# FINAL

# *Environmental and Social Management Framework*

**ATN/SF-11841-GY & ATN/OC - 11842-GY:**
**Support to the Road Improvement and Rehabilitation Program (RIRP).**
**Sheriff Street – Mandela Avenue roadway**

**Submitted by**

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**November 14, 2013**

[1] Information taken from the Draft pre-Design Report prepared by exp (Services Inc. of Canada), and CEMCO (Caribbean Engineering and Management Consultants Inc.), July 17, 2013.

**Acknowledgements**

Sincere thanks are expressed to the following persons who have provided invaluable information and/support for the successful completion of this Environmental and Social Management Framework.

| | |
|---|---|
| Work Services Group | Mr Geoffrey Vaughn<br>Mr. Phillip Bryan<br>Ms Shawn-Anne Greene |
| Inter-American Development Bank | Mr Christopher Persaud |
| Environmental Protection Agency | Dr. Indarjit Ramdass |
| Research Assistants | Ms Jewell Liddell<br>Ms Claudette Foo<br>Ms Kaslyn Holder<br>Mr Steven Husbands |
| Communities | Households and Businesses along the Sheriff Street-Mandela Avenue roadway |

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**Abbreviations and Acronyms**

| | |
|---|---|
| CH &PA | Central Housing and Planning Authority |
| DSL | Demerara Shipping Limited |
| EBDMR | East Bank Demerara Main Road |
| ECDMR | East Coast Demerara Main Road |
| EMP | Environmental Management Plan |
| EPA | Environmental Protection Agency |
| ESIA | Environmental and Social Impact Assessment |
| ESMF | Environmental and Social Management Framework |
| GGDP | Greater Georgetown Development Plan |
| IDB | Inter-American Development Bank |
| MCC | Mayor and City Council |
| MoNRE | Ministry of Natural Resources and Environment |
| MPWC | Ministry of Public Works and Communication |
| NDS | National Development Strategy |
| NEAP | National Environmental Action Plan |
| OP | Operational Procedures |
| PSRP | Poverty Reduction Strategy Paper |
| SEA | Strategic Environment Assessment |
| UNEP | United Nations Environment Programme |
| USEPA | United States Environmental Protection Agency |
| Vehicles per hour | Vehicles per hour |
| WHO | World Health Organisation |
| WSG | Work Services Group |

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# 1 Introduction

## 1.1 The Sheriff Street – Mandela Avenue Roadway: A synopsis of the Current Situation[2]

The Sheriff Street – Mandela Avenue roadway was constructed in the 1970's by the Ministry of Works, Hydraulics and Supply. It is a main urban artery that crosses the capital city of Georgetown, connecting the East Coast Demerara Main Road (ECDMR) to the East Bank Demerara Main Road (EBDMR).Additionally, the roadway serves as the principal access to many residential areas in Georgetown.

Notably, the Sheriff Street-Mandela Avenue roadway was initially constructed as a bypass for Georgetown. As such, it provided a through and direct connection from the East Bank Highway at the southwest end of Georgetown to the East Coast Highway northeast of the City around the commercial and residential areas. However, since the roadway was constructed the City has experienced considerable shift in growth to the east. As residential, industrial and commercial activity grew along the Sheriff Street –Mandela Avenue roadway, the demand for local access from the east and the west grew along the route.

## 1.2 Defining the Problem

Commercial activity is on the rise along the corridor, creating a chaotic mix of pedestrian and vehicular traffic. Current traffic levels on the road exceed20,000 vehicles per day with peak periods experiencing 1500 vehicles per hour (vph)(capacity on this type of road is 1320 vph) and the average travel speed being less than 30 km per hour for the entire road with some sections averaging only 15km per hour.

New and existing housing schemes outside of Georgetown require access roads to transfer internally generated traffic onto the adjacent main roads. These accesses are commonly two lane roads (between 5m and 6m wide) with little or no provision for pedestrian and bicycle traffic and a single access road is usually shared by two or more housing schemes. Commuters experience traffic congestion during peak hours along the length of the accesses and especially at the intersection with the main roads. The narrowness of these roads and absence of alternatives are the main contributors to traffic congestion and safety problems in the schemes.

Moreover, the main road network is comprised of two lane roads with two 3.3 m wide driving lanes and shoulders varying between 0.0 and 1.5 m wide. These road shave limited road safety features and there are no provisions for pedestrian and bicycle traffic. There is a total of 10km of four lane road consisting of four 3.4 m driving lanes, shoulders and intermittent parking lanes and sidewalks. There are developments and settlements along the side of the main roads and these roads also serve industries involved in providing construction materials, manufacturing and food or agriculture processing. The traffic along these roads is a mixture of commuter and truck traffic, and congestion can now be experienced along some sections of the network due to the

[2] Information taken from the Draft pre-Design Report prepared by exp (Services Inc. of Canada), and CEMCO (Caribbean Engineering and Management Consultants Inc.), July 17, 2013.

slow moving trucks, the lack of overtaking opportunities owing to the narrowness of the roadway and friction from parked vehicles, pedestrian and bicycle traffic.

Importantly, there have been efforts aimed at improving the above-mentioned situation over the years. For example, traffic signals have been installed and intersections have been upgrade at many locations along the Sheriff-Mandela roadway. Although these improvements served to improve traffic flow, the high demands on the corridor warrant much more significant upgrades. Therefore, additionally, improvements are urgently needed to address the current situation in a holistic manner. To this end, interventions should include lane median separation, addition and/or widening of lanes, upgraded traffic intersection signals, street lighting, separation of turning lanes at intersection approaches, provision of pedestrian sidewalks and crosswalks, and delineated on-street parking and bus stops- all of which are roadway features necessary to facilitate the driving and pedestrian safety of the public attracted to the numerous businesses along the roadway.

## 1.3 General Objective and Program Components

The general objective of the Program is to enhance urban and suburban mobility and safety by reducing vehicle operating costs, travel times and road fatalities. This objective will be achieved through the upgrade, improvement and expansion of the road network.

The expected components of Project are: (i) Civil works: This includes the rehabilitation, improvement and construction of roads, construction of sidewalks, bikeways and streets, shoulder widening, construction and rehabilitation of bridges and culverts, incorporation of bus stops, passing lanes and other features to reduce congestion and improve safety; (ii) Studies. These activities include technical analyses, feasibility studies, environmental and social assessment studies, stakeholder engagement, engineering and road safety designs, and road safety audits; (iii) Sustainable Urban Transportation and Road Safety: This will finance a comprehensive urban transportation study aimed at improving mobility in and around Georgetown. A Road Safety Action Plan would be financed including the studies needed to be developed and the activities to be implemented under the program (iv) Implementation Support and Institutional Strengthening: These activities will be carried out through the hiring of consulting firms that will support the Executing Agency in ensuring the adequate progress and performance of civil works and all contractors. This component will also finance the strengthening of the capacity of the WSG in the areas of transportation planning and evaluation, project management and monitoring, and environmental and social safeguards; and (v) Routine Maintenance Management System. This component will finance road maintenance utilizing local counterpart resources. The resources allocated for this component will allow for uninterrupted routine maintenance of the main road network utilizing three-year performance-based lump sum contracts. These contracts will also include the maintenance of Road Safety features for the main road network such as signage and line markings.

## 1.4 The Need for an Environmental and Social Management Framework

In 2006, the IDB approved a new Environment and Safeguard Compliance Policy that prompted environmental issues to be identified and addressed during the project design. This policy is premised on the i) OP-703 Environment and Safeguards Compliance Policy; ii) OP-102 Disclosure of Information Policy; and iii) OP-710 Involuntary Resettlement.

Basically, an Environmental and Social Management Framework (ESMF) is to be considered, in the context of the Sheriff Street-Mandela Avenue road project, the means of operationalising the IDB Environment and Safeguard Compliance Policy. Its principal objective is toprovide an overall framework for environmental and social management of the planned project activities associated the Sheriff Street and Mandela Avenue roadway project, and should be used as a practical tool during project implementation.

The ESMF explicitly describes the steps to be undertaken in identifying, assessing, mitigating and ultimately managing any potential environmental and social the selection and implementation of the project. The ultimate objective is to ensure that the implementation of Sheriff Street-Mandela Avenue roadway project will be carried out in an environmentally and socially sustainable manner. It also provides a framework for institutional mechanisms and responsibilities to address adverse environmental and social impacts.

## 1.5 Objective of the Consultancy

The objective of the consultancy is to prepare an ESMF required for the construction and post-construction stages. Appendix 1 provides details on the scope of the ESMF.

## 1.6 Approach for the Preparation of ESMF

The ESMF has been prepared in accordance with applicable IDB safeguard policies and Guyana's environmental assessment guidelines (in accordance with Part IV of the Environmental Protection Act, 1996) , and which involves the following activities:

- Desk review of key documents (technical reports etc. as indicated in list of references)
- Field reconnaissance: Several field visits were made to the project areas during the period July-August, 2013 to: (i) observe and record special environmental features; (ii) conduct the floral and faunal surveys; (iii) map the land use activities; and (iii) conduct the rapid survey of households and businesses within the area of influence.
- Attendance at participatory stakeholders consultations with relevant sector institutions, businesses, concerned residents, among others);
- Review of comments from stakeholders as documented in reports submitted to the Work Services Group (WSG) by the Social Engagement Specialist;

- Data collection and analysis based on conventional methods as described in Section on Environmental and Social Baseline Conditions;
- Assessment of significance and design of an Environmental and Social Management Plan, using laboratory experiments, similarity and expert judgment as the main techniques; and
- Preparation and submission of Reports.

# 2 Policy, Legal and Administrative Framework[3]

## 2.1 National Policy

### 2.1.1 National Environmental Action Plan (2001-2005)

Guyana's National Environmental Action Plan (2001-2005) indicates national commitment to sustainable development in the pursuit of Guyana social and economic goals. It offers a framework for integrating cross-sectoral environmental concerns into the wider context of Guyana's economic and social development programme (NEAP, 2001-2005).

Specifically, the NEAP states that "in order to conserve and improve the environment, the Government of Guyana will endeavour, among other things, to:

- Conserve and use the environment and natural resources of Guyana for the benefit of both present and future generations, based on the principle of the exercise of sovereignty.
- Maintain ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and to observe the principle of optimum sustainable yield in the use of renewable natural resources and ecosystems, both on land and the sea."

The NEAP further states that in order to fulfill these objectives, the Government will:

- Institute punitive measures to deter possible violations of environmental norms;

[3] This section is an updated version of what was presented in The Black Bush Polder Economic Analysis, Environmental Assessment & Design Studies for Black Bush Polder Road Environmental Impact Assessment and Environmental Management Plan (EMP), January 2009.

- Ensure that, where environmental damage occurs, remedial action will be taken with the cost being covered by those responsible for causing the damage;
- Rehabilitate damaged ecosystems where possible and reverse any degradation of the environment;
- Ensure prior environmental assessments of proposed activities that may significantly affect the environment;
- Ensure that conservation is treated as an integral part of the planning and implementation of development activities;
- Raise the consciousness of the population on the environmental implications of economic and social activities through comprehensive education and public awareness programmes; and
- Involve the population, including indigenous peoples, women and youth, in the management of the environment and natural resources.

### 2.1.2 National Development Strategy (NDS) and Poverty Reduction Strategy Paper (PRSP)

The NDS was adopted by National Parliament and is clearly a national guide for the pursuit of sustainable development, which seeks to integrate development goals with environmental protection. The PRSP provides a balanced policy framework for poverty reduction, in recognition of the nexus between maintaining a productive and growing economy in the pursuit of economic development and the need to protect the natural resource base in Guyana.

### 2.1.3 Land Use Policy

Guyana developed, in 2005, a draft Land Use Policy, which is still to be finalised, then approved by the Government. When approved, this policy is expected to provide the guiding framework for coordination among various land uses, promote optimum land use as well as integration of land use and to inform the preparation of a National Land Use Plan. The latter is envisaged to support biodiversity conservation by optimising land use and minimising adverse impacts from competing land uses.

## 2.2 National Legislative Framework

### 2.2.1 Guyana's Constitution

Guyana's Constitution gives birth to an institutional and legal framework embedded in an ethos of environmentally sustainable and prudent policy. First, Article 25 states: `18

*Every citizen has a duty to participate in activities designed to improve the environment and protect the health of the nation.*

This is supported by Article 36, which originally stated:

*In the interests of the present and future generations, the State will protect and make rational use of its land, mineral and water resources, as well as its fauna and flora, and will take all appropriate measures to conserve and improve the environment*

Notably, in 2003, Article 36 was repealed and substituted as follows:

*The well- being for the nation depends upon preserving clean air, fertile soils, pure water and rich diversity of plants, animals and ecosystems*

This provision was also enhanced by the addition of Article 149 J on the environment:

*149 J (1) everyone has the right to an environment that is not harmful to his or her health or well-being*

*149 J (2) the State shall protect the environment, for the benefit of present and future generation, through reasonable legislative and other measures designed to: (a) prevent pollution and ecological degradation; (b) promote conservation; and (c) secure sustainable development and use of natural; resources while promoting justifiable economic and social development*

*149 J (3) it shall not be an infringement of a person's rights under paragraph (1) if, by reason only of an allergic condition or other peculiarity the environment is harmful to that person's health or well being.*

### 2.2.2 Environmental Protection Act

The Environmental Protection Act (1996) is an act *"to provide for the management, conservation, protection and improvement of the environment, the prevention or control of pollution, the assessment of the impact of economic development on the environment and the sustainable use of natural resources"* (EPAct, 1996). It is best described as the umbrella legislation that mandates the undertaking of a number of measures to safeguard the environment and its resources, including water resources. In particular, Section IV deals with the execution of environmental impact assessment and Section V deals with prevention and control of pollution l-

both of which are necessary tools to mitigate watershed degradation. For example, Part IV (19) 1 states *"A person shall not discharge or cause or permit the entry into the environment, of any contaminant in any amount, concentration or level in excess of that prescribed by the regulations or stipulated by any environmental authorisation."*

Further, the EPAct has allowed for the development of regulations, including the water quality pollution abatement and control and hazardous wastes disposal which will help safeguard water systems in Guyana. Additionally, the Environmental Act empowers the Environmental Protection Agency to issue four types of environmental authorizations. These are:

- Construction Permits: issued for construction activities that may have significant impacts on the environment;
- Operations Permits: issued for activities that, for example, may have been operation before the EPAct came into being and whose activities are likely to be affecting the environmental resources negatively and operations which are undertaken modifications to their operating process that may result in a change of effluent or emissions;
- Environmental Permits: issued for activities listed in the Fourth Schedule of the EPA Act, and any other project may have a significant impact on the environment; and
- No objections or letters of authorization for projects projected to have very limited impact on the environment and where not necessarily required to apply to the Guyana EPA.

The purpose of the Act is to provide for the management, conservation, protection and improvement of the environment, the prevention and control of pollution, the assessment of the impact of economic development on the environment and the sustainable use of natural resources. It supersedes all other legislation regarding the environment

### 2.2.3 Environmental Protection Regulations

#### *(i) Water Quality Regulations 2000*

The Water Quality Regulations, 2000 allow for the protection of aquatic resources in Guyana by controlling discharges of waste matter into any of the coastal and inland waters or land. Table 3-1 provides details on the parameters and the World Health Organization Standards that are used as the benchmark in Guyana. These regulations require registration and environmental authorization by any person whose construction, installation, operation, modification or extension of any facility may result in the discharge of effluents. Moreover, the regulations establish parameter limits of effluent discharges, new sources of effluent discharges, fees for

| Parameters | Standard (WHO) |
|---|---|
| *Physical text* | |
| pH | 6.5 – 8.5 |
| Conductivity | N/A |
| Total suspended solids | 25 mg/ L |
| Dissolved oxygen | ≥ 4 mg /L |
| Turbidity | max. day < 150 NTU |
| Temperature | - |
| *Anions* | |
| Alkalinity | nil |
| Sulphate | 250 mg/L |
| *Heavy metals* | |
| Calcium | 145 – 250 mg/L |
| Copper | nil |
| Iron | 0.3 mg / L |
| Lead | nil |
| Mercury | nil |
| Zinc | nil |
| Sodium | 70 mg / L |

Table 1 Water Quality Standards

registration and environmental authorizations, sampling points, records and reports and general provisions for the registration of water effluent, biological integrity, spills or accidental discharges and standard methods of analysis.

#### *Air Quality Regulations, 2000*

The EPAct empowers the Agency to determine and establish the allowable level of atmospheric pollutants that can be emitted without adversely affecting the health living and nonliving components of ecosystems. The EPA has not developed air quality standards; nevertheless,

existing standards such as those established by the World Bank may be used as the point of reference.

**World Bank Standards**

| Pollutant | World Bank Std. |
|---|---|
| Nitrogen Dioxide (NO2) Maximum 24-hour average | 150mg/$m^3$ |
| Particulate Matter (PM10) 24-hour average | 70mg/$m^3$ |
| Sulphur Dioxide (SO2) 24-hour average | 125mg/$m^3$ |

***Noise Management Regulations, 2000***

Under the Noise Management Regulations operations that produce noise during construction and operation activities require an environmental authorization from the EPA. The Agency has identified categories for permissible noise levels as: residential, institutional, educational, industrial, commercial, construction, transportation and recreational and has Guyana National; Bureau of Standards (GNBS) local interim noise standards which stipulate level of:

- 50 decibels during the night for residential areas;
- 55 decibels during the day for residential areas;
- 70 decibels during the night for industrial areas; and
- decibels during the day for industrial areas.

It is an offence under the Noise Regulations 2000, *Part v, for any person, proprietor or occupier of any building, private premises (including night clubs) or vehicle, to cause or allow any loud, unnecessary, excessive or unusual noises in the operation of any sound making device or equipment audible at a distance of 50ft from the source and shall be liable to a fine between G$300,000 and G$750,000 and to imprisonment of one (1) year*

***Hazardous Waste Regulations, 2000***

The hazardous waste management regulations outline the rules and procedures for transport, storage, treatment and disposal of hazardous wastes. These regulations may be supported by the Local Democratic Organs Act, 1980 and the Public Health Ordinance Cap 145, 1953 Ed.

### 2.2.4 Occupational Safety and Health Act 1997

The identification of the health and safety hazards during the operation of the proposed development must be seen as a key element for assessment. The Occupational Safety and Health Act 1997 outlines the procedures for establishing a factory site, regulating its and mandates that health and safety facilities are provided, maintained and the industrial establishment complies

with the regulations under the Act. In keeping with the laws and regulations a description of the established management procedures to monitor and manage occupational health and safety hazards is critical for this project.

### 2.2.5 Other Relevant Legislation

The following list of environmental legislation; policies, regulations and guidelines have applicability to the Bridge Rehabilitation Project:

***Roads Act, 1909***

This Act concerns the administration, maintenance and construction of roads. It also governs the movement of vehicles on land.

***Motor Vehicles and Road Traffic Act, 1940***

Deals with the licensing, regulation and use of motor vehicles and the regulation of traffic upon roads.

***State Lands Act, 1903***

This Act ensures the proper administration and regulation of lands, rivers and creeks of the State. It allows the President to grant leases or licenses for the use of State property.

### 2.2.6 Enforcement

The Country Environmental Profile (2007) observes, however that *"enforcement and implementation of strategic actions and policies remains problematic. Compliance monitoring involves planning, developing and executing assessment programmes based on criteria and indicators, the collection and analysis of samples and the interpretation of data measurements. Strong regulatory compliance monitoring and enforcement institutions require not only expenditure, but also major financial resources to support the independence and integrity of those involved in the execution of these mandates. Consequently, the issue of legislation enforcement remains a critical one, and requires urgent attention if the sound sentiments presented in the NDS and NEAP are to have any meaning."*

## 2.3 Organizational Framework

### 2.3.1 The Ministry of Natural Resources and Environment (MoNRE)

The Ministry of Natural Resources and the Environment (MoNRE)[4] in Guyana was created in November 2011 to have responsibilities for the eight natural resource entities, land use planning and coordination, and climate change. The primary objective is to improve environmental

[4] For more information see http://www.nre.gov.gy/.

governance at the national level. This will be possible through effective planning, institutional collaboration and capacity building. Already, a three day training programme on Strategic Environment Assessment (SEA) was held for officers of all entities with varying responsible for environmental management.

### 2.3.2 Environmental Protection Agency

The Environmental Protection Agency was established under the EPA Act on June 5 1996. This institution has overall responsibility for the management of the environment. The specific functions of Guyana EPA are clearly set out in Part II (4) of the EPA Act (1996).

Chief among these are:

(i) to take such steps as are necessary for the effective management of the natural environment so as to ensure conservation, protection, sustainable use of its natural resources;

(ii) to promote the participation of members of the public in the process of integrating environmental concerns in planning for development on a sustainable basis

(iii) to establish, monitor and enforce environmental regulations;

(iv) to prevent or control environmental pollution;

(v) to ensure that any developmental activity which may cause an adverse effect on the natural environment be assessed before such activity is commenced and that such adverse effect be taken into account in deciding whether or not such activity should be authorized;

(vi) to promote and encourage a better understanding and appreciation of the natural environment and its role in social and economic development;

(vii) to advise the Minister (who is also the President of Guyana) on matters the criteria and thresholds of activity for specifying what may amount to a significant effect on the environment; and

(viii) to advise the Minister on matters of general policy relating to protection, conservation and care of the environment and the impact of development

The EPA has institutional capacity challenges, particularly, human and financial resources. It is therefore very difficult to monitor development activities in interior regions; hence the need for the involvement of the other key stakeholders in what is currently referred to as collaboration management of the environment and its natural resources.

### 2.3.3 The Ministry of Public Works and Communication

In 2002, the Ministry of Public Works and Communication (MPWC) created the WSG that has responsibility for the planning and management of road investments and maintenance activities

that are executed by private firms. The recently established body has a full time environmental engineer who carries out the following duties:

- administration of the rehabilitation or reconstruction of bridges on all roads;
- adoption of environmental management plan as agreed by the IDB;
- preparation and issuing of construction tenders for bridge rehabilitation;
- preparation of environmental guidelines, mitigation measures etc.
- monitoring of EMP work and receiving evaluation reports from the engineering supervisory firm;
- preparing contracts for the additional environmental studies for bridges;
- ensuring compliance with applicable laws and regulations;
- liaison with the EPA, the Land Evaluation Committee and other government agencies; and
- the preparation and submission of reports on the above.

Like the EPA, the MPWC faces the challenge of human capital that can match the demands placed on the organisation. This affects, to a large extent, the Ministry's ability to monitor closely the projects and to provide timely comments on environmental reports.

### 2.3.4 National Land Use Committee

The GoG has established a National Land Use Committee as a coordinating mechanism for managing conflicts among natural resource uses. This Committee comprises the Commissioner of Lands and Surveys, the Commissioner of Guyana Geology and Mines, Commissioner of Forestry, the Guyana Environmental Protection Agency's Executive Director, and the Office of the President's Land Use Advisor.

### 2.3.5 The Georgetown Mayor and City Council

The Georgetown Mayor and City Council (M &CC), like other Town or municipal councils in Guyana, is responsible for the services allocated to the statutory body under the Municipal and District Councils Act 1998. The Georgetown M &CC is required to establish finance, works and social development committees and have full discretion to establish further committees as deemed necessary in order to execute a range of services such as drainage and irrigation, solid waste collection and disposal, maintenance of infrastructure, among others.[5] The Council also has a legal mandate to levy and collect rates, though this has proven to be a significant challenge and as such has impeded the extent to which the Council can carry out its functions.

[5] Source of information:
http://www.clgf.org.uk/userfiles/1/file/Guyana_Local_Government_Profile_2013_CLGF.pdf

# 3 Environmental and Social Baseline Conditions of Project Areas

Section 3 of the report provides baseline data of Sheriff Street-Mandela Avenue roadway project in terms of its physical, biological and socio-economic environmental features. The baseline data provided in this section will be used as the point of reference to identify and assess potential environmental and social impacts.

## 3.1 Physical Environmental Components

### 3.1.1 Air quality

This sub-section highlights the existing air quality status and potential air quality impacts associated with Sheriff Street-Mandela Avenue Road, Georgetown, Guyana and mitigation measures that can be implemented to reduce the levels of pollutants during operational and construction phase of the proposed road development.

Air quality simply refers to the state of the air around us. There are several air pollutants including particulate matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, lead, etc. These pollutants can be hazardous to human health and environment and can also cause property damage. Particle pollution and ground-level ozone are the most widespread health threats (USEPA, 2012). This report assessed particle pollution.

Particulate matter is a mixture of solid and liquid droplets found in the air. Two main sizes of particulate matter are usually assessed i.e. particles larger than 2.5 µm referred to as coarse particles and particles smaller than 2.5 µm referred to as fine particles. Coarse particles are usually formed from windblown dust and grinding operations, while fine particles are formed from fuel combustion, power plants and diesel operated vehicles (USEPA 2012). PM10 and PM2.5 were monitored during this investigation because studies have shown them to be associated with more severe respiratory diseases.

3.1.2 Methodology

Site Description

Air quality monitoring was conducted at seven points along Sheriff Street-Mandela Avenue Road. Points were plotted approximately 1 km apart along the seven kilometers asphaltic concrete surfaced road. The first point was plotted at the junction of Rupert Craig Highway and Sheriff Street and the last point was plotted between John Fernandes Limited Bulk Terminal Yard and Demerara Shipping Limited (DSL) at the junction of Mandela Avenue and the East Bank Highway.

Sheriff Street is a commercial center providing various services such as supermarkets, nightclubs, restaurants, hotels and numerous shops. Mandela Avenue also house important structures such as schools, gas stations and a shipping container yard.

**Figure 1 showing the Seven Air Quality Monitoring Points**


Location 1

The first monitoring point was located at the junction between Rupert Craig Highway and Sheriff Street. Residents are located on both sides of Sheriff Street. The area is residential and a 8m wide trench is located on the eastern side of Sheriff Street while a 2m trench was found on the western side. Between the first and second monitoring point an established food business, mini mall, railway embankment, gas station, supermarket and several shops can be found. The shoulders of the roads are covered with grass. The monitoring equipment was positioned at the traffic light located at the junction of Rupert Craig Highway and Sheriff Street.

Location 2

The second monitoring point was set up at the junction of Fourth Avenue and Sheriff Street, Georgetown. Between the second and third monitoring point businesses were found on both sides of Sheriff Street, including; vehicle repair shops, supermarkets, restaurants, schools, etc. A 8m wide trench runs through the two points. Many covered drains were found on the western side of the road. The shoulder of the road was covered with grass. The monitoring equipment was positioned in front of the American Peace University.

Location 3

The third monitoring point was set up on Sheriff Street between Dadanawa and Enacu Streets. Many residential houses and the Lamaha Canal are located between the third and fourth monitoring point. The 10m trench between these two points is narrowed in some areas, covered in some areas and non-existence in other areas. The shoulder of the road is covered with grass.

Location 4

The fourth monitoring point was set up at the intersection of Joseph Pollydore Street and Mandela Avenue (Easter Side). Many residential houses are located between the fourth and fifth monitoring point. Narrow drains exist on the western side of the road. The shoulders of the road were covered with grass but appeared dustier than the other areas. Construction was in progress on the opposite site of the monitoring point.

Location 5

The fifth monitoring point was set at the intersection of Go Slow Avenue and Mandela Avenue (Eastern Side). Residential houses, school and a gas station are located between the fifth and sixth monitoring point. Narrow drains exist on the eastern and western side of the road. The shoulders of the road were covered with grass.

Location 6

The sixth monitoring point was set up in the vicinity of Mandela and South Bridge. Many residential houses are located on the southern and northern side between the sixth and seventh monitoring point. A water pump station and a vehicular repair shop are located on the southern side on the unoccupied lands. Narrow drains exist on the eastern and western side of the road. The road was very dusty although the shoulders were covered with grass.

Location 7

The seventh monitoring point was set up between the John Fernandes Limited Bulk Terminal and Demerara Shipping Limited (DSL). Many residents are located on the northern side of Mandela Avenue. Narrow drains are located on both sides of the road. This part of the road is noisier compared to the other points. The road is extremely dusty, a cloud of dust can be seen on the road whether the traffic heavy or light. There is little grass on the shoulders of the road especially on the southern side where the container yard is located.

### 3.1.3 Traffic Flow

From 20th August-22nd August, 2013, heavy traffic was observed between 7:30 and 10:10 am, it accelerated again at 12:00 noon until 2:00pm, and then around 4:00pm. The traffic was generally heavy (approximately 20 vehicles per minute).

Monitoring Procedure

Air quality monitoring of particulate matter was conducted for three days from the 20th August-22nd August, 2013. A twelve hour monitoring period was established from 7 am in the monitoring. Both PM 10 and PM 2.5 were monitored for duration of 20 minutes at each monitoring point. After all 7 sampling points were monitored; the cycle began for a second round

of monitoring. On the second day monitoring started at sample point 7 instead of sample point 1. On the third day monitoring started at sample point 1. This allowed the parameter concentrations to be collected at the same location at different times of the day.

The SKC Environmental Particulate Air Monitor Model: SKC EPAM-5000 was used to test the air quality. This equipment has a highly sensitive real time particulate monitor designed for both ambient and indoor air quality applications. Concentration of particulate matter were recorded in milligrams per cubic meter ($mg/m^3$) and then converted to micrograms per cubic meter ($\mu g/m^3$). The results were then compared to international standards to determine whether monitoring points were within the acceptable levels.

Picture 1: Air Quality Monitoring Equipment

Weather Condition

Although the prevailing weather condition was rainy, no rain fell at the seven monitoring points during the air quality testing. It was sunny and the environs were dry. It was windy at different times of the day; the wind mainly blew in a north easterly direction.

***Limitations***

- Concentrations of particulate matter are strongly influenced by meteorology; this study is therefore limited by the absence of important meteorological data such as temperature, wind speed and humidity.
- The air quality test does not specify the constituents of the particle pollution thus one cannot accurately determine the source of particulate matter in the atmosphere.
- This data was not modeled into any software to determine various factors, such as building height, topography other anthropogenic and environmental factors that can impact dust pollution levels.

Tables 2& 3 highlight the average concentration of PM 10 & PM 2.5 in µg/m³ over a three days period for seven monitoring points at various times of the day. It also shows the WHO and USEPA standards that were used in comparing the data.

| DAY 1 | | | | Day 2 | | | | Day 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Morning Monitoring** | | | | **Morning Monitoring** | | | | **Morning Monitoring** | | | |
| PM10 Avera | WHO /USE | Time | Location | PM10 Avera | WHO /USE | Time | Location | PM10 Avera | WHO /USE | Time | Location |
| 20 | 50/150 | 7:35 AM | 1 | 99 | 50/150 | 7:26 AM | 7 | 12 | 50/150 | 7:47 AM | 1 |
| 7 | 50/150 | 08:26 | 2 | 21 | 50/150 | 08:12 | 6 | Missed | 50/150 | Missed | 2 |
| 13 | 50/150 | 09:28 | 3 | 10 | 50/150 | 08:32 | 5 | 11 | 50/150 | 09:25 | 3 |
| 7 | 50/150 | 10:16 | 4 | 4 | 50/150 | 10:05 | 4 | 9 | 50/150 | 10:18 | 4 |
| 17 | 50/150 | 11:16 | 5 | 5 | 50/150 | 10:56 | 3 | 19 | 50/150 | 11:16 | 5 |
| 13 | 50/150 | 12:14 | 6 | 6 | 50/150 | 11:44 | 2 | 21 | 50/150 | 12:05 | 6 |
| 108 | 50/150 | 01:13 | 7 | 26 | 50/150 | 12:33 | 1 | 31 | 50/150 | 12:52 | 7 |
| | | | | | | | | | | | |
| PM2.5 Avera | WHO/USE | Time | Location | PM2.5 Avera | WHO/USE | Time | Location | PM2.5 Avera | WHO/USE | Time | Location |
| 9 | 25/35 | 7:14 AM | 1 | 60 | 25/35 | 7:03 AM | 7 | 16 | 25/35 | 7:26 AM | 1 |
| 6 | 25/35 | 08:04 | 2 | 16 | 25/35 | 07:50 | 6 | Missed | 25/35 | Missed | 2 |
| 7 | 25/35 | 09:05 | 3 | 9 | 25/35 | 08:30 | 5 | 7 | 25/35 | 09:04 | 3 |
| 5 | 25/35 | 09:54 | 4 | 6 | 25/35 | 09:43 | 4 | 5 | 25/35 | 09:56 | 4 |
| 6 | 25/35 | 10:54 | 5 | 3 | 25/35 | 10:43 | 3 | 31 | 25/35 | 10:44 | 5 |
| 16 | 25/35 | 11:52 | 6 | 6 | 25/35 | 11:23 | 2 | 8 | 25/35 | 11:42 | 6 |
| 59 | 25/35 | 12:51 | 7 | 31 | 25/35 | 12:12 | 1 | 27 | 25/35 | 12:30 | 7 |

**Table 1**

| DAY 1 | | | | Day 2 | | | | Day 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Afternoon Monitoring** | | | | **Afternoon Monitoring** | | | | **Afternoon Monitoring** | | | |
| PM10 Avera | WHO /USE | Time | Location | PM10 Avera | WHO /USE | Time | Location | PM10 Avera | WHO /USE | Time | Location |
| 18 | 50/150 | 15:06 | 1 | 139 | 50/150 | 14:38 | 7 | 22 | 50/150 | 15:03 | 1 |
| 8 | 50/150 | 16:04 | 2 | 34 | 50/150 | 15:23 | 6 | 19 | 50/150 | 15:53 | 2 |
| 29 | 50/150 | 16:54 | 3 | 15 | 50/150 | 16:10 | 5 | 17 | 50/150 | 16:41 | 3 |
| 24 | 50/150 | 17:43 | 4 | 17 | 50/150 | 16:55 | 4 | 24 | 50/150 | 17:34 | 4 |
| 29 | 50/150 | 18:29 | 5 | 19 | 50/150 | 17:41 | 3 | 46 | 50/150 | 18:20 | 5 |
| 68 | 50/150 | 19:16 | 6 | 22 | 50/150 | 18:09 | 2 | 80 | 50/150 | 19:09 | 6 |
| 62 | 50/150 | 20:03 | 7 | 11 | 50/150 | 19:19 | 1 | 64 | 50/150 | 19:58 | 7 |
| | | | | | | | | | | | |
| PM2.5 Avera | WHO/USE | Time | Location | PM2.5 Avera | WHO/USE | Time | Location | PM2.5 Avera | WHO/USE | Time | Location |
| 8 | 25/35 | 2:43 PM | 1 | 76 | 25/35 | 2:15 PM | 7 | 17 | 25/35 | 2:41 PM | 1 |
| 7 | 25/35 | 15:42 | 2 | 30 | 25/35 | 15:02 | 6 | 7 | 25/35 | 15:32 | 2 |
| 10 | 25/35 | 16:32 | 3 | 18 | 25/35 | 15:48 | 5 | 18 | 25/35 | 16:19 | 3 |
| 13 | 25/35 | 17:21 | 4 | 5 | 25/35 | 16:35 | 4 | 13 | 25/35 | 17:08 | 4 |
| 13 | 25/35 | 18:07 | 5 | 11 | 25/35 | 17:20 | 3 | 23 | 25/35 | 17:58 | 5 |
| 45 | 25/35 | 18:55 | 6 | 19 | 25/35 | 18:09 | 2 | 56 | 25/35 | 18:47 | 6 |
| 29 | 25/35 | 19:43 | 7 | 7 | 25/35 | 18:59 | 1 | 32 | 25/35 | 19:36 | 7 |

**Table 2**

**PM10**

An analysis of the results reveals that location 7 consistently (whether it was in the morning or afternoon) recorded the highest average concentration of PM10 over the three days period when compared with the other six locations. Under all circumstances except, for the morning of day three the average concentration of PM10 exceeded the Particulate Matter Emission Standards of WHO i.e. 50 µg/m³. The highest average concentration of PM10 was 139µg/m³; it was recorded at location 7 at 14:38pm. This concentration not only exceeded WHO's standards but is close to the USEPA Particulate Matter Emission Standards of 150 µg/m³ for 24H mean. The standards set by WHO and USEPA are also used by the Guyana EPA. At concentration levels between 101-150 µg/m³ persons with respiratory disease, such as asthma are usually advised to limit outdoor exertion.

The high average concentration of PM10 at location 7 could be attributed to the frequent traffic flow of heavily loaded container trucks and the fact that the shoulder of the road in that vicinity is not covered with grass. The dispersion of dust into the air as a result of the traffic flow could have contributed to the high average concentration of PM10 since coarse particles are usually formed from windblown dust and grinding operations.

Location 6 also recorded average concentration of PM10 that exceeded the WHO's Particulate Matter Emission Standards. All the other locations recorded average concentrations of PM10 within the acceptable Particulate Matter Emission Standards of both WHO and USEPA.

Location 4 recorded the lowest PM10 average concentration for all three mornings.

**PM2.5**

Location 7 & 6 consistently recorded the highest average concentration of PM2.5. All records for location 7 were above WHO's standard of 25µg/m³; while three records were below USEPA standards of 35µg/m³. This could be attributed to the heavy diesel operated vehicular flow of traffic in this vicinity.

Location 5 had one elevated PM2.5 record on the third day that was above WHO's standard. Although the rest of the records for this site were at the acceptable level of WHO it was generally higher than locations 2, 3, 4. A contributing factor could be the existing gas station located 20m from the monitoring point since fine particles are formed from fuel combustion, power plants and diesel operated vehicles.

Location 1 also recorded an elevated PM2.5 level according to WHO's standard. This was noted around 12:12pm during one of the peak periods thus, heavy traffic may have contributed to the elevated average concentration of PM2.5.

Nonetheless, the general trend of the results highlight that the locations (various human activities/anthropogenic and environmental factors) have a greater influence on PM10 and PM2.5 average concentrations over time of day.

## 3.2 Soil Quality

This sub-section highlights the existing soil quality status and potential soil quality impacts associated with Sheriff Street-Mandela Avenue Road, Georgetown, Guyana and mitigation measures that can be implemented to increase the success of the proposed road development.

"Soil is defined as the top layer of the earth's crust. It is formed by mineral particles, organic matter, water, air and living organisms. It is in fact an extremely complex, variable and living medium. The interface between the earth, the air and the water, soil is a non-renewable resource which performs many vital functions: food and other biomass production, storage, filtration and transformation of many substances including water, carbon, and nitrogen" (European Commission, 2012).

Often overlooked and unthought-of during the early concept stages of a construction project, the properties in soil can hugely affect both the basic structure and the construction materials used during the course of the project. Ascertaining soil strength, density, compaction and contamination are vita during the construction process. Suitability of soil for construction is an important element in construction because projects can be delayed or even cancelled if soil is unsuitable.

### 3.2.1 Methodology

Site Description

The proposed site for the road construction is along the Sheriff Street/Mandela Avenue route which starts at the seawall (coordinates: Lat - 6°49'31.16"N, Long - 58° 7'59.17"W),continuing south pass the Kitty/Campbellsville areas then through the East Rumveldt area for approximately 4.4Km, Thence turning west stretching for approximately 2.2 Km ending at a junction (coordinates: Lat - 6°47'34.62"N, Long - 58° 9'53.13"W). The seven locations that were used in the air quality assessment were utilized in the soil assessment.

The prevailing weather conditions were mostly rainy with intermittent sunny periods, soil samples were collected on sunny days.

Procedure

The procedures used to evaluate the chosen soil parameters in this report followed the Soil Sampling and Testing for Transportation Engineers and Technicians Training Manual (Multi-Regional Training and Certification Task Group 2006).

Figure 2 showing the propose route of the road expansion


***Red line: Sheriff Street, Green line: Mandela Avenue***

### 3.2.2 Soil Analysis Results

**Table 4 Soil Analysis Results**

| Characteristics | **Sample Point 1** | **Sample Point 2** | **Sample Point 3** | **Sample Point 4** | **Sample Point 5** | **Sample Point 6** | **Sample Point 7** |
|---|---|---|---|---|---|---|---|
| **Bulk Density** | 1.05 $gcm^{-3}$ | nil | 1.2 $gcm^{-3}$ | 1.1 $gcm^{-3}$ | 1.8 $gcm^{-3}$ | 1.7 $gcm^{-3}$ | nil |
| **Permeability** | .05 to .25 cm/hr | | | | | | |
| **Porosity** | 60.2% | 40% | 35% | 36% | 28.9% | 35.2% | 38.8% |
| **Type** | Clay (Gleysol) | | | | | | |
| **Texture** | Fine | | | | | | |
| **Moisture Content** | 90.57% | nil | 60.01% | 56.04% | 31.00% | 30.96% | nil |

Bulk Density

Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pores among soil particles. The bulk density that was estimated for the study area ranged from $1g/cm^3$ to $1.9g/cm^3$. This was found to closely coincide with bulk density measurements for gleysols found in similar edaphic conditions (De Kimpe and Mehuys, 1979). The higher the bulk density, the higher the compaction potential of the soil, so this is an indication the soil along the proposed alignment is suitable for foundation stability and has a high load baring capacity (both static and active). This can be increased by using mechanical compaction techniques.

Permeability and Porosity

The permeability refers to the ease of which the soil will allow water to pass through it and the porosity refers to the amount of pore or void space within the soil mass. The soil permeability and porosity ranged from 0.05cm/hr to 0.25cm/hr and 28% to 60% respectively. In areas where the soil porosity is high e.g. SP1, mitigation measures will have to be taken to reduce this so as to minimize the chances of water seeping under the road and weakening the foundation.

Soil Type

Based on the on the analysis of the samples that were taken from the proposed project area, the soil types was determined to be clay. According to the World Database for Soil Resources (FAO 2006), this soil type can be grouped as Gleysols. A Gleysol is a wetland soil (hydric soil) that, unless drained, is saturated with groundwater for long enough periods to develop a characteristic gleyic colour pattern. This pattern is essentially made up of reddish, brownish or yellowish colours at surfaces of soil particles (peds) and/or in the upper soil horizons mixed with greyish/blueish colours inside the peds and/or deeper in the soil. Gleysols are also known as Gleyzems and meadow soils (Russia), Aqu-suborders of Entisols, Inceptisols and Mollisols (USDA soil taxonomy), or as groundwater soils and hydro-morphic soils.

Picture 2: represents the soil layers in the field

Gleysols occur on wide range of unconsolidated materials, mainly fluvial, marine and lacustrine sediments of Pleistocene or Holocene age, with basic to acidic mineralogy. They are found in depression areas and low landscape positions with shallow groundwater.

They exhibit a greenish-blue-grey soil color due to anoxic wetland conditions. On exposure, as the iron in the soil oxidizes colors are transformed to a mottled pattern of reddish, yellow or orange patches. Gley soils may be sticky and hard to work, especially where the gleying is caused by surface water, held up on a slowly permeable layer.

Groundwater gley soils develop where drainage is poor because the water table (phreatic surface) is high, whilst surface-water gleying occurs when precipitation inputs at the surface do not drain freely through the ground. A reducing environment exists in the saturated layers, which become mottled greyish-blue or brown because of the content of ferrous iron and organic matter. The presence of reddish or orange mottles indicates localised re-oxidation of ferrous salts in the soil matrix, and is often associated with root channels, animal burrows or cracking of the soil material during dry spells.

Moisture Content

This parameter was found to predominantly more than 50%. This may be due to the fact that there is a reasonably high frequency of rain. The water table along the study area is also very high being not more than 1m below the surface.

Due to the high plasticity of the soil type in question that dominates the study area two possible issues must be addressed regarding the problem of soil strength degradation:

- the degree of strength loss occurring in the soil
- the depth to which this strength degradation will occur

During dry periods, cracks develop in the soil surface. The depth and spacing of cracks will depend on the intensity and duration of the dry period and this cause the formation of small crack on the road surface.

During wet periods, moisture penetrates into cracks and diffuses into the soil mass, thereby reducing the suction in the soil. The reduction in suction due to infiltrating moisture results in a reduction in soil strength. When the strength declines to levels less than the driving stresses associated with the weight of the soil mass, failure occurs. Soil lifting can also be caused when the soil get highly saturated which can in turn disturb the bituminous layer of the road by forming bulges which can cause the road to become uneven and can further be compounded by traffic activity over time.

### 3.2.3 Limitations

There was no access to important laboratory equipment such as liquid limit devices, etc to evaluate important soil parameters such as the atterberg limits so assumptions had to be made about these parameters.

## 3.3 Water Quality

This sub-section describes the assessment of the water quality, potential ecological impacts and recommendations for mitigation measures of the proposed road development along Sheriff Street-Mandela Avenue Road.

Water quality is evaluated by the presence and quantity of pollutants, by physical/chemical factors such as pH and conductivity, by the number of salts present and by the presence of nutrients. Humans are largely responsible for these factors through the discharge of their waste in water. Change in the quality of water can cause harmful effects on any living thing that drinks or uses or lives (in) it. It can also cause infrastructural damages.

There are several classes of water pollutants namely (1) disease causing e.g. bacteria, (2) oxygen-demanding wastes; these waste can ultimately result in the depletion of oxygen in the water which further influences the survivability of aquatic life such as fishes, (3) water-soluble inorganic pollutants, such as acids, salts and toxic metals in high concentration can result in the death of aquatic life, (4) nutrients such as water soluble nitrates can result in excessive growth of algae and other water plants which can deplete oxygen supply causing the death of aquatic life, (5) organic compounds such as oil and plastics are harmful to plants and animals in the water, and (6) suspended sediment; this can causes the depletion in the water's light absorption capacity (USEPA 2012). The water samples tested in this project are surface water, ground water was not evaluated. The water bodies assessed in this report came from trenches/ditches along both sides of the road and are not used for drinking purposes.

### 3.3.1 Methodology

Site Description

Water quality was evaluated at six points along Sheriff Street-Mandela Avenue Road, Georgetown, Guyana. Points were plotted approximately 1km apart beginning from the intersection at Sheriff Street and Rupert Craig Highway and ending at the Well located in East Ruimveldt. The same air quality locations/points were utilized for the water quality assessment, thus the same general description holds.

The water evaluated in this project is not used for drinking, the only drinking source is the Lamaha Canal and this was not tested. The trenches/ditches on both sides of the road were assessed; it ranged from 8m to 2m wide on the eastern side of the road and 5m to 2m wide on the western side of the road; they were also varying depths as deep as 5m and as shallow as 1/2m. Various flora and fauna were observed in the water bodies including *Lemna minor*, *Nymphae* and *Oreochromis mossambicus*. The general odour was offensive and litter was observed at some of the locations.

The sampling days were sunny.

Procedure

The parameters reviewed in this project are total dissolved solids, suspended solids, conductivity, turbidity, nitrate, iron, Mg as Ca Co3, chloride, total coliform and *E.coli.* The procedure used to evaluate the chosen water parameters followed the Guyana Sugar Cooperation Laboratory Department Methods.

| **PARAMETERS TESTED** | **WATER QUALITY VALUES FOR ASSESSMENT CONDUCTED ALONG SHERIFF STREET-MANDELA AVENUE ROAD** | | | | | |
|---|---|---|---|---|---|---|
| | **Location 1** | **Location 2** | **Location 3** | **Location 4** | **Location 5** | **Location 6** |
| **Turbidity, NTU** | 10.6 | 29.7 | 27.5 | 21.3 | 18.2 | 20.3 |
| **Suspended Solids, mg/L** | 88 | 60 | 55 | 446 | 315 | 60 |
| **pH** | 7.195 | 6.956 | 7.070 | 6.797 | 7.059 | 7.590 |
| **Hardness, Mg as $CaCO_3$** | 13 | 18.6 | 159 | 8 | 19 | 2.64 |
| **Hardness, Ca as $CaCO_3$** | 91 | 30 | 177 | 0.57 | 43 | 0.39 |
| **Chloride, mg/L** | 20 | 32 | 552 | 20 | 32 | 72 |
| **Nitrate ($NO_3$ – N), mg/L** | 0.2 | 0.4 | 0.3 | 0.3 | 0.4 | 0.3 |
| **Iron (Total), mg/L** | 1.74 | 1.72 | 0.40 | 1.11 | 1.61 | 1.54 |
| | | | | | | |
| **Total Dissolved Solids, mg/L** | 1358 | 421 | 435 | 419 | 465 | 262 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Conductivity µs/cm** | 2670 | 862 | 888 | 857 | 948 | 540 |
| | | | | | | |
| **Total Coliform (MPN/100mL)** | >200.5 | >200.5 | >200.5 | >200.5 | >200.5 | >200.5 |
| **E. coli (MPN/ 100mL)** | >200.5 | >200.5 | >200.5 | >200.5 | >200.5 | >200.5 |

**Table 5 Water Qualities Values**

### 3.3.2 Results

Suspended solids

According to the Kentucky River Basin Assessment Report 2000, 80mg/L of total suspended solids can decrease macro invertebrate population by 60%. The results from location 1, 4 and 5 are therefore high. Suspended solids consist of an inorganic fraction (clays, etc.) and an organic fraction (algae, etc.) that are carried along by water as it runs off the land.

Ecologically, suspended solids can block fish gills, either killing them or decreasing their growth rate. They can reduce light infiltration which can reduce the ability of algae to produce food and oxygen. Suspended solids can result in siltation which can prevent the smooth flow of water thereby aiding in flooding.

pH

pH ranges from 0-14; the lower the value the more acidic the substance; the higher the value the more basic is the substance; while a pH of 7 is neutral. Each change in pH unit represents a tenfold change in acidity. A pH range of 6.0 to 9.0 appears to provide protection for the life of freshwater fish and bottom dwelling invertebrates (Kentucky River Basin Assessment Report 2000).

All water samples tested were found to be between the recommended ranges. An important environmental impact of pH is the effect it has on the solubility and thus bioavailability of other substances for example 4mg/L of iron would not present a toxic effect at a pH of 4.8, however, 0.9mg/L of iron at a pH of 5.5 can cause fish to die. Low pH can also have negative impacts on infrastructure.

Hardness

Water hardness is a result of dissolved minerals in water. Hardness is based on the ability of ions to react with soap to form a precipitate or soap scum. Hardness is classified as soft (0-75 CaCO3 (mg/L)), moderately hard (75-150 CaCo3 (mg/L)), hard (150-300 CaCO3 (mg/L)) and very hard (300 and up CaCO3 (mg/L)) (Kentucky River Basin Assessment Report 2000). All water

samples tested were found to be higher than 300CaCo3 (mg/L) they therefore fell into the category of soft, moderately hard and hard.

The most important ecological effect hardness has on fishes and other aquatic life is in the presence of other more toxic metals such as zinc, lead, cadmium and chromium, the harder the water the lower the toxicity of other metals to aquatic life.

Chlorides

Chlorides are salts resulting from the combination of the gas chloride with a metal. Examples of common chlorides include sodium chlorides (NaCl) and magnesium chlorides (MgCl2). Chlorides can enter into the environment through road salting, oil well waste and effluent wastewater. The criteria for the protection of aquatic life require levels of less that 600mg/L for long-term exposure and 1200mg/L for short-term exposure. All water bodies tested were below 600mg/L.

Another impact chloride can have on the environment is the corrosion of metals.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. All water samples tested were above the limit of 800µmho/cm set Kentucky River Basin Assessment report 2000

Conductivity is a measurement used to determine a number of applications related to water quality for example, determining mineralization: this is commonly called total dissolved solids. Total dissolved solids information is used to determine the overall ionic effect in a water source. Certain physiological effects on plants and animals are often affected by the number of available ions in the water.

Nitrate

Inorganic nitrogen may exist in the free-state as a gas $N_2$, or as nitrate $NO_3$, nitrite $NO_2$ or ammonia $NH_3$. Nitrogen-containing compounds act as nutrients in water bodies. Nitrogen-containing compounds can enter water bodies via municipal and industrial wastewater, septic tanks, animal wastes (including birds and fish).

Ecologically, excessive concentrations of nitrites can produce a serious condition in fish called "brown blood disease". The major impact of nitrates/nitrites on fresh water bodies is that of eutrophication. Nitrates stimulate the growth of algae and other plankton which provide food for higher organisms (invertebrates and fish); however an excess of nitrogen can cause over-production of plankton and as they die and decompose they use up the oxygen which causes other oxygen-dependent organism to die. Kentucky River Basin Assessment Report 2000

It is apparent that the nitrate values of the water samples evaluated are below 10mg/L as stipulate by Kentucky River Basin Assessment.

Faecal Coliform Bacteria

Indicator organisms such as faecal coliform bacteria usually do not cause disease, but they are used to detect the possibility of pathogens in water. Coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of animals including man. They aid in the digestion of food. A specific subgroup of this collection is the faecal coliform bacteria, *Escherichia coli*.

The criterion stipulated by Kentucky River Basin Assessment Report 2000 for swimming is fewer than 200 colonies/100 mL and for fishing and boating, fewer than 1000 colonies/100 mL. All water samples tested were greater than 200 colonies/100mL; it therefore means persons should not enter into these water bodies.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. Pathogens or disease producing bacteria or viruses can exist in fecal material. Some waterborne pathogenic diseases include typhoid, viral and bacterial gastroenteritis. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water.

## 3.4 Biological Environmental Components

### 3.4.1 Description of the Ecological Setting

Ecologically the project site lies within an area that has been altered by humans. Hence, the project site can be described as disturbed. The terrestrial ecosystem within the project site is comprised of secondary disturbed vegetation mainly consisting of grasses and shrubs. None of the vegetation at the project site has significant ecological values. Vegetation along Mandela Avenue is more intact than those along Sheriff Street. Complete removal of vegetation is common along some sections of Sheriff Street, especially in the vicinity of business premises. Concrete pavement replaces lost vegetation and used to show case merchandise or as parking lots.

Open drains varying in diameter and depth borders the Sheriff Street –Mandela Avenue Roadway. Along Mandela Avenue some sections of the drains are covered with aquatic plants. The trenches bordering Sheriff Street are predominantly open and are bisected by a number of cross streets. However, trenches bordering some businesses are completely covered with concrete bridges. Like along the Mandela Avenue Roadway, some sections of the open trenches along Sheriff Street were completely covered by aquatic plants.

Garbage and other household waste were commonly encountered along the Sheriff Street Mandela Roadway. However, there appeared to be less dumping of garbage along the Sheriff Street section of the roadway. Generally, garbage comprised mainly household refuse, old furniture and construction material. Styrofoam boxes, plastic and glass bottles and cloth were

frequently observed in illegal dump sites which were more common along Mandela Avenue. For example, dumping of garbage in bulk in waterways was observed close to the DSL outlet and GWI water purification plant. Solid waste was also present in the trenches and was often concentrated in the vicinity of culverts. Residents, especially those along Mandela Avenue complained of persistent flooding in the area.

Picture 3 Garbage in trench along Mandela Avenue

Picture 4 Garbage disposed along Mandela Avenue

### 3.4.2 Survey Methodology

Primarily, information on the flora and fauna of the project site was obtained through a series of field visits. Firstly, a reconnaissance visit was undertaken to obtain an understanding of the project site. Secondly desk reviews were conducted to obtain information on the terrestrial and aquatic biological environment within the area of influence of the project. Field visits were then conducted over a ten day period to identify flora and fauna along the Sheriff Street Mandela Avenue Roadway. Finally, the baseline data was analyzed and used to determine the potential impacts of the proposed project on existing flora and fauna.

There were two criteria that were used to determine areas to be sampled. These were divided into zones and were selected to represent the various vegetation types and land use along the road. Based on the foregoing a total of five zones were demarcated.

The boundaries for the various zones were as follow:

Zone 1- East Bank bypass and Mandela Avenue to entrance of John Fernandes container terminal

Zone 2 Vlissingen road to David Rose Street (by stop light)

Zone 3- Multilateral School to Arapaima Street (Police station)

Zone 4 Meadow Brook Drive to Enachu streets

Zone 5 -Campbell Avenue (OMG) to Third Avenue Subryanville

### 3.4.3 Floral survey

The floral survey entailed the characterization of the terrestrial vegetation along both shoulders of the Sheriff Street Mandela Avenue Roadway. Additionally, aquatic vegetation encountered was also recorded. The ACFOR scale which records the presence of species at a given site as Abundant, Common, Frequent, Occasional and Rare was used to describe species occurrence within the various zones.

### 3.4.5 Faunal Survey

Due to the diversity of faunal species known to inhabit roadside vegetation taxa specific methods were employed for baseline characterization. Surveys were conducted early in the morning between 6:00 hrs and 9:00 hrs and then in the afternoons from 17:00 hrs to 19:30 hrs. This was done to ensure that both nocturnal and diurnal species were inventoried. The methods used to survey the various taxa are described below.

***Birds***

Birds were identified by direct observation or their vocalization. During the survey the canopy of trees along the road and areas close to the roads were inspected for the presence of bird. Habitats occupied by birds and the number of birds spotted were recorded. Birds that could not be identified during the survey were described and later identified by comparing them with online databases. Additionally, attempts were made to survey birds by their vocalization. Birds have characteristic sounds and can be distinguished by their vocalization. However, there was difficulty in using this method along most sections of the road way because of intense noise that was generated by vehicular traffic.

***Fishes***

The aquatic sampling zones coincided with those established for the floral surveys. For each of the sites surveyed the following information was collected: trench substrate, velocity, depth, water body variability, and aquatic vegetation. Each of the sample zones was surveyed once in the mornings. Information on fishes was collected using hook and line and dip nets. When possible fishes caught were identified on site and returned to the waterway. Those that were unidentifiable were kept in ice and identified by comparing them with the collection at the Centre for the Study of Biological Diversity museum and with online databases.

***Macro-invertebrates***

Macro invertebrates were actively captured or observed during visual encounter surveys. Sampling was done one day at each zone. Identification of invertebrates presented several

challenges including the lack of comprehensive guides for identification to species level and the time available for identification since, many species require microscopic identification. In the light of these constraints, classification of macro invertebrates was restricted to Order. The number of individuals observed in each zone was counted to determine their respective abundances. Invertebrates encountered were classifies as below.

Uncommon (U) – Small numbers recorded, but not encountered daily

Fairly Common (F) – Less than 5 individuals recorded daily

Common (C) – Observed between one to ten individuals daily

Abundant (A) – Observed more than ten individuals daily (abundant)

Rare (R) – Observed less than once a day (rare**)**

### 3.4.6 Baseline Biological Environment along Sheriff Street-Mandela Avenue Roadway

### Flora

The vegetation within the entire project site is very typical of roadside areas. A total of 67 plant species representing 32 families were recorded in the project site. The most dominant family was Poaceae (14 species) followed by the families Cyperaceae and Asteraceae with 6 species each. The vegetation recorded in the project area is common in disturbed areas. No threatened or endemic plant species or sensitive habitats were present in the project site. Floral species recorded in the project site are shown in the table 1 below.

In most of the zones surveyed both sides of the road were completely covered with vegetation comprising common road side flora. Interspersed between the grasses were a few small trees and shrubs including Cassia alata (zone 3 and 4), *Cocos nucifera* (Vlissengen Road), *Hura crepitana* (zone 5) and *Zizyphus mauritana* (zone 3). Dense expanse of shrubs exists particularly on the eastern side of Mandela Avenue in the vicinity of the Botanical gardens.

A total of 29 plant species were recorded in Zone 1 (East Bank bypass and Mandela Avenue to entrance of John Fernandes container terminal) while 24 and 14 were recorded in Zones 2 (Vlissingen road to David Rose Street) and zone 3 (East Ruimveldt Multilateral to East Ruimveldt Police Station) respectively. Twenty two and sixteen species of plants were recorded in Zones 4 (Meadow Brook Drive to Enachu street) and zone 5 (Campbell Avenue (OMG) to Third Avenue Subryanville) respectively.

Carpet grass (*Axonopus compressus)* was the dominant grass observed along the shoulders of the Sheriff Street Mandela Avenue Roadway. The dominant grass in zone 1 was bahama grass (*Cynodon dactylon)* then followed by carpet grass *(Axonopus compressus.*

Although the composition of the vegetation on the road shoulders was almost constant there were variations in the composition of aquatic flora in the water ways.


Picture 5 *Axonopus compressus on* road shoulder at zone 5  Picture 6 *Nelumbium nelumbo in zone 5*

Nine totally aquatic and four semi aquatic plants were recorded within the various zones surveyed. The water way on the eastern side of the road in zone 5 was dominated by water nut (*Nelumbium nelumbo)* and *Brachiaria mutica,* while on the western side there were small patches of *Brachiaria mutica* (para grass). In zone 4 the dominant aquatic plants were water lettuce (*Pistia stratiotes), Sagittaria guyanesis* (duck weed) Alligator eye *(Salvinia auriculata)* and Morning glory *(Ipomea aquatic)*. Water lettuce (*Pistia stratiotes)* and morning glory (*Ipomea aquatic)* dominated the canal at Vlissingen Road.
The four semi aquatic species recorded in the project area were *Montricardia arborescens (moca moca), Echinochloa pyraidalis (*antelope grass), *Hymenachne amplexicaulis (*bamboo grass) and *Brachiaria mutica* (para grass).

The water hyacinth (*Eichhornia crassipes) is a* perennial herbaceous plant that historically has been very difficult to control. Because the plant reproduces vegetatively, infestation of water ways is extremely rapid. The water lettuce (*Pistia stratiotes)* reproduces by means of stolons and seeds. Both the water hyacinth and water lettuce are able to bio accumulate heavy metals.

Picture 7 Aquatic plants in trench at Vlissengen road  Picture 8 Clogged drains on Sheriff Street

| Species | Common Name | Family | Zone | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| Colocasis sp | Wild eddoes | Araceae | ❖ | ❖ | | ❖ | ❖ |
| *Sagittaria guyanesis* | Duck weed | Alismataceae | | | ❖ | ❖ | |
| *Achyranthes aspera* | Soldier rod | Amaranthaceae | ❖ | | | | |
| *Amaranthus spinosus* | Spiny bhajee | Amaranthaceae | ❖ | | | | ❖ |
| *Pistia stratiotes* | Water lettuce | Araceae | | ❖ | | ❖ | |
| *Montricardia arborescens* | Moco moco | Araceae | | ❖ | ❖ | ❖ | ❖ |
| | Coconut palm | Arecaceae | | ❖ | | | |
| | Palm | Arecaceae | | ❖ | | | |
| *Caliotropias gigantea* | Madar | Asclepidaceae | | | | | ❖ |
| *Vernonia cinerea* | Iron Weed | Asteraceae | ❖ | | | | |
| *Wedelia indica* | Daisy | Asteraceae | ❖ | ❖ | | | |
| *Bidens alba* | Hairy beggar sticks | Asteraceae | ❖ | | | | |
| *Tridax procumbens* | Button weed | Asteraceae | ❖ | | | | |
| *Synedrella nodiflora* | unknown | Asteraceae | | ❖ | ❖ | | |
| *Eclipta prostrate* | Congo lana | Asteraceae | | ❖ | | ❖ | |
| *Cordia macrostachya* | Black sage | Boraginaceae | ❖ | | | | |
| *Hydrochelis nymphiodes* | Water puppy | Butomaceae | ❖ | ❖ | | | |
| *Cassia alata* | Carrion crow bush | Caesalpinaceae | ❖ | ❖ | ❖ | ❖ | |
| *Terminalia catappa* | Almond | Combretaceae | ❖ | | | | ❖ |
| *Commelina diffusa* | canner grass | Commeninaceae | ❖ | | | | |
| *Ipomea aquatica* | Morning glory | Convolvulaceae | ❖ | ❖ | ❖ | | |
| | Baby pumpkin | Cucurbitaceae | ❖ | ❖ | ❖ | ❖ | |
| *Cyperus difformis* | Sedge | Cyperaceae | ❖ | | | | |
| *Cyperus digitatus* | Sedge | Cyperaceae | ❖ | | | | |
| *Paspalum virgtaum* | Razor grass | Cyperaceae | ❖ | ❖ | ❖ | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Cyperus luzulae* | Razor grass | Cyperaceae | ❖ | | | ❖ | ❖ |
| *Cyperus compressus* | Bisi bisi | Cyperaceae | ❖ | | | ❖ | |
| *Cyperus esculentus* | Yellow nut sedge | Cyperaceae | ❖ | | | | |
| *Phyllanthus amarus* | Seed under leaf | Euphorbiaceae | | ❖ | ❖ | | |
| *Hura crepitana* | Sand box tree | Euphorbiaceae | | | | ❖ | |
| *Jathropa gossypifolia* | Belly ache bush | Euphorbiaceae | ❖ | | | ❖ | |
| *Sesbania sesban* | Unknown | Fabaceae | | | | ❖ | |
| *Centrosema pubescence* | Unknown | Fabaceae | ❖ | | ❖ | | ❖ |
| *Samanea saman* | Rain tree | Fabaceae | | | | | ❖ |
| *Desmodium adscendens* | Sweet heart | Fabaceae | ❖ | ❖ | | | |
| *Heliconia sp* | Heliconia | Heliconaceae | | | | ❖ | |
| *Malachna capitata* | Wild ochro | Malvaceae | | | | ❖ | |
| *Neptunia prostrata* | Shame bush | Mimosaceae | ❖ | ❖ | | | |
| *Musa sp* | Banana | Musaceae | | ❖ | | ❖ | |
| *Syzgyium cumini* | Jamoon | Myrtaceae | ❖ | ❖ | | | |
| *Psidium gujava* | Guava | Myrtaceae | | | | ❖ | |
| *Nelumbium nelumbo* | Water nut | Nymphaceae | | | ❖ | ❖ | ❖ |
| *Ludwigia erecta* | Wild clove | Onagraceae | ❖ | ❖ | ❖ | ❖ | |
| *Antidesma ghaesembilla* | Antidesma | Phyllanthaceae | | ❖ | | ❖ | |
| *Peperomia pellucida* | Soldier parsley | Piperaceae | ❖ | | | | |
| Commelina elegans | Rabbit grass | Poaceae | ❖ | | ❖ | ❖ | |
| *Echinochloa pyraidalism* | Antelope grass | Poaceae | | ❖ | | ❖ | ❖ |
| *Cynodon dactylon* | Bahama grass | Poaceae | ❖ | ❖ | | | |
| *Commelina diffusa* | Rabbit grass | Poaceae | ❖ | | ❖ | ❖ | |
| *Echinochloa colonum* | Bird seed | Poaceae | ❖ | | ❖ | ❖ | |
| *Panicum maximum* | Guinea grass | Poaceae | ❖ | | | ❖ | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Axonopus compressus* | Carpet grass | Poaceae | ❖ | ❖ | ❖ | ❖ | ❖ |
| *Hymenachne amplexicaulis* | Bamboo grass | Poaceae | ❖ | | ❖ | | |
| *Sporobolus jacquemontii* | Iron grass | Poaceae | ❖ | | | | |
| *Cyperus rotundus* | Nut grass | Poaceae | ❖ | ❖ | | ❖ | ❖ |
| *Cynodon dactylon* | Bahamia grass | Poaceae | ❖ | | ❖ | | ❖ |
| *Eleusine indica* | Fowl foot | Poaceae | ❖ | | | | ❖ |
| *Brachiaria mutica* | Para grass | Poaceae | ❖ | ❖ | | ❖ | ❖ |
| *Ischaemum timorense* | Lucuntu | Poaceae | ❖ | ❖ | ❖ | | |
| *Coix lachryma* | Buck bead | Poaceae | | | | ❖ | ❖ |
| *Triplaris surinamensis* | Long John tree | Polygonaceae | ❖ | | | | |
| *Eichhorina crassipes* | Water hyacinth/alligator spoon | Pontederiaceae | ❖ | | ❖ | | |
| *Portulaca oleracea* | Hog bhajee | Portulaceae | ❖ | ❖ | | | |
| *Zizyphus mauritana* | Dunks | Rhamnaceae | | ❖ | | ❖ | |
| *Salvinia auriculata* | Alligator eye | Salvinaceae | | | ❖ | ❖ | |
| *Solanum stramonifolium* | Buru buru | Solanaceae | ❖ | | | | |
| *Lantana camra* | Sweet sage | Verbenaceae | ❖ | | ❖ | | |

Table 6 : Plant species recorded in zones 1 to 5
Source: Survey data

### 3.4.7 Fauna

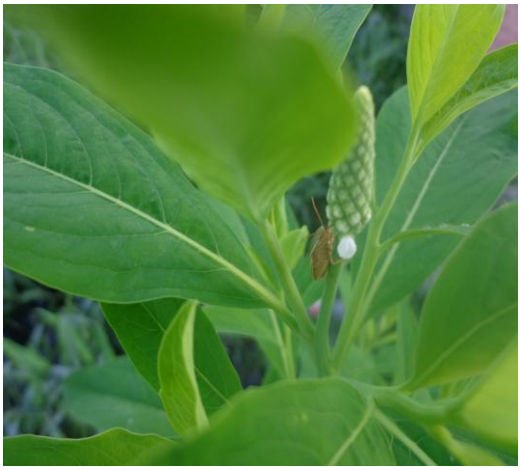
#### *Macro invertebrates*

Macro- invertebrates are important components of ecological systems since they play vital roles in pollination and recycling of organic materials. Further, they are an important component of terrestrial and aquatic food web. Macro invertebrates are also pests and assist in the transmission of disease.

Ten Orders of macro invertebrates were recorded. Macro invertebrate that were abundant were the dragon fly, honey bee (*Apis mellifera),* spiders, butterflies and bugs. The high number of pollinators observed could be associated with the large number of shrubs in the project site that

that were flowering. The dominant aquatic macro invertebrate belongs to the group Mollusca. See Table 2 for Orders of macro invertebrates recorded.

Picture 9 Odonata on vegetation along Mandela Avenue



Picture 10 Hemiptera on vegetation along Mandela Avenue

| Common Name | **Order** | **Abundance** |
|---|---|---|
| Bees and wasps | Hymenoptera | C |
| Dragon flies | Odonata | A |
| Butterflies and moths | Lepidoptera | C |
| Grasshopers | Orthoptera | F |
| True bugs | Hemiptera | C |
| Bugs | Homoptera | C |
| Spiders | Aranea | F |
| Snails | Mollusca-Gastropoda | A |
| Walking sticks | Plasmida | U |
| Beetles | Coleoptera | U |

Table7: Macro-invertebrates recorded in project site

**Abundance Codes:**

U – Small numbers recorded, but not encountered daily (uncommon)
F – Less than 5 individuals recorded daily (fairly common)
C – Observed between one to ten individuals daily (common)
A – Observed more than ten individuals daily (abundant)
R – Observed less than once a day (rare**)**

### 3.4.8 Fishes

Apart from the trenches that bordered the road on its eastern and western sides there are no other aquatic systems at the project site. Observation of the water ways revealed that significant quantities of waste (plastic bottles, Styrofoam boxes and household waste) are being dumped into the trenches, particularly along Mandela Avenue.

A total of 31 fishes were collected representing two families and five species.

Species belonging to the family Poeciliidae give birth to live young. These live bearers consume insects, other small invertebrates, and aquatic vegetation. The two species documented were less that 2cm long and are not a source of food. The Mozambique tilapia (*Oreochromis mossambicus*) is found in a wide range of habitats including brackish waters, lakes and ponds. Studies done on *Oreochromis niloticus* confirmed it usefulness as bio indicators of heavy metal pollution in aquatic ecosystems.

None of the fishes were of significant environmental or ecological importance. The most common species was the Nile tilapia. See table 3 for fish species recorded in project site.

| **Order** | **Family** | **Species** | **Common name** | **#** |
|---|---|---|---|---|
| Perciformes | Cichlidae | *Cichlasoma bimaculatum* | Patwa | 1 |
| Perciformes | Cichlidae | *Oreochromis mossambicus* | Mozambique tilapia | 3 |
| Perciformes | Cichlidae | *Oreochromis niloticus* | Nile Tilapia | 15 |
| Cyprinodontiformes | Poeciliidae | *Poecilia reticulata* | Guppy | 8 |
| Cyprinodontiformes | Poeciliidae | *Poecilia vivipara* | Guppy | 4 |

Table 8: Fish species recorded within project site
Source: Field survey data

### 3.4.9 Avifauna

Ecologically birds are important in pollination, seed dispersal, seed predation, and therefore tree species regeneration. Seven avian species were observed along Sheriff Streets and Mandela Avenue. Most of the birds observed were transient. However, a few were spotted utilizing vegetation along the road including grasses. Most of the birds were recorded in zone 1, on trees close to the DSL outlet and in the vicinity of the Botanical Gardens. The number spotted during the survey does not reflect the diversity that is known to occur in the Botanical Gardens since previous reports indicates 158 bird species within this area. The Botanical Garden is currently a bird sanctuary. Birds recorded within the proposed project site are shown in table below.

| Scientific Name | Common Name | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 |
|---|---|---|---|---|---|---|
| *Bubulcus ibis* | Cattle Egret | ❖ | | ❖ | ❖ | |
| *Coragyps atratus* | Black Vulture | | ❖ | ❖ | | |
| *Columbina passerina* | Common ground dove | ❖ | | | | |
| *Crotophaga ani* | Smooth bill ani | ❖ | | | ❖ | |
| *Megaceryle torquata* | King fisher | | | | | ❖ |
| *Pitangus sulphuratus* | Great kiskadee | ❖ | ❖ | ❖ | ❖ | ❖ |
| *Elaenia flavogaster* | Yellow-bellied Elaenia | | | | ❖ | |

Table 9 Birds recorded in the project site

## 3.5 Social Environmental Components

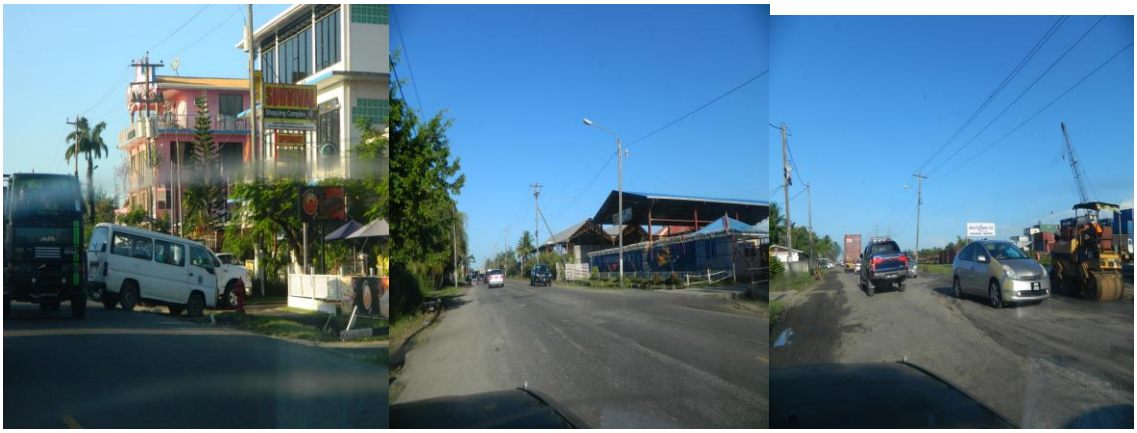
### 3.5.1 Land Use

It is useful to reiterate some points mentioned in the introduction of this ESMF Report in an effort to describe the context within which the land use map has been prepared[6].

Sheriff Street stretches from north Rupert Craig Highway and south to Botanical Gardens for one and half miles (2.4km), it divides Campbellville one of the ward in Georgetown and also encompass several other wards, some of them residential. This street is the commercial hub with a series of different types of businesses for instance hardware, auto sales, restaurants, hotels, supermarkets and taxi services.

From Sheriff Street, the road continues into Mandela Avenue which starts from the back of the Botanical Gardens and continues south for one and three-quarters miles (2.8km), to the North Ruimveldt Multilateral School. This stretch of road has the National Cultural Centre, Lands and Surveys Commission, Davis Memorial Hospital, a Sports Complex and Police Station and two schools, the North Ruimveldt Multilateral School and the East Ruimveldt Secondary School, businesses which includes Gas Station, restaurants, Post Office, Television Station, and several residential wards and some squatting on the canals banks. It then turns eastwards to join the East Bank Demerara Highway for a distance of one and three-eighths miles (2.6km). This stretch of road has several residential wards on the northern side and on the southern side the Industrial Site which has the Guyana Water Inc., John Fernandes Container Terminal, BK International, Gafoors Toyota, Guytrac and DSL Supermarket.

The Sheriff Street/Mandela Avenue is the main thoroughfare from the East Coast Demerara to East Bank Demerara Public Road which leads to the Cheddi Jagan International Airport, to the Bauxite town of Linden and the interior of Guyana.



Pictures 11, 12, and 13: Views from the Project Areas

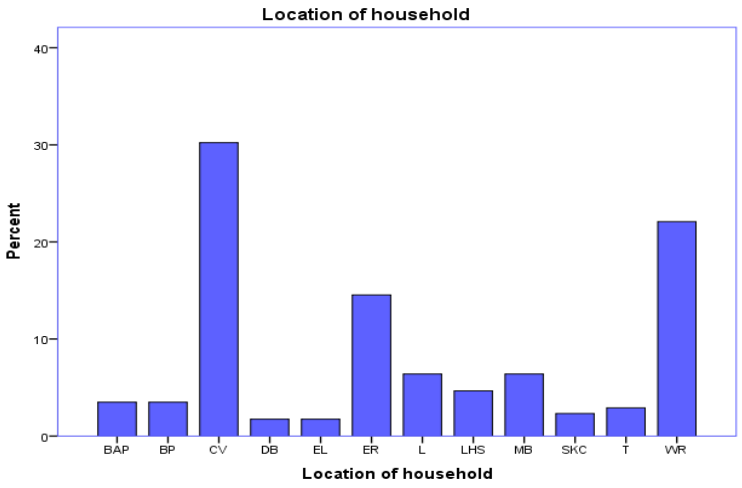
[6] Land Use map will be submitted manually given its size.

### 3.5.2 Socio-demographic Profiles of Homes and Businesses

***Methodology***

The survey was conducted by distributing a predetermined number of questionnaires separately among domestic household and businesses over a period of two (2) days. After the distribution phase was complete, the questionnaires were coded then analyzed using SPSS Statistics Version 21(IBM 2012) frequency analysis function. A total of 50 questionnaires were administered to residents along the Sheriff Street-Mandela Avenue Roadway. A majority (66%) of the household that participated in the survey were located in Campbelville and East and West Ruimveldt. See figure. 4 below for distribution of households.

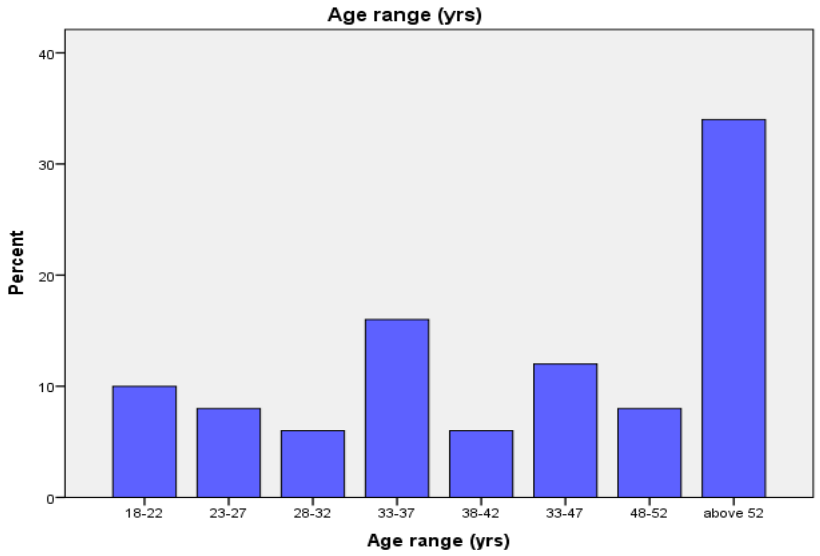
Figure 4: Location and distribution of household surveyed




BAP – Bel Air Park, BG – Bel Air Gardens, CV – Campbellville, DB – Durban Backlands, EL – La Penitence, ER – East Ruimveldt, L – Lodge, LHS – Lodge Housing Scheme, MB – Meadow Brook, SKC – Section K Campbellville, T – Tucville and WR – West Ruimveldt.

A little over half (58%) the respondents that participated in the survey were female. The remaining 42% were males. Most of the respondents (66%) that participated in the survey were below the age of 52. Twenty four (24%) of the respondents were below 32 years of age, while 34% were above age of 52. See Fig. 5 below.

Figure 5: Age range of respondents




Household sizes of residents within the study area ranged from minimum of 1 (4%) to a maximum of 10 (2%). Fourteen households (28%) had between 2 and 3 inhabitants. Forty six percent (46%) of the households had between 4-6 residents while 20% consists of between 7-9 members.

Most of the households surveyed (46%) did not have children below the age of 15. While 38% had between 1 and 2 occupants below age 15. Only two Percent (2%) of the households had four occupants below age 15. Sixty four (64%) and (34%) percent of household had none and one occupant respectively above the age of 65, while a mere 2% had 2 occupants who were above this age. A significant majority of the households (90%) did not have any differently-able person.

A small percentage of household (10%) reported that public sector employment is their primary source of revenue. On the other hand, private sector employment (35%) and self-employment were major sources of income for households. Private sector employment included masonry, carpentry, mining, welding and security. Self-employment activities reported by households were small roadside confectionery and beverage stalls, snackettes and hair salons. See Figure 6 below.

Most of the households (63%) had no secondary source of income. Thirty two percent (32%) of the households surveyed indicated that the private sector and self-employment were their main secondary sources of income. Two percent (2%) of households indicated that pension accounted for 2% of their secondary income. See Figure 7 below.

Figure 6: Source of household's revenue

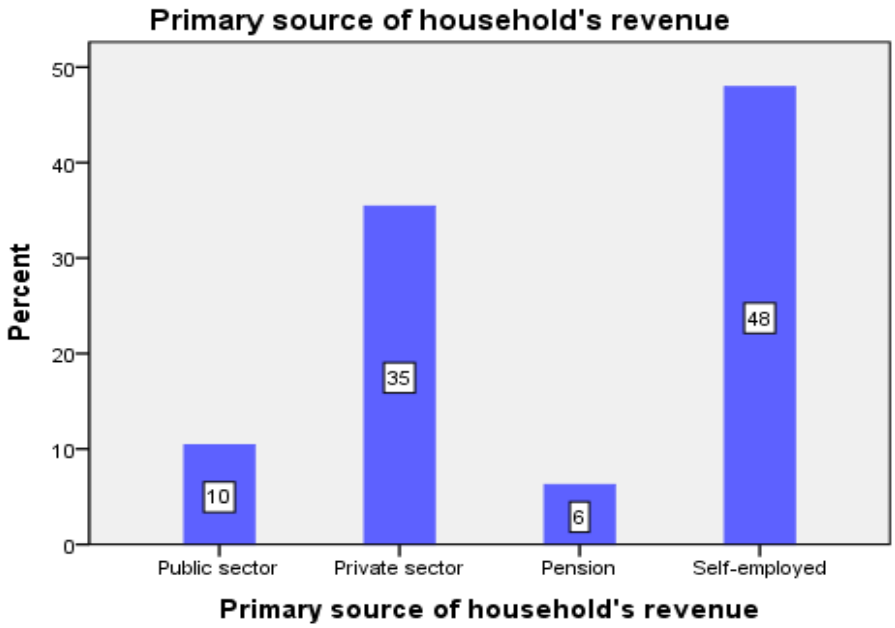
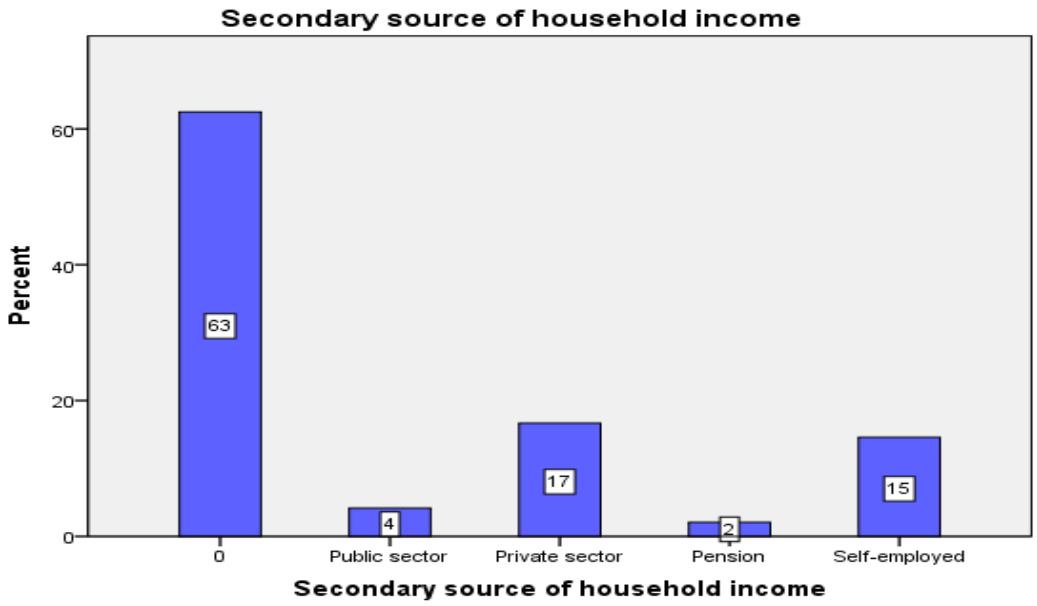
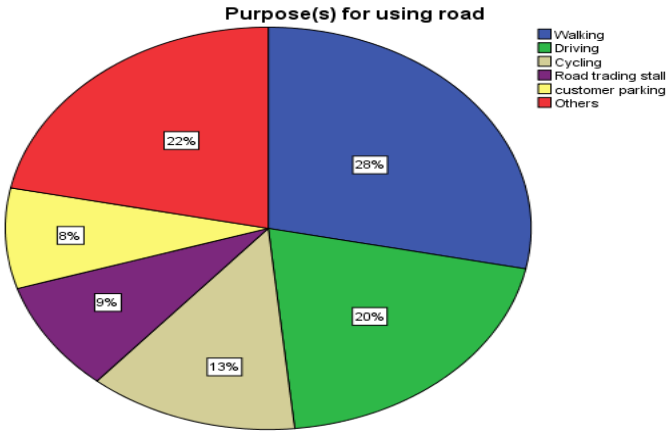



Figure 7: Secondary source of household's income



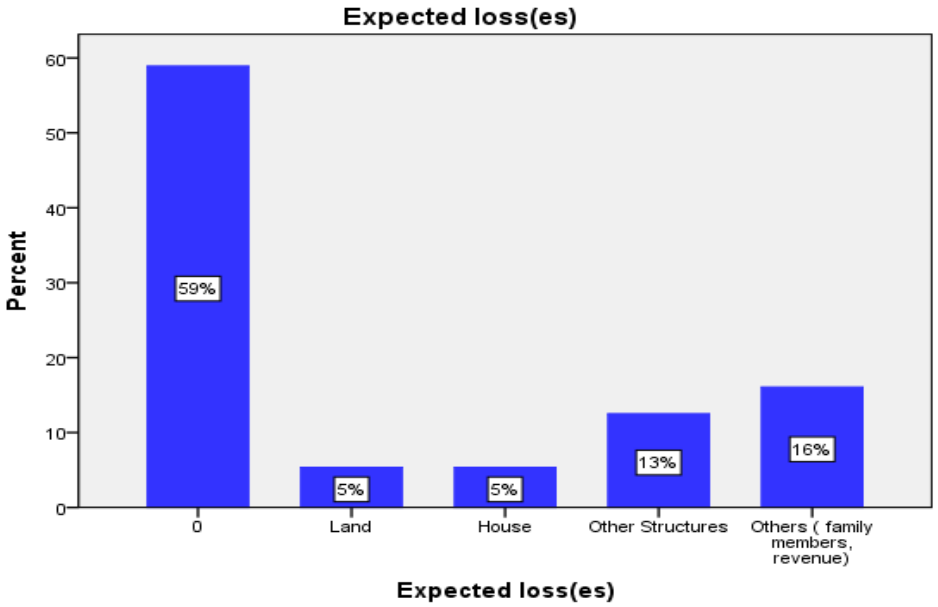
Households were asked to identify the purpose(s) for which the road is being used. Seventeen percent (17%) of households utilize the road for vending and parking. The most common purposes for which the road is being used for are walking (28%) and driving (20%). Only 13% percent of the households surveyed reported that they the use road for cycling. Other activities for which the road is currently being used for include recreation, leisure and transportation. See Figure 8.

Figure 8: Use of road




More than half (68%) of the respondents do not foresee any loss of personal assets because of the proposed project, while 32% of household believe the opposite (that the project will impact on their personal assets). As shown in figure 9, a majority of the household (59%) who expected to lose personal assets were unsure of the exact nature of their losses. This they claimed will depend on the nature of the work undertaken and may be determined when the road is under construction or operation. Sixteen percent express fears of the loss a family members, while 13% believe that there will be loss to structures such as parapets, fences and bridges. Loss of house and land was expressed by only 10% of households.

Figure 9: Expected losses




Fifty eight percent (58%) of the respondents agreed that the road expansion project should go ahead, while, 40% of the responds wee not in support of the project. Two percent of the household were unsure whether the project should go ahead or not. Approximately, 36% of the household surveyed believe that the project will not be beneficial. Respondents in support of the road project identified a number of benefits to be had from the expansion of the proposed project. Benefits to be gained from the project include abatement of heavy traffic (37.3%) and improved road safety (13.6%). The remaining 14% of the household believes that the project will improve drainage, enhance parking, which in turn will augment businesses in the area.

Households were asked to identify concerns regarding the road expansion project. Most of the respondents expressed concerns for pedestrian and public safety (13.2% and 12.3% respectively) during the construction and operational phase of the project. Respondents cited that the area is heavily populated and widening the road would only encourage drivers to speed and drive recklessly (13.2 % of the respondents).

Most of the respondents expressed concern for pedestrian and public safety (13.2% and 12.3% respectively) during the construction and operational phase of the project. Speeding was a concern of 13.2% of households while 11% of households felt that drainage was an issue. Respondents noted that the area is a heavily populated and widening the road would only encourage reckless driving. Other concerns were generation of dust (10%) and loss of customers (5%).

Household reported specific times when there are peaks in traffic. Eighty percent of the respondents reported peaks in traffic between 7:00 hrs and 10:00 hrs and 15:00 hrs and 6:30 hrs while ten percent (10%) believes that there is a peak all day and night.

Households were asked to identify concerns and make recommendations for addressing them. Approximately, 16% of these respondents expressed the need for an alternative route for the diversion of traffic. This is particularly necessary for heavy duty vehicle that cause damage to the road and produce excess noise and vibrations. Respondents (7.1%) also indicated that the road should be repaired and upgraded (not widened) and parking should be properly planned (3.6%). This is to ensure that parking is not done haphazardly and cause unnecessary traffic congestion. The implementation of noise reduction measures and more policing were recommended by 7% of households.

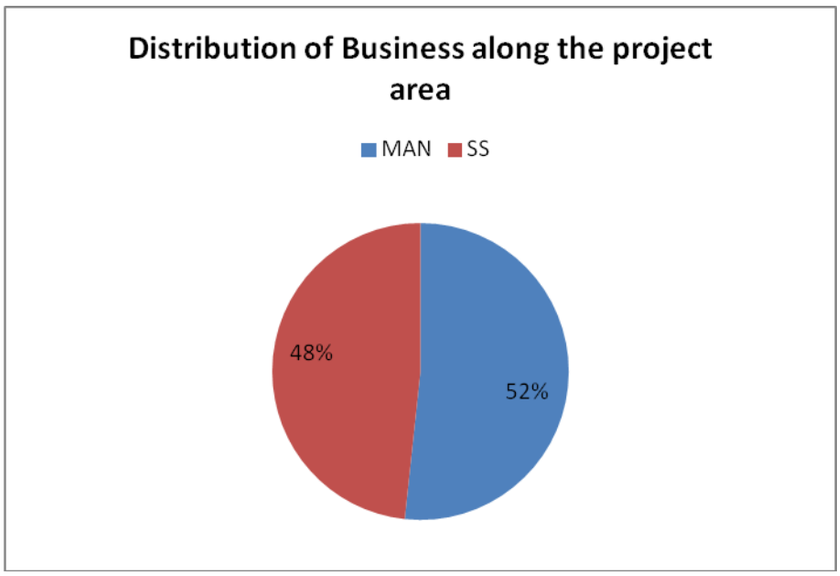
A significant proportion of the respondents (80%) have not attended any of the public consultations regarding the road expansion project. Of this group, 69% indicated that they were not informed of the road expansion project nor were they invited. 16.7% of the respondents knew about the public consultations but could not attend because they were unavailable during the time of the meeting. The survey indicates that only 20% of the respondents knew about the public consultations and attended or sent a representative on their behalf. Moreover, approximately 5% did not attend because they were not interested or felt that it was not important A small percentage of the respondents (2.4%) provided no reason for not attending the consultations..

Other issues raised by households in respect of the road include indiscriminate dumping of garbage, reckless driving and resultant increase in accidents. Additionally, requests were made for better infrastructure (lighting, drainage, parking, pavements). Further, households believe that there is need for education and awareness sessions for road users. Better policing and enforcement were additional issues raised by respondents. Additionally, the need to relocate because of noise, road expansion or criminal activities was concern of households.

### 3.5.3 Report for businesses

Most of the businesses (52%) are located along the Mandela Avenue Stretch and these are small businesses including bike repair and vulcanizing shops, beverage and confectionery stalls and snackettes. The Large and medium businesses make up a smaller percentage of the population sampled along the project. See figure 10. These area and are mainly concentrated along Sheriff Street.

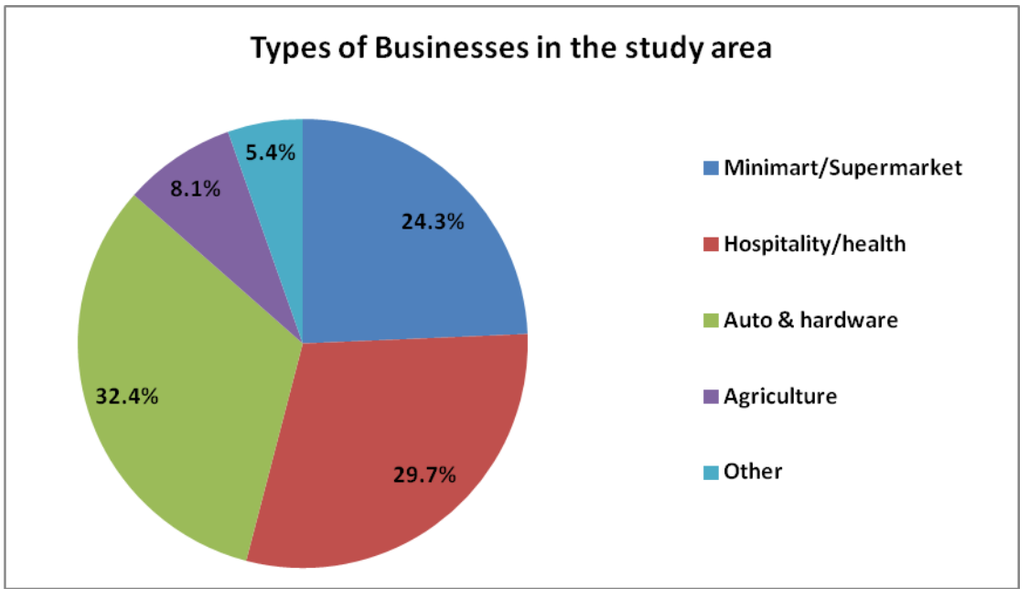
Figure 10:  Distribution of businesses




MAN – Mandela Avenue, SS – Sheriff Street

The business samples were placed in to five (5) categories, as depicted in figure 11. The three dominant types of businesses that were found in the study area are Auto & hardware stores which accounted for 32.4% of the business surveyed. Hospitality/health and minimart/supermarket accounted for an additional 29.7% and 24.3% of the businesses respectively. Hospitality/health includes businesses such as hotels, guesthouses and restaurants while health entities included pharmacies and gyms. Agricultural type business (plant shops and agrispare stores) accounted for 8.1% of the business population while others (confectionery stalls) accounted for 5.4% of the businesses surveyed.

Figure 11: Types of businesses




A significant proportion of the businesses (79.4%) have between 1 to 20 employees, while 8.8% of the businesses had 21 – 40 employees. Approximately 3% had 41 – 60 employees and an insignificant percentage had over 80 employees. See figure 12 below.

Figure 12: Number of employees of businesses

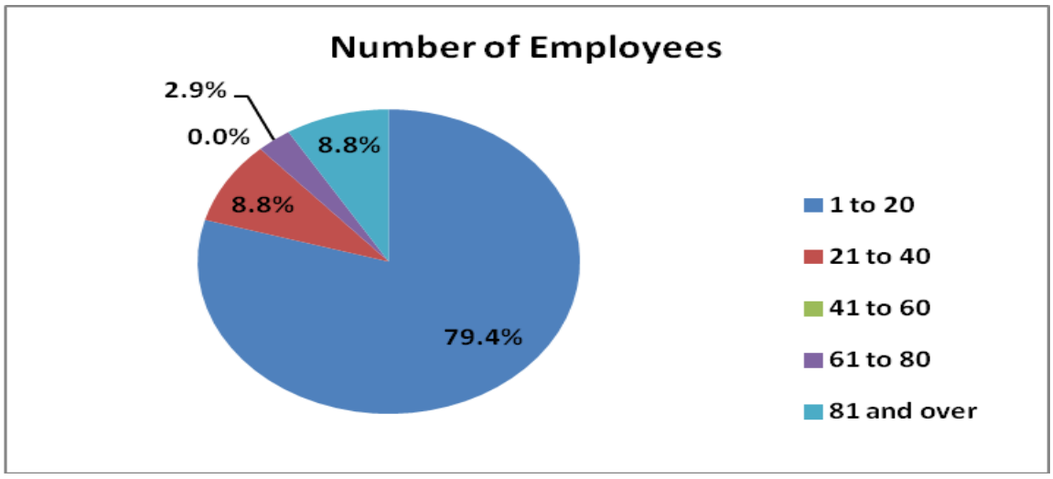
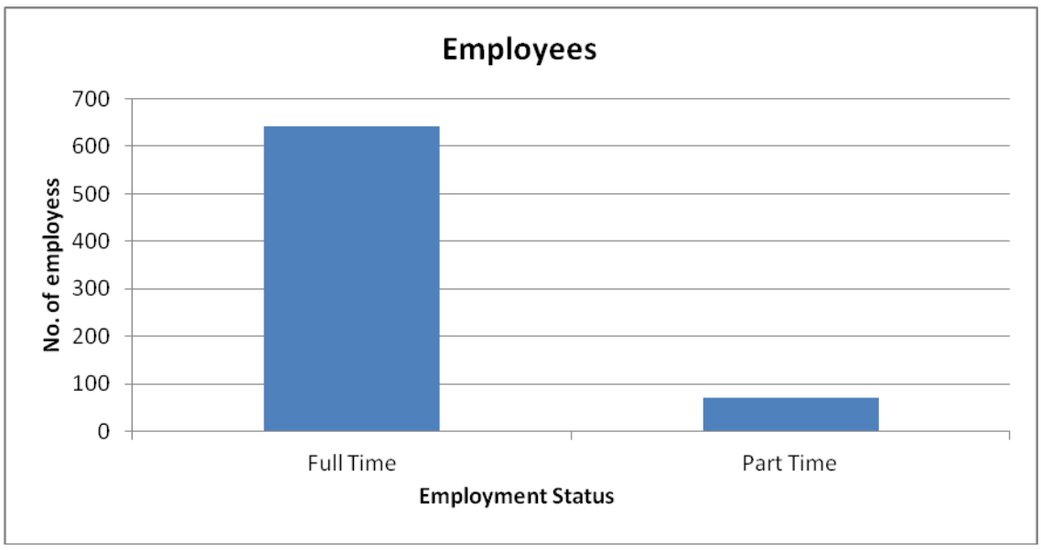


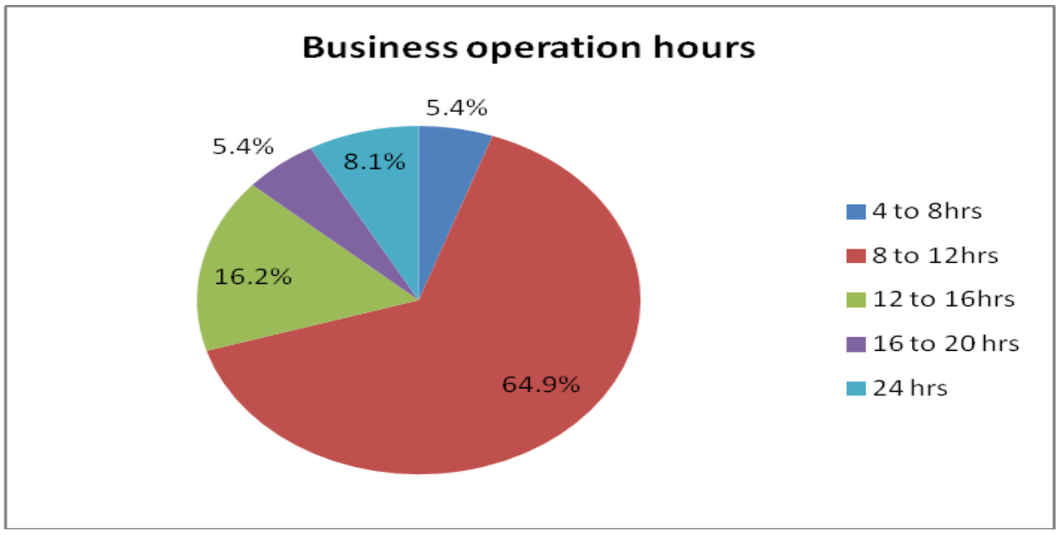

Figure 13 indicates that approximately 641 (90%) of the 711 employees of all the businesses surveyed are employed on a full- time basis, with the remaining 70 (10%) being part time employees. Only eight of the business employed staff on a part time basis. Five (5) of these businesses were located on Sheriff Street.

Figure 13: Employment status of respondents



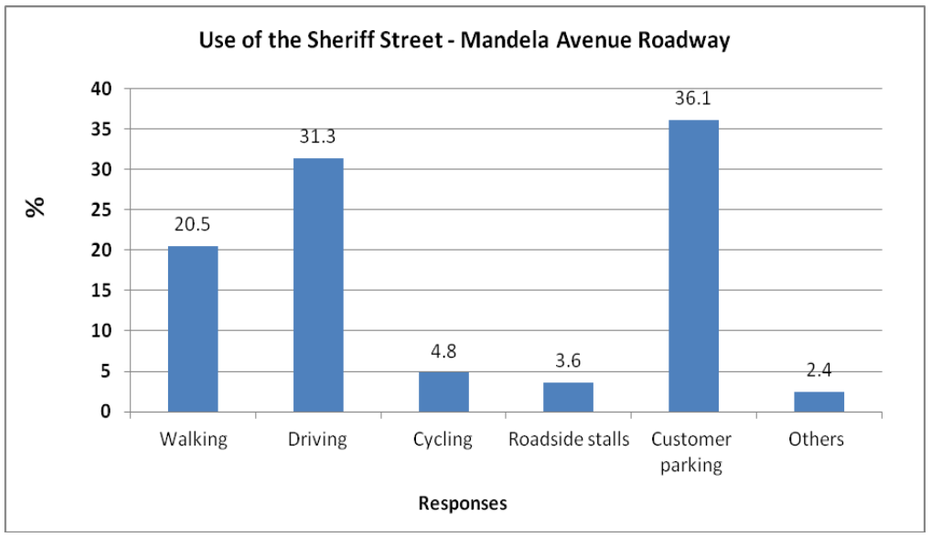

Approximately 65% of the businesses operated for a period of 8 – 12 hours each day. Another 16% operate for a period 12 – 16 hours and a small percentage (8.15) operated 24 hours each day. The remaining 11% of the businesses operated for a period of 4 to 8 hours and 16 to 20 hours respectively. See figure 14.

Figure 14: Business operation hours



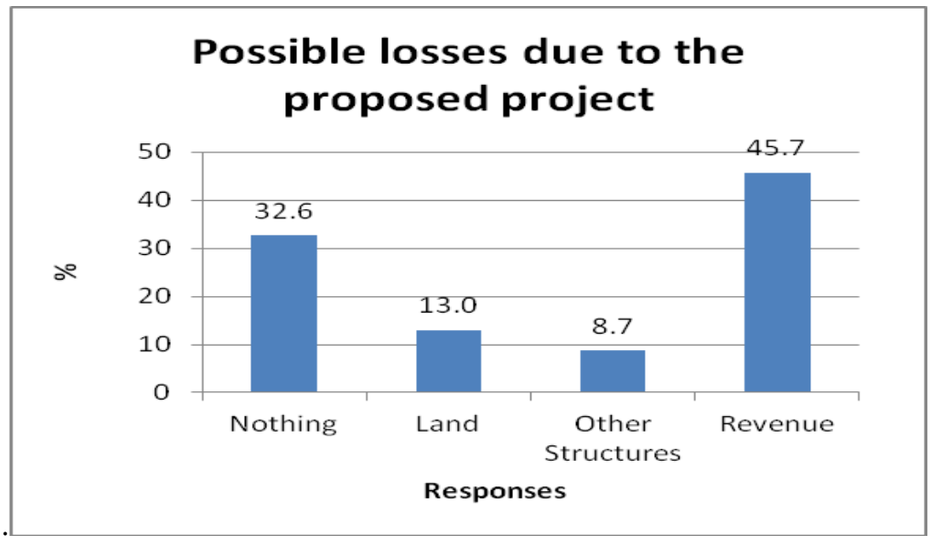

Approximately 36% of the businesses use the roadway for customer parking while 33% use it for driving. Figure 15 shows that a combined 26% of the businesses uses the roadway for walking or cycling. A small proportion of the businesses (2.4%) use the road for other purposes such as transportation, recreation and leisure.

Figure 15: Use of Roadway by business respondents



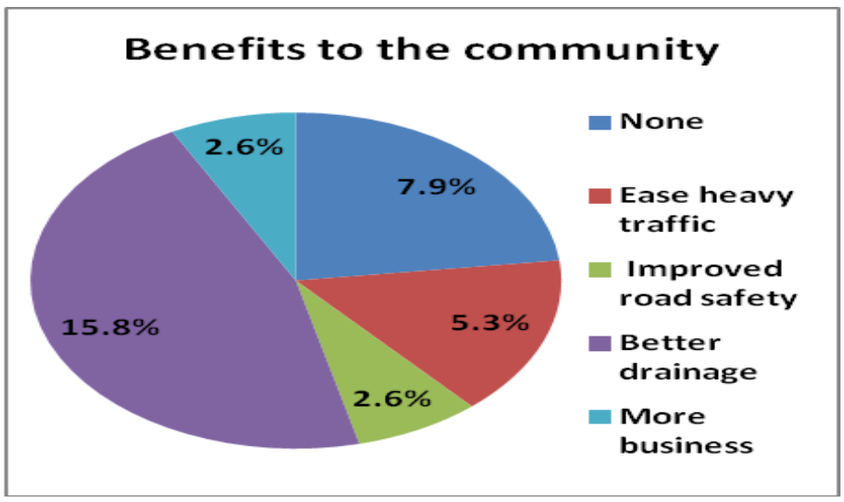

Businesses were asked whether the proposed project would result in a loss of personal assets. Approximately 62.2% of the respondents foresee losses due to the expansion project. The respondents cited mainly a loss of land (13%) and revenue (45.7% ). Nine percent of the respondents said that they will lose other structures such as fences, parapets and bridges. See figure 16.

Figure 16: Potential Losses



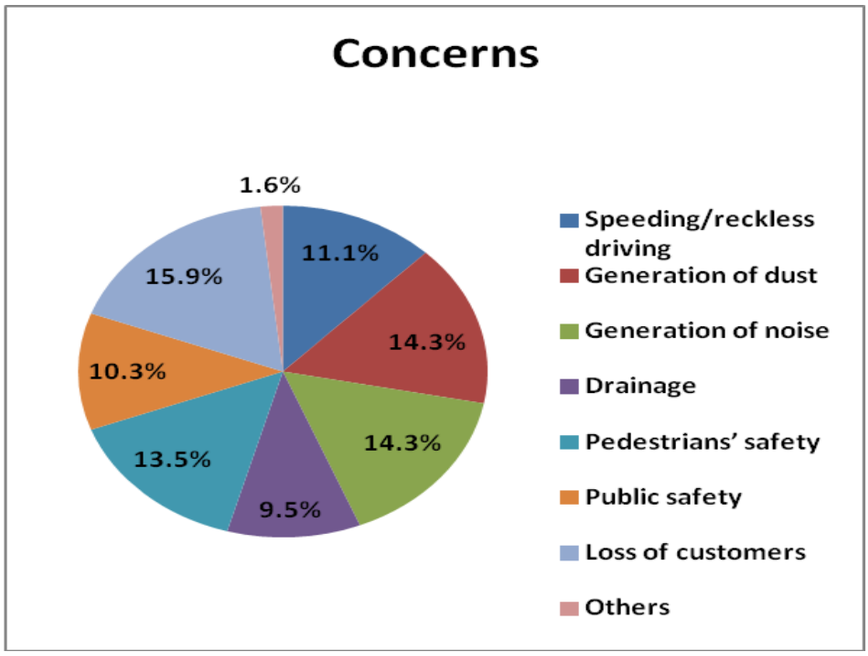

Most of the businesses (62.2%), as depicted in figure 17, were in support of the road expansion project. However, 37.8% of the respondents are against the project. When asked how such a project would benefit the community, the respondent indicated that there will be improved road safety (15.8%) and reduction in traffic flow (5.3%). Respondents (15.8%) also noted that improved drainage will be a spin-off of the project. Few ( 7.9%) said that it would bring more customers to the area.

Figure 17: Community benefits




Various concerns regarding the road expansion project were voiced by respondents. Most respondents (29%) were concerned about the generation of noise and dust. Respondents (23.8%) were also worried about the general safety of pedestrians during the construction phase of the project. A few (1.6%) were concerned about the possible damage to their personal property that may be associated with the expansion of the road. See figure 18.

Figure 18: Concerns of Business Owners




Recommendations for addressing concerns identified above included:

- The timing of construction work. This should be planned for hours outside the normal business hours (mostly at night) so that noise and dust generation will have less effect on surounding businesses.

- The road should be repaired and not expanded in order to prevent possible damage to property and other structures. An atlternate route should be built which connects the airport, Linden highway, Georgetown and the Rupert Craig Highway together and if possible should extend as far as Berbice.

- The road should be fitted with more safety features such as pedestrian crossings and traffic lights.

- The current drainage facilities should also be improved.

- There is need for greater enofrcement of traffic laws to prevent motorists from engaging in unlawful practices e.g going above the legal speed limit and double parking.

When asked whether there are certain times of the day or night when there are peaks in traffic, more than 90% of the respondents responded in the affirmative. A mere 2% indicated that there are no peaks while 5% stated that traffic is heavy all day long. The other respondents identified period in the morning and afternoons when there is more traffic on the road. A majority of the respondent mentioned that traffic peak in the morning between 7:00hrs and 10:00hrs and the afternoon between 15:00hrs and 18:00hrs.

Most of the respondents (56.8%) indicated that they were fully aware of the plans to expand the road but did not attend any of the public consultations. The main reasons provided were otherwise that they were otherwise engaged (47.8% of the respondents) or the timing of the consultations were not convenient to them. Some of the businesses (26.1%) were not aware of the schedules of the meetings and indicated that the schedule for such meets should be publicized a bit more.

### 3.5.4 General Comments

In both the business and household surveys the respondents indicate that the roadway more or less always has a heavy flow of traffic which causes great difficulty for pedestrians and motorists alike. When the numbers of business employees are combined with the number of household occupant living along the proposed project site, it is estimated that more than 900 people will be affect by the proposed road expansion. Proper measures have to be put in place to mitigate the negative effects of the project on the surrounding population as much as possible.

## 4 Assessment and Analysis of Potential Environmental and Social Impacts and related Management Plan

### 4.1 Impact Assessment

In this section of the report an analysis of the potential positive and negative consequences of the proposed project is presented. Mitigation measures to enhance, avoid or minimize are also discussed. Impacts will be categorized based on the phase of the project it is likely to occur. Impacts were categorized based on the project phases, that is pre-construction, construction and operational.

Information on potential impacts associated with the various phases of the proposed development was obtained from expert judgment, field surveys and existing literature including Environmental Impact Assessment for similar projects in Guyana. Potential impacts associated with each phase of the proposed project are shown in table 10 below.

### 4.2 Determination of environmental and social significance of impacts

The actual impact significance rating depends on a lot of factors, including:

- the magnitude of the impact;
- probability of occurrence;
- geographic extent of the impact; and
- duration of the impact.

In addition consideration was given to views and concerns of stakeholders.

The initial step in the determination of the significance of potential impacts of the road expansion project was the characterization of its baseline conditions. This was followed by a determination of the impacts that may result during the pre-construction, construction and operational phases of the project. Impacts were then rated before the implementation of mitigation measure. Finally impacts were then re rated after mitigation to determine the final impact rating (residual impacts). The significance of impacts is equal to sum of four elements ($I = \sum P+G+D+M$) as shown in the table below. Impacts were then categorized as high, moderate or low based on the final values obtained. Impacts were of a:

- High significance if its total value was between 9 and 12;
- Moderate significance if its total value was between 5 and 8 and,
- Low significance if the values were between 1 and 4.

Beneficial impacts were represented as +ve, while adverse impacts were represented as –ve.

| Element of the Impact | Impact characterization and definition | Value |
|---|---|---|
| Nature (N) | Positive | + ve |
| | Negative | -ve |
| | | |
| Probability of occurrence(P) | High (common) | 3 |
| | Medium (uncommon) | 2 |
| | Low-(extremely rare) | 1 |
| | | |
| Geographical extent (G) | Impacts are expected outside the area of influence of the project | 3 |
| | Impacts expected within the area of influence of the project | 2 |
| | Impacts confined to the proposed project's immediate environment | 1 |
| Duration (D) | Long term-( impacts expected for more than one year) | 3 |
| | Medium-term (6 months to 12 months) | 2 |
| | Short-term (less than 6 months) | 1 |
| | | |
| Magnitude (M) | General public and workers are impacted | 3 |
| | Adjacent community and workers are impacted | 2 |
| | Workers alone are impacted | 1 |

Table 10: Impact Rating Matrix

Table 11 below shows the expected impact and their ratings.

| Impacts/effects | + OR - IMPACT | SIGNIFICANCE VALUE 9-12 (High/H); 5-8 (Moderate/M); and 1-4 (Low/L) | | | | |
|---|---|---|---|---|---|---|
| **Bio-physical Impacts: Pre-Construction and Construction Phase** | | **PROBABILITY OF OCCURRENCE** | **EXTENT** | **DURATION** | **SEVERITY/ MAGNITUDE** | **TOTAL VALUE** |
| Direct loss of plant species (shrubs and grasses)/loss of habitats | - | 3 | 1 | 2 | - | **6 (M)** |
| Decrease in plant species diversity | - | 1 | 1 | 2 | - | **4 (L)** |
| Loss of fauna | - | 1 | 1 | 2 | - | **4 (L)** |
| Contamination of soil | - | 2 | 1 | 2 | - | **5 (M)** |
| Sedimentation of waterway and decreased water quality | - | 1 | 1 | 2 | 2 | **6 (M)** |
| Water pollution | - | 2 | 1 | 3 | - | **6 (M)** |
| Dust on vegetation and in air | - | 3 | 2 | 3 | - | **8 (M)** |
| Generation of solid waste | - | 2 | 1 | 3 | 2 | **8 (M)** |
| Air pollution | - | 3 | 2 | 3 | 2 | **10 (H)** |
| Noise | - | 3 | 2 | 3 | 2 | **10 (H)** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Bio-physical Impacts: Operational Phase** | | | | | | |
| Air pollution | - | 2 | 2 | 3 | 2 | **9 (H)** |
| Traffic Noise and other Disturbances | - | 2 | 2 | 3 | 2 | **10 (H)** |
| Direct road kill of domestic animals | - | 3 | 1 | 2 | - | **6 (M)** |
| Pollution of Waterways | - | 1 | 1 | 2 | 2 | **6 (M)** |
| **Socio-economic Impacts: Pre-Construction and Construction Phase** | | | | | | |
| Increased level of traffic congestion due to reduced carriageway | - | 3 | 3 | 1 | 3 | **10 (H)** |
| Road accidents/loss of life | - | 1 | 1 | 1 | 3 | **6 (M)** |
| Disruption of commercial activities, including roadside stall/vending and negative effect on local livelihoods | - | 3 | 2 | 2 | 1 | **8 (M)** |
| Loss of business and customers (e.g. Supermarkets) due to loss of roadside parking | - | 3 | 1 | 1 | 1 | **6 (M)** |
| Loss of personal assets (structures) such as bridges, fences, and parapets. | - | 3 | 1 | 3 | 1 | **8 (M)** |
| Induced vending (growth in informal local economy) in adjacent areas to satisfy | - | 3 | 2 | 2 | 2 | **9 (H)** |

| | | | | | | |
|---|---|---|---|---|---|---|
| needs of local workforce | | | | | | |
| Relocation of property /homes or businesses or displacement of families | - | 2 | 1 | 3 | 3 | **9 (H)** |
| Change in existing land use patterns in areas in which by-pass roads are used to reduce traffic congestion | - | 3 | 2 | 1 | 2 | **8 (M)** |
| **Socio-economic Impacts: Operation Phase** | | | | | | |
| Reduced traffic congestion as a result of road expansion | + | 3 | 2 | 3 | 3 | **11 (H)** |
| Risk of accidents to all road users due to speeding etc. | - | 3 | 1 | 3 | 3 | **10 (H)** |
| Increased pedestrian safety during crossing and use of walkways | + | 3 | 1 | 3 | 3 | **10 (H)** |
| Minimisation of u-turns, right turns and the risk of accidents through use of concrete medians | + | 3 | 1 | 3 | 3 | **10 (H)** |
| Increase in property value due to enhanced infra-structure | + | 3 | 2 | 3 | 2 | **10 (H)** |
| Improved transport infrastructure | + | 3 | 2 | 3 | 3 | **11 (H)** |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

Table 11: Expected impact and their ratings.

## 4.3 Impact Analysis and Mitigation

The direct impact area will be limited to those along the existing Sheriff Street- Mandela Avenue Road. Both from an anthropogenic and natural standpoint the proposed project site has already been affected by the existence of the current road. Notwithstanding this some environmental impacts will be experienced locally in the proposed project site. Impacts will mainly result from activities associated with the widening and general improvement of the existing road.

The anticipated impacts on the bio-physical environment are not expected to be very significant since the work only involves widening the existing roadway. Due to the nature of the proposed project most of the bio-physical impacts are likely to be manifested at the local level. Impact analysis and mitigation for the bio-physical environment are discussed below.

### 4.3.1 Pre construction Phase

Preconstruction impacts will be restricted to vegetation, soil and surface water.

***Impact on Flora and fauna***

No endemic or protected plant of animal species is present in the proposed project site. Additionally, the area does not contain any sensitive habitat. Vegetation in the area can be classified as typical roadside vegetation.

Preconstruction activities will include mobilization of machinery and setting up of roadside camps. Minor clearing of vegetation will be required for the setting up of roadside camps. This will be localized to small sections along the road. The pre construction phase will have a low impact on vegetation. Mitigation measure will include limiting clearing to areas that are only required for the construction of camps.

***Aquatic resources***

The main source of impact on surface water quality will be accidental entry of fuel and oil into waterways. However, machinery will not be operational at the proposed project site during this phase of the project. Clearing of vegetation for the setting up of camps may result in the entry of sediments into water ways. This may cause localized sedimentation of water and the resultant decrease in water quality. The pre-construction phase will have minor impact on surface water quality. Mitigation measures include:

- Preventing soil from entering water ways.
- Stockpiling soil in areas away from trenches
- Implementing best practices in soil management.

***Soil***

Removal of vegetation for the establishment of camps can potentially impact on soil. Removal of vegetation can result in erosion of soil. The site of the proposed development is flat and not prone to erosion. No chemicals or lubricants will be used during the pre construction phase, thus eliminating soil contamination. Impact on soil will be low during the preconstruction phase. Impact of soil erosion can be mitigated by:

- Implementing best practices in soil management
- Limiting removal of vegetation to areas required for the establishment of camps so as to reduce the amount of soil exposed.

***Air quality and noise***

The use of construction equipment during the pre-construction phase will be restricted to the setting up of roadside camps. This activity is expected to generate small amount of air pollutants (dust) and noise. This impact will be of low significance. Measures to mitigate this impact include:

- Ensuring that equipment used in the setting up of camps is well maintained.
- Not conducting preconstruction work between 11:00 pm and 6:00 am (Monday-Saturday) and not before 6:00 am and after 6:00 pm on Sundays
- Wetting areas around camp to reduce dust emission to the atmosphere.
- Monitoring $PM_{10}$ and $PM_{2.5}$ to ensure that they conform to Guyana's EPA standards.

### 4.3.2 Construction phase

***Biological Impacts***

**Flora**

Construction will involve clearing of vegetation along the shoulders of the road. This will result in the direct loss of plant species and a reduction in plant species diversity. Clearance of vegetation and the loss of plant species will be of moderate significance. This loss will be permanent and this impact cannot be mitigated. On the other hand, change in plant species diversity will be of a low significance because of the uniformity of plant species as one transcend from the edge of the road towards the drains.

Habitat loss will be of low insignificance during construction since vegetation clearing will be restricted only to areas allocated for the expansion of the road. Expansion of the proposed access road will require very small land take, resulting in the loss of a small amount of vegetation and habitats Apart from providing habitats for a number of insect orders, the vegetation along the road does not provide any critical habitats for other fauna. No sensitive habitats occur in the project site. Overall the loss of habitat will be of low significance.

This impact can be mitigated by;

- Ensuring that comparable vegetation in areas adjacent to the proposed are maintained so that they can be used as alternative habitats for macro invertebrates
- Clearing areas only required for road expansion
- Re-vegetating roadside where necessary.

***Fauna***

There will be a loss of some terrestrial macro-invertebrate due to direct kills during construction. This loss will be confined mainly to species that are less mobile and are therefore unable to escape. This loss of faunal species (macro-invertebrates) and resultant decreased in species diversity will be impacts of low significance. This impact is insignificant and cannot be mitigated.

A small number of birds were observed in the vicinity of the proposed project. However, a total of 158 bird species are known to inhabit the Botanical Gardens, which lies on the western side of Mandela Avenue. The Botanical Gardens was in 2011 declared a bird sanctuary.

None of the trees within the Botanical Gardens will be removed. Hence, there will be no disruption of habitats used by birds within the Botanical Gardens. Further, only clearing vegetation on the eastern section of the road for the road expansion will mitigate the impact on bird's habitat. Impact on bird's habitat will be of low significance.

Mitigation measures to reduce impact on bird's habitat will involve:

- Confining clearing of vegetation only to areas designated for expansion ,
- Monitor bird activity during construction activity
- Avoiding disruption of nesting sites

***Physical Environment***

***Air quality***

No baseline data exists for gaseous pollutants at the proposed project site. However, the World Bank Guidelines for ambient air mandates that the concentration of contaminants should not exceed the following limits: Nitrogen Oxides as $NO_2$ (maximum 24-hr average) $200mg/m^3$ and sulphur dioxide (Maximum 2- hr average) = $500mg/m^3$. There are no standards for carbon monoxide concentration. Gaseous pollutants will be emitted from construction machinery and equipment. In the absence of baseline information it is recommended that the contractor ensure that all vehicles are properly maintained and are turned off when not in operation. This will mitigate the potential impact of construction activities on air quality.

Road work activities such as materials handling, top soil removal and site clearance will generate dust which may increase the concentration of particulates in the atmosphere. Clearing, stockpiling and hauling will give rise to fugitive dust especially during dry periods. The average

concentration of $PM_{10}$ and $PM_{2.5}$ are therefore likely to surpass baseline values. In fact, baseline data shows elevated concentration at the John Fernandes container terminal and Mandela Avenue and David Rose Street. Persons suffering from asthma, the elderly and small children in particular should not be exposed to dust on a regular basis. Impact on air quality will be significant before mitigation measures are employed.

Impact on air quality can be mitigated by:

- Proper handling of construction debris to control fugitive dust emission.
- Immediate removal, dampening or covering of soil.
- Regular and proper maintenance of machinery and equipment so as to reduce exhaust emissions
- Environmental monitoring to ensure $PM_{10}$ and $PM_{2.5}$ are maintained within acceptable standards. Baseline measurements indicate elevated levels of $PM_{10}$ and $PM_{2.5}$ above the threshold established by WHO or the US EPA at John Fernandes Limited Terminal and at Mandela Avenue and David Rose Street. Hence, regular watering to suppress dust generated during construction activities will be done.
- Ensuring that all construction workers wear dust masks
  The resultant impacts will be of moderate significance when mitigated. However, there impacts will be temporary.

***Soil /Land***

Construction activities will be aimed at widening the Sheriff Street- Mandela Avenue Roadway. Soil erosion and compaction will be expected. The repetitive movement construction machines over exposed soil will cause compaction. This may hamper natural vegetation regeneration and reduce its permeability. Construction activities will also expose loose soil making it susceptible to erosion by wind and run off. This will result in the direct loss of soil. Soil may also enter water and cause sedimentation. This may impact of water quality. Also soil may settle on vegetation and decrease photosynthetic activities. Impacts on soil will be moderate before mitigation. The implementation of mitigation measures will result in an impact of low significance.

Measures to mitigate these impacts include:

- Covering excavated top soil and use to rehabilitate road shoulders
- Loosening compacted soil and re-vegetate where necessary
- Limiting vegetation removal to areas that are designated for expansion
- Not allow soil to enter water ways.
- Stockpiling soil in areas away from trenches

***Waste Generation***

Solid and liquid waste generated during construction may impact on surface water quality and change the aesthetics of the area. Currently there is indiscriminate dumping of solid waste on land and in water way. Decomposing animals were observed in the trenches. Garbage within the project site already had an offensive odour. Improper treatment of solid waste may be potential

breeding sites for rats and flies. There organisms are instrumental in transmitting diseases. Decomposing solid waste in water ways may alter the microbial composition of water and may cause the death of aquatic organisms.

Construction activities will also generate construction waste or refuse. Liquid waste will also be generated. Such waste should not be discarded at the worksite. This impact will be moderate. Mitigation measures include:

- Placing of waste receptacle strategically for the collection of refuse and construction waste.
- Removing current solid waste from waterway and road shoulder to ensure workers health and safety
- Disposal of waste in a timely an proper manner
- Prohibit burning of waste at project site
- Prohibiting maintenance of vehicles at worksite
- Having drums in strategic locations for the collection of liquid wastes that might be generated during construction.

***Water quality***

Construction activities will entail the excavation of soil. During removal soil may enter water way. Soil entering the water way may change flow volumes or cause increase the turbidity. Alteration in flow volumes may lead to flooding along some sections of the road. Turbidity will affect the amount of light reaching lower levels of the water way and therefore impede photosynthesis. This may disrupt the productivity of the aquatic ecosystem. Runoff from construction areas may contain increase loads of sediments, other suspended solids and contaminants. Sediment entering the water way may affect water quality parameters including pH, temperature, dissolved oxygen. Change in these water quality parameters may result in death of aquatic fauna.

Oil products will be used in machinery and vehicles during construction and may accidentally enter water way. Potential pollutants are, fuel, oil and lubricants from maintenance of construction vehicles and equipment.

Solid waste generated during construction could be a source of water pollution. Currently, most of the water way is polluted with solid waste. Dead and decaying animals are also being dumped into the water way. The water may thus contain elevated levels of microbes responsible for decomposition. Impacts on water quality will be of moderate significance before mitigation.

Mitigation includes:

- Adoption of soil erosion protection measures to minimize the entry of soil into waterways by runoff.
- Prevention of the servicing and repairs of vehicles at the project site.
- Prohibition of the washing of vehicles and construction equipment at the project site.

- Ensure that portable washroom on site are emptied regularly. The contractor will have the responsibility to ensure that toilets are used properly maintained and that licensed contractors are employed to collect and dispose of waste off-site at approved locations
- Ensuring that there are procedures to contain and clean up spills and leakages of fuel and other petroleum products.
- Ensure adequate protection at the East Ruimveldt Well and Lamaha Canal since these are a source of drinking water.
- Precaution should be taken during the construction phase especially around gas stations to prevent the seepage of pollutants into ground water since the water table is moderate along the proposed area of influence.
- Although water in trenches is not consumed by residents precaution must be taken by construction workers to ensure that the water does not enter their mouth or comes come into contact with their skin.

***Noise***

Heavy machinery and equipment will be in operation during the construction of the road. However, most activities will be intermittent and localized. Notwithstanding this construction activities will contribute to sustained noise levels that will affect residents. Noise can result in the loss of sleep by residents within the area of influence of the project. There are four schools in close proximity to the project site.

Seventy two (72) decibels is the acceptable threshold of noise. Noise generated above this level can result in exhaustion and low levels of output. Noise may impact on student's performance since they may become easily distracted. Noise may cause tiredness in workers, making them less alert and prone to accidents. Impaired hearing may be associated with exposure to noise levels above 90 decibels.

In addition to affecting humans construction noise may also impact on wildlife. Noise affects the behaviour of animals and may disrupt breeding patterns and migration. The Botanical Gardens is a bird sanctuary. Noise generated from the use of machinery during construction activities may disrupt birds' habitats and impact on their behaviour. Noise may therefore cause migration of species and changes in the ecosystem. Impact on bird's habitats will be moderate and will mainly be localized to area around the Botanical Gardens.

Daytime noise levels thresholds for residential area (75 decibels), commercial (80decibels) and construction (90 decibels) are stipulated by the Guyana National Bureau of standards. Night time threshold levels are; Residential (60 decibels), Commercial (65 decibels) and construction (75 decibels). During construction noise will be produced from the operation of heavy-duty machines in operation. Noise production will be of high significance and will be mitigated by:

- Turning equipment off when not in use.
- Maintaining vehicles regularly.
- Restricting hours when construction work will be done.
- Avoiding horn blowing on machinery.
- Monitoring noise levels to ensure that they confirm with those stipulated by GNBS.

The mitigation measures when employed will result in moderate residual impacts.

### 4.3.3 Operational phase

***Vegetation***

During the operational phase traffic will have impact on early colonizers of road shoulders. Increased dust is expected to settle on vegetation during road operation. Dust deposited on plants can reduce photosynthetic rates and make plants prone to diseases. Pollutants may become incorporated in dust and when deposited on vegetation. Decreased chlorophyll content has been observed in plants exposed to automobile pollutants (Brinda and Prabakaran, 2010). The impact of dust and automobile pollutant on vegetation will be experienced over a small geographic area. Mitigation measure will include:

- Monitoring re-vegetation process.
- Maintaining vegetation on shoulders of road.

***Air quality***

Increased concentrations of dust and exhaust smoke during operation of the road are expected. Gaseous emissions are expected to increases with increases in volume of traffic during the operational phase of the project. Dust will be generated as vehicles traverse the road. Dust generated may impact on residents and may aggravate respiratory ailments such as asthma and bronchitis. The roads will be paved and shoulders re-vegetated. This will reduce the amount of dust generated during its operation. Current dust emission measurements indicate elevated levels $PM_{10}$ and $PM_{2.5}$. at two points along the Sheriff Street- Mandela Avenue Roadway. At most sections along the road concentration of particulate matter are within the acceptable limits mandated by the Environmental Protection Agency.

During its operation dust pollution will be of high significance along some sections of the road. This impact will be significant only at the beginning of the operation phase but will be of low significance as re-vegetation progresses. . This is because re-vegetation but only at some sections along the road. This impact will be mitigated by:

- Educating drivers and ensuring that they adhere to the speed limits. Reduced speed limits will decrease the amount of dust generated.

***Noise***

During operation there will be increase in the number of vehicles using the road. Noise generate is not expected to significantly exceed that currently produces. Noise is expected to peak during working/ school hours. Increase in noise levels will be restricted to certain hours during the day.

The noise will be intermittent and would correlate with the passage of vehicles. This impact will be significant. Mitigation measures will include:

- Ensuring that the sounding of horn is kept to minimum.
- Install warning signs strategically along road.
- Periodically monitoring noise levels.

***Road Kill***

The project will allow the passage of more traffic into the area of influence of the project. There may be increased speed on the road. This increased traffic and speed associated with the expanded roadway may result in increase of vehicular accidents on the road. This impact is of moderate significance. Mitigation measures include:

- Post signs along roadways to encourage safe driving on roadway.
- Restrict speed limit on road to 40-50km/hr.

***Water***

Operation of the road may have impacts on water quality. The waterways in the vicinity of the project may be contaminated with hydrocarbons that are contained in fuels and lubricants of vehicles traversing the road. The entry of such contaminants into waterways will impact water quality and affect growth of aquatic plants. Decreased water quality may promote fish mortality. These are moderate impacts and will be not be mitigated.

## 4.4 Land Use Issues

### 4.4.1 The Historical Context

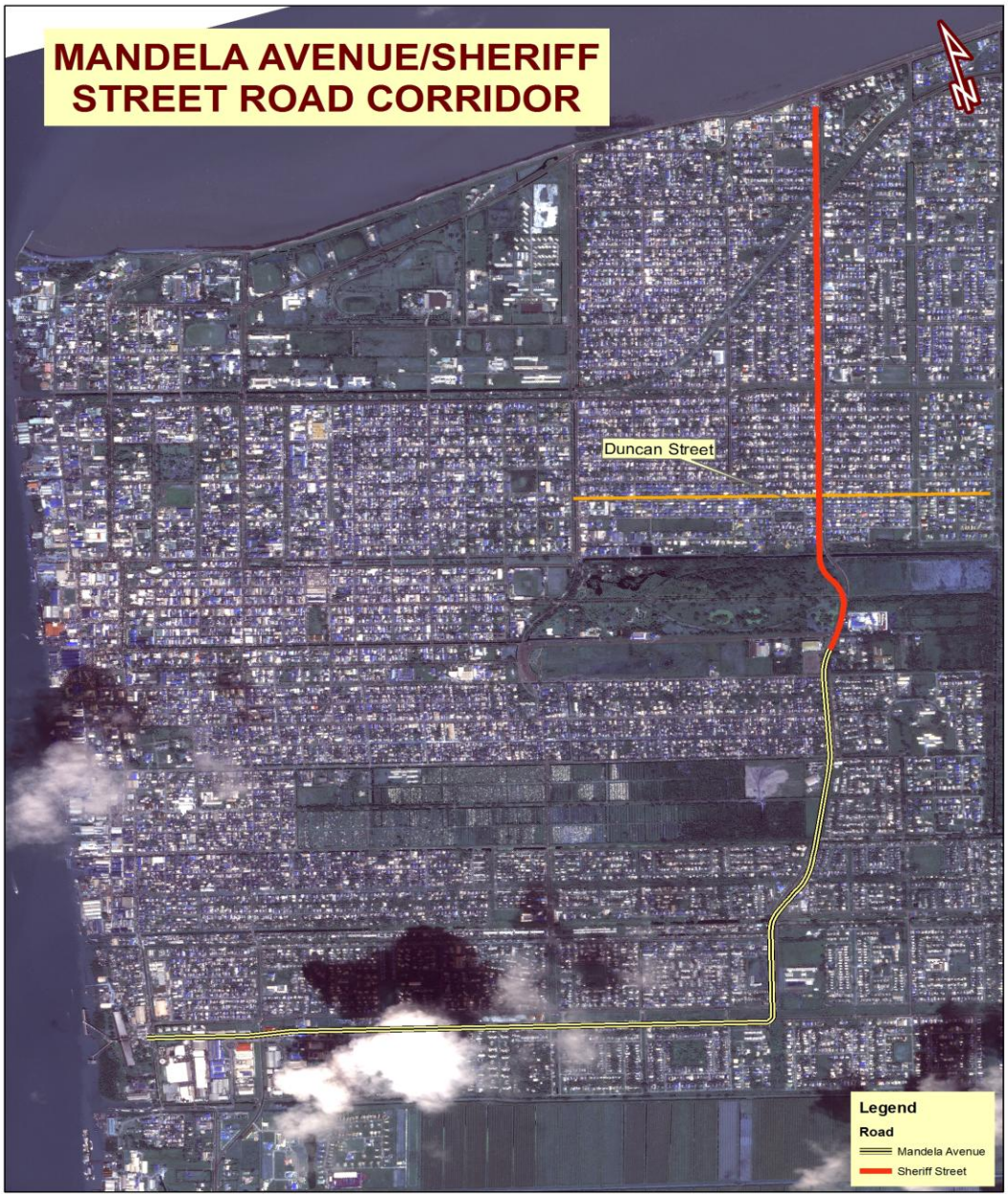
From the perspective of the development of Georgetown's urban road network, the Mandela Avenue – Sheriff Street road was designed and developed with intent to function as a major east to west /north to south thoroughfare of the City, moving through traffic form the southwestern end of Georgetown to its northeastern end.

Prior to the emergence of the Mandela Avenue to Sheriff Street road, the traffic function of connecting through traffic from the southern to northern Georgetown was performed by Vlissengen Road and Camp Street. However, over time the primary functions of Vlissengen Road and Camp Street as major arterial roads in the City give way to the Mandela Avenue to Sheriff Street option. As noted in the Greater Georgetown Development Plan (2001-2010), Mandela Avenue now carries the majority of east to west traffic and similarly Sheriff Street carries north to south traffic.

The prominence of the Mandela to Sheriff Street option as a primary distributor road, in particular the high volume of traffic it catered for, gradually impacted on the land use characteristics along the road corridor to the extent that the original agricultural land use status of lands along Sheriff Street rapidly changed to residential and subsequently commercial.

The current position is one whereby land use along this major roadway is rapidly and continually changing; with this land use change process being driven by an intensification of commercial land uses either as a mix of residential/commercial or purely commercial establishments. To some extent, the Mandela Avenue segment has also witnessed land use change by way of land use conversions for commercial and industrial establishments.

Current plans by the Government of Guyana to expand and improve the Mandela Avenue to Sheriff Street road is highly likely to impact on land use along the defined road corridor and even in areas beyond. This phenomenon of land use change clearly has other socio-economic implications.




### 4.4.2 The Current Land Use Policy context:

***The Greater Georgetown Development Plan (2001-2010)***

The Greater Georgetown Development Plan (GGDP) defines the land use policy context for the determination of land use applications with respect to properties both along Sheriff Street and along Mandela Avenue. For example, **Policy BE 7** states that 'when determining applications for new development the Local Planning Authority will fully consider (among other things) the following matters:

- Any additional traffic expected to arise from the development, either in relation to the highway capacity or general disturbance and the extent to which the development fully complies with the Council's adopted car parking standards'.

- Any adverse effects on the natural environment likely to arise from the development.

***The Existing Situation***

Research conducted in 2008 showed that businesses accounted for thirty-six percent (36%) of land uses along Sheriff Street, while residential land use accounted for forty-three percent (43%) (Baksh, 2008). This situation has intensified over the 2008-2013 period with commercial land use intensification primarily along Sheriff Street. Records of the Central Housing and Planning Authority (CH&PA) indicate that during the said period, the Authority approved twenty-four applications for commercial development along Sheriff Street. Additionally, several informal commercial activities now characterize the commercial landscape of Sheriff Street.

While the intense commercialization of the Duncan Street to the Railway embankment segment of Sheriff Street has been a pronounced land use change, particularly in the 2008 to 2012 period, there is need to note that the following residential areas along the Sheriff Street corridor have retained a predominant residential land use character:

- Subryanville
- Bel Air Gardens
- Section 'K' Campbellville
- Bel Air Park

Along Mandela Avenue, there has also been a trend towards land use conversions for commercial purposes. However, this has been less intensive as compared to the case of Sheriff Street.

There is the view among many that the accessibility factor has been critical in fuelling the intense commercialization of major segments of Sheriff Street and Mandela Avenue since accessibility is an essential factor that enables people and businesses to engage in activities at various locations.

### 4.4.3 Socio-economic perspectives on land use impacts

***Impact on use of existing residential properties***:

Due to the rapid commercialization of Sheriff Street and Mandela Avenue, it is expected that the interplay of market forces as a result the continued demand for commercial space and the high accessibility factor will lead to the perpetuation of the trend of conversion of residential land uses to commercial land uses. Current land use planning policy does not restrict this tendency where considerations of land use compatibility are satisfied but requires that the impact of

commercial activities on the environment be considered where necessary. In this regard, the demand for parking spaces for new commercial establishments is of major concern.

***Impact on use of reserve land along the Mandela Avenue to Sheriff Street road***

The increased commercial use of properties, in particular the development of multi-storied commercial complexes will create a serious demand for parking and space for the movement of commercial vehicles serving the various establishments. If the demand for such space cannot be provided on-site or available space proves to be otherwise inadequate, the incidence of roadside parking is likely to continue and even become more intensive. On the other hand, should road expansion works lead to the removal of roadside parking spaces within the existing road reserve, the viability of existing commercial establishments can be negatively affected.

***Impact on communities beyond the defined road corridor***

While communities beyond the defined road corridor but accessible from either Sheriff Street or Mandela Avenue currently enjoy an acceptable degree of land use stability, the construction phase of the road expansion project may warrant traffic diversion through these communities. This may pose issues of nuisance and the destruction of existing road transport infrastructure servicing these areas.

***Impact on Land Development***

Because the Mandela Avenue to Sheriff Street road improvement project will improve the accessibility factor along this road corridor, there is great likelihood that land values will increase and the land development potential of properties be enhanced. It will be essential however, that new development projects take into consideration the need for on-site parking particularly in recognition of the high likelihood of the positive impact the road can have on traffic movement.

***Impact on Travel behavior and travel trends***:

From the perspective of travel behavior and trends, the more intense use of the Sheriff Street/Mandela Avenue road corridor as a preferred route of travel is highly likely. This may be attributed to the development of other transport hubs such as the Ogle Airport, the future southern by-pass road and the new Demerara Harbour Bridge, as well as the intensification of residential and commercial activity along the East Bank and East Coast of Demerara. This futuristic situation has strong inherent socio-economic dimensions linked to the likely land use impact the more intense movement of people, goods and services can have on land use along the road corridor. Quite clearly, this points to the need for the integration of land use considerations with transport planning.

***Enhanced context for socio-economic development of Georgetown and the country as a whole***:

The positive impact road improvement works can have in terms of improved travel time and enhanced connectivity within the City's road transport network can provide great impetus for the development of new commercial enterprises, thus creating additional job opportunities and diversifying the City's economic base. The primary importance of the Sheriff Street/Mandela Avenue Road corridor as a connector road between the East Coast and East Bank of Demerara also means that its improvement (enhanced functional efficiency) is likely to significantly impact on land use change and economic ventures beyond the study area. In this way, national economic development can be better facilitated.

***Social factors related to road use***

It must be noted that the Sheriff Street/Mandela Avenue road corridor functions as a point of connection for access to major residential communities within its area of influence. Given this land use consideration, the social aspects connected with road use are equally important. Consideration must therefore be given to the safety of pedestrian use of the defined roadway.

Of critical consideration is also the pivotal role of the road in facilitating the further decentralization of social services and facilities. This is particularly worthy of consideration in view of the eastwards growth of Georgetown. By facilitation the decentralization of social services and facilities, the dependence on the city centre for such services will be reduced, thus stimulating a more convenient spatial distribution while minimizing the negative externalities associated with over concentrated city center provision.

Georgetown's urban form has changed over time and the Sheriff Street/Mandela Avenue roadway was a major road transport change element. As the city moves away from the historic dominance of port-centred development, there is likely to be growing reliance on the City's road network for the efficient movement and distribution of people, goods and services. It is precisely in this context that the expansion/improvement of major urban roads such as the Sheriff Street/Mandela Avenue roadway can have profound direct and indirect socio-economic impacts.

# 5 Monitoring Plan for Biophysical and Socio-Economic Impacts

## 5.1 Objective of the Impact Monitoring Plan

The objective of monitoring is two-fold:

i. to notify project authorities by providing timely information about the success or otherwise of the environmental management process outlined in this ESMF in such a manner that timely changes can be made as required to ensure continuous improvement to Sheriff Street –Mandela Avenue roadway project environmental management process (including post construction); and

ii. to determine whether the mitigation measures outlined in the ESMF have been successful to the extent that the baseline environmental and social conditions have been restored, improved upon, or are worst than before and to determine what further mitigation measures may be required.

Monitoring of the bio-physical and socio-economic impacts will be conducted during all phases of the project namely pre-construction, construction and operational. The monitoring of the biophysical and socio-economic environment will be undertaken to ensure that the various environmental parameters are in sync with the relevant legislations and regulations. Additionally it will provide a foundation for remedial actions and adjustment of project related activities when required. Monitoring schedules will be dependent on the time and location of activities undertaken during the various project phases.

The monitoring plan outlined below specifies the environmental parameters that must be monitored and the frequency of monitoring. Monitoring locations are also identified in the plan.

An important step in the implementation of the monitoring programme will be consultations with the EPA to establish the methods that will be used for monitoring the various bio-physical environmental parameters. Additionally, assistance the EPA will be asked to provide guidance on equipment used especially for air quality monitoring. Guidelines for collecting and monitoring water as recommended by the EPA will be followed. Samples will be analyzed at GUYSUCO or the Institute of Applied Science and Technology. See Table 12.

| Parameter | Frequency of monitoring | Location of monitoring | Indicator | Responsible Officer |
|---|---|---|---|---|
| **Biological** | | | | |
| Vegetation | Weekly | Along entire shoulder of road | Amount of vegetation cleared<br>Re-growth after clearing | Consultant/Environmental Inspector |
| Aquatic fauna (fishes) | Weekly | In waterways alongside road | Dead fishes in water | Consultant/Environmental Inspector |
| Birds | Weekly | Botanical Gardens | Nesting sites | Consultant/Environmental Inspector |
| **Physical** | | | | |
| **Air Quality** | | | | |
| Dust and particulate matter in air | Weekly during construction | Construction areas | Roads to ensure that excessive dust is not emitted from its surface.<br>Accumulation of dust on buildings<br>Concentration of<br>$PM_{2.5}$ and $PM_{10}$ | Consultant/Environmental Inspector |
| **Water Quality** | Monthly during construction | Waterway along roadway | pH, turbidity, TSS, Coliforms, conductivity, Total oil and Grease | Consultant/Environmental Inspector |
| | | | | |
| **Waste Management** | | | | |
| Conditions of waste receptacles | Daily | Along road and in waterway | Accumulation of solid and liquid waste | Consultant/Environmental Inspector |

| | | | | |
|---|---|---|---|---|
| | | | Solid waste disposal operation | |
| **Socio-economic** | | | | |
| Impact on traffic | Weekly | On the Sheriff Street-Mandela Avenue roadway | Traffic incidence records<br><br>Grievances recorded | Project Engineer<br><br>Local communities (via Grievance Committee) |
| Employment and loss of livelihood | Bi-monthly | Businesses Along roadway | Complaints from local communities | Consultant/Environmental Inspector<br><br>Local Communities |
| Loss of structures/ assets | During construction | Along roadway and in the Right of Way | Number of structures/assets<br><br>Grievances recorded | Project Engineer<br><br>Local communities (via Grievance Committee) |
| Impacts on Human Health/ Safety and Sanitation | Monthly | Households and businesses along roadway | Health and safety incident register<br><br>Grievance records | Consultant/Environmental Inspector<br><br>Local communities (via Grievance Committee) |

Table 12 Monitoring Plan

## 5.2 Monitoring of participation process

The following are indicators for monitoring of the participation process involved in the project activities.

- Number and percentage of affected households consulted during the
- planning stage:
- Level of participation of affected people in decision - making;
- Level of understanding of project impacts and mitigation;

- Effectiveness of local authorities to make decisions;
- Frequency and quality of public meetings; and
- Degree of involvement of affected businesses, households or disadvantaged groups in discussions.

## 5.3 Monitoring Frequencies

The monitoring frequencies proposed in the above table are a guide. The Environmental Protection Agency may wish to adjust the frequencies as deemed necessary.

## 5.4 Reporting

The Project Environmental Officer and others identified in the table above will prepare all records and reports relating to the monitoring activities and submit them to the Environmental Protection Agency or other agency/ies through the Consultant/Environmental Inspector. The reports will be submitted on an annual basis or as determined by the Environmental Protection Agency.

# 6 Institutional Capacity for ESMF Implementation

## 6.1 Institutional Roles and Responsibility in the ESMF Implementation

The ESMF provides the environmental and social safeguards for the Sheriff Street-Mandela Avenue roadway project. Importantly, its successful implementation will depend largely on the capacity of key stakeholder institutions. This will ensure that all project sub-components and related activities are executed with due regard for the integrity of the ecological and socio-economic systems that are in the projects area of influence.

The roles of the major stakeholders are identified in Table 13 , which is basically an institutional role identification matrix. To a great extent, the roles and responsibility of the institution identified in Table 13 should be considered critical from the perspective of compliance monitoring.

| **Key Stakeholder Institution** | **Role and Responsibility in safeguarding the Bio-physical and Socio-Cultural Environment** |
|---|---|
| Environmental Protection Agency | The Guyana EPA is responsible for ensuring compliance with established ESIA procedures in accordance with the EPA Act 1996. The Agency also has a legal mandate to grant environmental approval for Projects, as and as such, can support the project by exercising its permitting and monitoring powers. However, lack of adequate capacity in terms of finance, personnel and material resources can constrain the extent to which the Agency can successfully carry out its functions. |
| Work Services Group of the Ministry of Public Works and Communications | The WSG has responsibility for the planning and management of road investments and maintenance activities that are executed by private firms. There is an established Environmental Unit staffed with full time environmental professionals with responsibility for preparation of guidelines for mitigation measures, monitoring of the EMP etc. This Unit works closely with the EPA. |

| | |
|---|---|
| The Ministry of Health Environmental Health Department | The Ministry of Health is responsible for national policies on sanitation and health and provides technical advice to the municipalities and administrative centres regarding waste management. The Environmental Health Officers are responsible for approving sanitary facilities, including on site disposal facilities. Moreover, there is a signed Memorandum of Understanding with the EPA to deal with matters pertaining to environmental health. |
| Central Housing and Planning Authority | The Central Housing and Planning Authority has a legal mandate to ensure orderly and progressive development of land, towns, cities, rural and urban areas; to prepare development plans for urban centres, and to provide services such as access roads, internal road networks etc. in housing areas. |
| Local Communities | Local communities will be useful agents in collection of data that will be vital in monitoring and as such they will play a role in the monitoring framework. Local communities in the project intervention areas will receive training and build capacity on skills for data collection to be done by the implementing agencies so as to equip them with the ability to collect data. |

**Table 13 Role and Responsibility of Key Institutions**

## 6.2 Capacity Building Requirements

Effective implementation of this ESMF will require technical capacity in the human resource base of implementing institutions as well as logistical facilitation. Those tasked with implementing the measures to mitigate or enhance the environmental and social impacts associated with the project should be sensitised to inherent social and environmental issues and values and be able to clearly identify indicators of these.

Training aspects should include the following:

- Policy, legislative and administrative framework that governs the ESMF;
- The EIA system in Guyana and the process;
- Importance of stakeholder engagement, techniques and partnerships;
- Participatory monitoring;
- Use and application of ESMF tools;
- Developing monitoring indicators; and

- Reporting, monitoring and follow-up.

Training directly linked to the implementation of the ESMF should be undertaken first and subsequently followed by training on aspects influencing success of ESMF.
Given the current situation in Guyana where institutional capacity in terms of availability of human resource is inadequate, the project will facilitate the hiring of qualified staff to provide necessary expertise.

In cases where there is adequate institutional resources and equipment, the project will develop a priority list and thereafter provide financial support to purchase necessary equipment etc. The priority list will ensure that key necessities to successful implementation of the ESMF are addressed in order of their strategic importance.

### 6.3 Estimated Budget to Implement ESMF (To be completed)

## 7 Public Consultation and Participation and Information Disclosure

### 7.1 Importance of Public Participation

Public participation is a cornerstone of the EIA process; hence the necessary provision should be made for affected and interested parties to comment on a proposal and its impacts. It is a key to achieving both other procedural principles and the substantive objectives of the EIA process.

To this end, information should always be made available to the concerned public and their views should be sought. This will ensure that the procedures outlined in this ESMF are implemented in an open, transparent and accountable manner. Further, the various stakeholders[7] should be given an opportunity to participate in various steps of the process, including scoping, impact identification, examination of alternatives and planning of mitigation measures.

Finally, the inclusion of public views and comments in the decision-making process should be upheld, as this will promote equitable and informed choice, leading towards better and more acceptable social and environmental outcomes in respect of the project.

At a minimum, efforts should be made to provide for public notification, disclosure of information on a proposal, access to EIA documentation and comment by affected and interested parties on scoping and EIA reports. In addition, the procedures for public consultation should allow for all interested and affected parties to express their views. Importantly, procedures for implementing public involvement in accordance with international good practice (for e.g. IDB Public Disclosure Policies) will emphasise "active" rather than "passive" engagement of stakeholders, beginning early in the process and continuing throughout.

[7]Stakeholders Basically, they are individuals and groups who have a "stake" or an "interest" that may be affected by a decision on a proposed programme of project.

## 7.2 Benefits of Public Consultation and Participation

Apart from the promotion of good governance, public consultation and participation leads to:

(i) better programmes and projects;
(ii) a greater probability of achieving project objectives; and
(iii) reduced time lags and associated costs related to issuance of permits and licences.

According to United Nations Environment Programme (UNEP) (2004) the principal aims and objectives of public consultation and participation are:

- allowing the public to express its view on the scope and content of an EIA(and the proposed development action);
- obtaining local and traditional knowledge (corrective and creative) before decision-making;
- allowing more sensitive consideration of alternatives, mitigation measures and trade-offs;
- ensuring that important impacts are not overlooked and benefits are maximized;
- reducing conflict through the early identification of contentious issues;
- influencing project design in a positive manner (thereby creating a sense of ownership of the proposal);
- improving transparency and accountability of decision-making; and increasing public confidence in the EIA/SEA process.

## 7.3 Elements of a Stakeholder Engagement Plan

To prepare a plan for involvement will require consideration of the following elements:

- objectives of the EIA/SEA;
- identification of stakeholders and, if any are transhumant7 or pastoral, mapping of
- their routes in time/space;
- budgetary/time constraints and opportunities;
- identification of appropriate techniques to involve stakeholders;
- traditional authority structures and decision-making processes;
- identification of approaches to ensure "feedback" to stakeholders;
- identification of mechanisms to ensure consideration of stakeholders' views/
- opinions/suggestions by the study team; and
- need to guide involvement to focus on issues.

UNEP (2004) identifies the following techniques that can be used to involve stakeholders. These include:

- public meetings (these are "open" with no restriction as to who may attend);
- advisory panels (a group of individuals, chosen to represent stakeholder groups, which meets periodically to assess work done/results obtained and to advise on future work);

- open houses (a manned facility in an accessible local location which contains a information display on the project and the study. Members of the public can go in to obtain information and make their concerns/views known);
- interviews (a structured series of open-ended interviews with selected community representatives to obtain information/concerns/views);
- questionnaires (a written, structured series of questions issued to a sample of local people to identify concerns/views/opinions. No interviewing may be involved); and
- participatory appraisal techniques (a systematic approach to appraisal based on group inquiry and analysis and, therefore, multiple and varied inputs. It may be assisted, but not controlled or directed, by external specialists).

# 8 Grievance Redress Mechanism[8]

## 8.1 Importance of Grievance Redress Mechanism

Having in place grievance[9] redress mechanisms is an means of (i) providing an effective avenue for expressing concerns and achieving remedy for communities; (ii) promoting a mutually beneficial relationship; and (iii) and enhancing the achievement of project development objectives.

Grievance redress mechanisms are considered very important for all IDB funded development projects for which there are continuing risks or adverse impacts. To this end, grievance mechanisms serve as a way to prevent and address community concerns, reduce risk, and assist larger processes that create positive social change. This is only possible through open dialogue and collaborative grievance resolution.

Grievances may issues such as loss of assets, loss of business and revenue, noise, dust etc. that affect people and business in the area of influence of the Sheriff Street-Mandela Avenue roadway project development project. The mechanisms therefore aim to find satisfactory solutions.

[8] For more information see Office of the Compliance Advisor/Ombudsman for the International Finance Corporation (CAO). 2008. Advisory Note: A Guide to Designing and Implementing Grievance Mechanisms for Development Projects, Washington, D.C.

[9] An issue, concern, problem, or claim (perceived or actual) that an individual or community group wants a company or contractor to address or resolve.

## 8.2 System for Grievance Mechanism

The specific individuals or groups within the project area of influence can voice their concerns through a number of channels, namely:

i. Local Communities Grievance Committee that will liaise with the EPA, WSG and other authorities;
ii. The CH & PA or Georgetown Mayor and City Council;
iii. The Environmental Protection Agency Compliance Monitoring Unit; and
iv. The IDB Independent Consultation and Investigation Mechanism that gives better access to communities to express their concerns on Bank financed-projects in their countries and monitor their execution.

## 8.3 Benefits of a Grievance Mechanism

A Grievance Mechanism can benefits the project as well as affected persons and other stakeholders, as noted in other countries such as Ghana and Rwanda.

*To the Project:*

-Provides information about project implementation;
-Provides an avenue to comply with national policies;
-Provides a forum for resolving grievances and disputes at the micro level,
-Resolves disputes relatively quickly before they escalate to an unmanageable level;
-Facilitates effective communication between the project and affected persons;
-Helps win the trust and confidence of community members in the project and create productive relationships between the parties;
-Ensures equitable and fair distribution of benefits, costs, and risks;
-Mitigates or prevents adverse impacts of the project on communities and produces appropriate corrective or preventive action; and
-Helps avoid project delays and cost increases, and improves quality of work.

*To affected Persons and other Stakeholders*

-Provides a cost‐effective method to report their grievances and complaints;
-Establishes a forum and a structure to report their grievances with dignity;
and access to a fair hearing and remedy;
-Provides access to negotiate and influence decisions and policies of the project that might adversely affect them; and
-Facilitates access to information.

## 8.4 Grievance Prevention

It is possible also to prevent grievances, providing proactive measures are taken by the project proponents. Such measures include:

- Provide timely and adequate information about the project to local communities;
- Conduct genuine public consultations;
- Build capacity for project staff and other personnel to sensitize them to social issues and the need to transform conflicts into opportunities.

## 8.5 Procedures for Grievance Redress Mechanism

There are eight in basic steps in the process of grievance redress:

- Receive and register a complaint.
- Screen and validate the complaint.
- Formulate a response.
- Select a resolution approach, based on consultation with affected person/group.
- Implement the approach.
- Settle the issues.
- Track and evaluate results.
- Learn from the experience and communicate back to all parties involved.

# 9 Conclusion and Recommendations

This Environmental and Social Management Framework (ESMF) has been prepared in order to guide the project planners, the project engineers, the Environmental Inspector and other stakeholders to identify and mitigate environmental and social impacts associated with the proposed Sheriff-Street-Mandela Avenue roadway project. This ESMF is relevant to each project component and activity.

Successful implementation of this ESMF will depend to a large extent on the involvement and participation of local communities within the project area of influence, and the development of institutional capacities of key agencies.

It is therefore recommended that:

- Environmental and Social awareness and education for the key stakeholders and affected communities be an integral part of the ESMF implementation;

- Stakeholders at different levels receive the relevant training to develop and to implement appropriate Environmental Management Plans;

- This ESMF be considered as a 'model' and should be reviewed and updated in response to the dynamic nature of the environmental and social environment.

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**Appendix 1**

**TOR for Environmental and Social Management Framework (ESMF)**

6.1 The Program will manage environmental and social impacts through the implementation of an ESMF which will be integrated in the Operations Manual. The ESMF shall contain the following elements:

(A) requirements for individual projects:(i) environmental and social selection and screening criteria, including exclusions to ensure that projects that the Bank would classify in category A environmental impact are excluded from the Program; (ii) social and environmental assessment; (iii) consultation and stakeholder engagement; (iv) implementation, supervision and reporting arrangements for the resulting environmental and social requirements for each project;

(B) at the program level: (i) organizational capacity; (ii) training; (iii) community engagement; (iv) monitoring; (v) reporting; (vi) program level initiatives with respect to traffic safety and road regulations as found necessary to improve traffic conditions and community safety at the project level or at a broader scale where feasible and appropriate.

6.2 In the context of accepted international frameworks for quality and environmental and social management systems, this management framework can be summarized as follows:

- Definition/identification of a set of policies and objectives for social and environmental performance including compliance with local laws and IDB policies, basic commitments, standards, indicators and reporting requirements for each project activity, and for the program as a whole.
- Establishment of a management program to achieve these objectives, including:
  - Identification and review of the social and environmental impacts and risks of the operations, including an Environmental and Social Impact Assessment (ESIA) or other environmental and social studies as appropriate for each particular project, in accordance with Terms of Reference to be approved by the Bank, ensuring analysis of design alternatives that take into account environmental and social factors and compliance with local regulations and Bank Policies, prior to the call for bids for each project and/or any disbursement in respect thereof;
  - provisions to ensure that the environmental and social studies required for each project are completed in a timely manner, and evaluated by the Bank, and that their results incorporated in the Program and in each project as applicable;
  - development of an Environmental and Social Management Plan (ESMP) including preventive and mitigating measures, monitoring, supervision and

contingency programs, as well as general and specific environmental specifications for each selected eligible projector activity; and

- for any and all relocation requirements, the development and implementation of a resettlement plan that will comply with the Bank's OP-710 involuntary Resettlement Policy. The development and implementation of any such Resettlement Plan(s) (RP) of the affected population, will be required to be coordinated with the final engineering designs, and presented to the Bank for approval as a condition prior to the Bank's no objection to the bidding documents for construction works and engineering supervisory services, as well as of construction and supervisory contracts;

- Establishment of a monitoring system of performance against these policies and objectives, including:
  - allocation of necessary financial resources of the loan to ensure there is adequate implementation, follow–up and control of all necessary environmental and social mitigation and management activities;
  - retaining of a project supervision firm to support the MPW&C staff in monitoring construction activities including independent supervision of environmental and social measures; and
  - a reporting system and Bank supervision framework to ensure adequate compliance.

6.3 The ESMF will include the requirements necessary to evaluate the potential impacts and risks resulting from the construction and operation phases of the individual projects and activities, and operation and closure of materials extraction and disposal sites, and will specifically address the following aspects of compliance with IDB policies:

- OP-703 Directive B.2 – Country Laws and Regulations: Assess program and project compliance with applicable Guyana regulations (e.g., national, provincial, municipal) environmental, social, and health and safety regulatory requirements (e.g., laws, regulations, standards, permits, authorizations, applicable international treaties/conventions) and recommend any measures needed if non-compliances are identified.

- OP-703 Directive B.5 – Environmental Assessment Requirements: Require that each project ESA or ESIA:

  a) Consolidate the environmental and social impact assessment of all project components, including a cumulative impacts assessment.

  b) Evaluate potential impacts from project facilities, ancillary facilities and relocation/resettlement activities.

  c) Evaluate effects of each road project on land use changes in the short and long

runs.

d) Evaluate project effects on the nearby environment (surface and ground water, soil, air quality) both during construction and operation.

e) Characterize the populations in the road corridor (direct and indirect areas of influence) and identify the presence of any vulnerable groups and the specific needs of different road users and nearby residents, and clearly document potential impacts and proposed mitigation measures.

f) Propose adequate environmental and social mitigation measures and monitoring, considering their completeness, sufficiency of detail, feasibility, cost, definition of responsibilities, schedule, and quality control.

g) Present adequate health and safety plans and procedures for project-specific health and safety risks (with particular attention to traffic and pedestrian safety), adequate level of training to be performed, and sufficient resources to be made available to ensure adequate implementation.

h) Present a project ESMP including key indicators and requirements for environmental and social performance during project execution and operation.

i) Provide for Contractors' and Operators' environmental, social and health and safety management systems for all project phases that are reasonably consistent with ISO 14001 and OHSA 18001 (for environment and health and safety, respectively).

j) Propose program and project level traffic safety measures to be incorporated in each project or in a program level Traffic Safety Program.

- OP-703 Directive B.6 – Consultations: Require that for each project, the Borrower: (i) conduct project-related public consultations and disclosure, document stakeholder concerns and how these have been accounted for in the project design or proposed mitigation measures; (ii)provide for adequate ongoing information disclosure and public consultation with the affected population and key stakeholders; and (iii)document the establishment of a grievance mechanism for the Program.
- Directive B.7 - Supervision and Compliance: Continuous monitoring of construction works and operations to ensure environmental and social standards are met throughout the construction process and operation of the road. This will include supervision and reporting of the ongoing consultation process and grievance mechanism.
- OP-703 Directive B.9 – Natural Habitats and Cultural Sites:

  a) Natural Habitats – verify and document that no critical or sensitive natural

habitats will be affected and identify any natural areas that may require conservation or mitigation measures; Establish selection criteria to exclude projects that might have significant impacts on critical habitats and to select alternatives that minimize impacts on natural habitats.

b) Cultural Sites – verify whether any cultural or historical sites are present in the project corridor and determine if consultation with local authorities and/or chance find procedures are needed

- OP-703 Directive B.10 – Hazardous Materials: Assess the need for and scope of contingency plans (e.g., emergency and spill plans), including confirmation that all relevant project-specific environmental risks have been identified, proper procedures have been developed, and sufficient resources will be made available to ensure adequate implementation.
- OP-703 Directive B.11 – Pollution Prevention and Abatement: Identify emissions (estimate gross and net GHG emissions from each project's components)and potential risks of contamination and the mitigation measures and standards that the projects will have to meet.
- OP-102 Disclosure of Information Policy: The available non-confidential Project information will be disclosed on the Bank's website in accordance with OP-102. Information to be disclosed includes the projects' environmental assessments, the Environmental and Social Strategy (ESS), the Project Abstract and any other key environmental documentation. This Environmental and Social Management Report (ESMR) will also be published on IDB's website.
- OP-710 Involuntary Resettlement: Establish selection criteria to exclude from the program any projects that would require significant resettlement activities. Prepare guidelines for project specific Resettlement, Compensation and/or Location Impact Mitigation Plans consistent with IDB's OP-710 Involuntary Resettlement Policy that ensure that each project will: (i) prepare a social baseline for potentially physically and economically displaced people and communities; (ii)develop or set the criteria to develop a project census to accurately inventory the number of people, sites and businesses potentially affected by each project. The guidelines should place particular emphasis on mitigating or compensating the impacts of disruption (temporary or permanent) of economic and livelihood activities.

6.4 The ESMF has not yet been fully developed for this Program; however, construction activities are not scheduled to begin for several months. The Bank will require the full development and implementation of a Program level ESMF prior to the first disbursement, and of ESMPs for each individual project prior to the call for bids for each such project.

6.5 As part of the ESMF, the Executing Agency will need to develop a supervision mechanism and performance assessment criteria for the various contractors retained for the construction phase, as well as for the post construction monitoring of the performance of the individual projects with respect to environmental and social compliance.