

11. Environmental Monitoring and Management

An Environmental Management Plan should be developed which will detail the requirements for the pre-construction, construction, operation and decommissioning/closure phases of the project. This should include, but not be limited to training for staff, as well as recommendations to ensure the implementation of mitigation measures and long term minimization of negative impacts. Proposals for compliance reporting and the responsible reporting parties should be detailed.

The plan should include at a minimum:

- Summary of potential impacts & recommended mitigation measures
- Allocation of resources and responsibilities for plan implementation
- Administrative and technical setup for management of environment
- Institutional arrangements proposed with other organizations including government authorities for effective implementation of environmental measures proposed in the EIA
- Environmental specifications and safeguards for contractors during construction and rehabilitation stage

An Environmental Monitoring Programme should also be included in the EIA. It should include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, and emergency procedures).

At the minimum the monitoring programme should include:

- Introduction outlining the need for a monitoring programme
- The activities and parameters being monitored, implemented mitigation measure and reference standards
- The areas being monitored (including a control site), the methodology, analysis and data evaluation to be employed for the monitoring of the various parameters (during construction and operational phases), and the frequency of sampling and monitoring recommended
- Proposed location of monitoring stations
- The name and qualifications of the person(s) proposed to undertake the monitoring
- Frequency of submission of monitoring reports to NEPA
- A sample of the report
- A public complaints register
- Recommendations

12. List of References

13. Appendices

The appendices should include but not be limited to the following documents:

i. Reference documents
ii. Photographs and maps
iii. Data tables
iv. Glossary of technical terms
v. EIA TOR
vi. Composition of the consulting team (team that undertook the study/assessment, including name, qualification and roles of team members)
vii. Notes of public consultation sessions
viii. Instruments used in community surveys

14. Activities

In order to effectively and efficiently conduct the EIA it will be necessary to carry out various activities which include:

Documentation Review

All documentation pertaining to the development will need to be reviewed. These should include, but not limited to, the project profile, site plan, drainage plan, vegetation clearance plan, applications made for financing or planning approval, and any technical and engineering studies that have been done.

Analysis of Alternatives

Alternatives to the site location, project design and operation conditions will be analyzed including the "no-action" alternative. These alternatives will be assessed based on the physical, ecological and socio-economic parameters of the site identified. The physical, biological and sociological settings will provide the framework in which to assess the different project alternatives. This would clarify, for instance, whether the site could be used for other purposes as well as whether there are any particular aspects of the development that can be sited differently, operated differently, etc.

Impact Assessment

The consultant should carry out a detailed impact assessment of the project components (preconstruction, construction, operational and decommissioning/closure stages) in order to identify the potential impacts (positive, negative and cumulative impacts) that will be associated with the project. The significance and magnitude (major, moderate and minor) of the impacts identified will also be evaluated through the use of a weighted matrix.

The impacts to be assessed will include but not limited to the following:

- Effects of project design and engineering;
- Effects on visual aesthetics and landscape;
- Effect of noise and vibration;
- Effects of operation activities such as site clearance and geological formation, earthworks, hurricanes, access routes, transportation networks and spoil disposal;
- Effects of operation and maintenance activities such as waste disposal, traffic management, site drainage, sediment, sewage, public access and air quality; and
- Effects on ecology including effect on terrestrial and other habitats

- Emphasis should be placed on any rare, endangered, and endemic species found
- Effects on socio-economic status such as changes to public access, recreational use, existing and potential agricultural activities, contribution of development to national economy and development of surrounding communities.

All findings must be presented in the EIA report and must reflect the headings in the body of the TORs, as well as, references. GIS references should be provided where applicable. One hard copy and an electronic copy must be submitted to NEPA for review after which ten (10) hard copies and an electronic copy of the report should be submitted. One copy of the document should be perfect bound.

The report should include appendices with items such as maps, site plans, the study team and their individual qualifications, photographs, and other relevant information. All of the foregoing should be properly sourced and credited.

Appendix 2 – Study Team

- **CL Environmental Co. Ltd.:**
    - Carlton Campbell, Ph.D., CIEC (Noise, Noise modelling)
    - Matthew Lee, M.Sc. (Water Quality, Air Quality, Climate)
    - Rachel D'Silva, B.Sc. (Water Quality, Topography)
    - Karen McIntyre, M.Sc. (Legislation, Socioeconomics and GIS)
    - Errol Harrison (Field Technician – Air Quality and Noise)
    - Glen Patrick (Field Technician – Air Quality and Noise)

- **Stanley Consultants INC.:**
    - Andrew Evans, P.E. (Engineering Aspect)
    - Stephanie Bromfield, P.E. (Traffic Impact Assessment)
    - Lawrence Barrett, P.E. (Hydraulic/Hydrology Assessment)
    - Rick Black, P.E. (Environmental Reviewer)
    - Natalee James (Project Coordinator)

- **Associate Consultants:**
    - Eric Garraway, Ph.D. (Faunal Survey)
    - Catherine Murphy, Ph.D. (Faunal Survey)
    - Damion Whyte, M. Phil (Faunal Survey)
    - Philip Rose, Ph.D. (Vegetation Survey)
    - Jannette Manning, M.Sc. (Perception Survey)

Appendix 3 – Land Parcels with ROW, Section 1A

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
1		0							85.863568
3	106B5Z13044	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	286.962226
4		0							8134.665349
8	106B5Z13056	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	8.159765
9	106B5Z13	0							56.782083
11	106B6Y11001	1202	961	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	651.001361
13	106B5Z15007	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	191.718344
18	106B5Z13053	1218	842	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	99.278069
21	106B5Y01120	975	239	25 MARS DRIVE	1982		KINGSTON 17	ST.ANDREW	37.705076
24	106B6Y05	0							93.552995
27	106B6Y01	0							433.156309
29	106B5Z15012	627	13	ST THOMAS ROAD	2		BULL BAY P O	ST.ANDREW	14.234148
31	106B5Y06020	819	2	SAINT THOMAS ROAD	4		SEVEN MILES P A	ST.ANDREW	449.894834
32	106B5Y07001	1133	211	SAINT THOMAS ROAD			SEVEN MILES P A	ST.ANDREW	1344.799819
33	106B5Y01	0							5033.184809
35		0							188.348051
36		0							78.783149
42	106B5Z13013	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	194.274925
43		0							123.071973
44	106B5Y06023	1282	209	SAINT THOMAS ROAD	7		SEVEN MILES P A	ST.ANDREW	439.126764
46		0							38.854753
47	106B5Y01109	975	243	3 MARS DRIVE	2086		KINGSTON 17	ST.ANDREW	26.446265
55		0							76.317197
56		0							116.250505
57		0							143.567619
58		0							1947.626843
59		0							90.509281
60	106B5Y06017	0		SAINT THOMAS ROAD	1		SEVEN MILES P A	ST.ANDREW	139.871822
61	106B5Y06022	1278	333	SAINT THOMAS ROAD	6		SEVEN MILES P A	ST.ANDREW	290.900353
62	106B5Y01112	975	248	9 MARS DRIVE	1990		KINGSTON 17	ST.ANDREW	33.035341
63	106B5Y06030	976	151	SAINT THOMAS	13 PT		SEVEN MILES P A	ST.ANDREW	129.642593
64	106B5Y01125	975	234	35 MARS DRIVE	1977		KINGSTON 17	ST.ANDREW	49.001499
65	106B5Z13004	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	191.95374
67	106B5Y01115	975	245	15 MARS DRIVE	1987		KINGSTON 17	ST.ANDREW	34.471583
68	106B5Y01124	975	235	33 MARS DRIVE	1978		KINGSTON 17	ST.ANDREW	44.11209
70	106B5Z13011	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	78.944794
71	106B5Z13011	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	71.13998
75	106B5Y01107	978	361	1A MARS DRIVE	2070		KINGSTON 17	ST.ANDREW	41.727193
76	106B5Y01122	975	237	29 MARS DRIVE	1980		KINGSTON 17	ST.ANDREW	47.863267
78	106B5Y01121	975	238	27 MARS DRIVE	1981		KINGSTON 17	ST.ANDREW	42.469032
81	106B5Z13012	1375	51	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	199.138817
82	106B5Z13010	988	543	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	377.527576
83	106B6Z08025	0							16.535312

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
84	106B5Z13022	945	469	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	234.47224
87	106B5Z15008	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	1501.043517
89		0							139.836408
90		0							260.783449
91		0							236.97974
94	106B5Y06026	1077	873	SAINT THOMAS ROAD	10+		SEVEN MILES P A	ST.ANDREW	453.303981
95	106B5Z13019	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	294.237379
99		0							366.979913
102	106B5Y01110	975	250	5 MARS DRIVE	2085		KINGSTON 17	ST.ANDREW	25.538055
103	106B5Y11	0							512.192687
104	106B5Y01118	975	241	21 MARS DRIVE	1984		KINGSTON 17	ST.ANDREW	43.761693
106	106B5Z13020	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	240.703776
110	106B5Z15006	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	1552.588028
112	106B5Y01108	975	251	1 MARS DRIVE	2087		KINGSTON 17	ST.ANDREW	45.332403
114	106B5Z13	0							5125.114062
117	106B5Y01113	975	247	11 MARS DRIVE	1989		KINGSTON 17	ST.ANDREW	35.933885
119	106B5Z15005	1004	605	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	1252.801974
120	106B5Z13002	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	251.50721
123	106B5Z13042	1079	793	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	238.318885
124	106B5Z13016	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	90.864036
129	106B5Z13067	0							312.184402
130	106B5Z15010	627	13	ST THOMAS ROAD	1		BULL BAY P O	ST.ANDREW	86.068548
132	106B5Y06024	522	24	SAINT THOMAS ROAD	8		SEVEN MILES P A	ST.ANDREW	477.120365
133	106B5Z13025	999	682	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	145.492536
134	106B5Z16	0							348.729778
139	106B5Y06026	1077	873	SAINT THOMAS ROAD	10+		SEVEN MILES P A	ST.ANDREW	413.3604
142	106B5Y02	0							818.981105
143	106B5Y01123	975	236	31 MARS DRIVE	1979		KINGSTON 17	ST.ANDREW	48.094628
146	106B5Y02	0							455.173807
148		0							56.488189
150	106B5Y06039	1078	248	12-14 COPLY DRIVE	7-Jun		KINGSTON 17	ST.ANDREW	159.639003
151	106B5Z13	0							610.240319
152	106B5Z13003	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	103.003803
153	106B5Z13023	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	205.78139
155	106B5Y01117	975	242	19 MARS DRIVE	1985		KINGSTON 17	ST.ANDREW	28.056294
162	106B5Z13	0							184.027118
164	106B6Y09	0							310.790894
171	106B5Y01111	975	249	7 MARS DRIVE	2084		KINGSTON 17	ST.ANDREW	28.509129
174	106B5Z13005	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	262.35385
178	106B5Z15009	963	275	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	17.414535
180	106B5Y01119	975	240	23 MARS DRIVE	1983		KINGSTON 17	ST.ANDREW	42.308722
188	106B5Y01132	975	227	49 MARS DRIVE	1970		KINGSTON 17	ST.ANDREW	57.364221
189	106B5Y01126	975	233	37 MARS DRIVE	1976		KINGSTON 17	ST.ANDREW	45.719023
190	106B5Y01127	975	232	39 MARS DRIVE	1975		KINGSTON 17	ST.ANDREW	48.346024
192	106B5Z13017	1154	362	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	170.347157
193	106B5Z13001	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	158.705945

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
208	106B6Y01025	0							37.541335
214	106B6Y01	0							243.284149
215	106B6Y05	0							105.527145
217	106B6Y08	0							170.973938
219	106B6Y08	0							274.092033
227	106B6Z03046	0		GEM AVENUE	70		BULL BAY P O	ST.ANDREW	854.837206
228	106B6Y05012	1047	219	BAY VIEW TERRACE	12		BULL BAY P O	ST.ANDREW	345.118434
231	106B5Z08062	0							367.205146
232	106B5Y01131	975	228	47 MAR DRIVE	1971		KINGSTON 17	ST.ANDREW	35.966896
235	106B5Z13041	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	393.666278
238	106B6Y01	0							526.580727
243	21301019075	0							2048.871618
244	21301021069	0							1513.051577
245		0							146.888357
246	21304005	0							2190.57435
247	21304005	0							2219.479601
249	106B6Y08	0							252.614944
251	106B5Z13052	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	2696.904142
253	106B5Z13040	1164	589	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	704.001234
254	21301021084	0							126.834451
255	21304006001	0							518.889124
256	23202005	0							290.652977
257	23202005	0							86.008376
259	21301019043	0							38.084959
260	21301019074	0							377.89277
261	21301021088	0							6173.463778
262	21304005	0							28737.41081
263	21301021090	0							12268.4919
265	21301021	0							85.845529
267		0							1176.131453
270	21304006034	0							943.061485
272	21304006	0							25.281891
274	21304006	0							18021.78598
277	21301021087	0							1173.655992
279	21301021066	0							997.374211
280	21301021	0							2711.442253
281	21301021072	0							189.079972
282	21305019	0							1017.888864
284	21301021068	0							1571.938352
286	21301021071	0							588.327566
287	21304006	0							3385.3506
294	21301021083	0							7.674072
295	21304006028	0							1954.142052
299	21304006087	0							710.300909
300	21304006031	0							1781.775286
303	21305019	0							3186.141389

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
306	23202014	0							112.842277
307	21301021067	0							1107.525993
309	21304006030	0							1528.380532
310	21304006032	0							1038.428782
311	21301021074	0							1333.037066
312	21304006	0							12596.88548
313	21304006003	0							0.102693
316	21301021073	0							1242.386279
317	21304006	0							658.079139
318	21304006029	0							1537.443393
320	21305016	0							947.368212
322	23202005	0							2394.465108
324	21304006026	0							98.476424
325	21301021062	0							43.748759
327	21304006027	0							6343.792523
328	23202009	0							1877.558414
332	21305016	0							10068.47933
338	21304006007	0							0.944751
339	21301021065	0							650.748042
340	21304006033	0							1911.302227
342	21301021064	0							411.862347
343	21301021070	0							891.444127
344	21301021063	0							342.219685
345	21304006086	0							3341.63118
346	21304002	0							10255.80359
348	21304001	0							14.709495
351	106B5Z03006	0							54.118931
354	21301021086	0							1259.877127
355	23202009	0							126.312854
361	21301021085	0							503.846322
364	23202001	0							23.360625
369		0							169.658031
370	21304006088	0							5657.075784
376	106B5Y07004	0							1176.537588
379	106B5Y07002	0		SAINT THOMAS ROAD			SEVEN MILES P A	ST.ANDREW	696.322375
381	106B5Y07004	0							1176.537588
392	23202003001	0							773.569079
395	106B5Y01106	978	362	1B MARS DRIVE	2071		KINGSTON 17	ST.ANDREW	14.646657
396	23202003001	0							773.569079
420	106B5Y07004	0							1176.537588
439		0							1309.695293
440		0							345.852942
443	23202002001	0							39318.84151
444		0							153.925466
445	21305015015	0							11656.59769
447		0							11656.59769

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
457	21305016	0							43772.80559
458		0							3203.709964
461	21306015150	0							11656.59769
464		0							40.180791
466	21306015150	0							11656.59769
471	21306015012	0							11656.59769
472	21305015015	0							11656.59769
475	106B6Y01	0							299.900761
476	21304004	0							362.440243
477	106B6Y01031	0							496.183827
482	21301021089	0							3420.62994
490		0							358.026015
492	21301021	0							2757.675877
494	21301019	0							2953.25363
496	21301021	0							12581.61023
499	21301006	0							383.087255
505	106B6Z03037	0							339.906675
506	21304004	0							6704.41664
507		0							335.788651
508		0							81.3012
514		0							449.319989
521	21301006	0							9283.402109
523	23202005	0							192.515344
524		0							773.374462
525	23202009	0							65.377293
528	23202009	0							365.710511
534	106B5Y06044	1030	60	SAINT THOMAS ROAD	4 PT		SEVEN MILES P A	ST.ANDREW	105.135021
535		0							345.080878
537	106B5Y06019	819	3	SAINT THOMAS ROAD	3		SEVEN MILES	ST.ANDREW	19.188089
539	106B5Y06041	1025	38	ST THOMAS ROAD			SEVEN MILES P A	ST.ANDREW	137.231599
540		0							67059.30438
541	106B5Z13051	1048	166	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	350.40823
542		0							8606.970427
544		0							43.073888
546	106B5Z13007	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	215.240233
547	106B5Z13008	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	546.542185
548	106B5Y08	0							1095.958972
549		0							1098.471127
550	106B5Z13006	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	247.376198
551		0							942.334546
552	106B5Z13009	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	431.949543
553	106B5Y11	0							297.196464
554	106B5Y11161	1014	70	ST THOMAS MAIN ROAD			SEVEN MILES P A	ST.ANDREW	590.160149
555		0							151.179629
558		0							2044.850283
562		0							297.474157

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
566	106B5Y11160	991	31	ST THOMAS MAIN ROAD			SEVEN MILES P A	ST.ANDREW	582.007497
574	106B5Y06016	955	483	SAINT THOMAS ROAD			SEVEN MILES P A	ST.ANDREW	216.682307
575		0							98.735854
581	106B6Y01	0							682.378662
585	106B6Y01	0							682.378662
588	23202009	0							3697.687188
589		0							2451.292033
590	106B5Y11	0							1102.416026
591	105D6Y01053	0							300.773772
592		0							80.26399
598		0							10588.56685
599	106B6Y01	0							295.956613
600		0							306.508887
641	23202016160	0							10.844148
651	23202015	0							1644.677187
667		0							8129.169709
668	106B5Z13	0							35.155408
669	106B5Z13026	978	633	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	122.880808
670	106B5Z13033	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	122.858508
671		0							288.234548
672	106B5Z13024	987	343	ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	253.697293
673	106B5Z13027	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	71.365881
674	106B5Z13034	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	75.262572
675	106B5Z13035	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	81.784283
676	106B5Z13028	0		ST THOMAS ROAD			BULL BAY P O	ST.ANDREW	50.065114
679	106B5Z13	0							52.042077
334	23202005001	1077	898	SUNSHINE DRIVE	1 & 2	ALBION	YALLAHS P O	ST.THOMAS	75.303435
335	23202005001	1077	898	SUNSHINE DRIVE	1 & 2	ALBION	YALLAHS P O	ST.THOMAS	1030.567371
441	21306015160	1408	877		10	ALBION	YALLAHS P O	ST.THOMAS	114.20738
446	23202001002	1053	380			ALBION	ALBION P O	ST.THOMAS	10881.85444
459	21306015151	1329	128		2	ALBION	YALLAHS P O	ST.THOMAS	2088.964697
463	21306015155	1398	735		3	ALBION	YALLAHS P O	ST.THOMAS	2159.740744
465	21306015153	1398	733		1	ALBION	YALLAHS P O	ST.THOMAS	6493.942415
470	21306015154	1398	734		2	ALBION	YALLAHS P O	ST.THOMAS	2445.661358
478	21306015165	609	29		9 PT	ALBION	YALLAHS P O	ST.THOMAS	1696.32658
527	21306015010	1140	937		129	ALBION EST	YALLAHS P O	ST.THOMAS	3043.549572
556	21306015011	1037	74		15 PT	ALBION EST	YALLAHS P O	ST.THOMAS	636.775966
587	21306015009	1037	74		15 PT	ALBION EST	YALLAHS P O	ST.THOMAS	1094.176614
248	21305019053	1106	47	BLUE MOUNTAIN ROAD	184A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	2554.494281
258	21305019048	1106	48	BLUE MOUNTAIN ROAD	185A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	6140.917151
266	21305016047	1106	115	DOVER CLOSE	26	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	153.616392
278	21305016046	1106	116	DOVER CLOSE	27	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	2071.616344
285	21305019046	1105	855	SANTA CRUZ WAY	2A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	396.898513
298	21305019045	1202	606	SANTA CRUZ WAY	3A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	6.543453
304	21305019047	1105	854	SANTA CRUZ WAY	1A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	1368.129938
315	21305019050	1106	45	SANTA CRUZ WAY	182A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	380.908715

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
321	21305019049	1106	46	SANTA CRUZ WAY	183A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	1889.931081
333	21305016048	1106	114	DOVER CLOSE	25	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	24.354211
336	21305016045	1106	117	DOVER CLOSE	28	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	2422.20373
341	21305016042	1106	120	DOVER CLOSE	31	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	3915.827281
347	21305019044	1105	857	SANTA CRUZ ROAD	4A	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14.695329
349	21305016043	1106	119	DOVER CLOSE	30	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	1788.752181
356	21305016122	1106	827		131	ALBION ESTATE	YALLAHS P O	ST.THOMAS	15359.84115
357	21305016119	1106	824		128	ALBION ESTATE	YALLAHS P O	ST.THOMAS	7578.231774
358	21305016121	1106	826		130	ALBION ESTATE	YALLAHS P O	ST.THOMAS	6179.014797
359	21305016122	1106	827		131	ALBION ESTATE	YALLAHS P O	ST.THOMAS	16.451603
362	21305016040	1106	122	DOVER CLOSE	33	ALBION ESTATE	YALLAHS P O	ST.THOMAS	62.016267
365	21305016041	1106	121	DOVER CLOSE	32	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	3211.84541
367	21305016044	1106	118	DOVER CLOSE	29	ALBION ESTATE	YALLAHS P O	ST.THOMAS	1275.678951
372	21305016120	1106	825		129	ALBION ESTATE	YALLAHS P O	ST.THOMAS	9545.947582
460	21305016118	1106	823		127D	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14947.57262
576	23202008020	1070	920	SANDALWOOD AVENUE	18	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	186.390196
577	23202008009	1070	917	NORTHERN PARKWAY	9	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	164.039276
578	23202008021	1070	921	SANDALWOOD AVENUE	19	ALBION ESTATE	YALLAHS P O	ST.THOMAS	702.720291
579	23202008011	1070	918	NORTHERN PARKWAY	10	ALBION ESTATE	YALLAHS P.O.	ST.THOMAS	655.643356
601	23202015118	1366	60	DAFFODIL WAY	380	ALBION ESTATE	YALLAHS P O	ST.THOMAS	7.177085
602	23202016166	1366	73	DAFFODIL WAY	393	ALBION ESTATE	YALLAHS P O	ST.THOMAS	9.478728
603	23202016157	1366	64	DAFFODIL WAY	384	ALBION ESTATE	YALLAHS P O	ST.THOMAS	10.835317
604	23202015106	1366	48	DAFFODIL WAY	368	ALBION ESTATE	YALLAHS P O	ST.THOMAS	17.113705
605	23202015115	1366	57	DAFFODIL WAY	377	ALBION ESTATE	YALLAHS P O	ST.THOMAS	11.036152
606	23202015103	1366	45	DAFFODIL WAY	365	ALBION ESTATE	YALLAHS P O	ST.THOMAS	23.821425
607	23202016168	1366	75	DAFFODIL WAY	395	ALBION ESTATE	YALLAHS P O	ST.THOMAS	12.441652
608	21306015119	1373	984		412	ALBION ESTATE	YALLAHS P O	ST.THOMAS	69.793738
609	21306015113	1366	86		406	ALBION ESTATE	YALLAHS P O	ST.THOMAS	16.353376
610	23202015116	1366	58	DAFFODIL WAY	378	ALBION ESTATE	YALLAHS P O	ST.THOMAS	10.185344
611	23202016172	1366	79	DAFFODIL WAY	399	ALBION ESTATE	YALLAHS P O	ST.THOMAS	15.301819
612	23202015111	1366	53	DAFFODIL WAY	373	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14.358554
613	23202015113	1366	55	DAFFODIL WAY	375	ALBION ESTATE	YALLAHS P O	ST.THOMAS	12.43155
614	21306015124	1373	989		417	ALBION ESTATE	YALLAHS P O	ST.THOMAS	27.179925
615	23202015112	1366	54	DAFFODIL WAY	374	ALBION ESTATE	YALLAHS P O	ST.THOMAS	12.888169
616	23202015108	1366	50	DAFFODIL WAY	370	ALBION ESTATE	YALLAHS P O	ST.THOMAS	141.140786
617	23202015121	1366	63	DAFFODIL WAY	383	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.701435
618	23202016161	1366	68	DAFFODIL WAY	388	ALBION ESTATE	YALLAHS P O	ST.THOMAS	10.491456
619	21306015117	1373	982		410	ALBION ESTATE	YALLAHS P O	ST.THOMAS	25.04053
620	21306015123	1373	988		416	ALBION ESTATE	YALLAHS P O	ST.THOMAS	29.939672
621	23202016162	1366	69	DAFFODIL WAY	389	ALBION ESTATE	YALLAHS P O	ST.THOMAS	9.788454
622	23202015102	1366	44		364	ALBION ESTATE	YALLAHS P O	ST.THOMAS	27.68247
623	21306015046	1373	952		138	ALBION ESTATE	YALLAHS P O	ST.THOMAS	0.912977
624	21306015118	1373	983		411	ALBION ESTATE	YALLAHS P O	ST.THOMAS	38.199119
625	21306015122	1373	987		415	ALBION ESTATE	YALLAHS P O	ST.THOMAS	29.645304
626	23202016171	1366	78		398	ALBION ESTATE	YALLAHS P O	ST.THOMAS	15.589164
627	23202016165	1366	72	DAFFODIL WAY	392	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.597404

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628	23202016159	1366	66	DAFFODIL WAY	386	ALBION ESTATE	YALLAHS P O	ST.THOMAS	11.540943
629	23202016177	1454	717	DOFFODIL WAY	387 PT	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.694939
630	23202016158	1366	65	DAFFODIL WAY	385	ALBION ESTATE	YALLAHS P O	ST.THOMAS	12.942674
631	23202015107	1366	49	DAFFODIL WAY	369	ALBION ESTATE	YALLAHS P O	ST.THOMAS	126.854444
632	23202016170	1366	77	DAFFODIL WAY	397	ALBION ESTATE	YALLAHS P O	ST.THOMAS	13.545727
633	23202015109	1366	51	DAFFODIL WAY	371	ALBION ESTATE	YALLAHS P O	ST.THOMAS	47.794051
634	23202016163	1366	70	DAFFODIL WAY	390	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.835794
635	23202016169	1366	829	DAFFODIL WAY	396	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14.284781
636	23202015104	1366	829	DAFFODIL WAY	366	ALBION ESTATE	YALLAHS P O	ST.THOMAS	20.920751
637	23202015119	1366	61	DAFFODIL WAY	381	ALBION ESTATE	YALLAHS P O	ST.THOMAS	5.623295
638	21306015125	1373	990		418	ALBION ESTATE	YALLAHS P O	ST.THOMAS	29.006353
639	21306015109	1366	82		402	ALBION ESTATE	YALLAHS P O	ST.THOMAS	15.575111
640	21306015127	1373	992		420	ALBION ESTATE	YALLAHS P O	ST.THOMAS	25.140471
642	21306015121	1373	986		414	ALBION ESTATE	YALLAHS P O	ST.THOMAS	64.456861
643	21306015131	1373	994		422	ALBION ESTATE	YALLAHS P O	ST.THOMAS	93.512934
644	21306015130	1373	993		421	ALBION ESTATE	YALLAHS P O	ST.THOMAS	3.015363
645	23202015127	1078	845	PALM BOULEVARD	432	ALBION ESTATE	YALLAHS P O	ST.THOMAS	1052.350988
646	21306015120	1373	985		413	ALBION ESTATE	YALLAHS P O	ST.THOMAS	73.750438
647	23202015110	1366	52	DAFFODIL WAY	372	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14.543762
648	23202015117	1366	59	DAFFODIL WAY	379	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.714172
649	21306015111	1366	84		404	ALBION ESTATE	YALLAHS P O	ST.THOMAS	15.144098
650	23202016167	1366	74	DAFFODIL WAY	394	ALBION ESTATE	YALLAHS P O	ST.THOMAS	10.414449
652	21306015112	1366	85		405	ALBION ESTATE	YALLAHS P O	ST.THOMAS	16.659981
653	23202015114	1366	56	DAFFODIL WAY	376	ALBION ESTATE	YALLAHS P O	ST.THOMAS	12.057399
654	23202015120	1366	62	DAFFODIL WAY	382	ALBION ESTATE	YALLAHS P O	ST.THOMAS	5.677935
655	21306015126	1373	991		419	ALBION ESTATE	YALLAHS P O	ST.THOMAS	24.984723
656	21306015114	1366	87		407	ALBION ESTATE	YALLAHS P O	ST.THOMAS	19.188246
657	21306015116	1373	981		409	ALBION ESTATE	YALLAHS P O	ST.THOMAS	24.860598
658	21306015115	1373	980		408	ALBION ESTATE	YALLAHS P O	ST.THOMAS	21.070457
659	23202016176	1366	67	DOFFODIL WAY	387	ALBION ESTATE	YALLAHS P O	ST.THOMAS	2.149209
660	23202016164	1366	71	DAFFODIL WAY	391	ALBION ESTATE	YALLAHS P O	ST.THOMAS	8.46042
661	21306015110	1366	83		403	ALBION ESTATE	YALLAHS P O	ST.THOMAS	14.558749
662	21306015129	1373	996		426	ALBION ESTATE	YALLAHS P O	ST.THOMAS	663.094835
663	21306015108	1366	81		401	ALBION ESTATE	YALLAHS P O	ST.THOMAS	13.786564
664	23202015105	1366	47	DAFFODIL WAY	367	ALBION ESTATE	YALLAHS P O	ST.THOMAS	16.841595
665	23202016173	1366	80		400	ALBION ESTATE	YALLAHS P O	ST.THOMAS	18.963085
10	106B6Y05089	1325	504	GARCIA DRIVE	149	BAY VIEW	BULL BAY P O	ST.ANDREW	301.160716
41	106B6Y10001	939	207			BAY VIEW	BULL BAY P O	ST.ANDREW	2759.903243
45	106B6Y10001	939	207			BAY VIEW	BULL BAY P O	ST.ANDREW	5855.019252
48	106B6Y05003	1297	499	BAYVIEW CRESCENT	3	BAY VIEW	BULL BAY P O	ST.ANDREW	270.073235
49	106B6Y05004	1047	211	BAYVIEW CRESCENT	4	BAY VIEW	BULL BAY P O	ST.ANDREW	351.018332
109	106B6Y05199	1057	280	BAYVIEW BOULEVARD	A B & C	BAY VIEW	B & C BAY VIEW	BULL BAY P O	137.485232
158	106B6Y05090	1047	286	16 GARCIA DRIVE	150	BAY VIEW	BULL BAY P O	ST.ANDREW	522.967907
168	106B6Y05008	1335	689	BAYVIEW CRESCENT	8	BAY VIEW	BULL BAY P O	ST.ANDREW	273.064863
185	106B6Y05086	1047	282	GARCIA DRIVE	146	BAY VIEW	BULL BAY P O	ST.ANDREW	190.042463
194	106B6Y05083	1047	279	GARCIA DRIVE	143	BAY VIEW	BULL BAY P O	ST.ANDREW	160.127682

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195	106B6Y05006	1047	213	BAYVIEW CRESCENT	6	BAY VIEW	BULL BAY P O	ST.ANDREW	294.536957
198	106B6Y05088	1217	750	12 GARCIA AVENUE	148	BAY VIEW	BULL BAY P O	ST.ANDREW	285.331958
200	106B6Y05199	1057	280	BAYVIEW BOULEVARD	A B & C	BAY VIEW	B & C BAY VIEW	BULL BAY P O	2058.049053
202	106B6Y05005	1047	212	BAYVIEW CRESCENT	5	BAY VIEW	BULL BAY P O	ST.ANDREW	265.358712
206	106B6Y05002	1047	209	BAYVIEW CRESCENT	2	BAY VIEW	BULL BAY P O	ST.ANDREW	17.084959
211	106B6Y05007	1047	214	BAYVIEW CRESCENT	7	BAY VIEW	BULL BAY P O	ST.ANDREW	293.851063
216	106B6Y05084	1047	280	GARCIA DRIVE	144	BAY VIEW	BULL BAY P O	ST.ANDREW	310.325129
224	106B6Y05011	1047	218	BAY VIEW TERRACE	11	BAY VIEW	BULL BAY P O	ST.ANDREW	487.583947
229	106B6Y05001	1047	208	BAYVIEW CRESCENT	1	BAY VIEW	BULL BAY P O	ST.ANDREW	42.259914
233	106B6Y05085	1047	281	6 GARCIA DRIVE	145	BAY VIEW	KINGSTON 3	ST.ANDREW	209.124719
25	106B6Y08028	1079	412	4 BISCAYNE AVENUE	28	BISCAYNE BEACH	BULL BAY P O	ST.ANDREW	102.421011
197	106B6Y08027	0			27	BISCAYNE BEACH	BULL BAY P O	ST.ANDREW	109.231087
212	106B6Y08030	954	141	1 BEACH AVENUE	30	BISCAYNE BEACH	BULL BAY P O	ST.ANDREW	29.795581
221	106B6Y08029	954	140		29	BISCAYNE BEACH	BULL BAY P O	ST.ANDREW	96.164629
26	106B5Z03015	1351	769		1	BROOKS PEN	BULL BAY P O	ST.ANDREW	34.698591
140	106B5Z15004	1220	206	ST THOMAS ROAD		BROOKS PEN	BULL BAY P O	ST.ANDREW	838.375291
375	106B5Z03005	0				BROOKS PEN	BULL BAY P O	ST.ANDREW	145.095282
557	106B5Z03001	375	41			BROOKS PEN	BULL BAY P O	ST.ANDREW	121.759502
567	106B5Z03014	1299	309			BROOKS PEN	BULL BAY P O	ST.ANDREW	11.445197
568	106B5Z03020	1351	774	FREDGAR CLOSE		BROOKS PEN	BULL BAY P O	ST.ANDREW	40.77318
569	106B5Z03009	0				BROOKS PEN	BULL BAY P O	ST.ANDREW	29.434215
19	106B6Y07015	0				BULL BAY	BULL BAY P O	ST.ANDREW	140.836763
20	106B6Y09003	919	54		2	BULL BAY	BULL BAY P O	ST.ANDREW	823.657837
23	106B6Y09004	1146	984		1	BULL BAY	BULL BAY P O	ST.ANDREW	582.751604
28	106B6Y01022	968	74		6 & 8	BULL BAY	BULL BAY P O	ST.ANDREW	141.626454
34	106B5Y06036	1080	21		5	BULL BAY	KINGSTON 17	ST.ANDREW	42.845107
50	106B6Y07021	1090	174			BULL BAY	BULL BAY P O	ST.ANDREW	287.117075
66	106B5Y06038	976	150	ST THOMAS ROAD	2	BULL BAY	KINGSTON 17	ST.ANDREW	196.263121
80	106B5Y06037	976	149	ST THOMAS ROAD	1	BULL BAY	KINGSTON 17	ST.ANDREW	416.663622
88	106B5Y10015	0				BULL BAY	SEVEN MILES P A	ST.ANDREW	379.295071
96	106B6Z08003	0				BULL BAY	BULL BAY P O	ST.ANDREW	101.683616
98	106B5Y06037	976	149	ST THOMAS ROAD	1	BULL BAY	KINGSTON 17	ST.ANDREW	35.405295
108	106B5Z05003	0				BULL BAY	BULL BAY P O	ST.ANDREW	67.217001
121	106B5Y10014	0				BULL BAY	SEVEN MILES P A	ST.ANDREW	366.207365
126	106B6Z08009	0				BULL BAY	BULL BAY P O	ST.ANDREW	158.027147
131	106B5Y06035	669	13	ST THOMAS ROAD	5	BULL BAY	BULL BAY P O	ST.ANDREW	863.747069
144	106B5Y10005	0				BULL BAY	SEVEN MILES P A	ST.ANDREW	47.422713
160	106B6Y09011	771	93			BULL BAY	BULL BAY P O	ST.ANDREW	3768.450359
163	106B6Y07021	1090	174			BULL BAY	BULL BAY P O	ST.ANDREW	310.685716
175	106B6Y07016	0				BULL BAY	BULL BAY P O	ST.ANDREW	243.186017
184	106B6Y09006	572	51			BULL BAY	BULL BAY P O	ST.ANDREW	857.275889
186	106B6Y07014	0				BULL BAY	BULL BAY P O	ST.ANDREW	307.918664
191	106B5Y10006	1145	493			BULL BAY	SEVEN MILES P A	ST.ANDREW	4.656092
196	106B6Y09002	919	55		4	BULL BAY	BULL BAY P O	ST.ANDREW	463.870323
204	106B6Z08002	0				BULL BAY	BULL BAY P O	ST.ANDREW	419.697039
205	106B6Y09005	1081	991			BULL BAY	BULL BAY P O	ST.ANDREW	751.902374

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207	106B6Z08008	0				BULL BAY	BULL BAY P O	ST.ANDREW	147.324822
226	106B6Y09007	1066	796			BULL BAY	BULL BAY P O	ST.ANDREW	348.849318
234	106B6Y07017	824	25			BULL BAY	BULL BAY P O	ST.ANDREW	725.651349
237	106B6Y07012	913	2			BULL BAY	BULL BAY P O	ST.ANDREW	60.630107
239	106B6Y07011	1286	421			BULL BAY	BULL BAY P O	ST.ANDREW	20.018842
373	106B5Y10007	966	170			BULL BAY	SEVEN MILES P A	ST.ANDREW	3.47605
380	106B5Y10012	0				BULL BAY	SEVEN MILES P A	ST.ANDREW	279.084003
419	106B5Y10013	992	278			BULL BAY	SEVEN MILES P A	ST.ANDREW	400.397973
430	106B5Y10010	1052	49			BULL BAY	SEVEN MILES P A	ST.ANDREW	154.54579
479	106B6Z08013	1185	553			BULL BAY	BULL BAY P O	ST.ANDREW	3536.038441
480	106B6Z08019	0				BULL BAY	BULL BAY P O	ST.ANDREW	212.141555
485	106B6Z07001	593	90			BULL BAY	BULL BAY P O	ST.ANDREW	9.868887
493	106B6Z08010	1114	369			BULL BAY	BULL BAY P O	ST.ANDREW	11797.75724
495	106B6Z08012	0				BULL BAY	BULL BAY P O	ST.ANDREW	4504.75563
498	106B6Z08011	654	75			BULL BAY	BULL BAY P O	ST.ANDREW	3018.884621
500	106B6Z08019	0				BULL BAY	BULL BAY P O	ST.ANDREW	703.135267
518	106B6Y01052	1067	716			BULL BAY	BULL BAY P O	ST.ANDREW	272.967554
572	106B6Y11005	1442	984	ST THOMAS ROAD		BULL BAY	BULL BAY P O	ST.ANDREW	692.774364
580	106B6Y01026	968	75			BULL BAY	BULL BAY P O	ST.ANDREW	197.185447
582	106B6Y01026	968	75			BULL BAY	BULL BAY P O	ST.ANDREW	197.185447
583	106B6Y01027	1277	959		5	BULL BAY	BULL BAY P O	ST.ANDREW	322.694873
584	106B6Y01027	1277	959		5	BULL BAY	BULL BAY P O	ST.ANDREW	322.650177
593	106B6Z08007	1096	762			BULL BAY	BULL BAY P O	ST.ANDREW	180.059272
594	106B6Z08022	1451	33			BULL BAY	BULL BAY P O	ST.ANDREW	252.599511
595	106B6Z08005	0				BULL BAY	BULL BAY P O	ST.ANDREW	274.578436
596	106B6Z08015	1050	842			BULL BAY	BULL BAY P O	ST.ANDREW	373.507204
597	106B6Z08021	1297	337			BULL BAY	BULL BAY P O	ST.ANDREW	1108.072484
504	106B6Z03086	1192	396		61 PT	BULL BAY H/E	BULL BAY P O	ST.ANDREW	178.169219
93	106B5Y06003	938	394	SAINT THOMAS ROAD	5+	BULL BAY PEN	KINGSTON 17	ST.ANDREW	203.092787
141	106B5Y06025	520	22	SAINT THOMAS ROAD	9	BULL BAY PEN	SEVEN MILES P A	ST.ANDREW	494.190426
448	106B5Y06003	938	394	SAINT THOMAS ROAD	5+	BULL BAY PEN	KINGSTON 17	ST.ANDREW	38.100751
467	106B5Y07006	1023	400			BULL BAY PEN	SEVEN MILES P A	ST.ANDREW	757.859484
51	106B5Z01005	1089	409	2 CAMROSE DRIVE	3	CAMROSE	BULL BAY P O	ST.ANDREW	333.733267
165	106B5Z01004	1089	410	4 CAMROSE DRIVE	4	CAMROSE	BULL BAY P O	ST.ANDREW	467.392731
167	106B5Z01006	1089	408		2	CAMROSE	BULL BAY P O	ST.ANDREW	440.901531
176	106B5Z01001	1089	436	10 CAMROSE DRIVE	32	CAMROSE	BULL BAY P O	ST.ANDREW	252.63714
203	106B5Z01007	1089	407		1	CAMROSE	BULL BAY P O	ST.ANDREW	788.534592
209	106B5Z01003	1089	411	6 CAMROSE DRIVE	5	CAMROSE	BULL BAY P O	ST.ANDREW	476.378719
223	106B5Z01002	1089	412	8 CAMROSE DRIVE	6	CAMROSE	BULL BAY P O	ST.ANDREW	384.946833
17	106B5Z13061	0		EIGHT MILES		CANE RIVER	BULL BAY P O	ST.ANDREW	15.56707
77	106B5Z16008	0			1459A	CANE RIVER	BULL BAY P O	ST.ANDREW	4023.250846
97	106B5Z13068	1270	92			CANE RIVER	BULL BAY P O	ST.ANDREW	20852.43499
115	106B5Z13069	1413	861			CANE RIVER	BULL BAY P O	ST.ANDREW	14369.9421
250	106B5Z13068	1270	92			CANE RIVER	BULL BAY P O	ST.ANDREW	4129.552124
543	106B5Z13069	1413	861			CANE RIVER	BULL BAY P O	ST.ANDREW	7964.995335
252	106B5Z13086	961	17	PALM BEACH DRIVE	1	CANE RIVER - SEVEN MILES	BULL BAY P O	ST.ANDREW	1306.772959

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
2	106B5Z05006	0				CANE RIVER PEN	BULL BAY P O	ST.ANDREW	1103.055432
39	106B5Z05002	1013	433			CANE RIVER PEN	BULL BAY P O	ST.ANDREW	1.728776
72	106B5Z05005	0				CANE RIVER PEN	BULL BAY P O	ST.ANDREW	304.855444
118	106B5Z05001	1041	577			CANE RIVER PEN	BULL BAY P O	ST.ANDREW	380.924484
137	106B5Z11003	1209	336		3	CANE RIVER PEN	BULL BAY P O	ST.ANDREW	210.700399
145	106B5Z05017	1447	76			CANE RIVER PEN	BULL BAY P O	ST.ANDREW	1900.965321
147	106B5Z05004	0				CANE RIVER PEN	BULL BAY P O	ST.ANDREW	91.294716
149	106B5Z05021	1052	327		29	CANE RIVER PEN	BULL BAY P O	ST.ANDREW	98.193119
86	106B5Z02068	1052	363	COPABAN DRIVE	65	COPACABANA	BULL BAY P O	ST.ANDREW	106.505472
100	106B5Z02070	1052	365	COPABAN DRIVE	67	COPACABANA	BULL BAY P O	ST.ANDREW	294.465142
101	106B5Z02060	0		SEASHORE DRIVE	62	COPACABANA	BULL BAY P O	ST.ANDREW	1.989634
113	106B5Z02051	1052	361	COPABAN DRIVE	63	COPACABANA	BULL BAY P O	ST.ANDREW	33.922756
181	106B5Z02069	1052	364	COPABAN DRIVE	66	COPACABANA	BULL BAY P O	ST.ANDREW	204.011487
586	21301006011	0				ELEVEN MILES	BULL BAY P O	ST.THOMAS	28.808591
360	21304001010	0				GRANTS PEN	GRANTS PEN P A	ST.THOMAS	39.664364
363	21304001009	0				GRANTS PEN	GRANTS PEN P A	ST.THOMAS	63.552987
366	21304001008	0				GRANTS PEN	GRANTS PEN P A	ST.THOMAS	1.068609
236	106B6Y07013	115	48			GREENVALE	BULL BAY P O	ST.ANDREW	793.930758
218	106B6Y09010	950	260		5	HALBERSTADT	BULL BAY P O	ST.ANDREW	442.224714
225	106B6Y09009	936	19		3	HALBERSTADT	BULL BAY P O	ST.ANDREW	274.814362
73	106B5Y01128	975	231	41 MARS DRIVE	1974	HARBOUR VIEW	HARBOUR VIEW P O	ST.ANDREW	62.176825
79	106B5Y01129	975	230	43 MARS DRIVE	1973	HARBOUR VIEW	KINGSTON 17	ST.ANDREW	42.717129
107	106B5Y06004	1078	242	2 COPLY DRIVE	1	HARBOUR VIEW	KINGSTON 17	ST.ANDREW	78.308261
128	106B5Y01114	975	246	13 MARS DRIVE	1988	HARBOUR VIEW	KINGSTON 17	ST.ANDREW	34.12352
179	106B5Y01116	975	244	17 MARS DRIVE	1986	HARBOUR VIEW	KINGSTON 17	ST.ANDREW	36.628388
187	106B5Y01130	975	229	45 MARS DRIVE	1972	HARBOUR VIEW	KINGSTON 17	ST.ANDREW	40.401192
483	21301011002	1261	50		SECTION D	HENRYS RUN	BULL BAY P O	ST.THOMAS	1631.948476
5	106B5Z13072	961	232			JAMES COTTAGE	BULL BAY P O	ST.ANDREW	124.505341
6	106B5Z13045	1446	102	ST THOMAS ROAD		JAMES COTTAGE	BULL BAY P O	ST.ANDREW	352.57163
7	106B5Z13073	989	243			JAMES COTTAGE	BULL BAY P O	ST.ANDREW	10.449475
116	106B5Z13063	1284	729			JAMES COTTAGE	BULL BAY P O	ST.ANDREW	71.087964
371	106B5Z03021	0				MALIBU BEACH	BULL BAY P O	ST.ANDREW	54.118931
510	21301001015	1408	166		6	MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	0.871435
511	21301001014	1242	659		5	MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	1395.173973
513	21301001013	1242	659		4	MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	667.917351
515	21301001010	1404	873		1	MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	56.597071
516	21301001012	1242	659		3	MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	35.565444
517	21301001055	1242	659	MAR BELLA DRIVE		MAR BELLA ESTATE	BULL BAY P O	ST.THOMAS	449.319989
240	21304004062	1135	130		89	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	468.22234
241	21304004061	1135	129		88	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	218.329775
242	21304004056	1135	124		83	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	348.093727
264	21304002137	1135	394		365	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	16.558422
268	21304002118	1135	377		347	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.181211
269	21304004063	1135	131		90	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	693.722362
271	21304004055	1135	123		82	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	280.408812
273	21304004051	1135	119		78	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	5.122592

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
275	21304004060	1135	128		87	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	169.457874
276	21304004049	1135	117		76	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.386855
283	21304004052	1135	120		79	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	15.377242
288	21304002057	1135	319		288	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	0.169431
289	21304004035	1135	103		62	MEZGAR GARDENS	GRANTS PEN P A	ST.THOMAS	23.749907
290	21304004054	1135	122		81	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	152.272896
291	21304002055	1135	318		286	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.332737
292	21304002124	1135	382		353	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	30.771427
293	21304002125	1135	43		353A	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	27.743215
296	21304004050	1135	118		77	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	0.396695
297	21304003042	1135	159		126	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.227258
302	21304002058	1135	320		289	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	0.007116
305	21304002117	1135	376		346	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.091201
308	21304004057	1135	125		84	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	303.26315
314	21304002115	1135	374		344	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	8.06135
323	21304004058	1135	126		85	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	300.42377
326	21304004053	1135	121		80	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	11.285789
329	21304002138	1135	395		366	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	0.142827
330	21304002136	1135	393		364	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	457.453005
331	21304002114	1135	777		343	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.671355
337	21304003043	1135	160		127	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	0.553589
350	21304004064	1135	132		91	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	51.230936
368	21304004059	1135	127		86	MEZGAR GARDENS	YALLAHS P.O.	ST.THOMAS	205.165481
487	21301001008	1133	663		SEC 3 & 4	MEZGAR GARDENS	BULL BAY P O	ST.THOMAS	12897.05867
512	21304004034	1135	102		61	MEZGAR GARDENS	YALLAHS P O	ST.THOMAS	29.636402
301	21304004036	1135	104		63	MEZGARS GARDENS	YALLAHS P O	ST.THOMAS	9.959455
16	106B6Y06073	1046	506	WEST WINT ROAD	73	OCEAN LAKE	BULL BAY P O	ST.ANDREW	53.42657
22	106B6Y06002	1046	435	25 WEST WIND ROAD	2	OCEAN LAKE	BULL BAY P O	ST.ANDREW	150.04283
52	106B6Y06072	1046	505	WEST WINT ROAD	72	OCEAN LAKE	BULL BAY P O	ST.ANDREW	729.209274
54	106B6Y06001	1046	434	WEST WINT ROAD	1	OCEAN LAKE	BULL BAY P O	ST.ANDREW	530.053607
74	106B5Z11025	1351	385	PONDSIDE DRIVE	25 & 27	REST HAVEN	BULL BAY P O	ST.ANDREW	5460.741502
122	106B5Z11005	1028	623		5	REST HAVEN	BULL BAY P O	ST.ANDREW	55.572661
127	106B5Z11024	1215	740	PONDSIDE DRIVE	22	REST HAVEN	BULL BAY P O	ST.ANDREW	426.017363
136	106B5Z08001	1439	89	REST HAVEN DRIVE	1	REST HAVEN	BULL BAY P O	ST.ANDREW	242.670154
138	106B5Z11018	1351	382		21	REST HAVEN	BULL BAY P O	ST.ANDREW	120.935428
156	106B5Z08014	1028	632	REST HAVEN DRIVE	14	REST HAVEN	BULL BAY P O	ST.ANDREW	1666.747385
169	106B5Z08059	1262	43		1+	REST HAVEN	BULL BAY P O	ST.ANDREW	758.250883
199	106B5Z11004	0			4	REST HAVEN	BULL BAY P O	ST.ANDREW	13.18651
222	106B5Z11017	1219	320		8	REST HAVEN	BULL BAY P O	ST.ANDREW	24.316953
230	106B5Z11002	1227	827		2	REST HAVEN	BULL BAY P O	ST.ANDREW	736.413825
352	106B5Z04001	1093	808	RETREAT DRIVE	1	RETREAT	BULL BAY P O	ST.ANDREW	111.709038
353	106B5Z04002	1093	809	RETREAT DRIVE	2	RETREAT	BULL BAY P O	ST.ANDREW	84.851597
559	106B5Z12076	1442	508	VILLA AVENUE	24	RETREAT	BULL BAY P O	ST.ANDREW	151.651334
560	106B5Z12077	1442	509	VILLA AVENUE	25	RETREAT	BULL BAY P O	ST.ANDREW	122.042363
561	106B5Z12073	1442	505	VILLA AVENUE	21	RETREAT	BULL BAY P O	ST.ANDREW	161.009207
563	106B5Z12072	1442	504	VILLA AVENUE	20	RETREAT	BULL BAY P O	ST.ANDREW	188.668245

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
564	106B5Z12075	1442	507	VILLA AVENUE	23	RETREAT	BULL BAY P O	ST.ANDREW	141.493039
565	106B5Z12074	1442	506	VILLA AVENUE	22	RETREAT	BULL BAY P O	ST.ANDREW	145.373524
570	106B5Z12053	1442	458	VILLA AVENUE	1	RETREAT	BULL BAY P O	ST.ANDREW	533.215798
571	106B5Z12071	1442	503	VILLA AVENUE	19	RETREAT	BULL BAY P O	ST.ANDREW	297.143225
573	106B5Z12054	1442	487	VILLA AVENUE	2	RETREAT	BULL BAY P O	ST.ANDREW	4.075081
125	106B6Y09012	1056	613			RETREAT PEN	BULL BAY P O	ST.ANDREW	7574.471758
501	21301001002	1354	479			ROBERTS PEN	BULL BAY P O	ST.THOMAS	26210.44379
677	106B5Z13065	1239	85	ST THOMAS ROAD	1+	SEVEN & EIGHT MILES	BULL BAY P O	ST.ANDREW	68.836123
38	106B5Z13015	0				SEVEN MILES	BULL BAY P O	ST.ANDREW	232.772156
159	106B5Z05024	0				SEVEN MILES	BULL BAY P O	ST.ANDREW	631.016458
172	106B5Z05023	0				SEVEN MILES	BULL BAY P O	ST.ANDREW	734.513264
374	106B5Y10023	1239	977			SEVEN MILES	BULL BAY P O	ST.ANDREW	52.039486
536	106B5Y06018	1416	37	SAINT THOMAS ROAD	1+	SEVEN MILES	SEVEN MILES P A	ST.ANDREW	236.516318
666	106B5Z13070	1275	753		1+	SEVEN MILES	BULL BAY P O	ST.ANDREW	33.392633
135	106B5Z13036	1010	444			SEVEN MILES&FALLTAVE	BULL BAY P O	ST.ANDREW	644.401952
378	106B5Y11009	1054	131			SHOOTERS HILL PEN	SEVEN MILES P A	ST.ANDREW	39.352666
431	23202001027	608	2		23 & 25	SOUTH ALBION	YALLAHS P O	ST.THOMAS	608.367318
434	23202001030	608	2			SOUTH ALBION	YALLAHS P O	ST.THOMAS	11.314157
435	23202001024	608	2		5	SOUTH ALBION	YALLAHS P O	ST.THOMAS	649.164965
377	106B5Y07010	1385	732		3	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	244.988093
397	106B5Y07008	1385	730		1	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	178.808195
398	106B5Y07011	1385	733		4	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	181.386115
417	106B5Y07012	1385	734		5	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	40.832154
418	106B5Y07013	1385	735		6	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	267.12858
421	106B5Y07009	1385	731		2	ST BENEDICTS HEIGHTS	KINGSTON 17	ST.ANDREW	369.702738
166	106B5Z13018	965	693			ST THOMAS ROAD	BULL BAY P O	ST.ANDREW	214.441708
489	21301001006	1037	141			SUGAR LOAF MOUNTAIN	BULL BAY P O	ST.THOMAS	22414.89689
462	21306015013	1312	744			WEST ALBION	YALLAHS P O	ST.THOMAS	1288.638503
210	106B6Y06084	1046	517	WINDWARD CLOSE	84	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	774.996126
422	106B5Z18012	931	98	94 WICKIE WACKIE BOULEVARD	12	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	282.996808
423	106B5Z18019	822	87	12 JUPITER CLOSE	19	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	231.183046
425	106B5Z18018	931	98	10 JUPITER CLOSE	18	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	225.426383
426	106B5Z18011	931	98	92 WICKIE WACKIE BOULEVARD	11	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	68.798248
427	106B5Z18021	822	87	16 JUPITER CLOSE	21	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	301.271429
450	106B5Z18020	822	87	14 JUPITER CLOSE	20	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	255.945459
451	106B5Z18013	822	87	96 WICKIE WACKIE BOULEVARD	13	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	562.549337
452	106B5Z18010	931	98	90 WICKIE WACKIE BOULEVARD	10	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	69.301783
453	106B5Z18015	822	87	4 JUPITER CLOSE	15	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	186.579419
454	106B5Z18016	822	87	6 JUPITER CLOSE	16	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	199.67953
455	106B5Z18007	822	87	84 WICKIE WACKIE BOULEVARD	7	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	41.626581
456	106B5Z18017	931	98	8 JUPITER CLOSE	17	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	213.215639
468	106B5Z18167	822	87	WICKIE WACKIE ROAD	167	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	732.24279
469	106B5Z18091	931	98	20 SUNSHINE CLOSE	91	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	48.536123
473	106B5Z18008	822	87	86 WICKIE WACKIE BOULEVARD	8	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	64.91912
474	106B5Z18009	931	98	88 WICKIE WACKIE BOULEVARD	9	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	71.219675
481	106B5Z18014	822	87	2 JUPITER CLOSE	14	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	186.218086

No.	LV NUMBER	VOLUME	FOLIO	STREET ADDRESS	LOT	SCHEME NAME	LOCATION	PARISH	AREA (SQM)
519	106B5Z18090	931	98	18 SUNSHINE CLOSE	90	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	6.402873
520	106B5Z18171	931	98	ST THOMAS ROAD	171	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	4663.517882
545	106B5Z18168	931	98	ST THOMAS ROAD	168	WICKIE WACKIE	BULL BAY P O	ST.ANDREW	1281.333566
429	106B5Y10016	1323	653		1+	WINDSOR FOREST	BULL BAY P O	ST.ANDREW	323.549126
37	106B5Y10009	966	170			WINDSOR FOREST PEN	SEVEN MILES P O	ST.ANDREW	1.955827
69	106B5Y10004	1064	295			WINDSOR FOREST PEN	SEVEN MILES P A	ST.ANDREW	148.046028
85	106B5Z13058	1043	396			WINDSOR FOREST PEN	BULL BAY P O	ST.ANDREW	487.900286
105	106B5Z13021	0				WINDSOR FOREST PEN	BULL BAY P O	ST.ANDREW	246.005771
111	106B5Z17007	1034	621		1	WINDSOR FOREST PEN	BULL BAY P O	ST.ANDREW	0.525057
154	106B5Z13074	982	252			WINDSOR FOREST PEN	BULL BAY P A	ST.ANDREW	94.047648
157	106B5Y10003	1032	222			WINDSOR FOREST PEN	SEVEN MILES P A	ST.ANDREW	126.356388
170	106B5Z13021	0				WINDSOR FOREST PEN	BULL BAY P O	ST.ANDREW	314.297568
173	106B5Z13014	1003	481			WINDSOR FOREST PEN	BULL BAY P O	ST.ANDREW	208.444432
424	106B5Y05001	572	47			WINDSOR FOREST PEN	SEVEN MILES P A	ST.ANDREW	893.292522
428	106B5Y10008	1050	641			WINDSOR FOREST PEN	SEVEN MILES P A	ST.ANDREW	0.634608
678	106B5Y05003	0				WINDSOR FOREST PEN	SEVEN MILES P A	ST.ANDREW	681.97031
40	106B5Y05002	1260	802		1+	WINDSOR FORREST PEN	SEVEN MILES P A	ST.ANDREW	425.046125
12	106B6Z03040	1126	36		64	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	299.95177
14	106B6Z03041	506	35		65	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	416.541408
15	106B6Z03042	1081	783		66	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	602.211861
30	106B6Y01114	0			65	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	386.681101
53	106B6Z03039	1222	87		63	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	434.396366
92	106B6Z03042	1081	783		66	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	445.718121
161	106B6Z04056	1373	165		4	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	179.581743
177	106B6Z03045	1125	259	GEM AVENUE	69	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	251.624599
182	106B6Z03044	506	35	MANGO ROAD	68	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	145.919911
183	106B6Z03036	1015	558		60	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	485.624708
201	106B6Z03035	1079	37	MANGO ROAD	59	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	178.37288
213	106B6Z03043	1018	226	MANGO ROAD	67	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	356.344632
220	106B6Z03038	506	35		62	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	329.324258
484	106B6Z04012	506	35		12	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	329.501717
486	106B6Z04008	506	35		8	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	274.476038
488	106B6Z04015	506	35		15	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	233.412462
491	106B6Z04016	1357	294		16	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	47.410898
497	106B6Z03087	1401	426		61B	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	161.737456
502	106B6Z04011	0			11	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	376.339351
503	106B6Z04007	1858	354		7	WINDSOR LODGE	BULL BAY P O	ST.ANDREW	205.38645
632	= Total no. of parcels							Total area (sq m): =	893,802.41

Appendix 4 – NEPA Guidelines for Public Participation

SECTION 2

PUBLIC CONSULTATIONS GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENTS

SECTION 2 - TABLE OF CONTENTS

CHAPTER 1: GENERAL GUIDELINES

1.0 Introduction

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

The second level of involvement takes place after the EIA report is prepared in the form of a public meeting and the submission and review of comments on the EIA report. This occurs after the applicant has provided the information needed for adequate review by the public.

1.1 Purpose

These guidelines are prepared in relation to the second level of consultation outlined above for the use of the applicant and the public.

CHAPTER 2: SPECIFIC GUIDELINES FOR PUBLIC MEETING FOR ENVIRONMENTAL IMPACT ASSESSMENTS (EIAS)

2.1 Requirements

Arrangements for the public consultation, in particular the public meeting, must be made in discussion with NEPA in respect of date, time, venue, chairperson, specially invited participants and length of time for the submission of comments.

A permanent record of the meeting is required hence, the applicant must submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

2.2 Public Notification

The public must be notified at least three (3) weeks before the date of the public meeting. The applicant must seek to ensure that in addition to specific invitation letters, at least **three (3)** notices are placed in the most widely circulated newspapers advertising the event; one (1) notice per week. A copy of the notice shall be forwarded to NEPA for approval prior to publication in the newspapers. The NEPA will also post a copy of the Notice on its Website once it has been approved. To ensure that the Notice is distributed as widely as possible, at least two (2) other methods of notification such as community notice boards, flyers, town criers etc. shall be utilized. In addition, specific notice to relevant local NGOs and community groups should be made by the applicants. Evidence of the two (2) additional methods of notification and specific notices must be submitted to the NEPA.

The notices should indicate that:-

-the EIA has been submitted to NEPA;
- the purpose of the meeting;
- how to access the EIA report for review;
- the date, time and venue of the public presentation;
- contact information (NEPA/NRCA/TCPA and the APPLICANT).

The public meeting should be conducted no less than 3 weeks after the EIA has been accepted for posting and has been made available to the public and no less than 3 weeks after the first notice announcing public meeting has been published by the applicant. ***(A typical notice is in***

Appendix 1).

2. 3 Responsibility of Applicant

The applicant is responsible for distribution of copies of the EIA Report to make them available to the public at least three (3) weeks before the public meeting. Copies should be placed in the Local Parish Library and the Parish Council Office as well as the NEPA Documentation Centre, NEPA Regional Office nearest to the project site and other community locations as agreed upon. A summary of the project components and the findings of the EIA in non-technical language should also be prepared for distribution at the public meeting.

2.4 Conduct of the Meeting

With respect to the conduct of the meeting, the chairperson should be independently selected so as to ensure his/her neutrality. NEPA should be consulted regarding the selection of a chairperson. The role and responsibilities of the chairperson are outlined in ***Appendix 3***.

2.5 The Presentation

The technical presentation by the applicant should be simple, concise and comprehensive. The main findings of the EIA including adverse and beneficial impacts identified and analyzed should be presented. **(A typical agenda for a meeting is given in Appendix 2)**

Mitigation measures and costs associated with these measures should be presented. The meeting should inform the public on how they will get access to monitoring results during the construction and operational phases of the project, as it seeks to facilitate their participation in the monitoring and enforcement of the conditions under which approvals may being granted. Graphic and pictorial representations should support the technical presentation.

Presenters are advised to keep the technical presentation simple and within a time limit of 20-30 minutes depending on the complexity of the project and to allow a minimum of 30 minutes for questions. ***(A typical outline of a Project presentation is given in Appendix 4)***

2.6 Submission of Verbatim Report

The applicant will submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

2.7 Submission of Public Comments

Please note that the public will be given a period of twenty-one (21) days after the public meeting to submit written comments to NEPA.

CHAPTER 3: CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

The applicant is required to conduct other public consultations once the scope and size of the project has changed significantly; once deemed necessary by the Authority. The additional consultation may be required whether or not a permit has already been granted and issued for the development.

3.1 Requirements

Arrangements for the public meeting must be made in consultation with NEPA in respect of date, time, venue, chairperson and participants.

A permanent record of the meeting is required hence, the project proponent/consultant will submit to NEPA a copy of the verbatim report of the public meeting within seven (7) days of the date of the meeting.

3.2 Public Notification

The public must be notified at least one (**1) week** before the date of the public presentation. The developer/consultants must seek to ensure that in addition to specific invitation letters; at least **one (1) notice** is placed in one of the most widely circulated newspapers advertising the event. The notice shall also be forwarded to NEPA for posting on its website. To ensure that the notice is distributed as widely as possible, other methods of notification such as community notice board, flyers, town criers etc. shall be utilized as appropriate. In addition, specific notice to relevant local NGOs and community groups should be made by the developer/consultants.

The notice should indicate that:-

- the purpose of the meeting
- changes have been made to original proposal for which the EIA has been submitted to NEPA;
- how to access the EIA report for review;
- the date, time and venue of the public meeting;
- contact information.

The public meeting should be conducted no less than **one (1) week** after the document outlining the changes and any supporting technical information have been made available to the public and no less than **one (1) week** after the notice announcing public meeting has been published by the applicant. ***(A typical notice is in Appendix 5).***

3.3 Responsibility of Applicant

The applicant is responsible for distribution of the document outlining the changes and any supporting technical information to the public at least **one (1) week** before the public meeting. The document outlining the changes and any supporting technical information should be placed in the Local Parish Library and the Parish Council Office, NEPA Documentation Centre as well as at the NEPA Regional Office nearest to the site and any other community locations as agreed upon.

A summary of the project components, highlighting the changes in <u>non-technical language</u> should also be prepared for distribution at the public meeting.

3.4 Conduct of the Meeting

With respect to the conduct of the meeting, the chairperson should be independently selected so as to ensure his/her neutrality. NEPA should be consulted regarding the selection of a chairperson. The role and responsibilities of the chairperson are outlined in ***Appendix 3***.

3.5 The Presentation

The technical presentation by the applicant should be simple, concise and comprehensive. The changes to the proposal and any supporting technical information should be presented as well as any adverse and beneficial impacts identified and analyzed. **(A typical agenda for a meeting is given in Appendix 7)**

Mitigation measures and costs associated with these measures should be presented. The meeting should inform the public on the ways in which monitoring results may be accessed during the construction and operational phases of the project, bearing in mind that the public and non-governmental groups are expected to be involved in post-approval monitoring. Graphic and pictorial documentation may support the technical presentation.

Presenters are advised to keep the technical presentation simple and within a time limit of 20-30 minutes depending on the complexity of the project and to allow a minimum of 30 minutes for questions. ***(A typical outline of a Project presentation is given in Appendix 6)***

3.6 Submission of Verbatim Report

The applicant will submit to NEPA a copy of the verbatim report of the public meeting within **seven (7) days** of the date of the meeting.

3.7 Submission of Public Comments

Please note that the public will be given **ten (10) days** after the public meeting to submit written comments to NEPA.

APPENDICES

APPENDIX 1

NOTIFICATION OF PUBLIC MEETING

THERE WILL BE A PUBLIC CONSULTATION ON THE ENVIRONMENT IMPACT ASSESSMENT REPORT

OF:

VENUE:

DATE:

TIME:

THE PUBLIC IS INVITED TO PARTICIPATE IN THE CONSULTATION BY WAY OF ASKING QUESTIONS RELATING TO THE PROPOSED PROJECT.

A COPY OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT MAY BE CONSULTED AT THE
____________________ PARISH LIBRARY
____________________ PARISH COUNCIL OFFICE
NEPA'S Documentation Centre at 11 Caledonia Avenue, Kingston 5
____________________ NEPA Website: www.nepa.gov.jm
For further information contact:

APPENDIX 2

AGENDA

1. WELCOME AND INTRODUCTION

2. STATEMENT BY THE NATIONAL ENVIRONMENT & PLANNING AGENCY

3. PRESENTATION OF EIA FINDINGS AND MEASURES TO MINIMIZE IMPACTS

4. QUESTION AND ANSWER SESSION

5. CLOSING REMARKS

APPENDIX 3

ROLE AND RESPONSIBLITIES OF THE CHAIRPERSON

The chairperson has the main role of guiding the conduct of the meeting and seeing to it that the concerns of the public are adequately aired and addressed by the proponent/consultants.

The responsibilities of the chairperson include explaining the NEPA approval process, that is, the steps involved and the role of the NEPA at these public presentations. In other words, the chairperson should explain the context within which the meeting is taking place.

The chairperson should ensure that adequate time is allowed for questions and answers, and must understand clearly and communicate the purpose of the meeting to the audience. The chairperson is responsible for introducing the presenters.

The chairperson should contribute to but not monopolize the meeting.

APPENDIX 4

STRUCTURE OF PRESENTATION

1. DETAILED DESCRIPTION OF PROJECT PROPOSAL

2. DETAILS OF IMPACTS IDENTIFIED

3. DESCRIPTION OF PROPOSED MITIGATION MEASURES

4. RESPONSE TO ANY ISSUES RAISED PRIOR TO PUBLIC CONSULTATION (MEDIA, WRITTEN QUERY ETC.)

APPENDIX 5

NOTIFICATION OF PUBLIC MEETING - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

FURTHER TO THE ENVIRONMENTAL IMPACT ASSESSMENT (titled) dated prepared by XXXX permit# (WHERE RELEVANT). The (name of applicant) INVITES YOU TO A PUBLIC MEETING FOR name of project and brief description of change to proposal of (location)

THE PUBLIC IS INVITED TO PARTICIPATE IN THE MEETING BY WAY OF ASKING QUESTIONS RELATING TO THE PROPOSED AMENDMENT TO THE PROJECT PROPOSAL.

VENUE:
DATE:
TIME:

A COPY OF THE (LIST DOCUMENTS TO BE CONSULTED) MAY BE CONSULTED AT THE:

For further information contact: applications@nepa.gov.jm

APPENDIX 6

STRUCTURE OF PRESENTATION - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

1. DETAILED DESCRIPTION OF PROJECT ORIGINALLY PROPOSED/APPROVED (IF PERMIT GRANTED)
2. CHANGES TO THE PROPOSAL
3. DETAILS OF IMPACTS IDENTIFIED BASED ON THE CHANGES
4. DESCRIPTION OF PROPOSED MITIGATION MEASURES
5. RESPONSE TO ANY ISSUES RAISED PRIOR TO PUBLIC CONSULTATION (MEDIA, WRITTEN QUERY ETC.)

APPENDIX 7

AGENDA - CONDUCTING SUBSEQUENT PUBLIC CONSULTATIONS

1. WELCOME AND INTRODUCTION
2. STATEMENT BY THE NATIONAL ENVIRONMENT & PLANNING AGENCY
3. PRESENTATION OF TECHNICAL DOCUMENTS RELATED TO THE CHANGE IN THE PROPOSAL AND MEASURES TO MINIMIZE IMPACTS
4. QUESTION AND ANSWER SESSION
5. CLOSING REMARKS

Appendix 5 – Terrestrial Flora Species List

Plant Species	Common Name	Growth Form	DAFOR	Status
Alternanthera ficoidea	Crab Withe	Herbs	O-F	
Bromelia pinguin	Ping-Wing		R	
Bryophyllum pinnatum	Leaf-of-Life		R	
Commicarpus scandens	Easy-to-Break		O	
Leonotis nepetifolia	Christmas Candlestick		R	
Mimosa pudica	Shame Weed		F	
Panicum maximum	Guinea Grass		O	
Sida sp.			A	
Stachytarpheta jamaicensis	Vervine		R	
Stylosanthes hamata	Cheesy Toes		R	
Phoradendron piperoides	Mistletoe	Parasitic Shrub	R	
Antigonon leptopus	Coralita	Runners/Climbers	R	
Hyolocereus triangularis	God Okra		O	Endemic
Jacquemontia pentantha			R	
Urechites lutea	Nightshade		R-O	
Abutilon hirtum		Shrubby Herbs	O-F	
Heliotropium curassavicum			O	
Urena lobata	Ballard Bush		F	
Waltheria indica	Raichie		O	
Agave sp.		Shrubs	F	
Argythamnia candicans			O	
Bernardia dichotoma			R	
Bunchosia media			O	
Citrus sp.			R	
Cordia globosa var. humilis	Gout Tea		R	
Croton linearis	Rosemary		O	
Morinda royoc	Strongback		R	
Schaefferia frutescens			O-F	
Tecoma stans			F	
Acacia macracantha		Trees	R-O	
Acacia tortuosa	Wild Poponax		F-A	
Bauhinia divaricata	Bull Hoof		O	
Bourreria baccata			F	Endemic
Bursera simarouba	Red Birch		F	
Canella winterana	Wild Cinnamon		F-A	
Capparis ferruginea	Mustard Shrub		D	
Capparis flexuosa	Bottle-cod Root		O	
Cassia emarginata	Senna Tree		F	
Coccoloba sp.			O	
Crescentia cujete	Calabash Tree		R-O	
Diospyros tetrasperma	Clamberry		O	
Guiacum officinale	Lignum Vitae		O	National Flower
Gymnanthes lucida	Crab Wood		F-A	
Haematxoylon campechianum	Logwood		O-F	
Hibiscus tiliaceus	Seaside Mahoe		R	
Leucaena leococehphala	Lead Tree		A	
Malpighia glabra	Wild Cherry		O	
Manilkara sideroxylon	Naesberry Bullet		R	
Metopium brownei	Burn Wood		R	

Plant Species	Common Name	Growth Form	DAFOR	Status
Opuntia spinosissima	Prickly Pear Tree		R	
Pimenta dioca	Pimento		R	
Pithecellobium unguis-cati	Bread-and-Cheese		F-A	
Simaruba glauca	Bitter Damson		R-O	
Spathodea campanulata	African Tulip Tree		F	
Stenocereus hystrix	Dildo Pear		R-O	
Tabebuia riparia	White Cedar		R-O	Endemic
Trichilia reticulata			R	Endemic

Appendix 6 – Impacted Structure Profile Questionnaires

PROPOSED ROAD IMPROVEMENT PROJECT FROM HARBOUR VIEW, KINGSTON TO YALLAHS, ST. THOMAS (SECTION 1A OF THE SOUTHERN HIGHWAY IMPROVEMENT PROJECT)

POTENTIAL IMPACTED STRUCTURE QUESTIONNAIRE

DATE:	**INTERVIEWER:**
LOCATION:	**CODE:**

DEMOGRAPHICS

1. How many households are there? ____________________

2. How many persons in the household(s)? ____________________

3. What is the average weekly income of the household head? (*Circle answer in below table)*

1. Below $500	5. $2001 - $3000	9. $6001 - $7000
2. $ 501 - $1000	6. $3001 - $4000	10.Over $7000
3. $1001 - $1500	7. $4001 - $5000	
4. $1501 - $2000	8. $5001 - $6000	

4. If applicable, how many members of your household attend (*Insert number in brackets*):

Basic [ ] Primary [ ] All Age [ ] Junior High [ ] New Secondary [ ] Secondary High [ ]
Comprehensive High [ ] Technical High [ ] Vocational Agricultural [ ] Community College [ ]
Teachers College [ ] University [ ] HEART [ ] Other [ ] ____________________

Please give the name and approximate distance from home:

NAME/TYPE OF SCHOOL	DISTANCE FROM HOME (Km)

HOUSING & SOCIAL AMENITIES

5. Approximately how old is the house you are living in?

0 - 5 yrs. 6 - 11 yrs. 12 - 17 yrs. 18 - 24 yrs. 25 - 30yrs. Over 30 yrs.

6. How long have you (household) been living here?

0 - 5 yrs. 6 - 11 yrs. 12 - 17 yrs. 18 - 24 yrs. 25 - 30yrs. Over 30 yrs.

7. Number of bedrooms? ____________________

8. Where do you get your domestic water supply? ____________________

9. How do you dispose of your garbage? ____________________

____

STUCTURE

10. Building Condition

Abandoned
Derelict
Under Construction
Poor
Fair
Good
Very Good

11. Building Type

House
Shop
Garage
Farm
Pig Pen
Fowl Coup
Building Foundation
Unfinished Structure
Stall
Other

12. Type of Roof Material

Galvanized zinc
Aluminium Sheeting
Shingle/ (Decra)
Wood/ plywood
Thatch
Concrete
Other: ______________________

13. Floor Material

Concrete
Wood/ plywood
Tile
Other: ______________________

14. Wall Material

Block and Steel
Concrete
Wood/ plywood
Wattle & Daub
Thatch
Aluminium Sheeting
Other: ______________________

15. Building Use

Church
Residential
Commercial
Educational
Heavy Industrial
Light Industrial
Agricultural
Vacant/ Ruinate
Mixed Use
Other: ______________________

16. Lot Use

Church
Residential
Commercial
Educational
Heavy Industrial
Light Industrial
Agricultural
Ruinate/ Vacant
Pasture
Mixed Use
Other: ______________________

17. No. of Buildings on Lot ____________

PERCEPTION AND RELOCATION

18. Are you aware that the NWA intends to improve the main road between Harbour View and Yallahs? YES NO

19. If you were asked to relocate, would you be willing? YES NO DON'T KNOW NO RESPONSE

20. Do you have a preference in location if you were to be relocated? YES NO DON'T KNOW NO RESPONSE

If yes, where? ____

Any other comments:

____

____

____

SIGNATURE: ____________________

INTERVIEWER: ____________________

PROPOSED ROAD IMPROVEMENT PROJECT FROM HARBOUR VIEW, KINGSTON TO YALLAHS, ST. THOMAS (SECTION 1A OF THE SOUTHERN HIGHWAY IMPROVEMENT PROJECT)

POTENTIAL IMPACTED SHOP /STALL QUESTIONNAIRE

DATE:	**INTERVIEWER:**
LOCATION:	**CODE:**

1. Are you the owner of the stall? YES NO NO RESPONSE
2. How many persons are employed at the shop/stall? ______
3. About how many customers do you get per day? ______
4. About how much do you earn (make) per day? (*Circle answer in below table)*

1. Below $500	5. $2001 - $3000	9. $6001 - $7000
2. $ 501 - $1000	6. $3001 - $4000	10.Over $7000
3. $1001 - $1500	7. $4001 - $5000	
4. $1501 - $2000	8. $5001 - $6000	

5. Do you own any other stalls along the roadway? YES NO NO RESPONSE

If yes, where? ______

6. Is the owner of the stall the head of the household? YES NO NO RESPONSE
7. How many persons in the household? ______
8. If you were asked to relocate, would you be willing? YES NO DON'T KNOW NO RESPONSE
9. Would you be willing to pay a rental fee if you were located? YES NO DON'T KNOW NO RESPONSE
10. How much would you be willing to pay? ______
11. Do you have a preference in location if you were to be relocated? YES NO DON'T KNOW NO RESPONSE

    If yes, where? ______

STUCTURE

12. Building Condition

Abandoned
Derelict
Under Construction
Poor
Fair
Good
Very Good

16. Wall Material

Block and Steel
Concrete
Wood/ plywood
Wattle & Daub
Thatch
Aluminium Sheeting
Other: ______

Page 1 of 2

13. Building Type

House
Shop
Garage
Farm
Pig Pen
Fowl Coup
Building Foundation
Unfinished Structure
Stall
Other

14. Type of Roof Material

Galvanized zinc
Aluminium Sheeting
Shingle/ (Decra)
Wood/ plywood
Thatch
Concrete
Other: ________________________________

15. Floor Material

Concrete
Wood/ plywood
Tile
Other: ________________________________

17. Building Use

Church
Residential
Commercial
Educational
Heavy Industrial
Light Industrial
Agricultural
Vacant/ Ruinate
Mixed Use
Other: ________________________________

18. Lot Use

Church
Residential
Commercial
Educational
Heavy Industrial
Light Industrial
Agricultural
Ruinate/ Vacant
Pasture
Mixed Use
Other: ________________________________

19. No. of Buildings on Lot _______________

Any other comments:

____

____

____

SIGNATURE: ________________________________

INTERVIEWER: ________________________________

Appendix 7 – Community Survey Questionnaire

SOUTHERN COASTAL HIGHWAY PROJECT (SCHIP)
CONSTRUCTION OF SECTION 1A OF SEGMENT 1
HARBOUR VIEW TO YALLAHS COMMUNITY QUESTIONNAIRE

DATE:___________________

The National Works Agency (NWA) as part of the effort to develop the travel corridor between Port Antonio, Portland to Harbour View, St Andrew, proposes to build a highway along the southern and eastern coast of the island, traversing the parishes of St. Andrew, St. Thomas and Portland. The first section of this corridor to be developed is "**Section 1A**"and involves road improvement works between Harbour View, Kingston to Yallahs Bridge, St. Thomas which is approximately 17.3 km in length. Some communities within a 5 km radius of the road footprint are D'Aguilar Town/Rennock Lodge, Springfield, Port Royal, Bournmouth Gardens, Bull Bay/Seven Mile, Harbour View, Pamphret, Easington , Albion and Poormans Corner.

COHORT DESCRIPTION

1. What is the name of this/your community? ___________________________
2. (i) Male (ii) Female
3. Age group (i) 18- 25 yrs (ii) 26-33 yrs (iii) 34-41 yrs (iv) 42 – 50 yrs (v) 51 – 60 yrs (vi) older than 60 yrs
4. Are you the head of your household (i) yes (ii) no
5. What is your current employment status? (i) employed (ii) unemployed (iii) retired
6. If employed, are you (i) self employed or do you (ii) have an employer
7. If employed what do you do? ______________________________________
   (i) Casual labour (ii) semi-skilled (iii) skilled (iv) artisan (v) professional
8. Including yourself, how many people live in your household? ____ (i) # of adults ____ (ii) # of children under 18 yrs ____
9. How long have you lived in your community? (i) <2 yrs (ii) 3-5 yrs (iii)5- 10 yrs (iv)10-15 yrs (v) > 15 yrs
   (vi) all your life

EMPLOYMENT & INCOME

10. Including yourself how many people in your household are employed? ____________________________
11. What is the main employment status of household head? (If the interviewee is not the head of the household). (i) employed (ii) unemployed (iii) retired
12. If employed what does the head of household do? ______________________________________
    (i) Casual labour (ii) semi-skilled (iii) skilled (iv) artisan (v) professional

**** Use Table to answer questions below**

1. Below $500	6. $3001 - $4000
2. $ 501 - $1000	7. $4001 - $5000
3. $1001 - $1500	8. $5001 - $6000
4. $1501 - $2000	9. $6001 - $7000
5. $2001 - $3000	10.Over $7000

13. What is the average weekly income of the household head? ______________________
14. What is your average weekly income? ______________________________
15. What is the average weekly income of the household? (All sources) _________________
16. Do you depend on the proposed location for business? (i) yes (ii) no
    a. If yes what do you depend on it for?
    ____

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EDUCATION

17. What is the highest level of education you completed? (Which was the last school you attended) (i)None (ii) Primary/All Age (iii) Some High School (iv) High School (v) College (vi) University (vii) HEART/Vocational training institute

18. Is there anyone in your household attending school at this time? (i) yes (ii) no
    a. If yes, how many persons? ________________________
    b. What is/are the names of the school(s) ______________________________________

Name of School	How many persons attend	Approximate travel distance
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10 miles; (iv) more than 10 miles
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10 miles; (iv) more than 10 miles
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10 miles; (iv) more than 10 miles
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10 miles; (iv) more than 10 miles
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10 miles; (iv) more than 10 miles
		(i) 0-1 mile; (ii) 1-5 miles; (iii) 5-10miles; (iv) more than 10 miles

PERCEPTION

19. Have you ever heard of the National Works Agency (NWA)?
    (i) yes; (ii) no
    a. If yes, what have you heard and how did you hear? ____
    ____

20. Have you ever heard of the South Coast Highway Project (SCHIP)?
    (i) yes; (ii) no
    b. If yes, what have you heard and how did you hear? ______________________________________
    ____

21. Did you know that the National Works Agency (NWA) under the South Coast Highway Project (SCHIP) is proposing to construct a highway from Harbour View to Portland? (i) yes; (ii) no
    a. If yes, how were you made aware? ____
    ____
    b. What have you heard? ____

22. Do you have any concerns about the project as proposed? (i) yes; (ii) no
    a. If yes, what are they? ____
    ____

23. Do you think this project will affect your life in (i) positively or (ii) negatively? (iii) not at all
    a. If positive how so? ____
    b. If negative how so?____

24. Do you think that improvement of the roadway between Harbour View and Yallahs Bridge will make commuting (i) easier for you (ii) more difficult for you (iii) will not affect your commute
    a. If easier how so? ____
    b. If more difficult how so? ____

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HOUSING, HEALTH AND SOCIAL SERVICES

25. Do you _______ the house you live in? (i) Own (ii) Lease (iii) Rent (iv) Government Own (v) Squat (vi) Family own (vii) Other, specify _____________
Do you ________ the land on which your house is located?
(i) Own (ii) Lease (iii) Squat on (iv) Family Owned (v) Government Owned (vi) Other, specify ______________

26. What type of construction material is your residence made from?
    c. **Walls:** (i) Concrete and blocks (ii) Wood/Board (iii) Zinc (iv) Other specify________
    d. **Roof:** (i) Metal sheeting (zinc) (ii)Concrete (iii)Wood (iv) Other specify________

27. How many of the following rooms does your residence have? (i) Bedrooms _______ (ii) Bathrooms ________

28. What type of toilet facility do you have?
(i) Water Closet (ii) Pit Latrine (iii) None (iv)Other, specify ____________

29. What does your household use for lighting?
(i) Electricity (ii) Kerosene oil (iii) Gas (iv) Other, specify ___________

30. What type of fuel does the household use most for cooking?
(i) Gas (ii) Electricity (iii)Wood (iv)Coal (v)Other, specify _____________

31. What is the main source of domestic water supply for the household?
(i) Public piped water into dwelling (ii) Private Tank (iii) Community Tank (iv) Government Water Trucks (free) (v)Public Standpipe (vi). Private Water Trucks (paid) (vii) Spring or River (viii) Other, specify________

32. Do you have any problems with domestic/household water supply (i) yes (ii) no
    a. If yes, what is the problem? (i) no water at all (ii) no pipes run to the area (iii) irregular water supply (iv) low water pressure (v) other _____________________________
    b. If yes how do you cope with the problem (i) collect rain water (ii) buy water (iii) collect water from a spring/river (iv) water truck supplies water (v) community standpipe (vi) other ________________________
    c. How do you store water (i) drums (ii) underground tank (iii) aboveground tank (iv) other ________________

33. Do you have access to a residential telephone? (i) yes (ii) no
    a. If no, do you have a mobile/cell phone? (i) yes (ii) no
    b. If no, do you know of anyone having a residential telephone nearby? (i) yes (ii) no

34. What is the main method of garbage disposal for your household?
(i) Public Garbage Truck (ii) Private Collection (iii) Burn (iv)Other specify ________
    a. If public garbage truck, how often do trucks pick up garbage? (i) once per week (ii) twice per week (iii) every 2 weeks (iv) 1 time per month (v) Other, specify __________________

35. In the event of illness, where do you obtain health care? (i). Public Clinic (ii) Public Hospital (iii) Private Doctor (iv) Private Hospital

36. Do you suffer from any of the following conditions? (i). Asthma (ii). Sinusitis (iii) coughing (iv) congestion/bronchial problems (v) chest pains (vi) bouts of diarrhoea

37. Where do you usually shop (food, clothing etc)? (i) Supermarket (ii). Market (iii). supermarket & market (iv) Community Shop (v) Wholesale Shop

38. Are there any recreational centres/spaces in your community? (i). Yes (ii) No
(i) Is yes please give name and type ________________________________

39. What does the average person do for fun within the community? (i) Street dance/parties (ii) Youth Clubs (iii) Sports Clubs/bars (iv) Service clubs/Charity for e.g. Lions Club (v) Church groups/activities (vi) Other, specify________________

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NATURAL HAZARDS & SOCIAL AMENITIES

40. Are there problems with frequent flooding? (i) Yes (ii) No
    d. If yes how frequently (i) each time it rains (ii) only times of heavy rains (iii) during hurricanes (iv) other
    e. How frequently does flooding occur? (i) once weekly (ii) once monthly (iii) once in three months (iv) once in six months (v) once in a year (vi) less than once in a year

41. Where are the affected areas? ____

    How high does the water level rise? (i) less than 1 foot (ii) 1-5 ft (iii) more than 5 ft

42. Are there problems with frequent fires? (i) yes (ii) no

43. Do you know of any site or area along the proposed road layout considered to be (i) a protected area (ii) historic area (ii) or other area of national, historic or environmental importance

    If yes please give us as much detail as you can on this area ____________________________

    ____

44. Is there anything in particular about your area that you would like to tell us?

    ____

Signature of Interviewer: ....

Thank You for your time.

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Appendix 8 – Preliminary Environmental Feature Impact Matrix

Source: (CL Environmental Co. Ltd., 2014)

Theme	Features and Potential Environmental Effects		IMPACT			
			Major	Minor	Negligible	No Impact
ECOLOGY	**Rivers**	Degradation of natural ecological habitat, habitat fragmentation and the loss of important species within riverine and freshwater habitats that are traversed by or in proximity to alignment. Natural systems may be affected negatively by dust (siltation and sedimentation). Soil erosion, siltation and pollution of watercourses could have a negative impact on the flow regime, quality and clarity of watercourses and bodies. Of importance for example, is the Wicky Wacky Lake (Segment 1), which is also surrounded by mangroves.	X			
	Springs	Soil erosion, siltation and pollution of watercourses could have a negative impact on the flow regime and quality and clarity of watercourses and bodies. Surface and groundwater are important water sources for human and animal populations.	X			
	Mangrove/ swamp/ wetland	Degradation of natural ecological habitat, habitat fragmentation and the loss of important species within mangrove/swamp/wetland habitats. Also, natural systems may be affected negatively by dust (siltation and sedimentation) and hydrological regimes may also be affected by the proposed highway. For example, associated with the Western Alignment - Segment 2, the Negril Great Morass, the wetlands located between Savanna-la-Mar and Little London, along the coast from Savanna-la-Mar to Belmont and on to Black River and the Black River Lower and Upper Morass wetland ecosystems are vulnerable.		X		
	Dry forest	Degradation of natural ecological habitat, habitat fragmentation and the loss of important species within dry forest areas. There is concern regarding the protected and endemic Jamaican Boa/Yellow Snake which is found within these forested areas in St. Thomas (Eastern Alignment - Segment 1), some of the few areas in Jamaica where this species is consistently encountered. Also, natural systems may be affected negatively by dust (siltation and sedimentation).		X		
	Wet broadleaf forest (undisturbed, primary)	Degradation of natural ecological habitat, habitat fragmentation and the loss of important species within wet broadleaf forest habitats (Portland, Eastern Alignment - Segment 1). Also, natural systems may be affected negatively by dust (siltation and sedimentation).	X			
	Protected areas	Disturbance to protected areas, for example the Negril Environmental Protection Area (Western Alignment - Segment 2) and the area in proximity of Albion that is an important Bird Area (IBA) with high biological diversity and high levels of endemism (Eastern Alignment - Segment 1).		X		
	Forest estates	Disturbance to forest estates. Also, natural systems may be affected negatively by dust (siltation and sedimentation).				X

Theme	Features and Potential Environmental Effects		IMPACT			
			Major	Minor	Negligible	No Impact
	Species	Direct disturbance to important species, including endemic and/or protected/endangered species such as the Jamaican Boa, American Crocodile and Ground Lizard.		X		
	Caves	Damage to cave habitats.	X			
SOCIAL/ CULTURAL QUALITY & SERVICES	Parks	Recreation and amenity space for local populations are considered important to the quality of human life. Damage to recreational activities - parks.			X	
	Health centres	Damage to important social services - health centres. Also, health centres and hospital may be considered sensitive, at which persons may be particularly affected negatively by noise, vibrations, dust and emissions. Negative impacts include those to human health, local nuisance within communities (dust settling on surfaces) and impairment of visibility.		X		
	Hospitals	Damage to important social services - hospital. Also, health centres and hospital may be considered sensitive, at which persons may be particularly affected negatively by noise, vibrations, dust and emissions. Negative impacts include those to human health, local nuisance within communities (dust settling on surfaces) and impairment of visibility.		X		
	Schools	Damage to important social services - schools, and this includes the recreation and amenity space provided for the school populations. Also, schools may be considered sensitive, at which persons may be particularly affected negatively by noise, vibrations, dust and emissions. Negative impacts include those to human health, local nuisance within communities (dust settling on surfaces) and impairment of visibility.	X			
	Post offices	Damage to important social services - post offices.		X		
	Postal agencies	Damage to important social services - postal agencies.		X		
	Day care	Damage to important social services - day care. Also, day care facilities may be considered sensitive, at which persons may be particularly affected negatively by noise, vibrations, dust and emissions. Negative impacts include those to human health, local nuisance within communities (dust settling on surfaces) and impairment of visibility.		X		
	Fire stations	Potential interference with or destruction of existing emergency facility - fire stations.		X		
	Police stations	Potential interference with or destruction of existing emergency facility - police stations.		X		
	Archaeological locations	Damage to locations of cultural significance.			X	
	Cultural heritage	Damage to locations of archaeological significance.		X		
	Beaches	Potential interference with or destruction of existing natural and recreational beach locations.			X	
	Attractions	Potential interference with or destruction of existing infrastructure - attractions. However, on the other hand, reduced traffic results in reduced economic activity as well.		X		
	Service stations	Potential interference with or destruction of existing infrastructure - service stations.			X	
	Airports/ airfields	Potential interference with or destruction of existing infrastructure - airports and airfields.			X	

Theme	Features and Potential Environmental Effects		IMPACT			
			Major	Minor	Negligible	No Impact
	Cemeteries	Potential interference with or destruction of existing infrastructure - cemeteries.			X	
	Building and other infrastructure (residential)	Potential interference with or destruction of existing infrastructure (general urban and residential areas). In addition, possible fragmentation or destruction to communities (urban and residential areas). Potential dust and noise nuisances.		X		
INFRASTRUCTURE & UTILITIES	**NWC facilities**	Potential interference with or destruction of water and wastewater infrastructure - NWC facilities.	X			
	NWC hydrants	Potential interference with or destruction of water and wastewater infrastructure - NWC hydrants.		X		
	NWC manholes	Potential interference with or destruction of water and wastewater infrastructure - NWC manholes.		X		
	NWC pipelines	Potential interference with or destruction of water and wastewater infrastructure - NWC pipelines.	X			
	NWC system valves	Potential interference with or destruction of water and wastewater infrastructure - NWC system valves.	X			
	NWC wastewater facilities	Potential interference with or destruction of water and wastewater infrastructure - NWC wastewater facility.	X			
	NWC wastewater pipelines	Potential interference with or destruction of water and wastewater infrastructure - NWC wastewater pipeline.		X		
	Wells	Soil erosion, siltation and pollution of watercourses could have a negative impact on the flow regime and quality and clarity of watercourses and bodies. Surface and groundwater are important water sources for human and animal populations.	X			
	Transmission lines	Potential interference with or destruction of existing infrastructure - transmission lines.			X	
	LIME attached poles	Potential interference with or destruction of existing infrastructure - LIME poles.	X			
	LIME manholes	Potential interference with or destruction of existing infrastructure - LIME manholes.		X		
	LIME mobile sites	Potential interference with or destruction of existing infrastructure - LIME mobile sites.			X	
	LIME service cabinets	Potential interference with or destruction of existing infrastructure - LIME service cabinets.			X	
	LIME switching equipment	Potential interference with or destruction of existing infrastructure - LIME switching equipment.			X	
	JPS substations (transformer banks, switch banks and fuse banks)	Potential interference with or destruction of existing infrastructure - substations.	X			
	JPS poles	Potential interference with or destruction of existing infrastructure - JPS poles.		X		

Theme	Features and Potential Environmental Effects		IMPACT			
			Major	Minor	Negligible	No Impact
	Building and other infrastructure	Potential interference with or destruction of existing infrastructure (general urban areas). In addition, possible fragmentation or destruction to communities (urban and residential areas). Potential dust and noise nuisances.		X		
	Drains/gullies	Potential interference with or destruction of existing infrastructure. Further, increased soil erosion can lead to blockage of gullies/ drains.	X			
	Bridges	Potential interference with or destruction of existing infrastructure.		X		
INDUSTRY AND ECONOMY	Aqua farms	Potential interference with or destruction of existing agricultural infrastructure - aqua farms.			X	
	Fish landing sites	Potential interference with or destruction of existing agricultural infrastructure - fish landings.		X		
	Quarries	Potential interference with or destruction of existing quarries. However, some locations may be vital sources of construction materials.			X	
	Hotels	Potential interference with or destruction of existing hotels. However, on the other hand, reduced traffic results in reduced economic activity as well.		X		
	Markets	Potential interference with or destruction of existing infrastructure - markets. However, on the other hand, reduced traffic results in reduced economic activity as well. For example, existing economic activity within Middle Quarters (Western Alignment - Segment 2) represented by the vendors along the roadway must be considered as it represents a critical component of the communities and a well-known aspect of south coast tourism.		X		
	Proposed development	Interference with proposed development plans. For example, there have been proposals with respect to the development of an aerodrome in the vicinity of Golden Grove (Eastern Alignment - Segment 1).	X			
	Fields and Plantation	Potential interference with or destruction of existing agricultural land - plantations and fields. For example in Golden Grove (Eastern Alignment - Segment 1), a proposed alignment traverses agricultural holdings, and fragmentation of cane fields is likely if this option is chosen.	X			
	Bauxite extraction	Potential interference with or destruction of existing bauxite lands.			X	

Appendix 9 – Glossary of Technical Terms

A

ABRASION
The mechanical wearing away by rock material transported by wind or water.

ALIGNMENT (HIGHWAY)
The route travelled by a roadway that is described horizontally and vertically by a series of tangents and curves

ANNUAL AVERAGE DAILY TRAFFIC (AADT)
The total volume of two-way vehicle traffic on a road for a year divided by 365 days.

ARMOR UNIT OR STONE
A relatively large quarrystone or concrete shape that is selected to fit specified geometric characteristics and density. It is usually of nearly uniform size and usually large enough to require individual placement. In normal cases it is used as primary wave protection and is placed in thicknesses of at least two units.

B

BATHYMETRY
The measurement of water depths in oceans, seas, and lakes; also information derived from such measurements.

BAY
A recess in the shore or an inlet of a sea between two capes or headlands, not as large as a gulf but larger than a cove. See also BIGHT, EMBAYMENT.

BEACH
The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach--unless otherwise specified--is the mean low water line. A beach includes foreshore and backshore.

BEACH EROSION
The carrying away of beach materials by wave action, tidal currents, littoral currents, or wind.

BED
The bottom of a watercourse, or any body of water.

BENEFITS

The asset value of a scheme, usually measured in terms of the cost of damages avoided by the scheme, or the valuation of perceived amenity or environmental improvements.

BIOLOGICAL OXYGEN DEMAND (BOD)
The amount of oxygen taken up by aerobic microbes that decompose organic matter in a unit volume of water over a given time. It is used as a measure of the degree of organic pollution of water. The more organic matter the water contains, the more oxygen is used by microorganisms.

BOULDER
A rounded rock more than 256 mm (10 inch) in diameter; larger than a cobblestone. See SOIL CLASSIFICATION.

BRIDGE
An engineered structure that usually conveys vehicles over another roadway or drainage channel, such as a river.

BYPASS/DEVELOPMENT ROAD
A road that bypasses a town center or community that allows through traffic to detour around the town. It also provides access to undeveloped lands around the town for future development.

C

CHAINAGE
The horizontal length along a highway alignment measured in kilometers and meters from a starting location, which is not always zero. Chainage is displayed as “km + m”, i.e., CH 100+000.

CHART DATUM
The plane or level to which soundings (or elevations) or tide heights are referenced (usually LOW WATER DATUM). The surface is called a tidal datum when referred to a certain phase of tide. To provide a safety factor for navigation, some level lower than MEAN SEA LEVEL is generally selected for hydrographic charts, such as MEAN LOW WATER or MEAN LOWER LOW WATER. See DATUM PLANE.

CHLOROPHYLL A
A type of chlorophyll that is most common and predominant in all oxygen-evolving photosynthetic organisms such as higher plants, red and green algae. It is best at absorbing wavelength in the 400-450 nm and 650-700 nm of the electromagnetic spectrum.

CLAY
A fine grained, plastic, sediment with a typical grain size less than 0.004 mm. Possesses electromagnetic properties which bind the grains together to give a bulk strength or cohesion. See SOIL CLASSIFICATION.

CLIFF
A high, steep face of rock; a precipice.

CLIMATE
The characteristic weather of a region, particularly regarding temperature and precipitation, averaged over some significant internal of time (years).

CLIMBING LANE
An additional lane provided for vehicles moving slowly uphill so that other vehicles using the normal lane to the left of centerline are not delayed.

COAST
(1) A strip of land of indefinite width (may be several kilometers) that extends from the SHORELINE inland to the first major change in terrain features. (2) The part of a country regarded as near the coast.

COASTAL AREA
The land and sea area bordering the SHORELINE.

COASTAL DEFENSE
General term used to encompass both coast protection against erosion and sea defense against flooding.

COASTAL ZONE
The coastal zone may be simply defined as that transitional area between the land and sea. The coastal zone includes beaches and wetlands. Jamaica's coastal zone has important infrastructure including our ports, airports, oil refinery, road and electricity networks, and many towns and cities. It also includes important tourism related infrastructure (hotels and attractions). Coastal wetlands are valuable habitats for fish and other marine life. Coastal zones provide a buffer from flooding due to storm surges due to hurricanes.[8]

COASTAL ZONE MANAGEMENT
The integrated and general development of the coastal zone. Coastal Zone Management is not restricted to coastal defense works, but includes also a development in economical, ecological and social terms. Coastline Management is a part of Coastal Zone Management.

COASTLINE
(1) Technically, the line that forms the boundary between the coast and the shore. (2) Commonly, the line that forms the boundary between the land and the water, esp. the water of a sea or ocean. The SHORELINE.

CONCEPTUAL PLAN
A general development plan that shows the proposed development without the engineered details of a final plan.

CONSOLIDATION

[8] http://myspot.mona.uwi.edu/physics/sites/default/files/physics/uploads/02_CCAndCoastal%20Zones2.pdf

The gradual, slow compression of a cohesive soil due to weight acting on it, which occurs as water is driven out of the voids in the soil. Consolidation only occurs in clays or other soils of low permeability.

CONTOUR
A line on a map or chart representing points of equal elevation with relation to a DATUM. It is called an ISOBATH when connecting points of equal depth below a datum. Also called DEPTH CONTOUR.

CORAL REEF
A coral-algal mound or ridge of in-place coral colonies and skeletal fragments, carbonate sand, and organically-secreted calcium carbonate. A coral reef is built up around a wave-resistant framework, usually of older coral colonies.

CORRIDOR
An area along a highway alignment that may have a specific width.

CYCLONE
A system of winds that rotates about a center of low atmospheric pressure. Rotation is clockwise in the Southern Hemisphere and anti-clockwise in the Northern Hemisphere. In the Indian Ocean, the term refers to the powerful storms called HURRICANES in the Atlantic.

CULVERT
An engineered structure that usually conveys water under a roadway. Culverts may be circular, arch-shaped, square or rectangular.

D

DATUM
Any permanent line, plane or surface used as a reference datum to which elevations are referred.

DECIBELS (DB)
Is a dimensionless unit used to report sound pressure level (SPL or Lp). Decibels are used to represent the wide pressure range a human ear can detect. It is a logarithmic scale is used to report sound pressures.

DEGRADATION
The geologic process by means of which various parts of the surface of the earth are worn away and their general level lowered, by the action of wind and water.

DENSITY
Mass (in kg) per unit of volume of a substance; kg/m3. For pure water, the density is 1000 kg/m3, for seawater the density is usually more. Density increases with increasing salinity, and decreases with increasing temperature. More information can be found in "properties of seawater". For stone and sand, usually a density of 2600 kg/m3 is assumed. Concrete is less dense, in the order of 2400

kg/m3. Some types of basalt may reach 2800 kg/m3. For sand, including the voids, one may use 1600 kg/m3, while mud often has a density of 1100 - 1200 kg/m3.

DEPENDENCY RATIOS

It is the portion of a population which is composed of dependents (people who are too young or too old to work). The dependency ratio is equal to the number of individuals aged below 15 or above 64 divided by the number of individuals aged 15 to 64, expressed as a percentage.

DEPTH

The vertical distance from a specified datum to the floor of a water body.

DISCHARGE

The volume of water per unit of time flowing along a pipe or channel.

DISPERSION

Pattern of geographic distribution of individuals within a species. (2) Distortion of the shape of a seismic wave train or ocean wave train because of variations of velocity with frequency.

E

EASTBOUND

Traveling to the east, in the direction of increasing chainage. In Segment 1, traveling to the east is not always true as the roadway is going to the west near Port Antonio as the chainage values are increasing.

ECONOMIC INTERNAL RATE OF RETURN

The rate of return used in capital budgeting to measure and compare the profitability of investments. It is used to evaluate the desirability of investments or projects. The higher a project's EIRR, the more desirable it is to undertake the project.

ECOSYSTEM

The living organisms and the nonliving environment interacting in a given area, encompassing the relationships between biological, geochemical, and geophysical systems.

ELEVATION

The vertical distance from mean sea level or other established datum plane to a point on the earth's surface; height above sea level. Although sea floor elevation below msl should be marked as a negative value, many charts show positive numerals for water depth.

EL NIÑO

Warm equatorial water which flows southward along the coast of Peru and Ecuador during February and March of certain years. It is caused by poleward motions of air and unusual water temperature patterns in the Pacific Ocean, which cause coastal downwelling, leading to the reversal in the normal north-flowing cold coastal currents. During many El Niño years, storms, rainfall, and other meteorological phenomena in the Western Hemisphere are measurably different than during non-El Niño years.

EROSION
The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

F

FAECAL COLIFORM
A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals. Frequently used as an indicator of sewage pollution.

FAUNA
The entire group of animals found in an area.

FILTER
Intermediate layer, preventing fine materials of an underlayer from being washed through the voids of an upper layer.

FLOOD
(1) Period when tide level is rising; often taken to mean the flood current which occurs during this period (2) A flow beyond the carrying capacity of a channel.

FLORA
The entire group of plants found in an area.

FLUVIAL
Of or pertaining to rivers; produced by the action of a river or stream (e.g.,fluvial sediment).

G

GAUGE (GAGE)
Instrument for measuring the water level relative to a datum or for measuring other parameters

GEOGRAPHICAL INFORMATION SYSTEM (GIS)
Database of information which is geographically referenced, usually with an associated visualization system.

GEOMORPHOLOGY
(1) That branch of physical geography which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc. (2) The investigation of the history of geologic changes through the interpretation of topographic forms.

GEOTEXTILE
A synthetic fabric which may be woven or non-woven used as a filter.

GDP
Gross domestic product is the market value of all officially recognized final goods and services produced within a country in a given period of time (normally a year).

GLOBAL POSITIONING SYSTEM (GPS)
A navigational and positioning system developed by the U.S. Department of Defense, by which the location of a position on or above the Earth can be determined by a special receiver at that point interpreting signals received simultaneously from several of a constellation of special satellites.

GRADIENT
(1) A measure of slope (soil- or water-surface) in meters of rise or fall per meter of horizontal distance. (2) More general, a change of a value per unit of distance, e.g. the gradient in longshore transport causes erosion or accretion. (3) With reference to winds or currents, the rate of increase or decrease in speed, usually in the vertical; or the curve that represents this rate.

GRADING
Distribution, with regard to size or weight, of individual stones within a bulk volume; heavy, light and fine grading are distinguished.

GRAVEL
Unconsolidated natural accumulation of rounded rock fragments coarser than sand but finer than pebbles (2-4 mm diameter).

H

HACH HYDROLAB DATASONDE-5
A tethered device used to measure various water quality parameters.

HARBOUR
Any protected water area affording a place of safety for vessels. See also PORT. A harbor may be natural or man-made.

HEADWATER
The water or depth of water that is upstream of a bridge or culvert.

HERTZ (HZ)
The time that it takes for a vibrating particle to complete one vibration is known as the time period. The number of vibrations (pressure variations) per second is called the frequency of the sound, and is measured in Hertz (Hz). The frequency of a sound produces its distinctive tone. Thus, the rumble of distant thunder has a low frequency, while a whistle has a high frequency.

HURRICANE
An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 33.5 m/sec (75 mph or 65 knots) for several minutes or longer at some points. TROPICAL STORM is the term applied if maximum winds are less than 33.5 m/sec but greater than a whole gale (63 mph or 55 knots). Term is used in the Atlantic, Gulf of Mexico, and eastern Pacific.

HURRICANE PATH OR TRACK
Line of movement (propagation) of the eye through an area.

HYDROGRAPHY
(1) The description and study of seas, lakes, rivers and other waters. (2) The science of locating aids and dangers to navigation. (3) The description of physical properties of the waters of a region.

I

INTERSECTION U-TURN
An intersection that allows vehicles to turn 180 degrees, usually from a right turn lane.

K

KNOT
The unit of speed used in navigation equal to 1 nautical mile (6,076.115 ft or 1,852 m) per hour.

L

LANDMARK
A conspicuous object, natural or artificial, located near or on land, which aids in fixing the position of an observer.

LAYBY
An additional width of pavement to allow buses and taxis to pull out of the travel lane to pick up and discharge passengers without delaying vehicles using the normal lane to the left of the centreline.

LEVEL OF SERVICE (LOS)
The quality of traffic service provided by a highway or street and is based on the operational characteristics of the roadway such as speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience. LOS A is the least congested. LOS F is the most congested.

LINK ROAD
A road that connects the main road to a town or community bypassed by the main road.

M

MANGROVE
A tree or shrub which grows in tidal, chiefly tropical, coastal swamps, having numerous tangled roots that grow above ground and form dense thickets.

MEAN SEA LEVEL
The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. Not necessarily equal to MEAN TIDE LEVEL. It is also the average water level that would exist in the absence of tides.

MEAN TIDE LEVEL
A plane midway between MEAN HIGH WATER and MEAN LOW WATER. Not necessarily equal to MEAN SEA LEVEL.

MESOTROPHIC
A body of water having a moderate amount of dissolved nutrients.

MORPHOLOGY
River/estuary/lake/seabed form and its change with time.

MUD
A fluid-to-plastic mixture of finely divided particles of solid material and water.

N

NET PRESENT VALUE
The present value of an investment’s future net cash flows minus the initial investment. In the case of highways, the positive cash flows are savings in user costs over the life of the project, for example, reduction in travel time, reduction in fuel usage and a reduction in maintenance costs.

NISKIN
Device used to collect water samples at discrete depths in the water column.

NOISE
Noise is unwanted sound without agreeable musical quality. It is unwanted /undesired sound or sound in the wrong place at the wrong time. It is considered a pollutant and can be measured.

NUMERICAL MODELING
Refers to analysis of coastal processes using computational models.

O

OCEANOGRAPHY

The study of the sea, embracing and indicating all knowledge pertaining to the sea's physical boundaries, the chemistry and physics of seawater, marine biology, and marine geology.

OUTCROP

A surface exposure of bare rock, not covered by soil or vegetation.

P

PARKING LANE

Additional pavement added outside the normal travel lanes to allow vehicles to stop and park without interfering with vehicles in the normal lanes. Parking lanes are usually found in urban area that do not have shoulders.

PEAK FLOW

The maximum flow in a stream or channel for a given rainfall event. Rainfall events are defined by the probability of occurrence in a year.

PERCOLATION

The process by which water flows through the interstices of a sediment. Specifically, in wave phenomena, the process by which wave action forces water through the interstices of the bottom sediment and which tends to reduce wave heights.

PHOTOSYNTHETICALLY ACTIVE RADIATION (PAR)

The amount of light available for photosynthesis, which is light in the 400 to 700 nanometer wavelength range.

PHYTOPLANKTON

Microscopic plant-like organisms that inhabit oceans and bodies of freshwater requiring sunlight in order to live and grow.

PM 10

These are airborne particles that fall between 2.5 and 10 micrometers in diameter. They are considered coarse particles which are generated from sources such as crushing or grinding operations, and dust stirred up by vehicles traveling on roads.

PM 2.5

These are airborne particles that have diameters below 2.5 micrometres. Sources of these fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

POPULATION DENSITY

The number of persons per square kilometre or acre of land area.

PROBABILITY
The chance that a prescribed event will occur, represented by a number (p) in the range 0 - 1. It can be estimated empirically from the relative frequency (i.e. the number of times the particular event occurs, divided by the total count of all events in the class considered).

PROFILE SHEET
A plan sheet that shows the vertical alignment and elevations of a highway alignment.

R

RIGHT TURN LANE
A turning lane located between the normal lanes specifically for the use of vehicles turning right at an intersection.

RISK ANALYSIS
Assessment of the total risk due to all possible environmental inputs and all possible mechanisms.

ROADWAY GRADE
The longitudinal slope of the roadway vertical alignment, expressed in percent, which represents the elevation change over a given horizontal distance.

ROCK WEATHERING
Physical and mineralogical decay processes in rock brought about by exposure to climatic conditions either at the present time or in the geological past.

ROCK
(1) An aggregate of one or more minerals; or a body of undifferentiated mineral matter (e.g., obsidian). The three classes of rocks are: (a) Igneous – crystalline rocks formed from molten material. Examples are granite and basalt. (b) Sedimentary – resulting from the consolidation of loose sediment that has accumulated in layers. Examples are sandstone, shale and limestone. (c) Metamorphic – formed from preexisting rock as a result of burial, heat, and pressure. (2) A rocky mass lying at or near the surface of the water or along a jagged coastline, especially where dangerous to shipping.

ROUNDABOUT
A specific type of intersection where all traffic enters a circular roadway to connect to the various connecting roadways. Traffic entering the circular roadway must yield to any approaching traffic already in the circular roadway.

S

SALINITY
Number of grams of salt per thousand grams of sea water, usually expressed in parts per thousand (symbol: ‰).

SAND
Sediment particles, often largely composed of quartz, with a diameter of between 0.062 mm and 2 mm, generally classified as fine, medium, coarse or very coarse. Beach sand may sometimes be composed of organic sediments such as calcareous reef debris or shell fragments.

SEA
(1) A large body of salt water, second in rank to an ocean, more or less landlocked and generally part of, or connected with, an ocean or a larger sea. Examples: Mediterranean Sea; South China Sea. (2) Waves caused by wind at the place and time of observation. (3) State of the ocean or lake surface, in regard to waves.

SEA LEVEL RISE
The long-term trend in MEAN SEA LEVEL.

SEDIMENT
(1) Loose, fragments of rocks, minerals or organic material which are transported from their source for varying distances and deposited by air, wind, ice and water. Other sediments are precipitated from the overlying water or form chemically, in place. Sediment includes all the unconsolidated materials on the sea floor. (2) The fine grained material deposited by water or wind.

SEGMENT
A portion of the project. The Southern Coastal Highway Improvement Project is divided into two segments. Segment 1 covers the corridor from Harbour View to Port Antonio. Segment 2 covers the corridor from Negril to Mandeville.

SHORELINE
The intersection of a specified plane of water with the shore or beach (e.g., the high water shoreline would be the intersection of the plane of mean high water with the shore or beach). The line delineating the shoreline on National Ocean Service nautical charts and surveys approximates the mean high water line (United States).

SIGNALIZED INTERSECTION
An intersection whose movements are controlled by a traffic signal. Traffic on the main road and traffic on the side roads take turns in progressing through the intersection as controlled by the traffic signal.

SIDE ROAD
A road intersection the main road on either side of the main road.

SILT
Sediment particles with a grain size between 0.004 mm and 0.062 mm, i.e. coarser than clay particles but finer than sand. See SOIL CLASSIFICATION.

SLOPE
The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25, indicating one unit rise in 25 units of horizontal distance; or in a decimal fraction (0.04). Also called GRADIENT.

SOCIAL IMPACT AREA (SIA)
Estimated spatial extent of the proposed project's effect on surrounding communities, demarcated as a buffer of specified distance, e.g. 2 km from the proposed project.

SOIL
A layer of weathered, unconsolidated material on top of bed rock; in geologic usage, usually defined as containing organic matter and being capable of supporting plant growth.

SOIL CLASSIFICATION (SIZE)
An arbitrary division of a continuous scale of grain sizes such that each scale unit or grade may serve as a convenient class interval for conducting the analysis or for expressing the results of an analysis. There are many classifications used.

SPECIFIC GRAVITY
The ratio of the weight of unit volume of any material to the weight of unit volume of water at 4 deg C, $Gs = \gamma s/\gamma w$. Typical values of Gs for soil solids are 2.65 to 2.72.

SPL (SOUND PRESSURE LEVEL)
A ratio of one sound pressure to a reference pressure.

$SPL = 20 \log (L/Lr)$ dB   where Lr is the reference pressure

STONE
Quarried or artificially-broken rock for use in construction, either as aggregate or cut into shaped blocks as dimension stone.

STORAGE LENGTH
The length of a turning lane provided for vehicles waiting to turn.

STORM SURGE
A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes that rise in level due to atmospheric pressure reduction as well as that due to wind stress.

SUSPENDED LOAD
(1) The material moving in suspension in a fluid, kept up by the upward components of the turbulent currents or by colloidal suspension. (2) The material collected in or computed from samples collected with a SUSPENDED LOAD SAMPLER. Where it is necessary to distinguish between the two meanings given above, the first one may be called the "true".

T

TAILWATER
The water or depth of water that is downstream of a bridge or culvert.

TIDE
The periodic rising and falling of the water that results from gravitational attraction of the Moon and Sun and other astronomical bodies acting upon the rotating Earth. Although the accompanying horizontal movement of the water resulting from the same cause is also sometimes called the tide, it is preferable to designate the latter as TIDAL CURRENT, reserving the name TIDE for the vertical movement.

TOPOGRAPHIC MAP
A map on which elevations are shown by means of contour lines.

TOPOGRAPHY
The configuration of a surface, including its relief and the positions of its streams, roads, building, etc.

TOTAL DISSOLVED SOLIDS (TDS)
Compounds in the water that cannot be removed by a traditional filter and are made up of salts or compounds which dissociate in water to form ions.

TOTAL PETROLEUM HYDROCARBON (TPH)
A mixture of chemicals made mainly from hydrogen and carbon.

TOTAL SUSPENDED SOLIDS (TSS)
Solid materials, including organic and inorganic, that are suspended in the water.

TROPICAL CYCLONE
See HURRICANE

TROPICAL STORM
A tropical cyclone with maximum winds less than 34 m/sec (75 mile per hour). Compare with HURRICANE (winds greater than 34 m/sec).

TROUGH
A long and broad submarine DEPRESSION with gently sloping sides.

TSUNAMI
A long-period water wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Also SEISMIC SEA WAVE. Commonly miscalled "tidal wave."

TURBIDITY
(1) A condition of a liquid due to fine visible material in suspension, which may not be of sufficient size to be seen as individual particles by the naked eye but which prevents the passage of light through the liquid. (2) A measure of fine suspended matter in liquids.

TURNING LANE
A lane added either on the outside of the normal travel lanes or between normal travel lanes for the exclusive use of turning vehicles so that other vehicles using the normal lanes are not delayed.

TWO-WAY STOP CONTROLLED (TWSC) INTERSECTION
An intersection with a side road that allows vehicles on the main road to travel without having to stop while vehicles on the intersection side road must stop at a stop sign.

U

UPLAND
Dry land area above and landward of the ORDINARY HIGH WATER MARK (OHWM). Often used as a general term to mean high land far from the COAST and in the interior of the country.

UPLIFT
The upward water pressure on the base of a structure or pavement.

W

WATER DEPTH
Distance between the seabed and the still water level.

WATER LEVEL
Elevation of still water level relative to some datum.

WAVE
A ridge, deformation, or undulation of the surface of a liquid.

WAVE CLIMATE
The seasonal and annual distribution of wave height, period and direction.

WESTBOUND
Traveling to the west, in the direction of decreasing chainage. In Segment 1, traveling to the west is not always true as the roadway is going to the west near Port Antonio as the chainage values are increasing.

WETLANDS
Lands whose saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities that live in the soil and on its surface (e.g. Mangrove forests).