



Ministry of Public Infrastructure

Anchoring Guyana's Development

Consultancy Services for Preparation of **Detail Project Report** for **Construction of East Bank-East Coast Road Linkage Project,** **Georgetown (Guyana)**



Draft Detailed Project Report **Volume VI: Environmental and Social** **Impact Assessment Report (Draft)**

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Submitted By:



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Global Contents

For

Draft Detailed Project Report

- Volume - I** Main Design Report;
- Volume - II** Bridges and Culverts Design Report;
- Volume - III** Cost Estimate including Rate Analysis;
- Volume - IV** Drawings;
- Part 1: Road Works
- Part 2: Bridges & Culverts Works
- Part 3: Strip Plan for Utility Relocation
- Volume - V** Land Acquisition Plan & Report;
- Volume - VI** **Environmental and Social Impact Assessment Report**

Volume VI: Environmental and Social Impact Assessment Report for captioned project is presented in this Volume.

Volume I to Volume V have been submitted on March 29, 2019.

Draft Environmental and Social Impact Assessment (ESIA) Report

For the

Construction of East Bank - East Coast Road Linkage Project, Georgetown (Guyana)

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Table of Contents

Global Contents.....	i
List of Figures	vii
List of Tables.....	ix
Abbreviations and Acronyms	xii
Executive (Non-Technical) Summary.....	1
0.1. Background.....	1
0.2. Project Description.....	1
0.3. The Objective of the Proposal and the Proponent of the Project.....	4
0.4. Impact Assessment, Mitigation, and Monitoring Plan.....	4
0.5. Stakeholders' Analysis	4
0.6. Legislative and Regulatory Framework	5
0.7. Impact Assessment, Mitigation Measures and Monitoring Plan.....	5
Chapter 1: Introduction and Background.....	14
1.1. Project Background, Rationale, and Need	14
1.2. Organization Profiles: The Proponent, Implementing Organization and Project Consultant.....	15
1.3. Scope of the Environmental and Social Impact Assessment	16
1.4. Environmental and Social Impact Assessment Study Team.....	16
1.5. Organization of the Report.....	17
Chapter 2: Methodology, Significance, Criteria and Area of Influence	19
2.1. Description of Project Methodology	19
2.2. Study Area/Area of Influence.....	23
Chapter 3: Legislative and Regulatory Framework	26
3.1. Environmental Impact Assessment Process.....	26
3.2. Environmental Impact Assessment Guidelines.....	28
3.3. National Policies, Regulations, and Legislations	29
3.4. International and Regional Policies and agreements	34
3.5. Local regulatory agencies responsible for environmental protection and planning.....	37
Chapter 4: Project Alternatives.....	38
4.1. No-Go Alternative	38
4.2. Relocation Alternative.....	38
4.3. Alternative Designs	39
4.4. Analysis of Alternative Construction Materials and Technology.....	39
4.5. Solid waste management alternatives.....	39
Chapter 5: Comprehensive Description of Proposed Project.....	40
5.1. Importance of the Project.....	40
5.2. Project Description.....	40

5.3.	Project Engineering Surveys and Investigations.....	42
5.4.	Design Standards.....	45
5.5.	Design Proposals	45
5.6.	Construction Planning	57
5.7.	Associated Activities.....	57
5.8.	Energy to be used.....	58
5.9.	Manpower Requirement	58
Chapter 6: Stakeholder Identification and Consultation Plan		59
6.1.	Introduction	59
6.2.	Approach to Stakeholder Consultation.....	60
6.3.	Stakeholder Analysis	61
6.4.	Consultation Workshops:.....	62
6.5.	Public Consultations.....	64
Chapter 7: Environmental Impact Analysis		67
7.1.	Baseline Studies/Assessment.....	67
7.2.	Assessment of Environmental Impacts.....	67
7.3.	Cumulative Impacts	70
Chapter 8: Water Resources		71
8.1.	Introduction	71
8.2.	Background.....	71
8.3.	Policy, Legislation and Regulatory Framework	73
8.4.	Baseline.....	75
8.5.	Discussions.....	77
8.6.	Impact Prediction and Evaluation	78
8.7.	Mitigation and monitoring - Environmental and Social Management Plan	80
Chapter 9: Soils, Land and Geology		88
9.1.	Introduction	88
9.2.	Background.....	88
9.3.	Policy, Legislations and Regulatory Framework	88
9.4.	Baseline.....	89
9.5.	Impact Prediction and Evaluation	92
9.6.	Mitigation and Monitoring - Environmental and Social Management Plan.....	93
Chapter 10: Air Quality.....		96
10.1.	Introduction.....	96
10.2.	Background	96
10.3.	Methodology	96
10.4.	Policy, Legislation and Regulatory Framework.....	96
10.5.	Baseline.....	98
10.6.	Impact Prediction and Evaluation.....	102
10.7.	Mitigation and monitoring - Environmental and Social Management Plan.....	105

Chapter 11:	Climate and Climate Change.....	107
11.1.	Introduction.....	107
11.2.	Background	107
11.3.	Policy, Legislation and Regulatory Framework.....	107
11.4.	Baseline	108
11.5.	Impact prediction and Evaluation.....	110
11.6.	Mitigation and monitoring - Environmental and Social Management Plan.....	110
Chapter 12:	Biological and Ecological Resources and Ecosystem Services	112
12.1.	Introduction.....	112
12.2.	Background	112
12.3.	Policy, Legislation and Regulatory Framework.....	113
12.4.	Existing Information, Surveys and Base line Studies	115
12.5.	Impact Prediction and Assessment	122
12.6.	Mitigation and monitoring - Environmental and Social Management Plan.....	127
Chapter 13:	Noise and Vibrations	130
13.1.	Introduction.....	130
13.2.	Policy, Legislation and Regulatory Framework.....	130
13.3.	Baseline	131
13.4.	Impact Prediction and Assessment	135
13.5.	Mitigation and monitoring- Environmental and Social Management	135
Chapter 14:	Transportation	137
14.1.	Introduction.....	137
14.2.	Background	137
14.3.	Baseline	137
14.4.	Impact Prediction and Evaluation.....	145
14.5.	Mitigation and monitoring- Environmental and Social Management Plan	146
14.6.	Traffic control.....	148
Chapter 15:	Hazardous Waste and Waste Management Materials	153
15.1.	Introduction.....	153
15.2.	Policy, Legislation and Regulatory Framework.....	153
15.3.	Baseline	154
15.4.	Impact Prediction and Evaluation.....	157
15.5.	Mitigation and monitoring - Environmental and Social Management.....	158
Chapter 16:	Landscape and Aesthetics.....	163
16.1.	Introduction.....	163
16.2.	Baseline	165
16.3.	Impact prediction and assessment.....	166
16.4.	Mitigation and monitoring - Environmental and Social Management Plan.....	167
Chapter 17:	Socio-Economic Impacts	168
17.1.	Introduction.....	168

17.2.	Policy, legislation and Regulatory Framework.....	169
17.3.	Baseline.....	170
17.4.	Impact Prediction and Evaluation.....	173
17.5.	Mitigation and monitoring - Environmental and Social Management Plan.....	179
Chapter 18:	Health Impact Assessment	186
18.1.	Introduction.....	186
18.2.	Definitions, scope and concepts	186
18.3.	Policy, Legislation and Regulatory Framework.....	187
18.4.	Baseline.....	188
18.5.	Mitigation and monitoring - Environmental and Social Management Plan.....	190
Chapter 19:	Risks and Risks Assessment.....	194
19.1.	Risk Assessment Study.....	194
Chapter 20:	Land Acquisition and Resettlement Plan	196
Appendices		198
Appendix 1:	Terms and Scope Issued by EPA for this ESIA Study	199
Appendix 2 :	List of Plant and Machinery for Project Construction	244
Appendix 3:	Stakeholder Consultation.....	245
Appendix 4:	ESIA Team.....	256
Appendix 5:	TIN, DEM, Contour and GIS Maps,	284

List of Figures

Figure 1: Showing the Project Area (Source: Draft DPR, RITES Ltd. 2019).....	2
Figure 2: Showing Connector one Extension (Source: Draft DPR, RITES Ltd. 2019)	2
Figure 3: Showing Connector two Extension (Source: Draft DPR, RITES Ltd. 2019).....	3
Figure 4: Showing Connector three Extension (Source: Draft DPR, RITES Ltd. 2019).....	3
Figure 5: Showing Connector four Extension (Source: Draft DPR, RITES Ltd. 2019).....	4
Figure 6 Showing the East Coast - East Bank Road Linkage Project(Source: Draft DPR RITES Ltd. 2019).....	15
Figure 7 : Project Proponent.....	15
Figure 8 : Location Plan	25
Figure 9: Location Plan of Project Roads	41
Figure 10: Stakeholder consultation held at Critchlow Labour College.....	62
Figure 11: East Demerara Water Conservancy Locations	72
Figure 12: East Demerara Water Conservancy : the Sluice Locations	72
Figure 13: Geologic Cross Section in the Georgetown Area	73
Figure 14 : Showing the Sample Points for Water Quality Testing.....	76
Figure 15 : Showing the Sample Points for Soil Testing	90
Figure 16 : Showing the Air Monitoring Locations.....	101
Figure 17 Average monthly temperature and rainfall for Guyana at location (6.79°,- 58.14°) for Region 4 based on records for the 1901-2015 period (World Bank 2017).....	109
Figure 18 Seasonal Precipitation Variation for Georgetown based on records for 1971- 2017 period (Hydro-met division 2018).....	109
Figure 19 Pavement covered with cement on Aubrey Barker Road.....	112
Figure 20 :Antelope grass in GUYSUCO drain where the road will pass through.....	119
Figure 21: Sour grass Aubrey barker road.....	119
Figure 22 Monitoring at Intersection at Rupert Craig Highway and Ogle Airport Road.....	132
Figure 23:Noise Monitoring at Between Rupert Craig Highway and Railway Embankment.....	133
Figure 24:Noise Monitoring at Starting of Mocha Arcadia Road.....	133
Figure 25:Noise Monitoring at Starting of Great Diamond Road.....	133
Figure 26: Showing the Noise Monitoring Sample Points.....	134
Figure 27 Traffic Volume Count Survey, Turning Movement and O-D Survey Station	138
Figure 28: Origin-Destination Zones	139
Figure 29: Showing traffic management arrangement during construction works.....	150
Figure 30: Showing traffic management arrangement during construction works on a turn / Curve.....	151
Figure 31: Showing the Landscape/ Visual of the Project Area	166
Figure 32. - Regional Distribution of Final Population Guyana: 2012	171
Figure 33. – TIN Map for EB-EC Road Linkage Project.....	285
Figure 34. : Digital Elevation Models (DEMs) Map for EB-EC Road Linkage Project.....	286

Figure 35. : Contour Map for EB-EC Road Linkage Project.....	287
Figure 36. : GIS Map for Main Alignment From Km 0+000 to Km 1+000	288
Figure 37. : GIS Map for Main Alignment From Km 1+000 to Km 2+200	289
Figure 38. : GIS Map for Main Alignment From Km 2+200 to Km 3+400	290
Figure 39. : GIS Map for Main Alignment From Km 3+400 to Km 4+600	291
Figure 40. : GIS Map for Main Alignment From Km 4+600 to Km 5+800	292
Figure 41. : GIS Map for Main Alignment From Km 5+800 to Km 7+000	293
Figure 42. : GIS Map for Main Alignment From Km 7+000 to Km 8+300	294
Figure 43. : GIS Map for Main Alignment From Km 8+300 to Km 9+500	295
Figure 44. : GIS Map for Main Alignment From Km 9+500 to Km 10+800.....	296
Figure 45. : GIS Map for Main Alignment From Km 10+800 to Km 12+100	297
Figure 46. : GIS Map for Main Alignment From Km 12+100 to Km 13+400	298
Figure 47. : GIS Map for Main Alignment From Km 13+400 to Km 14+700	299
Figure 48. : GIS Map for Main Alignment From Km 14+700 to Km 15+340 (end).....	300
Figure 49. : GIS Map for Connector - 1 Alignment From Km 0+000 to Km 1+200	301
Figure 50. : GIS Map for Connector - 1 Alignment From Km 0+600 to Km 1+743 (end).....	302
Figure 51. : GIS Map for Connector - 2 Alignment From Km 0+000 to Km 1+200	303
Figure 52. : GIS Map for Connector - 2 Alignment From Km 1+200 to Km 2+500	304
Figure 53. : GIS Map for Connector - 2 Alignment From Km 2+400 to Km 3+580 (end).....	305
Figure 54. : GIS Map for Connector - 3 Alignment From Km 0+000 to Km 1+200	306
Figure 55. : GIS Map for Connector - 3 Alignment From Km 1+200 to Km 2+500	307
Figure 56. : GIS Map for Connector - 3 Alignment From Km 2+100 to Km 3+140 (end).....	308
Figure 57. : GIS Map for Connector - 3 Alignment From Km 0+000 to Km 0+200	309
Figure 58. : GIS Map for Connector-4 Alignment From Km 0+500 to Km 1+631 (end)	310

List of Tables

Table 1: The Environmental and Social Impact Assessment (ESIA) Team.....	16
Table 2: Method of Survey for Air Quality, Water Quality, and Noise Pollution.....	21
Table 3: Location of Start and End Point for EB EC Linkage Road Sections	25
Table 4: Summary of Design Lengths of EB-EC Linkage Road Sections	40
Table 5: Details of Inventory and condition of existing Bridge and Culverts.....	42
Table 6: Trial Pit Investigations: Summary of Pavement Composition.....	42
Table 7: List of Bore Holes	43
Table 8: Details of Un-bridged canal & drainage crossing.....	44
Table 9: Design Speed Main Alignment Road.....	45
Table 10: Design Speed Connectors Road	46
Table 11 : Details of Designed Typical Cross Section.....	47
Table 12: Designed Carriageway Widths and Typical Cross sections (Main Alignment).....	47
Table 13: Designed Carriageway Widths and Typical Cross sections (Connectors)	48
Table 14: Proposed Layers: Stage Construction	49
Table 15: Major Junctions/Intersections (at Grade Junctions).....	51
Table 16: Alternative Study for Culverts and Small Bridges	52
Table 17: Alternative Study for Large Bridges.....	53
Table 18: Summary of Design Proposal for Bridges	55
Table 19: Summary of Design Proposal for Culverts.....	55
Table 20: Summary of Road Signs.....	56
Table 21: Stakeholder Classification Matrix	59
Table 22: Criteria for the Rating of Impacts.....	69
Table 23 Water Quality Standards – WHO 2018.....	75
Table 24: Showing the Water Quality Parameters.....	75
Table 25: Summary of Water Resource Impact.....	80
Table 26 Monitoring Plan.....	84
Table 27 : Showing Soil Analysis at Ten Different Points.	89
Table 28: Potential Impacts and their Significance	93
Table 29: Soil Quality Monitoring Plan	95
Table 30: WHO Air Quality Guidelines.....	97
Table 31: Showing the Day Time Levels of PM10 and PM2.5 within Area of Influence	99
Table 32: Showing the Night-Time Levels of PM10 and PM2.5 within the Area of Influence	100

Table 33: Potential Air Quality Impacts and their Significance	105
Table 34: Air Quality Monitoring Plan.....	106
Table 35: Summary of Climate and Climate Change Impacts	111
Table 36: List of Flora found in Survey.....	119
Table 37: Orders of Macroinvertebrates Recorded	121
Table 38: List of Fishes Recorded.....	121
Table 39: List of Birds Recorded.....	122
Table 40: Biodiversity Monitoring Plan.....	129
Table 41: Magnitude of Noise Impacts due to Changes in Road Traffic Noise (short term)	131
Table 42: Magnitude of Noise Impacts due to Changes in Road Traffic Noise (Long term).....	131
Table 43: Day Time Noise Assessment - Averages for dbz.....	131
Table 44: Night Time Noise Assessment.....	132
Table 45: Past Traffic Data	137
Table 46: Present Traffic Scenario.....	138
Table 47: Annual Average Daily Traffic (AADT)	139
Table 48: Turning Movement Volume Count Survey Locations.....	140
Table 49: Peak Hours Traffic on Each Junction	141
Table 50: Summary of Axle Load Survey	141
Table 51: Traffic Diversion Zones.....	142
Table 52: Traffic Diverted to Main Alignment and Connectors.....	143
Table 53: Final Adopted Growth rates (%).....	144
Table 54: Diverted Traffic on Main Alignment and Connectors (In the Year 2018)	144
Table 55: Diverted Traffic Projection for Main Alignment (Bypass Road).....	145
Table 56: Diverted Maximum Traffic Projection for Connectors.....	145
Table 57: Traffic Flow Mitigation and Monitoring.....	152
Table 58: Summary of Estimated Quantities of Construction and Demolition Materials and Disposal Routes	157
Table 59 : Monitoring Plan	162
Table 60: Visual Impacts from Construction Activities	164
Table 61: Potential Impacts on Aesthetics and Landscape	165
Table 62. - Regional Distribution of Final Population Count by Category and Gender, Guyana: 2012 (Bureau of Statics 2018)	171
Table 63: Impact Rating Matrix.....	173
Table 64: Potential Impact Matrix.....	174

Table 65: Assessment of Land Acquisition	176
Table 66: Affected Assessment of Utility and Property	178
Table 67: Accident Report Format.....	183
Table 68: Showing the Monitoring Plan	185
Table 69: Risk Assessment Matrix for Combine Low, Medium and High Probability of Occurrence and Severity of Consequences.....	194
Table 70: Risk Assessment	195
Table 71: Assessment of Land Acquisition	197
Table 72: Affected Assessment of Utility and Property	197

Abbreviations and Acronyms

EPA	-	Environmental Protection Agency
MoPI	-	Ministry of Public Infrastructure
GoG	-	Government of Guyana
Gol	-	Government of India
EDWC	-	East Demerara Water Conservancy
ESIA	-	Environmental and Social Impact Assessment
EP	-	Environmental Protection
EIA	-	Environmental Impact Assessment
EAB	-	Environmental Assessment Board
EIS	-	Environmental Impact Statement
EA	-	Environmental Assessment
NDC	-	Neighbourhood Development Council
UNDP	-	United Nations Development Program
UNICEF	-	United Nations Children's Fund,
PAHO	-	Pan-American Health Organization
NGO	-	Non-Governmental Organization
GWI	-	Guyana Water Incorporated
SPAW	-	Specially Protected Area and Wildlife
ToR	-	Terms of Reference
EXIM Bank	-	Export Import Bank of India
CARICOM	-	Caribbean Community
GUYSUCUO	-	Guyana Sugar Corporation Inc.
HMV	-	Heavy Motor Vehicle
LCV	-	Light Commercial Vehicle

Executive (Non-Technical) Summary

0.1. Background

Ministry of Public Infrastructure (MoPI) Government of Guyana (GoG) has assigned Consultancy Services to **M/s RITES Ltd. (A Government of India Enterprise under Ministry of Railways)** for providing consultancy Services for Preparation of Detailed Project Report for East Bank-East Coast Road Linkage Project in Georgetown, Guyana. The Project is proposed to be funded under Indian Lines of Credit.

This project has been designed to improve the quality of life and to facilitate further community and economic development in the selected communities through the delivery of quality and basic road infrastructure solutions.

0.2. Project Description

The Project Road sections are:

- ◆ **East Bank -East Coast (Main Alignment):** The main alignment (15.340km) runs from East Coast (Ogle Airport) to East Bank to Diamond Village. The proposed road will commence at the Junction of the Ogle Airport entrance Road and the East Coast Demerara Public Road. The Proposed Alignment follows the existing ogle airport road for about 1.2 km from East Coast road to ogle airport junction. In this stretch the Main Alignment traverse through residential area of Courida Park, Prado Ville, connects to Eugene F. Correia International Airport and ends at the GUYSUICO factory area. Thereafter, the balance length of proposed main alignment is traversing through the abandoned cane fields only.
- ◆ **Extension of Aubrey Barker Road (Connector-1):** The Connector – 1 takes off from km 4.955 on Main Alignment on RHS and joins with the existing Aubrey Barker Road. The total designed length of connector 1 is 1.743 km including taper length for merging with existing Aubrey Barker Road.
- ◆ **Extension of Haag Bosch Road (Connector-2):** The Connector – 2 takes off from 7.705 km on Main Alignment on RHS and joins with the existing Haag Bosch Road. The designed length of connector 2 is 3.580 km including taper length for merging with existing Haag Bosch Road.
- ◆ **Extension of Mocha Arcadia Road (Connector-3):** The Connector – 3 takes off from km 10.145 on Main Alignment on RHS and joins with the existing Mocha Arcadia Road. The designed length of connector 3 is 3.140 km including taper length for merging with existing Mocha Arcadia Road.
- ◆ **Extension of Great Diamond Road (Connector-4):** The Connector – 4 takes off from km 14.885 on Main Alignment and joins on RHS with the existing Great Diamond Road. The designed length of connector 4 is 1.631 km including taper length for merging with existing Great Diamond Road.

The Project area is shown in Figure 1, 2, 3, 4, and 5, extending from Ogle, East Coast Demerara to Diamond, East Bank Demerara.



Figure 1: Showing the Project Area (Source: Draft DPR, RITES Ltd. 2019)

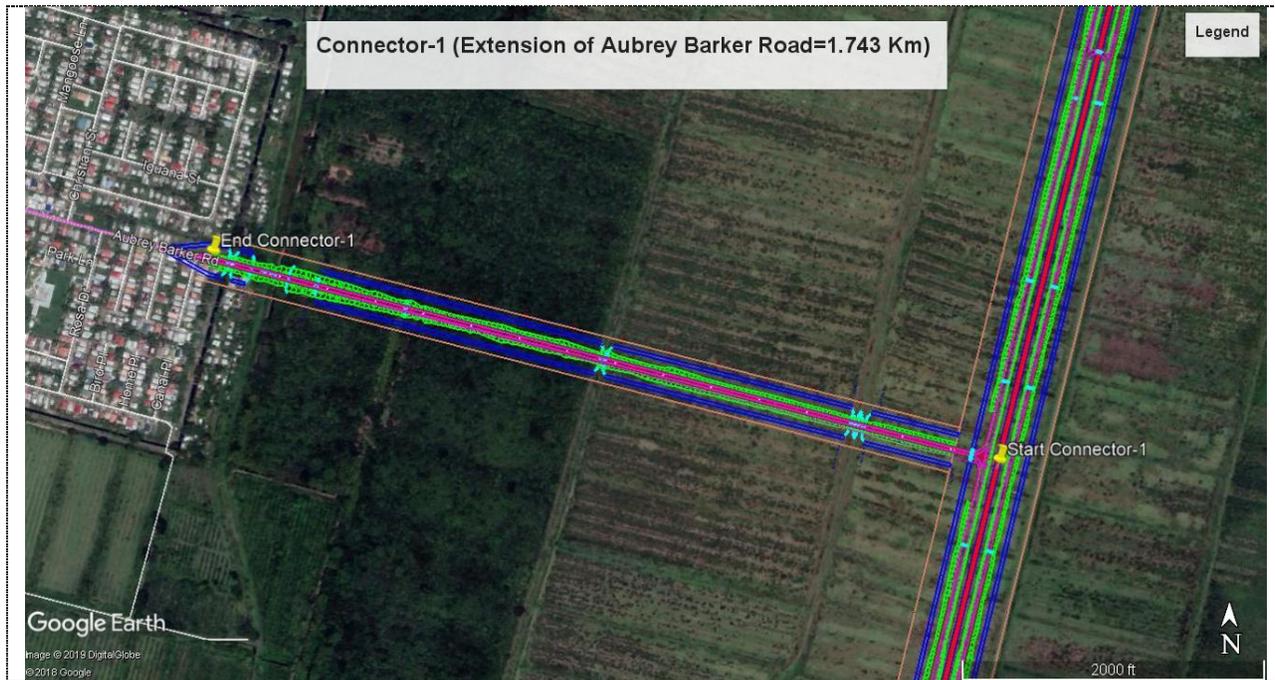


Figure 2: Showing Connector one Extension (Source: Draft DPR, RITES Ltd. 2019)



Figure 3: Showing Connector two Extension (Source: Draft DPR, RITES Ltd. 2019)



Figure 4: Showing Connector three Extension (Source: Draft DPR, RITES Ltd. 2019)



Figure 5: Showing Connector four Extension (Source: Draft DPR, RITES Ltd. 2019)

0.3. The Objective of the Proposal and the Proponent of the Project

The Environmental Protection Agency (EPA) has determined that the project requires an Environmental and Social Impact Assessment (ESIA) in accordance with the Environmental Protection Act, 1996, Cap 20:05.

The main objective of this **Environmental & Social Impact Assessment (ESIA)** proposal is to identify priority of Environmental & Social Impacts and related issues associated with the construction of 'Main Alignment and four connectors from Main Alignment to meet with existing roads and to suggest possible mitigation measures for the associated impacts.

0.4. Impact Assessment, Mitigation, and Monitoring Plan

The likely impacts of the project are considered for all environmental and social components identified in the Scope and Terms for the project, issued by the Guyana Environmental Protection Agency (EPA).

Baseline information has been drawn from both desk study and field surveys. The impact assessment and prediction also considered the additional possibility of impact interactions that is between different impacts of the project, or between project impacts and the impacts of other projects that may result in one or more additional impacts.

The ESIA identifies reasonable alternatives in terms of Project Design, technology, location, solid waste management and no-go alternative, considered by the developer, which are relevant to the proposed project and its specific characteristics and indicates the main reasons for selecting the chosen alternative.

0.5. Stakeholders' Analysis

The ESIA identified project stakeholders as individuals and organizations actively involved in the project whose interests may be affected because of the project. Stakeholders are considered in

achieving project goals since their participation and support would be crucial to the success of the project. The ESIA defines key stakeholders as those who can significantly influence or are important to the success of an activity. Secondary stakeholders are defined as all other individuals or institutions with a stake, interest or intermediary role in the project. Stakeholders have been identified based on the construction of a stakeholder matrix where stakeholders are plotted against two variables. These variables are the level of a stake in the outcome of the project against the resources of the stakeholder and the importance of the stakeholder against the influence of the stakeholder.

This consultation has been preceded by a letter to all stakeholders requesting submission of issues and concerns to be considered by the ESIA. Focused consultations have been held with residents of communities within the project area of influence. All consultations have been initiated with a detailed description of the project and its anticipated environmental and social impacts. Stakeholders have been subsequently invited to identify issues and concerns for inclusion into the impact assessment and management measures for the facility.

0.6. Legislative and Regulatory Framework

This document is guided by several international policies and local legislation and regulations, developed to ensure adequate management of the environment. The ESIA has looked at the following National Policies, Regulations, and Legislations;

- ◆ The National Environmental Action Plan;
- ◆ The Environmental Protection Act 1996;
- ◆ The Environmental Protection (Authorizations) Regulations 2000;
- ◆ The Environmental Impact Assessment Guidelines;
- ◆ The Environmental Protection (Hazardous Wastes Management) Regulations, 2000;
- ◆ The Environmental Protection (Air Quality) Regulations 2000; and
- ◆ The Environmental Protection (Water Quality) Regulations 2000.

While, international convention and standards incorporated into this ESIA include

- ◆ The World Bank Water Quality Standards;
- ◆ The Basel Convention on the Trans-boundary Movement of Hazardous Waste and their Disposal;
- ◆ WHO Guidelines;
- ◆ The Convention on Biological Diversity;
- ◆ The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);
- ◆ the Protocol concerning Pollution from Land-Based Sources and Activities (LBS);
- ◆ Rio Declaration;
- ◆ Agenda 21;
- ◆ UN Framework Convention on Climate Change (UNFCCC);
- ◆ Paris Agreement; and
- ◆ the Low Carbon Development Strategy (LCDs).

0.7. Impact Assessment, Mitigation Measures and Monitoring Plan

Impact Assessment, Mitigation Measures and Monitoring Plans have been arrived at for different possible impacts of project road construction on Environment and Society in accordance with Terms and Scope issued by Environment Protection Agency.

◆ **Water Resources:**

The construction activities will require large quantities of water which will be supplied mainly from nearby streams. Water will mainly be used for embankment construction, granular layers construction, concrete mixing, dust suppression, and sanitary purposes. If there is no adequate water in nearby streams, then the town council will be contacted to supply water in tanks to the construction site.

- **Management Plan** : Site clearing operations will progress in a gradual and phased manner to ensure there are no large increases in sediment discharge. Surface runoff from the workshop and other vehicle service areas will be channeled to oil/water separators. All water from the oil/water separators will be skimmed prior to discharge. The operations will monitor discharges to surface water up-gradient and down-gradient of the site as per recommended by Environmental Protection Hazardous Waste (Regulations) 2000 and the constant monitoring of ground and surface water quality should be maintained.
- Monitoring would be carried out by employing Inspections, Receptor monitoring , Compliance monitoring and Auditing (internal and external)
- The protection of **Lamaha Canal water Course** has been proposed as follows:
 - Bridges crossing Lamaha Canal are to be provided with "navigation spans".
 - The navigational requirement has been considered for fixing of formation level for bridges over Lamaha Canal.
 - Minimum vertical clearance of 1.2m above the normal supply level has been considered after discussions with MoPI.
 - No foundation has been provided within the water channel of Lamaha Canal.
 - Fencing of 2m height on the each bank for 250m length on upstream and downstream side of the bridge.
 - Fencing of 2m height on outer edge of each carriageway, 250m length on both ends of approach.
 - 600mm diameter concertina coil provided on top of fencing at canal bank and carriageway edge to prevent trespassing to the canal.
 - Whole superstructure is covered with 50mmx50mm opening chain-link mesh of 4mm diameter zinc coated wire, supported by steel frame fixed to crash barrier.
 - 2m height of transparent polycarbonate sheet over crash barrier top is attached.
 - Provision of Drainage spout is avoided on spans over Lamaha Canal to prevent contamination of canal water.

◆ **Soils, Land and Geology :**

The project site is located on the Coastal Plain of Guyana where the soils are predominantly alluvial deposits over organic material and silts comprising the Demerara clay with localized pockets of peat (pagesse). Four different types of clays are associated with the Demerara Formation; the Mara Clay, Brickery Clay, Tuschen Clay, and Lama Muck. At the project site, the clay exposed at the surface consists of the Demerara Clay.

- **Impact Prediction and Evaluation** : Potential impacts to soil could result from the development of the roads, site clearing and access road diversion and construction can potentially result in soil loss through increased soil erosion. Roads and other transport lines in the terrain may result in increased soil erosion. If site clearing activities coincide with the rainy season, heavy rainfall may increase erosion on roads and surrounding areas.
- **Mitigation, Monitoring of Soil, Land & Geology and Environmental & Social Management Plan:** Soils will be protected from contamination as detailed in the Spill Prevention and Control Plan. Contaminated soil will be remediated by in situ or ex-situ means as appropriate. In the event of chemical spills, soil samples will be recovered from the impacted areas after cleanup to ensure that residual levels of hydrocarbons and other fuel oil constituents do not exceed tolerable limits. If these limits are exceeded in the soil, additional soil will be removed from the spill area until the residual levels fall below tolerable limits. The soil excavated from the area shall be disposed of in accordance with the Hazardous Waste Management protocol.
- **Erosion and Sediment Control Plan:** Erosion control operations would be performed under favorable weather conditions. When excessive moisture or other unsatisfactory conditions prevail, the work would be stopped. Erosion control materials will not be applied in adverse weather conditions which could affect their performance.
- **Monitoring Plan** : The removal, storage, of topsoil and organic matter would be registered and documented. The removal, storage, treatment, and final disposition of contaminated soils would also be registered and documented.

◆ **Air Quality:**

The development has the potential to alter air pollutants concentrations from the baseline situation and may affect people, plants, animals, materials and buildings. If air quality standards are exceeded mitigation measures will be identified to minimize impacts associated therewith.

- **Impact Prediction and Evaluation** : Dust emissions from roads would occur for the duration of both the construction and operation phases. Dust would be emitted from the access road surface and from unsurfaced areas during operation. Equipment traversing the road will emit products of combustion. Equipment passage over the access road will be intermittent. The impacts to air quality would, therefore, be moderate (short-term, moderate severity, local extent). These impacts will be mitigated by employing to Limiting vehicle speed
- **Mitigation, Monitoring of Air Quality and Environmental & Social Management Plan** : To reduce impacts on air quality through Institute a speed limit for vehicles, watered during the dry season to keep dust levels down; No open dumping or burning of wood waste or vegetation and maintaining a vegetated buffer zone on the project boundary. If further mitigation is required at specific locations (e.g., active stockpiles), dedicated water sprays will be employed.

Other emissions to air would include NO_x, CO, VOCs, SO₂, PM₁₀, PM_{2.5}, and hazardous air pollutants (HAPs) from the operation of gasoline and diesel fired

equipment. These emissions would be reduced to minimum levels by following the protocols of the manufacturer for equipment use and maintenance.

- **Monitoring Plan** : Vehicles and non-stationary equipment would be visually monitored to identify any vehicles or equipment with visible particulate emissions that should be repaired or maintained. Roads and roadside vegetation would be monitored to ensure that excessive dust is not emitted by vehicle traffic, construction, and maintenance activities.

◆ **Climate and Climate Change :**

Climate change is a political, social and economic challenge which requires action at global, national, local and individual scales.

- **Impact prediction and Evaluation** : The project can alter the local climate in many ways. Exposed topsoil, construction of new roads, culverts, bridges, rehabilitation of existing roads, and buildings will replace natural vegetation at several locations within the project area.
- **Mitigation, Monitoring and Management Plan** : Climate change will be mitigated by employing a resource hierarchy for energy at all stages of the project (construction and operation) and through the supply chains and will include: Adopting alternatives to avoid GHG emissions where possible; Minimizing energy use through energy-efficient design and energy conservation; Employ renewable (non-fossil fuel sources) and low-carbon materials such as geosynthetic materials. Mitigation will also include offsetting measures, where possible, such as enhancement of natural carbon sinks by retaining vegetated areas to the maximum extent possible and by considering carbon management programs or clean technology such as renewable energy schemes for residential and other facilities.

◆ **Biological and Ecological Resources and Ecosystem Services:**

The vegetation in the project area is represented mainly by members of the Poaceae and Cyperaceae families such as *Cynodon dactylon*, *Axonopus affinis*, *Cyperus rotundus*, and *Cyperus digitatus*. The larger trees that are more common are *Samanea saman* and *Terminalia catappa*. It is expected that some trees will be needed to be cut for the construction and rehabilitation works planned for the Project.

The terrestrial ecosystem within the project site such as the ogle access road, great diamond, Haag Bosch Road, Aubrey Barker, and Mocha Arcadia road is comprised of secondary disturbed vegetation mainly consisting of grasses and shrubs. None of the vegetation along these altered sites has significant ecological values. Complete removal of vegetation is common among some sections of the Project Roads.

- **Mitigation, Monitoring and Environmental & Social Management Plan** : Temporary and permanent alteration of terrestrial habitats will be minimized to the extent feasible and be consistent with the requirement to protect and preserve critical habitat. Recommended management strategies will include such as Siting facilities in locations that avoid impacts to critical terrestrial habitat, Minimizing disturbance to vegetation and soils , Implementation of mitigation measures appropriate for the type

of habitat and potential impacts including, for example, post-operation restoration (which may include baseline inventories, evaluations, and eventual rescue of species), offset of losses, or compensation of direct users, Avoiding or minimizing the creation of barriers to wildlife movement, or threats to migratory species (such as birds) and providing alternative migration routes when the creation of barriers cannot be avoided, Planning and avoiding sensitive areas and implementing buffer zones and Implementing soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation) and Manage vegetation growth along roads and at permanent above-ground facilities. Removal of invasive plant species and replanting of native species.

◆ **Noise and Vibrations**

Noise is essentially unwanted sound and deals with people's subjective responses to objective reality. It is the annoyance caused by noise that is critical in ESIA.

During the field survey programs, noise levels were recorded at several locations. 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.

Fourteen of the locations had average sound levels compliant with the GNBS Noise Emission into the Environment of 75 db during the day. The Station located at the starting of Aubrey Barker Road recorded the highest, 78.5 db, which was due to the proximity of the monitoring station to the existing roadway.

Twelve of the locations had average sound levels compliant with the GNBS Noise Emission into the Environment of 75 db during the day. The Stations located at the Intersection at Rupert Craig highway and ogle airport road, Starting of Mocha Arcadia road and Starting of Great Diamond road recorded the highest, 65.8 Dbz, 73.3 Dbz, and 77.4 Dbz, respectively which was due to the proximity of the monitoring station to the existing roadway.

- **Impact Prediction and Assessment:** Construction activities will produce noise levels above the WHO industrial/commercial noise level guideline value of 70 decibels (dBA) from heavy earthmoving machinery operation.
- **Mitigation Proposals:**
 - Installation of soil berms as noise barriers to mitigate noise impacts adjacent to work site areas;
 - Installation of sound suppression devices (such as mufflers) on earthmoving equipment, generators, etc.;
 - Avoiding unnecessary idling of vehicles and machinery that are used intermittently
 - Employing the best available work practices on-site to minimize occupational noise levels and
 - Provide personal protective equipment (PPE) to employees and contractors and requiring their usage under the health and safety plan.
 - Implementation of these measures would result in low residual impacts (short-term, low severity, local extent).

◆ **Hazardous Waste and Waste Management Materials**

Construction waste is any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. The Environmental Protection Hazardous Waste Management Regulations provides regulations for chemical waste control and administers the possession, storage, collection, transport, and disposal of chemical wastes.

The construction activities to be carried out for the proposed Project will result in the generation of a variety of wastes which can be divided into distinct categories based on their composition and ultimate method of disposal. The identified waste types such as Site clearance waste; Construction and demolition (C&D) materials; Chemical wastes; and General refuse.

- **Impact Prediction and Evaluation:** The Project has the potential to give rise to a number of wastes during the Construction and Operational and Decommissioning phases. The potential impacts arising from the management of wastes such as Impacts on human health and on ecological receptors from releases of waste to air, water or land; and Nuisance, including litter, odour, dust, and vermin. Impact of incorrect disposal of spoil and excavated materials will be direct in nature, moderate in magnitude with local in extent and mid-term in duration.
- **Mitigation, Monitoring and Environmental & Social Management :** The following mitigation measures have been proposed to be employed to reduce the impacts of the aforementioned impacts:
 - Minimizing/ Managing Impacts due to Solid Waste
 - Minimizing/ Managing Impacts due to Soil Waste
 - Minimizing/ Managing Impacts due to Liquid Waste
 - Minimizing/ Managing Impact due to Soil Contamination and Top Soil
 - Avoiding Chemical Impact upon Environment
 - Avoiding hazards caused by explosive, combustible and Toxic Materials

◆ **Waste Management Plan**

A significant amount of solid waste from site clearance and earthworks will be generated. Removal and disposal of hazardous waste material shall be performed in accordance with all applicable government regulations. Contractor will be required to submit documentation attesting to the method proposed for disposal of wastewater from hydrostatic tests and disinfection, prior to performing hydrostatic tests. Test results from an accredited commercial laboratory verifying disinfection will also be submitted.

Efforts will be made to avoid and minimize spillage of fuels, lubricants, cleaners, solvents, or other hazardous substances which may potentially contaminate surface water bodies and groundwater bodies.

◆ Landscape and Aesthetics

The landscape impact Study Area is 500m from the boundary of the project work for the purposes of this assessment. This has been offset from the location of the Main Alignment and the furthest extent of the head of the four (4) connectors. This encompasses the GUYSUCO Estate, Backland of Mocha Road, etc.

- **Impact prediction and assessment:** The construction of the East Coast to East Bank Road Linkage will alter the landscape and change the project area aesthetic. However, there are already existing roads such as the Ogle Airport Road and roads leading to the end of the connector such as the Haag Bosch, Aubrey Barker, Mocha Arcadia and Great Diamond roads which are quite significant. As such, the change in aesthetics is not expected to be a significant impact.
- **Mitigation, Monitoring and Environmental & Social Management Plan :**
 - Mitigation measures will be implemented to prevent/avoid, reduce, and where possible offset or remedy any significant adverse landscape and visual effects. Efforts will be expended initially to prevent or avoid adverse landscape and visual effects.
 - If adverse effects cannot be prevented they will be reduced as far as possible. Unavoidable adverse effects will be offset or remedied.
 - Mitigation measures will such as Avoiding and much as is practicable sensitive locations and sites of highly valued historic or naturalistic landscapes, and siting project facilities to minimize visibility, Enhance the road corridor with new planting where possible using a planting palette which is consistent with the existing plants in the area and Maintaining and protecting existing vegetation wherever possible
 - Monitoring will be performed to test whether the predicted effects occur and whether any unforeseen effects arise and to ensure that mitigation measures which are implemented are effective in avoiding or reducing the predicted effects.

◆ Socio Economic Impacts

The positive impact of road improvement works can have in terms of improved travel time and enhanced connectivity between the East Coast and East Bank. The primary importance of the East Coast to East Bank road linkage as a connector road between the East Coast and East Bank of Demerara means that its improvement (enhanced functional efficiency) is likely to significantly impact land use and economic ventures beyond the study area. In this way, national economic development can be better facilitated.

- **Impact Assessment:** Potential social changes associated with the road project include land use changes, growth inducement, income generation, access to social services, capacity strengthening, improvement of public infrastructure, education, health, and welfare, and livelihood. Some of these changes are a direct consequence of project operations; most are not.
- During Construction Phase socio economic impacts may occur
 - on traffic flow and Transportation
 - due to transportation of Raw Materials and Equipment;
 - due to refuelling storage and Maintenance of Equipment;
 - on Land Use and Acquisition;

- due to Construction Crew Soild Waste Generation;
- Health and Safety;
- Employment;
- Mitigation mearues & monitoring plan have been identified for implementation.

◆ **Health Impact Assessment (HIA):**

HIA takes a broad perspective that considers health and wellbeing as well as the environmental, social, demographic, and economic conditions that shape them. The use of HIA serves to ensure transparency and acctontabilty of decision making making process that affects health, addressing issues of public controversy and concern, potentially generating greater support for decision implementation; and Engaging affected communities in the decision process.

- **Impact Assesement:** Workers health and safety can be impacted during construction activities. The major impacts are:
 - Risk of accidents from the operation of heavy-duty machines during the construction of the road, bridges and culverts and the construction of the base camp;
 - Exposure to excessive noise, dust and fumes from the operation of machines during construction;
 - Exposure to vector borne diseases;
- Mitigation measures and Monitoring Plans have been identified for implemetation

◆ **Risks and Risk Assemmment**

The Risk Assessment undertaken for all natural and man-made hazards. Risk Assessment Matrix for Combined Low, Medium and High Probability of Occurrence and Severity of Consequences has been prepared and analysed for following

- Heavy Rain
- Flooding
- Vehicular Accidents
- Workplace Accidents
- Spills
- Obstructions
- Fires
- Snake and Insect Bites

Overall assessed risk levels result from a combination of low, medium and high severity of occurrence and probability of occurrence. It should be noted that priority hazards include: Flooding and Accidents;

◆ **Land Acquisition and Resettlement Plan**

As a consequence of the construction of the highway it is inevitable that communities and individuals will be affected. All resettlement activities carried out will be sustainable in nature by providing sufficient resources or alternatives to those who are displaced.

All persons affected will be consulted and given the opportunity to participate in the planning and implementation of their own resettlement. Assistance will be provided in

helping individuals to restore their standard of living or to raise it, but no individual's standard of living should be lowered as a consequence of the project.

The legal tenure of affected persons will determine the type of compensation and resettlement assistance to be received. Particular attention will be given to groups such as the elderly, unemployed, those living below the poverty line, women and children and those without land tenure.

Chapter 1: Introduction and Background

This report presents the results of an Environmental and Social Impact Assessment (ESIA) undertaken for the construction of the East Coast – East Bank road linkage.

1.1. Project Background, Rationale, and Need

Ministry of Public Infrastructure (MoPI) Government of Guyana (GoG) has assigned Consultancy Services to *M/s RITES Ltd. (A Government of India Enterprise under Ministry of Railways)* for providing consultancy Services for Preparation of Detailed Project Report for East Bank-East Coast Road Linkage Project (**Tentative Length 24.62 km**) in Georgetown, Guyana. The Project is proposed to be funded under Indian Lines of Credit.

This project seeks to improve access to and from the East Coast of Demerara to East Bank of Demerara, Linden and other connecting communities, by reducing time and money spent traversing the status quo – Rupert Craig Highway and the East Bank Public Road. Moreover, this project seeks to enhance local connectivity and integration that is achieved through increasing transport efficiency, facilitating trade and development. Additionally, the quality of life of selected communities will be improved through the delivery of quality and basic road infrastructure solutions.

The Main Green Field alignment starts from East Coast Road (Rupert Craig Highway) and finishes at the end of the extension connector for the Great Diamond road with East Bank Public Road. The Main Alignment passes through existing Ogle Airstrip Road whose length approximates to 1.2 km, after which it leads to Green Field which is primarily sugar cane field with many crossing canals along and across. The Ogle Airstrip road starts from the Rupert Craig Highway (East Coast) and passes through the residential area of Courida Park, Prado Ville and connected to Eugene F. Correia International Airport and end at the sugar cane factory area.

Approval of the project necessitates an Environmental Analysis (ESA) as per the provisions in the Environmental Protection Act 1996. This ensures that all adverse impacts on local people, their livelihoods, culture and the environment during the implementation and completion of the project are assessed through the environmental and social impact assessments. This Project Report gives the findings of the Environmental and Social Impact Assessment Study undertaken as an integral part of the construction process. The project highlights salient social, economic and environmental issues associated with the construction and operational aspects of the proposed East Bank – East Coast Road Linkage Project.

This document is part of the full report that presents an Environmental and Social Impact Assessment (ESIA) and an Environmental Management Plan (EMP) for the project. This assessment focuses primarily on the proposed road infrastructure between Ogle, East Coast Demerara and Diamond, East Bank Demerara, as well as the four connectors aforementioned. While the project seeks to bring relief to the communities and road users with respect to traffic congestion, it is expected that there will be environmental impacts. The ESIA is a requirement by the Environmental Protection Act 1996, and would represent the potential environmental impacts.

The full report seeks to identify these potential environmental impacts and recommends an environmental framework to be put into place to mitigate, manage, and monitor these impacts and risks for the life of the project.



Figure 6 Showing the East Coast - East Bank Road Linkage Project (Source: Draft DPR RITES Ltd. 2019).

1.2. Organization Profiles: The Proponent, Implementing Organization and Project Consultant

The proponent for this project, as well as the implementing organization and environmental sub-consultant, are listed below:

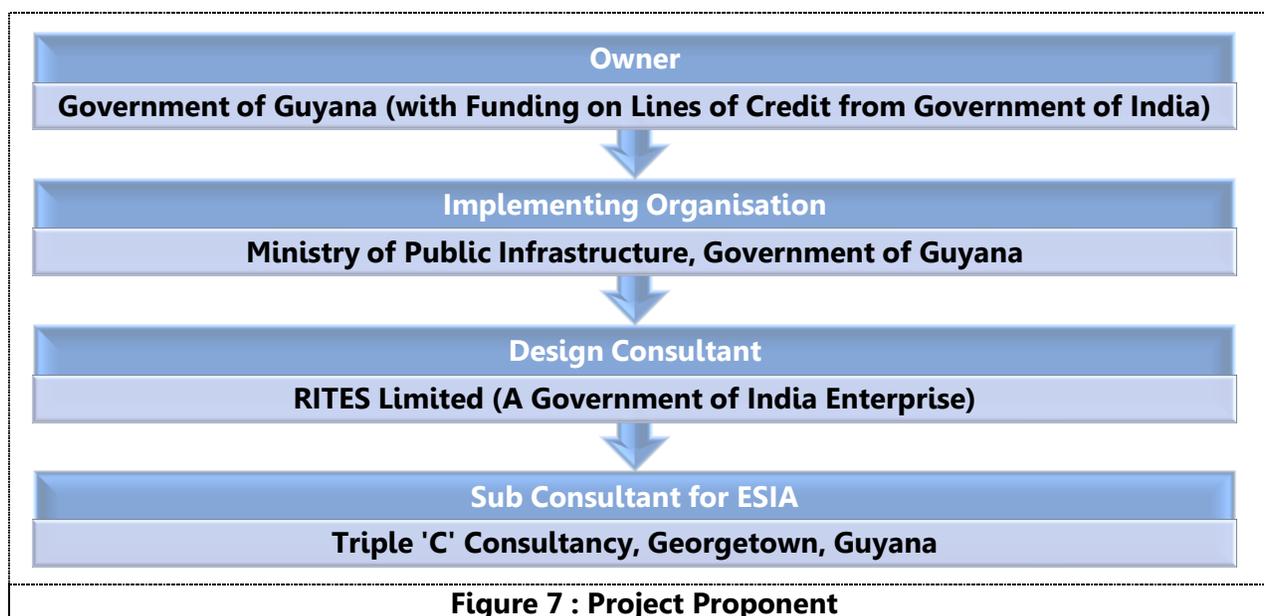


Figure 7 : Project Proponent

1.3. Scope of the Environmental and Social Impact Assessment

This ESIA has been prepared to conform to guidelines established by the Guyana Environmental Protection Agency and as detailed in the EPA publication titled Environmental Impact Assessment Guidelines, Volume 3, and August 2000.

In accordance with those guidelines, this ESIA is comprised of three following three components,

- ◆ The Environmental Baseline Study;
- ◆ The Environmental & Social Assessment; and
- ◆ the Environmental & Social Impact Management Plan.

The **base line** herein is a record of the present quality of the physical, biological and socio-economic and socio-cultural variables within the project area of influence. The existing environment is described only for those aspects of the physical, biological, social and economic environment within the study area that is relevant to the project.

The **Environmental and Social Impact Assessment** (ESIA) identifies and assesses the impacts of the proposed action and its alternatives taking into consideration the measures that are proposed to mitigate and/or enhance the probable impacts. The assessment identifies the project-environment interactions during the design, construction, and operation of the project.

The **Environmental Management Plan** (EMP) has been prepared to conform to the “Guidelines for Preparing Environmental Management Plans” detailed in the referenced document. In accordance with those guidelines, the EMP identifies feasible and cost-effective measures to reduce the potentially adverse environmental impacts to acceptable levels. It also includes operational procedures to avoid environmental risks during operations as well as emergency and contingency plans in the event of accidents during operations.

1.4. Environmental and Social Impact Assessment Study Team

This report is the work of a multi-disciplinary team of specialists deployed on the project. The team included Triple C’s personnel as well as specialist consultants. The specialists (listed in table below) undertook the majority of the baseline study and also contributed to the impact assessment. More details on the Team Members qualification and experience are outlined in **Appendix 4**.

Team Member	Company / Position	Role
Bissasar Chintamanie	CEO- Triple ‘C’ Consultancy	ESIA Team Coordinator
Sudershan Kumar Popli	RITES Limited	ESIA Team Manager
Rodolph Small	Triple ‘C’ Consultancy	Health, Safety and Social Specialist
S. Gafoor	Independent Consultant, Environmental Management Specialist	Baseline studies, impact analysis and prediction, environmental management planning
Dayanand Persaud	Triple ‘C’ Consultancy	Environmental Specialist
Glenroy Ennis	Triple ‘C’ Consultancy	Biodiversity Specialist
Dr.Surendra Pal Singh	Independent	Hydro-geologist

Table 1: The Environmental and Social Impact Assessment (ESIA) Team

1.5. Organization of the Report

The ESIA has been prepared in a modular structure with each environmental variable being covered by a single chapter. Environmental management measures are encapsulated within each module, confirming to the EPA "Guidelines for Preparing Environmental Management Plans". The management measures, in each module, identify feasible and cost-effective measures to reduce potentially adverse environmental impacts to acceptable levels, including operational procedures to avoid environmental risks during operations as well as emergency and contingency plans in the event of accidents during operations.

The general regulatory framework for road projects and alternative analyses precede the presentation of baseline data, impact assessment and management measures for each environmental variable. The ESIA has been developed in the following sequence:

- ◆ Chapter 3: Details the Legislative and Regulatory Framework applicable to construction Projects in Guyana
- ◆ Chapter 4: Identifies and discusses alternatives to the Proposed Action
- ◆ Chapter 5: Identifies the various phases and details the components of the proposed Action
- ◆ Chapter 6: Details the Stakeholder Identification and Public Consultation Process
- ◆ Chapter 7: Details the impact prediction and evaluation methods of this ESIA
- ◆ Chapter 8: Addresses issues related to water resources, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for water resources
- ◆ Chapter 9: Addresses issues related to soil, land, and geology, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for soil, land, and geology.
- ◆ Chapter 10: Addresses issues related to air quality, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for air quality.
- ◆ Chapter 11: Addresses issues related to climate and climate change, the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for climate and climate change.
- ◆ Chapter 12: Addresses issues related to biological resources, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for biological resources.
- ◆ Chapter 13: Addresses issues related to noise as vibrations, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented.
- ◆ Chapter 14: Addresses issues related to transportation, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented

- ◆ Chapter 15: Addresses issues related to hazardous waste and waste management including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented
- ◆ Chapter 16: Addresses issues related to land resources, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented for land resources
- ◆ Chapter 17: Addresses issues related to socio-economic aspect including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented
- ◆ Chapter 18: Addresses issues related to health impacts, including the legal and institutional framework, baseline compilation, impact prediction, and evaluation, and the environmental management and mitigation measures to be implemented.
- ◆ Chapter 19: Addresses issues related to risk assessment
- ◆ Chapter 20: Addresses issues related to land acquisition and resettlement

Chapter 2: Methodology, Significance, Criteria and Area of Influence

2.1. Description of Project Methodology

Road projects will create a range of direct and indirect impacts on the physical, biological and human environment. Understanding the environmental settings, issues and constraints along the proposed road area are essential for the design of road projects.

The methodology follows the conventional pattern for road project EIA's and meets the requirements of the Environmental Protection Act 1996, guideline, and procedure.

The ESIA applies as its principle, the methodology of focusing on key (sensitive) sites, cover selected sections and reflecting the entire project area. Site investigation and collected data analysis are the primary methods for the assessment of social and economic impacts, as well as ecosystem impacts assessment.

The analogy analysis method is applied to assessing the acoustic environment and ambient air impacts. Extensive public consultations were conducted to understand and address the concerns from the directly affected public.

The general methodologies are discussed below:

2.1.1. Preparatory Works for ESIA Conduction

2.1.1.1. Literature Review

Relevant information for the study has been collected through an extensive review of the literature. Relevant documents and reports have been collected and reviewed to detail out the nature of the project and identify the preliminary list of potential environmental impacts. Information on existing environmental conditions, necessary to provide the basic background for impact identification and assessment, has been obtained from these published sources. The national legislative and institutional framework, policies, procedures, guidelines, etc. have also been reviewed.

After the review of the literature and documents, the Study Team delineated the areas, where the Project is expected to have its impacts. Maps have been prepared to show potential development areas, natural resources and possible impacts on them from Project activities. Based on this information, a base-map of the Project area has been prepared for its use during field surveys.

2.1.1.2. Study of Maps

In conjunction with the Project's technical reports, topographic maps were carefully reviewed and present changes occurred were noted during field verification by all experts within the direct and indirect impact zones in the Project area. Similarly, Geological Maps and Satellite Images are also used to study the existing geology for the project.

Following Maps have been presented in Appendix 5 at end of this report

- ◆ Triangulated Irregular Network (TIN) Map (Scale 1:5000);

- ◆ Digital Elevation Model (DEM) Map (Scale 1:5000);
- ◆ Contour Map (Scale 1:5000):
- ◆ Geographic Information System Maps for Main Alignment and Connector (Scale 1:5000);

Geographic Information System (GIS) Mapping, referred in **Appendix 5** as per Terms and Scope, separate soft copy of all Maps (i.e. shape files — point, raster and vector data, TIN, Contour Map, Alignment Plan with all footprints and features/attributes in scale of 1:5000) also submitted in form of DVD or CD with this report in a working GIS project compatible with ARC View.

Referred **GIS** generated Maps in form of Figures no. 32 to 57 in **Appendix 5** such as TIN Map, DEM Map, Contour Map of Project and Site layout, i.e. Major Building Footprints and Storage area, Canals, Streams, Proposed Drain, Proposed Road, Proposed Junctions and Proposed Main Alignment (from Km 0+000 to 15+340) and Proposed Connectors Alignment of all four Connector Roads.

2.1.1.3. Scoping Exercise

A scoping exercise has been carried out to identify and highlight the key issues and impacts likely to occur during the construction, operation and maintenance phases of the project under consideration. The effort has been focused on the most important aspects of impact identification.

2.1.1.4. Preparation of Scoping Document (SD)

The Scoping for the ESIA has been undertaken in accordance with the EPA 1996, Cap 20:05, to determine the scope of the EIA, and to inform stakeholders about the proposed project and to receive their comments on relevant environmental issues and identify priority issues for environmental assessment. Scoping exercise have been conducted with, besides review of the project-related literature, publication of 30 days Public Notice (Appendix 3), inspections of project construction sites, and discussions with local people, stakeholders, and concerned Government Officials. The environmental issues of priority concerns in the scoping document have been based on the experiences of the consultants on similar type of projects incorporating the concern received during formal and informal deliberations with local people and other concerned stakeholders. The main ESIA study focused on the detailed analysis of the environmental issues identified in the approved SD.

2.1.2. Conduction of Field Data Collection for ESIA Study

2.1.2.1. Site Inspection and Field Study

After the approval of the scoping document, field studies have been conducted in the project site areas in an extensive manner. The study team's professionals visited and collected the overall basic information regarding the project site area and site-specific information. The data collection and field study had been carried out since May 28, 2018.

2.1.2.2. Public Consultation

The field visits also included consultation with various stakeholders along all sections of the proposed road. The purpose is to obtain supplementary information on social, socio-economic and socio-cultural conditions, and views on various aspects of the project. The consultation has been done also to obtain background information relevant to impact assessment and

environmental management and, in particular, to identify any areas of specific concern which needed to be addressed.

2.1.2.3. Field Study and Collection of Baseline Data

The detailed field study has been conducted to generate information on physical and biological resources and social status of those found within the area of influence. Information on major flora and fauna species has been collected through a site visit walk and interacting with the local population. The study team has also discussed with the officials of the local bodies to verify the information and collected their concerns and opinions. The brief description of the Field Study methods is given below.

2.1.2.4. Physical Environment Survey

Field observation and walk-through survey has been adopted to verify information on the drainage system, land stability and soil type, hydrological study of area, water sources (type, quality, and quantity), solid waste management system and construction materials storage sites, groundwater level, wetland area, work camp, and other construction-related environmental issues. A Checklist has been used to generate information on water drainage and insulation problem, erosion problem and possible accumulation of construction waste in the natural resources including residential land. Similarly, baseline data for air, water, and noise quality have also been measured and recorded with the following outline method of survey.

Environmental Aspect	Parameters	Method of Measurement
Water Quality	Total Dissolved Solids, Turbidity, suspended solids, Hardness, Conductivity, E. coli, and pH	Lab
Air Quality	PM 10, PM 2.5	Particulate Matter –EPA 5000
Noise Management	BdA	Sound Level Meter

Table 2: Method of Survey for Air Quality, Water Quality, and Noise Pollution

2.1.2.5. Biological Environment Survey

A checklist has been used to generate field level information on major plant species, mammals and birds, status and occurrences of other wildlife. Guyana Forestry Commission (GFC), GUYSUCO and other relevant stakeholders have been contacted to collect information on the occurrence of the place species and status of wild mammals, birds and reptiles with focus on their movement and distribution using the parameters like, common, fair, sparse and rare. Likely environmental impact and practical mitigation measures due to proposed project activities on the biological environment have been discussed with local people and stakeholders. Sampling and quantification methods are used for collecting information on trees within the project area are discussed hereunder.

- ◆ **Ecosystem: Fauna and Flora:** Guyana Forestry Commission (GFC), GUYSUCO and other relevant stakeholders, were contacted to collect information on fauna and flora. According to the residents, they observed some kinds of frogs, snakes, and wild birds in the project area that is very common around the region. The possible ecosystems in the surrounding areas are listed below and will be expounded in subsequent chapters.

- ◆ **Non Timber Forest Product (NTFP):** Regarding NTFP, there are very few significant species reported. The NTFP reported within the area of influence and on the surrounding area of the project area with their uses are described in Chapter 12.
- ◆ **Faunal Species:** Mammals have been found in the surroundings of the project area. These animals do not have their permanent habitat in and around the project area but have been spotted and seen and will be discussed in Chapter 12.
- ◆ **Birds:** Birds have been identified and discussed in detail in Chapter 12.
- ◆ **Amphibians, Reptiles and Aquatic Life:** Some of the aquatic life is present in the small streams and reptiles and amphibians are also observed. The observed species are not recorded in IUCN's Red List. A detailed description of these species is discussed in Chapter 12.

2.1.3. Socio-economic Survey

The study team have visited the entire project area and households along proposed roads to be constructed to gather information related to socio-economic conditions of the people residing in the project area.

Community social service structures, including the location of religious and other historic structures, are demarcated on the map and possible impacts predicted.

Possible loss of land and property have been calculated.

To carry out the analysis on impact due to losses, a social impact assessment followed by a census of potentially affected persons and verification of their affected assets have been conducted and discussed in the Resettlement Plan.

2.1.4. Preparation of EIA Report

2.1.4.1. Compilation of Baseline Information, Impact Identification, Prediction and Evaluation

Based on the primary and secondary information, the baseline information has been completed related to the issues indicated in Scoping Document and Term of Reference and are presented in Chapters 8 to 18 in this ESIA Report. The possible environmental impacts have been identified considering proposed Project activities and its interaction with the surrounding environment in time and space and Accordingly the impacts have been evaluated and presented in the above-mentioned chapters.

2.1.4.2. Prescription of Mitigation and Enhancement Measures and Monitoring

The mitigation and enhancement measures have been proposed in order to ameliorate the beneficial impacts and avoid or mitigate the adverse impacts considering the identified impacts, their nature, extent, and complexity, identified during the ESIA exercise. While recommending the mitigation option, a realistic approach have been applied such that the measures could be employed in the local context and is discussed in Chapters 8 to 18. The monitoring plan has been formulated to assess the effectiveness and implementation status of mitigation and benefit augmentation measures.

2.1.4.3. Preparation of Environment Management Plan

The Environment Management Plan (EMP) has been prepared to ensure and evaluate the effectiveness of each of the mitigation and enhancement measures implemented to minimize the environmental impacts and to ameliorate the overall environmental conditions within the region of influence. The basic objective of EMP is that it clearly spells out the environmental concerns of the project and prescribes a systematic environmental management system to be followed to attain the environmental improvements in and around the project vicinity. The associated costs for adopting mitigation measures and enhancement measures have also estimated and given in Chapters 8 to 18.

2.1.5. Alternative Analysis

The possible alternatives to the project have been identified and discussed in Chapter 4.

2.2. Study Area/Area of Influence

Guyana officially the Co-operative Republic of Guyana is a sovereign state on the northern mainland of South America. It is, however, often considered as part of the Caribbean region because of its strong cultural, historical, and political ties with other Anglo Caribbean countries and the Caribbean Community (CARICOM). Guyana is bordered by the Atlantic Ocean on the north, Brazil to the south and southwest, Suriname to the east and Venezuela to the west. With 215,000 square kilometers (83,000 sq. mi), Guyana is the fourth-smallest country on mainland South America after Uruguay, Suriname and French Guiana (an overseas region of France).

Georgetown is the capital of Guyana, located in Region 4, which is also known as the Demerara-Mahaica region. Georgetown is Guyana's largest urban center, containing a large portion of its commerce. It is situated on the Atlantic Ocean coast at the mouth of the Demerara River and it is nicknamed 'The Garden City of the Caribbean'. It is an important city for Guyana and the Caribbean. Within the metro area, there is the CARICOM headquarters, the Administrative Arm of the Caribbean Regional Integration Organization. Georgetown is also home to a seaport. Guyana's international airport, Cheddi Jagan International Airport/Timehri, an hour south of Georgetown is a destination for Caribbean Airlines (the airline formerly known as BWIA or "bwee"), LIAT, META, and Travel Span GT. Closer to the city is the newly expanded Ogle Airport, with a terminal facility geared to handle regional, international and inter-CARICOM flights, connecting CARICOM states with the CARICOM Secretariat.

The project would have a direct influence on the CBD of Georgetown. The Main Greenfield alignment (15.340 km) starts from East Coast Road (Rupert Craig Highway) and ends at the connector of extension of the great diamond road with East Bank Public Road.

The Ogle Airstrip Road starts from the Rupert Craig Highway (East Coast) and passes through the residential area of Courida Park, Prado Ville and connected to Eugene F. Correia International Airport and end at Sugar cane factory area. The Main Alignment passes through the existing Ogle Airport Road for a length of approximately 1.2 km, thereafter it runs through the green field and sugar cane fields with many crossing canals along and across.

The existing Road Network in the Project Influence Area consists of the following roads that will have a direct impact on the development of the highway project:

- ◆ **The East Coast road (Rupert Craig Highway):** the volume of traffic on East Coast Road is high. The proposed bypass road starts from **Ogle Airstrip Road** intersection.

- ◆ The **first connector** starting from Main Alignment and linking to the existing **Aubrey Barker Road** which is further connected to **Critchlow Ave Road and Mandela Road**.
- ◆ The **second connector** starting from Main Alignment and linking to existing **Haags Bosch road** connected to **East Bank Road**, the volume of traffic is also high on East Bank Road at the intersection of East Bank Road and Haags Bosch Road due to its proximity to the Demerara Harbour Bridge and traffic coming from West Bank/Coast to Georgetown.
- ◆ The **Third Connector** starting from Main Alignment and linking the **Mocha Arcadia** road which is further connecting to **the East Bank Road**.
- ◆ The **fourth Connector** starting from Main Alignment and linking to **Great Diamond Road** which is further connected to East Bank Road, the traffic on East Bank road leads to southwards for Eugene F. Correia International Airport, Timehri.

2.2.1. Specific project location

There are 5 road sections designated as project roads i.e. Main Alignment and its four connectors as detailed below:

- ◆ **East Bank -East Coast (Main Alignment):** The main alignment (15.340km) runs from East Coast (Ogle Airport) to East Bank to Diamond Village. The proposed road will commence at the Junction of the Ogle Airport entrance Road and the East Coast Demerara Public Road. The Proposed Alignment follows the existing ogle airport road for about 1.2 km from East Coast road to ogle airport junction. Thereafter, the balance length of proposed main alignment is traversing through the cane fields only.
- ◆ **Extension of Aubrey Barker Road (Connector-1):** The Connector – 1 takes off from km 4.955 on Main Alignment on RHS and joins with the existing Aubrey Barker Road. The total designed length of connector 1 is 1.743 km including taper length for merging with existing Aubrey Barker Road.
- ◆ **Extension of Haag Bosch Road (Connector-2):** The Connector – 2 takes off from 7.705 km on Main Alignment on RHS and joins with the existing Haag Bosch Road. The designed length of connector 2 is 3.580 km including taper length for merging with existing Haag Bosch Road.
- ◆ **Extension of Mocha Arcadia Road (Connector-3):** The Connector – 3 takes off from km 10.145 on Main Alignment on RHS and joins with the existing Mocha Arcadia Road. The designed length of connector 3 is 3.140 km including taper length for merging with existing Mocha Arcadia Road.
- ◆ **Extension of Great Diamond Road (Connector-4):** The Connector – 4 takes off from km 14.885 on Main Alignment and joins on RHS with the existing Great Diamond Road. The designed length of connector 4 is 1.631 km including taper length for merging with existing Great Diamond Road.

The Easting Northing & Latitude Longitude of Start and End point for all 5 sections is presented in table below:

Project Road Section	Start					End				
	Km	Easting	Northing	Latitude	Longitude	Km	Easting	Northing	Latitude	Longitude
East Bank - East Coast Linkage Road	0.000	378747.36 E	754130.22 N	6° 49' 16.616" N 58° 5' 50.344" W		15.340	373060.39 E	740068.94 N	6° 41' 38.360" N 58° 8' 54.517" W	
Extension of Aubrey Barker Road (Connector-1)	0.000	377651.06 E	749310.90 N	6° 46' 39.619" N 58° 6' 25.697" W		1.743	375961.17 E	749738.20 N	6° 46' 53.405" N 58° 7' 20.772" W	
Extension of Haag Bosch Road (Connector-2)	0.000	376937.57 E	746656.86 N	6° 45' 13.151" N 58° 6' 48.739" W		3.580	373474.14 E	747573.42 N	6° 45' 42.732" N 58° 8' 41.615" W	
Extension of Mocha Arcadia Road (Connector-3)	0.000	375732.24 E	744536.78 N	6° 44' 4.032" N 58° 7' 27.838" W		3.140	372692.80 E	745314.59 N	6° 44' 29.127" N 58° 9' 6.889" W	
Extension of Great Diamond Road (Connector-4)	0.000	373299.17 E	740468.24 N	6° 41' 51.379" N 58° 8' 46.771" W		1.631	371732.08 E	740920.59 N	6° 42' 5.988" N 58° 9' 37.840" W	

Table 3: Location of Start and End Point for EB EC Linkage Road Sections



Figure 8 : Location Plan

Chapter 3: Legislative and Regulatory Framework

3.1. Environmental Impact Assessment Process

3.1.1. Role of EPA in EIAs

The EP Act mandated four functions for the EPA as related to environmental assessments. These four functions are:

- ◆ To take such steps as are necessary for the effective management of the natural environment to ensure the conservation, protection and sustainable use of natural resources;
- ◆ To promote the participation of members of the public in the process of integrating environmental concerns in planning for development on a sustainable basis;
- ◆ To ensure that any developmental activity which may cause an adverse effect on the natural environment to be assessed before such activity is commenced and that such adverse effect is considered in deciding if such activity should be authorized; and
- ◆ To coordinate environmental management activities of all persons, organizations, and activities.

The Agency is mandated to be guided by several principles of environmental management as part of this process. These principles are:

- ◆ The “polluter pays principle”- the polluter should bear the cost of measures to reduce pollution;
- ◆ The “precautionary principle”- where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation;
- ◆ The “strict liability” legal principle: any person who contravenes this Act or regulations shall be liable to the penalties prescribed thereafter;
- ◆ The “avoidance” principle: it is preferable to avoid environmental damage, as it can be impossible or more expensive to repair rather than prevent damage; and
- ◆ The “state of technology” principle: measures protecting the environment are restricted by what is technologically feasible and as technology improves, the improved technology should be used to prevent and repair environmental damage.

3.1.2. The ESIA Process

The EPA has indicated that an EIA, (herein referred to as an ESIA), must be conducted for this project. The ESIA must conform to the EIA process established by the Guyana EPA. In accordance with the EIA process, the EPA has published, at Triple C Cost, a notice of the project in at least one daily newspaper and has made a non-technical summary of the project available to members of the public. Members of the public have had more than twenty-eight days from the date of publication to make a written submission to the agency setting out those questions

and matters which they require to be answered or considered in the environmental impact assessment. The EPA has issued terms and scope of the environmental impact assessment considering all submissions made by members of the public.

During the performance of the ESIA, MoPI, RITES and Triple 'C,' Consultancy consulted members of the public, interested bodies, and organizations and provided to members of the public on request, and at no more than the reasonable cost of photocopying, copies of information obtained for the ESIA. In accordance with the EP Act, the ESIA included the identification, description, and evaluation of the direct and indirect effects of the proposed project on the environment including:

- ◆ Human beings;
- ◆ Flora and fauna and species habitats;
- ◆ Water;
- ◆ Soil;
- ◆ Air and climatic factors;
- ◆ Material assets, cultural heritage and the landscape;
- ◆ Natural resources, including how much of a particular resource is degraded or eliminated, and how quickly the natural system may deteriorate;
- ◆ The ecological balance and ecosystems;
- ◆ The interaction between the factors listed above and other environmental factors which need to be taken into account or which the EPA requires to be included;
- ◆ The need to protect and improve human health and living conditions; and
- ◆ The need to preserve the stability of ecosystems as well as the diversity of species.

Further to ensure compliance with the EP Act, this ESIA contains the following information

- ◆ A description of the project, including in particular the geographical area involved, the physical characteristics of the project, land-use during construction and operational phases, including plans, drawings, and models;
- ◆ The main characteristics of the production process, including the nature and quantity of materials used, plans, drawings and models;
- ◆ An estimate, by type and quantity, of expected contaminants, residues, and emissions (water, air, and soil pollution, noise, vibration, light, heat, radiation) resulting from the operation of the proposed project);
- ◆ An outline of the main alternatives studied and an indication of main reasons for the choice, taking into account the environmental factors;

- ◆ A description of the likely significant effects of the proposed project on the environment resulting from
 - The existence of the project
 - The use of natural resources
- ◆ The emission of contaminants, creation of nuisances and elimination of waste;
- ◆ A description of the forecasting methods used to assess the effects on the environment;
- ◆ An indication of any difficulties (technical deficiencies or lack of knowledge or expertise) encountered in compiling the required information;
- ◆ A description of the best available technology;
- ◆ A description of any hazards or dangers which may arise from the project and an assessment of risks to the environment;
- ◆ A description of measures which will be used to mitigate any adverse effects;
- ◆ A statement of reasonable alternatives (if any) and reasons for their rejection;
- ◆ A statement of degree of irreversible damage, and an explanation of how it is assessed;
- ◆ An emergency response plan for containing and cleaning up any pollution or spill of any contaminant;
- ◆ A programme for rehabilitation and restoration of the environment.

After completion, ESIA will be submitted to the EPA for evaluation and recommendations. A notice will be published, by the Environmental Protection Agency (EPA) in at least one daily newspaper confirming that the ESIA has been submitted to the agency. Members of the public shall have sixty days from the date of publication of that notice to make submissions to the Agency as they consider appropriate. Concurrently, the EPA shall submit the ESIA to the Environmental Assessment Board for its consideration and recommendation as to whether the environmental impact assessment and environmental impact statement are acceptable.

3.2. Environmental Impact Assessment Guidelines

The EPA in collaboration with the Environmental Assessment Board (EAB) has produced guidelines for conducting EIAs for large scale construction projects in Guyana. The guidelines are intended to complement those in Section IV of the Environmental Protection Act, 1996 (EP Act). In accordance with these guidelines, this ESIA consists of three components; Environmental Baseline Study, Environmental Assessment and Environmental Impact Statement. The Environmental Baseline Study records the quality of the environment within the area of influence before the project is implemented. The data is analyzed in the environmental assessment and is used to predict and quantify impacts. The Environmental Assessment (EA) is identification and assessment of impacts of the proposed project and its alternatives. The EA considers mitigation measures to offset negative impacts and assesses impact of implementing these measures on the environment. The Environmental Impact Statement is a summary of

findings of the Environmental Baseline Study and the Environmental Assessment and includes an Environmental Management Plan.

3.3. National Policies, Regulations, and Legislations

This chapter summarizes Guyana's legislation and policies, as well as other policies, regulations, and norms that are applicable to the project.

3.3.1. National Legal Framework

This section provides an overview of the national environmental and infrastructure-oriented legislation currently enforced in Guyana that could apply to the project.

3.3.2. National Constitution of Guyana

Guyana is governed according to the Constitution of the Co-operative Republic of Guyana, as amended. The constitution took effect in 1980 and expressly provides for the protection of the environment. Article 25 establishes "improvement of the environment" as a general duty of the citizenry. In addition, Article 36 reads as follows:

In the interests of 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 (OAS, 2013).

3.3.3. Environmental Protection Act (1996)

In 1996, the Environmental Protection Act (the Act) was ratified to implement environmental provisions of the Constitution. The Act is Guyana's single most significant piece of environmental legislation because it articulates national policy on important environmental topics such as pollution control, requirements for environmental review of projects that could potentially impact the environment, and penalties for environmental infractions. It also provides for the establishment of an environmental trust fund. Most importantly, the Act authorized the formation of EPA and establishes EPA as the lead agency on environmental matters in Guyana (FAO, 2013). The Act further mandates the EPA to oversee the effective management, conservation, protection, and improvement of the environment (EPA, 2012). It also requires the EPA to take the necessary measures to ensure the prevention and control of pollution, assessment of impact of economic development on the environment, and the sustainable use of natural resources.

3.3.4. Environmental Protection (Hazardous Waste) Management Regulations

These regulations outline rules and procedures for the transport, storage, treatment, and disposal of hazardous substances, with the intent of protecting human health and the environment. For the purposes of these regulations, hazardous materials and wastes are:

- ◆ Explosives
- ◆ Flammable liquids
- ◆ Flammable solids or waste solids other than explosives which may be readily combustible
- ◆ Oxidizing substances
- ◆ Organic peroxides
- ◆ Poisonous substances

- ◆ Infectious substances
- ◆ Corrosives
- ◆ Toxic gases
- ◆ Toxic substances which if inhaled or ingested may cause delayed or chronic effects
- ◆ Toxic substances which, if released, may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and or toxic effects upon the system

A material capable, after disposal, of yielding another material which possesses any of the characteristics specified above.

3.3.5. Environmental Protection Air Quality Regulations

These regulations require that any operation emitting air contaminants during construction, installation, operation, modification or extension of any facilities relating to industry, commerce, agriculture or any institution must apply to the EPA for an environmental authorization. The regulations also stipulate that the EPA shall establish emission limits for specific parameters; however, these have not been established to date and the WHO Guidelines are used.

3.3.6. Environmental Protection (Water Quality) Regulations

These regulations require registration and environmental authorization for construction, installation, operation, modification or extension of any facility that will cause the discharge of effluents. The regulations include parameter limits for concentrations of specific constituents which can be discharged into any inland or coastal waters or lands in Guyana.

3.3.7. Environmental Protection (Noise Management) Regulations

These regulations require operations that emit noise to apply to the EPA for an environmental authorization, and also establish permissible noise levels for specific types of land uses such as residential, institutional, educational, industrial, commercial, construction, transportation and recreational.

3.3.8. Environmental Protection (Hazardous Waste Management) Regulations 2000

These Regulations cover management of waste including chemical waste and cover industrial, commercial and any other activity that produces waste. Some of the key activities which are covered under the Regulations are generation, treatment, and disposal of hazardous waste. The Regulation is read and construed as being in addition to, and not in contravention of the Pesticides and Toxic Chemicals Control Act 2000 (No. 13 of 2000). Based on the definition of all chemical wastes including persistent organic pollutants (POPs) are covered under these Regulations for the purposes of management.

Permits are required for the generation of waste which is monitored throughout the production, storage, transport, and release phases. The waste streams on which focus is centered for control are as follows

- ◆ Clinical Waste from medical care in hospitals, medical centers, and clinics;
- ◆ Waste from the production and preparation of pharmaceutical products;

- ◆ Waste from the production, formulation, and use of biocides and phyto-pharmaceuticals;
- ◆ Waste pharmaceuticals, drugs and medicines; and
- ◆ Waste from the manufacture, formulation, and use of wood preserving chemicals.

3.3.9. Environmental Protection (Authorization) Regulations 2000

These Regulations are concerned with the guidelines for granting authorization for projects that can have medium to high environmental impacts in Guyana. Guidelines and procedures are specified in its contents and a fee structure in its schedule.

3.3.10. Environmental Protection (Wildlife Management and Conservation) Regulations 2013

The Wildlife Management and Conservation Regulations (2013) were made under the Environmental Protection Act. This critical piece of legislation focuses on the management and conservation of wildlife. It addresses issues including the capturing, gathering, collecting, hunting, killing and taking of wildlife. The regulations cover the use of wildlife for any purposes, including as bush meat, for research, and for medicinal purposes. It also makes provisions for the classification of wildlife, as well as areas within Guyana. The regulations are already being enforced.

3.3.11. Forestry Act - 2009

The Forestry Act 2009 sets a regime for the sustainable management of the state forests, by providing State forests through concessions for forest activities, including the conservation of biological diversity and environmental services provided by the forest. The second part of the Act provides for the issuance of five types of state forest authorizations: concessions, exploratory permits, use permits, community forest management agreements, and afforestation agreements. This section also addresses compliance with occupational health. The Act prohibits acts that could cause forest fires in State Forest areas and allows the GFC to declare certain areas to be fire protection areas. The Act places emphasis on value-added activities by addressing issues of quality control through legally binding codes of practice which can be subject to amendments from time to time. Issues of underpricing, unlawful exportation of forest produce, trade of timber in contravention to the GFC's guidelines, and procedures for ownership of concession areas and change thereof, are also outlined in the Act

3.3.12. Fisheries Act- 2002

The Fisheries Act, which was enacted in 2002, is intended to assure the sustainable management of fisheries resources and replaced the 1957 Act. Together with the Fisheries Regulation of 1959, the Fisheries (Pin Seine) Regulations of 1962, the Fisheries (Aquatic Wildlife Control) Regulation of 1966, as well as the Maritime Boundaries Act of 1977, these pieces of legislation provide for the development, management, exploration, utilization and conservation of fisheries and for associated purposes. These existing pieces of legislation provide a framework for sustainable fisheries management and the protection of Guyana's aquatic environments from pollution, which is necessary for biodiversity conservation and management.

3.3.13. Protected Areas Act, 2011

The Protected Areas Act was enacted in 2011 and provides the framework for the establishment and management of a national system of protected areas, including a mechanism for sustainable long-term financing (the National Protected Areas Trust Fund) and establishment of

a Protected Areas Commission. Under the Protected Areas Act, existing and new state-owned protected areas, Amerindian protected areas, privately managed protected areas, and Urban Parks such as the Botanical Gardens and Zoological Park will comprise the national protected areas system.

3.3.14. Wild Birds Protection Act, 1919

The Wild Birds Protection Act was enacted in 1919 and seeks to enforce fines and penalties on persons who are inclined to injure, harm or capture wild birds without consent.

3.3.15. Plant Protection Act, 2011

The Plant Protection Act, which was enacted in 2011, provides for the prevention, eradication, and control of diseases and pests affecting plants. The Act is administered by the National Agricultural Research and Extension Institute.

3.3.16. National Trust Act - (No. 7 of 1972)

The Act provides for the preservation of monuments, sites, places and objects of historical interest or national significance. The main body vested with this responsibility is the Office of the National Trust of Guyana which was established in 1972. The Act states that "when it appears to the National Trust that in the public interest that any monument (defined as: "any building structure, object or other work of man or of nature whether above or below the surface of the land or the floor of the sea within the territorial waters of Guyana and any site cave or excavation") should be preserved on account of the historic, architectural or archaeological attaching to it or its national importance, the National Trust may declare the monument to be a national monument." At present, there are nine gazetted National Monuments.

3.3.17. Town and Country Planning Act, 1946 - 2012

This Act makes provision for the orderly and progressive development of land, cities, towns and other areas both urban and rural. The Act provides development guidelines for the built environment and is enforced by the Ministry of Communities' Ministry of Public Infrastructure (MOPI).

3.3.18. Regional and Neighbourhood Democratic Councils, 2006

The Local Domestic Organs Act, amended in 2006, divides Guyana into 10 regions each with their own Democratic Council (RDC), 33 Neighborhood Democratic Councils (NDCs), and 76 Amerindian Village councils for the purposes of administrative management. The RDCs have some level of autonomy, although they are under the purview of the Ministry of Communities.

3.3.19. Water and Sewerage Act, 2002

This Act provides for the ownership, management, control, protection and conservation of water resources, provision of safe water and sewerage services, and regulation thereof. The Act establishes Guyana Water Incorporated (GWI), a merger of the previous bodies Guyana Water Authority and Georgetown Sewerage and Water Commissioners. The Act also defines fines for offenses relating to wastage, tampering, damage, and pollution to waterworks.

3.3.20. Labour Act, 1942

The 1942 Labour Act and its regulations specify the conditions that an employer must observe in the hiring of employees, including terms of payment. The Act also provides for prevention of discrimination and outlines conditions for the employment of young persons and children.

3.3.21. Occupational Health and Safety (OHS) Act, 1997

The 1997 OHS Act regulates the registration and regulation of industrial establishments, and legally defines the responsibilities of workers and management with respect to keeping workplaces safe.

3.3.22. National Policy Framework

Guyana's government has articulated national policies on several environmental, social and development topics that are relevant to the Project. This section provides an overview of the key government policies applicable to the Project.

3.3.23. National Development Strategy

The National Development Strategy 2001 - 2010 (NDS) recommends priorities for Guyana's economic and social development policies. The document contains a technical analysis of problems and future prospects in all sectors of the economy and in areas of social concern. A number of the priorities highlighted in the NDS are directly relevant to the project, including transport infrastructure, housing, urban development, and environment, as well as poverty eradication and gender equity.

3.3.24. National Environmental Action Plan

Guyana's National Environmental Action Plan (NEAP) articulates the national government's approach to manage the environment from the perspective of economic development. The NEAP considers the issues of environmental management, economic development, social justice, and public health to be inextricably linked. It identifies deforestation, pollution, and unregulated gold mining as historically minor but growing environmental problems, while identifying the country's most serious current environmental problems, vulnerable area of the coastal zone where most of the population and physical assets are concentrated.

The NEAP is directly relevant to the project in several ways. It identifies the coastal zone, where the project communities are located, as an area in need of focused management due to the susceptibility of the coastal environment to both natural and human-induced degradation. It also identifies liquid and solid waste management, and establishment of national, regional and local institutions to improve environmental management as key priorities.

3.3.25. Integrated Coastal Zone Management Action Plan

Guyana's Integrated Coastal Zone Management (ICZM) Process is an ongoing initiative to promote the wise use, development, and protection of coastal and marine resources; enhance collaboration among sectoral agencies; and promote economic development. In 2000, after two years of study, the ICZM Committee produced an ICZM Action Plan, which was approved by the GOG in 2001.

The ICZM Action Plan addresses policy development, analysis and planning, coordination, public awareness building and education, control and compliance, monitoring and measurement, and information management (GLSC, 2006). Other coastal-zone related tasks currently being undertaken by the Government include strengthening of the institutional setup for ICZM; a public awareness campaign to increase public understanding of the vulnerability of the coastal zone to sea level rise and climate change; and the creation of a database of coastal resources to facilitate improved ICZM. Currently, the EPA is mandated to coordinate the ICZM Project and coordinate the development of the ICZM Action Plan through the ICZM Committee. Under the Caribbean Planning for Adaptation to Climate Change (CPACC) Project, Guyana has conducted a socioeconomic assessment of sea-level rise as part of a wider vulnerability assessment and

developed a Climate Change Adaptation Policy and Implementation Strategy for coastal and low-lying areas.

3.3.26. National Forest Policy

The National Forest Policy (NFP) was revised in 2011 and aims to ensure the conservation, protection, management, and utilization of the nation's forest resources while ensuring that the productive capacity of the forests for both goods and services is maintained or enhanced. The revised NFP addresses the country's national and global responsibility for the sustainable management of the forest and recognizes the critical role of forests in maintaining the ecosystems and life-supporting services.

3.3.27. ABS Policy

A national policy addressing Access and Benefit Sharing (ABS) has been finalized and endorsed by the GoG in 2007. The policy addresses ABS in the context of Guyana and the UNCBD and defines the mandates and the responsibilities of the national agencies directly involved in the implementation of the policy. Implementation of the ABS policy follows a draft ABS Regulations that address prior informed consent, sharing of benefits, genetic resources among other aspects.

3.3.28. National Biosafety Framework

A National Biosafety Framework for Guyana was developed and is currently in the implementation phase. As part of the National Biosafety Framework, a draft policy on biotechnology, biosafety and biosecurity have been prepared in accordance with Guyana's obligations under the Cartagena Protocol. The policy aims to control and monitor Genetically Modified Organisms (GMO) and Living Modified Organisms (LMO) while preventing adverse effects on the conservation and sustainable use of biological diversity in Guyana. In addition to GMO's, and LMO's, the policy also targets all elements of genetic materials used in genetic manipulation, as well as laboratory and field applications of biotechnology within Guyana. Consultations were recently held on the draft policy and the feedback from these consultations is currently being addressed.

3.4. International and Regional Policies and agreements

3.4.1. Rio Declaration

The Rio Declaration on Environment and Development was one of five (5) documents that resulted from the Earth Summit in Rio de Janeiro in 1992. The other documents which apply to this project are:

- ◆ Agenda 21
- ◆ United Nations Framework Convention on Climate Change
- ◆ United Nations Convention on Biological Diversity

The Rio Declaration consisted of 27 principles intended to guide sustainable development around the world. It confirms the responsibilities of all countries including Guyana to among other principles:

- ◆ Use the precautionary approach to prevent environmental degradation (Principle 15)

- ◆ Undertake activities having environmental impacts with full public participation (Principle 10)
- ◆ Include Indigenous People and their communities in development projects (Principle 22)

Guyana practices sustainable development guided by the Rio Declaration and has developed and implemented guidelines for conducting Environmental Impact Assessments, which will be used to guide this project.

3.4.2. Agenda 21

Agenda 21 arose from the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. It outlines several environmental policies and management issues for a more sustainable pattern of development in the 21st century. Four major areas of political action were identified in Agenda 21; social and economic development, natural resources, fragile ecosystems, major organizations and groups of people and means of implementation (Selman, 1996). Further, twenty-seven (27) environmental principles for the protection of environmental resources were outlined as the Agenda 21 action programs. One of its principles which states that environmental impact assessments should be a national instrument and shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority is applicable to this project (Principle 17). This global principle guided the development of a national policy on environmental impact assessments.

The UNCED Conference also initiated global statements on key environmental issues. These included the Framework Convention on Climate Change and the Convention on Biological Diversity which Guyana has ratified. Guyana must, therefore, consider these global agreements during environmental impact assessment for developmental projects.

3.4.3. United Nations Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promote sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that "biological diversity is about more than plants, animals, and microorganisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live." Guyana became a party to the CBD on August 29, 1994.

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

The Ramsar Convention is an intergovernmental treaty that focuses on maintaining ecological wetland systems and planning for sustainable use of their resources. It was adopted on 2nd February 1971 in Ramsar, Iran. The mission of the convention was adopted by the Parties in 1999 and revised in 2005 - "the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". Under Article 2.2 it is stated: Wetlands should be selected for the list on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" and indicates that "in the first instance, wetlands of international importance to waterfowl at any season should be included.

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

CITES generally seeks to protect endangered plants and animals and owing to the cross-boundary nature of animals and plants. This protection requires international cooperation. It aims to ensure that international trade of wild animal and plant species does not threaten the survival of the species in the wild, and it accords varying degrees of protection to over 35,000 species. This convention was drafted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN) and finalized in 1973. After being opened for signatures in 1973, CITES entered into force on 1 July 1975. Guyana became a Party to CITES in August 1977. In 2013, Guyana enacted domestic legislation, the Wildlife Act, and Regulations to fulfill its obligations to CITES.

3.4.6. United Nations Framework on Climate Change

This convention takes into account the fact that climate change has transboundary impacts. The basic objective of this convention is to provide for agreed limits on the release of greenhouse gases into the atmosphere so as to prevent the occurrence of climate change. It also aims to prepare countries to minimize the impact of climate change should it occur.

3.4.7. The Basel Convention on Transboundary Movement of Hazardous Waste

The Basel Convention aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. Guyana is a party to this convention which came into force in 1992. It was designed specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). The Convention is also intended to minimize the amount and toxicity of wastes generated. This ensures that toxic waste is managed as closely as possible to the source of generation. Examples of hazardous waste as defined by the convention are:

- ◆ Wastes from the manufacture, formulation and use of wood preserving chemicals
- ◆ Waste pharmaceuticals, drugs and medicine
- ◆ Wastes from the production, formulation and use of organic solvents
- ◆ Waste mineral oils unfit for their originally intended use
- ◆ Waste oils/water, hydrocarbons/water mixtures, emulsions
- ◆ Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish

3.4.8. Vienna Convention (ozone layer depletion)

The basic objective of the Convention is to combat the negative impact on the environment and human beings resulting from ozone-depleting substances by reducing their amounts released and eventually banning their commercial use through internationally agreed measures. The Montreal Protocol entered into force in 1989 to facilitate the implementation of the convention.

3.4.9. The Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants by Proclamation No. 279/2002 designed to ban the use of Persistent Organic Pollutants (POP).

3.4.10. The Rotterdam Convention

This Rotterdam Convention on Prior Informed Consent (PIC) relates to prior informed consent in the context of international trade in specific hazardous chemicals and pesticides.

3.5. Local regulatory agencies responsible for environmental protection and planning

The local regular agencies responsible for environmental protection and planning are detailed below:

- ◆ The Environmental Protection Agency (EPA)
- ◆ Department of Environment
- ◆ Ministry of Natural Resources
- ◆ Guyana Geology and Mines Commission
- ◆ Guyana Forestry Commission
- ◆ Department of Energy

Chapter 4:

Project Alternatives

This section describes the alternatives to the proposed project that were considered:

- ◆ No-Go Alternative
- ◆ Location Alternative
- ◆ Alternative Design
- ◆ Alternative Design, Technology
- ◆ Solid waste Management Alternative

4.1. No-Go Alternative

The No Project option with respect to the proposed project implies that the status quo is maintained or that the proposed project is not executed. If the alternative is taken, then the existing conditions provided in Chapters 8 to 19 would remain unaffected and the positive and negative impacts described in Chapters 8 – 19 would not be realized. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. This option will, however, involve negative tradeoffs for both commuters and Guyana's economy. If the no-go alternative is realized, the constraint for the proper and safe functioning of growing traffic from the east bank to the east coast. The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- ◆ The economic status of Guyanese would remain unchanged.
- ◆ The road and surroundings currently utilized would see an increase in traffic congestion in the near future.
- ◆ No employment opportunities will be created for the local residents who will work in the project area.
- ◆ Discouragement for investors on the east coast and east bank areas.
- ◆ Development of infrastructural facilities (roads and associated infrastructure) will not be undertaken.
- ◆ From the analysis above, it becomes apparent that the No Project alternative is no alternative to the local people and the government of Guyana.

4.2. Relocation Alternative

The relocation option to a different site is not an option available for the project implementation as this project is to improve accessibility to the already established east bank road and housing schemes. Several alternatives were considered to improve other roads in the area, but the construction of a new road was selected because it is more beneficial to the needs of the east bank and east coast residents after the development.

4.3. Alternative Designs

Alternatives considered in the context of the alternative designs and alternative processes (for example such as intersection).

4.4. Analysis of Alternative Construction Materials and Technology

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security, and environmental aesthetic requirements. The road-works will be made using locally sourced materials such as soil, aggregates that meet the Guyana Bureau of Standards requirements and imported materials such as cement, Bitument Steel (Structural Steel and Reinforcement), Traffic Sign Boards etc.

The alternative technologies available include conventional concrete roads, prefabricated concrete panels, or even temporary structures. These may not be desirable from a cost and durability perspective. The technology to be adopted will be the most economical and one sensitive to the environment.

4.5. Solid waste management alternatives

A lot of solid wastes will be generated from the proposed project. An integrated solid waste management system is recommendable. First, the proponent will give priority to the reduction of materials from the source. This option will demand a solid waste management awareness program for the staff. Recycling and reuse options of the waste will be the second alternative in priority. This will call for a source separation program to be put in place. The third priority in the hierarchy of options is combustion of the waste that is not recyclable. Finally, the proponent will need to establish an agreement with the mayor and city council to ensure regular waste removal and disposal in an environmentally-friendly manner. In this regard, a registered solid waste handler would be engaged as required. This is the most practical and feasible option for solid waste management considering the delineated options.

Chapter 5: Comprehensive Description of Proposed Project

5.1. Importance of the Project

The importance of the Ogle to Diamond Alignment Roads funded through Export Impart (EXIM) Bank of India, Government of India. This is to improve access to and from the East Coast of Demerara to the East Bank of Demerara, Linden and other connecting communities, by reducing time and money spent to traverse the status quo. Moreover, this project seeks to enhance local connectivity and integration which is achieved through increasing transport efficiency, facilitating trade and development. Additionally, the improvement in the quality of life in the selected communities through the delivery of quality and basic road infrastructure solutions.

5.2. Project Description

The present proposal is for the construction of a 15.340 km East Bank-East Coast Road linkage, and four connectors starting from Main Alignment and joining to existing roads leading to East Bank Road. The aggregate length of four connectors is 10.094 km.

The total project length considering the main alignment (15.34 km) and connectors from the main alignment (length 10.094 km) i.e. total 25.434 km is to be finalized in the DPR by RITES, which is now proposed under GoI/LoC funding. The Summary is presented in table below:

S. No.	Description	Designed Length (km)
1	East Bank – East Coast Linkage Road (Main Alignment)	15.340
	Connectors	
2	Extension of Aubrey Barker Road (Connector 1)	1.743
3	Extension of Haag Bosch Road (Connector 2)	3.580
4	Extension of Mocha Arcadia Road (Connector 3)	3.140
5	Extension of Great Diamond Road (Connector 4)	1.631
	Total Connectors	10.094
	Total Project Road Lengths	25.434

Table 4: Summary of Design Lengths of EB-EC Linkage Road Sections

The four existing roads i.e. connectors joining the existing roads to East Bank are to be designed by MoPI, GoG and no inputs required from RITES. This length of existing road sections of connectors about 13.61 km shall be upgraded by GoG from their own funding.

The details of project road sections are presented below.

- ◆ **East Coast -East Bank (Main Alignment):** The main alignment (15.340km) runs from East Coast (Ogle Airport) to East Bank to Diamond Village. The proposed road will commence at the Junction of the Ogle Airport entrance Road and the East Coast Demerara Public Road. The Proposed Alignment follows the existing ogle airport road for about 1.2 km from East Coast road to ogle airport junction. Thereafter, the balance length of proposed main alignment is traversing through the cane fields only.

- ◆ **Extension of Aubrey Barker Road (Connector-1):** The Connector – 1 takes off from km 4.955 on Main Alignment on RHS and joins with the existing Aubrey Barker Road. The total designed length of connector 1 is 1.743 km including taper length for merging with existing Aubrey Barker Road.
- ◆ **Extension of Haag Bosch Road (Connector-2):** The Connector – 2 takes off from 7.705 km on Main Alignment on RHS and joins with the existing Haag Bosch Road. The designed length of connector 2 is 3.580 km including taper length for merging with existing Haag Bosch Road.
- ◆ **Extension of Mocha Arcadia Road (Connector-3):** The Connector – 3 takes off from km 10.145 on Main Alignment on RHS and joins with the existing Mocha Arcadia Road. The designed length of connector 3 is 3.140 km including taper length for merging with existing Mocha Arcadia Road.
- ◆ **Extension of Great Diamond Road (Connector-4):** The Connector – 4 takes off from km 14.885 on Main Alignment and joins on RHS with the existing Great Diamond Road. The designed length of connector 4 is 1.631 km including taper length for merging with existing Great Diamond Road.

The Location Plan of Project Roads is presented in the figure below.

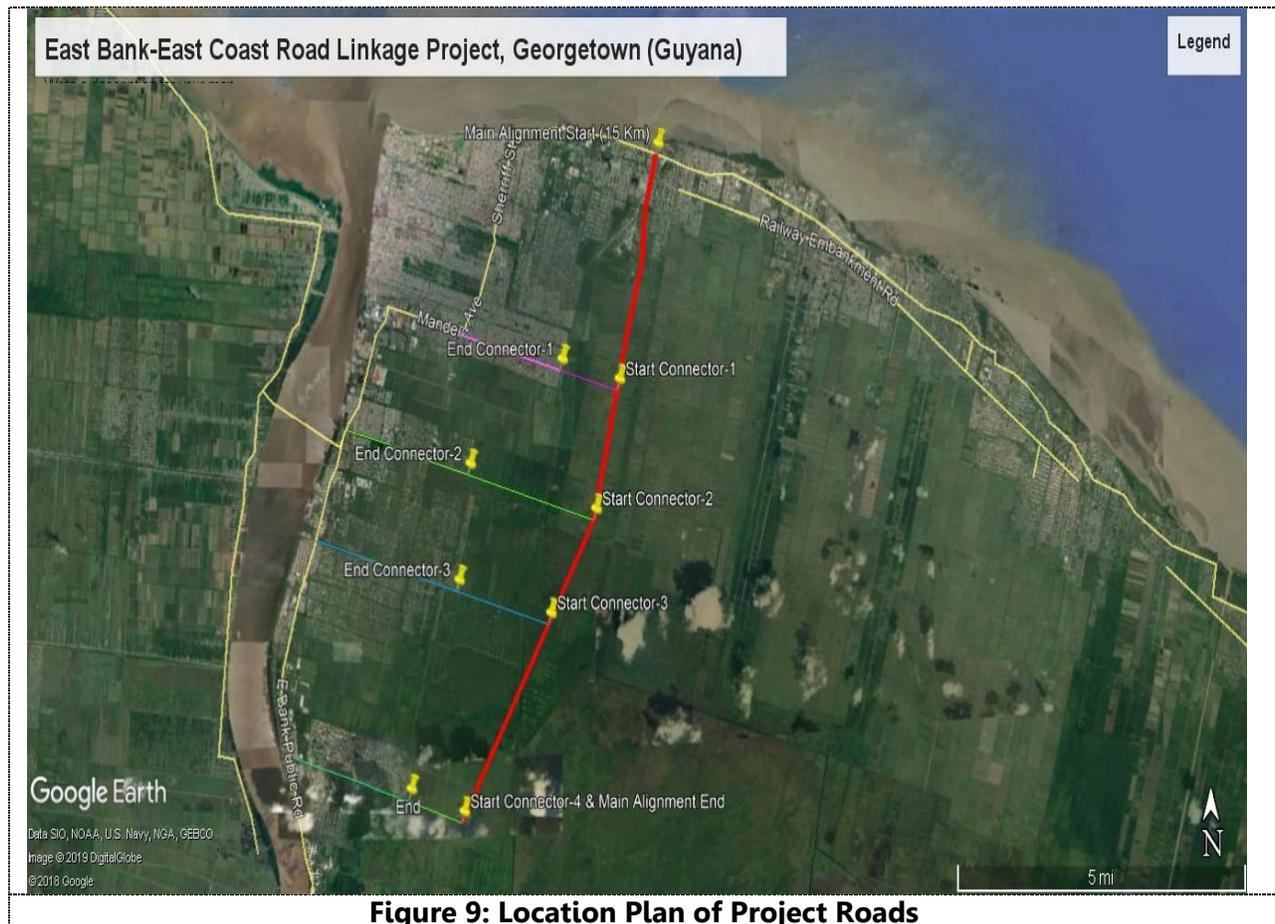


Figure 9: Location Plan of Project Roads

5.3. Project Engineering Surveys and Investigations

Engineering Surveys and Investigations have been carried out by the consultant on the project road section as per Terms of Reference. The Engineering Surveys and Investigations include:

5.3.1. Inventory & Condition Survey

Road and Pavement Condition Inventory Survey have been done from East Coast Road to Ogle Airport. The Bituminous carriageway width is 5.5m with 2.4m earthen shoulder on both side and condition of pavement generally found in good condition.

Inventory & Condition Survey for Existing Cross Drainage Structures has been carried out and generally varies in fair to poor condition. The Summary is presented in table below:

Sl. No.	Existing Ch. (Km)	Drainage Structure Id No.	Type & Span	Overall Width (m)	Carriageway width (m)	Adequacy of Vent way	Overall Condition
1	0.385	E-1	1 x 5.300 m RCC Slab on RSJ	5.80	5.50	No	Poor
2	0.636	E-2	1 x 0.500 m dia Pipe Culvert	15.00	5.00	No	Fair
3	1.070	E-3	1X 0.5 Pipe Culvert	15.00	5.50	No	Very Poor (Not Visible from one side)

Table 5: Details of Inventory and condition of existing Bridge and Culverts

5.3.2. Pavement Investigations

Existing Pavement Trial Pit Investigations: Existing Pavement composition has been explored by carrying out trial pit investigations along existing roads. The details of existing pavement composition are presented below:

Pavement Layer	Trial Pit on		
	East Coast Road	Ogle Airport Road	Diamond Road
Asphalt Concrete	130	50	30
Crusher run	200	80	150
Loam	0	0	250
White Sand	300	0	460
Quarry Cleaning	0	130	0
Mini Boulders	0	280	0
Clay	370	470	110

Table 6: Trial Pit Investigations: Summary of Pavement Composition

5.3.3. Soil Investigation Pits along the Main Alignment

The consultant has identified locations for carrying out test pits for soil investigation along the main alignment from Ogle to Diamond. The Soaked CBR test detailed that existing soil has a CBR value in the range of 1.5 to 2%. The remaining identified trial pit is within the swamp location and would be taken up after drainage out by MoPI.

5.3.4. Soil and Construction Material Investigations

Road Construction would essentially require naturally occurring materials viz. stones, sand, soil, etc. Geological formations of Guyana detail that sufficient quantities of construction materials are available for infrastructure projects, though there can be certain apprehensions w.r.t. extraction, crushing quality and supply mechanism.

The Consultant has collected construction materials samples and obtained details from different quarry operators for supply of construction materials. The rate of royalty charged by the Government of Guyana on the extraction of Stones is Guyanese Dollars 25 per MT and on Sand / Loam soil is Guyanese Dollars 15 per MT.

The consultants consider that contractors may be permitted to import aggregates in case the volume of supplies or quality fails to meet the project specifications.

5.3.5. Sub-soil Investigations

In order to prepare the Design and General Arrangement Drawings (GADs) of proposed new/reconstructed structures, geo-technical investigation for bridges/structures has been carried out.

The geotechnical investigations have been carried out conforming to established standards and as deemed necessary to determine the sub-soil characteristics of the underlying strata for preliminary assessment of the type of foundation to be provided for the abutment and piers of the proposed cross drainage structures on the project road. The works have been carried out through Geotechnical Consultants M/s Demerara Engineering, PLLC, New York. The locations of boreholes, where subsoil investigations have already been completed along with the depth of borehole are presented in the table below:

Sl. No.	Location of Bore Holes	Bore Hole Depth (m)	Remarks
1	Km 0/000 on Ogle, East Coast Demerara Road	35.70	On Main Alignment
2	Km 2/900 on Ogle Backland	35.50	On Main Alignment
3	Km 8/000 on Ogle Backland	20.10	On Main Alignment
4	Km 11/300 on Mocha Backland	24.60	On Main Alignment
5	Km 1/340 Eccles Backland	30.00	On Connector 2
6	Km 1/500 Ogle Backdam	29.10	On Connector 1
7	Km 1/000 Ogle Airport Road	30.04	On Main Alignment
8	Km 0/300 Ogle Backlands	20.50	On Connector 1
9	Km 6/500 Ogle Backlands	20.00	On Main Alignment
10	Km 2/500 Eccles Backland	20.00	On Connector 2
11	Km 0/650 Mocha Backland	38.50	On Connector 3
12	Km 1/500 Diamond Backland	19.50	On Connector 4
13	Km 15/400 Diamond Backland	13.00	On Main Alignment

Table 7: List of Bore Holes

The project site is located on the coastal plain of Guyana and is specifically situated next to the Atlantic Ocean, which is the most northern portion of the County of Demerara. The main geo-

morphological elements are composed of Beach Ridges, Marine Tidal Clay Flats and Marshes, Natural Levees of Rivers and Estuaries & Peat Swamps.

The topsoil comprises of Medium Brown Silty clay organic matter around 1 to 1.5 m deep followed generally by layers of very soft brownish grey silty clay, soft to very soft grey silty clay, very soft bluish-grey silty clay, medium soft grey silty clay, soft to very soft grey light grey silty clay at most locations while a few locations have a layer of stiff grey silty clay and very stiff to hard silty clay. Thus at most locations, the soil is weak to very weak clay, with SPT N values ranging from 1 to 4.

5.3.6. Hydraulic and Hydrological Investigations

There are 3 nos existing cross drainage structures on the existing project road and connectors. The main alignment follows the existing road for 1.1 km. After 1.1 km the alignment traverse through the open cane field (Chainage 1.10 to 15.30 Km.) where most of the cross drainage is either drains or canals that were serving abandoned sugar estate cane fields. A network of rectangular pattern irrigation canal (Navigational Canals & Punt Canals) and drainage channel system.

The details of un-bridged canal & drainage crossing with measurable catchment area located beyond 1.30 km are compiled and shown in the table below. Flood estimation is done only for those waterways whose catchment area is measurable.

The project road traverses through a Cane Field alignment and crosses a number of Irrigation ditch. To find out the cross drainage requirement for project road, the consultants have collected the rainfall data of the project area and delineated the catchment of watercourses whose catchment is measurable. By using rational formula, the discharge of the channel has been estimated. The adequacy for proposed waterway has also been checked by well-known manning's equation. For channels with non-identifiable catchment area, balancing culverts at regular intervals have been provided to make flow paths remain unhindered due to the construction of project road.

Sl. No.	Un-bridged Drainage No.	Cross Design Chainage (Km.)	Bed Level (M)	Name of Channel	Remarks
On Main Alignment					
1	U-1	2.857	14.480	Drain	
2	U-2	2.917	14.380	Drain	
On Connector-1					
3	U-3	0.285	14.700	Drain	
4	U-5	0.825	13.100		
On Connector-2					
5	U-4	0.275	15.300	Drain	
6	U-6	0.880	14.400	Drain	
On Connector-3					
7	U-7	0.256	13.623	Drain	

Table 8: Details of Un-bridged canal & drainage crossing

5.3.7. Topographic Survey

The basic objective of the topographic survey would be to capture the essential ground features on the alignment after the completion of reconnaissance surveys. The detailed field surveys shall be carried out using high precision instruments i.e. total stations. The topographic survey has three controlling parameters i.e. X, Y, and Z. Whereas X and Y represent the horizontal location of any feature on earth and Z represents its elevation.

As the proposed project highway is passing through the very difficult terrain, having abandoned cane fields with a grid of canals at close intervals, swamps, and wild creatures, the consultants have carried additional field survey works beyond scope of ToR to maintain the highest level of accuracy. The consultants have ensured horizontal accuracy by fixing GPS control stations at regular intervals. Similarly, the vertical accuracy has been ensured by identifying the Land and Surveys department permanent benchmarks on both ends of the main alignment.

The topographic survey covered a strip of 182 m width with cross-sections taken at 50-meter intervals in plain terrain to form a Digital Terrain Model (DTM). Topographic surveying and leveling have been done by Total Station in combination with Auto level/Digital level so as to ensure a higher degree of accuracy while fixing benchmarks and reference pillars.

The designed alignment has been staked on ground. The central line along with referencing with ROW pillars on road reserve has been fixed.

5.4. Design Standards

The highway design standards adopted for the project road are primarily based on American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets 6th Edition 2011, Guide for Design of Pavement Structures, and relevant Indian Roads Congress Codes, Specifications for Road and Bridge Works of Ministry of Road Transport & Highways (5th Revision, 2013).

These factors are taken into consideration while adopting the design criteria of the road.

5.5. Design Proposals

5.5.1. Design Speed

East Bank – East Coast Linkage Road (Main Alignment) has been designed for following speeds

S. No.	Existing Location (km)			Proposed Location (km)			Speed km/h
	From	To	Length	From	To	Length	
1	0.000	0.800	0.800	0.000	0.800	0.800	100
2	-	-	-	0.800	15.340	14.540	120

Table 9: Design Speed Main Alignment Road

The design speed for connectors is presented in the following table:

Name of Connector	Connector No.	Proposed Location (m)			Total Length	Speed km/h	Remarks
		From	To	Length			
Aubrey Barker	1	0.0	1743	1743	1731	80	Including Merging length with existing road

Name of Connector	Connector No.	Proposed Location (m)			Total Length	Speed km/h	Remarks
		From	To	Length			
Haag Bosch	2	0.0	3580	3580	3580	100	Including Merging length with existing road
Mocha Arcadia	3	0.0	3140	3140	3140	100	Including Merging length with existing road
Great Diamond	4	0.0	1631	1631	1631	100	Including Merging length with existing road

Table 10: Design Speed Connectors Road

5.5.2. Cross-Sectional Details

The Cross-Section of highway considers its adequacy for the function of the road and the mix of traffic likely to use it. The summary of design cross-sections along with applicability on proposed road sections is summarized in tables below:

Description	TCS A	TCS B	TCS C	TCS D	TCS E	TCS F
Carriageway Width	2 x 7.2 m = 14.40m	2 x 7.2 m = 14.40m	2 x 7.2 m = 14.40m	2 x 7.2 m = 14.40 m	2 x 7.2 m = 14.40m	1 x 7.2 m = 7.2 m
Granular Shoulder on the outer side of each side Carriageways			2 x 2.4 m = 4.80m	2 x 2.4 m = 4.80m	2 x 2.4 m = 4.80m	2 x 2.4m = 4.8 m
Granular Shoulder on each of inner edge of Carriageways				2 x 1.0 m = 2.00m	2 x 1.0 m = 2.00m	
Drain cum Footpath	2 x 1.5 m = 3.0 m	1 x 1.5 m = 1.5 m				
Raised Median	4.2 m	4.2 m	4.2 m to 12.0 m			
Depressed Median				12.0 m to 40.0 m	40.0 m	
Roadway Width	21.6 m	21.6 m	23.4 to 31.2	33.2 to 61.2	61.2 m	12.0 m
Space between Footpath cum Drain to Fence Line (Including Utility Corridor)	4 m (minimum)	4 m (minimum)				
Fence Line Drain	2 x 0.4 = 0.80m	1 x 0.4m = 0.40m				
Open Lined Drain on LHS (min)		1 x 8.0m = 8.0 m				
Utility Corridor / Access Road on	1 x 2.0m = 2.0 m	1 x 2.0m = 2.0 m				

Description	TCS A	TCS B	TCS C	TCS D	TCS E	TCS F
LHS towards drain side (min)						
Embankment Side Slopes			4 : 1 (H : V)	4 : 1 (H : V)	4 : 1 (H : V)	4 : 1 (H : V)
Unlined Ditch Drain on LHS Road Reserve			Top width 8.0m	Top width 8.0m	Top width 8.0m	Top width 7.0m
Unlined Ditch Drain on RHS Road Reserve			Top width 5.0m	Top width 5.0m	Top width 5.0m	Top width 7.0m
Median Drain				Top Width = 10m	Top Width = 10m	
Utility Corridor			2 x 2.0 = 4.0	2 x 2.0 = 4.0	2 x 2.0 = 4.0	2 x 2.0 = 4.0
Proposed Right of Way	30.4 m (minimum)	42.0 m (minimum)	182.88 m	182.88 m	182.88 m	92.0 m

Table 11 : Details of Designed Typical Cross Section

The Cross Sections applicable along the project road sections (Main Alignment and Connectors) are as follows

Sl. No.	Design km			Cross Section Type	TCS Type
	From	To	Length		
1	0.000	0.400	0.400	4 lane with raised median with RCC Trapezoidal Drain on both sides	A
2	0.400	1.100	0.700	4 lane with raised median with Stone Pitched Drain on LHS and RCC Trapezoidal Drain on RHS	B
3	1.100	2.050	0.950	4 lane with varying raised median (4.2m to 12.0m) with Earthen Drain on both sides	C
4	2.050	2.450	0.400	4 lane with varying Depressed median (12.0m to 40.0m) with Earthen Drain on both sides	D
5	2.450	15.340	12.890	4 lane with Depressed median with Earthen Drain on both sides	E
Total Length			15.340		

Table 12: Designed Carriageway Widths and Typical Cross sections (Main Alignment)

Name of Connector	Connector No.	Design km			Cross Section Type	TCS Type
		From	To	Length including Tapering		
Aubrey Barker	1	0.000	1.743	1.743	2 lane	F
Haag Bosch	2	0.000	3.580	3.580	2 lane	F
Mocha Arcadia	3	0.000	3.140	3.140	2 lane	F
Diamond	4	0.000	1.631	1.631	2 lane	F
				10.094		

Table 13: Designed Carriageway Widths and Typical Cross sections (Connectors)

5.5.3. Geometric Design

5.5.4. Horizontal Alignment

The 'East Bank – East Coast Road Linkage' alignment is designed to take off from existing junction of 'East Coast Road (Rupert Craig Highway) with Ogle Airport Road and terminates at the point, where the extension of Great Diamond road i.e. connector 4 intersects with this proposed alignment.

This design alignment of the East Bank – East Coast Linkage Road follows existing Ogle Airstrip Road length for 1.2 km and thereafter it diverges to the left, into the abandoned cane fields. These abandoned cane fields have abandoned grid of canals which are across/along the proposed alignment in abandoned cane fields. The site proposed for construction of the project roads is in Plain Terrain.

The 'East Bank – East Coast Linkage Road' is designed as "Partial Access Controlled Highway", the minimum radius of circular curve is taken as 2000 m radius. The Connectors from Main Alignment through the Cane field have been provided to join with existing Aubrey Barker, Haag Bosch, Mocha Arcadia and Great Diamond intersects designed alignment of East Bank – East Coast Linkage Road at km 4.954, km7.705, km 10.145 and km 14.885 respectively.

The Horizontal alignment for these Connectors is designed as Straight tangent from 'East Bank – East Coast Road' to meet the existing road and tapered to finally merge into existing cross section.

5.5.5. Vertical Alignment

The vertical tangents (longitudinal gradient) have been designed, based on following:

- ◆ Highest Flood Level;
- ◆ Elevation required for bridge across Lamaha Canal;

- ◆ The proposed subgrade bottom level, in cane fields, to be above existing ground level.
- ◆ Existing unsuitable soils in swamp area

The vertical curves have been designed for Intermediate Sight distance except for merging of connector 1 with existing Aubrey Barker Road where in Safe Stopping Distance has been provided.

5.5.6. Pavement Design

The design of flexible pavement having design life of 15 years have been proposed using AASTHO GUIDE for the Design of Pavement Structure and Indian Roads Congress Publication IRC 37 2012 : Tentative Guidelines for the Design of Flexible Pavements.

The required Pavement Structure for Project Roads Main Alignment (4 Lane), Connector 1, 2, 3 and 4 (2 Lane)) have been calculated as per AASHTO & IRC design methodologies.

The pavement composition proposed is given below:

Proposed Layer	Main Alignment (4 Lane)	Connector 1 & 4 (2 Lane)	Connector 2 & 3 (2 Lane)
Bituminous Concrete	40	40	40
Dense Bituminous Macadam	65	65	40
Crusher Run Macadam Base	250	250	250
Granular Sub Base	200	200	200
Subgrade (min CBR 15% @ 97% of MDD)	500	500	500
SN Provided as per IRC	4.0	4.0	3.6

Table 14: Proposed Layers: Stage Construction

5.5.7. Embankment and Slope Protection

The project road is passing through the flat brown field. The road finish level is generally proposed 2.5m to 3m above adjoining ground level. The embankment has been proposed to be built as follows:

- ◆ Clearing and Grubbing for 150 mm depth between drain inner edges along the right of way
- ◆ Loosening & re compaction for 150 mm depth for clearing of vegetation roots, if any.
- ◆ Prefabricated Vertical drains have been proposed for Ground Improvement as required.
- ◆ In Swamp locations, Slope protection with 0.3m thick stone pitching should be used on embankment slopes.

5.5.8. Intersection Design

Project road sections are well connected with proposed connectors. The peak hour distribution at each arm of the junctions has been analyzed. Based on peak hour traffic at intersection improvement has been proposed as per AASTHO.

S. No.	Design Chainage / Location	Summary of Designed Components
1	0.000 / East Coast Road	<ul style="list-style-type: none"> ◆ Equivalent Simple Curve Radius is 34 m on all Entry/Exit curves except for entry curve radius from 'East Coast Road' to 'Main Alignment', which is designed as 27m to accommodate within available road reserve. ◆ Auxiliary Lanes ◆ Acceleration Lane :The Length, Width and Taper Length for Acceleration Lane on East Coast Road is 245m, 3.6m & 90m respectively The acceleration lane on 'Main Alignment', is designed as 70m, 3.6m & 55 m respectively to accommodate within available road reserve. ◆ Deceleration Lane: The Length, Width and Taper Length for Deceleration Lane on East Coast Road and Main Alignment is 155m, 3.6m & 90m respectively. ◆ Median Right Turn Lane: The Length, Width and Taper Length for Median Right Turn Lane on East Coast Road and Main Alignment is 80m, 3m & 45m respectively.
2	0.535/ Railway Embankment Road	<ul style="list-style-type: none"> ◆ Roundabout (Rotary) Junction has been proposed at Railway Embankment Road from 'Main Alignment' to 'Railway Embankment Road, which is designed to accommodate within available road reserve ◆ Rotary of Central Island radius is 16 m and all Entry and Exist are 25 m and 20 m respectively on all the legs ◆ Carriageway width has been designed around the central island is 7.2 m (2 lane) and 10.8 m (3 lane) on waving length of Rotary (Entry & Exit)
3	1.691 / Ogle Airport Road	<ul style="list-style-type: none"> ◆ Equivalent Simple Curve Radius is 34m on entry /exit curves. ◆ Auxiliary Lane ◆ Acceleration Lane: The Length, Width and Taper Length for Acceleration Lane on all legs is 245m, 3.6m & 90m respectively. ◆ Deceleration Lane: The Length, Width and Taper Length for Deceleration Lane on all legs is 155m, 3.6m & 90m respectively. ◆ Median Right Turn Lane: The Length, Width and Taper Length for Median Right Turn Lane on all legs is 80m, 3m & 45m respectively.
4	4.954,7.705, 10.145, 14.886 / Proposed Connectors	<ul style="list-style-type: none"> ◆ Equivalent Simple Curve Radius for Entry/Exit curves on all connectors is 34m. The left in left out design arrangement is provided on all connectors ◆ Auxiliary Lanes ◆ Acceleration Lane : The Length, Width and Taper Length for Acceleration Lane on all connectors is 245m, 3.6m & 90m

S. No.	Design Chainage / Location	Summary of Designed Components
		<p>respectively.</p> <ul style="list-style-type: none"> ◆ Deceleration Lane: The Length, Width and Taper Length for Deceleration Lane on all connectors is 155m, 3.6m & 90m respectively.
5	U turns	<ul style="list-style-type: none"> ◆ U-Turns are provided with inner radius 16.5m and outer radius 25.6m. Width of all U-Turns is provided 7.2m with 1m shoulder on either side. ◆ Auxiliary Lanes ◆ Acceleration Lane: The Length, Width and Taper Length for Acceleration Lane on U-Turn is 245m, 3.6m & 90m respectively. ◆ Deceleration Lane: The Length, Width and Taper Length for Deceleration Lane provided for taking U-Turn is 155m, 3.6m & 90m respectively.

Table 15: Major Junctions/Intersections (at Grade Junctions)

Apart from above, the other crossroads at 10 locations (0.131 (RHS), 0.133 (LHS), 0.411(RHS), 0.458 (RHS), 0.603 (RHS), 0.876 (RHS), 0.892 (LHS), 2.815 (RHS), 2.835 (LHS) and 2.983 (LHS)) have been designed for access to Main Alignment. The improvement along cross road is designed for 60 m length along with minor intersections.

5.5.9. Option study for Culverts and small Bridges

Considering the length of structure required for culverts and small bridges (individual span length less than 10m) the alternatives which are considered for the project road are

- ◆ RCC Box on Ground;
- ◆ RCC Slab type superstructure on RCC substructure; and
- ◆ RCC T-beam girder on RCC substructure;

A comparison for all type structures have been presented in Table below:

Sl. No.	Criteria	RCC Box on Ground	RCC Slab type superstructure on RCC substructure	RCC T-beam girder on RCC substructure
1.	Safe Bearing Capacity Requirement	Suitable to low bearing capacity soil as dead load on the structure is less. Earth pressure equilibrium on box structure reduces base pressure.	Unsuitable to low bearing capacity soil as dead load on the structure is large. Unbalanced earth pressure creates high moment on the foundation resulting high base pressure	Unsuitable to low bearing capacity soil as dead load on the structure is large. Unbalanced earth pressure creates high moment on the foundation resulting high base pressure

Sl. No.	Criteria	RCC Box on Ground	RCC Slab type on RCC substructure	T-beam girder on RCC substructure
2.	Constructability	Common bridge type, rigid frame structure simple in construction. Shallower footing & founding depth make construction in soft soil less troublesome.	Common bridge type, easier to construction but requirement of thicker footing & deep founding depth make construction in soft soil troublesome. Placing of Concrete easier than girder type structure.	Common bridge type but less easy to construction. Shuttering works for girder is cumbersome. Thicker footing & deep founding depth make construction in soft soil troublesome.
3.	Capital Cost	Box structure is economical due to its rigidity and monolithic action. Separate foundations are not required.	Less economical. Simple supported superstructure and cantilever type substructure/ foundation make section size thicker than box structure, resulted to increase in cost.	Less economical. Simple supported superstructure and cantilever type substructure/ foundation make section size thicker than box structure, resulted to increase in cost.

Table 16: Alternative Study for Culverts and Small Bridges

On examination of above evaluation, as elaborated above, it is observed that the box on ground alternative is the economical, easy to construct and most suitable where safe bearing capacity of soil is low. As the preliminary assessment of sub soil data shows that bearing capacity of sub soil layer in project influence zone is very low, the Consultant has recommended Box on Ground type structure for culverts and small bridges.

5.5.10. Option study for large span Bridges

The project alignment crosses Lamaha Canal at four locations. Lamaha canal feed surface water from East Demerara Water Conservancy (EDWC) to GWI water treatment plant at Georgetown. GWI officials on Sep 25, 2018 has requested to avoid any foundation within the Lamaha Canal. As the width of Lamaha Canal is more than 20m, which necessitate providing of medium span superstructure for the bridges across the Lamaha canal.

The option studied to firm up the superstructure schemes for the bridges across Lamaha Canal are:

- ◆ Steel, concrete Composite Superstructure
- ◆ In-situ RCC T-beam and slab Superstructure and
- ◆ Precast PSC girder and RCC slab Composite Superstructure.

A comparison for all type structures have been presented in Table below:

Sl. No.	Criteria	Steel Composite Superstructure	concrete In-situ and Superstructure	RCC T-beam slab	Precast PSC girder and RCC slab Composite Superstructure
1.	Constructability	Common bridge type. Prefabricated steel girder can be erected in position by cranes or other means and deck slab can be cast in-situ position. Lightweight steel girder easier to launch in place, no need of staging from ground, formwork is also minimal.	Common bridge type. For concreting of cast in situ RCC girder, staging works is required from bed of Lamaha canal, which may not be permitted by GWI. Soft soil at bed and banks of the canal may create difficulty for erection of staging work.		Common bridge type. Precast girder can be launched in position by cranes or other means, but movement of cranes on soft soil may be difficult during launching due to high weight of PSC girder.
2.	Load on Foundation	Dead load of steel girder considerable low compare to concrete girder, resulting less load on foundation. Most suitable for when soil have low bearing capacity.	Dead load of the superstructure is higher than Steel / PSC girder type superstructure, resulting high pressure on foundation, which is undesirable for low bearing capacity soil		Dead load of the superstructure is higher than Steel girder type superstructure, resulting high pressure on foundation, which is undesirable for low bearing capacity soil
3	Time for construction	Fast construction can be achievable as Steel Girder fabrication and construction of substructure/ foundation can be done simultaneously. The launching of girder is less time consuming due to its low weight.	Construction time is more as construction of superstructure and substructure/ foundation cannot be done simultaneously.		Fast construction achievable as precast PSC Girder casting and construction of substructure/ foundation can be done simultaneously. The launching of girder is time consuming due to its high weight.
4.	Capital Cost	Cost of steel Super structure is higher than concrete but due to comparatively low weight of superstructure than concrete, the cost of substructure and foundation will be less.	Cost of Superstructure is Economical. But due to high weight of superstructure the cost of foundation and substructure will be more. Cost of staging works on soft soil may also increase the cost of construction.		Cost of Superstructure Economical than steel girder but more than RCC girder. Due to Heavy weight of superstructure, the cost of foundation and substructure will be more. Launching of heavy girder on soft soil may also increase the cost of construction.

Table 17: Alternative Study for Large Bridges

On examination of the above evaluation as elaborated in table above, it is observed that the fast track construction for bridges across Lamaha canal can be done by adopting Steel concrete Composite Superstructure. Since the bearing capacity of the soil near the bridge site is very poor, the low weight of Steel Concrete Composite Superstructure will be most suitable for the bridges. Although the cost of RCC/ PSC superstructure is comparatively less than steel

composite girder but the increased cost of substructures and foundation make the cost benefit very less. Considering the above, the Consultant has designed the Steel concrete Composite Superstructure of required length and span for bridges across Lamaha canal.

5.5.11. Bridge and Culverts Proposals

The project road between East Coast (Rupert Craig Highway) Road and Ogle near Airport follow alignment of existing road. In the remaining portion the project road traverse through brown fields. The existing cross drainage structure at Km 0.385 of the project road has RCC slab on RSJ and resting on RCC Column type abutment. The spill protection component of abutment is also in damaged condition and the overall condition of the structure is poor. Beside the above, there is a pipe culvert located at Km 0.636 on the project road. The culvert vent way is not visible and due to low height of head wall, the embankment slope is eroding. Considering the condition of existing structures, it is proposed to reconstruct the structures according to geometric standard of the project.

In the brown field alignment of the project, new bridges and culverts have been proposed based on site investigations, hydraulic studies, geo technical investigations, topographic studies and other parameters like bridge sitting, alignment, hydrological adequacy, H.F.L, scour, bearing capacity at bridge locations etc. The type structure is finalized based on evaluation of option studies given above.

The project has been proposed 4 Major Bridges, 12 minor bridges and 85 box culverts. The summarized improvement proposal for bridges and culverts on main alignment and connectors of the project road has been tabulated below:

S.No.	Existing Chainage	Design Chainage	Structure Designation	Structure Type	Foundation Type	Span Arrangement	Structure Width	Improvement Proposal/ Remarks
Main Alignment								
1	0.385	0.422	Minor Bridge	RCC Box	Pre-Cast Driven Pile	3x3.0x4.0	22.6	Reconstruction
2	-	1.636	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	28.8	New Construction
3	-	2.857	Minor Bridge	RCC Box	Pre-Cast Driven Pile	3x3.0x3.0	2 x 11.6	New Construction
4	-	2.917	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	2 x 11.6	New Construction
5	-	11.615	Major Bridge	Steel Composite Girder	Bored Cast in-situ Pile	3x50.0	2 x 11.8	New Construction
Connector-1								
1	-	0.285	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x2.65	24.4	New Construction
2	-	0.306	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	24.4	New Construction
3	-	0.825	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x4.5	24.4	New Construction
4	-	1.520	Major Bridge	Steel Composite Girder	Bored Cast in-situ Pile	3x25.0	24.4	New Construction

S.No.	Existing Chainage	Design Chainage	Structure Designation	Structure Type	Foundation Type	Span Arrangement	Structure Width	Improvement Proposal/ Remarks
5	-	1.610	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	24.4	New Construction
Connector-2								
1	-	0.275	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	13.0	New Construction
2	-	0.880	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	13.0	New Construction
3	-	1.286	Major Bridge	Steel Composite Girder	Bored Cast in-situ Pile	3x25.0	13.0	New Construction
4	-	1.362	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x4.5	13.0	New Construction
Connector-3								
1	-	0.675	Major Bridge	Steel Composite Girder	Bored Cast in-situ Pile	3x25.0	13.0	New Construction
Connector-4								
1	3.570	1.512	Minor Bridge	RCC Box	Pre-Cast Driven Pile	2x3.0x3.0	24.4	New Construction

Table 18: Summary of Design Proposal for Bridges

The Summary Design proposal for Culverts is presented in the following table:

Sl. No.	Road Name	Box Culvert			Total
		1x1.5x2.0	1x3.0x2.0	1x3.0x3.0	
1	Main Alignment	37	3	2	42
2	Connector-1	1	0	1	2
3	Connector-2	6	2	0	8
4	Connector-3	4	0	2	6
5	Connector-4	4	0	0	4
6	Cross Road	7	0	16	23
	Total	59	5	21	85

Table 19: Summary of Design Proposal for Culverts

5.5.12. Proposal for Roadside Drainage

The longitudinal drainage has been designed as follows:

- ◆ In built-up areas RCC drains have been proposed alongside Road Reserve;

- ◆ Stone pitched drains have been proposed on LHS from first canal crossing from East Coast Road i.e. 0.400 km to 1.100 km on Main Alignment.
- ◆ Open earthen drains have been proposed on both sides of the roads passing through cane field area.
- ◆ The open earthen drains have been proposed in the central depressed median on the main alignment passing through cane field area.

5.5.13. Road Safety and Appurtenances

Road safety awareness is increasing in almost all developing countries and effective action needs to be taken at the design stage itself in order to ensure safety during operation.

5.5.14. Road Signs

Traffic Signs speak the language of the road and is required for guidance of motorists on the highway. Traffic Signs installed at appropriate locations on the highway controls the motorists driving behaviors on the road. The summary of different type of road signs designed for road projects is presented in the table below:

S. No.	Description	Number
1	Regulatory Sign	80
2	Warning Sign	170
3	Object Marker (Hazard)	346
4	Conventional Road Guide Sign	53
5	Distance Indicator	52
6	General Service Signs and Size	2
Total		703

Table 20: Summary of Road Signs

5.5.15. Road Markings

Different type of road markings have been provided using road paints as per Manual on Uniform Traffic Control Devices (MUTCD-2009 Edition).

5.5.16. Traffic Signals

Road Signal provisions would be made at-grade intersections for safe turning movement at East Coast Road Junction (Km 0+000) and Ogle Airport Junction (Km 1+691) on the main road. The signals would be designed and installed as per section 4B of Manual on Uniform Traffic Control Devices (MUTCD-2009 Edition).

5.5.17. Road Delineators

Road Delineators are proposed for information and safety of road users in coordination with road marking. Rumble strip with thermoplastic raised yellow marking of 300mm wide and 5 mm height, at 600mm apart (one set of 6 strips), is provided at 2+500 Km, 6+300 Km, 8+800 Km, 11+200 Km and 13+700 Km on the main alignment.

5.5.18. Gantry Mounted Road Signs

Gantry Mounted signs enhance visibility of signs for driver much before reaching the intersections and is proposed to be installed on intersections and Connectors locations.

5.5.19. Metal Beam Crash Barrier

Single faced metal beam crash barrier has been proposed at locations where embankment height is above 3.0m from natural ground level on roadway edges. The total length of the metal crash barrier is 37,556m.

5.5.20. Crash Barrier

Concrete crash barriers are proposed on all the bridges and box culverts structures.

5.5.21. Highway Lighting

Highway, street lighting is proposed for the entire length of the main alignment and connectors. The spacing of light poles is 30 m apart.

5.5.22. Traffic Impact Attenuation Devices

The self-restorable type of traffic impact attenuators have been provided at 10 locations (East Coast Road Junction (1), Railway Embankment Junction (4), Ogle Airport T-Junction (1) and Connectors T-Junction (4).

5.5.23. Bus Bay and Passenger Shelter

Bus bays cum passenger shelter have been proposed at four locations (Near East Coast Road (0.220, LHS), Near East Coast Road (0.313, RHS) and Near Ogle Airport Road (1.515 both sides).

5.6. Construction Planning

Pre-construction Activities:

- ◆ Land acquisition and compensation,
- ◆ Relocation of houses, sheds, shops etc. and rehabilitation of affected families,
- ◆ Relocation of electric power lines, communication lines, water supply lines,
- ◆ Quarry and storage facilities management: material storage, transport,
- ◆ Traffic management: construction and provision of diversions to re-routing of traffic, and
- ◆ Camp site management: contractor's labor camp, contractor's equipment storage site, contractor and engineer's officer.

5.7. Associated Activities

A number of associated activities for upgrading works will be undertaken at ancillary sites away from the road corridors. These activities will include:

- ◆ Extraction of materials from quarries and borrow pits: construction materials, primarily for road gravelling and toe wall construction will be sourced from quarries.

- ◆ Material crushing and storage: the crushing of aggregates will be done at the quarry site and no crushing plants should be operated near the project areas. Storage of construction materials should be done at an appropriate place that does not affect the local habitations.
- ◆ Workforce camps: The project may need to establish a workforce camp if the majority of workers are from outside the area. These temporary camps should be located at places so that it does not disturb the local community and the environment.

5.8. Energy to be used

The energy that is used in the operation of construction equipment such as crushers, asphalt and concrete plants will be petroleum fueled.

5.9. Manpower Requirement

The workforce required for the project has not been calculated in detail.

Chapter 6: Stakeholder Identification and Consultation Plan

6.1. Introduction

Project stakeholders are individuals and organizations who would be actively involved in the project, or whose interests may be affected because of the project execution. Stakeholder analysis results in the development of cooperation between the stakeholder and the project team and, ultimately, assure successful project outcomes. Stakeholders were considered in achieving project goals since their participation and support would be crucial to the success of the project. A stakeholder analysis was conducted to identify individuals or groups which are likely to be affected by the project. Stakeholders were then sorted according to how much they can affect the action and how much the action can affect them. The information was subsequently used to assess how the interests of those stakeholders were best addressed by the project.

This ESIA defines a stakeholder as any person or organization, who can be positively or negatively impacted by, or cause an impact on the actions of the Project and includes individuals, government and non-Governmental organizations. Those individuals and groups can be ultimately affected by project activities, either as beneficiaries (positively impacted) or dis-beneficiaries (adversely impacted).

Key stakeholders are defined as those who can significantly influence or are important to the success of an activity. Secondary stakeholders are all other individuals or institutions with a stake, interest or intermediary role in the project. Stakeholders were identified based on the construction of a stakeholder matrix where stakeholders are plotted against two variables. These variables were the level of a stake in the outcomes of the project against the resources of the stakeholders and the importance of the stakeholder against the influence of the stakeholder. The matrix is demonstrated in Table below:

		Important Stakeholders			
		Unknown	Little or no importance	Some Importance	Significant Importance
Influence of Stakeholders	Significant influence	C		A	
	Somewhat influence	C		A	
	Little or no influence	D		B	
	Unknown	D		B	

Table 21: Stakeholder Classification Matrix

The matrix box 'A' includes stakeholders with a high degree of influence on the project, who are also of high importance for its success. These include senior government officials, politicians or trade unions. Box 'B' are stakeholders of high importance to the success of the project, but with low influence. This implies that they will require special initiatives if their interests are to be protected and include traditionally marginalized groups (e.g. Indigenous people, youth, seniors), who might be beneficiaries of a new service, but who have little 'voice' in its development. Box 'C' are stakeholders with high influence, who can affect the project outcome, but whose

interests are not necessarily aligned with the overall goals of the project. These include the Environmental Protection Agency, Conservation International and World Wildlife Fund. These stakeholders may be a source of significant risk, and they will need careful monitoring and management. Box 'D' are stakeholders such as the Guyana Revenue Authority, which have a low influence on, or importance to the project objectives but require limited monitoring or evaluation, but are of low priority.

6.2. Approach to Stakeholder Consultation

Section IV of the Environmental Protection Act 1996, Cap 20:05, requires that all environmental assessment process in Guyana should incorporate Public Consultation. The aim is to ensure that all stakeholder interests are identified and incorporated in project development, implementation and operation. Of necessity, stakeholder consultations should take place alongside project design and implementation to ensure that the project puts in place measures to cater for stakeholder concerns in all project phases. In the case of the proposed road project, public consultations followed several steps as follows:

6.2.1. Identification of Stakeholders

Like in all works projects, the core stakeholders comprise people to be directly served by the road projects and then comprise residents along the road corridor, motorists, businessmen and service providers who rely on the road, etc. This is the group that is likely to benefit or be affected by the proposed development. The stakeholders were consulted as key informants on road usage and to advise this ESIA study on mitigation measures to be put in place so as to minimize adverse impacts.

6.2.2. Stakeholder Consultation Plan Methodology

Meetings were carried out within the project area to find out all the views from the neighbors' and other stakeholders on the proposed project. The main objective was to find out if the stakeholders support the project and have no objection to it. Additionally, the proponent inquired if the project would cause any negative impacts on the following;

- ◆ Local residents and their businesses;
- ◆ Ecology of the area;
- ◆ Human environment;
- ◆ Recreational and leisure facilities;
- ◆ Public health and safety;
- ◆ Effect on water resources and quality;
- ◆ Effect on the soils;
- ◆ Effect on road transport and;
- ◆ Waste disposal.

The said parameters were directly mentioned to foresee which had intense negative impacts. The meeting of the key stakeholders (Governmental Agencies) assessed the need for the project

and its attendant benefits. During such meetings, it was emphasized that high standard for environmental, occupational health and safety would be adhered to during implementation.

Correspondence was sent to Government and Non-Governmental organizations to solicit their comments and concerns related to the proposed project. The correspondence identified the project location Ogle to Diamond and solicited any information in stakeholder possession related to:

- ◆ **Public Administration:** Government and regulatory agencies, elected officials, and public service providers that may be at the local, state, national or international levels. Examples include the Ministry of Communities, Ministry of Social Protection, Ministry of Public Infrastructure, and the local NDCs.
- ◆ **International Organizations:** Organizations operating in Guyana that may be involved in community projects and initiatives, such as the UNDP, UNICEF, PAHO.
- ◆ **NGOs:** NGOs operating in Guyana and that may have an interest in the project area, such as Habitat for Humanity, YMCA/YWCA, and Guyana Red Cross Society.
- ◆ **Private Sector:** Businesses of any scale that could be affected positively or negatively by the project. Examples include commercial enterprises within and adjacent to the project areas that could be affected positively or negatively during the construction and operations phases; and prospective suppliers of goods and services to the project.
- ◆ **Media:** News media outlets that may range from local to international in distribution.
- ◆ **Community Groups:** This includes faith-based organizations, community and social groups, and service clubs such as the Rotary Club and Lions Club.
- ◆ **General Population of the Beneficiary Community:** The project influence area begins at Ogle and terminates at Great Diamond. It also encompasses Georgetown and the East Bank of Demerara via the connector roads.

In accordance with Good International Industry Practice (GIIP), these stakeholders were requested to provide any information in their possession and were also invited to a meeting to identify issues for inclusion in the ESIA document

6.3. Stakeholder Analysis

Public meetings were organized with the residents of the surrounding areas at North Ruimveldt Secondary School, Ogle Community Centre, Grove/Diamond Secondary School and Better Hope Community Centre where the project was discussed and further views sought. During the initial reconnaissance conducted, the residents and the general public all support the project and are waiting eagerly for its commencement and full implementation. Those that attended the meeting included;

- ◆ Traders along the road – greengrocers, salon attendants
- ◆ Drivers of vehicles along the road

- ◆ Businessmen and women – for businesses along the road to be constructed including butchery, furniture, welding, masonry, etc.
- ◆ Residents owning properties along the road to be constructed

The ESIA consultations included disclosure of the design and project status that was done by RITES Limited. **Appendix 3** highlights the main concerns by the stakeholders during the Scoping Meetings.

Public Participation Photograph



Figure 10: Stakeholder consultation held at Critchlow Labour College

6.4. Consultation Workshops:

Formal Consultation sessions have been conducted with the representatives of the affected-cum-beneficiary communities. The Agenda used in guiding the discussions was as follows:

- ◆ Community's overall response to the proposed Project Road
- ◆ Perceived benefits and impacts of the road subproject
- ◆ Current road related problems and future concerns
- ◆ Road alignment needs/options
- ◆ Resettlement and Environmental concerns

Joint site visit have been conducted with MoPI, Social Expert and Utilities Stake holders along the project road and assess the Impact and its mitigation measures. The joint site visits as details are presented in photos below:



Join Site Visit for affected property in Ogle area with MoPI Officials on February 09, 2019



Join Site Visit with Social Expert at Extension of Aubrey Barker Road



Join Site Visit with Social Expert at Extension of Mocha Arcadia Road



Join Site Visit with Officials of Utilities (GPL, Gtt, GWI) and MoPI on February 15, 2019



Join Site Visit in Cane Field Area with Officials of EPA and MoPI on February 14, 2019

Photo 6.1::Photographs of Joint Site Visits

6.5. Public Consultations

As per guidelines and suggestions of Environmental Protection Agency (EPA) and MoPI, one stakeholder and four public consultations were conducted between December 17, 2018 and February 10, 2019 within the project influence area as follows:

- (i) Stakeholders consultation Meeting at Georgetown on December 17, 2018
- (ii) Public Consultation Scoping Meeting at Great Diamond & Golden Grove on January 10, 2019
- (iii) Public Consultation Scoping Meeting at Great Diamond & Golden Grove on January 31, 2019
- (iv) Public Consultation Scoping Meeting at North Ruimveldt on February 03, 2019
- (v) Public Consultation Scoping Meeting at Ogle Airport on February 09, 2019

Stakeholders Consultation Meeting was held at Critchlow Labour College, Georgetown and meeting was chaired by Ms. Sharifah Razack, Director, Technical Secretary, EPA with Various Stakeholders such as Officials of MoPI, Police, Land and Survey Dept., Media, University Professors, GPL, GWI, CHPA and prominent citizens in the area.

In the Stakeholders Consultation Meeting, detailed discussion & question –answer session was held with various stakeholders and issues raised by stakeholders are follows:

- ◆ Benefits and impacts of the road project;
- ◆ Traffic Congestion issues
- ◆ Current road related problems and future concerns
- ◆ Road alignment options
- ◆ Road Safety Issues
- ◆ Design parameters of Project Road such as Bridges, Culverts, design speed, pedestrian facility, cycle track and Intersection
- ◆ Resettlement and Environmental concerns
- ◆ Lamha Canal Flow and its environmental issues
- ◆ Communities affected

Public Scoping Consultations meeting were held at various location as mentioned above and meeting was chaired by Ms. Sharifah Razack, Director, Technical Secretary, EPA and officials of EPA, Media, MoPI, and RITES& Triple C Consultancy. A detailed discussion & question –answer session was held with local people in the presence of Media (Print and Electronic). The issues were raised by prominent citizens and stakeholders in the area are follows:

- ◆ Traffic Congestion issues
- ◆ Existing road up gradation
- ◆ future development plan of area
- ◆ Benefits and impacts of the road project
- ◆ Current road related problems and future concerns
- ◆ Road alignment options
- ◆ Resettlement and Environmental concerns
- ◆ Communities affected
- ◆ Safety and Security in Cane Field area
- ◆ Lamha Canal Flow and its environmental issues
- ◆ Environmental aspects and EIA & EMP base line study
- ◆ Quality of Water and its monitoring Locations
- ◆ Dumping Site during Construction Phase
- ◆ Waste Materials such as Soil, Cane
- ◆ Air Pollution and its mitigation
- ◆ Affected Wild Animals and Insects, if any
- ◆ Affected Plants and Tree
- ◆ Drainage Plan and its mitigation plan
- ◆ Discussion on affected properties in in the influence area

Stakeholder and public consultation meeting photographs as given below:

Consultation Meetings Photographs



Stakeholders Consultation meeting was conducted on December 17, 2018 at Georgetown



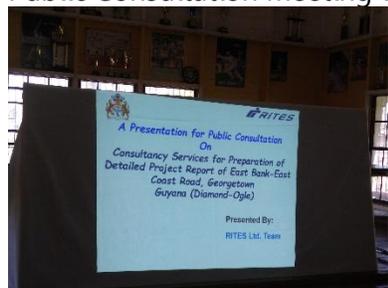
Public Consultation meeting was conducted on January 10, 2019 at Great Diamond Area



Public Consultation meeting was conducted on January 31, 2019 at Great Diamond Area



Public Consultation meeting was conducted on February 03, 2019 at North Ruimveldt Area



Public Consultation meeting was conducted on February 09, 2019 at Ogle Area

Photo 6.2 : Stakeholders and Public Consultations Meetings

Chapter 7: Environmental Impact Analysis

7.1. Baseline Studies/Assessment

For this ESIA, the baseline study was undertaken to determine the level of impact expected and to enable monitoring of impacts after the project is completed. Chapter 8 to 19 provides the baseline for the various environmental elements as well as the methodology utilized.

7.2. Assessment of Environmental Impacts

This ESIA defines direct impacts as environmental changes directly associated with project activities. Typical of these would be changes of topography, erosion and dust emissions. Indirect impacts are defined as environmental changes not directly associated with project activities which occur at a distance from the project because of complex pathways. Indirect impacts are referred to as second or third level impacts or secondary impacts. This ESIA also considers induced development impacts, including possible increases in population and related environmental impacts and cross-media impacts.

The likely impacts of the project were considered for all environmental and social components identified in the Scope and Terms for the project, prepared by the Guyana Environmental Protection Agency (EPA). Baseline information was drawn from both desk study and from field surveys.

Impact significance was defined based on evaluations of several significance attributes. These attributes have gained common acceptance (although definitions may vary) as a means of identifying and measuring various aspects of an impact and collectively assist in evaluating impact significance.

The categorization of impacts into positive or negative (adverse) impacts is not necessarily simple as project impacts may have both positive and negative effects, for example, one group may benefit while another is disadvantaged or the impact may be positive socio-economically but not ecologically. Impact magnitude measures the severity of environmental effects. Effects range from minor or inconsequential with little significance to major or catastrophic, with significant adverse environmental effects which may be unacceptable. When considering the magnitude of potential impacts, the development was considered within the context of regional development and the extent to which the project could trigger or contribute to any cumulative effects.

Reversibility, in this ESIA, refers to the environmental recovery once an impact has occurred. Irreversible environmental impacts are commonly considered more significant than those that are reversible. Irreversible changes always command attention because they signal a loss of future options. Species extinction, severe soil erosion, destruction of an ancient rain forest, and other habitat destruction are examples of irreversible changes.

Change in land use by providing access to remote areas is also virtually impossible to reverse once land-use changes commence such as the conversion of forest areas to agricultural land. Duration, within this ESIA, considers the period over which an environmental effect occurs. Long-term environmental effects may be significant. Short-term environmental effects may also be significant, especially if the short-term effects negatively affect public perception of a project. Frequency is closely related to the duration of the environmental effect. The frequency of effects

and the potential of the environment to recover from these effects are important. If an activity is intermittent, for example, it may allow for environmental recovery during inactive periods.

This ESIA defines geographic extent as to how far an effect propagates. Localized adverse environmental effects may not be significant, while widespread effects may be significant. Geographic extent considers the extent to which environmental effects, caused by the project, may occur in areas far removed from it. In this ESIA, likelihood, is defined as the probability of an impact occurring. Two criteria are considered when examining likelihood: (1) probability of occurrence: if there is a high, medium or low probability that a particularly significant environmental impact will occur, (2) the certainty of significance: the level of uncertainty associated with the environmental assessment, often termed as 'confidence limit'. If confidence limits are high and impacts are evaluated as significant, there is a high degree of certainty that the conclusions are accurate and environmental impacts are significant. If confidence limits are low, there is a high degree of uncertainty about the accuracy of conclusions, and it will be difficult to decide whether significant environmental effects are likely or not.

The impact assessment, in this ESIA, is based on the following:

- ◆ An understanding of the nature of the proposed project, including project design, construction activities, timing, and decommissioning.
- ◆ Information about the relevant receptors and how they respond to changes/disturbances.
- ◆ The effectiveness of mitigation measure for similar projects
- ◆ The impacts of the project on other environmental and social components that may interact
- ◆ Existing and previously approved projects which can contribute to cumulative impacts

Both qualitative and quantitative methods were used to determine the magnitude of impacts (severity), duration, reversibility/irreversibility and geographic extent in addition to the frequency of impacts. Qualitative assessments employ ratings such as neutral, slight, moderate or large and are applied to both negative and positive impacts. Qualitative assessments are used where quantitative assessments are difficult or impossible, for instance in a landscape, archaeological, or biodiversity assessment. Quantitative assessments involve measurement or calculation of numerical values, e.g. the level of a pollutant in relation to a statutory threshold value.

Information on potential impacts from the construction and operation of the project has been obtained from various sources, including consultation with the EPA, the public consultations process, ESIA's for similar projects in Guyana and worldwide; literature, research, and independent modeling and analysis. The project team used professional judgment, fieldwork, and computerised analysis to identify potential impacts and their interactions. The methodology which was used to identify and assess the potential physical and social impacts of the proposed project is described in the following sections.

The assessment of impacts for each environmental component followed the sequence below: Characterization of the baseline for specific environmental components before the project is undertaken;

- ◆ Identification of the sources of impacts and the impacts themselves, for specific environmental components, during the construction, operation and closure phases of the project;

- ◆ Rating of the impacts, on a specific environmental component, before any mitigation (for negative impacts) or enhancement (for positive impacts) is implemented;
- ◆ Recommended mitigation and enhancement measures, on a specific environmental component, to address the impact
- ◆ Rating of the impacts after mitigation, on a specific environmental component, to produce a “residual” impact rating.

7.2.1. Rating of Environmental Impacts

Potential environmental impacts were rated to:

- ◆ Provide a basis for prioritization of impacts to be dealt with
- ◆ Provide a method of assessing the effectiveness of proposed mitigation measures and
- ◆ Provide a scale which shows the level of impact both before and after a proposed mitigation measure has been applied.

A consistent system for rating impacts was used to apply analytical rigor to the assessment and rating process. However, outcomes related to the reduction of major negative impacts or enhancement of positive impacts is dependent on the selection, applicability, implementation, and effectiveness of mitigation measures for the proposed project.

7.2.2. Criteria for Rating the Impacts

Impacts were rated as the product of three elements: (1) the duration of the potential impact, (2) the severity (magnitude) of the impact and (3) its geographical extent. The overall rating of the impacts was determined based on Table 21. This matrix acts as a guide and there may be situations where its rigid application is inappropriate and where the perceptions of stakeholders and their feedback play a more significant role. For specific impacts where this is the case, the rating is clearly explained in the evaluation of the impact.

7.2.3. Severity and Enhancement Criteria

The severity or enhancement of each impact was rated using the criteria identified in the table below. Colors are used to assist the reader in reviewing the impacts and their relative magnitude.

Duration	Magnitude	Local	Regional	Territorial	National
Short-term	Low	Low	Low	Moderate	Moderate
Short-term	Moderate/ High	Low	Moderate	Moderate	Moderate
Medium-term	Low	Moderate	Moderate	Moderate	Moderate
Medium -term	Moderate/High	Moderate	Moderate	Moderate	High
Long-term	Low	Moderate	Moderate	High	High
Long-term	Moderate/high	Moderate	High	high	High
Long -term	Moderate/High	Moderate	High	High	High

Table 22: Criteria for the Rating of Impacts

7.3. Cumulative Impacts

Cumulative impacts are mostly indirect impacts and defined as incremental environmental changes caused by independent or repetitive activities. These impacts may occur as interactions between activities, between an activity and the environment, and across environment media. Cumulative effects can occur in many ways including (CEAA 2003; Spalding 1994):

*A physical or chemical constituent can be transported away from the impact source only to interact with another activity or environmental medium (e.g. soil erosion or acid rock drain-age)
The gradual disturbance and loss of land and habitat, or nibbling loss (e.g. incremental land clearing as the mine advances or incremental road development into forest areas, alienating wildlife habitat due to sensory disturbances)*

Spatial and temporal crowding, when too much is happening within too small an area and/or in too brief a period. Spatial crowding includes overlapping effects from separate activities (e.g. downstream confluence of effluent plumes from multiple discharge points). Temporal crowding occurs when impacts from different actions overlap or occur before the receiving environment has had time to recover (e.g. family stress due to continuous fly-in/fly-out employment)

Each impact can induce further effects, sometimes called growth-inducing potential. The effects of these spin-off impacts (e.g. increase in hunting or trade of endangered species due to improved access to areas) may add to the cumulative effects near the mine. The magnitude of cumulative effects, or the impact propagation between causes and effects, can equal the sum of each individual effect (additive effects) or can result in an increased effect (synergistic effect). There are many other examples of cumulative impacts; incremental noise from independent activities (either from one or several projects) or the cumulative effect of individual impacts on a receptor, such as human stress due to combined noise and dust exposure, or visual impacts. Impact interactions, a subset of cumulative impacts, can occur either between the impacts of one project or between the impacts of several projects.

The opposite of cumulative impacts are cancelling, offsetting or compensating impacts. These are also quite common. Examples include water abstraction that is offset by water discharges, or increases in traffic, offset by improvements in capacity of local roads. The objective is to generate impacts that will offset the significant adverse impacts.

Chapter 8:

Water Resources

8.1. Introduction

This chapter defines the regulatory framework and baseline data for water resources for the proposed action and identifies project impacts on the water resources including water quantity and fluvial geomorphology.

The methodology used to rate the environmental impacts on water resources replicates that outlined in Chapter 7. This chapter further outlines environmental management actions to mitigate the impacts on water resources.

The construction activities will require large quantities of water which will be supplied mainly from nearby streams. Water will mainly be used for embankment construction, granular layers construction, concrete mixing, dust suppression, and sanitary purposes. If there is not adequate water in nearby streams, then the town council will be contacted to supply water in tanks to the construction site.

8.2. Background

8.2.1. Surface Water

Guyana has a network of rivers and streams with many rapids and waterfalls. Surface water makes up about 10 percent of the country's drinking water and about 60 percent of Georgetown's drinking water.

In a number of communities on the East Coast and East Bank, the Guyana Water Incorporated (GWI) is in the process of increasing water system capacity to include more surface water sources, since there are now challenges with groundwater availability in the areas (GWI, 2018).

There is currently no monitoring surface water quality in the Lamaha Canal and Demerara River or in the drainage canals. However, it is believed that the water quality is poor since household greywaters, including septic tank effluents, discharges into the drainage canals.

The East Demerara Water Conservancy was developed in 1880 to channel a number of water sources into a storage area. It was formed using the natural gravity water flow from the upper southern parts of the country and has a bearing capacity of more than 100 square miles of water, thereby being the largest conservancy in Guyana.

The primary function of the conservancy is for the storage water for irrigation of sugar cane plantations, rice fields, and other cash crops during periods of drought. The Northern side of the Conservancy dam also protects the land between the conservancy and the sea (the coastal zone) against flooding from rainfall in the southern catchment area (see Figures below).

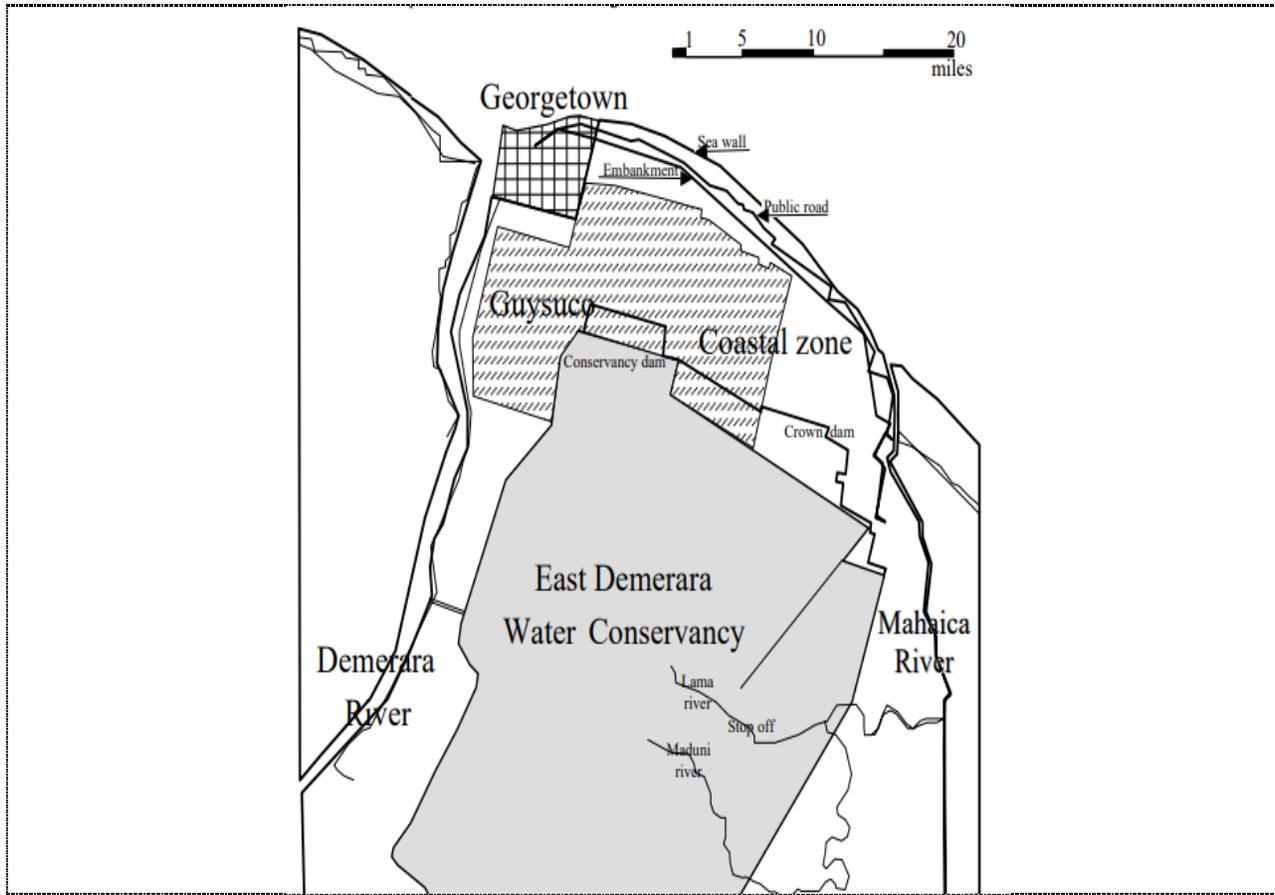


Figure 11: East Demerara Water Conservancy Locations

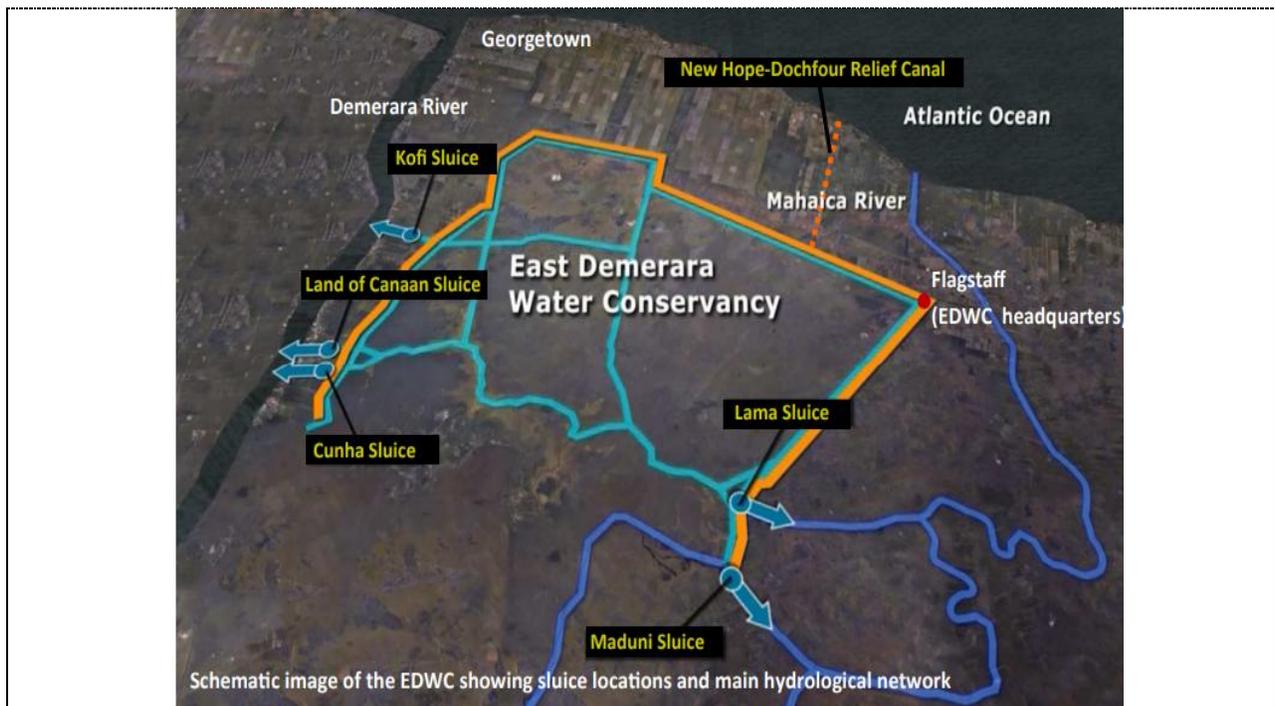


Figure 12: East Demerara Water Conservancy : the Sluice Locations

8.2.2. Groundwater

Coastal Aquifer System

Large quantities of fresh water are available from the coastal aquifer system. This system occupies a subsurface area of about 20,000 square kilometers, extending for about 250 kilometers along the Atlantic coast and 40 to 150 kilometers inland. Sediments reach a thickness of 1,800 meters onshore and become progressively thicker offshore and toward the east. The coastal aquifer system is composed of three connected but hydro-geologically distinct aquifers. Overlying layers of clays confine the lower two aquifers, protecting them from contamination by overlying sources. The three aquifers are named, from upper to lower, the Upper Sands, the A Sand, and the B Sand, with each capable of yielding large amounts of water (US Army Corps 1998).

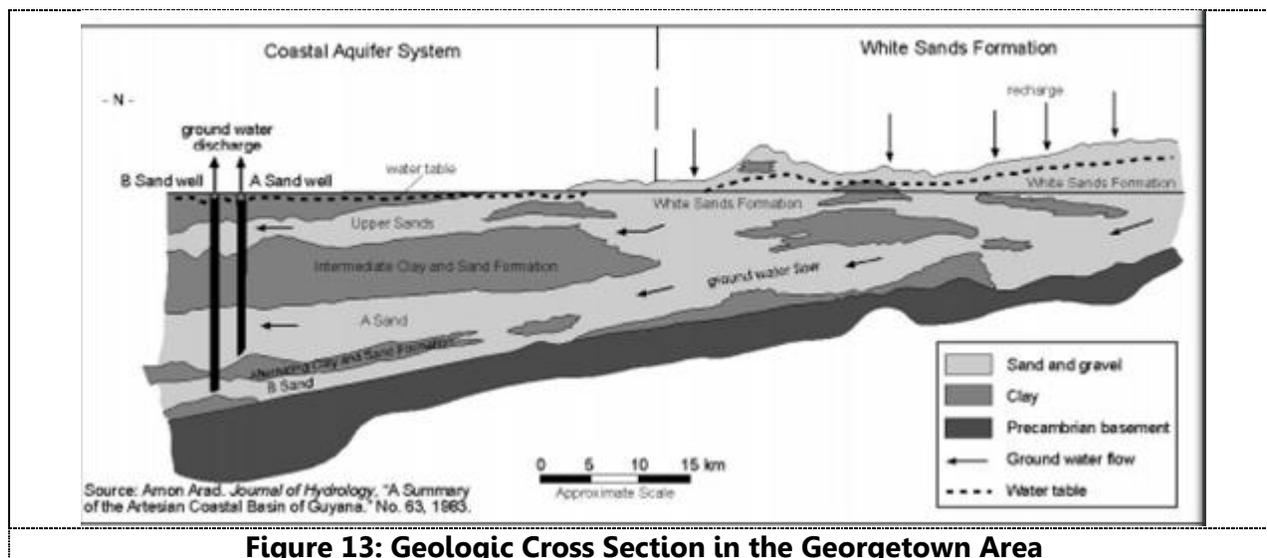


Figure 13: Geologic Cross Section in the Georgetown Area

The Guyana Water Incorporated (GWI) monitors static and dynamic groundwater levels on a monthly basis but does not currently monitor water quality. Groundwater level monitoring shows a steady decline in static levels over the last decade, suggesting that groundwater is being exploited at an unsustainable rate. The corporation recently started a project to monitor saline intrusion, which is considered to be a risk but has not occurred yet due to the clayey soils and high water pressure in Guyana's coastal zone (GWI, 2018). Generally, the water provided to households by GWI, even when treated, is not used by the population for drinking. It is used for other household uses such as washing and cooking, while bottled water or harvested rainwater are more often used for drinking.

8.3. Policy, Legislation and Regulatory Framework

8.3.1. Environmental Protection Act (1996)

In 1996, the Environmental Protection Act was ratified to implement the environmental provisions of the Constitution. The Act is Guyana's single most significant piece of environmental legislation because it articulates national policy on important environmental topics such as pollution control, the requirements for environmental review of projects that could potentially impact the environment, and the penalties for environmental infractions. It also provides for the establishment of an environmental trust fund. Most importantly, the Act authorized the formation of the EPA and established the EPA as the lead agency on

environmental matters in Guyana (FAO, 2013). The Act further mandates the EPA to oversee the effective management, conservation, protection, and improvement of the environment (EPA, 2012). It also requires the EPA to take the necessary measures to ensure the prevention and control of pollution, assessment of the impact of economic development on the environment, and the sustainable use of natural resources.

8.3.2. Environmental Protection (Water Quality) Regulations

These regulations require registration and environmental authorization for construction, installation, operation, modification or extension of any facility that will cause the discharge of effluents. The regulations include parameter limits for concentrations of specific constituents that can be discharged into any inland or coastal water or lands in Guyana.

8.3.3. Water and Sewerage Act, 2002

This Act provides for the ownership, management, control, protection and conservation of water resources, provision of safe water and sewerage services, and regulation thereof. The Act establishes Guyana Water Incorporated (GWI), a merger of the previous bodies; Guyana Water Authority and Georgetown Sewerage and Water Commissioners. The Act also outlines fines for offenses relating to wastage, tampering, damage, and pollution to waterworks.

8.3.4. 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 below 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 regulation establishes parameter limits of effluent discharges, new sources of effluent discharges, fees for 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.

Parameters	Standard (WHO)
Physical Text	
pH	6.5 - 8.5
Conductivity	25 mg/l
Dissolved Oxygen	≥ 4 mg/l
Turbidity	Max. day < 150 NTU
Temperature	
Anions	
Alkalinity	Nil
Sulphate	250 mg/l
Heavy Metals	
Copper	Nil
Iron	0.3 mg/l
Lead	Nil

Parameters	Standard (WHO)
Mercury	Nil
Zinc	Nil
Sodium	g/l

Table 23 Water Quality Standards – WHO 2018

8.3.5. Guyana National Bureau of Standards Interim Guidelines for Industrial Effluent Discharge into the Environment

Discharges into the environment should be in accordance with the Guyana National Bureau of Standards interim guidelines for industrial effluent discharge into the environment. The following are the allowable limits for an operation and should not be exceeded:

- ◆ pH 5.0 - 9.0;
- ◆ Temperature <40°C;
- ◆ Biological Oxygen Demand (BOD) <50 mg/l;
- ◆ Chemical Oxygen Demand (COD) <250 mg/l;
- ◆ Total Suspended Solids (TSS) <50 mg/l ;
- ◆ Oil & Grease <10 mg/l;

8.4. Baseline

Baseline surface water quality for the project area was conducted and have been analyzed to determine the concentration of parameters mandated in the EPA Water Quality (Regulations) 2000. The results of analytical tests on surface water samples collected, are detailed in Table below. Sample locations are shown in Figure below.

Parameter tested	Water Quality Test Results at Sample locations (values)									
	SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10
Total Dissolved Solids, mg/L	321	478	435	552	544	1221	621	432	442	398
Turbidity, NTU	11.3	12.1	22.9	25.8	37.2	14.5	9.8	17.4	22.4	22.7
Suspended Solids, mg/L	45	58	70	64	237	77	37	58	179	312
Ph	7.1	6.9	7.4	7.4	6.8	6.3	7.2	5.7	5.8	6.5
Hardness, Mg as CaCO3	15	21	17.3	21.7	40.1	18	9.73	111	19.8	35.3
Nitrate (NO3 – N), mg/L	0.5	0.3	0.4	0.4	0.3	0.2	0.5	0.6	0.7	0.2
Conductivity µs/cm	1835	2716	1754	1125	895	873	674	674	721	534
E. coli (MPN/ 100mL)	>200.5	>200.5	>200.5	>200.5	>200.5	>200.5	>200.5	>200.5	>200.5	>200.5
Iron (Total), mg/L	1.78	1.45	1.35	0.55	1.11	0.21	0.27	1.01	0.34	0.69

Table 24: Showing the Water Quality Parameters



Figure 14 : Showing the Sample Points for Water Quality Testing

8.5. Discussions

8.5.1. pH

The pH of soils range from 0-14; lower the value the more acidic the substance; higher the value the more basic is the substance; while a pH of 7.0 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 set by the Guyana National Bureau of Standard for industrial effluent discharge. An important environmental impact of pH is the effect it has on the solubility and bioavailability of 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.

8.5.2. 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 by Kentucky River Basin Assessment report 2000. Conductivity is a measurement used to determine the 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.

8.5.3. Suspended solids

According to the Kentucky River Basin Assessment Report 2000, 80mg/L of total suspended solids can decrease the macroinvertebrate population by 60%. The results from locations 2, 3, 4, 5, 9 and 10 are therefore high with regards to the Guyana National Bureau of Standards (GNBS) for Industrial Effluent Discharge into the environment. 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 contributing to floods.

8.5.4. Fecal Coliform Bacteria

Indicator organisms such as fecal 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 fecal 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. Similarly, the criterion stipulated by USEPA, 1986, for the use of marine and fresh recreational waters (a GM of 33 enterococci cfu per 100 mL in fresh water and 35 enterococci cfu per 100 mL in marine water) and *E. coli* for fresh recreational waters (a GM of 126 *E. coli* cfu per

100 mL) (U.S. EPA, 1986). All water samples tested were greater than 200 colonies/100mL; it, therefore, means persons should not enter into these water bodies.

8.5.5. Hardness

Water hardness is a result of dissolved minerals in the 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 less than 300CaCO₃(mg/L) and therefore fall into the soft and moderately hard categories. The most important ecological effect hardness has on fish 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.

8.6. Impact Prediction and Evaluation

Sediment discharge from cleared areas has the potential to reduce water quality in the waterways in close proximity to the cleared areas. These are moderate impacts (long-term, high severity, regional extent). The construction duration is likely to be relatively long. The clearing of vegetation will reduce interception and may result in an increased discharge to the waterways around the construction area and increased water levels in these water bodies. These are moderate impacts (medium-term, moderate severity, local extent). Increased water levels in the streams and creeks are unlikely to exceed typical wet season levels. These impacts will be mitigated by undertaking most of the construction activities, which may result in increased storm water runoff, in the dry season. These mitigation measures will result in low impacts (short-term, low severity, local extent).

Surface water quality may be negatively impacted during construction by accidental discharges of fuels, oils, and grease from construction equipment. These are high impacts (medium-term, high severity, regional extent). The potential for accidental spills of fuels, oils, and grease and the associated contamination of surface water will be minimized by implementation of a Spill Prevention and Contingency Plan. This plan detail measures which will be implemented to prevent, and if necessary, contain spills of fuels, oils, or other contaminants. Such measures will include siting of fuel containment tanks on impervious bases located within a bonded impermeable enclosure designed to hold 110 percent of the contents of the largest tank and channeling storm water discharge from fuel storage areas to an oil-water separator prior to being discharged to surface water. Implementation of these mitigation measures will effectively remove any potential impacts to surface water quality. The residual impacts will consequently be at allow level (short-term, low severity, local extent).

Road construction activities will include placing culverts at several waterways. Culverts constructed through the roads will modify the natural flow of surface water, concentrate flows at certain points and may increase the speed of surface water flow. These changes may potentially result in flooding and increased sediment discharge to waterways near roads. These are high (long-term, high severity, regional extent) impacts. These impacts will be mitigated by designing culvert sizes to pass the natural surface water flows. Culverts will also be lined with grass and/or, riprap, where necessary. This will result in low residual impacts (short-term, low severity, local extent)

Land clearing and earthmoving activities associated with the development of the road infrastructure may increase the potential for erosion and the associated increased sediment transport to waterways and sedimentation of these waterways in the project area. Construction activities will pose increased risks of added sediment discharge to these streams. The potential for increased sediment discharge to surface water because of construction activities is a high impact (medium-term, high severity, regional extent). The potential for sediment discharge to waterways will be minimized or avoided by the implementation of best management practices such as:

- ◆ Optimization/minimization of vegetation clearance;
- ◆ Revegetation of disturbed areas (even if temporary);
- ◆ Use of storm runoff retention ponds and silt fences, etc.

Implementation of these mitigation measures will result in low residual impacts (short-term, low severity, local extent).

During the Construction and Operational Phases, the waterway may become contaminated due to processed materials or from the production or use of raw materials, intermediate product, finished product, by-product, waste product or wastewater. Water quality may be potentially impacted by wastewater discharges domestic wastewater and/or by storm water runoff from developed areas (i.e., workshops, equipment storage, and service areas, etc.), as well as solid waste generated. . Discharge of wastewater from these areas to surface water may impair surface water quality by causing changes to physical, chemical and biological properties within the receiving waters. These potential wastewater discharges are high impacts (long-term, high severity, regional extent). Mitigation measures will include the following:

- ◆ Proper disposal of sludge (i.e., in a secure landfill);
- ◆ Storm water runoff from developed areas will be channeled through several oil-water separators prior to discharge to surface water;
- ◆ Placing solid waste into garbage bins with cover;

Implementation of these mitigation measures will result in low impacts (short-term, low severity, local extent).

Spills of fuel and oils from equipment and from fuel storage can flow to the underlying aquifer and potentially impact groundwater quality. This will result in high impacts (long term, high severity, regional extent) to groundwater quality. Potential contamination of the underlying aquifer will be minimized by installing drip pans on all equipment, enforcing a program to check for equipment leaks and implementation of the Spill Prevention and Contingency Plan(SPCP). The SPCP will detail plans for utilization of sorbents, biological agents, chemical dispersants and gelling agents. All fuel will be stored within containment walls designed to contain 110 percent of the tank contents. Implementation of these mitigation measures will result in low residual impacts (short-term, low severity, local extent) to groundwater quality.

Project phase	Conditions	Potential environmental impact	Significance
Construction and Rehabilitation phase	fuel/oil spills	Water contamination from fuel/oil spills	Ex, Irr, LT, Av, M, Sig
	Erosion and Sedimentation	Surface runoff to creeks from construction activities: culvert, bridge and road construction; base camp resulting in discoloration and sedimentation.	Lo, Rev, ST, Av, M, Sig.
	Waste disposal	Improper disposal of solid waste from worker camp.	Ex, Rev, LT, Av, M, Sig.
Operational phase	Water	Contamination and siltation as a result of erosion and sedimentation	Ex, Rev, LT, Av, M, Sig
		Contamination from spills such as fuel and waste oil	Ex, Irr, LT, Av, M, Sig
		Contamination of soil from insecticide/chemical spills	Lo, Irr, ST, Av, M, Sig
		Contamination from improper waste disposal including solid and liquid waste	Ex, Rev, LT, Av, M, Sig
Impact Significance Parameters			
Lo – Localised	Ex – Extensive	Rev – Reversible	Irr. Irreversible
ST – Short Term	LT – Long Term	Av. – Avoidable	Un - unavoidable
Sig. – Significant	Insig. –Insignificant	M. – Mitigable	UM – Unmitigable

Table 25: Summary of Water Resource Impact

8.7. Mitigation and monitoring - Environmental and Social Management Plan

8.7.1. Environmental Management Plan

Site clearing operations will progress in a gradual and phased manner to ensure there are no large increases in sediment discharge. Sediment control structures will be used to prevent the inflow of sediment to surface water. These control practices will include sediment traps and screens to control run-off and sedimentation. Surface runoff from the workshop and other vehicle service areas will be channeled to oil/water separators. All water from the oil/water separators will be skimmed prior to discharge. The operations will monitor discharges to surface water up-gradient and down-gradient of the site.

Additionally, other mitigation measures that should be taken are:

- ◆ Ensure adequate drainage around camp sites;
- ◆ Ensure fuel and other chemicals are stored as recommended by Environmental Protection Hazardous Waste (Regulations) 2000;
- ◆ Ensure workshop area is covered so as to prevent storm water/runoff being contaminated

- ◆ Ensure greywater from the washroom is discharged via a soak-away system;
- ◆ No dumping of solid waste into water bodies should be allowed;
- ◆ Care should be taken to ensure that downstream sedimentation during construction is minimized and temporary water crossings are to be decommissioned after their period of usage to ensure that they do not collapse and block stream flow;
- ◆ Removal of soil vegetative cover should be kept at a minimum and should only be carried out with absolute necessity;
- ◆ To avoid oil contaminants into water bodies, a system for the proper collection and disposal of lubricants at both site and maintenance depot should be maintained;
- ◆ In the absence of a sewage system, portable toilets located far away from groundwater aquifers; and
- ◆ The constant monitoring of ground and surface water quality should be maintained.

8.7.2. Lamaha Canal Water Course Protection

Project Roads Construction would require crossing of Lamaha Canal at four locations. The protection of Lamaha Canal water Course has been discussed with respect authorities at GWI and NDAI.

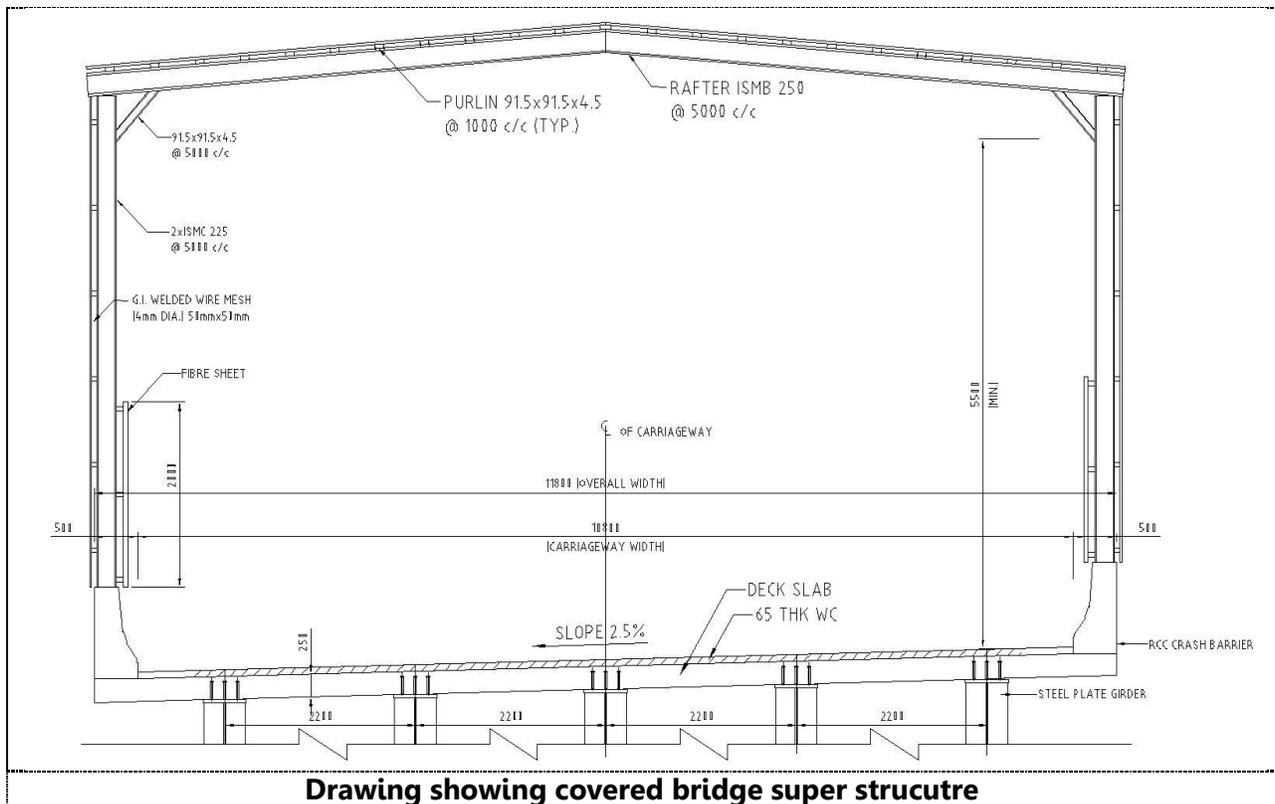
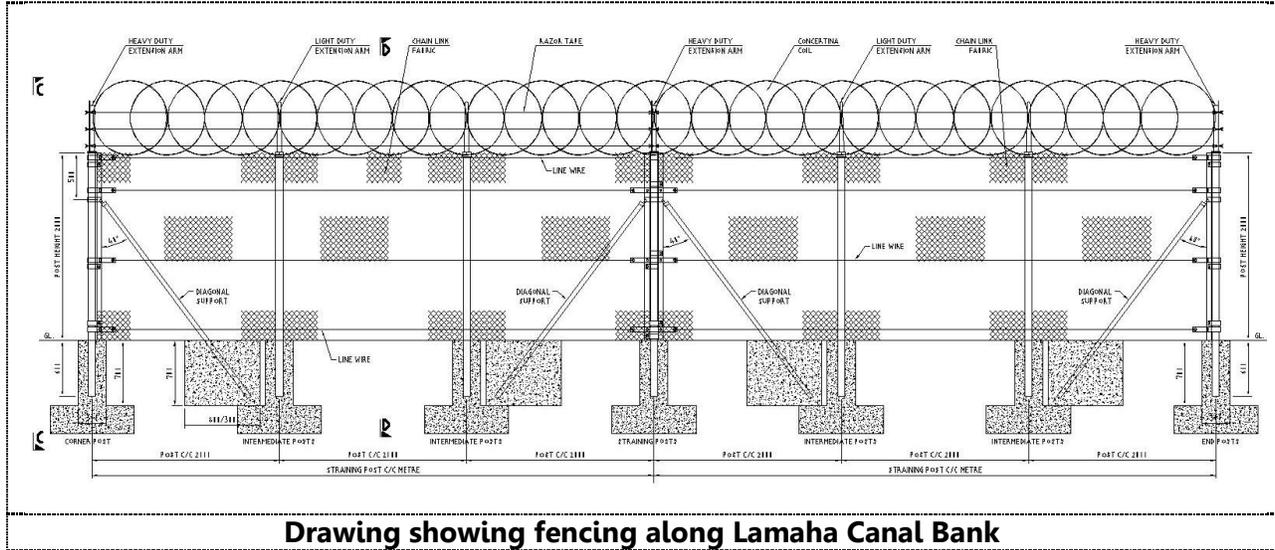
Following has design consideration have been kept for bridges design across Lamaha canal

- ◆ Bridges crossing Lamaha Canal are to be provided with "navigation spans".
- ◆ The navigational requirement has been considered for fixing of formation level for bridges over Lamaha Canal.
- ◆ Minimum vertical clearance of 1.2m above the normal supply level has been considered after discussions with MoPI.
- ◆ No foundation has been provided within the water channel of Lamaha Canal.

In addition to above, following have been proposed to be included in project construction proposals:

- ◆ Fencing of 2m height on the each bank for 250m length on upstream and downstream side of the bridge.
- ◆ Fencing of 2m height on outer edge of each carriageway, 250m length on both ends of approach.
- ◆ 600mm diameter concertina coil provided on top of fencing at canal bank and carriageway edge to prevent trespassing to the canal.

- ◆ Whole superstructure is covered with 50mmx50mm opening chain-link mesh of 4mm diameter zinc coated wire, supported by steel frame fixed to crash barrier.
- ◆ 2m height of transparent polycarbonate sheet over crash barrier top is attached.
- ◆ Provision of Drainage spout is avoided on spans over Lamaha Canal to prevent contamination of canal water.



8.7.3. Monitoring

The following four types of monitoring will be employed:

- ◆ **Inspections** planned and conducted on a regular basis to ensure that mitigation measures and commitments are properly maintained and implemented, and that specific management procedures are being followed.
- ◆ **Receptor monitoring** undertaken to confirm that activities at the site are not resulting in an unacceptable deterioration in the quality of habitats or infrastructure.
- ◆ **Compliance monitoring** involving periodic sampling or continuous recording of specific environmental quality indicators or discharge levels to ensure compliance of discharges and emissions with project standards.
- ◆ **Auditing (internal and external)** to assess compliance of the project activities with both regulatory and site management system requirements.

The outputs from monitoring will be used in the following ways:

- ◆ To provide early warning for asset/ site management, to assess mitigation measures on a day to day basis to suit evolving conditions.
- ◆ To enable the consultants and the contractors to demonstrate that mitigation measures and procedures laid down in mitigation plans are being followed and operations are being conducted within compliance limits.
- ◆ To provide formal assurance to the EPA and other regulatory authorities that the project is compliant with regulations and agreed limits and that relevant mitigation/enhancement measures are being adhered to.

8.7.4. Monitoring Plan

Water samples will be recovered for analytical tests, from nearby streams and the Lamaha Canal Conservancy, quarterly, during the period of the construction. The sampling results would be used to determine if there are any changes in surface water quality associated with the project. Test will be conducted for temperature, pH, conductivity, turbidity, presence of oils/grease, TSS and coliform, and these will be compared against the baseline data and regulation guidelines. Monitoring of streams flow would also be conducted quarterly to ensure that that the project does not alter the waterway significantly. For cases where the baseline conditions exceed WHO standards, the surface water parameters should not show a statistically significant increase over the baseline levels. Runoff from the stockpiles would be monitored for water quality as well chemical use to ensure that the waterway is not contaminated.

Parameter	Institution responsible	Frequency of monitoring	Location of monitoring
Water Quality Temperature pH Conductivity	Proponent/ Construction Contractor	Quarterly	Nearby streams Lamha Canal at points where road

Parameter	Institution responsible	Frequency of monitoring	Location of monitoring
Turbidity Oils/Grease TSS Coliform			construction passes through.
Stream Flows	Proponent/ Construction Contractor	Quarterly	Main creeks and waterways.
Chemical use	Proponent/ Construction Contractor	Quarterly	Monitor volume of chemicals used, quantity discharged via various routes and any quantity spill

Table 26 Monitoring Plan

8.7.5. Fuel Oil Management

Spills of fuel oil could result in surface and groundwater contamination. Fuel oil storage areas will be located well away from areas of fire hazard and all fuel will be barged and/or trucked to site by secure fuel trucks and transferred into fuel storage tanks that are founded on impervious concrete surfaces. The fuel tanks will be housed within bunded enclosures. The enclosures will be sized to retain the contents of 120% of the largest tank in the event of tank failure. Discharge from fuel storage areas will be channeled to oil water separators prior to being discharged to surface water.

Indiscriminate dumping of waste oil will not be permitted under any circumstances. Waste oil will be stored in approved containers, under a secondary containment to deal effectively with any leakage or spillage, before dispose of via a recommended method, and/ sold to lumber companies. Liquids, spent oils, fuels and lubricants will be collected and returned in drums to oil companies.

8.7.6. Spill Contingency Plan

Two plans; the Emergency Response Plan (ERP) and the Spill Prevention and Cleanup Control (SPCC) Plan. The elements of each plan are detailed below:

8.7.7. Emergency Response Plans

The objective of the Emergency Response Plan (ERP) is the protection of the communities and the environment in the project area of influence through the development of emergency response strategies and capabilities. This Emergency Response Plan details measures to respond to potential releases of chemicals, process wastewater, fuel oils and/or other hazardous material. In addition, it details emergency response procedures for potential release of hazardous material which is being transported to the site. Examination of the proposed project has identified several possible scenarios which may require the activation of emergency response procedure. Emergency response actions will be needed for the following:

- ◆ Spills of fuel oil or other hazardous material during road transport to the site;
- ◆ Releases of fuel oil or other hazardous material during unloading and mixing;

- ◆ Releases of fuel oil or other hazardous material during fires and explosions;
- ◆ Release of fuel oil or other hazardous material due to pipe, valve and tank ruptures

This ERP describes specific response actions, as appropriate for each emergency situations identified above. The response actions include:

- ◆ Clearing site personnel from the area of exposure, notification to operational, management and response personnel;
- ◆ Use of antidotes and first aid measures for chemical exposure;
- ◆ Control of releases at their source, containment of releases, assessment of the release and mitigation of the releases;
- ◆ Implementation of measures to prevent reoccurrence of releases;

The Emergency Response Center will be the closest Health Care Centre within the vicinity. There will be a primary and alternate Emergency Response Coordinator at the site. The coordinators will have explicit authority to commit the resources necessary to implement the ERP. Emergency response teams would be identified and would be appropriately trained and prepared. After the commencement of construction, this ERP shall be extended to include call-out procedures and 24-hour contact information for the coordinators and response team members.

All personnel involved in hazardous waste management would be trained to recognize and respond to situations which can result in releases to the environment. The training will include:

- ◆ Identification of procedures to be followed if a chemical release is discovered, including notification of the appropriate site personnel;
- ◆ Measures to assure worker safety, and methods to stop or contain the release, if possible.

The following list of equipment and supplies will be provided for response to emergencies.

- ◆ Earthmoving Equipment
- ◆ Mobile Generators
- ◆ Sand and Gravel
- ◆ Pumps
- ◆ Pipes
- ◆ Absorbents

The Regional Democratic Council of Region 4 will be notified of the potential problem and will be kept advised of the situation. During these contacts, the agencies will be requested to

indicate if there are any immediate actions that can be taken to reduce the risk of the emergency and if necessary, preventative actions will be implemented. An Emergency Response Coordinator will be assigned the task to continuously monitor the situation and to coordinate emergency action if required. If there is a release of fuel oil or other hazardous material, all persons and communities within the vicinity will be notified immediately and efforts will be coordinated with others to reduce impacts associated with the release. The EPA will be immediately notified.

All transport vehicles will be fitted with absorbent material. If there is a spill/leak of fuel oil or other hazardous material onto roadways during transportation to/from the site, prompt action will be taken to contain the leak or spillage. All combustibles/ignition sources such as running engine, likely to result in fires, will be removed from the vicinity of the spill and anyone in the area will be advised to stay upwind of the spill. Absorbent material in the transport vehicle will be used to cover small spills. The vehicle operator will immediately notify the Contractor which will assign an Emergency Response Coordinator to respond to the emergency. A berm will be constructed around the spill area to control runoff to surface water.

All soils impacted by the spills will be excavated from the spill area and disposed in accordance with the hazardous waste management procedures. In the events of spills to surface waters, fauna will be trapped and will be relocated to areas within proximity of the site, which are the same ecologically as the spill area. Fishes will be trapped with nets and animals will be snared in traps designed to ensure that animals are not injured during trapping. The relocation of fauna impacted by accidental spills is expected to be a very infrequent occurrence and will have insignificant impacts on the areas to which the fauna is relocated.

Spills of fuel oil will be responded to by the addition of surfactants and by retrievals with skimmers. Other chemicals, which cannot be recovered manually, chemically or by mechanical means will be allowed to naturally degrade by dilution and dispersion. During the degradation process water quality would be monitored in the spilled area. After monitoring determines that water quality has attained acceptable standards, sensitive fauna will be allowed to naturally reenter the area.

8.7.8. Spill Prevention and Cleanup Contingency Plan

This Spill Prevention and Cleanup Contingency (SPCC) Plan will become effective coincident with the commencement of construction activities. Emergency Response Coordinators will have authority to expend funds and recruit employees to implement the Spill Prevention and Cleanup Contingency Plan. The SPCC Plan addresses the following:

- ◆ Operating procedures to prevent oil spills
- ◆ Control measures which will be installed to prevent a spill from reaching navigable waters, and
- ◆ Countermeasures to contain, clean up, and mitigate the effects of any spill which discharges to surface or ground water.

This SPCCP also sets out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or release of hazardous material which could threaten human health or the environment. The SPCC Plan would be implemented for on-site, as well as off-site releases that could threaten human health and the environment, even if the Emergency Response Coordinator does not believe that the spill will leave the site. The Plan deals with

threats to facility personnel, as well as with threats to people outside the facility. Appended to this SPCCP, will be information such as contact list and phone numbers for the Emergency Response Coordinator(s), the EPA, cleanup contractors, and other appropriate national and local agencies who will be contacted in case of a discharge.

Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment will also be maintained at the project area. All fuel storage areas shall be founded on impervious surface and be sited in containment facilities designed to retain 120% of the tank contents. The containment may be either dikes, berms, retaining walls or curbs. Discharge from the containment area shall be directed into gutters which flow to oil-water separators prior to release to the environment. Water discharges to the environment shall be monitored to ensure adherence to water quality.

If there is a discharge from the fuel storage area to the environment, an Emergency Response Coordinator shall respond to that discharge. Spills of fuel oils will be cleaned by mechanical methods and chemical dispersants. The specific method to be used will depend on the quantity and location of the spill. Mechanical cleanup, using booms and skimmers, will be used to recover spills to surface water. Containment booms would be used to control the spread of spilled product and to concentrate the product in thicker surface layers to make recovery easier. In addition, booms will be used to divert and channel oil slicks along desired paths, making them easier to remove from the surface of the water. Skimmers would be used to recover spilled oil from the surface of the water. Skimmers will be either self-propelled or operated from the bank of streams/creeks.

Chemicals dispersants will be used to accelerate the breakup of fuel oil and refined product spills to surface water. Dispersants would be applied immediately following a spill, before the lightest materials in the oil have evaporated. The use of dispersants in freshwater would be authorized by the Emergency Response Coordinator only if it does not pose any threat to human health or the environment. Surface water samples will be recovered from the impacted areas after cleanup to ensure that residual levels of hydrocarbons and other fuel oil constituents do not exceed tolerable limits. If surface water quality has not been water until water in the affected area again attains acceptable water quality.

The SPCC Plan will be reviewed, and be immediately amended whenever the following situations apply:

- ◆ Applicable regulations are revised
- ◆ The plan fails in an emergency
- ◆ The project changes its design, construction, or other circumstances in a way that materially increases the potential for fires, explosions, or releases
- ◆ The list of emergency coordinators changes
- ◆ The list of emergency equipment changes.

Chapter 9: Soils, Land and Geology

9.1. Introduction

Land is the terrestrial part of the earth's surface and is an area or location where we can live and carry out activities for subsistence, wealth-creating employment, leisure activities, and other lifestyle choices. Soil is the top layer of the terrestrial part of the surface of the earth (i.e. land). It contributes towards terrestrial ecosystem services that people rely upon when they use the land for food, shelter and biomass production and these are central to social, economic and environmental sustainability. Soil is a component/subsystem of terrestrial ecosystems, providing a growing medium for flora and habitat for fauna. Soil is one of the main environmental receptors of development impacts.

9.2. Background

The project site is located on the Coastal Plain of Guyana where the soils are predominantly alluvial deposits over organic material and silts comprising the Demerara clay with localized pockets of peat (pagesse). Four different types of clays are associated with the Demerara Formation; the Mara Clay, Brickery Clay, Tuschen Clay, and Lama Muck. At the project site, the clay exposed at the surface consists of the Demerara Clay.

9.3. Policy, Legislations and Regulatory Framework

9.3.1. Town and Country Planning Act Chapter 20:01

Provisions are made in this Act for the orderly and progressive development of land (which is specifically defined), cities, towns, and other areas, either urban or rural, for their preservation and improvement and for other related matters. The prescribed authority, responsible for effecting the provisions of the Act is the Central Housing and Planning Authority established under the Housing Act Chapter 36:20. The Central Housing and Planning Authority will be required to provide consent for the development and regulation of any new settlement associated with the project operations.

9.3.2. Environmental Protection (Hazardous Wastes Management) Regulations, 2000

These regulations outline the rules and procedures to transport, store, treat and dispose of hazardous wastes. There are no regulations for the management of hazardous substances. These regulations are intended to ensure, through the environmental authorization process, that all operations that generate, transport, treat, store and dispose of hazardous wastes are managed in a manner that protects human health and the environment. The regulations allow for the provision of information on the types of facilities and quantity of hazardous waste generated, treatment standards and efforts to reduce the waste generated. An emergency preparedness plan is required for anyone who operates a hazardous waste facility. For the purposes of that regulation, hazardous material/waste is regarded as the following:

- ◆ Explosives
- ◆ Flammable liquids
- ◆ Flammable solids or waste solids other than explosives which may be readily combustible
- ◆ Oxidizing substances
- ◆ Organic peroxides
- ◆ Poisonous substances

- ◆ Infectious substances
- ◆ Corrosives
- ◆ Toxic gases
- ◆ Toxic substances which if inhaled or ingested may cause delayed or chronic effects
- ◆ Eco-toxic substances which if released may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon systems
- ◆ Materials capable, after disposal, of yielding another material which possesses any of the characteristics specified above

The fuel used to power equipment is also classified as a hazardous material. The hazardous wastes regulations will, therefore, apply to fuel oil/used oils at the project site.

9.3.3. **Basel Convention on the Transboundary Movement of Hazardous Waste and their Disposal**

The Basel Convention aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. Guyana is a party to this convention which came into force in 1992. It was designed specifically to prevent the transfer of hazardous waste from developed to less developed countries (LDCs). The Convention is also intended to minimize the amount and toxicity of wastes generated. This ensures that toxic waste is managed as close as possible to the source of generation. Examples of hazardous waste as defined by the convention are:

- ◆ Wastes from the manufacture, formulation, and use of wood preserving chemicals
- ◆ Waste pharmaceuticals, drugs, and medicines
- ◆ Wastes from the production, formulation, and use of organic solvents
- ◆ Waste such as mineral oils that are unfit for their originally intended use
- ◆ Waste oils/water, hydrocarbons/water mixtures, emulsions
- ◆ Wastes from production, formulation, and use of inks, dyes, pigments, paints, lacquers, and varnish

Consequent to this convention, Guyana developed regulations on environmental protection. One of these regulations focuses on the management of hazardous wastes.

9.4. **Baseline**

	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	SP 8	SP 9	SP 10
Texture	Fine									
Permeability	0.06 to 0.34 cm/hr									
Porosity (%)	36.8	45	63.4	44	28	28.7	66	74	51.5	49.7
Bulk Density (g/cm ³)	1.6	1.2	1.09	1.3	1.8	-	1.05	-	1.01	1.03
Moisture Content (%)	87.3	62.1	45.7	47.1	72.3	-	57	-	72.1	61.4

Table 27 : Showing Soil Analysis at Ten Different Points.



Figure 15 : Showing the Sample Points for Soil Testing

9.4.1. Methodology

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 (Multiregional Training and Certification Task Group 2006).

9.4.2. Site Description

The proposed site for the road construction starts from East Coast (Rupert Craig Highway) road at Latitude N 06049.264' and terminates at Great Diamond Connector Road at Longitude W 58005.869' and ends at N 6041.858' & W 58008.779'. The prevailing weather conditions were mostly rainy with intermittent sunny periods; soil samples were collected on sunny days.

9.4.3. Discussion

9.4.4. Permeability and Porosity

The permeability of soil refers to the ease with which it 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 0.06 to 0.34 cm/hr and 28.7% to 74% respectively. In areas where the soil porosity is high e.g. Sample point 8, 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.

9.4.5. 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 between soil particles. The bulk density that was estimated for the study area ranged from 1.01 g/cm³ to 1.8 g/cm³. This was found to closely coincide with bulk density measurements for entisols 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 that the soil along the proposed alignment is suitable for foundation stability and has a high load-bearing capacity (both static and active). This can be increased by using mechanical compaction techniques.

9.4.6. Moisture Content

This parameter was found to be predominantly over 50%. This may be due to the fact that there was a reasonably high frequency of rain during the soil sampling process. The water table along the study area is also very high being not more than one meter 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 causes the formation of small cracks 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 gets highly saturated which can, in turn, disturb the

bituminous layer of the road by forming bulges which can lead to the road becoming uneven and can further be compounded by traffic activity over time.

9.5. Impact Prediction and Evaluation

Potential impacts to soil could result from the development of the roads and the connectors, from vegetation clearance of the project area and infrastructure area footprints. Soil is a complex ecosystem containing millions of living things, including small rodents, insects, worms, algae, fungi, and bacteria. These organisms are important for mixing, aerating the soil particles and aiding in the release or conversion of nutrients in soils into forms that are useful for plants. The development and maintenance of the terrestrial ecosystems, in the project area, depends upon the surficial soils as basic components of the system.

Construction activities will result in soil degradation since minerals necessary to support the ecosystem may be depleted by construction activities. These are moderate impacts (long-term; moderate severity, local extent). These impacts will be mitigated by confining, clearing and excavation activities only to those areas required for the execution of the project. The mitigation measures will result in low impacts (short-term, low severity, local extent).

Site clearing and access road diversion and construction can potentially result in soil loss through increased soil erosion. Roads and other transport lines in the terrain may result in increased soil erosion. If site clearing activities coincide with the rainy season, heavy rainfall may increase erosion on roads and surrounding areas.

Soil erosion may also occur if construction activity blocks natural watercourses. Site clearing and access road maintenance and construction can potentially result in increased soil erosion. These impacts could be pronounced in areas where soil erosion potential is severe. The area has no slopes and as such, the impact of the proposed project would be moderate (medium-term, moderate severity, local extent). The likelihood of soil erosion will be minimized or avoided by the implementation of the following mitigation measures:

- ◆ Implementation of best management practices (Storm Water Management Plan) for soil erosion
- ◆ Implementation of site reclamation activities
- ◆ Installation of channel control structures

These mitigation measures will result in low impacts (short-term, low severity, local extent).

The movement of heavy equipment may cause rutting and compaction of susceptible soils. Near-surface soil compaction will reduce the ability of the soil to absorb water. Furthermore, water already in the soil will become more tightly held and, thus, less available to plants and animals. Compaction will also change the variability of soil temperature. This effect would be most apparent near the surface, where the soil becomes hotter during the day and colder at night. Heavy earthmoving equipment will also increase mechanical erosion and facilitate wind and water erosion of soil materials loosened by their passage.

The construction will be restricted to the proposed project area; compaction, rutting, and erosion would, therefore, be localized to these areas. These impacts to soil resources are

expected to be low (short-term, low severity, local extent). No mitigation would be required. The environmental impacts that are likely to result from the aforementioned activities are:

- ◆ Loss of land due to direct land take
- ◆ Improper disposal of excavated materials
- ◆ Improper disposal of vegetation from land clearing activities

Project Phase	Conditions	Environmental Impact	Significance
Construction and Rehabilitation Phase	Land clearing for the construction of the base camp and roads.	Loss of land through direct land takes for project components. Removal of vegetation, where necessary, to facilitate construction of project facilities, thus, may contribute to erosion.	Lo, Irr, LT, Un, M, Insig.
	Constructing skid trails	Removal of vegetation, where necessary, to facilitate the marking of skid trail and construction of log ponds.	Lo, Irr, LT, Un, M, Insig.
	Operation of machines	Compaction of soil from the operation of heavy-duty machines for construction and rehabilitation works.	Lo, Rev, LT, Un, UM, Insig
	Disposal of materials(vegetation).	Improper disposal of vegetation from land clearing.	Lo, Irr, LT, UM, Un, Insig.
	Storage of fuel and refueling of equipment	Fuel and/or oil spill from the operation of heavy-duty machines can cause soil contamination.	Lo, ST, Irr, Av, M, Sig
Operational Phase	land/soil	Erosion from surface runoff	Lo, Irr, LT, Un, M, Insig
		Soil compaction from the operation of heavy machines	Lo, Rev, LT, Un, UM, Insig
		Contamination of soil from fuel spills /waste oil	Lo, Irr, LT, Av, M, Sig
		Contamination of soil from insecticide/chemicals spills	Lo, Irr, LT, Av, M, Sig
		Improper disposal of solid and liquid waste from living quarters.	Ex, Rev, LT, Av, M, Sig
Impact Significance Parameters			
Lo – Localised	Ex – Extensive	Rev – Reversible	Irr. Irreversible
ST – Short Term	LT – Long Term	Av. – Avoidable	Un - unavoidable
Sig. – Significant	Insig. –Insignificant	M. – Mitigable	UM – Unmitigable

Table 28: Potential Impacts and their Significance

9.6. Mitigation and Monitoring - Environmental and Social Management Plan

Soils will be protected from contamination as detailed in the Spill Prevention and Control Plan. Contaminated soil will be remediated by in situ or ex-situ means as appropriate. In the event of chemical spills, soil samples will be recovered from the impacted areas after cleanup to ensure

that residual levels of hydrocarbons and other fuel oil constituents do not exceed tolerable limits. If these limits are exceeded in the soil, additional soil will be removed from the spill area until the residual levels fall below tolerable limits. The soil excavated from the area shall be disposed of in accordance with the Hazardous Waste Management protocol.

The following measures should be implemented to reduce the impact of erosion and sedimentation activities:

- ◆ Minimize the removal of vegetation to areas where it is absolutely necessary
- ◆ Encourage natural re-vegetation in areas where possible to prevent soil exposure
- ◆ Monitor areas of exposed soil during periods of heavy rainfall
- ◆ Slopes should be constructed at the recommended angle to prevent collapse
- ◆ No harvesting should be done on slopes greater than 40%.
- ◆ Use appropriate machines for all earthworks
- ◆ Designate routes of heavy-duty equipment to prevent compaction of soil
- ◆ Avoid discharging of storm water runoff directly into the nearby watercourses. This discharged can be channeled through the vegetative area which will serve as a natural filter for any sediment contained.
- ◆ If ponding is observed due to compaction, it may be necessary to scarify the topsoil
- ◆ Consider the weather pattern before initiating major earthworks. Earthworks should be avoided during periods of heavy rainfall.
- ◆ Raising low spots on the embankments
- ◆ Routine inspection of dams and structures

9.6.1. Erosion and Sediment Control Plan

Construction will be undertaken with long-term erosion and sediment control as a primary consideration. When construction occurs in the rainy season, the smallest practicable area of erodible land will be exposed and the time of exposure shall be minimized. Natural features, including vegetation, terrain, watercourses and similar resources shall be preserved wherever possible. Site clearing operations will progress in a gradual and phased manner to ensure there are no large increases in sediment discharge. Sediment control structures will be used to prevent the inflow of sediment to surface water. These control practices will include sediment traps and screens to control run-off and sedimentation.

Topsoil overburden shall be stockpiled and redistributed to provide a suitable base for seeding and planting. Runoff from the stockpiled area shall be controlled to prevent erosion and resultant sedimentation of receiving waters. Runoff shall not be discharged from the site in quantities or at velocities substantially above those which occurred before grading. All spoil piles would be surrounded by a soil containment berm to preclude the easy flow of surface runoff and sediment from stockpiles. The containment berms would be constructed of soil pervious enough to enable the passage of surface runoff water while trapping sediment contained in that runoff.

Erosion control operations would be performed under favorable weather conditions. When excessive moisture or other unsatisfactory conditions prevail, the work would be stopped. Erosion control materials will not be applied in adverse weather conditions which could affect their performance. Erosion control will be accomplished by using one of the following:

- ◆ Erosion control blankets

- ◆ Geotextile fabric
- ◆ Seeding

Before placing erosion control blankets the subgrade will be graded smooth with no depressions or void areas and would be free from obstructions, such as tree roots, projecting stones or other foreign matter. No vehicles will be permitted directly on the blankets. Before geotextile fabric is placed, the subgrade shall be compacted and graded level with no depressions, voids, soft or uncompacted areas and shall be free from obstructions, such as tree roots, projecting stones or other foreign matter. Seeding shall then be applied to the areas.

9.6.2. Monitoring Plan

The removal, storage, of topsoil and organic matter would be registered and documented. The removal, storage, treatment, and final disposition of contaminated soils would also be registered and documented.

9.6.3. Hazardous Material Monitoring

Inventories of hazardous material would be monitored to ensure all material is used for the purposes intended. Waste containment areas would be monitored to ensure that the impervious surface upon which they are sited is not breached. The area would be monitored to determine that incompatible chemicals are not stored together and that storm water discharges from the area are channeled to the waterway. Hazardous material inventory data would be reported to the EPA and made available to interested stakeholders.

9.6.4. Solid Waste Monitoring

The solid waste disposal operation would be monitored to determine the effectiveness of the recycling, composting and disposal operations.

Parameter	Institution Responsible	Frequency of Monitoring	Location of Monitoring
Permeability / Porosity / Bulk density / Moisture content	Proponent Contractor	/ Monthly	Immediate project site
Soil contamination from chemical/oil spill	Proponent Contractor / Contractor	/ Weekly	Immediate project site and base camp
Loss of top soil due to temporary access roads and work areas	Proponent/ Contractor	After construction works	At access roads and work sites
Cleaning of access roads and work sites after construction works completion	Contractor, Supervisor Engineer	After construction works	At access roads and work sites

Table 29: Soil Quality Monitoring Plan

Chapter 10:

Air Quality

10.1. Introduction

The development has the potential to alter air pollutants concentrations from the baseline situation and may affect people, plants, animals, materials and buildings. Development also has the potential to create a local dust nuisance due to earth-moving and material-handling operations during periods of dry weather if appropriate mitigation measures are successfully implemented. Combustion engines may give rise to both routine and non-routine pollutant emissions. Non-routine emissions may include accidental releases.

10.2. Background

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

10.3. Methodology

Air Quality Monitoring for PM₁₀ and PM_{2.5} particulate matters were conducted for three days in May, 2018, using the SKC Environmental Particulate Air Monitor Model: SKC EPAM-5000. The SKC Environmental Particulate Air Monitor Model: SKC EPAM-5000 was utilized to provide a complete real-time profile and graphical representation of airborne particulate levels and exposures with data presented in milligrams per cubic meter (mg/m³). A twelve-hour monitoring period was used, from 07:00 hrs to 19:00 hrs. 20 minutes duration was utilized for each monitoring point, for both PM₁₀ and PM_{2.5}. After all, 10 sampling points were monitored; the cycle began for the second round of monitoring. On the second day, monitoring started at sample point 10 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.

10.4. Policy, Legislation and Regulatory Framework

10.4.1. Environmental Protection Air Quality Regulations 2000

Environmental Protection (Air Quality) regulations were developed in 2000 under the Environmental Protection Act 1996. In accordance with these regulations anyone who emits any air contaminant in the construction, installation, operation, modification or extension of any facility related to industry, commerce, agriculture or any institution shall apply to the EPA for an environmental authorization and shall apply to the EPA at least one hundred and eighty days before the date on which the emission is to commence. In accordance with the regulations, the EPA shall establish parameter limits with respect to the emission of smoke, solid particles, sulfuric acid mist or sulfuric trioxide, fluoride compounds, hydrogen chloride, chlorine, hydrogen sulfide, nitric acid or oxides of nitrogen and carbon monoxide. No parameters limits have been mandated to date.

10.4.2. WHO Guidelines

The WHO guideline values are based on the lowest concentration of a pollutant that has been shown to produce adverse health effects or the level at which no observed health effect has been demonstrated, plus a margin of protection to safeguard sensitive groups within the population. Sensitive groups include people with asthma, those with pre-existing heart and lung

diseases, the elderly, infants, and pregnant women and their unborn babies. Some pollutants, notably carcinogenic pollutants (e.g. arsenic, benzene, chromium, polycyclic aromatic hydrocarbons (PAHs) and vinyl chloride) have not been given a guideline value. Instead, exposure-effect information is provided, giving guidance to risk managers about the major health impact for short- and long-term exposure to various levels of this pollutant.

The WHO guideline values are based on health considerations alone and do not consider the technical feasibility or the economic, political and social dimensions of attainment. In the absence of parameter limits, this project proposes to adhere to WHO Ambient Air Quality (2007) and World Bank Guidelines. The WHO ambient air quality guidelines are detailed below:

Pollutant	Averaging Time	Guideline Value
PM 2.5	24 h	25 µg/m ³
	Annual	10 µg/m ³
PM	24 h	50 µg/m ³
	Annual	20 µg/m ³
Nitrogen dioxide	1 h	200 µg/m ³
	Annual	40 µg/m ³
Sulphur dioxide	10 min	500 µg/m ³
	1 h	
	3 h	
	24 h	20 µg/m ³
Carbon monoxide	15 min	100 µg/m ³
	30 min	60 µg/m ³
	1 h	30 µg/m ³
	8 h	10 µg/m ³
Ozone	8 h	100 µg/m ³
Benzene	Annual	20 µg/m ³
Dichloromethane	24 h	3 mg/m ³
Formaldehyde	30 min	0.1 mg/m ³
PAHso	UR/ Lifetime	8.7×10 ⁻⁵ (µg/m ³)
	Annual	-
Styrene	1 week	0.26 mg/m ³
Tetrachloroethylene	Annual	0.25 mg/m ³
Toluene	1 week	0.26 mg/m ³
Trichloethylene	UR/lifetime	4.3×10 ⁻⁷ (µg/m ³)

Table 30: WHO Air Quality Guidelines

10.4.3. World Bank Air Quality Guidelines

The World Bank guidelines limit concentrations of contaminants in ambient air, measured at the project property boundary to the following limits:

Particulate matter (<10 mm)

Annual Arithmetic Mean	100 mg/m ³
Maximum 24-hour Average	500 mg/m ³

Nitrogen Oxides as NO₂

Annual Arithmetic Mean	100 mg/m ³
Maximum 24-hour Average	200 mg/m ³

Sulphur Dioxide

Annual Arithmetic Mean	100 mg/m ³
Maximum 24-hour Average	500 mg/m ³

If warranted, emission modeling will be conducted to determine whether the most stringent of these air quality standards will be exceeded. If these standards are exceeded mitigation measures will be identified to minimize impacts associated therewith.

10.5. Baseline

During May, 2018, the level of PM₁₀, and PM 2.5 were recorded, in ambient air, at ten (10) locations. The locations and levels of PM₁₀ and PM_{2.5} recorded at detailed in Tables below. Sample Points are shown in Figure 15.

Day	Time	Concentration (µg/m ³)	
		PM 2.5	PM 10
1	7:13	72	9
	8:15	14	8
	9:10	5	10
	10:10	8	9
	11:10	7	15
	12:10	2	7
	1:10	5	6
	2:15	5	1
	3:15	3	9
	4:10	nil	14
2	8:10	5	12
	9:15	3	9

Day	Concentration ($\mu\text{g}/\text{m}^3$)		
	Time	PM 2.5	PM 10
	9:45	15	13
	10:30	7	8
	11:00	9	Nil
	11:45	22	12
	12:30	11	22
	1:30	6	9
	2:30	21	18
	3:35	7	25
3	6:50	17	2
	7:45	5	12
	8:45	13	83
	9:30	5	4
	10:30	3	11
	11:35	7	10
	12:05	9	3
	1:30	12	13
	2:30	3	4
	3:35	21	5

Table 31: Showing the Day Time Levels of PM10 and PM2.5 within Area of Influence

Night	Concentration ($\mu\text{g}/\text{m}^3$)		
	Time	PM 2.5	PM 10
1	17: 04	14	12
	17:30	12	8
	18:00	27	17
	18:30	22	22
	19:05	13	19
	19:30	9	32

Night	Concentration ($\mu\text{g}/\text{m}^3$)		
	Time	PM 2.5	PM 10
	20:00	263	23
	20:40	69	6
	21: 30	10	9
	22:10	11	16
2	16:30	11	11
	17:00	7	9
	17: 45	9	14
	18:15	5	7
	19:35	12	9
	19:55	11	21
	20:05	13	35
	21:00	7	32
	21:50	22	68
	22:45	48	45
3	17:04	34	22
	17:30	68	46
	18:00	27	23
	18:35	16	24
	19:05	18	19
	19:55	8	22
	20:00	12	17
	21:00	7	17
	22:00	9	18
	22:55	10	9

Table 32: Showing the Night-Time Levels of PM10 and PM2.5 within the Area of Influence



Figure 16 : Showing the Air Monitoring Locations

The results of PM10 and PM 2.5 day time samplings are shown in the above table. Nine of the locations had average particulate PM10 values compliant with the 24-hour WHO standard of $50\mu\text{g}/\text{m}^3$. Similarly, nine locations had average particulate PM 2.5 values compliant with the 24-hour of $25\mu\text{g}/\text{m}^3$. The proximity of the monitoring stations to the existing roadway will result in the stirring up of particulates from vehicles traversing the road. Day 3, Station 3, recorded the highest average PM10 ($83\mu\text{g}/\text{m}^3$) while, Day 1, Station 1 recorded the highest average PM 2.5 ($72\mu\text{g}/\text{m}^3$). The elevated PM2.5 and PM 10 values along the existing roadway was due to exhaust emissions and Bar-b-Que grilling within the area at the said time, respectively. However, on Day 1 and Day 2, that equipment malfunctioned at two locations leading the the nil values.

The results of PM10 and PM 2.5 night-time samplings are shown in the above table. Nine of locations had average particulate PM10 values compliant with the 24-hour WHO standard of $50\mu\text{g}/\text{m}^3$. Similarly, five locations had average particulate PM 2.5 values compliant with the 24-hour of $25\mu\text{g}/\text{m}^3$. The proximity of the monitoring stations to the existing roadway and residential property will result in the stirring up of particulates from vehicles traversing the road. Station 2 had the highest average PM10 ($68\mu\text{g}/\text{m}^3$) while Station 7 recorded the highest average PM 2.5 ($263\mu\text{g}/\text{m}^3$). The elevated PM2.5 value along the existing roadway maybe because of exhaust emissions from motor vehicles or from residential burning of fires.

10.6. Impact Prediction and Evaluation

Construction works will result in emissions of fugitive dust and products of combustion. Dust generated would be a function of construction activities, soil type, moisture content, wind speed, frequency of precipitation, vehicle traffic, and vehicle type. Dust is broadly defined as small solid particles created by the break-up of larger particles. Depending on their size, dust particles can become hazardous to worker health, particularly when suspended in the air. The largest size particle that can be suspended in the air for long periods of time from wind velocity acting upon it is about 60 micrometers (μm), which is about the thickness of a human hair.

Particles ranging from about 60 to 2,000 μm can also become suspended in air, but they only reach heights up to approximately three feet above the ground before they fall back to the surface. Particles larger than about 2,000 μm generally creep or roll along the surface due to wind velocity acting upon them. These larger particles of dust can affect the nasal passages, causing an irritated and congested nose, and might also cause an irritant cough should they be deposited in the throat. Smaller airborne particles of dust, which can remain suspended in the air for hours, pose a risk to the respiratory system when inhaled. In general, the smaller the aerodynamic diameter of the inhaled dust particle, the more likely it will be deposited deep in the respiratory tract. Fugitive emissions would be greater during dry periods. Dust emissions from roads would occur for the duration of both the construction and operation phases.

The impacts to air quality would, therefore, be low (medium-term, medium severity, local extent). These impacts will be mitigated by employing the following measures:

- ◆ Minimizing drop heights from excavation equipment
- ◆ Limiting vehicle speed to a maximum of 30 km/hr.
- ◆ Employing dust suppression techniques such as applying water or non-toxic chemicals
- ◆ Maintaining construction equipment according to manufacturer's specifications

- ◆ Providing facemasks with dust removal filters
- ◆ Conducting periodic medical checks of employees for the effects of dust exposure
- ◆ Providing goggles and eyewash lotion for dust-induced eye irritation.

Implementation of the mitigation measures will result in low impacts (short-term, low severity, local extent).

Combustion emissions would result from the use of diesel and/or gasoline-fired heavy-duty equipment. Products of combustion will include Benzene, PM10, PM2.5, carbon monoxide, NO_x, SO₂, VOCs –a precursor of ozone and hydrocarbons. Ozone, sulfur dioxide, fine particulates, and nitrogen dioxide have both acute and chronic health effects. Carbon monoxide has acute effects only, whereas lead, being a toxic metal, has chronic effects (at ambient air levels). Ozone is a strong oxidizer that affects the respiratory system and may lead to damage to lung tissues. Its acute effects include cough and chest pain, eye irritation, headaches, lung function losses, and asthma attacks. The acute effects of sulfur dioxide include irritation and restriction of air passages. There is reduced mucus clearance from the restricted air passages and chest tightness. Under normal conditions, the lung passages are open, however, the lung passages constrict in a response to SO₂. This constriction further aggravates other health conditions. Sulfur dioxide also causes immune system suppression and increases the probability of bronchitis. There are some indications that chronic exposure to sulfur dioxide may also act as a cancer promoter in addition to an immune system suppressor.

Exposure to elevated concentrations of fine particulates increases mortality rate, increases the incidence of asthma and bronchitis, and rates of infection in the respiratory system. Particulates also directly irritate the respiratory tract, constrict airways, and interfere with the mucous lining of the lung passages. The chronic effects of fine particulates include loss of lung capacity and lung damage, resulting from scarring caused when fine particulates are not cleared from the lung passages or alveoli. Fine particulates also act as carriers for toxic contaminants and heavy metals particularly when the contaminants exist in a fume or a vapor state and condense onto the fine particulates. In the alveolar regions, heavy metals may be absorbed into the blood and circulated to other parts of the body. Particulates and fine particulate fractions are also responsible for visibility reduction.

The acute effects of nitrogen dioxide are both direct and indirect. The direct effects are damage to the cell membranes in the lung tissues as well as constriction of the airway passages. Asthmatics are affected by these acute effects. The indirect effects are that nitrogen dioxide causes edema, or a filling of the intercellular spaces with fluid, which may develop into local areas of infection.

Carbon monoxide affects health through binding with hemoglobin in the blood. Hemoglobin is the oxygen-carrying protein that is responsible for the oxygen and CO₂ exchanges necessary for life. When CO binds to hemoglobin, the blood loses its ability to transmit vital oxygen to all tissues of the body. At high levels of carbon monoxide, the potential exists for asphyxiation. In addition, carbon monoxide causes performance impairment, slow reflexes, fatigue, and headaches due to the lack of oxygen in the brain. It also results in aggravated heart and lung disease symptoms as well as impairments in the central nervous system and brain functions.

Aromatic compounds such as benzene, directly affect the central nervous system by asphyxiation resulting from the loss of oxygen to the brain.

A list identifying equipment, number of pieces, manufacturers and capacity which will generate emissions during construction is presented in Appendix 2.

The operation phase of the project will see the generation of dust and combustion emissions from:

- ◆ Operation of heavy-duty equipment using the roads
- ◆ Operation of vehicles traversing the roads

Stripping topsoil and overburden will generate dust when undertaken in the dry season. Dust emissions from blasting, loading, and unloading of haul trucks haul roads, milling equipment, material stockpiles, and other fugitive dust-generating operations would occur over the duration of the operation. This will result in moderate impacts (medium-term, moderate severity, local extent). Dust and other emissions from haul roads and other sources will be mitigated by employing the following measures:

- ◆ Minimizing drop heights from vehicles
- ◆ Limiting vehicle speed
- ◆ Employing dust suppression techniques such as applying water or non-toxic chemicals
- ◆ Maintaining construction equipment according to manufacturer's specifications

Implementation of these mitigation measures will result in low impacts (short-term, low severity, local extent).

Dust would be emitted from the access road surface and from unsurfaced areas during operation. Equipment traversing the road will emit products of combustion. Equipment passage over the access road will be intermittent. The impacts to air quality would, therefore, be moderate (short-term, moderate severity, local extent). These impacts will be mitigated by employing the following measures:

- ◆ Limiting vehicle speed

Implementation of the mitigation measures will result in low impacts (short-term, low severity, local extent).

10.6.1. Power Generation

The Construction Phase will require a substantial supply of electrical energy and would be provided by three (3) diesel-powered generators with the following specifications.;

- ◆ 33 KVAGenerator
- ◆ 100 KVAGenerator
- ◆ 250 KVAGenerator

The generators will be fueled by heavy fuel oil, and the heat from the exhaust of the generators will be used to preheat the fuel oil to increase combustion efficiencies. An air quality monitoring

was not done to examine the impacts of the proposed power generating equipment, however, if warrant, it can be done.

The power generation units would comply with the air quality sections of the IFC Environmental, Health, and Safety General Guidelines. In accordance with the general guidelines, it was assumed that the stack would be constructed in accordance with Good International Industry Practice (GIIP) guidelines and would therefore not be subject to aerodynamic downwash from nearby buildings and structures.

Project Phase	Condition	Environmental Impact	Significance
Construction	Operation of heavy-duty Machines and equipment.	Fumes from the operation of machinery and equipment used during the construction of the base facilities and roads, culverts, and bridges can affect workers.	Lo, Rev, ST, Av, M, Insig.
	Operation of machines & storage of materials.	Dust from land clearing for construction activities, material stockpiles for road rehabilitation and constant movement of heavy duty equipment can affect workers.	Lo, Rev, ST, Av, M, Sig.
		Dust from the waste disposal area	Lo, Rev, ST, Av, M, Insig
		Fumes from the operation of heavy-duty machines and generator	Lo, Rev, LT, Av, M, Insig
Impact Significance Parameters			
Lo – Localised	Ex – Extensive	Rev – Reversible	Irr. Irreversible
ST – Short Term	LT – Long Term	Av. – Avoidable	Un - unavoidable
Sig. – Significant	Insig. – Insignificant	M. – Mitigable	UM – Unmitigable

Table 33: Potential Air Quality Impacts and their Significance

10.7. Mitigation and monitoring - Environmental and Social Management Plan

To reduce impacts on air quality the following measures will be taken;

- ◆ Institute a speed limit for vehicles around the housing and construction areas to reduce the quantity of airborne particulate matter;
- ◆ Where practical, ensure roads around the campsite are watered during the dry season to keep dust levels down;
- ◆ No open dumping or burning of wood waste or vegetation should be done;
- ◆ Travel surfaces will be maintained to minimize silt (fine material);
- ◆ If further mitigation is required at specific locations (e.g., active stockpiles), dedicated water sprays will be employed;
- ◆ Enclosing dusty materials storage areas by installing efficient dust suppression equipment in these areas;
- ◆ Emission reductions achieved through the use of current equipment that complies with WHO standard;
- ◆ Record all dust and air quality complaints, identify the cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. Make the complaints log available to the local authority when asked;

- ◆ Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the logbook; and
- ◆ Maintaining a vegetated buffer zone on the project boundary

Water would be used as the primary dust suppressant. Other suppressants may include surfactants, petroleum emulsions, polymers, and adhesives. Selection of the preferred agent for use will depend on conditions of the area. Performance of each dust control agent would be evaluated based on control efficiency which compares the dust concentration of a treated road surface to that of an untreated or uncontrolled road surface. Equipment to be used for the application of the dust suppressants will include a road grader equipped with scarifiers, a compactor, and a water truck for distribution of the suppressant to the road surface. Water will be periodically sprinkled on roads, stock piles and spoil piles to control dust emissions.

Other emissions to air would include NO_x, CO, VOCs, SO₂, PM₁₀, PM_{2.5}, and hazardous air pollutants (HAPs) from the operation of gasoline and diesel fired equipment. These emissions would be reduced to minimum levels by following the protocols of the manufacturer for equipment use and maintenance.

10.7.1. Monitoring Plan

- ◆ Vehicles and non-stationary equipment would be visually monitored to identify any vehicles or equipment with visible particulate emissions that should be repaired or maintained.
- ◆ Roads and roadside vegetation would be monitored to ensure that excessive dust is not emitted by vehicle traffic, construction, and maintenance activities. Dust emissions from the stockpiles would be visually monitored and corrective actions implemented if required. Corrective actions may include wetting or covering the stockpiles to reduce dust emission.

Parameter	Institution Responsible	Frequency of Monitoring	Location of monitoring
Air Quality / Dust accumulation and suspended particles	Proponent/ Contractor	Daily Annually	Operational areas in the construction site and the base camp
Atmospheric Pollutants	Proponent/ Contractor	Annually	Monitor volume of diesel, oil, gas used by vehicles and energy generation. Calculate emissions using accepted conversion factors and report against all major source of emissions.
Transport of materials and movement of machines	Proponent / Contractor	Daily	Project site
Sprinkling of water to suppress the dust	Contractor, Supervisor Engineer	Daily	Project site

Table 34: Air Quality Monitoring Plan

Chapter 11:

Climate and Climate Change

11.1. Introduction

Guyana is located within the Equatorial Trough (ET) Zone that presents wet tropical weather and a climate influenced by seasonal shifts of this trough and its associated Zone of rain-bands known as Inter-Tropical Convergence Zone (ITCZ) (SNC, 2012). Formation of El Niño and La Niña can disturb the regular location of the ITCZ which may result in higher or lower than normal rainfall at specific locations. The El Niño/La Niña is primarily responsible for inter-annual variation in rainfall.

Climate change is a political, social and economic challenge which requires action at global, national, local and individual scales. The first legally binding agreement to take urgent global action to address climate change was reached at the UN Climate Conference in Paris on December 2015, where 195 countries committed to (UN 2015 Art 2, 1a and 1b) holding the increase in global temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change, and increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a way that does not limit food production.

11.2. Background

Ogle East Coast Demerara and Diamond East Bank Demerara areas are part of the pre-urban footprint of Region 4 (Demerara- Mahaica). The climate of Region 4 is tropical, hot and humid along the coast and the climate is moderated by northeast trade winds. There are two rainy seasons (April-July and November-January) and two dry seasons (February-April and July-November) in both regions (PRD-CDC, 2016).

11.3. Policy, Legislation and Regulatory Framework

11.3.1. United Nations Framework on Climate Change.

This convention takes into account the fact that climate change has transboundary impacts. The basic objective of this convention is to provide for agreed limits on the release of greenhouse gases into the atmosphere so as to prevent the occurrence of climate change. It also aims to prepare countries to minimize the impact of climate change should it occur.

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, atmosphere and clouds. This property causes the greenhouse effect. Water vapor (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (C₄H₄) and ozone (O₃) are the primary greenhouse gases in the earth's atmosphere. Fluorinated gases were also covered under the Kyoto Protocol.

11.3.2. Low Carbon Development Strategy (LCDS)

The LCDS indicates that Guyana "supports international proposals to cut greenhouse gas emissions from deforestation and forest degradation in half by 2020 and make the global forestry sector carbon neutral by 2030 – where emissions from deforestation and forest degradation are balanced by new forest growth."

The LCDS recognizes Guyana must “Reform existing forest-dependent sectors, including forestry and mining, where necessary so that these sectors can operate at the standards necessary to sustainably protect Guyana’s forest”.

Guyana and Norway, subsequent to publication of the initial LCDS document, signed a Memorandum of Understanding related to the reduction in emissions thru deforestation and degradation. The agreement indicates that Norway would provide Guyana with result-based payments for forest climate services. Norway payments will total US \$250 million over the period 2010 – 2015 and would be based on performance as related to reductions in deforestation and degradation. “The Governments of Norway and Guyana believe that this can provide the world with a working example of how REDD+ might operate for a High Forest Low Deforestation (HFLD) country”.

11.3.3. Green State Development Strategy and Financing Mechanisms

Guyana is committed to developing a green economy to ensure the sustainable management of natural resources and balance economic growth with the preservation of the country's environmental treasures for generations to come. Guyana's commitment to green growth has been demonstrated by its pioneering environmental international partnerships and its status as a signatory to the Paris Agreement on Climate Change.

The Green State Development Strategy (GSDS) considers and puts emphasis on the balance between the three dimensions of sustainable development: economic, social and environmental to ensure comprehensive implementation of the 2030 Agenda and SDGs.

11.3.4. Paris Agreement

The Paris Agreement’s central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to increase the ability of countries to deal with the impacts of climate change, and at making finance flows consistent with a low greenhouse gases (GHGs) emissions and climate-resilient pathway.

To reach these ambitious goals, appropriate mobilization and provision of financial resources, a new technology framework and enhanced capacity-building is to be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for an enhanced transparency framework for action and support. Guyana became a signatory to the agreement in 2016.

11.4. Baseline

11.4.1. Precipitation and Temperature

Region four presents an average monthly temperature of approximately 26.6 °C (World Bank, 2017). Figure below Shows the average monthly temperature for the region indicates that there is a small variation in air temperature throughout the year.

The coldest month of the year is January, while October is the warmest. Figure 14 shows the historical average, maximum and minimum rainfall registered at the Georgetown climatological station operated by Hydro-meteorological Service for the 1971-2017 period.

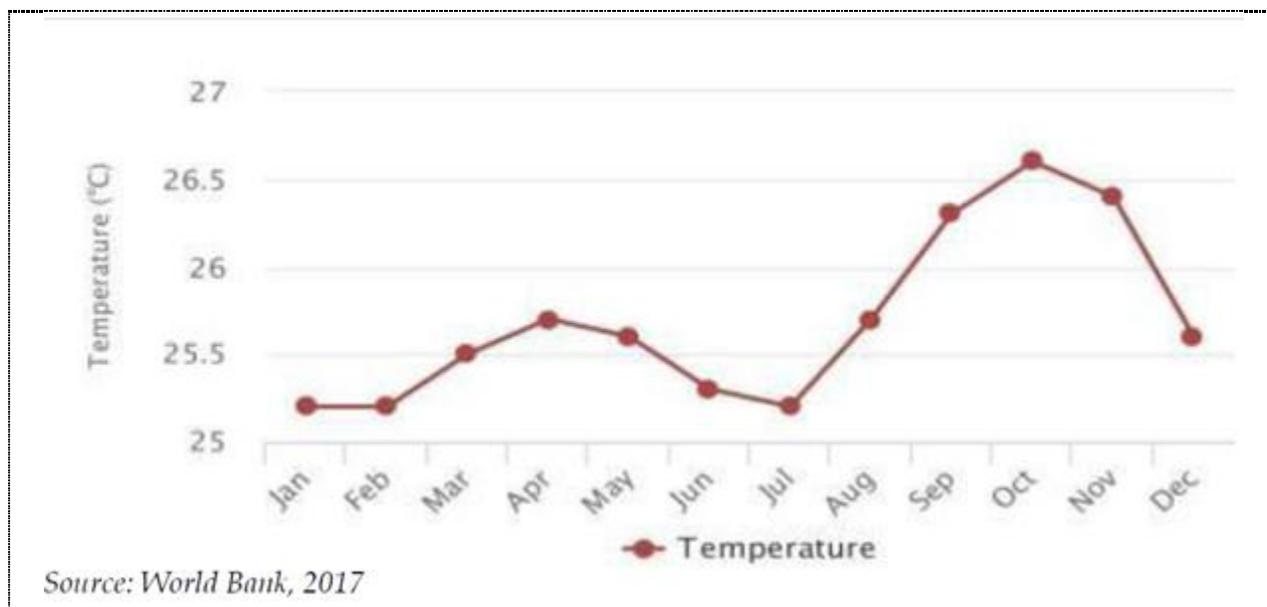


Figure 17 Average monthly temperature and rainfall for Guyana at location (6.79°,- 58.14°) for Region 4 based on records for the 1901-2015 period (World Bank 2017)

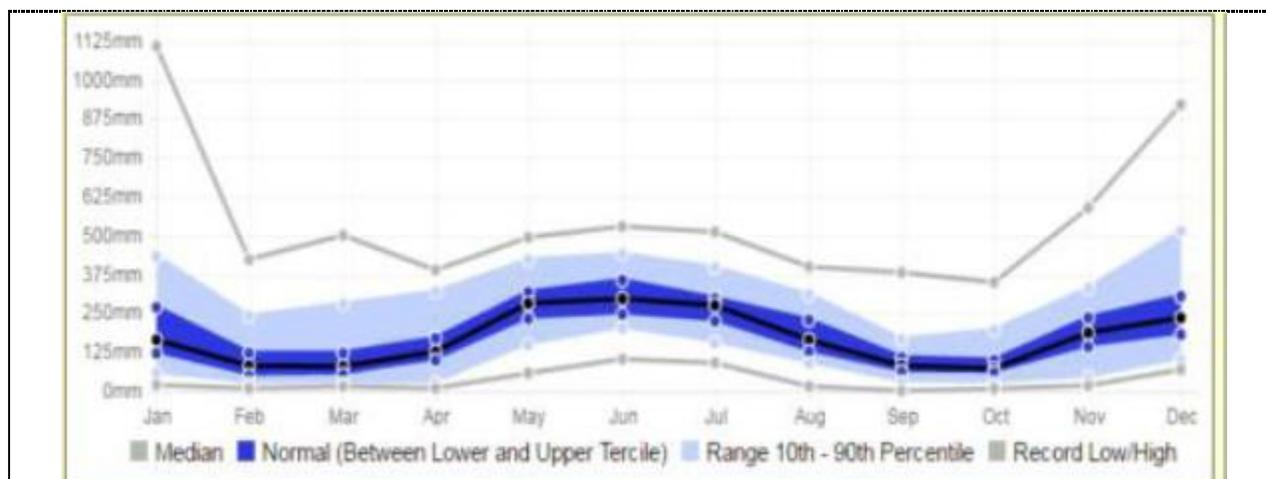


Figure 18 Seasonal Precipitation Variation for Georgetown based on records for 1971-2017 period (Hydro-met division 2018)

11.4.2. Greenhouse Gases

The Government of Guyana through its Ministry of Agriculture prepared its Second National Communication to the UNFCCC. The SNC details trends in Greenhouse Gas emissions from the base year 1990 up to 2004. The report concluded "For the period examined (1990-2004), there are no real apparent trends in GHG emissions" and goes on to state "CO2 emissions (Reference) range between 1,246 Gg (1992) and 1,813 Gg (1998), whereas GHG Removals (Forestry) vary between 65,318 Gg (1990) and 59,333 Gg (2004). However, when compared to the Initial National Communication (INC) of Guyana, GHG removals from the Land Use, Land-Use Change, and Forestry (LULUCF) sector was - 29,195 Gg for the year 1994. This change is due to the fact that for the sub-module on Changes in Forests and Other Woody Biomass Stocks, 15 % of the entire forest area (16.45 million hectares) of Guyana is now considered to be anthropogenically impacted, whereas for the INC only part of the forest area (2.273 million hectares: 13.8 %) was

considered as being affected by human activities. The categorization of forest classes was also changed from moist dry, and moist, to essentially moist.”

The report also examined non-carbon dioxide emissions and goes on to state “The non-CO₂ gases emissions are also remarkably stable from year to year. CH₄ emissions vary between 44 Gg (2002) and 56 Gg (2003). N₂O emissions remain stable at around 1 Gg for all years. CO, however, ranges from 205 Gg (1995) to 254 Gg (1990-1994). Finally, NMVOC emissions vary between 24 Gg (2000) and 30 Gg (1992-1994).

11.5. Impact prediction and Evaluation

The project can alter the local climate in many ways. Exposed topsoil, construction of new roads, culverts, bridges, rehabilitation of existing roads, and buildings will replace natural vegetation at several locations within the project area. The new asphalt road and its auxiliary components would also be added to the natural landscape. During the construction and operational phase, exposed land surfaces have greater heat conduction, and more heat storage than the natural land covers they replace. Heat energy would also be added at the construction site by the operation of heavy-duty equipment and power generation. Evaporation and transpiration from various natural surfaces existing prior to the main alignment would have acted to cool the land surface and local atmosphere. Drainage systems created for the road project will rapidly remove surface water from the project area making less water available for cooling. The road construction area will, therefore, become warmer than surrounding areas. This is a moderate impact (long-term, moderate severity, local extent). These impacts will be mitigated by minimizing the areas of exposed soil and revegetation along the roadway to compensate. This will result in low impacts (medium-term, low severity, local extent).

During the construction phase, several heavy-duty equipment would be utilized, all of which are energy-intensive. Energy generation at the construction site will be based on the consumption of fossil fuel which will release carbon dioxide (CO₂), a prominent greenhouse gas (GHG) to the atmosphere. Subsequently, the operational phase will see an influx of vehicles that would be using the Main Alignment, will add to CO₂ emissions. These are moderate impacts (long-term, moderate severity, national extent). Greenhouse gas emissions will be reduced by minimizing waiting times of heavy-duty equipment, reducing rolling resistance, and optimizing fuel efficiency. The mitigation measures will result in low impacts (long-term, low severity, regional extent).

Roads interact with the climate at a wide range of scales. At local scales, highly developed areas (urban centers) have been shown to experience an increase in temperature in a process called the urban-heat-island effect. Urban heating can also result in increased rainfall. Roads change the albedo (fraction of light reflected by a surface) and other surface characteristics, but other structures, such as buildings, parking lots and sidewalks also contribute to heat-island effects.

Local climate might also be affected simply by the presence of the road and associated development. The loss of pervious surfaces and vegetation and their replacement with impervious surfaces that hold heat and do not respire result in localized temperature increases. temperature increases can result in increased volatilization of organic contaminants from vehicular emissions.

11.6. Mitigation and monitoring - Environmental and Social Management Plan

Climate change will be mitigated by employing a resource hierarchy for energy at all stages of the project (construction and operation) and through the supply chains and will include:

- ◆ Adopting alternatives to avoid GHG emissions where possible;
- ◆ Minimizing energy use through energy-efficient design and energy conservation;
- ◆ Employ renewable (non-fossil fuel sources) and low-carbon materials such as geosynthetic materials.
- ◆ Employ sources with co-benefits such as combined heat and power stations. This would minimize project impacts, which can adversely affect climate change.
- ◆ Mitigation will also include offsetting measures, where possible, such as enhancement of natural carbon sinks by retaining vegetated areas to the maximum extent possible and by considering carbon management programs or clean technology such as renewable energy schemes for residential and other facilities.

Project Phase I	Impacts	Source	Project Impacts Rating	Mitigation Measures	Impact Rating after Mitigation
Construction	Loss of sequestration capacity	Vegetation Clearing	Moderate (long-term, medium severity, extent) Local	Phased vegetation clearing	Low (short-term, low severity, local extent).
	Increases CO2 emissions	Energy generation Operation of equipment	Moderate (long-term, moderate severity, national extent).	Reduced and minimization of equipment waiting times, Reduced rolling resistance by proper maintenance Optimizing fuel efficiency	Low (long-term, low severity, regional extent)
Operational	Increases CO2 emissions	Energy generation Operation of equipment	Moderate (long-term, moderate severity, national extent).	Reduced and minimization of equipment waiting times, Reduced rolling resistance by proper maintenance Optimizing fuel efficiency	Low (long-term, low severity, regional extent)

Table 35: Summary of Climate and Climate Change Impacts

Chapter 12: Biological and Ecological Resources and Ecosystem Services

12.1. Introduction

The vegetation in the project area is represented mainly by members of the Poaceae and Cyperaceae families such as *Cynodon dactylon*, *Axonopus affinis*, *Cyperus rotundus*, and *Cyperus digitatus*. The larger trees that are more common are *Samanea saman* and *Terminalia catappa*. It is expected that some trees will be needed to be cut for the construction and rehabilitation works planned for the Project. The birds and amphibians that are expected to be present are common to Guyana's coast and easily found in similar environments. Most of the fauna species are quite common to the coastal zone of Georgetown.

12.2. Background

Ecologically the project site lies within both altered and unaltered areas. Hence, the project site can be described as both disturbed and undisturbed. The terrestrial ecosystem within the project site such as at the ogle access road, great diamond, Haag Bosch Road, Aubrey Barker, and Mocha Arcadia road is comprised of secondary disturbed vegetation mainly consisting of grasses and shrubs. None of the vegetation along these altered sites has significant ecological values. Complete removal of vegetation is common among some sections of the Great Diamond and Aubrey Barker, especially in the vicinity of business premises. In some areas, concrete pavement replaces lost vegetation.



Figure 19 Pavement covered with cement on Aubrey Barker Road

Open drains varying in diameter and depth borders the four connectors as well as the ogle airport road. In most parts, the drains are covered with aquatic plants. Garbage and other household waste were commonly encountered along the Haag Bosch road and Aubrey Barker road; however, there appeared to be less dumping of garbage along the Ogle airport road. Generally, garbage comprised mainly household refuse, old furniture, and construction materials. Styrofoam boxes, plastic and glass bottles, and cloth were frequently observed in illegal dumpsites which were more common along Aubrey Barker Road.

12.3. Policy, Legislation and Regulatory Framework

12.3.1. Wildlife Conservation and Management Act (2016)

This Act provides for the protection, conservation, and management, and sustainable use, internal and external trade of Guyana's wildlife. It established and incorporated the Guyana Wildlife Conservation and Management Commission and identifies the power of the Minister to give directions to the Commission. The functions of the Commission and duties of the Commission are detailed in the Act which established a Wildlife Scientific Committee and detailed the functions of Wildlife Scientific Committee. The Act recognizes the Guyana Wildlife Conservation and Management Commission as the CITES Management Authority for Guyana.

The mandate of the Commission, according to the act, includes development and recommendation of strategies in the field of conservation, management and sustainable use of species of wildlife, consulting with the Wildlife Scientific Committee on the scientific aspects of the conservation, management and sustainable use of species of wildlife, developing, implementing and monitoring collaborative arrangements for the conservation, management and sustainable use of wildlife and coordinating in consultation with stakeholders, the establishment and maintenance of wildlife conservation and management plans and programs. This project involves no trade in wildlife. The sole aspect of this Act applicable to this project relates to the plans for the management of the biological resources located within the mine site area.

12.3.2. National Biodiversity Action Plan

The National Biodiversity Action Plan (NBAP) was prepared in 1999 to integrate the implementation of the Convention on Biological Diversity into national development. The overall goal of the NBAP was "to promote and achieve the conservation of Guyana's biodiversity, to use its components in a sustainable way, and to encourage the fair and equitable sharing of benefits arising out of the use of Guyana's biodiversity".

The stated objectives of the plan are to:

- ◆ Evaluate the state of capacity nationally to achieve the above goal
- ◆ Identify gaps and needs relating to achieving the above goal
- ◆ Propose actions to achieve this goal and close the gaps
- ◆ Develop activities in a number of priority areas relating to the overall goal
- ◆ Identify the roles and responsibilities of the various stakeholder groups in the implementation of the plan
- ◆ Increase public awareness of biodiversity.

The plan included several program areas partitioned under two phases with various actions for execution. Phase 1 identified, foundation programs that are essential for sustainable biodiversity planning and management. This included Human Resources and Institutional Capacity Building. Phase 2 on the other hand, consolidated phase 1 and initiated additional interventions for the second cycle of the plan. The program area for the additional interventions included a Biodiversity Action Plan.

This plan entered its second cycle in 2007 to focus mainly on conservation and sustainable use of biodiversity and sharing of benefits. It retained as its cornerstone the goal and seven objectives from the previous plan. Four thematic natural resource areas are listed as requiring attention. These are

1. Forests,
2. Agriculture,
3. Coastal resources, and
4. Marine resources

12.3.3. Convention on Biological Diversity

Guyana ratified this Convention on August 12, 1992. It was entered into force on November 12, 1997. The National Focal Point and the Implementing Agency is the Environmental Protection Agency. The objectives of the Convention include the conservation of biological diversity (defined as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexities of which they are part including diversity within species, between species and of ecosystems), the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The provisions of the Convention apply to areas within the limits of national jurisdiction of contracting parties. Contracting parties are required under Article 7 of the Convention to identify processes and activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity and to monitor their effects through sampling and other techniques. Parties are, also as far as is possible and as appropriate, required to establish protected areas or areas where special measures need to be taken to conserve biological diversity.

In areas adjacent to these protected areas, environmentally sound and sustainable development should also be promoted. Article 8 requires that degraded ecosystems be rehabilitated and restored and the recovery of threatened species be done through the development and implementation of plans or management strategies. Contracting parties are also required to regulate or manage relevant processes or activities where a significant adverse effect on biological diversity has been determined.

12.3.4. Protocol Concerning Specially Protected Areas and Wildlife (SPA)

The SPA Protocol, used as a means of regionalizing global conventions such as the CBD, utilizes an ecosystem approach to conservation by protecting rare and fragile ecosystems and the endangered species it houses. Through its Caribbean Regional Coordinating Unit, assistance is given for the establishment of protected areas to ensure attainment of the objectives of the SPA Program to significantly increase the number and improve the management of national protected areas and species in the region and assist the Governments of the region, on request, to develop guidelines for the establishment and management of such areas.

The Protocol extends to the Convention Areas as well as watercourses extending up to the freshwater limit or watersheds designated by the parties. It urges when necessary, the establishment of protected areas in instances where it is necessary to protect:

- ◆ Representative types of coastal and marine ecosystems of adequate size to ensure their long-term viability and to maintain biological and genetic diversity
- ◆ Habitats and their associated ecosystems critical to the survival and recovery of endangered, threatened or endemic species of flora or fauna
- ◆ The productivity of ecosystems and natural resources that provide economic or social benefits and upon which the welfare of local inhabitants is dependent and
- ◆ Areas of special biological, ecological, educational, scientific, historic, cultural, recreational, archaeological, aesthetic, or economic value, including, in particular, areas whose ecological and biological processes are essential to the functioning of the Wider Caribbean ecosystems.

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

This convention was established in 1972 to control the international trade of live and dead animals and plants through the issuing of permits/certificates for such trade. Requirements for the establishment of Scientific and Management authorities; regulation of trade in specific species via permits and certificates and maintenance of records of trade are detailed in the convention. The legal obligation under this convention was established in the Species Protection Regulations of 1999 under the Environmental Protection Act.

12.4. Existing Information, Surveys and Base line Studies

12.4.1. 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 has been undertaken to obtain an understanding of the project site. Secondly, desk reviews have been conducted to obtain information on the terrestrial and aquatic biological environment within the area of influence of the project. Field visits have been then conducted over a ten-day period to identify flora and fauna along the ogle road, the four connectors, and the main alignment. Finally, the baseline data has been analyzed and used to determine the potential impacts of the proposed project on existing flora and fauna.

Biodiversity assessment has been done at the soil sampling locations demarcated as well as the shoulders of the four connector roads. The soil testing locations have been chosen as they represent the areas that stand to be most affected by road construction activities.

12.4.1.1. Floral Survey

The floral survey entailed the characterization of the terrestrial vegetation along both shoulders of the ogle airport road, along with the proposed four connectors and the green field road. Additionally, aquatic vegetation encountered has also been 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.

12.4.1.2. Faunal Survey

Due to the diversity of faunal species known to inhabit roadside vegetation, canals, and wetlands, tax specific methods have been employed for baseline characterization. Surveys have been 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 has been done to ensure that both nocturnal and diurnal species are inventoried. The methods used to survey the various tax are described below.

12.4.1.2.1. Birds

Birds are identified by direct observation or their vocalization. During the survey, the canopy of trees along the road and areas close to the roads have been inspected for the presence of birds. Habitats occupied by birds and the number of birds spotted have been recorded. Birds that could not be identified during the survey have been described and later identified by comparing them with online databases. Additionally, attempts have been made to survey birds by their vocalization. Birds have characteristic sounds and can be distinguished by their vocalization.

12.4.1.2.2. Fishes

The aquatic sampling zones coincided with those established for the floral surveys. For each of the sites surveyed the following information has been collected: trench substrate, velocity, depth, water body variability, and aquatic vegetation. Each of the sample zones has been surveyed once in the mornings. Information on fishes has been collected using hook and line and dip nets. When possible fishes caught have been identified on-site and returned to the waterway. Those that are unidentifiable have been 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.

#	Common name	Scientific name	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14
1	Carpet grass	<i>Axonopus compressus</i>	X	X	X								X	X	X	X
2	Bahama grass	<i>Cynodon dactylon</i>	X		X			X			X		X	X	X	X
3	Antelope	<i>Echinochloa pyramidalis</i>	X		X		X			X			X	X		X
4	Tana grass	<i>Brachiaria radicans /arecta</i>	X	X		X		X		X		X	X		X	X
5	Wild ginger	<i>Eleusine indica</i>	X	X			X	X	X	X		X		X	X	
6	Aloo weed	<i>Asystasia gangetica</i>			X		X		X		X		X	X	X	X
7	Antidesma	<i>Antidesma ghaesambilla</i>	X	X		X	X	X	X	X		X			X	
8	Port mourant vine	<i>Phaseolus spp</i>	X						X	X						
9	Ink vine	<i>Macropitilium lathyroides</i>		X		X		X	X	X	X	X		X		X
10	Carilla	<i>Momordica charantia</i>			X											
11	Caner grass	<i>Commelina</i>			X	X			X	X				X		

#	Common name	Scientific name	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14
		<i>diffusa</i>														
12	Jungle rice /bird seed grass	<i>Echinochloa colonum</i>					X	X	X	X	X					X
13	Wild potato	<i>Ipomea tiliacea</i>				X	X	X	X	X						
14	White lady	<i>Heliotropium indicum</i>				X		X								
15	Grease brush/shaving brush	<i>Emilia sonchifolia</i>	X										X		X	
16	Wild starch	<i>Thallia geniculate</i>					X			X	X	X				X
17	Para grass	<i>Brachiaria mutica</i>	X		X		X		X				X			
18	Red rice	<i>Oriza sativa</i>			X	X	X	X								
19	Iron vine	<i>Desmodium canum</i>	X				X			X			X		X	
20	Pea vine	<i>Vigna luteola</i>					X									
21	Bind weed	<i>Ipomea tiliacea</i>			X	X						X				
22	Baby cucumber	<i>Cucumis melo</i>	X			X			X			X		X		X
23	Shrimp moss	<i>Cabomba aquatic</i>	X	X	X		X	X	X	X			X	X	X	X
24	Water hyacinth	<i>Eichhornia crassipes</i>	X	X	X			X		X		X	X	X	X	
25	Buck bead	<i>Coix lachryma-jobi</i>	X		X	X		X					X		X	
26	Finger grass/ crab grass	<i>Digitaria ciliaris</i>			X			X	X	X	X			X		X
27	Cowtail	<i>Andropogon bicornis</i>			X		X			X	X			X	X	
28	Burr grass	<i>Cenchrus eschinatus</i>	X	X	X	X			X	X		X			X	
29	Jew grass	<i>Imperata brasiliensis</i>			X		X	X	X	X			X	X	X	

#	Common name	Scientific name	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14
30	Sour grass	<i>Paspalum conjugatum</i>				X	X	X	X				X	X		
31	Razor grass	<i>Paspalum vigatum</i>	X	X	X			X	X				X	X	X	
32	Elephant grass	<i>Pennisetum purpureum</i>			X		X	X			X					X
33	Masala grass	<i>Fimbristylis miliacea</i>		X	X		X	X	X	X	X	X	X		X	X
34	Silk weed	<i>Asclepias curassavica</i>	X		X		X		X		X	X		X		
35	Broom weed	<i>Borreria latifolia</i>	X		X			X	X	X	X		X		X	
36	Borreria latifolia	<i>Cassia occidentalis</i>					X	X	X	X	X					
37	False daisy	<i>Eclipta prostrate</i>				X		X		X		X	X			X
38	Shame bush	<i>Mimosa pudica</i>	X		X			X		X			X	X	X	X
39	Soldier parseley	<i>Peperomia pellucida</i>						X		X				X		X
40	Seed under leaf	<i>Phyllanthus amarus</i>		X	X			X			X			X	X	X
41	Soap bush	<i>Sphenoclea zeylanica</i>	X		X					X				X	X	
42	Bauwaua	<i>Astronium ulei mattick</i>							X	X						
42	Cow wood	<i>Bagassa guianensis</i>							X							
43	Crab wood	<i>Carapa guianensis</i>									X					
44	Common baromalli	<i>Catostemma commune</i>							X							
45	Greenheart	<i>Chlorocardium rodiei</i>														
46	Water nut	<i>Nelumbium nelumbo</i>										X				
47	Bisi bisi	<i>Cyperus compressus</i>	X	X	X	X		X		X	X	X	X	X	X	X
48	Moco moco	<i>Montrcardia arborescens</i>		X	X		X	X	X		X	X		X	X	X

#	Common name	Scientific name	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14
49	Long john tree	<i>Triplaris surinamensis</i>				X		X	X	X			X			X
50	Heliconia	<i>Heliconia sp</i>		X	X				X	X	X					
51	Belly ache bush	<i>Jathropa gossypifolia</i>	X	X		X	X				X	X	X			X
52	Black sage	<i>Cordia macrostachya</i>	X	X	X	X	X	X			X	X	X	X	X	X

Table 36: List of Flora found in Survey



Figure 20 :Antelope grass in GUYSUCO drain where the road will pass through



Figure 21: Sour grass Aubrey barker road

12.4.1.2.3. Macro-invertebrates

Macroinvertebrates have been actively captured or observed during visual encounter surveys. Sampling has been done one day at each location. 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 light of these constraints, the classification of macroinvertebrates has restricted to Order. The number of individuals observed in each zone has been counted to determine their respective abundances.

Invertebrates encountered were classified 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)

12.4.1.3. Baseline floral survey

A total of fifty-two plant species have been recorded in the project site. The vegetation recorded at the ogle airport road area along with Aubrey barker, Haag Bosch and the great diamond road 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 Table below.

Carpet grass (*Axonopus compressus*) was the dominant grass observed along the shoulders of the ogle airport Roadway and Aubrey Barker road. The dominant grass at the Mocha Arcadia was Bahama grass (*Cynodon dactylon*) then followed by carpet grass (*Axonopus compressus*) while the Haag Bosch Road was comprised of mostly shrubs and Bahama grass (*Cynodon dactylon*).

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

12.4.1.4. Fauna

12.4.1.4.1. Macroinvertebrates

Macroinvertebrates 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 the terrestrial and aquatic food web. Macroinvertebrates are also pests and assist in the transmission of disease. Ten Orders of macroinvertebrates have been recorded. Macroinvertebrates that were abundant such as the dragonfly, honey bee (*Apis mellifera*), spiders, butterflies, and bugs. The high number of pollinators observed could be associated with a large number of shrubs in the project site are flowering. The dominant aquatic macroinvertebrate belongs to the group Mollusca.

See Table below for Orders of macroinvertebrates recorded.

Common Name	Order	Abundance
Bees and wasps	Hymenoptera	C
Dragonflies	Odonata	F
Butterflies and moths	Lepidoptera	A
Grasshoppers	Orthoptera	U
True bugs	Hemiptera	C

Common Name	Order	Abundance
Bugs	Homoptera	C
Spiders	Aranea	F
Snails	Mollusca-Gastropoda	A
Walking sticks	Plasmida	U
Beetles	Coleoptera	U
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)		

Table 37: Orders of Macroinvertebrates Recorded

12.4.1.4.2. Fishes

Observation of the waterways revealed that significant quantities of waste (plastic bottles, Styrofoam boxes and household waste) are being dumped into the trenches, particularly along Aubrey barker road. A total of 31 fishes are collected representing two families and five species. Species belonging to the family Poeciliidae give birth to live young. These livebearers consume insects, other small invertebrates, and aquatic vegetation. The two species documented were less than 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 its usefulness as bio-indicators of heavy metal pollution in aquatic ecosystems. None of the fishes are of significant environmental or ecological importance. The most common species is the Nile tilapia. Fish species recorded in the project site are given in previous table. The survey was conducted at the ogle road canal, trenches lining the four connector roads, GUYSUCO canals, and wetland areas.

Order	Family	Species	Common Name
Perciformes	Cichlidae	<i>Cichlasoma bimaculatum</i>	Patwa
Perciformes	Cichlidae	<i>Oreochromis mossambicus</i>	Mozambique tilapia
Perciformes	Cichlidae	<i>Oreochromis niloticus</i>	Nile Tilapia
Cyprinodontiformes	Poeciliidae	<i>Poecilia reticulata</i>	Guppy
Cyprinodontiformes	Poeciliidae	<i>Poecilia vivipara</i>	Guppy
			Hurrie
Catfish	Callichthyidae		Hassa
Perciformes	Centrarchidae		Sunfish

Table 38: List of Fishes Recorded

12.4.1.4.3. Birds

Ecologically birds are important in pollination, seed dispersal, seed predation, and therefore tree species regeneration. Seven avian species have been observed at the intended construction site. Most of the birds observed are transient. However, a few have been spotted utilizing vegetation along the road including grasses. Most of the birds are recorded in the areas with higher vegetation. The number spotted during the survey does not reflect the diversity that is known to

occur on the coast since previous reports indicate over 158 bird species within this area. Birds recorded within the proposed project site are shown in the table below.

Common Name	Scientific Name
Black Vulture	<i>Coragyps atratus</i>
Cattle Egret	<i>Bubulcus ibis</i>
Common ground dove	<i>Columbina passerine</i>
Smooth bill ani	<i>Crotophaga ani</i>
Kingfisher	<i>Megaceryle torquata</i>
Great kiskadee	<i>Pitangus sulphuratus</i>
Yellow-bellied Elaenia	<i>Elaenia flavogaster</i>

Table 39: List of Birds Recorded

12.5. Impact Prediction and Assessment

12.5.1. Construction Phase

12.5.1.1. Flora Resources

During the construction phase, dust and combustion emissions generated by equipment during the clearing of vegetation for the road and site facilities may cause injury to plants under ambient conditions of exposure. Pollutants confirmed to cause injury to plants includes NO₂ and particulate matter both of which would be generated by equipment operations at this site. Plant injury would depend on physical and biological factors. Emission impacts upon plants may include changes in leaf structure, which may include chlorophyll destruction (chlorosis), tissue death (necrosis), and pigment formation. Visible symptom patterns may result from either acute or chronic exposures. An acute injury may result from brief exposures (several hours) to elevated levels of a pollutant. Tissue necrosis is generally the dominant symptom pattern from acute exposures. Chronic plant injury may result from intermittent or long-term exposures to relatively low pollutant concentrations, with chlorophyll destruction or chlorosis as the principal symptom of injury. These are moderate impacts (long-term, moderate severity, local extent). These impacts will be mitigated by employing the following measures:

- ◆ Employing dust suppression technique such as applying water or non-toxic chemicals
- ◆ Maintaining construction equipment according to manufacturer's specifications

These mitigation measures will result in low impacts (short-term, low severity, local extent).

Construction works will include clearing the road footprint and areas for site facilities. Cutting of large tracts for the main alignment and connectors will make plant regeneration difficult, since nutrients, contained in the biomass can be washed away by rainwater after clearing. In addition, enhanced leaching, occasioned by clearing, can deplete the soil of nutrients. The absence of nutrients may result in any new vegetation consisting mainly of grass species. Aggressive grass species and shrubs will effectively prevent seed-bearing plants from finding satisfactory living conditions. These grasses serve as a food source for a significant population of birds. The surrounding area is the same ecologically as the cleared area and the area to be cleared is a very small percentage of the total area. Clearing will consequently result in only low impacts (short-term, low severity, local extent) on the overall area.

The Project Access roads will cut an existing ecosystem into two parts. The two parts created by the road may potentially have less value than the initial whole ecosystem since ecosystems are characterized by complex, interdependent relationships between component species and their physical environment. The project road may potentially fragment the area into weaker ecological sub-units and may make the entire area vulnerable to invasion and degradation. This is a moderate impact (long-term, moderate severity, regional extent). This impact will be mitigated by ensuring the width of the access road is as specified in the project document. The mitigation measures will result in low residual impacts (short-term, low severity, regional extent).

It is estimated that a significant amount of land will be cleared for the road and associated infrastructure. The loss of terrestrial habitats and flora is unavoidable within the project footprint area. None of the terrestrial habitats in the project area have been identified as critical habitat. None of the plant species known to be present in the project area are known to be threatened locally or to be restricted-range endemic. The loss of terrestrial habitats in the project area is a high impact (medium-term, high severity, local extent). With appropriate mitigations such as strict minimization of clearing and progressive re-vegetation along the access road corridor, the impact rating is low (medium-term, low severity, local extent).

The construction work will lead to increased human population and vehicular traffic and increased levels of general activity in the area. The increased human presence has the potential to lead to increased impacts on flora through harvesting, collecting, disturbance, and other activities by construction workers. This impact is considered high (long-term, high severity, regional extent). The Proponent / Contractor will enforce a policy of no harvesting of flora resources to ensure that no flora are harvested from the area or brought into the area. Implementation of these measures will result in low residual impacts (short-term, low severity, regional extent).

Weeds may be introduced into the project area during construction if the project uses plant and equipment, with soil and weeds from locations at which the equipment and plant were previously used. These are high impacts (long-term, high severity, local extent). These impacts will be mitigated by taking steps to ensure that all equipment, previously used at other locations, are free of all soils and weeds. This will result in low impacts (short-term, low severity, local extent).

12.5.1.2. Faunal Resources

Construction of the Main Alignment and four connectors and clearing of the area, will fragment the area and can potentially impact wildlife since some animal species depend on the existence of other plant and animal species within the habitat for nutrients/food, cover, etc. The areas to be cleared are relatively small in comparison to the available area. Clearing and encroachment will alter several of the physical conditions including light, humidity, and temperature. The construction of the main alignment and other construction works will form permanent barriers to the movement of animals, including access to water bodies. These are high impacts (long-term, moderate severity, local extent). These impacts will be mitigated by minimizing the area cleared for the facilities and by maintaining wildlife corridors within the cleared areas. The implementation of the proposed mitigation measures will result in low residual impacts (short-term, low severity, local extent).

The physical disturbance and noise produced by construction equipment may impose additional stresses upon wildlife and may lead to increased migration. While disturbances may be stressful

for some wildlife, other species may easily adapt to and thrive successfully in the area owing to the phenomenon of habituation. These are potentially moderate impacts (long-term, high severity, local extent). These impacts will be mitigated by ensuring that noise levels are maintained at the lowest possible and are in accordance with EPA Noise Guidelines. The mitigation measures will result in low impacts (long-term, low severity, local extent).

The construction works will lead to an increased human population, vehicular traffic and increased levels of general activity in the area. The increased human presence has the potential to lead to increased impacts on fauna through harvesting, collecting, hunting, fishing, disturbance, and other activities by construction workers. This impact is considered high (long-term, high severity, regional extent). The Proponent / Contractor will enforce a policy of no hunting and fishing by its employees and will also implement measures to ensure that no fauna is harvested from the area or brought into the area. Implementation of these measures will result in low residual impacts (short-term, low severity, regional extent).

Some loss of small and/or slow-moving fauna will inevitably occur during land clearing and earthmoving activity. None of the invertebrate, amphibian, non-avian reptile or small mammal species determined to be present in the project area is known to be threatened or endemic. More mobile fauna including large mammals and adult birds will very likely flee the area well in advance of any land clearing operations. The surrounding area is large enough to absorb fauna fleeing cleared areas. The loss of terrestrial fauna in the project area is estimated to be a moderate impact (medium-term, moderate severity, local extent). This impact will be mitigated by minimization of the areas cleared. The residual impact will consequently be low (short-term, low severity, local extent).

12.5.1.3. Aquatic Resources

The construction of the main alignment and associated infrastructure will result in the loss of various stream habitats within the project area. Surveys have not identified any critical aquatic habitats. Similar aquatic habitats are common in the region. Loss of aquatic habitats in streams trenches and canals where major conversion of the land surface is required will be unavoidable due to the nature of the activities. These are moderate impacts (long-term, moderate severity, local extent). Further retention ponds and other detention storage/sedimentation facilities will be installed to ensure that storm water discharges do not degrade the habitat structure of the receiving bodies. None of the aquatic fauna identified in the streams or creeks within the project area is known to be threatened or restricted-range endemic. The mitigation measures will result in low impacts (short-term, low severity, local extent).

The loss of aquatic habitat in the project area is a potentially high impact (long-term, moderate severity, local extent). These impacts will be mitigated by minimizing the extent of areas cleared for diversion channels and by installing bypass structures, where possible, to facilitate flow in the downstream section of streams which have been diverted. Application of these mitigation measures will result in low residual impacts (short-term, low severity, local extent) on aquatic habitats. Surface runoff from cleared areas may introduce additional nutrient loads to streams. Higher nutrient levels can potentially result in eutrophication. Pollution by contaminated surface runoff can also impact water quality in the streams and lead to denitrification and increased oxygen consumption resulting in an environment less conducive to the survival of fishes. Contaminants could be ingested by aquatic organisms causing reproductive impairment, stunted growth, and other physiological effects. Also, as contaminants naturally break down, they use dissolved oxygen, sometimes significantly reducing the dissolved oxygen content of

the water, which can lower spawning success for many fish species and reduce overall habitat suitability for many aquatic organisms.

During construction, there could be hydrocarbon contamination of the aquatic systems from accidental spills of lubricants and fuel. Hydrocarbons introduced into aquatic environments may change aquatic plant and animal growth, mortality and communities. These are potentially high impacts (long-term, high severity, regional extent). Further, the suspended sediment will ultimately settle onto in stream habitat features (e.g., downed wood, gravel, etc.) or the bottom substrate causing embeddedness, which will decrease the value of in stream habitat for macroinvertebrates and fish. Specifically, increases in embeddedness levels decrease the space between substrate particles and limit the available area and cover for small fish, macroinvertebrates, and periphyton.

The adverse effects of increased levels of fine sediments on fish include: increased mortality caused by gill damage; increased predation due to sedimentation of shelter; increased susceptibility to disease; impaired developmental rates, reduction of suitable spawning habitat, reduced spawning success, modification of migration patterns, impairment of visual feeders, and reduction of light penetration, which impedes primary production, reduces food availability, and alters food webs. These are high impacts (long-term, moderate severity, local extent). These impacts will be mitigated by channeling contaminated runoff to oil-water separators prior to discharge to streams/creeks. The mitigation measures will result in low impacts (short-term, low severity, local extent).

12.5.2. Operational Phase

12.5.2.1. Flora Resources

The removal of vegetation for the road works will alter the availability of food and shelter for wildlife. Utilization of the main alignment by vehicular traffic may impact biodiversity by changing species composition and structure and may provide access to previously isolated areas thereby enabling exploitation of biological resources from the area. Imported species including weedy plants and insect pests may thrive while native species may decline. Transportation can potentially reduce biodiversity either directly, through activities which remove, damage or modify habitats, or indirectly where changes caused by project activities may create situations where species or their habitats can be damaged by activities other than those directly associated with transportation.

Traffic on the project road would impact the early succession/edge and secondary habitats located along these roads by increasing dust, which will settle on vegetation. Dust accumulation on plants has been found to impair biological functions including metabolism and photosynthesis, stunt growth, make them more susceptible to disease, and even cause mortality. Road dust may deposit on vegetation up to one kilometer away from the generation site and may contain pollutants or chemicals that can alter the permeability of the leaves or the pH of the leaves' surfaces (Farmer, 1993). Given the limited geographic scope of this impact, the impact of dust accumulation on plants would be low (medium-term, low severity, local extent).

The movement of people, equipment, and materials along the road has the potential to cause the introduction of alien invasive species of plants. The disturbance and clearing of natural habitats can also promote the growth or colonization of alien invasive species. This impact is rated as moderate (long-term, moderate severity, local extent). These impacts will be mitigated by the implementation of the following mitigation measures:

- ◆ Monitoring of biodiversity and,
- ◆ Control of invasive species.

Implementation of these measures will result in low impacts (short-term, low severity, local extent).

12.5.2.2. Faunal Resources

During operation, additional loss of habitats will not affect any threatened or restricted-range endemic species of fauna since much of the fauna will have likely already left the affected habitats due to disturbance during the construction phase. This impact is rated as moderate (medium-term, moderate severity, local extent). These impacts will be minimized by the implementation of the following:

- ◆ Minimization of the Project footprint
- ◆ Initiating restoration as soon as practicable in temporary work areas

Implementation of these measures will result in low residual impacts (medium-term, low severity, local extent).

Most of the larger animals would have already abandoned the area during the construction phase. Only small fauna accustomed to disturbed environments are likely to remain and it is likely that small numbers of small animals such as amphibians and snakes will experience mortality due to equipment and vehicle use. The loss of terrestrial fauna during the mining operations phase is rated as moderate (long-term, moderate severity, local extent). These impacts will be mitigated by the implementation of the following:

- ◆ Minimization of the Project footprint
- ◆ Performance of preclearance surveys

The operation of the road, wildlife may move away from the area. This displacement will increase competition with wildlife on the periphery of the area. This is a moderate impact (medium-term, moderate severity, local extent). This impact cannot be mitigated. The physical disturbance and noise produced by vehicular traffic may impose additional stresses upon wildlife and may lead to increased migration. While disturbances may be stressful for some wildlife, other species may easily adapt to and thrive successfully in the area owing to the phenomenon of habituation. These are potentially high impacts (long-term, high severity, local extent). These impacts will be mitigated by minimizing the extent of the cleared areas. The mitigation measures will result in moderate impacts (medium-term, moderate severity, local extent).

Most animal species follow established patterns in their daily and seasonal movements. The areas through which animals travel on their way to and from feeding, breeding and birthing grounds, and between their seasonal ranges, are known as corridors. If the main alignment, intersects or blocks wildlife corridors, animals may cease use of the corridor since animals are reluctant to cross open spaces and maybe hit by vehicles using the roads. This may result in a

potential increase in animal mortality because of collisions with vehicles, or a delay in migration in search of food and for breeding and birthing. These are moderate impacts (long-term, moderate severity, local extent). These impacts will be mitigated by conducting an assessment after the roads are cleared to identify corridors and signs will be posted notifying drivers of the existence of these corridors and speed restrictions will be placed on the roads near the corridors. The mitigation measures will result in low impacts (short-term, low severity, local extent).

12.5.2.3. Aquatic Resources

The operation of the road will impact various stream habitats within the project area. These habitats will have already been affected by construction phase activities, but the initiation of roadway will bring additional impacts to these affected aquatic habitats. Impacts to aquatic habitats will be unavoidable due to the nature of the activities. Upstream and downstream segments of streams will be affected. The loss of aquatic habitats in the project area is a high impact (long-term, high severity, regional extent).

Some wildlife species depend on vegetation growing in natural drainages. This vegetation provides essential food, nesting sites, and cover for an escape from predators. Culverts and bridges may destroy vegetation near streams and reduce the quality and quantity of habitat essential for waterfowl, birds, and other terrestrial species. These are moderate impacts (long-term, moderate severity, local extent). These impacts will be mitigated by assessing the area and the alignment of streams to be diverted before the start of work.

12.6. Mitigation and monitoring - Environmental and Social Management Plan

12.6.1. Environmental Management Plan

Temporary and permanent alteration of terrestrial habitats will be minimized to the extent feasible and be consistent with the requirement to protect and preserve critical habitat. Recommended management strategies will include:

- ◆ Siting facilities in locations that avoid impacts to critical terrestrial habitat, and planning exploration and construction activities to avoid sensitive times of the year
- ◆ Minimizing disturbance to vegetation and soils
- ◆ Implementation of mitigation measures appropriate for the type of habitat and potential impacts including, for example, post-operation restoration (which may include baseline inventories, evaluations, and eventual rescue of species), offset of losses, or compensation of direct users
- ◆ Avoiding or minimizing the creation of barriers to wildlife movement, or threats to migratory species (such as birds) and providing alternative migration routes when the creation of barriers cannot be avoided
- ◆ Planning and avoiding sensitive areas and implementing buffer zones
- ◆ Conducting activities such that the risk of landslides, debris or mudflows, and bank or alluvial fan destabilization is minimized
- ◆ Implementing soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation); key factors

such as placement, location, design, duration, coverage, reuse, and single handling will be considered.

- ◆ Where topsoil is pre-stripped, it will be stored for future site rehabilitation activities. Topsoil management will include maintenance of soil integrity in readiness for future use. Storage areas will be temporarily protected or vegetated to prevent erosion
- ◆ Conserving the quality and composition of growth medium for use (e.g. for capping) during site reclamation and closure activities
- ◆ Ensuring that the growth medium is sufficient to support native plant species appropriate for the local climate and consistent with proposed future land uses. The overall thickness of the growth medium will be consistent with surrounding undisturbed areas and future land use and
- ◆ Manage vegetation growth along roads and at permanent above-ground facilities. Removal of invasive plant species and replanting of native species.

Vegetation control will employ biological, mechanical and thermal vegetation control measures and avoid the use of chemical herbicides as much as possible. If it is demonstrated that the use of herbicides is required to control vegetation growth along roads or at facilities, then personnel will be trained in their use. The Project footprint would optimize the use of areas which were previously cleared for earlier exploration and mining operations and clearing would be minimized to the extent practicable.

Vegetated corridors will be maintained and gradually removed during construction to enable wildlife present in the area to relocate to adjacent areas. Construction progress will be monitored in relation to the time it will take for animals to move away from construction areas and construction works will be programmed, based on the results of that monitoring, to occur in a manner slow enough to ensure that animals can move to other locations. Attention will be paid to vulnerable or conservation-worthy plant and animal species that will be affected and conservation measures will be enforced in consultation with the EPA.

Scrub forests and vegetation will probably be removed for improvement of road section between Ogle and diamond. The loss of vegetative cover will mostly be permanent and only some might be revived through mitigation efforts. Another impact from road construction activities and deriving from the cutting of hillsides, quarrying, preparation and transfer of stone chips and other earthworks; is the accumulation of dust on the surrounding vegetation. This leads to deterioration of the vegetative health, which in turn will affect the ecology as well as the aesthetic beauty of the area. Induced impacts may result from the following: increased forest harvesting for fire-wood, construction timber, forage, medicinal plants, and other products; increased earth and rock extraction; construction crew demands for wood as a fuel and for building materials; construction crew demands for food and recreational hunting and fishing;

- ◆ To minimize negative impacts on the vegetative cover the contract documents should specify that
- ◆ all wood building material for workers' housing should be brought from outside the project area

- ◆ workers should be supplied with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract
- ◆ all contracted equipment and plants should be cleaned to the satisfaction of the project engineer in charge prior to their relocation to project sites
- ◆ during site clearance, care should be taken to ensure that the minimum area of vegetation area is affected
- ◆ Water sprinkling of trucks used as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation is minimized.

Parameter	Institution Responsible	Frequency Monitoring	of Location Monitoring	of
Canopy Openings Retention of seed and keystone trees Biodiversity reserve integrity Protection of small trees Forest Damage	Proponent	Annually	Active clearing zones, permanent sample plots and biodiversity reserves within the construction area.	
Dust accumulation on vegetation	Proponent	Monthly	Project site	

Table 40: Biodiversity Monitoring Plan

Chapter 13:

Noise and Vibrations

13.1. Introduction

Noise is essentially unwanted sound and deals with people's subjective responses to objective reality. It is the annoyance caused by noise that is critical in ESIA. Sound consists of pressure variations that are detectable by the healthy human ear. These pressure variations have two key characteristics: frequency and amplitude. Sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)). Environmental noise can be dominated by a particular frequency or it may be described as 'broadband', i.e. comprising a range of different frequencies. Most sounds in an environmental context consist of many different frequencies, although equipment such as turbines, compressors, cooling fans, or transformers can generate noise with discrete frequencies that produce distinct tonal characteristics. Sound amplitude refers to the amount of pressure exerted by the air, which is often visualized as the height of the sound waves. Amplitude is described in units of pressure per unit area, micro-pascals (μPa). The amplitude is sometimes converted to sound power, in microwatts (10–12watts), or sound intensity (in 10–12watts/m²). Sound intensity is subjectively felt as the loudness of sound. However, none of these measures are easy to use because of the vast range which they cover. As a result, a logarithmic scale of decibels (dB) is used.

13.2. Policy, Legislation and Regulatory Framework

13.2.1. Environmental Protection Noise Management Regulations 2000

Under these regulations operations that emit noise in the execution of various activities such as construction, transport, industry, commerce, and other institutions are required to apply to the agency for an environmental authorization. The EPA is responsible for the establishment of standards for permissible noise levels in industry, construction and other areas. The categories for which permissible noise levels are fixed by the EPA are as follows: Residential, Institutional, Educational, Industrial, Commercial, Construction, Transportation and Recreational. The Guyana National Bureau of Standards (GNBS) and the EPA together with other relevant agencies developed Interim Guidelines for Noise Emission into the Environment. Under these guidelines, noise emissions from Industrial and Commercial sources for both days (06:00h – 18:00h) and night (18:00h – 06:00h) would be 100 and 80 decibels (Industrial) and 80 and 65 decibels (commercial) respectively at the property boundary or 15 meters from the source.

13.2.2. World Health Organization

The Guidelines for Community Noise (WHO 1999) are health-based guidelines that incorporate influential noise standards as part of a framework for noise management. The guidelines recommend internal and external noise levels that will prevent detrimental effects on a community, including rest, sleep, and work that requires concentration, amongst others:

To protect the majority of people from serious annoyance during the daytime, the noise level on balconies, terraces and outdoor living areas should not exceed 55 dB LAeq for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor noise level should not exceed 50 dB LAeq.

At night, noise levels at the outside façades of the living spaces should not exceed 45 dB LAeq and 60 dB L_{max}, so that people can sleep with bedroom windows open.

13.3. Baseline

During the field survey programs, noise levels were recorded at several locations. The locations and associated noise levels are detailed below. Figure shows the sampling locations.

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 Level Change dB LA10,18h	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5 +	Major

Table 41: Magnitude of Noise Impacts due to Changes in Road Traffic Noise (short term)

Noise Level Change dB LA10,18h	Magnitude of Impact
0	No change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10 +	Major

Table 42: Magnitude of Noise Impacts due to Changes in Road Traffic Noise (Long term)

Time	Location	Dbz
7:30	Intersection at Rupert Craig highway and ogle airport road	69.8
7:25	Intersection at railway embankment and ogle airport road	70.4
7:26	Between Rupert Craig Highway and Railway Embankment	59.0
7:33	Midway of ogle airport and Railway Embankment	54.7
7:30	Starting of Aubrey Barker Road	78.5
7:40	Midway of Aubrey barker Road	65
7:35	Starting of connector for Aubrey barker Road	46.1
7:30	Starting of Haag Bosch road	58.4
7:30	Midway of Haag Bosch road	52.6
7:33	Starting of connector for Haag Bosch road	58.0
7:45	Starting of Mocha Arcadia road	64.3
7:28	Midway of Mocha Arcadia road	60.2
7:35	Starting of connector for Mocha Arcadia road	49.3
7:25	Starting of Great Diamond road	67.5
7:30	Midway of Great Diamond road	71.5
7:38	Starting of connector for Great Diamond road	52.0

Table 43: Day Time Noise Assessment - Averages for dbz

The results of the daytime noise assessment is shown in the above table. Fourteen of the locations had average sound levels compliant with the GNBS Noise Emission into the Environment of 75 db during the day. The Station located at the starting of Aubrey Barker Road recorded the highest, 78.5 db, which was due to the proximity of the monitoring station to the existing roadway.

Time	Location	Dbz
4:22	Intersection at Rupert Craig highway and ogle airport road	65.8
4:15	Intersection at railway embankment and ogle airport road	55.8
4:30	Between Rupert Craig Highway and Railway Embankment	50.1
4:25	Midway of ogle airport and Railway Embankment	43.7
4:22	Starting of Aubrey Barker Road	60.7
4:30	Midway of Aubrey barker Road	48.2
4:30	Starting of connector for Aubrey barker Road	40.6
4:30	Starting of Haag Bosch road	55.2
4:25	Midway of Haag Bosch road	39.6
4:33	Starting of connector for Haag Bosch road	42
4:45	Starting of Mocha Arcadia road	73.3
4:22	Midway of Mocha Arcadia road	31.2
4:35	Starting of connector for Mocha Arcadia road	45.1
4:25	Starting of Great Diamond road	77.4
4:33	Midway of Great Diamond road	47.3
4:22	Starting of connector for Great Diamond road	40.2

Table 44: Night Time Noise Assessment

The results of the nighttime noise assessment is shown in the above table. Twelve of the locations had average sound levels compliant with the GNBS Noise Emission into the Environment of 75 db during the day. The Stations located at the Intersection at Rupert Craig highway and ogle airport road, Starting of Mocha Arcadia road and Starting of Great Diamond road recorded the highest, 65.8 Dbz, 73.3 Dbz, and 77.4 Dbz, respectively which was due to the proximity of the monitoring station to the existing roadway.



Figure 22 Monitoring at Intersection at Rupert Craig Highway and Ogle Airport Road

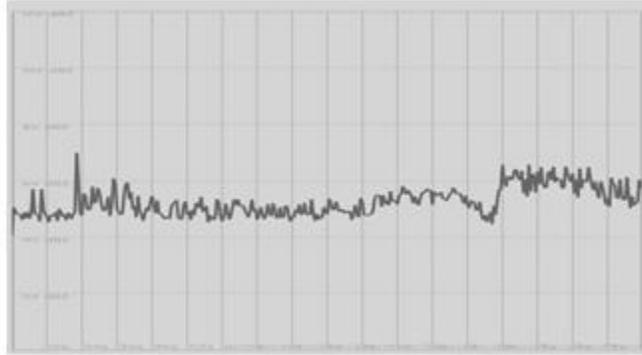


Figure 23: Noise Monitoring at Between Rupert Craig Highway and Railway Embankment

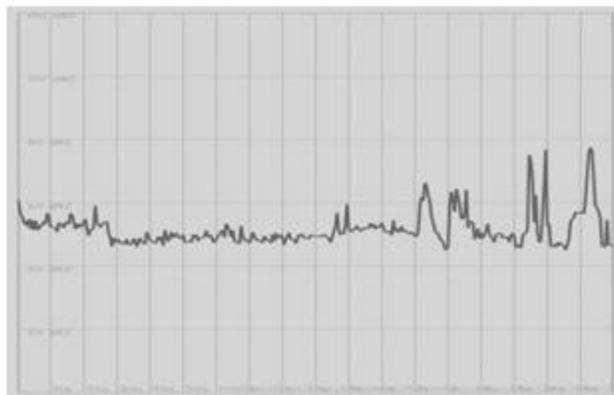


Figure 24: Noise Monitoring at Starting of Mocha Arcadia Road

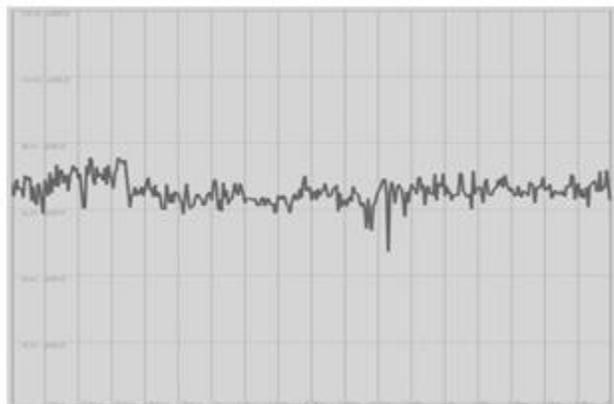


Figure 25: Noise Monitoring at Starting of Great Diamond Road

Sound is measured in terms of decibels (dB). The decibel is not an absolute unit of measurement. Instead it is a ratio of a measured quantity to an agreed reference level. The measured quantity is the variation in atmospheric pressure and the reference level is taken as the lowest pressure to which the average healthy human ear can respond i.e. 2×10^{-5} Pa. Moreover, although the audible frequency range extends from 20Hz to 20,000Hz, the ear does not respond equally across this frequency range and therefore, corrections or “weightings” are applied to the measured linear levels to simulate the response of the ear.

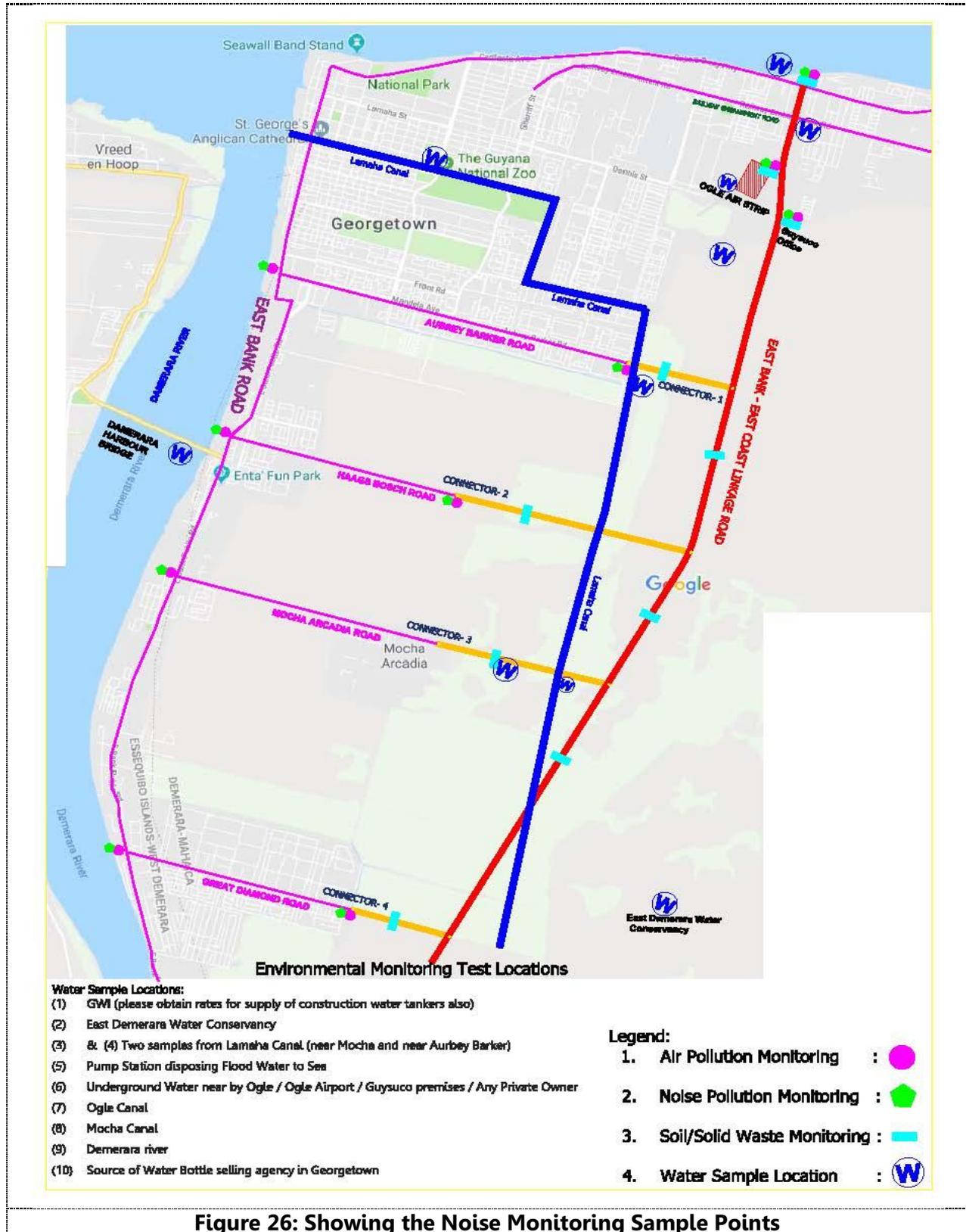


Figure 26: Showing the Noise Monitoring Sample Points

13.4. Impact Prediction and Assessment

13.4.1. Construction

Construction activities will produce noise levels above the WHO industrial/commercial noise level guideline value of 70 decibels (dBA) from heavy earthmoving machinery operation. Maintenance operations in workshops will generate noise levels about 72-110 dBA. Noise levels from the power generation plant will range from 90-105 dBA. Exposure to noise levels above 90 dBA can cause noise-induced hearing loss. Noise levels above the tolerable threshold of 72 decibels may result in fatigue, tiredness, low morale and decreased production levels. Primary noise receptors in the area will be individuals involved in construction activities at the site. There are several communities close to the project boundaries. Tired workers are prone to accidents which may contribute to an increase in work-related accidents. These are high impacts (medium-term, high severity, local extent).

Construction phase noise will have an adverse effect on many species of wildlife that are sensitive to increased noise levels. However, many species may become habituated to frequent noise events or continuous noise levels and may return to the area. The more sensitive fauna have likely, long abandoned the project area where there is frequent disturbance from noise associated with artisanal mining and exploration. Noise impacts will be mitigated by the implementation of the following:

- ◆ Installation of soil berms as noise barriers to mitigate noise impacts adjacent to work site areas;
- ◆ Installation of sound suppression devices (such as mufflers) on earthmoving equipment, generators, etc.;
- ◆ Avoiding unnecessary idling of vehicles and machinery that are used intermittently
- ◆ Employing the best available work practices on-site to minimize occupational noise levels and
- ◆ Provide personal protective equipment (PPE) to employees and contractors and requiring their usage under the health and safety plan.

Implementation of these measures would result in low residual impacts (short-term, low severity, local extent).

A nuisance to nearby properties is likely to result from:

- ◆ Noise and vibration from mechanical devices and construction plant;
- ◆ Dust during quarrying, construction and the trafficking of new surfaces prior to sealing;
- ◆ Gaseous emissions from heavy equipment;
- ◆ Fumes from asphalt boiling sites.

13.5. Mitigation and monitoring- Environmental and Social Management

Noise is expected to be a significant environmental impact that requires mitigation, especially to reduce the impacts on workers. Therefore the following measures must be implemented to reduce the impacts on noise:

- ◆ Workers must be mandated to wear appropriate protective gear and attire in accordance with the Occupation Health and Safety guidelines.

- ◆ Ensure that machinery and equipment are working efficiently and have the required mufflers/silencers installed.
- ◆ Noisy activities should not occur in close proximity to the housing areas during the night or on Sundays and holidays.
- ◆ Generators should be equipped with silencers and housed in an enclosed area
- ◆ Noisy equipment such as generators should be sited away from living quarters.
- ◆ Provide earplugs for employees who operate heavy-duty machines.

13.5.1. Environmental Management Plan

Good practice in the prevention and control of noise sources will be established based on prevailing land use and the proximity of noise receptors. Noise management strategies will include:

- ◆ Noise levels at the nearest sensitive receptor will meet the EPA noise guidelines
- ◆ Installation of proper sound barriers and /or noise containments, with enclosures and curtains at or near the source equipment (e.g. crushers, generators, and screens)
- ◆ Installation of natural barriers at facility boundaries, such as vegetation curtains or soil berms and
- ◆ Optimization of internal traffic routing, particularly to minimize vehicle reversing needs (reducing noise from reversing alarms) and to maximize distances to the closest sensitive receptors.

Noise emissions will be limited by appropriate soundproofing of individual pieces of equipment. Machinery exhaust systems will be fitted with mufflers. The electrical generators will be housed in closed structures with acoustic insulation that would reduce external noise levels. Additionally, all workers with potential chronic or acute noise exposures will be required to wear appropriate personal noise-protection gear. The most significant vibrations are usually associated with blasting activities. However, vibrations may also be generated by many types of equipment. During the construction phase, the Contractor will minimize significant sources of vibration by the implementation of best management practices such as through adequate design of crusher foundations.

13.5.2. Monitoring Plan

Noise monitoring program would be designed and conducted by trained specialists. Monitoring periods would be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that would be capable of logging data continuously over this period, or hourly, or more frequently, as appropriate (or else cover differing periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded will depend on the type of noise being monitored, as established by a noise expert. Monitors would be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit would be represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

Chapter 14:

Transportation

14.1. Introduction

Vehicles used in construction typically include excavators, bulldozers, front end loaders, rollers, trucks, asphalt-concrete pavers, and graders. Most of these vehicles operate on diesel fuel and require some form of daily maintenance. Truck traffic generated by the project during construction is largely dependent upon the amount of imported fill material required and also on the amount of asphalt required. Offsite truck traffic will also consist of hauling various unclassified excavated and other materials to approved disposal sites, and/or the movement of construction equipment to and from the project site. Heavy equipment used in base and pavement construction includes steel drum rollers, graders, trucks, and asphalt concrete pavers. Human beings are creatures of habit. Traveling patterns are routines that we repeat over and over until something disrupts those patterns. When disruption occurs, there is an opportunity to entice travelers into new travel patterns.

14.2. Background

The construction of the East Bank - East Coast Road Linkage (15.34 km) in Guyana entails the addition of four connectors starting from the main alignment and would be joining existing roads. The aggregate length of four connectors is 10.094 km. The main alignment runs from East Coast (Ogle Airport) to East Bank to Diamond Village. The proposed road will commence at the Junction of the Ogle Airport entrance Road and the East Coast Demerara Public Road. The Proposed Alignment follows the existing ogle airport road for about 1.2 km from East Coast road to ogle airport junction. Thereafter, the balance length of proposed main alignment is traversing through the cane fields only. The Vehicle traffic data collected are provided and discussed under the baseline conditions.

14.3. Baseline

14.3.1. Traffic Survey and Analysis

Traffic studies play a major role in assessing the existing traffic characteristics, designing the future requirements of carriageway and pavement for carrying the projected traffic and in establishing the viability of the project. Traffic forecasting, therefore, requires detailed studies on the type and composition of traffic.

14.3.2. Past Traffic

There is no sufficient past traffic data available with the Ministry of Public Infrastructure (MoPI). Demerara Harbour Bridge Corporation was requested and they provided traffic data for the last five years, as detailed below:

Year	2 W	Motor Cars/4WD Jeeps/Pick-up (Private)	Mini Bus	Goods Vehicle	Motor Lorry /Large Bus	Motor Tractor	Trailer	Others	Total Traffic (Nos.)	Yearly Growth (%)
2014	596	5901	1229	628	483	8	15	29	8889	
2015	619	6309	1307	618	455	8	22	23	9361	5.30
2016	653	6705	1389	634	496	6	114	18	10015	6.98
2017	636	6612	1384	614	440	6	11	24	9727	-2.87
2018(up to May)	658	6732	1353	628	466	6	11	23	9877	1.54

Table 45: Past Traffic Data

14.3.3. Present Traffic Scenario

The consultants have conducted the traffic surveys on the project highway to assess the present traffic plying on various road sections in the project influence area as detailed in the table below and shown on the map.

Sl. #	Description	Location	Duration
1.	Classified Traffic Volume Count	2	3 days for 16 hrs
2.	Origin-Destination and Commodity Movement Characteristics	2	1 day for 12 hrs
3.	Intersection Volume Count	6	1 day during peak hours (3 hours in morning and evening)

Table 46: Present Traffic Scenario

14.3.4. Traffic Survey Stations

The traffic Survey Stations are presented in figure below.:



Figure 27 Traffic Volume Count Survey, Turning Movement and O-D Survey Station

14.3.5. Annual Average Daily Traffic (AADT)

The classified traffic volume count survey have been conducted for 3-days (16-hr continuous, both directions) at 2-locations. The Traffic volume count data collected at different locations have been analyzed to arrive at average daily traffic (ADT) and finally, seasonal variation correction has been applied to determine AADT traffic.

Vehicle Description	Counting Station near	
	Movie Town Hall	Demerara Harbour Bridge
2Wheelers	581	2559
Passenger (Car, Jeep, Van, etc.)	19178	36283
Utility vehicle Freight (Jeep, Van etc.)	2652	1722
Bus (Mini)	4741	9172
Bus (Full)	50	96
LCV(Passenger)	241	132
LCV (Freight)	532	1677
Truck (MCV)	608	1010
Truck (HCV)	198	349
Truck (MAV)	455	512
Agricultural Tractor With Trailer	7	43
Agricultural Tractor Without Trailer	5	14
Slow Moving (Cycle)	37	796
Slow Moving (Horse Cart)	3	20
Total AADT(Nos.)	29284	54382
Total PCU	35096	63142

Note: LCV=Light Commercial Vehicle; 2W=Two Wheeler; MCV: Medium Commercial Vehicle (2 Axle Rigid Chassis); HCV= Heavy Commercial Vehicle (3 Axle Rigid Chassis); MAV=; Multi Axle Vehicle (Heavy Semi- Articulated and Articulated Vehicle); PCU = Passenger Car Unit

Table 47: Annual Average Daily Traffic (AADT)

14.3.6. Origin-Destination Survey and Commodity Movement Surveys

Origin-Destination survey has been conducted on the locations of the volume count survey. The Origin-Destination survey and Commodity-Movement Surveys have been conducted for 12 hours at two traffic volume count locations i.e. at movie town mall on the east coast road and near the demerara harbor bridge on the east bank road.

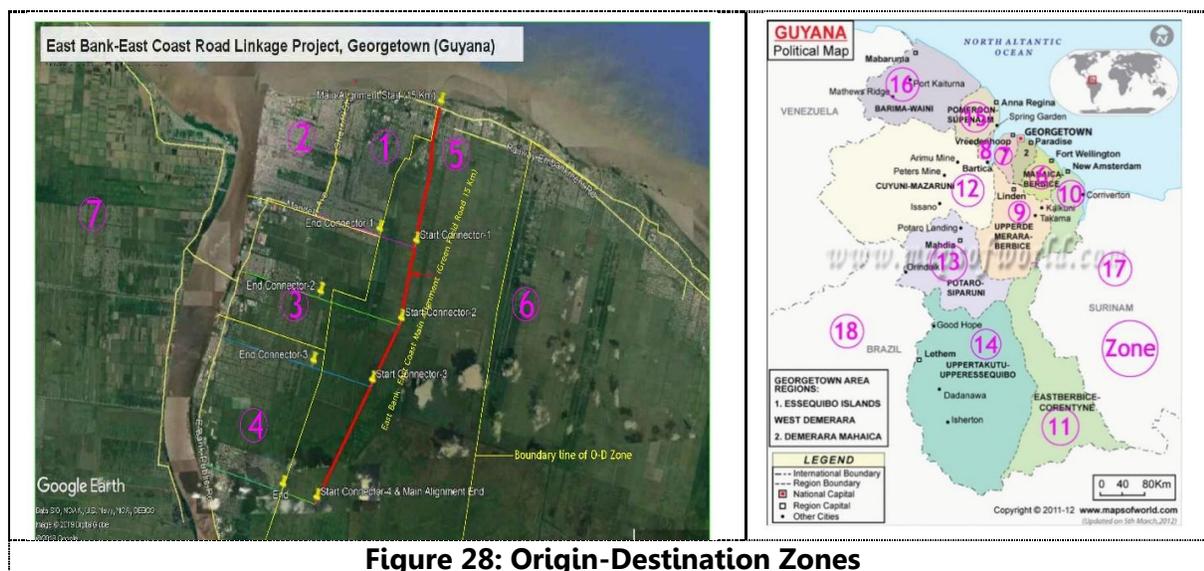


Figure 28: Origin-Destination Zones

The roadside interviews have been conducted by enumerators on a random sample basis of four-wheeled vehicles. Data regarding vehicle registration, origin & destination, trip length, route adopted, route preference along with additional information on commodities carried and weight of commodities for goods vehicles were collected.

The location of origin and destination zones plays a very important role to determine the possibility of traffic diversion to the Project Road from/to other road routes. In all 18 zones are identified for analysis of O-D survey data

It is observed from the O-D data analysis that major traffic plying between Georgetown and its suburbs.

14.3.7. Willingness to Use Road Survey

During traffic survey willingness to use bypass road, if the road section is constructed as a new alignment, has been asked and the views/comments have been recorded. The majority of respondents i.e. 85% expressed their consent for the construction of new road i.e. East Bank-East Coast link road.

14.3.8. Turning Movement Survey

The turning movement surveys have been conducted during morning and evening peak of 3 hours. The turning movement surveys have been conducted for estimation of peak hour traffic for the design of major intersections.

The consultants have conducted intersection turning traffic survey at 6 locations although these were not envisaged as per ToR. The survey locations have been selected in a manner to cover the intersections on Ogle road and East Bank Road with proposed connectors (4 nos). Locations of intersection survey are as below:

Sl. No.	Location	Name of Junction	Type of Junction
1	East Coast Road	East Coast –Ogle Road	4 legged
2	Ogle Junction	Railway Embankment Ogle Junction	4 legged
3	Aubrey Barker Road	David Road St -Aubrey Barker Road Junction	4 legged
4	East Bank	Haag Bosch Junction	T-Junction
5	East Bank	Mocha Arcadia Junction	T- Junction
6	East Bank	Diamond Junction	T-Junction

Table 48: Turning Movement Volume Count Survey Locations

14.3.9. Peak Hour Traffic Analysis

Peak hour traffic has been analyzed for all arms of the junctions and total inflow and outflow at the junctions have also been analyzed. As per traffic-wise, it can be seen that at 08:00-09:00 am is Peak Hour traffic on East Coast-Ogle Road Junction is 3249 PCUs and 07:00-08:00 am is peak hours traffic on Haag Bosch Junction with East Bank Road is 4461 PCU.

Name of intersection	Morning Peak Time	Total (PCU's)	Evening Peak Time	Total (PCU's)
East Coast –Ogle Road	08:00-09:00	3249	17:00-18:00	2528
Railway Embankment Ogle Junction	07:00-08:00	1908	17:00-18:00	1781
David Road St -Aubrey Barker Road Junction	07:00-08:00	813	16:00-17:00	788
Haag Bosch Junction	07:00-08:00	4461	17:00-18:00	4026

Name of intersection	Morning Peak Time	Total (PCU's)	Evening Peak Time	Total (PCU's)
Mocha Arcadia Junction	08:00-09:00	2360	16:00-17:00	2321
Diamond Junction	08:00-09:00	2203	16:00-17:00	1888

Table 49: Peak Hours Traffic on Each Junction

14.3.10. Axle Load Survey

Axle load surveys are not envisaged for the assignment as per ToR. The consultant has worked out a vehicle damaged factor by collecting secondary data as follows:

- ◆ During O-D Surveys at two locations, the weight of commodities carried by drivers was collected. The axle load data has been collected from working weighbridge at Toolsie Persaud Group of Companies, Georgetown. In Guyana, the legal axle load limit is 7.26 t as detailed by MoPI. MoPI further informed that the legal axle load limit is in process for revision. Accordingly, the internationally adopted standard axle load of 8.16 t (18000 ib) has been considered for calculation of Vehicle Damage Factor.

Type of Vehicle	No. of Vehicles sampled	Truck Load Factor	Vehicle Damage Factor
LCV (2 Axle)	15	0.06	0.15
2-Axle Truck	42	5.65	6.63
3-Axle Truck	33	1.58	2.75
4-Axle Truck	146	2.81	4.17

Table 50: Summary of Axle Load Survey

The consultants have also determined the truckload factor as per AASTHO guide for the Design of Pavement Structures, mixed traffic must be converted to an equivalent number of 18-kip single loads. Truck Load factor is equivalency factors representing the ratio of the number of repetitions of any axle load and axle configuration (Single, tandem, tridam, etc) necessary to cause the same reduction in Pavement Serviceability Index (PSI) as one application of an 18-kpi single axle load.

14.3.11. Traffic Assignments

To estimate the traffic for a route, which does not exist is a challenging task. Under such circumstances, the traffic characteristics of the adjoining network are quite useful. It is possible to estimate traffic on Proposed Road after analyzing traffic volume and origin-destination trip patterns. Classified traffic volume gives an idea of traffic volume along the route and desire lines help to find out the directional distribution of trips of traffic which will be interested in using the proposed road.

In a road network, trips from a particular origin to a particular destination may have more than one route to choose from. The decision to choose a route is driven by the distance saved in each route, time taken in each route, etc. The speed along each route is a function of road condition in the route and also traffic in the link forming the route.

The traffic diversion has been done separately for East Bank-East Coast Road and Connectors. The separate diversion estimate for different sections has been carried out depending on the flow of traffic, nature of traffic and zonal movement to occur on the new facility when it will be operational.

Based on the O-D survey, O-D desire line matrices have been prepared. The East Bank-East Coast road will shorten the distance traveled between various zones. Similarly, the time taken between various zones will get reduced as East Bank – East Coast Road will be constructed as partial access-controlled four lanes divided facility for the design speed of 120 kmph. So, the traffic will get diverted to the East Bank-East Coast road due to saving in distance and time. In addition, other factors will also influence a driver’s route choice decision, such as safety, comfort, and reliability. The diversion between various zones is presented in the tables below:

From		To	
Zone	Name of Place	Zone	Name of Place
1	Prasad Nagar, Turkeyan, UG, Festival City, Cummings Park, North and South Ruimveldt, Bel Air etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.	7	Parika, LaGrange, Essequibo Island, Windsor Forest
3	Industrial Estate, Huston, Agricola, Republic Park, Eccles etc.	6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.
4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.	5	Prado Ville, Plaisance , Courida Park, Success etc.
6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.	4	Providence, Mocha , Little Diamond, Great Diamond, Timehri etc.
9	Linden, Ituni, Ebini, Pubu, Kwakwani etc	2	Bel Air Park, Kitty, Campbellville, Queenstown, Bournda, Lcytown, Stabroek, Kignston, Cummings burg etc.
9	Linden, Ituni, Ebini, Pubu, Kwakwani etc	6	Lusignan, Buston, Enmore, Victoria, Belfield, Mahaica, cane Grove, Mahicony, Rosignol, Montrose etc.

Table 51: Traffic Diversion Zones

Traffic plying between Georgetown CBD, Parika, West Bank, Diamond, Timehri, Ogle, Enmore, Berbice, Mahaica, and Linden is expected to be diverted.

		East Coast – East Bank Linkage Road				Connectors			
	Vehicle	Ogle to Connect1	Connect - 1 to 2	Connect - 2 to 3	Connect - 3 to 4	Connect. - 1	Connect. - 2	Connect. - 3	Connect. - 4
Diverted Traffic from O-D Survey	Nos.	5251	24701	23428	23428	19451	1273	0	23428
	In PCU	7555	29123	27451	27451	26202	1697	0	32060
Existing Traffic on Connectors (Turning movement survey)	Nos.	540	-	-	-	637	312	252	998
	In PCU	540	-	-	-	637	312	252	998
Total Traffic (in Nos.)		5791	24701	23428	23428	20088	1585	252	24426

Table 52: Traffic Diverted to Main Alignment and Connectors

14.3.12. Traffic Growth Rates

For any transportation project, the traffic growth rate is an essential component required to be estimated reasonably well for the future traffic on the project road. Traffic forecasting using traffic growth pattern, which is the most important governing factor, in the present state of knowledge can at best be only approximate. Traffic is generated as a result of the interplay of a number of contributory factors like population, gross domestic product, vehicle ownership, agriculture output, fuel consumption, etc. to name a few. Any change in the pattern of these factors can only be estimated approximately with a limited degree of accuracy. The major factors affecting the transport demand are as follows:

- ◆ Growth in population
- ◆ Economic performance

The mathematical models used for forecasting the growth rates by regression method for passenger and freight traffic are given below:

For Passenger traffic: $\text{Log PN} = n \times \text{Log}(1+r) + \text{log P0}$ - Equation -A

Where,

- P0 = Traffic flow in the base year
- PN = Traffic in the nth year
- N = Number of years
- r = annual growth rate of traffic

For freight traffic: $\text{Log P} = A1 \times \text{Log}(\text{GDP}) + A0$ - Equation-B

Where,

- P = Traffic Volume
- GDP = Gross Domestic product
- A0 = Regression constant

A1 = Regression coefficient

The finally Adopted Traffic Growth Rate is as follows:

VEHICLES TYPE	2019-23 (%)	2024-28 (%)	2029-36 (%)
Two-wheeler	8.1	8.0	7.0
Car, Jeep, Van	9.4	9.0	8.0
Pickup	8.3	8.0	7.0
Bus	11.9	11.0	10.0
Trucks/Freight	8.7	8.0	7.0

Table 53: Final Adopted Growth rates (%)

12.5.2.4. Traffic Projections

The traffic projections have been made for each section i.e. East Bank-East Coast Road and connectors considering the base year traffic, generated traffic and growth factors.

The traffic projections for above two sections have been done based on the traffic growth rate calculated for the design life of 15 years.

Maximum Traffic has been generated from O-D Survey Data in-between Connectors as follows:

- ◆ On Main Alignment: In between Connector-1 to Connector-2 on main alignment, the maximum traffic will be plying due to traffic diverted from East Coast Road, Railway Embankment Road (Ogle), Diamond (East Bank Road) and Aubrey Barker Road to join main alignment road (East Bank- East Coast Road Linkage)
- ◆ On Connectors: Connector-1, the maximum traffic will be plying due to traffic diverted from East Coast Road, Railway Embankment Road (Ogle) and Diamond (East Bank Road).

SECTION ID	Light Fast Passenger			Public Transport		Freight Vehicles			Total Fast Vehicle	Total PCU
	Car	Utility	Mini Bus	Bus (Full)	LCV	MCV	HCV	MA V		
Main Alignment (EB-EC Road)	19346	1043	1747	18	1130	749	256	413	24702	29632
Connectors (1 & 4)	18390	931	1738	18	1037	697	239	379	23429	28051
Connector (2 & 3)	956	112	9	0	95	51	17	34	1274	1581

Table 54: Diverted Traffic on Main Alignment and Connectors (In the Year 2018)

The diverted traffic has been considered as the base traffic in the year 2018 and traffic projections have been made for the year 2036 as follows:

Year	Car / Jeep / Taxi	Utility (Pickup Van)	Mini Bus	Standard Bus	LCV	MCV	Truck HCV	MAV	Number	PCU
PCU	1	1	1.5	3	1.5	3	3	4.5		
2018	19346	1043	1747	18	1130	749	256	413	24702	29632
2036	88744	4986	11781	120	4429	2941	1005	1621	115626	137536

Table 55: Diverted Traffic Projection for Main Alignment (Bypass Road)

Section ID	Year	Car / Jeep / Taxi	Utility (Pickup Van)	Mini Bus	Standard Bus	LCV	Truck MCV	HCV	MAV	Number	PCU
	PCU	1	1	1.5	3	1.5	3	3	4.5		
Connectors (1 & 4)	2018	18390	931	1738	18	1037	697	239	379	23429	28051
	2036	84478	4486	11724	120	4073	2742	939	1491	110052	130771
Connectors (2 & 3)	2018	956	112	9	0	95	51	17	34	1274	1581
	2036	6673	831	766	6	464	267	89	169	9265	11195

Table 56: Diverted Maximum Traffic Projection for Connectors

Enhanced infrastructure facility promotes economic activity in the project influence area. Benefits derived from lower operating costs partially translate to additional vehicular trips. Therefore, generated traffic is expected on the project road once the East Bank-East Coast will be opened to traffic in the year 2022. The project development is linked with the development of land along the East Bank-East Coast Road and Connectors. The current and proposed development pattern along East Bank-East Coast road has been finalized by the Central Housing & Planning Authority and considered for generated traffic. The projected population in proposed development is 2280. Therefore, considering the vehicle ownership of 33.4%, it is expected to add 760 new vehicles in 2025 when these new settlements will be occupied.

14.4. Impact Prediction and Evaluation

During operation, the long term environmental effects of the Project will be positive, with an improved transportation network and an increase in public safety. However, the environmental effects on transportation resulting from the construction phase of the project are anticipated to be localized, short term, and minimal in number. Construction activities may result in temporary traffic disruptions or disturbances. Where possible, these disruptions will be minimized and timed to avoid both daily and seasonal peak traffic periods. No substantive adverse interaction between the Project and Transportation has been identified and overall the environmental effect of the Project on Transportation is positive; therefore, the environmental effects (including cumulative environmental effects) of the Project on Transportation during all phases of the Project are rated not significant.

While communities beyond the defined road corridor 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 a nuisance and the destruction of existing road transport infrastructure servicing these areas.

The main roads in the community are paved while many of the internal roads remain unpaved and/or poorly maintained, and lack elements to improve pedestrian safety such as crossings and cautionary signage. According to a survey conducted for the Ogle area, the majority of residents rely on private transportation and therefore do not walk on the community's roads daily.

According to a survey conducted for the Diamond area, the majority of residents rely on public transportation and therefore walk on the community's roads daily.

Road users especially pedestrians and cyclist can also be impacted by an increase in particulate matter in the air due to heavy machinery traversing the construction area. From the perspective of travel behavior and trends, the more intense use of a section of the east coast to east bank road linkage is highly likely. This may be attributed to the development of other transport hubs such as the Ogle Airport, the new Demerara Harbour Bridge, increased economic activity in Georgetown, 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

14.5. Mitigation and monitoring- Environmental and Social Management Plan

Throughout the course of the works, the contractor will be responsible for the safety of all persons present on the site of the works. As such, the contractor shall ensure, as far as is reasonably practicable and to the satisfaction of the engineer, the health, safety, and welfare of the employees including those of sub-contractors and all other persons on the site.

The responsibilities shall include:

- ◆ The contractor is required to perform work in a manner that ensures the safety and convenience of the public and protects the residents and property adjacent to the site.
- ◆ The contractor is required to allow the safe and unrestricted flow of public traffic on roads adjacent to and within the site.
- ◆ Throughout the project, the contractor shall ensure that the public road remains open and available for use in good condition and that delays to traffic are minimized.
- ◆ The contractor is required to keep existing roads open to traffic during construction operations but may bypass traffic over a detour of equal standard approved by an engineer. The contractor is required to cover the cost of all diversions.
- ◆ The contractor is required to keep roads and sidewalks affected by the activities free from soil and material spillage and ensure that construction areas can accommodate traffic safely at all times.
- ◆ The contractor is required to erect and maintain signs, barricades and other traffic control devices as may be required to guide traffic inside and outside work areas and as indicated by the manual of uniform traffic control devices, part 6-Temporary Traffic Control or as directed by the engineer.
- ◆ The contractor is required to replace traffic control devices that are lost, stolen, destroyed or deemed unacceptable while their use is required.
- ◆ During non-working hours and following completion of a particular construction operation, all warning signs except those necessary for public safety is required to be removed. The

retro-reflective and painted surface on signs, barricades, and other devices are required to be kept clean, in a good state of repair and retain the retro-reflective ability at all times. Sizes, colours messages, and locations are required to all be to the approval of the engineer.

- ◆ The contractor shall take care at all times to ensure the convenience and safety of residents along and adjacent to the road and any public highway affected by the works. Access to property adjacent to any worksite shall be maintained at all times.
- ◆ The contractor in having the responsibility for understanding the current traffic situation and establishing the requirements for traffic control and safety as already done so. As such, the contractor is now familiar with the existing traffic conditions, the importance of maintaining traffic safety and minimizing traffic delays by cooperating with pertinent traffic control agencies.

14.5.1. Traffic Control Schedule

The Contractor shall prepare a traffic control schedule that documents anticipated traffic control activities for the construction period. The schedule shall provide brief descriptions of the traffic control activity (e.g. lane width reduction, a lane shift, and detour), its location, approximate implementation date, and duration. This shall be submitted to the engineer prior to construction for approval.

14.5.2. Obstruction of Traffic

The contractor shall ensure that the flow of traffic is unimpeded by construction-related activities. Two lanes of traffic shall be maintained at all times. In cases where it is absolutely necessary to close the road to facilitate the works, the contractor shall ensure that the closure of one lane is done only for short periods. During lane closures, the flow of traffic shall be controlled by flaggers with stop and slow signs to ensure that undue delays are avoided.

The lane width shall be increased by temporarily grading and backfilling the existing road shoulder on both sides of the carriageway. Temporary road surfacing material shall be used to widen the road shoulder. All diversions, widened shoulders shall be maintained throughout the duration of construction works. If the option of widening the carriageway is not feasible in areas of limited space the option of diverting traffic through the secondary roads in the project shall be explored.

14.5.3. Construction and Advisory Signs

It is the responsibility of the contractors to install, maintain and remove all work-related signs. All signs shall be made in accordance with the Manual of Uniform Traffic Control Devices (MUTCD). Sign panels shall be orange with a black legend and be mounted on stands. the location and type of each sign shall depend on the area of placement.

14.5.4. Flagman

At each construction site traffic flow shall be guided by flagmen with STOP/GO signs when necessary. At the site, traffic flow shall be two-directional.

14.5.5. Lighting

All existing roadway lighting that is disturbed during construction shall be replaced with sufficient temporary lighting to illuminate the same roadway surface. Adequate lighting shall be provided for approved night works to ensure the safety of road users and construction workers.

14.5.6. Accommodation of Pedestrians and Cyclists

The contractor shall make provisions for pedestrians and cyclists to have safe access across the work zone at all times. If this cannot be readily accommodated then detours shall be readily provided. This shall be determined when the site is set out.

14.5.7. Access to Residence

The contractor shall ensure that access to residences is adequately maintained in case where access is affected by construction works. If access falls within the construction zone that is demarcated, the contractor shall ensure that access to the property is maintained by temporarily removing barricades. In cases where bridges are demolished to facilitate the works, the contractor shall provide suitable alternative arrangements to allow access to properties.

14.5.8. Public information plan

The public shall be informed through selective media of the projects duration and implementation phase. Road users shall be informed of possible traffic disruption and the importance of exercising caution in order to minimize accidents. The NDCs shall be engaged throughout the duration of the project to ensure information is communicated to the communities. Residents living in close proximity to the works shall be informed of the project, the duration of the construction, possible inconveniences and measures that shall be implemented to reduce impacts.

14.6. Traffic control

The traffic control plan includes two scenarios:

- ◆ Road works: Traffic will be diverted through adjacent streets where practical. In cases where alternative diversions are not practical, the road shoulder of the roadway can be upgraded to provide increased space, drainage trenches can also be backfilled (with a diversion in place) to facilitate the transport of vehicles. In the worst-case scenario, planks will be placed across the road to facilitate conveyance of traffic.
- ◆ Construction works on a turn

14.6.1. Mobilization phase

During mobilization, effective traffic management is essential. Traffic cones and other barriers shall be used to demarcate the area where the equipment is working. Works shall be limited to the road shoulders. The contractor shall ensure that two way traffic flow are maintained. Advanced warning signs shall be placed on either side of the approach to warn road users of construction in progress. All warning signs shall be reflective to warn road users who traverse the area at night. Advance warning signs shall include the following signs:

- ◆ Road works ahead: This sign shall be placed at least 300m before approaching the construction zone. This shall provide adequate warning to motorist before approaching the site.
- ◆ Speed limit (30km/h): All motorists shall be required to reduce their speed throughout the construction site. This sign shall be placed approximately 200m before approaching the construction site

- ◆ Narrow lane or Diversion Signs: This sign shall only be used when lanes are obstructed. This sign can be placed at least 100m before approaching the site. Diversion signs indicate the location of alternative routes.
- ◆ Road closed signs: Road closed signs/wooden barricades shall only be temporarily used during mobilization if any roadway has to be closed temporarily.

14.6.2. Construction Phase

The contractor is required to provide two way for traffic movement throughout the construction period. This shall be done by the various methods alluded earlier. To ensure that effective traffic flow is maintained and unnecessary disruptions are minimized, advanced warning signs shall be placed approximately 300m before approaching the site in both directions. Approaching the construction site in either direction, the following signs shall be placed in the sequence below:

- ◆ Road works ahead: This sign shall be placed at least 300m before approaching the construction zone. This shall provide adequate warning to motorist before approaching the site.
- ◆ Speed limit (30km/h): All motorists shall be required to reduce their speed throughout the construction site. This sign shall be placed approximately 200m before approaching the construction site
- ◆ Merge /narrow land: This sign shall only be used when lanes are obstructed. This sign can be placed at least 100m before approaching the site.
- ◆ Diversion sign: This sign shall be used, mainly when works require a total diversion.
- ◆ End road work: This sign shall be placed at least 150m after the construction area.

All wooden barriers shall be painted with and shall encompass the entire construction zone. roads/lane closed signs or wooden barriers shall be used when a lane is required to be closed to facilitate any work. This shall only be done for a short period to prevent any undue disruption of traffic.

Flagmen with stop and slow signs shall be placed on either side of the approach to guide incoming traffic when necessary (in situations where a lane is closed or if there is a significant build-up of traffic). Flagmen shall be placed approximately 30m before approaching the construction site. Flagmen shall use STOP/GO signs to assist in traffic control. Flagmen shall stand behind barriers to ensure safety.

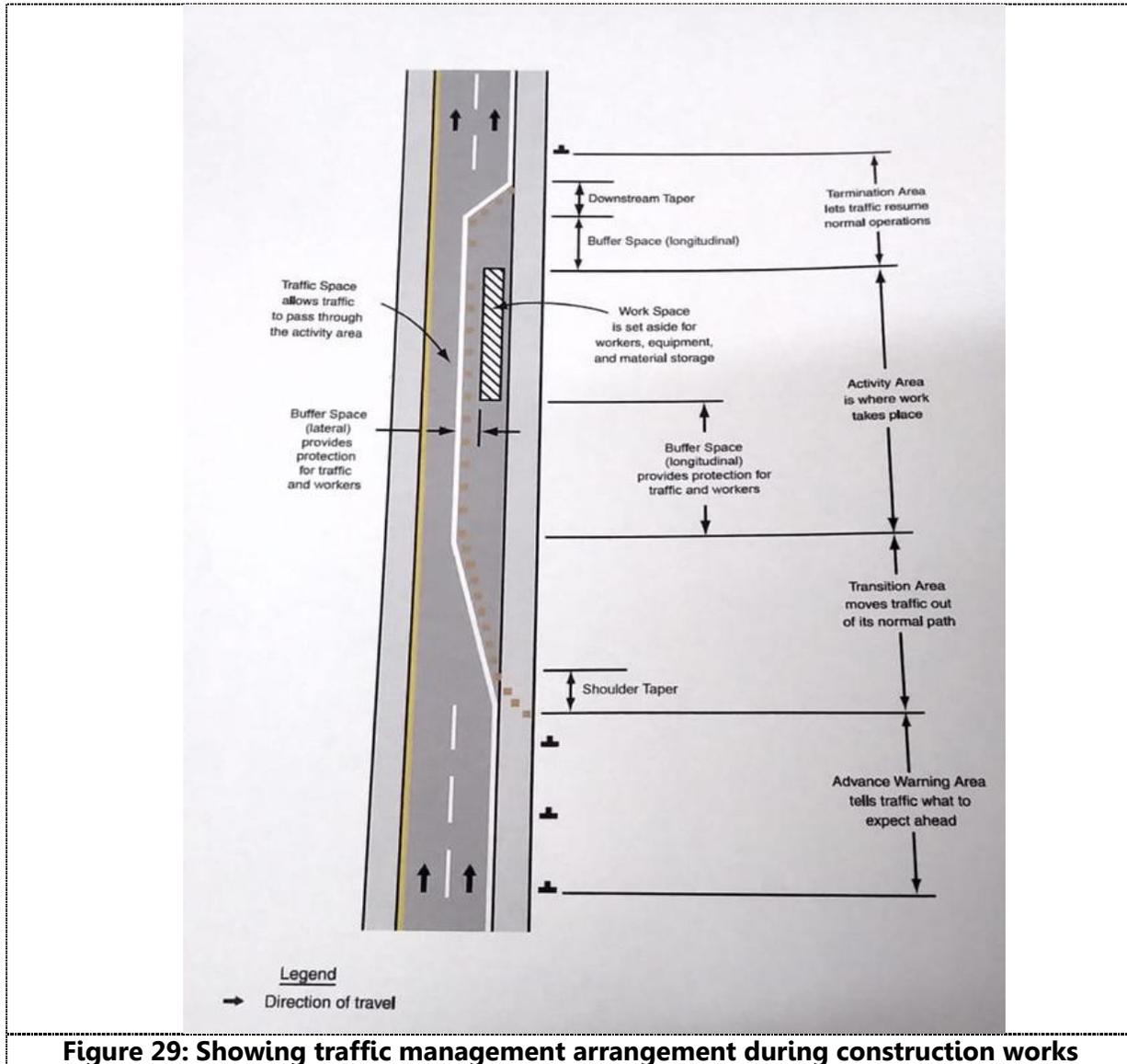
The contractor shall ensure that the existing carriageway is free of construction debris or any material that can pose a risk to the public. The road shall be wetted regularly is construction activities cause an increase in dust pollution.

The site (s) shall be lit at night to prevent accidents. When night operations are permitted, appropriate lighting shall be provided. During the construction phase, flashing lights would also be used to demarcate the construction zone in areas where no lights are present. All construction barricades shall be reflective to ensure the safety of road users in the night.

Flashing beacons should be placed at strategic points to ensure that motorists are forewarned of construction works. The traffic police shall be informed and the contractor shall request police presence on-site to assist with traffic management when necessary.

14.6.3. Construction work on a turn / Curve

The aforementioned traffic arrangement can be utilized for construction activities on a turn.



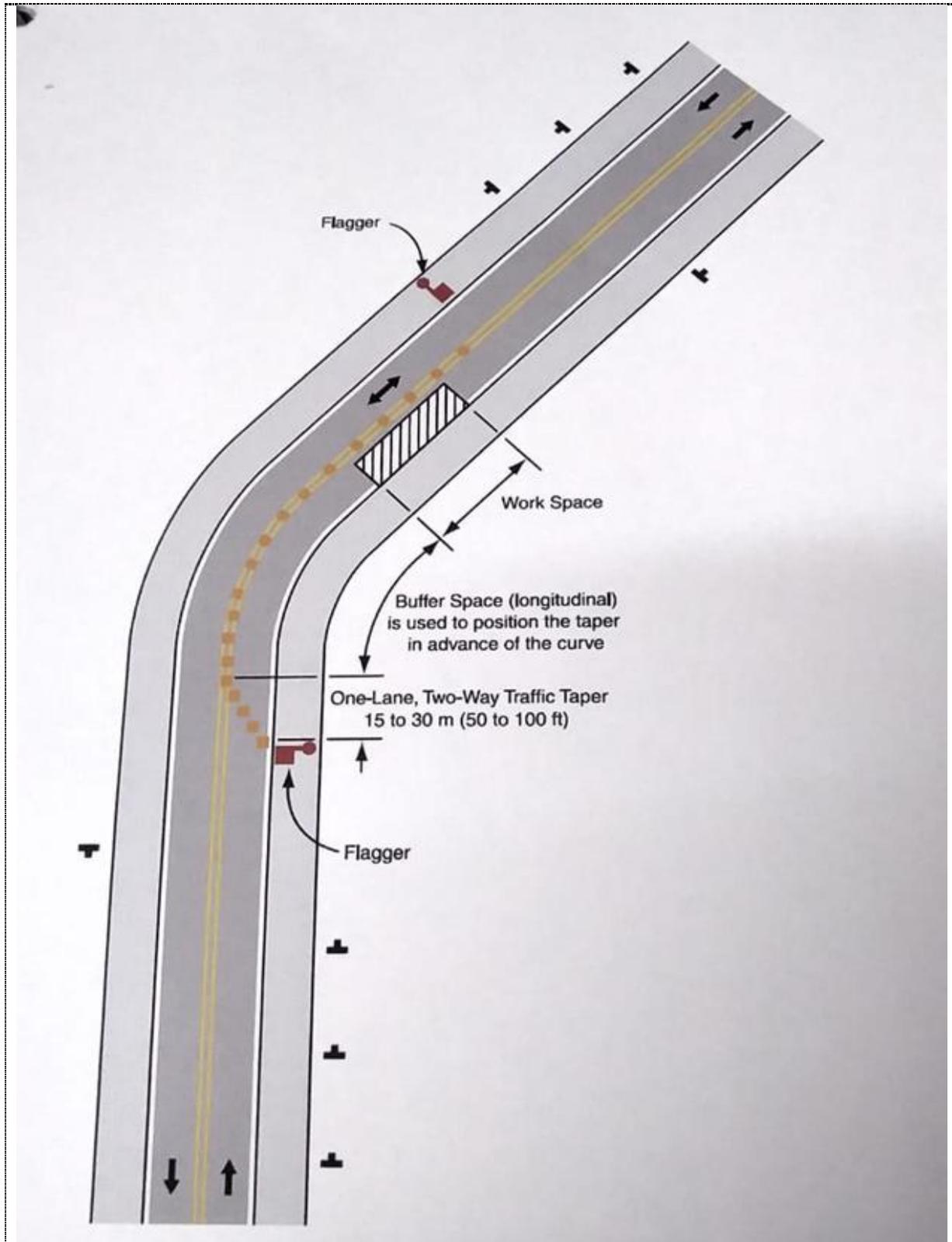


Figure 30: Showing traffic management arrangement during construction works on a turn / Curve

Sample notice

Sample Notice

The public is hereby notified that construction work on the East Coast-East Bank road linkage project will commence on June 2020. To facilitate this work, construction will be done alongside the ogle roadway resulting in a reduction of the lane width; however, both traffic lanes will remain open where possible. Where limited space prevents two functional lanes, an alternative road bypass will be constructed or an alternative street will be used. Road users are requested to exercise caution and adhere to signs and speed limit when traversing through the construction sites. We sincerely apologize for any inconvenience caused and thank road users for their full cooperation.

Topic	Potential Impact	Phase	Mitigation and management measures	Execution responsibility	Monitoring and Reporting
Transportation	Traffic Circulation, parking	Construction/ Operation	Develop a Traffic Management Plan for the Program Area. The plan may include methods for notification due to road closure, scheduling of deliveries to avoid peak traffic hours, identification of preferred transport routes, and measures to limit congestion and parking	Construction Contractor/ Ministry of Transport	A monthly inspection and corrective action directives

Table 57:Traffic Flow Mitigation and Monitoring

Chapter 15: Hazardous Waste and Waste Management Materials

15.1. Introduction

Construction waste is any substance, matter or thing that is generated from construction work and abandoned, whether or not it has been processed or stockpiled before being abandoned, but does not include any sludge, screenings or matter removed in or generated from any desludging, desilting or dredging works. The Environmental Protection Hazardous Waste Management Regulations provides regulations for chemical waste control and administers the possession, storage, collection, transport, and disposal of chemical wastes.

Impacts can arise throughout the waste management supply chain and therefore the generation, storage, collection and transport, reuse, recycling, recovery, treatment, and disposal of waste are all taken into account when assessing impacts. The impacts can be derived from inert waste or construction and demolition materials such as surplus excavated soil and rock, rubble and bricks; non-hazardous waste or general reuse such food waste, packaging waste and other general wastes from construction, businesses, industry and households; and hazardous or chemical waste such as oils, batteries and other waste exhibiting hazardous properties.

Waste is considered to be inert if it does not undergo any significant physical, chemical or biological transformations; and does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. Certain categories of municipal, industrial and construction waste (e.g. brick rubble) may be considered inert.

15.2. Policy, Legislation and Regulatory Framework

15.2.1. Environmental Protection (Hazardous Waste) Management Regulations

These regulations outline rules and procedures for the transport, storage, treatment, and disposal of hazardous substances, with the intent of protecting human health and the environment. For the purposes of these regulations, hazardous materials and wastes are:

- ◆ Explosives
- ◆ Flammable liquids
- ◆ Flammable solids or waste solids other than explosives which may be readily combustible
- ◆ Oxidizing substances
- ◆ Organic peroxides
- ◆ Poisonous substances
- ◆ Infectious substances
- ◆ Corrosives
- ◆ Toxic gases

- ◆ Toxic substances which if inhaled or ingested may cause delayed or chronic effects
- ◆ Toxic substances which, if released, may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and or toxic effects upon system

Material capable, after disposal, of yielding another material which possesses any of the characteristics specified above.

15.2.2. Basel Convention on the Transboundary Movement of Hazardous Waste and their Disposal

The Basel Convention aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. Guyana is a party to this convention which came into force in 1992. It was designed specifically to prevent the transfer of hazardous waste from developed to less developed countries (LDCs). The Convention is also intended to minimize the amount and toxicity of wastes generated. This ensures that toxic waste is managed as closely as possible to the source of generation. Examples of hazardous waste as defined by the convention are:

- ◆ Wastes from the manufacture, formulation, and use of wood preserving chemicals
- ◆ Waste pharmaceuticals, drugs, and medicines
- ◆ Wastes from the production, formulation, and use of organic solvents
- ◆ Waste mineral oils unfit for their originally intended use
- ◆ Waste oils/water, hydrocarbons/water mixtures, emulsions
- ◆ Wastes from production, formulation, and use of inks, dyes, pigments, paints, lacquers, varnish

15.3. Baseline

This baseline will describe the expected waste streams from the proposed project activities onto the environment during the construction and operational phases of the project. This will include information on the quantity, form (liquid, solid, gas), hazard, and toxicity of each significant waste, as well as any attributes that may affect its likelihood of dispersal in the environment, as well as the associated risk of causing environmental harm.

The construction activities to be carried out for the proposed Project will result in the generation of a variety of wastes which can be divided into distinct categories based on their composition and ultimate method of disposal. The identified waste types include:

- ◆ Site clearance waste;
- ◆ Construction and demolition (C&D) materials;
- ◆ Chemical wastes; and
- ◆ General refuse

15.3.1. Site Clearance Waste

The majority of the road works is through the abandoned Cane fields. The need for site clearance would consist of wood, large amounts of low and high graded vegetation such as grass and trees, and a large portion of the topsoil. It is considered that the handling and disposal of site clearance waste would be a key issue and the potential environmental impact arising from handling and disposal of such waste would be significant.

15.3.2. Construction and Demolition Materials

Construction and Demolition materials contain a mixture of inert and non-inert materials. The inert portion, such as soil, rock, concrete, brick and asphalt, etc., is the "public fill" and the non-inert portion, including metal, timber, paper, glass, and general garbage is the "Construction and Demolition waste". The Construction and Demolition materials will mainly arise from the road construction works. Construction and Demolition materials comprise unwanted materials generated during construction, including rejected structures and materials, materials which have been over-ordered and materials which have been used and discarded. Construction and Demolition waste may include:

- ◆ Wood from tree felling, formwork, and false work;
- ◆ Material and equipment, wrapping;
- ◆ Asphalt rubble, metal, and plastics from the construction of; and
- ◆ Damaged/ surplus construction materials.

The Contractor is responsible for the transfer of Construction and Demolition materials to public fill reception facilities or landfills, depending on the type of material and the percentage of inert material. The public fill should be reused on-site or disposed of to public fill reception facilities for beneficial uses. The non-inert portion of the Construction and Demolition materials should be reused or recycled and, disposal of at landfills as the last resort. A breakdown of the estimated quantities of wastes from the different work areas of the Project is given in Table 57.

The main sources of excavated materials will be generated from the foundation construction along the alignment. Excavated materials are usually inert such as soil and rock which can normally be reused on-site or in public fill reception facilities.

Construction and Demolition materials should be sorted on-site and separated public fill (inert portion) from Construction and Demolition waste (non-inert portion). Due to the inert nature of most of the Construction and Demolition materials generated, disposal would be unlikely to raise long-term environmental concerns. However, as some locations of the construction works areas would be in close proximity to roads and residential dwellings, improper management of waste may cause a severe nuisance to local residents.

The project being construction of a new road generation of Construction and Demolition materials is considered to be small and is not envisaged to have any adverse impact on the capacity of landfills and public fill reception facilities.

15.3.3. Chemical Wastes

Chemical Waste is any substance being scrap material or unwanted substances specified in the Regulation. However, substances likely to be generated by construction activities would mainly arise from the maintenance of equipment. These may include, but not be limited to, the following:-

- ◆ Scrap batteries or spent acid/alkali;
- ◆ Used engine oils, hydraulic fluids and waste fuel;
- ◆ Spent mineral oils/cleaning fluids from mechanical machinery; and
- ◆ Spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

It is difficult to quantify the amount of chemical waste that will be generated from the construction activities since it will be dependent on the Contractor's on-site maintenance requirements and the amount of plant utilized. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance, would be nominal and in the order of a few cubic meters per month.

Chemical wastes arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Regulation aforementioned. The potential hazards include:

- ◆ Toxic effects to workers, residents in close proximity and biological species;
- ◆ Adverse impacts on water and land quality from spills; and
- ◆ Fire hazards

Materials classified as chemical wastes will require special handling and storage arrangements before removal for appropriate treatment. Wherever possible opportunities should be taken to reuse and recycle materials. Provided that the handling, storage, and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts would be negligible.

15.3.4. General Refuse

Throughout construction, the workforce would generate general refuse comprising food scraps, waste paper, empty containers, etc. Release of general refuse into the roadside, and waterways should not be permitted as the introduction of these wastes is likely to have detrimental effects on water quality in the area. Rapid and effective collection of site wastes would be required to prevent waste materials being blown around by the wind, flushed or leached into the aquatic environment, and become an odour nuisance. The worksites may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. Disposal of refuse at sites other than approved waste transfer or disposal facilities can also result in similar impacts.

With the implementation of the recommended waste management practices at the site, adverse environmental impacts arising from the storage, handling, and transportation of refuse would not be expected.

Waste Type	Generated from work item	Total Quantity Generated	Method of Handling	Quantity to be disposed of off-site/ reuse
Construction and Demolition Materials	Construction of road works, site clearance works, tree felling, piling works, and formwork for the bridges	◆ Few cubic meters per month (preliminary estimate)	Sort on-site into : ◆ Inert Construction & Demolition material (public fill) ◆ Construction and Demolition waste	◆ Mostly Reduced
Chemical Waste	Cleansing fluids, solvent, lubrication oil and fuel from construction plant and equipment		Recycle on-site or by licensed companies Stored on-site within suitably designed containers	Chemical Waste Treatment Centre or another licensed facility
General Refuse	Waste paper, discarded containers, etc. generated from the workforce	◆ Few cubic meters per month (preliminary estimate)	Provide on-site refuse collection points	Refuse station for compaction and containerization and then to landfill

Table 58: Summary of Estimated Quantities of Construction and Demolition Materials and Disposal Routes

15.4. Impact Prediction and Evaluation

The Project has the potential to give rise to a number of wastes during the Construction and Operational and Decommissioning phases. The potential impacts arising from the management of wastes include:

- ◆ Impacts on human health and on ecological receptors from releases of waste to air, water or land; and
- ◆ Nuisance, including litter, odour, dust, and vermin.

Chemicals such as epoxy, gypsum, additives, admixtures, cement, bitumen, etc. are hazardous materials used for road construction and maintenance activities. Release of bitumen into the environment through runoff into surface water is likely during the construction phase if no cautionary measures will be taken seriously; such hazardous chemicals can also cause pollution due to their spillage in large quantity. The typical primary and secondary effects of water pollution include health hazards to the downstream water users and impact on local fisheries are likely. The impact will be direct in nature with the medium in magnitude, site-specific in extent and short-term in duration.

The main issues of concern with unmanaged disposal of solid and liquid wastes are the contamination of the waterways and improper disposal of storm water and black water in the residential land that existed in the project area. The impact of solid waste disposal will be direct in nature with a medium in magnitude, site-specific in extent and short-term in duration.

Construction materials are usually stockpiled for a relatively short period without covering. This situation may lead to environmental degradation in air pollution, land pollution, pollution of surface water, and permanent changes in land use if not rehabilitated after work complete. So while stockpiling construction material following area should take into consideration:

- ◆ Place where considerable vegetation is available.
- ◆ Low land inundation
- ◆ Forest area where folding and water logging is prone
- ◆ Settlement area where the excess road will be blocked inundation with materials

Impact of incorrect disposal of spoil and excavated materials will be direct in nature, moderate in magnitude with local in extent and mid-term in duration.

Operation of asphalt concrete plant/ hot mix plants and use of Bitumen during construction is one of the most hazardous materials during road construction and maintenance activities. Bitumen storage, transfer, and burning can cause frequent environmental problems that have to be handled with special precautionary measures. Bitumen drums during transportation often get damaged and lead to leakage in stored and hot mix plant area which cannot be adequately cleaned up afterward. During application and mixing of bitumen often have health and occupational hazard leading to workers injures and burn hence required protective equipment. The heating of bitumen may lead to environmental air pollution as well as the release of it into surrendering area can runoff into surface water causing pollution. The impact will be direct in nature, high in magnitude, local in extent and long-term in duration.

15.5. Mitigation and monitoring - Environmental and Social Management

The following mitigation measures should be employed to reduce the impacts of the aforementioned impacts:

15.5.1. Minimizing/ Managing Impacts due to Solid Waste

To minimize the impact due to solid waste following measures will be applied:

- ◆ Institutional coordination and budget plan for hiring collection and disposal service providers will be undertaken.
- ◆ Direct disposal of solid waste by the construction workers in the water bodies will be strictly prohibited.
- ◆ Knowledge and awareness about the biodegradable and non-biodegradable waste to the workers will be provided.
- ◆ Work camp will be established far from the water bodies.

- ◆ Strict code of conduct will be followed in the camp and the penalty for the violation of rules will be regulated

15.5.2. Minimizing/ Managing Impacts due to Soil Waste

To mitigate the impact due to soil waste during pre-construction careful and thorough communication will be undertaken in the Pre-construction Phase so that the site(s) are planned in the accepted area with sufficient safety measures and design. In order to minimize the impacts due to soil waste following methods are proposed:

- ◆ Natural water source below the disposal site shouldn't pose a significant threat.
- ◆ The irrigation canal below shouldn't be damaged due to the deposition of soil.
- ◆ The agricultural land below downstream shouldn't be damaged due to disposal activity.
- ◆ Careful and thorough communication will be undertaken in the Planning Phase so that the Disposal Site to be accepted.
- ◆ Design the Disposal Site so that the impacts on the water use downstream is minimized.

15.5.3. Minimizing/ Managing Impacts due to Liquid Waste

To minimize the impact due to liquid waste following measures will be applied:

- ◆ Portable toilet will be managed inappropriate manner.
- ◆ The bitumen will be stored at a proper place and not scattered along the road.
- ◆ Contamination of bitumen with the water body source will be avoided as possible.
- ◆ The fuel/lubricants for the construction vehicles will be stored in a proper place and the contamination with the water bodies will be avoided.
- ◆ Cleaning of construction vehicles in the water bodies will strictly be prohibited
- ◆ Direct disposal of chemical wastes from the workshop upon water bodies will be strictly prohibited.
- ◆ Workshops and chemical storage sites will not be established nearer to the water bodies and riverside.

15.5.4. Minimizing/ Managing Impact due to Soil Contamination and Top Soil

To minimize the impact due to soil contamination following measures will be applied:

- ◆ Educate and aware workers about the negative impacts of soil contamination.

- ◆ Conduct training on good handling of the oils and chemicals to avoid soil contamination.
- ◆ Prepare guidelines of handling, recycling and discarding the empty containers or bags of the chemicals.
- ◆ Designation of site managers to monitor the condition of stockyards.
- ◆ Storage and handling of bitumen will be done properly as per the manual and guideline and contamination with the existing water source should be avoided.
- ◆ Strict code of conduct should be regulated in the construction area and avoid spilling and leakage the chemicals in the work area.
- ◆ Pouring of oils/lubricants will be avoided so that it does not degrade the land located nearby of the construction area.
- ◆ Carefully Stripping and safely storing nutrient topsoil for later use. Use it as a valuable resource in backfilling and during bio-engineering works. Use it in slope filling and embankment fill before the plantation and bio-engineering work.

15.5.5. Avoiding Chemical Impact upon Environment

Avoiding chemical contamination in water bodies due to mechanical activities/ workshop/ vehicle maintenance, cleaning and mixing. Workshops and chemical storage sites will not be established nearer to the water bodies and riverside. Bitumen drums will be stored at designated locations and not scattered along the road. If contaminated; the contaminated runoff from storage areas will be captured in ditches or ponds with an oil trap at the outlet. The contaminated and worn plastic sheet will be packed into drums and disposed into a safe disposal site. Direct disposal of chemical wastes from the workshop upon water bodies will be strictly prohibited.

Site clearance and removal of residues of a chemical such as epoxy, gypsum, additives, admixtures, cement, bitumen, etc. avoiding impact upon land and water bodies. During site clearance, all cut and grubbed materials will be kept at a secured location so as to maintain environmental safety. The contractor will be responsible to restore all the construction related sites including workshop into their original state. The boundaries of the water body particularly existing nearby rivers will be left undisturbed and tidy with the completion of construction. If unavoidable, drainage channels of adequate capacity will be provided for the water body being impacted by storm waters.

In the case of bituminous wastes, dumping will be carried out over a 60 mm thick layer of rammed clay so as to eliminate any chances of leaching. In case of filling of low-lying areas with wastes, the contractor will ensure the ground level matches with the surrounding areas. In case oil and grease are trapped for reuse in a lined pit, care will be taken to ensure that the pit will be located at the lowest end of the site.

The contractor will regularly educate his workforce location of the disposal site as well as the specific requirement for the management of these sites. The waste management practices adopted by the Contractor, including the management of wastes at construction camps, etc.

Will be controlled on a regular schedule by the Project Engineer during the progress of construction.

15.5.6. Avoiding hazards caused by explosive, combustible and Toxic Materials

- ◆ The contractor must educate the workers to undertake safety precaution while working at the plant/site as well as in the around heavy equipment.
- ◆ The contractor will ensure the occupational health & safety measures of the labor workforce.
- ◆ The contractor will obey the Occupational Health and Safety Management Plan prepared for the project.
- ◆ The contractor must also ensure that all machinery, equipment, and vehicles will comply with the existing noise and emission norms.
- ◆ No bituminous materials will be discharged into side drains.
- ◆ Nearby tree, vegetation, and private property will be protected during bitumen spraying work.
- ◆ Skilled labor will be used while hand placing the pre-mixed bitumen material.
- ◆ The contractor will responsible to provide safety equipment i.e. gumboots and gloves to the workers while handling bitumen. While applying Tack Coat, spraying of bitumen will be done in the wind direction. The labourer will wear a jacket while spraying the bitumen.
- ◆ Transportation, storage and use of explosives will be carried out as per Act.

15.5.7. Waste Management Plan

A significant amount of solid waste from site clearance and earthworks will be generated. Removal and disposal of hazardous waste material shall be performed in accordance with all applicable government regulations. Contractor will be required to submit documentation attesting to the method proposed for disposal of wastewater from hydrostatic tests and disinfection, prior to performing hydrostatic tests. Test results from an accredited commercial laboratory verifying disinfection will also be submitted.

Efforts will be made to avoid and minimize spillage of fuels, lubricants, cleaners, solvents, or other hazardous substances which may potentially contaminate surface water bodies and groundwater bodies. Maintenance of vehicles and equipment will be conducted on hardstands in designated areas designed to contain incidental spills of hydraulic or other fluids. Secondary containment for all bulk storage tanks or drums will be provided. Secondary containment shall be of adequate size to contain the entire contents of the tank plus sufficient freeboard to allow for precipitation. All secondary containment shall be constructed of impermeable materials to prevent infiltration of spilled or leaked tank contents onto the ground.

Disposal of concrete residue and wash water, water from aggregate washing and other operations resulting in sedimentation will be treated by filtration, settling basins, or other means sufficient to reduce the sediment concentration to applicable limits established by WHO. The Project Manager and/or his designated representative will have the responsibility to

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

Litter control will be a key part of the solid waste plan. Gallon drums will be placed at strategic locations to collect litter. In addition, workmen will be given responsibility to control litter in their work area as part of the monitoring program. Monitoring of the transportation of solid waste from the construction site to the disposal site will be done so as to ensure that no debris being transported is falling unto the roadway along the route. Spot checks should be conducted by the Local Planning agencies. The only expected solid waste to be generated during operations will come from littering by users of the roadway and/or accidental spillage of debris/material etc. from trucks transporting said items.

Parameter	Institution responsible	Time	Location
Monitor volumes of hazardous and nonhazardous waste streams generated. Identify for each waste type the quantity of waste recycled or reused, treated, incinerated or sent to landfill.	Contractor/ Environmental Manager	Ongoing throughout life of project. Data collected monthly from waste contractors	Project site
Inspect waste storage areas for compliance with project standards. Specifically assess state of containment, bonding, presence of spills, and performance of treatment measures, correct segregation, safety systems, transport equipment and systems to ensure that appropriate mitigation measures are enforced.	Contractor/ Environmental Manager	Audit of waste contractors prior to agreeing to any formal contracts. Half yearly monitoring of facilities that receive waste	Project site
Report and investigate all leaks and spills, including type and quantities of substances spilled.	Contractor	Ongoing throughout life of project	Project site

Table 59 : Monitoring Plan

Chapter 16:

Landscape and Aesthetics

16.1. Introduction

When assessing the impact on landscape and aesthetics, the following methodology have been used:

- ◆ **Identification of the baseline Landscape Resources (LRs) and Landscape Character Areas (LCAs) found within the Study Area.**

This was achieved by site visits and desk-top studies of topographical maps, information databases, and photographs. Landscape resources within the Study Area described in Chapter 5 to 15, are identified on the plan and described in the text. Blank areas do not constitute landscape resources and typically include hard built elements such as buildings, roads, and paved areas.

- ◆ **Assessment of the degree of sensitivity to change of the LRs and LCAs.**

This is influenced by a number of factors including whether the resource/character is common or rare, whether it is considered to be of local, regional, national or international importance, whether there are any statutory or regulatory limitations/requirements relating to the resource, the quality of the resource/character, the maturity of the resource, and the ability of the resource/character to accommodate change. The sensitivity of each landscape feature and character area is classified as follows:

- ◆ **High:** Important landscape or landscape resource of the particularly distinctive character or high importance, sensitive to relatively small changes;
- ◆ **Medium:** Landscape or landscape resource of moderately valued landscape characteristics reasonably tolerant to change; and
- ◆ **Low:** Landscape or landscape resource, the nature of which is largely tolerant to change

16.1.1. Identification of potential sources of landscape change.

These are the various elements of the construction works and operational procedures that would generate landscape change.

16.1.2. Identification of the magnitude of landscape change.

The magnitude of the change depends on a number of factors including the physical extent of the change, the landscape and visual context of the change – i.e. a set circumstance/facts surrounding the change, the compatibility of the Project with the surrounding landscape; and the time-scale of the change - i.e. whether it is temporary (short, medium or long term), permanent but potentially reversible, or permanent and irreversible. Landscape changes have been quantified wherever possible. The magnitude of landscape change is classified as follows:

- ◆ **Large:** The landscape or landscape resource would suffer a major change
- ◆ **Intermediate:** The landscape or landscape resource would suffer a moderate change

- ◆ **Small:** The landscape or landscape resource would suffer slight or barely perceptible changes
- ◆ **Negligible:** The landscape or landscape resource would suffer no discernible change
- ◆ **Note:** The landscape or landscape resource would suffer absolutely no impact

16.1.3. Identification of potential landscape mitigation measures

These may take the form of adopting alternative designs or revisions to the basic engineering and architectural design to prevent and/or minimize adverse impacts; remedial measures such as colour and textural treatment of building features; and compensatory measures such as the implementation of landscape design measures (e.g. tree planting, creation of new open space etc.) to compensate for unavoidable adverse impacts and to attempt to generate potentially beneficial long term impacts. A program for the mitigation measures is provided.

16.1.4. Prediction of the significance of landscape impacts before and after the implementation of the mitigation measures.

By synthesizing the magnitude of the various changes and the sensitivity of the various landscape resources it is possible to categorize impacts in a logical, well-reasoned and consistent fashion. Table 58 shows the rationale for dividing the degree of significance into four thresholds, namely insubstantial, slight, moderate, and substantial, depending on the combination of a negligible-small-intermediate-large magnitude of change and a low-medium-high degree of sensitivity of the Land Resources (LRs / LCAs). The significance thresholds are defined as follows:

- ◆ **Substantial:** Adverse/beneficial impact where the proposal would cause significant deterioration or improvement in existing landscape quality
- ◆ **Moderate:** Adverse/beneficial impact where the proposal would cause a noticeable deterioration or improvement in existing landscape quality
- ◆ **Slight:** Adverse/beneficial impact where the proposal would cause a barely perceptible deterioration or improvement in existing landscape quality
- ◆ **Insubstantial:** No discernible change in the existing landscape quality
- ◆ **Note:** Absolutely no change in the existing landscape quality

The road project is expected to be impact visually in the following ways:

Type of Environment	Type of Development (Road Development Construction of a 15.340 km Main Alignment Construction and 4 connectors having length 10.092 km)
The abandoned cane fields where the Main Alignment and Connectors will be cutting through	The Low visual impact expected
Areas or routes of medium scenic, cultural, historical significance/ disturbed Existing Ogle Area	The high visual impact expected

Table 60: Visual Impacts from Construction Activities

16.2. Baseline

16.2.1. Landscape and Visual Study Area

The landscape impact Study Area is 500m from the boundary of the work and is defined in Figure 7 For the purposes of this assessment, this has been offset from the location of the Main Alignment and the furthest extent of the head of the four (4) connectors. This encompasses the GUYSUCO Estate, Backland of Mocha Road, etc.

16.2.2. Landscape Resources (LRs)

The baseline LR that fall within the landscape impact Study Area during the construction phase and operation phase are as follows:

- ◆ **Water Resources:** There are a number of waterways within the Area of Influence however, no species of conservation importance were identified in the ecological survey. Streams are relatively common within the communities of Guyana as a whole, the occurrence and quality are not under pressure from the development project. Overall as a landscape resource, the waterways have a low ecological value, and that they have a medium tolerance to change, their sensitivity as a landscape resource is assessed as Medium.
- ◆ **Natural Inland Vegetation and Wetland:** The inland vegetation ranges in height from low shrubs of 1 to 2 meters height to trees up to 8 meters height in places and is dominated by native species with some exotic species (further details of species can be found in the Biological Assessment Chapter). None of the tree and shrub species identified are recognized as having conservation importance. A species of birds of conservation importance have been identified within this landscape resource. The biological assessment carried out, rates the overall ecological value of these habitats as Low to Moderate. This type of vegetated inland covers the majority of the area where the alignment is to be constructed. Overall, in terms of a landscape resource, given its high scenic value and contribution to the distinctive landscape setting and its contribution as a wildlife habitat and medium tolerance to change, the sensitivity is assessed as High.
- ◆ **Domestic Amenity Tree and Shrub Planting:** Mature amenity tree and shrub planting occur around the village residential and open space developments. There are no plant species identified as conservation interest. Given that the vegetation generally comprises common exotic amenity species found throughout Guyana that can be easily replaced, the sensitivity is assessed as Low.
- ◆ **Artificial Ponds:** The ecological value of this pond has not been evaluated by the Biodiversity Assessment. As they are not natural features and create for irrigation of cane field. as the cane cultivation has already been abandoned, its sensitivity to change is low.

Phase	Conditions	Environmental impact	Significance
Operational	Aesthetics	Improper disposal of solid waste	Lo, ST, Av, Irr, M, Insig
		Hap-hazard stacking of raw materials and finish products	Lo, Rev, ST, Av, M, Insig
Impact Significance Parameters			
Lo – Localised	Ex – Extensive	Rev – Reversible	Irr. Irreversible
ST – Short Term	LT – Long Term	Av. – Avoidable	Un - unavoidable
Sig. – Significant	Insig. – Insignificant	M. – Mitigable	UM – Unmitigable

Table 61: Potential Impacts on Aesthetics and Landscape



Figure 31: Showing the Landscape/ Visual of the Project Area

16.3. Impact prediction and assessment

The construction of the East Coast to East Bank Road Linkage will alter the landscape and change the project area aesthetic. However, there are already existing roads such as the Ogle Airport Road and roads leading to the start of the connector such as the Haag Bosch, Aubrey Barker, Mocha Arcadia and Great Diamond roads which are quite significant. As such, the change in aesthetics is not expected to be a significant impact. In addition, the facilities will be well laid to minimize this impact.

However, the areas can become visually displeasing as a result of the following:

- ◆ Haphazard stacking of raw materials and finished products
- ◆ Improper disposal of solid waste

16.3.1. Analysis

Raw materials such as sand and loam can be stacked in a haphazard manner, aesthetically displeasing to the eye. This method of stacking/storage can also increase the risks associated with workers safety. Therefore, it is necessary to pack and store materials, raw and processed, in an organized manner and separated in designated areas.

Waste generated from the excavation of the road and canals can be stockpiled and or scattered in the surrounding environment and this is often visually displeasing. Other solid waste such as domestic garbage can contribute to this issue as well. Therefore, it is essential to institute waste management practices to reduce visual and environmental effects.

16.4. Mitigation and monitoring - Environmental and Social Management Plan

16.4.1. Good Site Practices

It is not anticipated that adverse waste management related impacts would be arisen, provided that good site practices are adhered to. Recommendations for good site practices during construction activities include:

- ◆ The nomination of an approved person, such as a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site;
- ◆ Training of site personnel in proper waste management and chemical waste handling procedures;
- ◆ Provision of sufficient waste disposal points and regular collection for disposal;
- ◆ Appropriate measures to minimize windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers; and
- ◆ Regular cleaning and maintenance program for drainage systems, sumps, and oil interceptors.

16.4.2. Environmental Management Plan

Mitigation measures will be implemented to prevent/avoid, reduce, and where possible offset or remedy any significant adverse landscape and visual effects. Efforts will be expended initially to prevent or avoid adverse landscape and visual effects. If adverse effects cannot be prevented they will be reduced as far as possible. Unavoidable adverse effects will be offset or remedied. The project design will incorporate measures to minimize negative and optimize positive landscape/visual impacts. Mitigation measures will include:

- ◆ Avoiding as much as practicable sensitive locations and sites of highly valued historic or naturalistic landscapes, and siting project facilities to minimize visibility
- ◆ Adjusting site levels
- ◆ Enhance the road corridor with new planting where possible using a planting palette which is consistent with the existing plants in the area
- ◆ Maintaining and protecting existing vegetation wherever possible

16.4.3. Monitoring Plan

Monitoring will be performed to test whether the predicted effects occur and whether any unforeseen effects arise and to ensure that mitigation measures which are implemented are effective in avoiding or reducing the predicted effects

Chapter 17:

Socio-Economic Impacts

17.1. Introduction

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

Socio-economic impacts will be a function of access between East Coast – East Bank and from opportunities created for participation of communities close to the project area. Employment and income generation is potentially one of the greatest benefits of the project for local and wider communities. Access to good employment may be a positive catalyst for a whole range of improvements in social and health indicators. However, these improvements are based on suitable conditions of employment and recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.

Employment practices must include:

- ◆ Fair treatment and non-discrimination
- ◆ Good worker–management relationships
- ◆ Compliance with relevant employment and labour laws
- ◆ Worker protection, especially vulnerable groups such as children
- ◆ Safe and healthy working conditions
- ◆ No use of forced labour.

This project area of influence is in rural areas and is populated by various ethnic groups. The project can create important employment opportunities for Indigenous Peoples and may help to fulfill their social and economic aspirations.

Indigenous People issues consider:

- ◆ Respect for human rights, dignity, aspirations, culture, and natural-resource based livelihoods
- ◆ Avoidance and/or minimization of project impacts on their communities

- ◆ Promotion of sustainable development benefits and opportunities in a culturally appropriate manner
- ◆ Free, Prior, and Informed Consent (FPIC) of affected communities as appropriate.

17.1.1. Social factors related to road use

It must be noted that the East Coast to East Bank road linkage functions as a point of connection for access to major residential communities within its area of influence. Given the land use consideration, the social aspects connected with road use are equally important. Consideration must therefore be given to the safety of pedestrian 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 growth of the Coast, East bank and Georgetown. By facilitating the decentralization of social services and facilities, the dependence on the city centre (Georgetown) for such services will be reduced, thus stimulating a more convenient spatial distribution on the Coast and East Bank while minimizing the negative externalities associated with over concentrated city center provision.

Economic activity on the East Coast and East Bank have changed over time and the East Coast and East Bank roads were major road transport change elements. As the country continues to move away from the historic dominance of port-centered development, there is likely to be growing reliance on the road network for the efficient movement and distribution of people, goods and services. It is precisely in this context that the construction of major roads such as the East Coast to East Bank road linkage can have profound direct and indirect socio-economic impacts.

17.2. Policy, legislation and Regulatory Framework

17.2.1. Labour Act (1942)

The Labour Act (1942) established the Department of Labour to regulate relationship between employers and employees and to settle differences between these groups. Part II details the conciliation process in instances where a difference exists between employer and employees or between different classes of employees. Part III grants authority to the Minister to appoint an advisory committee to investigate the conditions of employment of any occupation and to make recommendations for the minimum wage to be paid to that occupation.

The advisory committee must include a representative of both the employer and employee. Parts IV and V of the act respectively detail the right of employees, duties and obligations of employers and payment of wages and deduction from wages. Part VII of the act establishes the right of the Minister to make regulations regarding the hours of work. Collective agreements are covered under Part VII of the act. All aspects of this Act are applicable to this project. 16.1.3.3 Labour (Amendment) Act (1994) This Act amended the Labour Act by the substitution for the words "two hundred and fifty dollars" and "ten dollars" by the words "fifteen thousand, six hundred and twenty-five dollars" and "six hundred and twenty-five dollars", respectively.

The amendment further mandated where in any occupation rates of wages have not been prescribed, an employer shall pay wages to the person employed at the rate agreed upon between them, and if the employer fails to do so, he shall be liable on summary conviction to a

fine of fifteen thousand six hundred and twenty-five dollars, and on a second or subsequent conviction to a fine of forty-six thousand, eight hundred and seventy-five dollars. The Amendment also allows for any occupation in which the partial payment of wages in the form of allowances in kind is customary or desirable because of the nature of such occupation, nothing contained in the Amendment shall render illegal a contract with an employee for giving to him food, drink, a house, cottage, tenement or room, or other allowances or privilege in addition to money wages as a remuneration for his services. This part of the Amendment is particularly applicable to this project since the Project Proponent will be required to establish a man camp on site and to provide meals for persons employed on the project.

17.2.2. Termination of Employment and Severance Pay Act (1997)

This Act provides conditions to govern the termination of employment and grant of redundancy or severance payment to employees. Part II of the Act defines continuity of employment as beginning from and including the first day on which an employee begins to work for an employer and continuing up to and including the date of termination of employment of such employee and establishes conditions that cannot be regarded as interruptions in employment. Part III identifies conditions under which employment can be terminated and identify reasons which do not constitute good or sufficient cause for dismissal or for imposition of disciplinary action. Part IV of the Act mandates severance and redundancy paid upon termination of employment. These payments are related to the period for which the person has been employed. All aspects of this Act are applicable to this project.

17.2.3. Holidays with Pay Act (1995)

The Holidays with Pay Act, 1995 provides for the grant and regulation of annual holidays with pay for all categories of workers. The Act mandates that every worker is allowed a period of holidays with pay of not less than one day for each completed month of employment computed from the date of commencement of employment. Every worker who is employed on a half day basis shall have the half day counted as a day and every worker employed on a daily or an hourly basis shall be allowed a period of holidays with pay of not less than one day for every period of 20 (twenty) days or 160 (one hundred and sixty) hours worked.

17.2.4. Holidays with Pay (Amendment) Act (2009)

The Act repealed and re-enacted section of the Holiday with Pay Principal Act which deals with "Offences penalties and court order" and amended Section 11 which deals with the institution of prosecutions by the Chief Labour Officer and replaced the word 'holidays' with 'leave' throughout the Act.

17.3. Baseline

17.3.1. Population and Livelihood

Results of the most recent national census indicate that 87.5 percent of Guyana's Labor force was employed and 12.5 percent was unemployed in 2012. Data from the previous census in 2002 indicate that the unemployment rate did not change in this 10-year period (BSG 2012; BSG 2002). In 2012, Region 4 had an average unemployment rate of 11.3 percent. Census data show that tertiary(service) sector jobs such as wholesale and retail trade, public administration, and accommodation and food services are dominant in Region 4 (including Georgetown), making up 67.0 percent of jobs there. Female representation in this sector is high, with women making up 48.2 percent of workers in the sector (BSG, 2016). Secondary and primary sector jobs make up 21.0 percent and 12.0 percent of employment in Region 4.

The population within the project area estimated at 38,000, accounting for about 12 percent of Georgetown’s population. The unemployment rate within the project area is not available but is anecdotally reported to be relatively low. GUYSUCO and NICIL is in the process of allocation abandoned estate lands for divestment. This will see additional development within the project area that would positively affect Employment categories ranges from labourers to moderate income professional, administrative workers such as nurses, police, teachers, and public servants. A number of people in the community are also self-employed, relying on informal construction work or yard work, small enterprises such as sewing, furniture making, barbering or bicycle repair, or vending of food and other items.

Table 1: Regional Distribution of Final Population Count by Category and Gender, Guyana: 2012

Region	Enumerated Household Population			Institutional Population			Estimated No-Contact Persons			Grand Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Region 1	14,134	12,908	27,042	124	109	233	192	176	368	14,450	13,193	27,643
Region 2	23,131	22,883	46,014	317	269	586	106	104	210	23,554	23,256	46,810
Region 3	52,850	53,069	105,919	115	90	205	829	832	1,661	53,794	53,991	107,785
Region 4	144,013	152,396	296,409	2,685	1,168	3,853	5,490	5,811	11,301	152,188	159,375	311,563
Region 5	24,513	24,661	49,174	51	57	108	269	269	538	24,833	24,987	49,820
Region 6	53,969	53,985	107,954	604	313	917	390	391	781	54,963	54,689	109,652
Region 7	9,019	8,251	17,270	331	64	395	371	339	710	9,721	8,654	18,375
Region 8	5,939	4,953	10,892	43	50	93	50	42	92	6,032	5,045	11,077
Region 9	12,210	11,450	23,660	157	203	360	112	106	218	12,479	11,759	24,238
Region 10	19,068	19,779	38,847	501	192	693	222	230	452	19,791	20,201	39,992
Total	358,846	364,335	723,181	4,928	2,515	7,443	8,031	8,300	16,331	371,805	375,150	746,955

Table 62. - Regional Distribution of Final Population Count by Category and Gender, Guyana: 2012 (Bureau of Statics 2018)

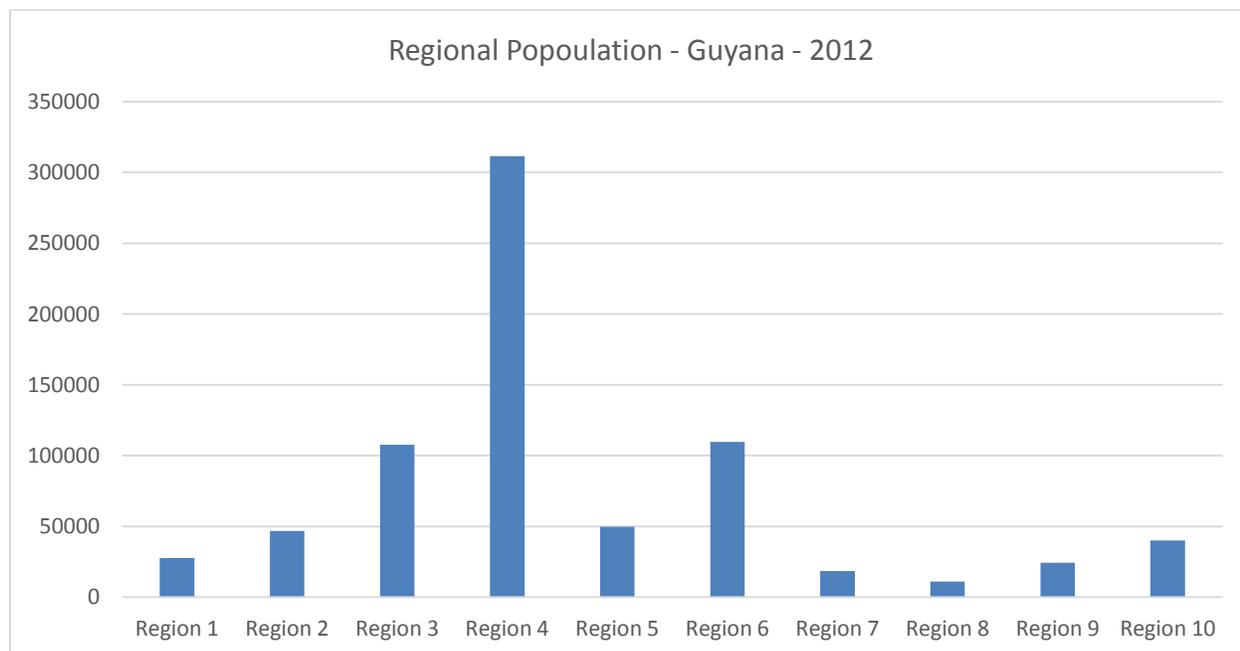


Figure 32. - Regional Distribution of Final Population Guyana: 2012 (Bureau of Statics 2018)

17.3.2. Community Services and Infrastructure

Between Ogle and Diamond tremendous infrastructure development in terms of housing and network of roads. However no new main road have been developed since the 2001. Given the large area of the community and the need for MOPI and the Ministry of Public Infrastructure to apportion their investments over many other housing schemes, this process has been implemented in an incremental manner and many infrastructure and service needs still exist.

17.3.3. Transportation Infrastructure

The main roads in the community are paved while many of the internal roads remain unpaved and/or poorly maintained, and lack elements to improve pedestrian safety such as crossings and cautionary signage. According to a survey conducted for the Ogle area, the majority of residents relies on private transportation and therefore do not walk on the community's roads daily. According to a survey conducted for the Diamond area the majority of residents rely on public transportation and therefore walk on the community's roads daily.

17.3.4. Utilities

The majority of households in Between Ogle East Coast Demerara and Diamond East Bank Demerara have electricity and piped water connections. However, some areas of the community are not yet regularized and lack these services.

17.3.5. Recreation

During the planning of housing schemes, certain areas are earmarked for recreational uses such as playgrounds and community centers. However, it may take years for funds to become available to actually develop the facilities on the earmarked lands. During the site reconnaissance, Triple "C" Consultancy noted a lack of adequate recreational spaces in the project neighborhood despite the high proportion of youth. In addition, community leaders reported that many playgrounds that have been built are completely unused due to a lack of maintenance and upkeep. For example, many playgrounds are overgrown with vegetation because there is no source of routine maintenance, and some lack fencing, lighting or other features needed to maintain safety.

17.3.6. Sanitation

There are three (3) community-wide waste disposal service available in the project area. Some residents pay for a private collection service, while others bury or burn trash on their properties. During the site reconnaissance Triple "C" Consultancy also observed evidence of illegal dumping in some of the community. There is no sewage system in the project areas many households make use of septic tanks. Most households have any sanitation infrastructure.

There is no authority charged with assuring the proper installation and maintenance of septic tanks and latrines.

17.3.7. Law Enforcement

The Guyana Police Force (GPF) is responsible for maintaining security and order in the greater Georgetown area, including within the social housing schemes. During an interview, a representative of the GPF indicated that robberies and break and entries are the most prevalent crimes in all communities. They also noted that parts of project area are considered to be crime hotspots and therefore greater resources are deployed here. It was noted that there is generally insufficient manpower and other resources such as transportation in the GPF, which poses challenges to serving all areas of Georgetown and East Bank adequately.

17.4. Impact Prediction and Evaluation

Element of the Impact	Impact characterization and definition	Value
Nature (N)	Positive	+ve
	Negative	-ve
Probability of Occurrence	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 63: Impact Rating Matrix

Project Phase	Potential impact	+/- impact	Significance value 9-12 (High/H); 5-8 (Moderate/M); and 1-4 (Low/L)				Total value
			Probability of occurrence	Extent	duration	severity/ magnitude	
Pre - Construction and Construction Phase	Increased level of traffic congestion due to reduced carriageway	-ive	3	3	1	3	10 (H)
	Road accidents/loss of life	- ive	1	1	1	3	6 (M)
	Disruption of commercial activities, including roadside stall/vending and negative effect on local livelihoods	- ive	3	2	2	1	8 (M)
	Loss of business and customers (e.g. Supermarkets) due to loss of roadside parking	- ive	3	1	1	1	6(M)
	Loss of personal assets (structures) such as bridges, fences, and parapets	- ive	3	1	3	1	8(M)
	Induced vending (growth in informal local economy) in adjacent areas to satisfy needs of local workforce	- ive	3	2	2	2	9(H)
Pre - Construction and	Relocation of property /homes or businesses or displacement of families	- ive	2	1	3	3	9(H)

Project Phase	Potential impact	+/- impact	Significance value 9-12 (High/H); 5-8 (Moderate/M); and 1-4 (Low/L)				Total value
			Probability of occurrence	Extent	duration	severity/ magnitude	
Construction Phase	Change in existing land use patterns in areas in which by-pass roads are used to reduce traffic congestion	- ive	3	2	1	2	8(M)
Operation Phase	Reduced traffic congestion as a result of road expansion	+ ive	3	2	3	3	11(H)
	Risk of accidents to all road users due to speeding etc.	- ive	3	1	3	3	10(H)
	Increased pedestrian safety during crossing and use of walkways	+ ive	3	1	3	3	10(H)
	Minimisation of u-turns, right turns and the risk of accidents through use of concrete medians	+ ive	3	1	3	3	10(H)
	Increase in property value due to enhanced infra-structure	+ ive	3	2	3	2	10(H)
	Improved transport infrastructure	+ ive	3	2	3	3	11(H)

Table 64: Potential Impact Matrix

Potential social changes associated with the road project include land use changes, growth inducement, income generation, access to social services, capacity strengthening, improvement of public infrastructure, education, health, and welfare, and livelihood. Some of these changes are a direct consequence of project operations; most are not.

During the Construction Phase the following socio-economic impacts may occur:

17.4.1. Traffic Flow and Transportation

Any works along the ogle airport road i.e. route to the Greenfield Alignment will have some impact on the commuting traffic and adjoining communities. Specific potential impacts as a result of site preparation and construction activities include:

- ◆ Reduced lane capacity or side friction along the routes will impact on traffic flow in the localized areas that works are taking place, and can cause backlogs in traffic in adjoining communities and areas.
- ◆ Complete road closures may be necessary for bridge and culvert works.
- ◆ Detour routes may add travel time and costs. The significant truck traffic in particular can create additional impacts for commuters on detours since trucks require wider swept paths, move slower on gradients and increase side friction on narrow detours.
- ◆ Project traffic and delivery of materials may cause delays to commuting traffic.

- ◆ Detour routes may cut through small communities and subdivisions.
- ◆ Weight of heavy vehicles, both for the project and external industrial activity can contribute to the deterioration of the existing roads. Local detour routes can be especially susceptible to rapid deterioration by an increase in truck traffic.
- ◆ Construction activities, particularly detours can affect public transport.
- ◆ Increased traffic associated with accommodations for construction workers.
- ◆ Increased risk of accidents or damage to vehicles caused by objects falling from construction vehicles.
- ◆ Roads and access points along the corridor will be directly impacted by the construction

17.4.2. Transportation of Raw Material and Equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along local roads and result in road wear and tear. There is also the potential for spillage onto the roadway which may in turn cause accidents and increased dusting of ambient environment. Ground and surface water quality may be prone to increased suspended solids from run-off from road construction activities.

17.4.3. Refueling, Storage and Maintenance of Equipment

Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils, etc. and thereby have the potential to contaminate the soil as well as groundwater quality.

17.4.4. Land Use and Acquisition

Communities and Land Parcels along the project area are therefore likely to be impacted. More detail is found in the Land Acquisition Plan and Chapter 21. Nonetheless, the proposed alignment has the potential to negatively impact movement across the corridor owing to increased road width and travel speed.

The details of utilities was presented in Strip Plan for Utility Relocation Plan volume-IV part-3 of Draft Detail Project Report.

As directed by MoPI, Road reserved of 600ft wide for Main alignment and 300ft wide for connectors has been proposed for land acquisition. The details of land acquisition was presented in Land Acquisition Plan (Volume-V) of Draft Detail Project Report. The summary of land acquisition area is given below:

Summary of Land Area to be Acquired (sqm)			
S. No.	Description	Available Land as per Site Condition (sqm) (Appx)	Area of Land to be acquired (sqm)
1	Main Alignment (East Coast to Great Diamond)	39355	2569522.5
2	Connector-1 (Aubrey Barker Road)		138736.00
3	Connector-2 (Haag Bosch)		313536.00
4	Connector-3 (Mocha Arcadia Road)		285936
5	Connector-4 (Great Diamond Road)		138736.00
6	Junctions		1440
7	Tapering Portion of Connectors		24500
	Total Area (sqm)	39355	3472406.5
	Total Area (sqm)	3511762m² (868 Acre)	

Table 65: Assessment of Land Acquisition

17.4.5. Construction Crew Solid Waste Generation

During this construction phase of the proposed project, solid waste generation may occur mainly from two points:

- ◆ From the construction campsite.
- ◆ From construction activities such as site clearance and excavation.

17.4.5.1. Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with sanitary conveniences. The disposal of the wastewater generated at the construction campsite has the potential to have a minor negative impact on groundwater and surface water.

17.4.5.2. Water Demand and Supply

Construction activities will require additional water resources. Suitable sources will be determined based on demand and location.

17.4.6. Health and Safety

17.4.6.1. Occupational Health And Safety

Construction of the road and its infrastructure may entail workers being suspended in the process. This has the potential for increase construction accidents. Additionally, there may be some drilling in preparing the site for the construction along sections of the alignment.

17.4.6.2. Air Quality

Site preparation has the potential to have a two-fold direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation. The second is fugitive dust from the proposed construction areas and raw materials stored on site. Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

17.4.6.3. Emergency Response

Construction of the proposed highway has the potential for accidental injury. There may be either minor or major accidents.

17.4.7. Employment

Potential job opportunities will directly arise from site clearance/ construction phases. The proposed project is expected to employ a substantial amount of workers (no actual figures have been determined as yet) during this phase. In addition to this potential direct employment. The project will therefore generate indirect jobs and induced jobs. Indirect jobs are those held by workers in industries that supply highway construction materials, manufacturers with materials and by off-site construction industry workers such as administrative, clerical, and managerial workers. Supplying industry jobs include those supported in stone and clay mining and quarrying, lumber, steel, concrete, and cement products, as well as in miscellaneous professional services. Induced jobs are jobs supported throughout the economy when highway construction industry employees spend their wages. Expenditures by these workers on various goods and services, stimulate demand for additional employees in these industries, resulting in jobs being supported throughout the general economy.

17.4.8. Workers Safety

Construction of the road and its infrastructure may entail:

- ◆ Use of bulldozer and other heavy duty equipment for site preparation.
- ◆ Trenching for site preparation and to install pipes and drains.

These activities increase accident potential to workers.

17.4.9. Commercial Activity

There is a potential for an increase as well as a decrease in commercial activity in the project area. A potential increase in commercial activity would be represented in the form of increased sales from food and beverages to construction crew while a potential decrease would be represented in the form of decreased access by the public to certain areas due to construction activities.

17.4.10. Land Use

◆ Residential Areas

The proposed alignment will pass through some residential area and those affected have identified during the Survey.

◆ GUYUCU (Mini Water Conveyancy)

Approximately 4km of the proposed project sections Main Alignment (3.4 km) and Connector 3 (0.6 km) will pass through the swamp/ wetlands (water storage ponds constructed by GUYUCU for specific use for irrigation of cane fields).

◆ Affected Structures

It is estimated that a number structures will be impacted by the proposed project, including houses, shops and stalls other types including garages, stalls, etc.

The summary of affected properties and utilities detail given below.

Area likely to be affected	Category of Utility/ Property likely to be affected					
	Residential Property	Commercial Property	Huts	GPL Utilities Poles	GWI Pipe Lines	GT&T Utilities
Goedeverwagting	2	0	0	135	2	2
Ogle	7	0	0		2	2
Aubrey Barker	5	0	0	2	0	0
Haag Bosch	0	0	0	2	0	0
Mocha Arcadia	18 (including 15 nos. vacant lots)	2	14	5	1	0
Great Diamond	2	0	1	5	0	0

Table 66: Affected Assessment of Utility and Property

During the Operational phase the following impacts may occur:

17.4.11. Transportation and Traffic

Upon completion, the improved road will likely cause an increase in vehicular speeds. The increase in speeds will decrease the travel time, increase capacity and increase efficiency of the road network, however it may also result in an increase in traffic crashes. The operations at roads and access points along the corridor may be permanently altered after construction.

Overall, on completion, the numerous potential positive impacts of the proposed highway to transportation include:

- ◆ Reduction in congestion during peaks hours
- ◆ Improved access
- ◆ Increase in reliability of the road network
- ◆ More predictable travel times
- ◆ Reduced vehicle operating costs
- ◆ Reduced travel time
- ◆ Improved pedestrian facilities in builtup areas

17.4.12. Housing

The proposed highway alignments have the potential to open up new areas for residential development. The resultant roadway and reduced travel times will make areas attractive to persons who do not want to live in major villages (for example Kitty, Bel Air) but instead prefer to commute to work or do business.

17.4.13. Commercial Activity and Tourism

With the development of the new road network and reduced travel time by the proposed roadway, there will be a potential increase in commercial activities. Upgraded transportation infrastructure can improve access of both commercial and residential populations, and ease delivery and receipt of goods and raw materials. Likewise, ease of travel may also encourage residents and visitors to visit tourist attractions.

17.4.14. Emergency Response and Accident Potential

17.4.14.1. Potential Hazards

There is a potential for the roadway to be impacted by natural or man-made disasters such as floods, fires and accidents. Other miscellaneous hazards that may result in potential accidents include; stray animals, dead animals, fallen tree limbs, accumulation of dirt, gravel or other granular materials, oil spills, pavement/surface defects (potholes, deformations, edge drops), missing or damaged safety barrier/guard rail/fencing at a critical location and abandoned/damaged vehicles.

17.5. Mitigation and monitoring - Environmental and Social Management Plan

17.5.1. Transportation and Traffic

17.5.1.1. Construction

The employees are requirements include the following that provide mitigation for traffic impacts:

- ◆ Maintain and provide access to property by owners, customers, visitors, and emergency vehicles, except as otherwise approved by the Proponent's Representative.
- ◆ Maintain the current pedestrian accommodations within the Project limits during construction.
- ◆ All existing safe routes to school must be maintained throughout the duration of construction.
- ◆ Provide Project Notification Signs on both sides of each arterial cross-street approaching the Main Road and on the Main Road approaching the Project limits.
- ◆ Provide a Traffic Operations Manager and Traffic Control Maintainer(s) who will coordinate all construction traffic.
- ◆ Correct all traffic control deficiencies upon notification or observance of the deficiency within 1 hour of notice or observation.

17.5.2. Transportation of Raw Material and Equipment

During the construction phase, the following mitigation measures should be employed during the transportation of raw material and equipment:

- ◆ Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example, reduced speed near the construction site.
- ◆ Raw materials such as gravel and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
- ◆ The trucks should be parked on the proposed site until they are off loaded.
- ◆ Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.
- ◆ The use of flagmen should be employed to regulate traffic flow.

No mitigation measures will be necessary during the operational phase.

17.5.3. Refuelling, Fuel Storage and Maintenance of Vehicles and Heavy Equipment

During the construction phase:

- ◆ Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system.
- ◆ Sediment basins and oil water separators should be constructed to intercept storm water before it is discharged.

During operational phase, with the exception of emergencies, no refuelling and or maintenance of vehicles or heavy equipment should be conducted along the roadway.

In emergency circumstances, refuelling and or repairs should be conducted on the soft shoulders and not on the roadway or vegetated areas.

17.5.4. Solid Waste Generation

During the construction phase, the following mitigation measures should be employed:

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

During the operational phase, no mitigation measures are required.

17.5.5. Wastewater Generation and Disposal

During the construction phase, the following mitigation measures should be employed:

- ◆ Provide portable sanitary conveniences for the construction workers for control of sewage waste (A ratio of approximately 25 workers per chemical toilet should be used).

No mitigation measures are required during the operational phase.

17.5.6. Workers Safety

Construction Phase:

- ◆ Adequate communication with workers and signage should be put in place to alert/inform workers of the time, location of such blasting and instructions
- ◆ Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye protection etc.)
- ◆ There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site
- ◆ Make prior arrangements with local health care facilities such as health centres or the hospitals to accommodate any eventualities
- ◆ Material Safety Data Sheets (MSDS) should be stored onsite.

No mitigation measures required during the operational phase.

17.5.7. Emergency Response

Construction Phase:

- ◆ A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
- ◆ The construction management team should have onsite first aid kits and arrange for a local nurse and/or doctor to be on call for the construction site.
- ◆ Make prior arrangements with local health care facilities such as health centres or the hospitals to accommodate any eventualities.
- ◆ Material Safety Data Sheets (MSDS) should be store onsite.

Operational phase:

- ◆ Alternate route or routes should be identified beforehand.
- ◆ Adequate and clearly defined signs should be erected and public announcements will be made if there is a need to use the alternate route(s).

17.5.8. Employee Health and Safety Plan

During the construction phase of the project, emphasis will be placed on providing a safe and healthy environment for the workers. A health and safety plan will be implemented to ensure compliance with the regulations of the OHS Act 1997.

Occupational Safety & Health plans will be implemented in the following areas:

- ◆ Industrial Accident prevention and management
- ◆ Occupational Hygiene
- ◆ Illness & Infectious disease prevention and management
- ◆ Waste Disposal

17.5.9.1. Industrial Accident Prevention and Management

Industrial accident prevention and management will be implemented via a safety program. This will commence during the construction phase and will last through the phase. The program will include the following:

- ◆ Hazard identification and control
- ◆ Monitoring and reporting of industrial accidents
- ◆ Training or education of employees in industrial first aid
- ◆ Industrial Accident Protocol
- ◆ Fire Safety & Preparation and
- ◆ Hazard Identification and Control

Chapter 19 lists potential hazards and risks for the project and the preventative and remedial activities necessary for their elimination and control. In addressing these hazards, the priority will be their elimination via modification in the design of equipment or process. If this is not possible or feasible and the hazard cannot be eliminated, then the employees will be provided with the necessary safety protective gear to prevent any injuries during the work process.

Hazard identification and reporting will constitute an ongoing activity in which the employees' participation will be considered an integral part of his work functions. The OHS Act 1997 clearly stipulates the responsibilities of employees and supervisor/management in this regard. In accordance with those regulations the supervisor/manager will do the following:

- ◆ Inspect all machines and equipment for the existence of potential hazards and ensure that they are in working order
- ◆ Inform the worker of any hazards present

- ◆ Instruct the employee in the correct safe work procedure to prevent injuries and ensure that those instructions are followed
- ◆ Provide the necessary safety protective gear when required.

In accordance with OSH Act 1997 employees will be authorized to do the following:

- ◆ Cease work once a hazard is perceived
- ◆ Report the hazard to the supervisor who will in company with the safety representative inspect the condition or circumstance and determine its validity
- ◆ Obey the instruction to perform alternative work or cease work completely as directed by the supervisor
- ◆ Return to the workstation or proceed once the hazard has been adequately dealt with or eliminated

17.5.9.2. Hazard Monitoring and Reporting

The Safety Representative, elected from among the workers, will monitor hazards and work conditions. He will do the following:

- ◆ Perform Safety Inspections of operations on a regular and programmed basis (at least once per month) for the detection of unsafe conditions or any potential hazards and report these hazards to management
- ◆ Record all minor and loss time accidents in a ledger as required by the Ministry of Labor (Table shows the format to be used for recording industrial accidents) •
- ◆ Remit reports of industrial accidents or fatalities to the Ministry of Labor when required.

Personal Injury	Equipment Damage
Name of Person Involved	Dept/Area
Name of Injury	
Place of Injury	
Description of Accident	
Type of Accident	Loss of Time Minor
Foreman Signature	
Diagnosis	
Remarks	

Table 67: Accident Report Format

In addition to the above mentioned, all employees will be educated about their responsibility to participate in the creation of a healthy and safe environment by:

- ◆ Reporting unsafe and hazardous conditions when detected

- ◆ Performing work in a safe manner by following the correct work procedure.

17.5.9.3. Training & Education of Employees

Contractor will run periodic training program in:

- ◆ Basic first aid programs (all employees)
- ◆ Advanced first aid programs
- ◆ Accident investigation & reporting seminars (supervisory personnel & safety reps.)

The basic first aid program will be extended to all employees and would be geared to ensure that in the event of an accident or injury someone with first aid knowledge will always be present to render initial assistance until further medical attention can be made available.

Qualified personnel will run seminars to impart the necessary theoretical as well as practical skills required. These courses will be scheduled depending on employee strength and attrition. The advanced first aid program will constitute an upgrading course from the basic first aid program in which selected employees including supervisors and the Safety representative will be exposed to advanced first aid knowledge and techniques which will enable them to participate in the recognition and the initial management of serious injuries and illnesses e.g. Fractures, Spinal Injuries, etc.

17.5.9.4. Industrial Accident Protocol

Serious injuries will be referred to a medical practitioner and medical institution. In the event of an industrial accident the following protocol will be followed:

- ◆ A basic first aider will be summoned if not already present at the scene of accident.
- ◆ The basic first aider will render first aid care
- ◆ The basic first aider will summon a vehicle and supervise the removal of the injured to a Health Centre or Hospital
- ◆ The employee's immediate supervisor will be informed and
- ◆ Make contact with the identified medical Practitioner and Institution and inform them of the time of arrival of the injured employee
- ◆ Complete the accident form and forward same along with the injured to the medical institution for completion by medical practitioner

17.5.9. Monitoring Plan

Contractor will provide ongoing monitoring to respond to concerns that arise in communities. This committee will meet quarterly or with greater frequency if circumstances dictate, to discuss issues and concerns related to the interaction of the project and the communities. At a minimum the committee will conduct periodic stakeholder and mine management reviews.

Communities will be encouraged to report instances of infractions of the norms by construction site personnel.

Members will also be informed of all incidents during operations that do not conform to sound environmental practice and specified operational environmental standards as set forth in the management, emergency response and Health and Safety plans, and of management measures implemented to prevent or remedy such occurrences and to counter their reoccurrence.

Monitoring	Institution responsible	Frequency	Location
Organize stakeholder consultation and feedback sessions to ensure community clearly understand the impacts of the project, what actions are ongoing and have access to opportunities created by the project. Assess community understanding of the project.	Proponent	Quarterly monitoring throughout life of the project	Construction Site
Monitor levels of complaints through the grievance procedure and track actions taken to resolve complaints	Proponent	As required in response to complaints and six monthly review of records and audit of actions arising throughout the project.	Construction Site
Continuous monitoring of safety exclusion zone and recording of all interactions between project workers/ machinery and other users of the area.	Contractor / HR Manager	Auditing with accident reporting procedure	Construction Site
Develop and implement a system for inspection and maintenance of navigation, communication and safety equipment	Contractor / HR Manager	Monthly audit of equipment inspection reports	Construction Site
Recording all complaints/ suggestions through the community liaison officer and assign remedial actions and responsibilities	Contractor / HR Manager	Six monthly reviews of interaction/ grievance records and audit of actions arising through the project.	Construction Site

Table 68: Showing the Monitoring Plan

Chapter 18:

Health Impact Assessment

18.1. Introduction

Many land use and transportation decisions affect health, even those that may not seem to on the surface. As such a decision to develop roadways can change noise and air quality for nearby residents. It also may change the safety of pedestrians or bicyclists along the street. Noise, air quality, and pedestrian or bicyclist safety are related to asthma, cardiovascular disease, hypertension, injury, and mortality, among other health issues. The Health Impact Assessment (HIA) a cost-effective approach to assess planning and policy proposals and make recommendations to improve the ways these proposals affect health.

18.2. Definitions, scope and concepts

HIA takes a broad perspective that considers health and wellbeing as well as the environmental, social, demographic, and economic conditions that shape them. The following steps are involved in HIA:

- ◆ Screening – Determine the value and need for HIA
- ◆ Scoping – Clarify and prioritize issues to focus on in the HIA, methods for analysis, and a work plan
- ◆ Assessment – Two parts that include: a) Conducting research on existing conditions; b) Identifying the effects of the project, plan, or policy on health;
- ◆ Recommendations – Identify actions to address any harms identified
- ◆ Reporting – Write a report and communicate its findings and recommendations
- ◆ Monitoring – Track how the HIA affected decision-making processes, the actual decision, and effects of the project on health

Health risk assessment (HRA) is different from Health Impact Assessment (HIA) in that, a HRA is a quantitative analytic method used to characterize the nature and magnitude of health risks associated with exposures to chemical contaminants and other environmental substances and processes.

The use of HIA serves to:

- ◆ Ensuring transparency and accountability of decision-making processes that affect health;
- ◆ Addressing issues of public controversy and concern, potentially generating greater support for decision implementation; and
- ◆ Engaging affected communities in the decision process.

18.3. Policy, Legislation and Regulatory Framework

18.3.1. Environmental Protection (Air Quality) Regulations

These regulations require that any operation emitting air contaminants during the construction, installation, operation, modification or extension of any facility relating to industry, commerce, agriculture or any institution must apply to the EPA for an environmental authorization. The regulations also stipulate that the EPA shall establish emission limits for specific parameters; however these have not been established to date.

18.3.2. Environmental Protection (Water Quality) Regulations

These regulations require registration and environmental authorization for construction, installation, operation, modification or extension of any facility that will cause the discharge of effluents. The regulations include parameter limits for concentrations of specific constituents which can be discharged into any inland or coastal water or lands in Guyana.

18.3.3. Environmental Protection (Noise Management) Regulations

These regulations require operations that emit noise to apply to the EPA for an environmental authorization, and also establish permissible noise levels for specific types of land uses such as residential, institutional, educational, industrial, commercial, construction, transportation and recreational.

18.3.4. Environmental Protection (Hazardous Waste Management) Regulations 2000.

These Regulations cover the management of waste including chemical waste and cover industrial, commercial and any other activity that produces waste. Some of the key activities which are covered under the Regulations are generation, treatment and disposal of hazardous waste. The Regulation is read and construed as being in addition to, and not in contravention of the Pesticides and Toxic Chemicals Control Act 2000 (No. 13 of 2000). Based on the definition all chemical wastes including persistent organic pollutants (POPs) are covered under these Regulations for the purposes of management.

Permits are required for the generation of waste which is monitored throughout the production, storage, transport and release phases. The waste streams on which focus is centered for control are as follows:

- ◆ Clinical Waste from medical care in hospitals, medical centers and clinics;
- ◆ Waste from the production and preparation of pharmaceutical products;
- ◆ Waste from the production , formulation and use of biocides and phytopharmaceuticals;
- ◆ Waste pharmaceuticals, drugs and medicines; and
- ◆ Waste from the manufacture, formulation and use of wood preserving chemicals.

18.3.5. Labour Act, 1942

The 1942 Labour Act and its regulations specify the conditions that an employer must observe in the hiring of employees, including terms of payment. The Act also provides for prevention of discrimination and outlines conditions for the employment of young persons and children.

18.3.6. Occupational Health and Safety Act, 1997

The 1997 OHS Act regulates the registration and regulation of industrial establishments, and legally defines the responsibilities of workers and management with respect to keeping workplaces safe.

18.4. Baseline

18.4.1. Impact Prediction and Evaluation

Workers health and safety can be impacted during construction activities. The major impacts are:

- ◆ Risk of accidents from the operation of heavy-duty machines during the construction of the road, bridges and culverts and the construction of the base camp
- ◆ Exposure to excessive noise, dust and fumes from the operation of machines during construction
- ◆ Exposure to vector borne diseases.

18.4.2. Analysis

Workers health and safety is always a major concern on construction sites since workers are usually exposed to conditions that can result in serious accidents, to the extent where some can be fatal. Risks to workers health and safety include accidents using heavy equipment and machines, excessive exposure to noisy equipment, inhalation of fumes, and improper use of equipment. The associated impacts, while significant, are short term and can be avoided and mitigated thereby reducing the risks.

To adequately address health and safety issues over the long term adequate systems must be in place to reduce the risks to workers' health and safety, in particular, from accidents using heavy equipment and machines, excessive exposure to noisy equipment, inhalation of fumes, and improper use of equipment. The health and safety measures outlined below must be complied with. In addition, if there is an accident, the procedures outlined in the Emergency Response should be followed. Personal Protective Equipment (PPE) should be provided and workers should be mandated to wear it so as to prevent/minimize any injury that could occur. Hard hats, ear plugs, respirators and safety boots are all necessary for this type of operation.

18.4.3. Exposure to Diseases

There is the possibility for the introduction of communicable diseases from workers to workers who will be housed at the same camp sites. However, this situation is not expected to be significant. There are a limited number of permanent communities in close proximity to the road construction area hence social interaction is limited, thus, reduces the risk of sexually transmitted diseases. Nevertheless, the contract will engage its employees on pertinent diseases such as HIV/AIDS, tuberculosis and malaria, especially regarding prevention and treatment.

18.4.4. Hazardous Exposure

The identification of PM10, PM 2.5 and asphalt are the pollutants of interest. The identified pollutants are hazardous to humans. Construction contributes significantly to air pollution in the form of dust. Although the exhaust from the construction vehicles and machinery adds to the NO2 levels as well, its impact is not as strong as dust. Dust is referred to as Particulate Matter or

PM. PM has major health and environmental implications. The WHO recognize PM10 and PM 2.5 among the most harmful pollutants. While the larger and heavier PM more commonly affect the construction site vicinity, the wind carries the lighter PM10 and 2.5 thus affecting people and vegetation miles away. Construction vehicles on the open ground further dissipate PM and carry it to farther distances.

PM is emitted at all stages of construction:

- ◆ demolition;
- ◆ earthworks;
- ◆ construction; and
- ◆ track out (The transportation of dust and dirt from the construction site onto the public road network, where it may be deposited or suspended by vehicles using the network).

The PM impact depends on factors such as the size of the construction site, duration of activity, weather conditions, the direction of the wind, proximity of people and vegetation, etc. Similarly asphalt affect people and vegetations.

18.4.4.1. Hazard characterization/guidance or guideline value identification

◆ **Asphalt**

The acute effects of exposure to asphalt fumes include headache, skin rash, fatigue, reduced appetite, throat and eye irritation, and cough. Asphalt paving workers, for example, have reported breathing problems, asthma, bronchitis, and skin irritation. Human studies have reported lung, stomach, and skin cancers following chronic exposures to asphalt fumes.

Asphalt fumes and vapours may be absorbed following inhalation and dermal exposure. Because asphalt is a complex mixture, its pharmacokinetic behavior will vary depending upon the properties of the individual constituents. Therefore, it is inappropriate to make generalizations regarding the extent of absorption, distribution, and metabolism of asphalt.

Acute effects of exposure to asphalt among workers in the various sectors of the asphalt industry (hot-mix plants, terminals, roofing application, and paving, roofing manufacturing) include symptoms of irritation of the serous membranes of the conjunctivae (eye irritation) and the mucous membranes of the upper respiratory tract (nasal and throat irritation) and coughing. These health effects appear to be mild in severity and transient in nature. Additional symptoms include skin irritation, pruritus, rashes, nausea, stomach pain, decreased appetite, headaches, fatigue, as reported by workers involved in paving operations, insulation of cables, and the manufacture of fluorescent light fixtures. Results from recent studies indicated that some workers involved in paving operations experienced lower respiratory tract symptoms (e.g., coughing, wheezing, and shortness of breath) and pulmonary function changes; bronchitis has also been reported. Burns may also occur when hot asphalt is handled. Burned areas usually include the head and neck, arms, hands, and legs.

◆ Particulate Matter

Health effects from some particles are immediate while others take years to develop. Particles greater than 10 microns cause eye, mouth, and skin irritations but smaller than PM 10 are much more harmful. PM10 affects the upper respiratory system by aggravating asthma and bronchitis. PM 2.5 penetrates deeper into the respiratory tract, dissolves into the blood and compromises immunity. When dust originates from activities on a formerly contaminated site, PM10-2.5 combine with heavy metals present in soil and cause toxicity in addition. Lead and asbestos toxicity from PM is fairly common.

PM also affects the ecosystem by wilting plants as dust on leaves prevents photosynthesis. Major construction projects over a long duration also increase the long-term PM10 concentrations in cities. However, with proper measures, dust emissions can be reduced. The mitigation controls depend on the effective assessment of dust emission prior to construction activities. An effective assessment forms the basis of a well-planned and environment friendly construction

18.5. Mitigation and monitoring - Environmental and Social Management Plan

Construction of the road will result in the generation of waste. In isolated places, the amount of waste generated may be greater than normal because of substandard subsoil materials, which will need to be replaced.

The Contractor will be required to control the construction site, keep it clean and provide facilities such as dust bins and collectors for the temporary storage of all waste. This waste should be adequately stored to avoid pollution of water supplies and water sources and to avoid dust formation. The Contractor will be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals.

All necessary safeguards should be taken to ensure the safety, welfare and good health of all persons entitled to be on the sites and to ensure that works are carried out in a safe and efficient manner. All personnel working at vulnerable site locations will wear safety helmets and strong footwear. It should be ensured that all workmen and staff employed on site use proper safety equipment – for example, eye protectors, ear plugs, safety helmets, the designated safety equipment when working over water - and that proper rescue equipment is available. Fire extinguishers and first-aid equipment will be kept at all sites.

The following actions will be undertaken at construction camps and stipulated in construction contracts:

- ◆ submit and obtain approval for a health and safety plan prior to the commencement of work;
- ◆ provision of adequate health care facilities;
- ◆ workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

The project will support a public health education programme for workers covering road safety, malaria, hygiene, and sexually transmitted diseases. The district health departments will also be

invited to participate in monitoring and educating communities and workers affected by the project.

18.4.5. Safety Equipment

The following safety equipment shall be provided on all sites. A sufficient number of safety equipment shall be provided for all construction workers on site. Spare safety gears shall be present on site for authorized and unauthorized visitors on the site.

- ◆ Safety Vests
- ◆ Helmets
- ◆ Goggles
- ◆ Ear plugs
- ◆ Dust Masks
- ◆ Safety Shoes
- ◆ Gloves
- ◆ Overalls
- ◆ First Aid Kits
- ◆ Fire Extinguisher
- ◆ Emergency Lights.
- ◆ Spill Kits
- ◆ The spill kit shall comprise the following materials:
 - ◆ Skimmers
 - ◆ Fire extinguishers
 - ◆ Absorbent foam
 - ◆ Gloves
 - ◆ Gallon sealable containers
 - ◆ Caution Tape
 - ◆ Bags containing sawdust

All workers shall be required to leave safety equipment on site at the end of the day. Equipment shall be stored in designated boxes in the site office. The environmental inspector shall inspect all safety equipment on a weekly basis to ensure that they are in working order. First Aid Kits, fire extinguisher and Spill kits shall be at hand at all construction sites and be stored in the Contractor's site office. The environmental inspector shall also inspect these items to ensure that necessary components are present. Damaged safety equipment or gears shall be replaced by the contractor. The environmental inspector shall routinely inspect emergency lights to ensure that they are in working order in the event that emergency night works is required.

18.4.6. General Health and Safety Measures that shall be Implemented by the Contractor.

The Contractor shall:

- ◆ Designate a person on staff with responsibilities for Occupational Health and Safety.
- ◆ Develop and implement Safety Rules for the operation which all employees should comply with and can include the following:

- ◆ Appropriate safety equipment and protective clothing should be provided for certain categories of workers as recommended by the Health and Safety Committee or Management.
- ◆ Employees are required to wear safety equipment and protective clothing provided by the Contractor in designated areas as and when directed by Management.
- ◆ Employees not wearing prescribed safety clothing and associated equipment in an area where the use of such is mandatory shall be required to leave such designated area and shall be subject to disciplinary action.
- ◆ Employees shall be expected to take due care of items of safety equipment and protective clothing issued to them.
- ◆ Employees who abuse safety equipment and protective clothing or fail to comply with instructions or requirements to wear such in designated areas shall be subject to disciplinary action.
- ◆ **Machines are to be operated:**
 - By competent and authorised personnel.
 - Only when safety gears are in position.
 - In a manner that does not endanger other employees, the general public or property. When the work area is clear and safe.
 - Operators are required to wear seat belts in the correct manner when operating machinery fitted with seat belts.
 - Operators of heavy duty machinery must be licensed in accordance with the Laws of Guyana.
 - Passengers are not permitted on mobile equipment unless they are being trained to operate the machine or are required to ride on it as an unavoidable part of their duties provided it is safe to do so.
- ◆ Smoking should absolutely not be permitted anywhere in or near fuel area.
- ◆ The Contractors would have the responsibility for the health and safety and well being of all workers and in ensuring that responsibility the Contractors should:
 - ◆ Provide first aid kits at the site office.
 - ◆ Provide adequate masks, face shield, gloves, fireproof garments, welding shields and goggles as protective measures as is considered necessary.
 - ◆ Employees required to work in the rain shall be provided with wet weather gear.

- ◆ Overalls and safety helmets shall be provided to employees as is considered necessary.
- ◆ **In addition to the above undertakings the Contractors should also:**
 - Ensure that workers are properly oriented to safety and health practices.
 - Abide by the guidelines set out in the Occupational Health and Safety Act.
 - Ensure workers wear the necessary protective gear at all times.
 - Ensure there are trained personnel in First Aid.
 - Liaise with health facilities in case of emergencies.
 - Provide potable water for employees.
 - Ensure garbage and sewage collection and disposal.
- ◆ A system should be implemented to detect hazards that may arise.

Both the Contractors and the workers have responsibility in this area.

The employer should:

- ◆ Inspect all machines and equipment for the existence of potential hazards and ensure that they are in working order.
- ◆ Inform the worker of any hazards present.
- ◆ Instruct the employee in the correct safe work procedure to prevent any injuries and ensure that those instructions are followed.
- ◆ Provide the necessary safety protective gear when required.
- ◆ **The employee on the other hand has the obligation to:**
 - Cease work once a hazard is perceived.
 - Report the hazards to the supervisor who shall in company with the safety representative inspect the condition or circumstance and determine its validity.
 - Obey the instructions to perform alternative work or cease work completely as directed by the supervisor.
 - Return to the workstation or proceed once the hazard has been adequately dealt with or eliminated.

Chapter 19: Risks and Risks Assessment

19.1. Risk Assessment Study

The first step in Risk Assessment is identifying the major hazards; that is, gathering and analysing data on meteorological, hydrological and geological hazards in terms of their nature, frequency and magnitude. These hazards can be natural or man-made or a combination of both. Assessing and characterising each by triggering factors, degree of severity, spatial occurrence, duration of the event and their relationship is what gives rise to the risk assessment.

The Risk Assessment undertaken for all natural and man-made hazards is given in table below with Risk Assessment Matrix for Combined Low, Medium and High Probability of Occurrence and Severity of Consequences.

Probability of Occurrence		Low	Medium	High
Severity of Consequences	High	Medium Risk	High Risk	High Risk
	Medium	Low Risk	Medium Risk	High Risk
	Low	Low Risk	Low Risk	Medium Risk

Table 69: Risk Assessment Matrix for Combine Low, Medium and High Probability of Occurrence and Severity of Consequences

Note: Overall assessed risk levels include HIGH (red), MEDIUM (yellow) and LOW risk (green).

A risk assessment matrix has been used to characterize the overall risk is given in Table below. Overall assessed risk levels result from a combination of low, medium and high severity of occurrence and probability of occurrence.

It should be noted that priority hazards include: Flooding and Accidents;

HAZARD	RISK RATING	PROBABILITY	SEVERITY	Protection Preventative Safety Measures	and COMMENTS
Heavy Rain	Medium	Seasonally - May - June October - November	May damage to infrastructure, property and individuals	Follow Practices	Best Storms are expected to increase in severity over time
FLOODING	Low	Likely to occur during heavy event. Heavy rain events may occur more than once a year i.e. during the seasons	Flood prone areas the route;	-	Project features are designed to reduce flooding
VEHICULAR ACCIDENTS	Medium	Improved drainage and infrastructure from the road	Road accidents range from minor to fatal.	Ensure vehicle use and maintenance are according to	Improved road quality should reduce the accident

HAZARD	RISK RATING	PROBABILITY	SEVERITY	Protection and Preventative Safety Measures	COMMENTS
		works should reduce the probability of vehicular accidents	Accidents may result in loss of use, property damage and loss of life	manufacture specifications	potential
WORKPLACE ACCIDENTS	Medium	Use of Personal Protective Equipment (PPE) and adherence to rules should reduce the probability of workplace accidents	Workplace accidents range from minor to fatal. Accidents may result in minor cuts and bruises and loss of life	Use of barrier creams & detergents on hands Use of PPEs	Improvement, use and adherence of Operational Health and Safety guidelines should reduce accidents potential
SPIILLS	High	Trucks have a high probability of spillage of material. Oil and other material spills are likely.	May result in loss of use and or damage, to roadway, disruptions in flow, accidents and other blockages	Containment around storage areas, Monitoring discharges Communication with impacted areas	The risk of spillage from trucks is not much expected as the quarries are far off.
OBSTRUCTIONS	Medium	Obstructions along the roadway are likely to be common	May cause result in property damage, loss of use and harm to individuals	-	Stray animals, Pavement or Surface Defects (potholes), Missing or damaged safety barriers, guard rails and/or fencing at a critical location are examples of common obstructions
FIRES	Low	There is low probability of fires along the roadway	Fires may result in mild to severe damage	Ensure flammable substances are stored safely	The cause and extent of the fire along with the response time of emergency services will dictate the severity of the impacts of the fire.
Snake and Insect Bites	Low	There is a low probability for snake bites	-	Use of insect repellants Provision of snake bite kits Use of safety shoes & gloves	The nature of the snake will dictate the severity of the impacts

Table 70: Risk Assessment

Chapter 20: Land Acquisition and Resettlement Plan

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

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

Displaced persons, and owners of businesses activities will be informed of their rights and be given options. There will be consultation with them and economically viable resettlement alternatives will be offered. Compensation will be prompt, effective and at full replacement cost for losses such as lands, structures, crops, trees, businesses and incomes lost, at present open market values. In accordance with the size of the lot, the government will either acquire the total lot or compensate the owner for that portion of land and other assets that will be affected. Where access to properties is affected Triple 'C' consultancy will seek to identify alternative access so as to ensure that there is no loss in value of the properties or impact on the businesses affected. Where no alternative access is possible then these individuals affected will be offered the same compensation packages and resettlement options provided for the dwellings and businesses located in the highway's right of way. Stakeholder meetings will be held with the owners of the businesses and dwellings to determine what will be required to ensure their livelihood is restored.

These meetings will be advertised via public media and other methods (newspaper, letters, flyers, libraries, post office, fire/police stations, town crier etc.). In addressing the farm lands and recreational areas that will be affected by the highway, the government will compensate the farm owners for the portion of property affected along with crops being cultivated. This

compensation will be at market values determined by a third party knowledgeable in land, structures, crops and plants/trees valuation. In the instance where recreational fields (football fields, cricket pitches, and walking/running tracks) are affected, the government will seek to rebuild these recreational facilities in close proximity to the original facility. For individuals temporarily affected, efforts will be made to provide an alternate route to their place of business. Signage informing the general public about changes in traffic flows and routings will be erected in visible locations. As indicated, compensation will also be made for the loss of income faced during their relocation activities. For the individuals that will experience a permanent loss of income, an offer to introduce them to organisations involved with skills training or re-training will be made and financial support given to offset the associated expenses. A Draft Land Acquisition Plan has been submitted in Draft Detail Project Report.

As directed by MoPI , Road reserved of 600ft wide for Main alignment and 300ft wide for connectors has been proposed for land acquisition. The details of land acquisition was presented in Land Acquisition Plan (Volume-V) of Draft Detail Project Report. The summary of land acquisition area is given below:

S. No.	Description	Available Land as per Site Condition (sqm) (Appx)	Area of Land to be acquired (sqm)
1	Main Alignment (East Coast to Great Diamond)	39355	2569522.5
2	Connector-1 (Aubrey Barker Road)		138736.00
3	Connector-2 (Haag Bosch)		313536.00
4	Connector-3 (Mocha Arcadia Road)		285936
5	Connector-4 (Great Diamond Road)		138736.00
6	Junctions		1440
7	Tapering Portion of Connectors		24500
	Total Area (sqm)	39355	3472406.5
	Total Area (sqm)	3511762m² (868 Acre)	

Table 71: Assessment of Land Acquisition

It is estimated that a number structures will be impacted by the proposed project, including houses, shops and stalls other types including garages, stalls, etc.

The summary of affected properties and utilities detail given below.

Area likely to be affected	Residential Property	Commercial Property	Huts	GPL Utilities Poles	GWI Pipe Lines	GT&T Utilities
Goedeverwagting	2	0	0	135	2	2
Ogle	7	0	0		2	2
Aubrey Barker	5	0	0	2	0	0
Haag Bosch	0	0	0	2	0	0
Mocha Arcadia	18 (including 15 nos. vacant lots)	2	14	5	1	0
Great Diamond	2	0	1	5	0	0

Table 72: Affected Assessment of Utility and Property

Appendices

Appendix 1: Terms and Scope Issued by EPA for this ESIA Study



FINAL TERMS AND SCOPE
ENVIRONMENTAL IMPACT ASSESSMENT
EAST BANK – EAST COAST ROAD LINKAGE
PROJECT
(GREEN FIELD EAST BANK – EAST COAST ROAD
ALIGNMENT)

CONTENTS

PREAMBLE	5
1.0: INTRODUCTION	6
2.0. PROJECT BACKGROUND.....	7
3.0: SCOPE OF THE EIA.....	11
4.0: REQUIREMENTS FOR THE EIA AND EIS	13
4.1 ORGANIZATION OF THE REPORT (ENVIRONMENTAL IMPACT STATEMENT	13
5.0 EXECUTIVE SUMMARY, INTRODUCTION AND BACKGROUND	17
EXECUTIVE SUMMARY	17
INTRODUCTION AND BACKGROUND	17
6.0 APPROACH AND METHODOLOGY.....	17
7.0 STUDY AREA AND AREA OF INFLUENCE.....	18
8.0: LEGISLATIVE AND REGULATORY FRAMEWORK	21
9.0 PROJECT ALTERNATIVES	22
10.0 DESCRIPTION OF THE PROPOSED PROJECT	23
11. STAKEHOLDER IDENTIFICATION AND CONSULTATION PLAN	25
12. ENVIRONMENTAL IMPACT ANALYSIS	26
12.1 BASELINE STUDIES	26
12.2 POTENTIAL IMPACTS ON THE ENVIRONMENT	27
11.3 ENVIRONMENTAL MANAGEMENT STRATEGIES, MITIGATION MEASURES, AND MONITORING PLAN	28
13: WATER RESOURCES	31
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	31
BASELINE CONDITIONS	31
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	31
CUMULATIVE IMPACTS.....	32
14: SOILS, LAND AND GEOLOGY	33
BASELINE CONDITIONS	33

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	33
CUMULATIVE IMPACTS.....	34
15: AIR QUALITY.....	34
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	34
BASELINE CONDITIONS	34
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	34
CUMULATIVE IMPACTS.....	35
16: CLIMATE AND CLIMATE CHANGE	35
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	35
17: BIOLOGICAL AND ECOLOGICAL AND ECOSYSTEM RESOURCES/ SERVICES.....	36
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	36
BASELINE CONDITIONS	36
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	37
CUMULATIVE IMPACTS.....	38
18: NOISE AND VIBRATIONS	38
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	38
BASELINE CONDITIONS	38
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES	38
CUMULATIVE IMPACTS.....	38
19: TRANSPORTATION	39
20: WASTE MANAGEMENT	39
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	39
BASELINE CONDITIONS AND ENVIRONMENTAL IMPACTS/MITIGATION.....	39
CUMULATIVE IMPACTS.....	40
21: LANDSCAPE AND AESTHETICS	40
22: SOCIO-ECONOMIC IMPACTS.....	41
KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS	41

BASELINE CONDITIONS	41
SOCIO-ECONOMIC IMPACTS AND MITIGATION MEASURES.....	42
CUMULATIVE IMPACTS.....	43
23: HEALTH IMPACTS ASSESSMENT	43
KEY RELEVANT POLICY POLICY, LEGISLTATION, GUIDELINES, STANDARDS	43
HEALTH IMPACTS ASSESSMENT AND MITIGATION/ENHANCEMENT.....	43
CUMULATIVE IMPACTS.....	44
24: HUMAN AND HUMAN HEALTH RISKS ASSESSMENT.....	44
25: RISKS AND RISK ASSESSMENT.....	44
26: LAND acquisition AND RESETTLEMENT	44
27: APPENDICES AND ADDITIONAL INFORMATION.....	45

PREAMBLE

This Terms and Scope for this Environmental Impact Assessment (EIA) for the proposed construction of the East Bank-East Coast Road Linkage project (Green Field East Bank - East Coast Road Alignment), has been prepared in accordance with Part IV, 11 (8) of the Environmental Protection Act (EP Act.), Cap. 20:05, Laws of Guyana.

It incorporates those questions and matters, received from members of the public during the mandated twenty-eight (28) days public comment period referred to in Part IV, 11 (7) of the EP Act and the various Public and Sector Scoping Meetings. Further, this ToR has been prepared by the Environmental Protection Agency (EPA) in consultation with RITES Limited and (the sub-consultant Triple 'C' Consultancy Firm) approved by the EPA to carry out the EIA.

This Terms and Scope sets out the requirements, both general and specific, that should be addressed by the consultant in the conduct of the EIA.

1.0: INTRODUCTION

The EPA, received from Ministry of Public Infrastructure (MoPI), an application for Environmental Authorization for the construction of the East Bank-East Coast Road Linkage project (Green Filed East Bank - East Coast Road Alignment) Georgetown, Guyana. The application was made in accordance with section 11(1) of the EP Act Cap.20:05 and was accompanied by a summary of the project with information on:

- the project description, design, and duration; and
- the potential effects on the environment and possible mitigation measures.

The EPA conducted a review of the application and determined in accordance with Part IV 11 (2) (b) of the EP Act Cap.20:05 that the project may significantly affect the environment and will require an EIA. The EPA consequently, and in accordance with Part IV 11 (6), of the EP Act Cap.20:05 published in two daily newspapers, a notice of this decision on the project and made available to members of the public the aforementioned project summary.

In accordance with Part IV 11 (4) of the EP Act Cap.20:05, this EIA will be carried out by an independent and suitably qualified firm. RITES Limited who has engaged Triple 'C' Consultancy as a sub-consultant, a Guyanese Agricultural and Environmental Consultancy Firm approved by the EPA as the firm to conduct the EIA which shall:-

- (a) identify, describe and evaluate the direct and indirect effects of the proposed project on the environmental including:-
 - (i) human beings;
 - (ii) flora and fauna and species habitats;
 - (iii) water;
 - (iv) soil;
 - (v) air and climatic factors;
 - (vi) material assets, the cultural heritage and the landscape;
 - (vii) natural resources, including how much of a particular resource is degraded or eliminated, and how quickly the natural system may deteriorate;
 - (viii) the ecological balance and ecosystems;
 - (ix) the interaction between the factors listed above; and
 - (x) any other environmental factor which needs to be taken into account or which the Agency may reasonably require to be included; and
 - (xi) in accordance with Part IV, 11 (4) (b) of the EP Act Cap.20:05, the EIA must assess the project with a view to the need to protect and improve human health and living conditions and the need to preserve the stability of ecosystems as well as the diversity of species.

This Terms and Scope guides the preparation of the Environmental Impact Assessment, referred to herein as the Environmental and Social Impact Assessment (ESIA).

2.0. PROJECT BACKGROUND

The **Government of Guyana** (Employer/Client) through the Ministry of Public Infrastructure (MoPI) has engaged **RITES Limited** (Consultant) (A Government of India Enterprise- Ministry of Railways) who has sub-contracted Triple 'C' Consultancy Firm to carry out the detailed project preparation for the East Bank – East Coast Road Linkage (tentative length 24.715 km) for roads and also to provide Construction Supervision Consultancy Services for the construction of East Coast-East Bank Road Linkage (please see figure 1 and 2 below).

The project has been proposed to be taken up in three distinctive stages:

- Stage-1 is for Detail Project Report Preparation
- Stage-2 is for Construction Supervision
- Stage-3 is Post-Construction stage-Defect Liability Period

The Stage -1 is Consultancy Services for Preparation of Detailed Project Report for Construction of East Bank - East Coast Road Linkage (15 km) and 4 connectors (9.62 km) as follows (please see figure 2 and 3 below):

- East Bank - East Coast Alignment = 15.00 km
- Extension of Aubrey Barker Road (Connector-1) = 1.57 km
- Extension of Haags Bosch Road (Connector-2) = 3.49 km
- Extension of Mocha Arcadia Road (Connector-3) = 2.99 km
- Extension of Great Diamond Road (Connector-4) = 1.57 km

The total project length considering the main green field alignment is 15 km and extension of connectors up to main alignment is 9.62 km i.e. total 24.62 km are to be finalized in the DPR by RITES, which is now proposed under Government of India (GoI/LoC) funding.

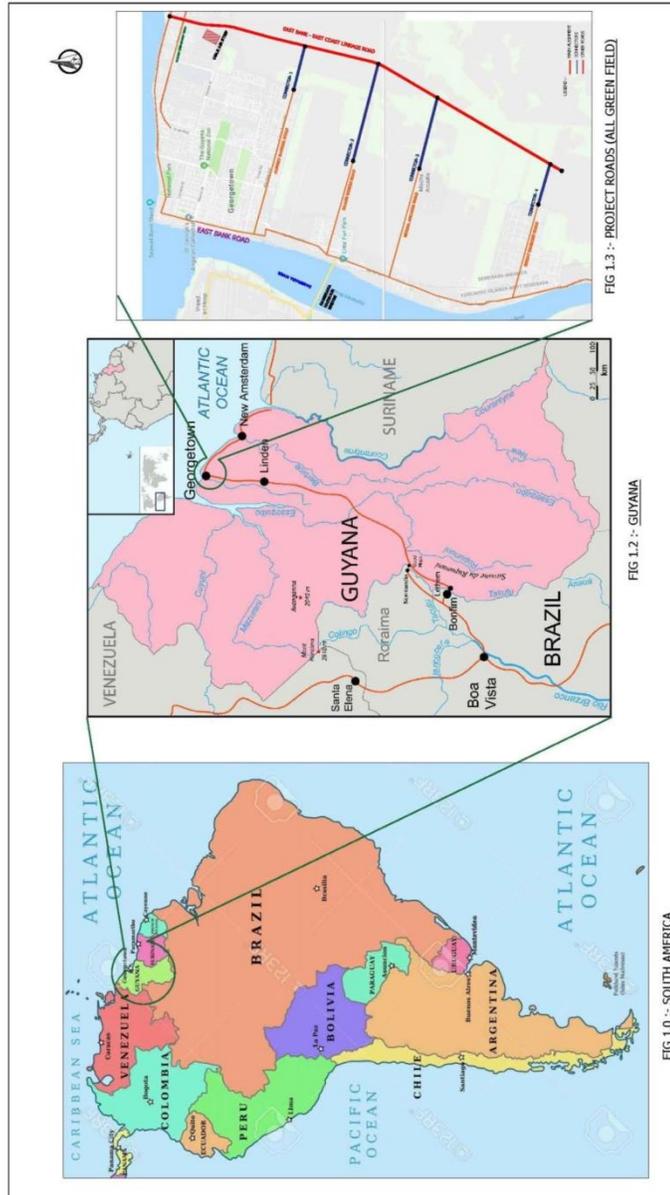


Figure 1 Key Map of Project Area

Source: RUTES Ltd. 2018

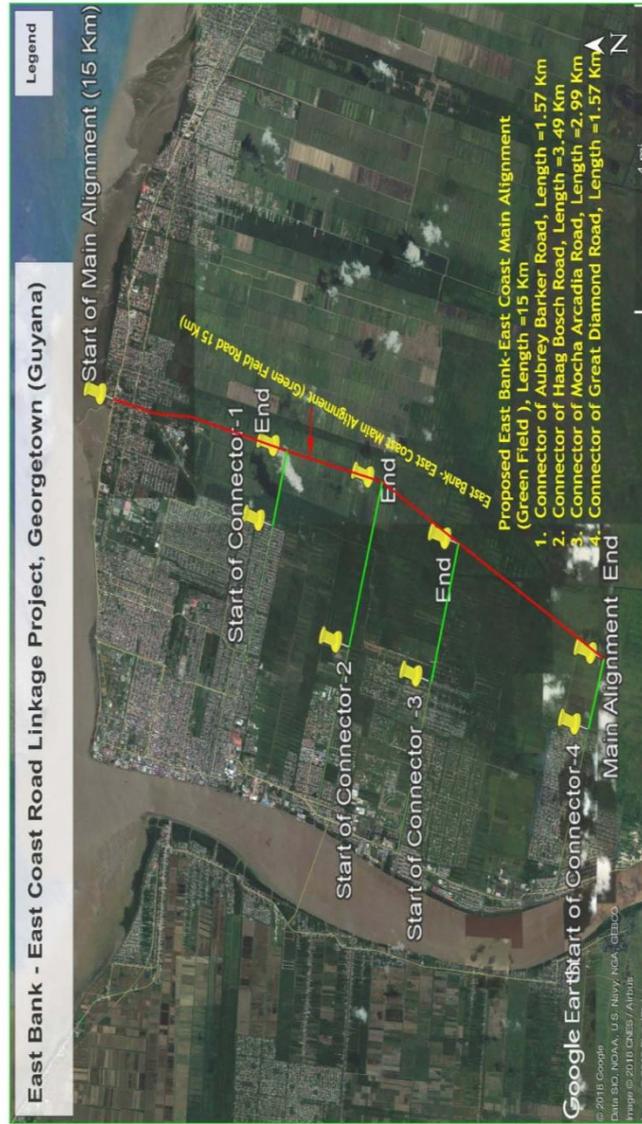


Figure 2. Start and End Alignment with connectors on Google Map
Source: RITES Ltd. 2018



Figure 3. Start and End Alignment with connectors
Source: RITES Ltd. 2018

3.0: SCOPE OF THE EIA

In accordance with Part IV (11) (5) of the EP Act Cap.20:05, every Environmental Impact Assessment shall contain the following information:-

- (a) Description of the project, including in particular:-
 - (i) the geographical area involved, the physical characteristics of the whole project and the land-use requirements during the construction and operational phases, including plans, drawings, and models;
 - (ii) the main characteristics of the construction process, including the nature and quantity of the materials used, plans, drawings and models;
 - (iii) an estimate, by type and quantity, of expected contaminants, residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation) resulting from the development of the proposed project;
 - (iv) the length of time of the project;
- (b) An outline of the main alternatives studied by the developer and an indication of the main reasons for the specific choice, taking into account the environmental factors;
- (c) A description of the likely significant effects of the proposed project on the environment resulting from:-
 - (i) The existence of the project;
 - (ii) The use of natural resources;
 - (iii) The emission of contaminants, the creation of nuisances and the elimination of waste, and a description of the forecasting methods used to assess the effects on the environment;
- (d) An indication of any difficulties (technical deficiencies or lack of knowledge or expertise) encountered by the developer in compiling the required information;
- (e) A description of the best available technology;
- (f) A description of any hazards or dangers which may arise from the project and an assessment of the risk to the environment;
- (g) A description of the measures which the proposed developer intends to use to mitigate any adverse effects and a statement of reasonable alternatives (if any) and reasons for their rejection;
- (h) A statement of the degree of irreversible damage, and an explanation of how it is assessed;
- (i) An emergency response plan for containing and cleaning up any pollution or spill of any contaminant;

- (j) The developer's programme for rehabilitation and restoration of the environment;
and
- (k) A non-technical summary of the information provided under the preceding paragraphs.

4.0: REQUIREMENTS FOR THE EIA AND EIS

4.1 ORGANIZATION OF THE REPORT (ENVIRONMENTAL IMPACT STATEMENT)

The EIA Report shall focus on significant environmental issues and must provide all the relevant information needed by the EPA to consider fully any adverse or beneficial impacts of the proposal.

The introduction to the EIA shall provide an explanation of the scope of the proposal and the issues and decisions which led to the proposal at this time and in this context, including a history of events leading up to project formulation, envisaged time scale for implementation and project life, anticipated establishment costs and actions already taken at the project site.

Suggested table of contents:

- Glossary
- Executive (non-technical) Summary
- Chapter 1: Introduction and Background
 - Project background- Rationale and Need
 - Organization Profiles: The Proponent, Implementing Organization and Project Consultant
 - Scope of the Environmental and Social Impact Assessment
 - Environmental and Social Impact Assessment Study Team (Detailed CV in Appendices)
 - Environmental and Social Impact Assessment: Organisation of the report
- Chapter 2: Approach and Methodology, Significance Criteria and Area of Influence
 - Description of project methodology
 - Study Area/Area of Influence
 - Specific project location
 - Mapping and use of Geographical Information System (GIS)
- Chapter 3: Legislative and Regulatory Framework
 - Environmental Impact Assessment Process
 - National Policies, Regulations and Legislations
 - International and Regional Policies and agreements
 - Local regulatory agencies responsible for environmental protection and planning

- Chapter 4: Project Alternatives
 - This chapter should focus on the most feasible, cost-effective, and environmentally sensitive alternatives. For each alternative, the EIA should include but not limited to (1) a balance description, and (2) a discussion including the size and location of facilities, land requirements, auxiliary structures and construction schedules.
- Chapter 5: Comprehensive Description of Proposed Project
- Chapter 6: Stakeholder Identification and Consultation Plan
- Chapter 7: Environmental Impact Analysis
 - Baseline Studies/Assessment
 - Assessment of Environmental Impacts
 - Cumulative Impacts
 - Rating of Environmental Impacts
 - Criteria for Rating of Impacts
 - Severity and Enhancement Criteria
 - Mitigation Measures and Monitoring
- Chapter 8: Water Resources
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Existing information, Baseline studies
 - Impact prediction and evaluation
 - Mitigation and monitoring - Environmental and Social Management Plan
- Chapter 9: Soils Land and Geology
 - Introduction
 - Definitions and scope
 - Key relevant policy and legislation
 - Existing information, Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan
- Chapter 10: Air Quality
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Existing information, Baseline studies
 - Impact prediction and assessment

- Mitigation and monitoring - Environmental and Social Management Plan
- Chapter 11: Climate and Climate Change
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Existing information, Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan
- Chapter 12: Biological and Ecological Resources and Ecosystem Services
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Existing information, Surveys and Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan
- Chapter 13: Noise and Vibrations
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Baseline
 - Impact prediction and assessment
 - Mitigation and monitoring- Environmental and Social Management Plan
- Chapter 14: Transportation
 - Introduction
 - Definitions and scope
 - Baseline
 - Impact prediction and assessment
 - Mitigation and monitoring- Environmental and Social Management Plan
- Chapter 15: Hazardous Waste and Waste Management Materials
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan

- Chapter 16: Landscape and Aesthetics
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Baseline
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan

- Chapter 17: Socio-Economic Impacts
 - Introduction
 - Definitions and scope
 - Key relevant policy, legislation, guidelines, standards etc.
 - Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan

- Chapter 18: Health Impact Assessment
 - Introduction
 - Definitions, scope and concepts
 - Key relevant policy, legislation, guidelines, standards etc.
 - Baseline studies
 - Impact prediction and assessment
 - Mitigation and monitoring - Environmental and Social Management Plan

- Chapter 19: Health Risk Assessment
- Chapter 20: Risks and Risks Assessment
- Chapter 21: Land Acquisition and Resettlement Plan

- Appendices and Other Information
 - All relevant documentation from the ESIA including records of consultations, data collection/survey forms etc.

5.0 EXECUTIVE SUMMARY, INTRODUCTION AND BACKGROUND

EXECUTIVE SUMMARY

Provide a brief statement on the content of the EIA report condensed to a maximum of 10 pages. The Executive Summary should provide a comprehensive overview and objectives for the project proposal, natural resources, justification for the project etc. In addition, it should include relevant background information, project description, and provide a summary of the main findings, including but not limited to, main impacts and mitigation measures, analyses, project alternative chosen, important aspects of the environmental monitoring and management plans and the conclusion of the report.

INTRODUCTION AND BACKGROUND

The introduction should give a background; explain the need for and the context of the project. The introduction should include, but not limited to the following:

- Purpose of the project, project proponent, brief description of the project including the name, size, and location of the project, and its importance to the surrounding communities and country.
- Land description- details of land acquisition inclusive of relocation of infrastructure and residences
- Details of existing communities/settlements
- Profile of the project proponent, implementing organization, and/or project consultants, including contact information for each to include, but not limited to name, contact address, telephone number, and email addresses. The ESIA Team must be highlighted and detailed CV's attached in Appendices.
- Confirm that the project meets the approve Terms of Scope and environmental and planning standards applicable to the project
- The proponent should declare any litigation pending against the proposed project and or any direction/order passed by the courts of law against the project, and if so, details thereof.

6.0 APPROACH AND METHODOLOGY

Describe the general methodology used in the conduct of the EIA, including data collection and analysis, impact analysis, cumulative impact analysis, formulation of mitigation measures and monitoring programme, and assessment of alternatives. A method of determination of impact significance must be clearly outlined, including specific significance criteria that would allow the reader to understand the level of impact of the project on key ecological and socio-economic components and how these levels were estimated.

7.0 STUDY AREA AND AREA OF INFLUENCE

The study area/area of influence for the purposes of this ESIA is initially defined as the Main Green field alignment (15.0 km) starting from East Coast Road (Rupert Craig Highway) Ogle and end at the connector of extension of Great Diamond Road with East Bank Public Road.

It is expected that the ESIA will determine and delineate the actual area of influence by considering the extent of direct and indirect interactions between the proposed project and the physical, biological and socio-economic environments. A graphical representation of the Area of Influence is necessary.

The study area will include the East Coast (Rupert Craig Highway), the proposed bypass road which starts from Ogle Airstrip road intersection, the first connector linking the existing Aubrey Barker Road which is connected to Critchlow Avenue Road and Mandela Road. The second connector linking the existing Haags Bosch road which is connected to the East Bank Road at the intersection of East Bank Road, Demerara Harbour Bridge and traffic coming from West Bank or West Coast to Georgetown. The Third Connector linking to Mocha Arcadia road and also connected to East Bank Road and the fourth Connector linking to Great Diamond Road and also connected to East Bank Road, which leads to southwards for Eugene F. Correia International Airport, Ogle.

The area of influence should also include areas that will be directly and indirectly disturbed by associated activities such as auxiliary works and facilities, clearing and removal of vegetation cover, land and site preparation for earthworks, routes used during the transportation of all raw materials required for the road development, sources, storage and transportation of raw materials, traffic control plans or mechanisms, removal and storage of top soils, land degradation (soil erosion, sedimentation, soil compaction), road side drainage and general drainage system for the road and the areas of influence etc. Surrounding communities that can be affected by noise, air emissions or upset conditions also need to be considered in defining the area of influence.

Specific Project Location

There are five (5) road sections designated as project roads i.e. Main Alignment and its four connectors.

The main alignment: East Bank-East Coast Road (15 km), Connector 1: Extension of Aubrey Barker Road (1.57 km), Connector 2: Extension of Haags Bosch Road (3.49 km), Connector 3: Extension of Mocha Arcadia Road (2.99 km), Connector 4: Extension of Great Diamond Road (1.57 km). Describe the project location to include surrounding areas; acreage to be cleared for the main alignment and the connectors, surroundings of the areas, boundaries, buffer zones/setback distances, roads, surface water bodies,

community settlements; location of any off-site processing sites to be utilized; and clear definition of the boundaries within which the activity is intended to occur.

Mapping and Use of Geographical Information System

Mapping, as referred to in this Terms and Scope, shall be considered to be spatial data to scale, represented in digital or printed format. Mapping should be illustrated with the use of photographs, map sheets and diagrams at easily understood and appropriate scales to illustrate the spatial extent of the project and the impact area. Printed maps of the site area shall clearly indicate the layout of the facilities in the context of the immediate site, as well as relative to the wider study area. Each printed map shall be at appropriate/easily-understood scales for the overview being illustrated (e.g. 1:10 000 or 1:5000 for site plans) and shall be inserted at the point of reference in the text in the EIA. In the event that any of the maps are large and/or bulky, these should be incorporated into one of the appendices, as appropriate. All maps and figures shall adhere to the following guidelines:

- Spatial data shall be appropriately scaled;
- Map/figures shall be clearly legible and include proper legends/keys;
- Maps/figures shall be dated and the source of the datum stated;
- Maps/figures shall include an appropriate scale and a north arrow.

The use of scanned documents, texts or graphics is not acceptable.

Due to the scale and nature of this intended project and the study area, the use of geographical information systems (GIS) to represent spatial data shall be required wherever practicable. Submitted data shall be presented in a working GIS project compatible with Arc View and be organised into discrete themes (i.e. shape files – point, raster and vector data). Data themes shall illustrate, but not necessarily be limited to, the following features/attributes:

- Site layout, i.e. major building footprints and storage areas;
- Proposed main alignment and connector roads;
- Roads (all classes);
- Health care facilities, schools, churches, recreational facilities, banks, etc.
- Housing schemes;
- Protected/Managed Areas;
- Demographics of the study area;
- Agriculture activities and other land use activities ;
- Topography (contour lines at appropriate intervals, preferably in metres) including derived digital elevation models (DEMs) and triangulated irregular networks (TINs);
- Sampling points for baseline data;
- Proposed monitoring stations/points;

- Intended effluent points;
- Proposed buffer zones/setback distances;
- Flora, including endemic species, and faunal habitats;
- Forested areas inclusive of forest reserves and wetlands;
- Administrative areas (e.g. regional corporation);
- Water resource - canals/streams, standing water bodies, aquifers/groundwater resources, known groundwater recharge areas, wells, watershed, etc.;
- Soil and geology; and
- Known archaeological sites and sites of historical interest.

Digital data themes or shape files should be clearly labeled/annotated with supporting metadata. The use of GIS would not otherwise exclude the use of photographs, map sheets and diagrams at easily understood and appropriate scales to illustrate the spatial extent of the project and the impacted area. Such photographs should be indexed with the map sheet to aid in the illustration process. Updated high resolution aerial and satellite imagery should be used as reference data.

8.0: LEGISLATIVE AND REGULATORY FRAMEWORK

Examine the general policy, legislative and regulatory framework such as national policies and legislations relevant to the project, which are not environmental media specific, and to assess the extent to which the project is in line with these requirements. This examination should include, but not necessarily be limited to the following:

- Environmental Protection Act and the authorisation process
- National environmental policy and legislation, planning and development control frameworks including protected areas and environmental quality standards with implications for the project, such as environmental protection, health and safety and land-use control;
- Regional and international agreements and conventions relevant to the project and its activities; and
- Regulatory agencies responsible for environmental protection and planning, their resources and capacity to address the issues raised by the project.

9.0 PROJECT ALTERNATIVES

The Project Proponent is required to examine alternatives to the project design, focusing on its impact on the environment. This investigation should include, but not necessarily be limited to, the following aspects:

- Any feasible alternatives to the project design as formulated, such as no-action alternative and any other that may not involve crossing the Lamaha Canal, the project location and camp sites, sources of materials, resources, technology and management;
- The Project Proponent is required to describe the findings of any work or study undertaken to date (either by comparing potential options or selecting a preferred option such as previous option studies or preparatory assessments). This should include any issues identified during consultation with the general public, regulatory authorities, special interest groups and other key stakeholders during such studies related to the alternatives and proposed project. The reasoning for the selection of the proposed project compared to other potential options should be given;
- The Project Proponent will benchmark, where applicable, the preferred alternative against case studies of similar projects and will describe reasonable alternatives to the proposed project that would achieve similar objectives. This extends to, but is not limited to, the project alternatives such as siting, road design, technology selection, construction and processing techniques, treatment of effluent, operation and maintenance procedures, schedules; and
- The 'no action' alternative must also be considered. Provide a comparison of impacts as a result of a continuation of existing activities and conditions with those of the proposed project and action alternatives. This will demonstrate potential changes in the existing socio-economic and environmental baseline conditions without the project. Alternatives shall be discussed in sufficient detail to clarify the reasons for preferring certain options and rejecting others. The reasons for choice of the preferred option(s) must be explained, including the following:
 - A comparison of the adverse and beneficial effects (both to the environment and community) used as the basis for selection;
 - Compliance with government policy;

- Compliance with the principles and objectives of sustainable development;
- The impact of significant delay or abandonment of the project before all of the proposed phases are completed.

10.0 DESCRIPTION OF THE PROPOSED PROJECT

The proponent should provide a comprehensive overview of the project, noting areas to be reserved for construction and verges. A description of all activities and features, which will introduce risks or generate impacts (negative and positive) on the environment, must be included. These activities may be associated with secondary facilities such as fuel dispensing sites, concrete and asphalt batching plants, camp sites and site offices, and material and spoil storage sites. This will involve the use of maps, site plans, aerial photographs, and other graphic aids and images, as appropriate, and include information on location, general layout and size, as well as pre-construction, construction, and post-construction plans. It is expected that all phases of the project are clearly defined, the relevant time schedules provided, and phased maps, diagrams and appropriate visual aids included. Further, project description should information on the following, but not limited to:

- Process description
 - Type of machinery or equipment to be utilised;
 - Method for the removal and clearing of vegetation cover,
 - Land preparation for earthworks,
 - Sources of raw materials including (sand, loam, aggregates, Bituminous, storage and transportation;
 - Method of storage and reuse of topsoil and overburden removed, land degradation (soil compaction, soil erosion, sedimentation etc.);
 - Rehabilitation after construction, demarcation and maintenance of buffer zones;
 - Road side drainage and general drainage system in the areas of influence;
 - Routes used during the transportation of all raw materials required for the road development for the main alignment and connectors.
- Identification of staffing, support facilities and services that would be required during the different phases of the activity;
- Name and address of land owners, accompanying title/deed of conveyance, as well as land tenure and use of immediately adjacent lands (plan required), where available;
- Description of general construction methodologies;

- Details of modification of the current road network adjacent to the project and any required, permanent or temporary road diversions;
- Modification of existing infrastructure including but not limited to natural and man-made drainage features, bridges, pipelines, utilities etc.;
- Discussion of the proposed project in context of existing and/or other proposed projects or activities in the project area;
- Details of off-site facilities such as construction camps and infrastructure services
- Details for the decommissioning and abandonment of works and/or facilities;
- Details of proposed accesses to the project sites (road and ancillaries) to be used for pre-construction, construction, and operational phases. This description should detail all activities and features which will introduce risks or generate an impact (positive or negative) on the environment including but not limited to soil erosion, sedimentation, slope stability, impact to biodiversity etc;
- A comprehensive description of all on and off site drainage works. This plan should consider existing natural drainage channels, proposed man-made drainage/ water features or any proposed changes in topography. Special emphasis should be placed on the storm water run-off, drainage patterns;
- Plans for providing utilities, particularly details relating to the source of potable water and electricity generation, and other services should be clearly stated; and
- A description of the maintenance of the buffer zones during the life of the roads.

11. STAKEHOLDER IDENTIFICATION AND CONSULTATION PLAN

This is enshrined In Part IV (11) (9) of the EP Act, which states: During the course of the environmental impact assessment the developer and the person(s) carrying out the environmental impact assessment shall:-

- (a) Consult members of the public, interested bodies and organizations;
- (b) Provide to members of the public on request, and at no more than the reasonable cost of photocopying, copies of information obtained for the purpose of the environmental impact assessment.

The EPA has determined that consultations should be conducted with (but not limited to) the following stakeholders:

- The Environmental Protection Agency, (EPA);
- GUYSUCO
- National Drainage and Irrigation Authority (NDIA)
- The Ministry of Public Infrastructure (MoPI);
- Guyana Water Inc.;
- National Industrial & Commercial Investments Limited (NICIL)
- Ministry of Agriculture (MoA);
- The Regional Democratic Council, Region #04;
- Neighbourhood Democratic Council (Golden Grove/Diamond, Mocha /Arcada, LBI, etc);
- The Guyana Lands and Surveys Commission (GL&SC);
- Central Housing and Planning Authority (CH&PA);
- Guyana Power and Light (GPL);
- Guyana Telephone and Telegraph (GT&T)/Digicel;
- Guyana Wildlife Management and Conservation Authority;
- Ministry of Natural Resources;
- Community-based organizations, NGOs including the World Wildlife Fund (WWF-Guianas) and Conservation International (CI – Guyana), Local decision-making bodies e.g.
- Other appropriate local authorities in Guyana.
- Other business interests that may be affected by the project.

The ESIA shall address the concerns raised during the scoping and during the consultation(s) as part of the conduct of the ESIA. The ESIA report must demonstrate that public concerns have been adequately considered by suggesting possible modifications to the project proposal or by clarification of items within the document.

All public consultation results must be documented and relevant records included in the appendices of the EIS. These records shall also contain details on the manner in which the public was notified, the groups targeted, a description of the stakeholder

consultation process, a list of all stakeholders included in the process, the number of meetings held, location of the meetings, dates held, minutes of all meetings, a copy of the survey questionnaires used (if any), and the results of surveys.

12. ENVIRONMENTAL IMPACT ANALYSIS

12.1 BASELINE STUDIES

A description of existing environmental, physical and social conditions and trends focused on those aspects potentially affected by the proposed project shall be provided in the EIA. The EIA shall include a review of recent studies undertaken in the intended project area to determine the relevance of these studies as they relate to the current physical, biological and socio-economic environments. Where it is believed that past studies failed to produce a relatively good assessment of baseline conditions, the Company shall undertake field studies to fill appropriate data gaps so that a comprehensive description of the physical, biological and socio-economic environments can be produced.

The data presented shall be representative of the study/project area. The term 'representative' defines the extent to which a set of measurements taken at a collection site spatially and temporally reflects the actual conditions within the study/project area. Therefore, in instances where the data are being collected and reported from stations that are located off site (i.e. outside the boundaries of the study/project area), a justification must be provided to demonstrate that the data are representative of the study/project area. Otherwise, the Project Proponent will be required to provide more accurate, site-specific data.

The EIA shall include changes that may occur before the project commences in light of previous, ongoing (i.e. other operations within the defined study area) or future activities that could reasonably be determined to have a combined effect. Sufficient detail is needed to allow a clear understanding of the likely negative impacts of the proposed activity, and to assess the effectiveness of any proposed mitigation measures. An examination of any positive impacts should also be included to ensure as comprehensive an assessment as possible.

Baseline data for the specific environmental medium including data compiled by review of existing information and from NGOs, published reports or studies, experts and other sources will be presented in separate chapters.

Examples of documents to be reviewed include:

- Geological publications for the area

- Data on terrestrial and aquatic Resources of the area
- Land use plans and topographic Maps, etc

All readily available historic baseline data for the bio-physical and socio-economic environment must be assembled and evaluated. The historic baseline data will possibly include:

- Biological resources in the area including the presence of any unique ecosystems, natural habitat or endangered and or critically endangered species;
- Geological and hydrology data;
- Contamination levels in soil and surface water;
- Risk of natural hazards, e.g. flooding and seismic events; and
- Local meteorological conditions.

12.2 POTENTIAL IMPACTS ON THE ENVIRONMENT

The project proponent shall identify and undertake a qualitative and quantitative analysis and evaluation of all impacts that could arise during each phase of the of the project. The analysis should cover but not necessarily be limited to the negative and positive impacts, direct and indirect impacts, immediate, short-term and long-term impacts, reversible or irreversible and cumulative impacts. To illustrate significance, direct comparisons should be made between estimates of the potential impacts and the baseline conditions for given parameters/indicators.

This description shall include an assessment of the cumulative environmental effects that are likely to result from the proposed activities in combination with other existing, approved and proposed projects in the area that could reasonably be considered to have a combined effect. The cumulative assessment must be based on an adequate understanding of the design and operation of the proposed activity, as well as other existing, approved and proposed projects. The expansion of the road towards CJIA must be considered. Cumulative effects shall either be described within a specific section of the EIA report on cumulative effects, or be well defined within each of the report's sub-sections on potential effects, as relevant.

The EIA shall also consider the impacts that can occur in unforeseen circumstances. The reliability of forecasts and predictions shall be indicated as appropriate. Impacts must be categorised and illustrated using an appropriate format e.g. matrices where applicable. The project proponent shall also provide data from other existing activities using the same technology with which to compare, or assist in the prediction of impacts for this proposed project, where applicable.

A method of determination of impact significance must be clearly outlined, including specific significance criteria that would allow the reader to understand the level of impact of the project on key ecological and socio-cultural components and how these levels were estimated.

Areas of impact/hazards shall be illustrated in map form and those that are unavoidable or irreversible must be specifically identified. Significant changes to baseline conditions shall also be quantified where possible.

A determination of impact significance shall be provided for each key environmental or socio-economic component (by major phase or activity) after considering the application of proposed mitigation measures (i.e. rank the significance of residual effects following mitigation) Proposed mitigation measures to reduce adverse effects and measures to enhance benefits must be clearly described.

11.3 ENVIRONMENTAL MANAGEMENT STRATEGIES, MITIGATION MEASURES, AND MONITORING PLAN

Mitigation measures and monitoring should be presented in the form of an Environmental and Social Management Plan (ESMP) that must be presented for each medium and should be combined in the final chapter of the EIA

The appropriate environmental management practices to be followed during the various phases of the project with respect to the various environmental baseline conditions shall be described. Adverse impacts identified during impact analysis, the project proponent shall propose realistic, feasible measures to avoid, mitigate or remedy such impacts to acceptable levels.

In situations where negative impacts are known or expected to be significant, the project proponent should, where practical, follow the impact hierarchy of avoidance, minimisation, and mitigation in the project planning. Avoidance of impacts (e.g. to sensitive areas) should be considered as the first choice which can be the most beneficial to the project proponent in economic terms. If significant impacts can be avoided, the costs and delays associated with mitigation planning and permitting are also avoided. In cases where the impacts cannot be entirely avoided, the project proponent should seek to minimise those impacts.

Where avoidance or minimization cannot be applied, then the project proponent shall formulate mitigation measures and management strategies which shall be discussed under the respective environmental baseline conditions. These shall be considered as the framework management plan for the project that seeks to manage existing health, safety and environmental issues resulting from the proposed project. Mitigation

measures shall specifically describe how existing pollution would be handled to prevent a cumulative effect with respect to the intended project. Ensure measures to:

- Minimize the impacts to the Lamaha canal during construction phases.
- Minimize impacts to all water bodies within the project area. These should satisfy, and show comparison with, local environmental, health and safety standards/guidelines and international standards/guidelines shall be used.

A Monitoring Plan shall be developed to ensure that the safeguards identified as necessary during the EIA process, as well as statutory obligations are all satisfactorily complied with. The Monitoring Plan will be devised to:

- Implement mitigation measures;
- Monitor the implementation programme; and
- Report to the designated institutions/statutory bodies.

Where monitoring indicates that objectives are not being met, contingency plans to minimise adverse situations that may arise (or that have arisen) must be described. Monitoring programmes shall address the physical, biological and social impacts of the project. The parameters/indicators to be monitored and their respective frequencies of measurement must be detailed. The Monitoring Plan shall also include any monitoring programs that project proponent is proposing to conduct collaboratively with other stakeholders. Included in this program shall be a description of the role and responsibilities that project proponent will be taking in each of the programme.

The Monitoring plan shall include mechanisms for sharing results, reviewing findings and adjusting programs, monitoring unanticipated consequences of the operations or mitigation plans.

The Environmental and Social Management Plan which will be presented in the final Chapter must include:

- **An Emergency and Response and Contingency Plan:** This plan must outline the response procedures and preventive measures that are essential for effective and timely management of an emergency/emergencies situation. The following should be considered:
 - what possible emergencies may occur and what actions can be taken to prevent those emergencies;
 - what precautions would minimize the effects of an emergency/emergencies should any occur;
 - what immediate actions personnel should take to contain an emergency/emergencies;

- whether employees have the skills necessary to carry out the procedures outlined within the ERP;
 - who will assume temporary command of the emergency effort;
 - who is in charge of which parts of the emergency operation;
 - how key personnel will obtain information and assess reports to make critical decisions; and
 - Make available to the staff and public: accident report and grievance forms.
- **A Contingency Plan (CP)** should be prepared outlining actions in an unforeseen event that will result in the disruption of construction activities to the main alignment and the connector roads. The following should be considered:
 - Designate a qualified person or persons with the responsibility to declare a situation an emergency, to clean up and handle all emergencies during his/her shifts and the authority to indicate that an area is declared safe and free to return back to work after an emergency.

13: WATER RESOURCES

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS

With regard to this medium, baseline shall include but not limited to:

- Water quality of ground and surface water features including canals, drains, wells, impoundments and other water bodies in the vicinity of the development, with special emphasis on those to be crossed by the proposed alignment and plans to augment the existing information where needed.
- Water Quality indicators should include but not limited to: total suspended solids, turbidity, oil and grease, pH, dissolved solids, electrical conductivity, BOD, DO and Total coliform bacteria.
- Analysis must include assessment of seasonal variations, and comparison of findings with acceptable water quality standards (GNBS interim Industrial Effluent Standards, World Health Organization, IFC where applicable).
- Assessment of point and non-point sources of pollution to determine the type and extent of contamination in the area including an identification of the location of any legal or illegal dumping or other activities within the project location that may be a source of pollution.
- List the distance of the proposed alignment from water bodies used for drinking or domestic uses (where applicable).

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- Impacts to the hydrology of the study area in terms of changes to, Flooding potential, and changes in drainage patterns, sediment loads (impacts should be quantified/qualified in relation to appropriate baseline parameters).
- Consider impacts to hydrological resources in terms of loss or impairment of resource (i.e. healthy ecological/aquatic habitat and source of potable water);
- Pollution of wells, potable surface or ground water.
- Identify all main and subsidiary canals and drains that the road and connectors will impact. Describe the impact of the project, for example the effects of increased sedimentation during construction and the aquatic ecological effects within water ways.

- The cumulative water quality effects that are likely to result from the project in combination with other existing, approved and other ancillary projects;
- Discuss the potential for flooding as a result of the proposed activities.
- Assessment of the impact of site drainage on adjacent communities and on future developments including mitigation measures.
- Proposed future development of surrounding lands with special emphasis on storm water run-off, and drainage patterns
- Projected vehicular density should be described in correlation with rain patterns and projected run-off (with pollutants) from the roads and potential effects on water quality.
- An assessment of where the road may intercept shallow ground water flow paths and the diversions caused by the road project.
- An assessment of the storm water drainage should be conducted and proposed drainage features should be designed and calculated to accommodate the volume and velocity of storm water post construction and not cause flooding of the highway or the adjacent lands or communities. Therefore it should include but not be limited to:
 - Assessment of the impact of site drainage on adjacent communities and on future developments including mitigation measures.
 - Drainage during construction and operation to include mitigation for erosion and sediment control.
 - Drainage control for the crossing of the Lamaha Canal and other drainage canals, to include impacts that drainage control features could have on aesthetics, water quality and sedimentation.
 - Surface Hydrology and Drainage - mapping and discussion of the existing drainage patterns/characteristics of the sites and wider study area
 - Discussion of the dry season and wet season flow rates of the canals, drains and watercourses.
- An assessment with proposed mitigation measures of potential changes to hydrology slopes and stream channels, resulting in alteration of surface water habitats.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

14: SOILS, LAND AND GEOLOGY

BASELINE CONDITIONS

This baseline will present:

- Geology and soil characteristics of the site including, but not limited to:
 - Subsurface stratigraphy (mapped).
 - Description supported by a map the soil types and their distribution in the study area inclusive of the main alignment and all connectors.
 - Topography evidenced by a topographical map that shows the elevation patterns at the site and zone of impacts.
 - Geomorphology of the study area and specifically for the site wherever practicable (i.e. rates of landform change, erosion and depositional processes).
 - Existing Levels of soil contamination/degradation in the Field from previous land use or activities.
 - Describe the baseline of constituents of soil, eg heavy metals, physio-chemical soil constituents and potential changes expected as a result of constructing and operating the road.
 - Baseline soil types to the depth and below the depth of which the road will disturb should be described.
 - Identification (described and mapped) and a complete description of Pagasse areas adjacent to or through which the road will travel.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- Assess the impact of soil compaction resulting from the roads.
- Assess extent of soil erosion from clearing of land, and construction of roads.
- Impacts of roads passing through pegasse soil and mitigation measures ensuring integrity of road.
- Identify the intended construction materials to be used in construction of the road, e.g. concrete, asphalt etc, and describe the impact on the surrounding soil quality.
- Geology, soils and terrain: assess the impact of operational activities on the geological features of the site, including the type, extent and frequency of these impacts to the pre-development topography. Assess the potential for operations to affect the stability of the substrate in terms of slope stability (i.e. vulnerability to land slippage, erosion), shear strength, porosity and compressibility. Assess

flooding possibility if filling of low-lying areas are to occur. This assessment should be done in the context of baseline pre-development conditions.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

15: AIR QUALITY

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS

- The wind regime of the project area, including wind speed and direction, prevailing wind conditions, seasonal variations and storm conditions as supported by representative meteorological data for the area.
- Rainfall in the areas, including seasonal variations.
- Air Temperature and Relative Humidity.
- Baseline data for appropriate ambient air quality parameters associated with expected emissions of this type of project including, but not limited to, the ambient concentration of total particulate matter (PM), PM 10 and 2.5 and smoke, carbon monoxide (CO), oxides of Nitrogen (Nox) and Volatile Organic Compounds (VOCs).

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- Air quality, including, but not limited to, such aspects as:
 - the generation and movement of dust off site during the construction activities, especially transport and storage of stockpiles;
 - Air quality as a result of exhaust emissions from machinery and equipment deployed for construction.
 - Air quality as a result of increased traffic, emission inventory for critical pollutants with and without mitigation measures.
- Identification of pollutants to monitor, the type of monitoring equipment to be employed, the number and location of sampling sites and the duration of the survey.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

16: CLIMATE AND CLIMATE CHANGE

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This section should include all relevant policies, programmes, and plans related to climate change and its overarching links to the UNFCCC multi-national environmental agreement of which Guyana is party to. Key institutions and organizations directly and indirectly responsible for climate change policy implementation should also be examined.

- Prepare a Flood Vulnerability Map for the roadway, at a minimum 1:5000 scale, or at a useful size relative to the study catchment, as determined with the MoPI and end-users showing projected water table levels for mid-century (2050), current development activities, critical infrastructure and population at risk in the flood zones.
 - Potential of flooding must be assessed in the main road and all connectors especially the Aubrey Barker connector.
- The consultant shall identify and prioritize the most appropriate adaptation options to incorporate into the project design parameters to address the potential climate impacts. A range of resilience options are to be explored (e.g. increasing drainage and culvert capacity, stabilizing slopes, using geomembranes, rerouting segments of roadways, increasing maintenance etc.)
- An economic analysis of each technical feasibility option should be conducted, showing the costs and benefits, of a cost effectiveness analysis if the measures are expected to deliver the same benefits. Based on the outcome of the economic analysis, the consultant will prioritize the identified adaptation measures.
- Describe the existing vegetation cover and provide a vegetation map of the proposed green alignment and the areas to be cleared to connect with the connectors. After the assessment of the existing vegetation cover assess the carbon sequestration resulting from the clearing of vegetation to construct the roads.
- An assessment of projected temperature changes resulting from the paved road and potential ecological effects, especially on the fauna of the area.

- Estimate the projected rate of human fatalities and injury resulting from construction and operational use of the roads during the day, night, Rainy and dry periods.

17: BIOLOGICAL AND ECOLOGICAL AND ECOSYSTEM RESOURCES/ SERVICES

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS

For this medium the baseline shall include but not limited to:

- Aquatic and Terrestrial flora and fauna: characterize the biological environment to include the following:
 - A qualitative (composition/variety) and quantitative (density) assessment of the existing diversity including all snakes, birds, fishes and amphibians reliant on the current ecosystem. Map the location of species identified.
 - Use of site-specific field surveys to assess the terrestrial and aquatic environments for impact prediction and development of mitigation and monitoring programs. The sampling regime must be scientifically rigorous and statistically significant to allow for future comparisons.
 - If the project involves breeding or nesting grounds for particular species, details of species must be provided.
 - Provide information on plant species and communities that are present within the study area, including information on any rare or endangered plant species and information on any specialised or unique plant communities that may be present.
 - Mapping of plant communities and the area of estimation of any community type that may be lost due to project activities.
 - Fauna of the site and their use of the surrounding environments - document and describe any species of wildlife including, but not limited to, amphibians, fish, reptiles, birds, mammals and invertebrates, that use the study area.

- Provide a detailed habitat assessment, including identification of those of resident species of major watercourses on site, and especially those which will be altered by the project (where applicable);
- Describe any fisheries practices (whether commercial, subsistence, or recreational), including the species targeted by local household units in the study area;
- Identify and describe environmentally sensitive species and areas in the study area;
- Identify invasive and economically important species.
- Identify rare, threatened, endangered and endemic species.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- A complete description of the potential adverse effects on reproduction, movement from the sites and fatalities resulting from the road resulting from clearing the vegetation and building the road to the habitats and reproductive lives and survival of the animals.
- Natural habitats - determine/estimate the degree of habitat fragmentation or degradation likely to occur both in qualitative and quantitative terms (i.e. acreage or extent of habitat fragmentation or reduction as well as the reduction in biodiversity and available ecological niches);
- Expected changes in the health of flora and fauna that will result from the introduction of the activity. This must include any expected changes to species count and diversity within the study area. The assumptions used for making such correlations must be explained;
- Spread of noxious or invasive species
- Wildfires or Accidental Fires
- Increased road access to previously uninhabited area leading to destruction of existing vegetative cover.
- Disturbance of aquatic resources during construction, operations, or maintenance activities, including equipment noise, erosion and sedimentation, vehicular movements
- Loss of habitat, migratory routes/corridors, and breeding areas due to changes in vegetative cover/wetlands loss.
- Poisoning (e.g., air emissions, direct contact with toxic water/substances)
- Animals attracted to garbage and food waste at construction camps or onsite facilities.
- Overall assessment of significance of direct, indirect and cumulative impacts for all phases of the proposed project based upon analysis of magnitude, frequency, scope and duration in context.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

18: NOISE AND VIBRATIONS

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS

The baseline shall present, assess and discuss:

- Ambient noise and vibration levels representative of the present study area supported by relevant data on:
 - Peak and average sound pressure and vibration levels.
 - Background noise and vibration levels.
 - Data on ambient sound pressure level and vibrations from readings taken for morning and afternoon and a range of descriptors used to ensure the respective areas are adequately characterized.
 - Long-term baseline noise monitoring at Diamond, Mocha Arcadia and Aubrey Barker, consisting of at least 24-hour periods should be conducted.
 - Identification and Prediction of noise sources closest to noise sensitive receptors closest to all alignments.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

- Employ established methodology and criteria to assess the impact of noise emissions from construction and operational use at sensitive receptors.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

19: TRANSPORTATION

- The scope and level of details required for this medium may varied per location however it is expected that at minimum this medium addresses the following:
 - Site layout, transport access and layout across all modes of transportation;
 - Neighbouring uses, amenity and character, existing functional classification of any nearby road network;
 - Existing public transportation provision, including provision/frequency of service and proposed transportation changes
 - Data on current traffic flow on connectors/links at junctions (including by different modes of transportation and the volume and type of vehicle) within the study area and identification of critical links and junctions on the road network;
 - Analysis of accident records on local roads for the most three- or five years period;
 - Qualitative and quantified description of the travel characteristics of the proposed deployment, including movement of all modes of transportation that would result from the development and in the vicinity of the site; and
 - Parking facilities in the area and the possible parking strategy for the proposed road development.
 - Potential for inclusion or consideration in road plan- bypass, bicycle lanes, road vending, resting areas etc.
 - A traffic management plan

20: WASTE MANAGEMENT

KEY RELEVANT POLICY, LEGISLTATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS AND ENVIRONMENTAL IMPACTS/MITIGATION

Describe and assess the expected waste streams (hazardous and non-hazardous) from the proposed project activities onto the land during the construction and operational phases of the road. This will include information on:

- The quantity, form (liquid, solid, gas), hazard, and toxicity of each significant waste stream, as well as any attributes that may affect its likelihood of dispersal in the environment, as well the associated risk of causing environmental harm.

- The handling, storage, treatment, and disposal of waste generated.
- The introduction of increased dangers (e.g. fire, explosion, spills, chemical and other hazardous substances, if applicable) to the surrounding environment, including neighbouring/adjoining communities;
- Mitigation measures to reduce all associated risks arising from waste streams.
- Monitoring protocol for the management of waste (hazardous and non-hazardous) utilizing the 3-Rs (Reduce, Reuse, and Recycle) and hierarchy for waste management.

Further, the proponent should:

- Identify the skill set and qualifications of the personnel responsible for waste management.
- Establish and develop a spill prevention, cleanup and emergency response plan.

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.

2.1: LANDSCAPE AND AESTHETICS

- The key aim of this section is to identify and evaluate the existing landscape of the site and surrounding area, include the individual elements that characterize the landscape. The landscape impact assessment should describe the likely nature and scale of changes to individual landscape elements and characteristic, and the consequential effects arising from the development.

22: SOCIO-ECONOMIC IMPACTS

KEY RELEVANT POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

BASELINE CONDITIONS

- The baseline will describe the social and economic baseline of the project. Representation of the baseline conditions will be relevant to the proposed project's area of influence, as it relates to its potential biophysical and socio-economic and cultural impacts. This may be achieved through the collection, reporting and analysis of appropriate and sufficient data from relevant sources (including Census data, information from Neighbourhood Democratic Councils, local government, community-based organizations, Town Council) and primary research. Primary research must be highly participatory, particularly representative of women and men and vulnerable groups such as children, youth, elderly and Persons with Disabilities (PWDs). Map overlays (depicting communities/households within the areas of potential impact, including those pending relocation) should be used to provide a spatial portrayal of socio-economic data. Field studies shall be undertaken to fully establish an appropriate social baseline, and to update information that may no longer be current. Appropriate data gathering methods shall be used commensurate with the level of detail required to determine risk to socio-economic components.
- The social baseline shall include, but not be limited to, the following information:
- Description of demographic, economic, and social data which should be disaggregated by sex, age groups, minority or special needs groups (such as Persons With Disabilities (PWDs), informal settlers, immigrants). Information should reflect:
 - Total population of the project Area of Influence (both present and projected)
 - Population density of the project area
 - Number of households by sex of household head
 - Labour force participation, employment and occupation (Analyse the local labour force and the potential of engaging community groups in the construction)
 - Crime and violence
 - Prevalence of poverty

- Information about the existing, proposed, and potential land use (e.g. housing developments) in the project's area of influence identified above, and the nature, size, location and duration of their potential interactions with the environment. Land use shall be described both for amenity and aesthetics, and in terms of its importance to economic activities.
- Issues relating to squatting and resettlement (participatory consultations must be observed and reported).
- Customs, aspiration and attitudes - indicate (by providing documentation) the acceptability of the proposed project to nearby communities and users of the area;
- Baseline data of existing public utility infrastructure to assess the impacts of the project on these utilities.

SOCIO-ECONOMIC IMPACTS AND MITIGATION MEASURES

The EIA Study shall describe the likely impacts (positive and negative) of the project on the economies materially and communities impacted by the project. The analysis shall include but not be limited to the following:

- Community (health, safety, socio-cultural);
- Investigate possible effects to demographic and socio-cultural profiles of the communities that would be potentially affected by the project e.g. consider neighbouring farmlands, local employment and training, local procurement, vulnerable groups (youth and elderly, handicapped, other users of the area etc.), transport, health services, security etc. The potential for unplanned settlements, overloading of municipal infrastructure and social conflict between workers and communities, and the potential for the project to result in displacement/relocation of community members and/or services should also be included;
- Infrastructure and utilities (roads, bridges, water, electricity, services, waste disposal). Consider the indirect impact of accessibility of this area to humans and the attendant demand on infrastructure and utilities;
- Impact of the project on transportation planning and traffic. Discuss the potential health and safety impacts due to changes in traffic conditions, such as increased volumes and increased incidence of large/heavy vehicles;

CUMULATIVE IMPACTS

- Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects.
- Assess projected land uses. Investigate future developments with GLSC and CH&PA.
- Socio-economic impacts of future road expansion.

23: HEALTH IMPACTS ASSESSMENT

KEY RELEVANT POLICY POLICY, LEGISLATION, GUIDELINES, STANDARDS

This aspect of the ESIA will provide details on the national and international policies and legislative, regulatory and planning framework governing Water Quality and Standards.

HEALTH IMPACTS ASSESSMENT AND MITIGATION/ENHANCEMENT

Based on the data collected and generated during the EIA process, a Human Health Impact Assessment should be conducted to help predict the potential effects of the projected on selected health issues. The assessment will look at both the potential for positive health benefits to accrue, as well as the potential for the project to result in adverse health consequences. Health impacts can include:

- Risks of day and night time noise on human health;
- Health risks of relocating homes to accommodate the road;
- Projected rate of human fatalities and injury resulting from construction and operation of the roads during the day, night, Rainy and dry periods;
- The introduction of increased dangers (e.g. fire, explosion, spills, chemical and other hazardous substances, if applicable) to the surrounding environment, including neighbouring communities; and
- Health assessment is to include the Occupational safety and health of all construction workers.

Proponent should ensure that strong definitions are developed to characterize the anticipated effects.

Appropriate mitigation and enhancements must be determined, with the objective of minimizing potential adverse health effects and enhancing health benefits, where possible.

CUMULATIVE IMPACTS

Cumulative effects which are likely to result from the project in combination with other existing, approved and other ancillary projects

24: HUMAN AND HUMAN HEALTH RISKS ASSESSMENT

A Human Health Risk Assessment should be conducted to assess the potential for human exposure to environmentally mediated chemical contaminants, and to predict the change in health risks that could occur. This assessment should bring together information collected on the population that are exposed, the dose to which they are exposed, and the toxicity of the substances, to provide an estimate of the human health impacts that could be expected from the development. Health risks to consider are:

- Projected vehicular density the impacts of vehicular chemical pollutants eg NOx, VOCs, carbon dioxide to human health.
- Road side pollutants on human health, eg deposition of heavy metals adjacent to roads on food sources, crops and fruit trees cultivated in proximity to the road.
- Discuss the potential for changes to air quality that might increase human exposure to contaminants/pollution including the impacts of the increased volume of dust and the potential health impacts associated with exposure to these contaminants/pollutants. Information generated from air quality modeling and dispersion can be incorporated in assessment.

25: RISKS AND RISK ASSESSMENT

Risks and Risks Assessment must be devoted to identifying the major hazards; that is using and analyzing data gathered (including meteorological, hydrological and geological hazards) in terms of their nature, frequency and magnitude. Each hazard must be assessed and characterized by triggering factors, degree of severity, spatial occurrence, duration of the event and their relationship. These hazards can be natural or man-made or a combination of both.

26: LAND ACQUISITION AND RESETTLEMENT

This chapter must outline the proponent's Resettlement Action plan, providing full details of the resettlement process, likely impacts and mitigation measures. There must be a complete census of people affected by the project and an assets inventory of their property.

The Resettlement Action Plan should include, but not limited to:

- The team of social consultants coordinating the resettlement process

- Procedures to be followed and actions taken to mitigate adverse effects
- Eligibility and valuation of losses and compensation entitlements
- Stakeholder engagement
- Housing and social services
- Organizational responsibilities- demonstrating that the resettlement team is suitably qualified
- Resettlement schedule
- Budget
- Monitoring, evaluation and reporting

27: APPENDICES AND ADDITIONAL INFORMATION

Environmental assessment requires interdisciplinary analysis. Experts in their relevant fields should interpret information obtained and where necessary, appropriate references and technical/scientific analyses shall be provided to support such interpretations. This shall also apply to social issues, especially when dealing with sensitive matters.

An environmental impact assessment shall be submitted for public comment in accordance with Section 11 (10) of the EAct Section 11(10) stipulates a period of not less than sixty (60) days to receive public comments and this EIA and EIS would be made available for such comments as part of an administrative record.

In order to aid the review process, the following information should be submitted to the EPA:

- Four (4) hard copies and one (1) digital copy of the EIA report to be submitted to the EPA in the first instance for preliminary review. If the EPA is not satisfied with the original submission, the documents will be returned to the Proponent to address these concerns; If the submission is deemed acceptable, the proponent will be requested to submit a further 21 hard copies and two (2) digital copies of the EIS;
- Digital copies of the EIS should be in PDF format and the Executive Summary in Microsoft Word. Each Module/Volume of the EIS and each Appendix must be individual PDF files; all spatial and mapped data required must be provided digitally in a GIS format compatible with ArcView 9.3.

These will be copied and used for the public comment process, as well as being available to other departments/agencies that would have a critical role in the evaluation of the EIS.

Appendix 2 : List of Plant and Machinery for Project Construction

S. No.	Equipment
1.	Dozer
2.	Tractor (Trolley / Ripper)
3.	Tippers
4.	Hydraulic Excavators
5.	Motor Grader
6.	Vibratory Roller
7.	Tandem Roller
8.	Front End Loader
9.	Bitumen Distributor
10.	Hydraulic Broom
11.	Air Compressor
12.	Water Tanker
13.	Plant for GSB and CRM
14.	Hot Mix Plant
15.	Paver Mechanical / Sensor
16.	Truck Trailer – 60 T
17.	Concrete Mixer (Weigh Batch)
18.	Crane – 10 T , 40 T
19.	Vibratory Pile Hammer
20.	Hydraulic Pilling Rigs
21.	Batching Plant
22.	Transit Mixer – 4 cum
23.	Concrete Pump
24.	Bentonite Pump
25.	Light Crane
26.	Jacks – 40 T

Appendix 3:

Stakeholder Consultation

Questions and Concerns

Questions & Concerns – East Bank-East Coast Road Linkage Project				
Public Scoping Meeting-Diamond (Jan. 10, 31), Georgetown (Feb. 03) and Ogle (February 09, 2019)				
Waste Management	Project Design/Alternatives	Drainage System	Socio-Economic Impacts	Other
<p>-Waste Management Plan should be included in the EIA Report. It should clearly define the roles of each person involved in it and the Hierarchy of Waste Management should be considered.</p> <p>- Excavated waste must be managed properly</p>	<p>-Inquiries were made on why some parts of the road will be 4 lane and some parts will be 2.</p> <p>-It was mentioned that Haags Bosch Road and the Diamond/Grove Road should be improved since they will be connectors.</p> <p>-The Diamond Grove Road should be extended into four-lanes.</p> <p>-A round-about should be placed at the intersection between Mandela Avenue and Aubrey Barker Road</p> <p>-Shoulders along the corners of the Diamond/Grove road.</p> <p>-Road Linkage should stop at Moca Arcadia and not extend into Diamond.</p> <p>-Anticipating future development the road should be 6 lanes rather than 4 lanes.</p> <p>-More connectors around Diamond and Grove are needed to connect further up the East Bank, as far as, Soesdyke if possible.</p>	<p>-The impacts the project will have on the existing drainage system. Water should be able to flow through the canal during and after construction of the project.</p> <p>--Impacts on the trench running parallel to the Ogle Airstrip Road arising from the project, should be considered in the EIA study</p> <p>-Impacts arising from filling the old navigation canals should be studied</p> <p>-Considerations must be taken to ascertain the impacts of filling the swampy cane fields since they may be catchment areas.</p> <p>-During excavation, drainage systems must not be disrupted.</p>	<p>- There should be a police station on the highway for security purposes.</p> <p>-All communities that will be directly or indirectly affected by the project should be consulted including Grove and communities on the West Coast of Demerara.</p> <p>-Consider the increase in traffic at each connectors so they can be improved accordingly.</p> <p>-Trucks should not be allowed to access the Diamond/Grove Main Road.</p> <p>-How will the project affect the Linden/Soesdyke Highway and the road between Grove and Timhen?</p> <p>-Recommendations were given on methods that can be used to better mobilise the public.</p> <p>-Measures should be taken to ensure road safety for children using the road.</p>	<p>-It was recommended that future development around the site location should be considered. Buffer zones between road and potential house lots need to be adequate to allow for future expansion</p> <p>-A risk assessment needs to be included in the study and the direct and indirect impacts should be clearly defined.</p> <p>-A request was made for the study to include statistics and quantifiable values along with an Economic Assessment.</p> <p>-The direction of traffic that will most likely use the Diamond/Grove Road should be studied.</p> <p>-The impacts the project will have on the proposed location for RUMACEL should be taken into consideration</p> <p>- It was emphasized by residents that consideration must be taken during</p>

	<p>-The road running parallel the Diamond/Grove Road should be developed and used to reduce traffic congestion.</p> <p>-The load road next to DDL can be used as an alternative access road.</p> <p>-Long-term improvements need to be carried out on the Aubrey Barker Road, especially if a large number of vehicles will be traversing on it to access Georgetown.</p>		<p>If the width of Diamond/Grove Road should be expanded, this should not affect vendors or be too close to houses.</p> <p>- The reserve that is suggested to be developed as a connector run through private properties, hence, there is a need for an alternative option.</p> <p>- Inquiries were made on whether or not the compensation plans for the residents whose house lots will have to be used to facilitate the project, will be made available to the public.</p> <p>- Inquiries were made on whether or not traffic will still build up on the Green Field Highway and if there will be need for traffic police.</p> <p>-Residents of the squatting area behind Aubrey Barker Road should be consulted since their houses may have to be moved to facilitate the extension of the road</p>	<p>construction to control the various pollution arising from the activity from affecting them.</p>
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Attendance Sheets of EPA Sector Scoping meeting of Stakeholders on December 17, 2018 at Critchlow Training College Boardroom, Georgetown



EPA Sector Scoping Meeting for the East Bank-East Coast Road Linkage Project
Registration Form 2018

Date: December 17, 2018

Venue: Critchlow Training College Boardroom

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Linden Isles	" " "	Traffic Officer	627-3423	Linden.Isles@yahoo.com
Michael Harding	EPA	Environmental Officer	225 5467 ext 230	m.harding@epa.gov.gy
LAUREN SIMPSON	EPA	Legal Assistant	2256044 Ext 228	lbn.som91@gmail.com
Omeanna Finch	Critchlow Labour College	student	601-5481	"
Kresha Seales	Critchlow Labour College	student	685-2273	
Denise Simms	UG	lecturer	639-4610	denise.simms@aog.edu.gy

Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on January 09, 2019 at Better Hope Community Centre , Georgetown



EPA Public Scoping Meeting for the East Bank - East Coast Road Linkage Project
Registration Form 2019

Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
Shanfah Razack	EPA	Director		
K. Pausam	EPA	Director		
Kaethia David	EPA	EO II	225 0506 ext 262	
Richard Jaydeo	TUG	Camerman	688-6662	
Sammand garrison	G.W.I	ASSISTANT REGIONAL MANAGER	691-0709	
del jervis	La Rais./Man Repos NDC		643-2661	anurje@yahoo.com
J. Rander	BV/NDC	Typist	671 9611	-



EPA Public Scoping Meeting for the East Bank - East Coast Road Linkage Project
Registration Form 2019

Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
Ross Sullivan	EPA	SEO		Sullivan.ross@epa.gov.gy
Khadija Ali	EPA	EO II		khadijaali24@yahoo.com
LAUREN SAMPSON	EPA	Legal Assistant	2256044 Ext. 228	lbn.sampson@gmail.com
Vidyanand Mehabir	EPA	Env. OFFICER	225-5467	vmehabir@gmail.com
Salqa Zaman	EPA	Env OFFICER		salqazaman0@gmail.com
Candace Thompson	EPA	SEO	225-5467	cthompson@epa.gov.gy
Tricia Noble	EPA	Env. OFFICER		tricianoble24@gmail.com
Susan Rodriguez			685-3794	446 Baranoff St S/R/G



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Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
John Scandaloffe	Unicomex	Director of Logistics	600 0856	john-scandaloffe@unicomex.com
K. Pausam	EPA	Director		
C. Adams	EPA	SEO - EXT 224		
T. Noble	EPA	Environmental officer		tricianoble24@yahoo.com
Akil Jervis	(NDC) Man Repos/La Recon.	Councillor	643-2661	anurje@yahoo.com
MR. ROACH			680-7307	
O Telhan			691 6663	
H/W - R/h			216 2462	

Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on January 09, 2019 at Better Hope Community Centre , Georgetown



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Name	Organisation	Designation	Contact Number/s	Email Address
Ravi Jagan Narain	E.P.A.	Driver	#6967189	—
Sharim Khan	Carbons Industries Ltd.	Assistant Sales Manager	627-8583	salesmanager@gafesva.gy
Jurell Pedro	GRACE	Pharmacist	6171081	jurellpedro@gmail.com
Rozanne Petro	GP&C	Medical Social Worker	667-5286	amberkluher@gmail.com
Kester Hinds	MOPI	Manager	624-0725	kester-hinds@gmail.com
G. Vaughn	MOPI			
A. Pelletier	MOPI			
K. Lucas	MOPI	Environmental Officer	621-9750	Kevvy.lucas@gmail.com



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project

Registration Form 2019

Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
LAUREN SIMPSON	EPA	Legal Assistant	6-	lbr.simpson@gmail.com
Dwayne Bancroft	EPA	EO II		dwayne.bancroft@gmail.com
WENDY CHICHESTER	NEW DIAMOND/GEORGE PRIMARY	H.M.	684-7980	misswendyc@yahoo.com
Rang Sullivan	EPA	SFP		
Chetana George	Banks DEH	Medical Technician	656-7347	chetana.george@gmail.com
Taramatte Poshob			619-5182	
Robin Wilson	New Diamond Grade Primary	Teacher	690-9730	robin.wilson@caricom.gy
Olga Ado	CARICOM Secretariat	Senior Project Officer	622 0005	olgaado@caricom.gy



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project

Registration Form 2019

Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
Imvan Baksh	MOPI	Design Engineer	69623-1146	imvan-baksh89@yahoo.com



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project

Registration Form 2019

Date: January 9, 2019

Venue: Better Hope Community Center

Name	Organisation	Designation	Contact Number/s	Email Address
ERIC BENJAMIN	Resident Design Perspectives	CEO	681-9366	ericbenjamin1971@hotmail.com
Saliga Zaman	EPA	EO		slpguyana@gmail.com

Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on February 01, 2019 at North Ruimveldt , Georgetown



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project
Registration Form 2019

Date: February 1, 2019

Venue: North Ruimveldt Multilata

Name	Organisation	Designation	Contact Number/s	Initials
DR. HERBERT MALONEY MD	ENVIRONMENTAL H. OFFICER	U-G SURVEYS	618 7732 - 2184111	MDL
Akeem KPT Brown			674-2227	Akeem
Orlando Ogle			672 7244	Orlan
Ham Hope			641 7998	
Geoffrey Vaughn	Ministry Public Infa.	Coordinator	623 5004	gvaun
Jemaine McInnes			639-0909	jmcp
Doreen L. Tucker			626-8262	dnv
Nickcosie Paul	GSO East Ruimveldt		691-8120-641-5114	scfied



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project
Registration Form 2019

Date: February 1, 2019

Venue: North Ruimveldt Multilata

Name	Organisation	Designation	Contact Number/s	Initials
Ram Singh		Businessman	617-8908	Ran
Shmika Kendall			603-9821	Shm
Shon Ferrister			674-9561	Shon
Bhemarie Griffith			649 - 6699	Bhemar
Alcina Johnson			608 - 0948	Alcinjo
Nigel Duke			677-0802	Nigel
Saliga Leman	EPA.	EO	643-5494	salig
Marcia Hiles			647-4266	Marcia

**Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on February 01,
2019 at North Ruimveldt , Georgetown**



EPA Public Scoping Meeting for the East Bank-East Coast Road Linkage Project
Registration Form 2019

Date: February 1, 2019

Venue: North Ruimveldt Multilane

Name	Organisation	Designation	Contact Number/s	
Michael Harding	EPA	EO1		m-h
Kevin Lucas	MOPI	Env. Officer	621-9750	Kevin
Nigel Erskine	MOPI	Tech. Services Manager	666-2362	Nigel
Shenlynn Overton			648-7502	S.O
RAJENDRA SOTHWAL	RITES LTD	DGM Civil Highway & Traffic Engineer	679-7050	rajisc
Gwenetta Fordyce	EPA	EO11	647-0677	gfo
B. Chintanovic	Triple C County	CEO	616-6157	triple
Levi Sarranaru	E.P.A.	Driver	6967187	

Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on February 09, 2019 at Ogle Community Centre Ground , Georgetown

East Bank/East Coast Road Linkage Project
Venue: Ogle Community Center Ground
Date: 9th February, 2019 Time: 15:00hrs

Name	Organization	Contact	Email Address
V. Garbarau	-	644 6974	vrishaal.garbarau@gmail.com
Ramesh	-	643 3344	Ramesh@hot.com
LAUREN SAMPSON	EPA	642-2182	lbm.sampson@gmail.com
Kevin Lucas	MOPI	621-9750	kevinlucas@gmail.com
Imvan Baksh	"	623 1146	imvan-baksh@yaho.com
Bissara Chintanaja	Triple 'c' Consultancy	656-6157	bchintanaja@gmail.com
Dayanand Persaud	"	610-4890	dayanand_persaud@yahoo.com
Ladonna Kisson	EPA	225-0506 ext 216	ladonna-kisson@hotmail.com

East Bank/East Coast Road Linkage Project
Venue: Ogle Community Center Ground
Date: 9th February, 2019 Time: 15:00hrs

Name	Organization	Contact	Email Address
Shankar Sahdeo	Ogle Cricket club	655-1884	
Shivnand Gosain	}	626-3855	shivnandgosain@yahoo.com
Dayanand Persaud		653-1671	
Rudranath Kisson		638 14 87	
Mark Sakhai		648-4472	
i			
RAJENDRA SOTHWAL	RITES Ltd	679-7050	rajsothwal@gmail.com
Devin Persaud	Triple 'c' Consultancy	6588672	kellydevin@telwig@gmail.com

Attendance Sheet of EPA Sector Scoping meeting of Public Consultation on February 09, 2019 at Ogle Community Centre Ground , Georgetown

East Bank/East Coast Road Linkage Project

Venue: Ogle Community Center Ground

Date: 9th February, 2019

Time: 15:00hrs

Name	Organization	Contact	Email Address
Damion Sanicharan	—	222-4999	Damionsanicharan ⁰³ @idbud.com
Dominic Helwig	—	6108868	Dominicguyana@helwig@gmail.com
DAVIDRA RAMTAHAL	UC	649527	clawindra_rtl@yahoo.com
BETHESSA JAGRAH		611-0100	30 OGLE EAST COAST RDU
Sanjeer Lalchman	—	627-4061	401 Cummins Lodge

East Bank/East Coast Road Linkage Project

Venue: Ogle Community Center Ground

Date: 9th February, 2019

Time: 15:00hrs

Name	Organization	Contact	Email Address
Ravi L. Narine	E.P.H	6967189	
C. Payne Thomas	EPA	664-6339	
D. Bancroft	EPA	677-2300	
Saliga Laman	EPA	643-5494	
Sileen Randal	—	694-6320	

Appendix 4:

ESIA Team

Bissasar Chintamanie CV

Bissasar Chintamanie



Lot 72, "Block 5"
Hopa
East Coast Demerara
Guyana
South America

Tel: + 592 – 226-2481/3 (OFF) Tel: 592-656-6157(Mobile)

E-mail: bcchintamanie@irites.com and bcchintamanie@gmail.com

Objective

With more than 25 years' experience in the provision of effective leadership, functional and technical advice on climate change, agricultural and sustainable development is my mantra. A Leader analytical studies and policy analysis in a wide range of issues relevant to climate change and the agriculture sector in Guyana. Promoting the understanding of the ecosystems approach in regard to climate change adaptation and mitigation in the agriculture sector; Specialist in irrigation water management, Aquaculture, Pest Management and crop modelling; Leads the production of reports, articles and other resources on climate change and agriculture in Guyana; Experience in Construction and Design; Community Capacity Building through Farmer Field Schools in multiethnic and multi-religious environments in Guyana. Rice Research and Extension Support programme; liaison with Agricultural Research Scientists both locally and internationally conducting Research in relation to Rice and Other Crop and Delivery of Quality Control Services to the Rice Industry of Guyana; Expert in fieldwork, data collection and qualitative data analysis; writing Project Proposals and reports.

Education

Dates	Degree	Institution
2016	PhD - Climate Change and Sustainable Development	2 Year Part Time Student (Columbia University NY) in Collaboration with AIT and IITR
2015	PG Diploma in Public Policy	TERI University, NEW Delhi India
2015	PG Diploma – Rain Water Harvesting and Technology	Mexican Institute of Water Technology (IMTA) Chitre, Panama
2014	PG Diploma in Family Farming	Colegio de Postgraduados Campus Puebla Mexico
2009	Masters of Technology (M.Tech)	Indian Institute of Technology – Roorkee, India
2006	Bachelors of Science (BSc.)	University of Guyana- Guyana
2001	Diploma in Agriculture (Dip. Agri)	Guyana School of Agriculture – Guyana

Special Award

2013 – Ministry of Agriculture – Long Service Award – 20 years Contribution in the Agriculture Sector

2007 – ITEC Scholarship – India – Masters of Technology Degree – IIT, Roorkee

2003 – GRDB Scholarship – University of Guyana

1999- RPA Scholarship – Guyana School of Agriculture

Special Achievement

2017 – Conducted Forty Training Workshops in one Year – Training over 1500 Farmers

2013-2015 – Successfully Demonstrated the Cultivation of Broccoli, Cauliflower and Carrot in open field

2013 – Facilities Coordinator – Caribbean Week of Agriculture (CWA)

2009-2011- Research, Design, develop and manage the First Ever Mangrove Project in Guyana (GMRP)

2009- Research, Design, develop and manage the Guyana Climate Change Agricultural Adaptation Unit – NAREI

Resumé Chronologic CV.

2015-2017 – Development of Climate Resilient Project for the Upper Corentyne Fisherman’s Coop. (UCFCS). UNDP – SGP – Guyana.
 2016- Developed and Published Aquaculture and Fish Processing Manual for the UCFCS

Work Experience

Date	Job Title	Company or Organization	Job Description
2009- Present	Founder/ CEO	Triple “C” Consultancy	Research, Design, Plan, Develop and Implement Programs to advance the Consultancy Firm.
JAN 2008- MAY 2018	Sustainable Forestry Specialist	IDB – SHB Guyana Value of Consultancy USD \$ 65,000	Providing training on Sustainable Forestry to 300 clients in five (5) regions of Guyana.
JAN 2006- Jan 2018	Chief Facilitator/ Trainer	IDB – SHB Guyana Sub-Contractor – Critchlow Labour College Value of Consultancy USD \$ 200,000	Research, Plan, Design and Implement Training Programs for the Farmers and Clients of the Small Business Bureau (SBB)
January 2007 – Present	Academic Director Head of CLC Center for Agricultural and Environmental Studies	Critchlow Labour College	Reports to the Principal/ Board of Governors Main Responsibilities 1. Prepare course outline and syllabus, develop course and lesson plans, and engage in the selection of textbook and other teaching aids necessary to the instruction of courses. 2. Teach pertinent courses subject using lectures, demonstrations, class discussion, and other appropriate modes of educational delivery. 3. Lead and monitor classroom instruction that promote educational and learning process keeping with faculty academic freedom and responsibility. 4. Foster student development. 5. Participate in co-curricular activities such as department colloquia and honors seminars. 6. Maintain laboratories and equipment.

Resumé Chronologic CV.

			<p>7. Serve as academic advisor to graduate and undergraduate students and be available to faculty and students for consultation for questions in ones area of expertise. Pursue on an ongoing basis the continuance of scholarly growth, both within and outside the subject discipline, in the academic profession. Engage in scholarly/creative activity and make results available for critical peer review; Examples may include but are not limited to: development of experimental programs; delivering papers at professional association meetings at regional and national levels; regional and national awards, holding office in professional organizations; presentations; participating in panels at regional and national meetings of professional organizations; grants acquisitions; editorship of professional journals; participation in juried shows; program related projects; consulting; research project and publication record; additional graduate work; and contributing to the scholarly growth of one’s peers</p> <p>Foster education for service by contributing professionally to department and school governance outside the classroom for the School and community at large, in a participatory, developmental, or advisory capacity. Examples include but are not limited to: quality of participation of programs, department, school, and University committees; Agricultural activity contributing to School governance; development of new courses, programs, colloquia, lectures, and consultations; voluntary membership in profession and community-based organizations reasonably related to the discipline; lectures, consultations, consulting with local and area agencies and organizations; support and participate in student organization activities.</p>
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CURRICULUM VITAE (CV)

Position Title	Team Leader cum Senior Highway Engineer
Name of Expert:	Sudershan Kumar Popli
Date of Birth:	17/03/1962
Country of Citizenship/Residence:	India

Education:

Names of Educational Institutions	Dates attended	Degree(s)/Diploma(s) obtained
School of Planning & Architecture (SPA), Delhi	2003-05	Masters in Transport Planning (Transportation Engineering)
Board of Technical Education, Delhi	1987-88	Post Diploma in Business Administration (PDBA)
Institution of Engineers, India	1983-86	AMIE (Graduation) in Civil Engineering
Board of Technical Education, Delhi	1980-83	Diploma in Civil Engineering
Institute of Electronics and Telecommunication Engineers, Delhi	1988	Certificate Course in Computer Applications
Professional Trainings relevant to the Assignment:		
Institution of Engineers, India	18 Mar 2017	Safety during Working at Heights
Ministry of Road Transport & Highways	25 Oct 2016	National Workshop on Road Safety Engineering
Institute of Urban Transport	8-11 Nov 2016	Planning Mobility for City's Sustainability
TRIPP, IIT Delhi, India	29 Jul-2 Aug 2016	Planning & Design of safe transport infrastructure
Institute of Urban Transport	24-27 Nov 2015	Transforming Mobility for Liveability
International Road Federation	5-6 Oct 2015	Road Safety Initiatives: Status and the way forwards
International Road Federation	15-16 Jan 2015	Status of Road Safety and Safe Mobility initiatives
International Road Federation	3-5 Oct 2013	Road Infrastructure for Safe Mobility
College of Traffic Management (CTM)	15-15 Dec 2012	Training on Motor Vehicle Legislation
International Road Federation (Indian Chapter), New Delhi	01-02 Nov 2012	7th Regional Conference on Road Safety in Urban and Rural Roads
International Quality & Productivity Centre - Bangalore	27-28 Feb 2012	Conference on 2nd Annual Intelligent Transport Systems
Central Road Research Institute, New Delhi	17-20 Aug 2011	Training on Road Safety Audit by CRRI, Jaipur
NITHE at Noida (U.P.)	20-26 Jun 2011	Training on Road Safety Audit
International Road Federation	14-18 Feb 2011	Certification course for Road Safety Auditors
Institute of Engineers (India)	28-30 Dec 2010	Safety Convention 2010
Punjab Roads and Bridges Develop. Board	19-21 Mar 2008	Seminar on Road Asset Management
Central Road Research Institute, New Delhi	08-19 Oct 2007	Training on HDM-IV
Indian Road Congress	02-04 Sep 2006	Innovation in Construction and Maintenance of Flexible pavement
Institute of Engineers (India)	2005	Safety Convention, Challenges of Occupational Safety & Health
NHAI, New Delhi	2002	World Bank workshop on "Grand Trunk Road Improvement Project"
Asian Institute of Transport Development (AITD), New Delhi	2002	World Bank seminar on "Impact of Four Lining of Highways on Poverty Alleviation"
CRRI, New Delhi	2001	Road Safety Audit of Highway Engineering Design
NITHE, New Delhi	1989	Bituminous Construction and Pavement Evaluation

Membership in Professional Associations:

- Life Fellow, Institution of Engineers, India
- Member, Indian Roads Congress
- Life Member, Institute of Urban Transport
- Associate Member, Institute of Town Planners, India

Employment record relevant to the assignment: Jun 1987 - Present

Title/ Position	Summary of activities performed relevant to the Assignment
Employing	Over 33 years of experience in the field of Design and Construction Supervision of

Title/ Position	Summary of activities performed relevant to the Assignment
<p>organization: RITES Limited (Permanent Employment) And Title/Position: Additional General Manager / Joint General Manager / Dy. General Manager / Manager / Assistant Manager</p> <p>(as Team Leader/ Sr. Highway Engineer / Sr. Traffic Engineer / Pavement Specialist / Road Safety Engineer/Road Safety Auditor/ Transport Specialist on various Highway projects)</p>	<p>Highways, Traffic & Road Safety Engineering covering planning, investigations, design, construction supervision. Project preparation for Feasibility Studies and Detailed Engineering Design for major Expressways, International Highways, National highway projects, feeder roads and low volume roads. Major thrust areas encompass field studies for highways, traffic studies (characteristics and projections), formulation of designs, highway geometric design, interchange/ intersection design, traffic features and safety measures, feasibility & DPR project preparation, costing, contract documents (ICB) and technical specifications, concession agreements, bid evaluation and negotiation for award of contracts. Well familiar with modern techniques of traffic and safety management, accident analysis, black spot identifications, safety engineering, road design safety audit, construction work zone audit, safety awareness workshops, road asset management, road safety policy, road safety trainings, transport planning, traffic management etc. Possesses rich experience for working in projects funded by International Lending Agencies viz. WB, ADB, AfDB, JICA, ITEC, EXIM Bank, etc. involving FIDIC conditions. Countries of work experience include India, Nepal, Botswana, Kenya, Guyana and Myanmar.</p> <p>Experience in design and preparation of Feasibility Report, Preliminary Project Report (PPR), Detailed Project Report (DPR) and Detailed Design Report (PDR) for major Expressways/highway projects adopting international practices and Standards.</p> <ul style="list-style-type: none"> ☛ Planning, Investigations, Design and Project Preparation for Feasibility Studies and Detailed Engineering Design for major Expressway/highway projects <ul style="list-style-type: none"> ☐ Topographic Surveys and Pavement Investigations ☐ Traffic studies (characteristics and projections) ☐ Geometric Design in Plain and Mountainous Terrain ☐ Grade Separated and At-Grade Intersections ☐ Rate Analysis, Quantity Calculations, Costing and BoQ ☐ Economic Analysis using HDM-IV and financial Analysis ☐ Preparation of Project Reports, Specifications and Bids ☛ Road Safety Engineering and Road Safety Audit <ul style="list-style-type: none"> ☐ Road Safety audit (familiar with modern techniques of traffic and safety management) and Installation ITS ☐ Design Stage Safety Audit of Traffic Management Plan, Cross Sections, Geometric Design, At-grade Junction, Grade separated junction, Interchanges, Pavement markings, Traffic signs, Road studs, Lighting, Impact attenuators, Intelligent Transport System, Provision for Vulnerable road users, Provision for road side facilities, etc. ☐ Existing Road Safety Audit/Inspections, Review of Road Geometry, Intersections, Review of Adequacy of Road Signs, Markings and Medians, Provisions for Vulnerable Road Users ☐ Accident Data Collection & analysis, Identification of high-risk section on the road, identification of Black spots, GIS Mapping ☐ Suggesting Long term/short term mitigation measures, Traffic Calming measures, prioritization of implementation, costing, etc. ☐ Formulation of Road Safety Management Plans, Polices and Safety Codes for existing and new roads ☛ Construction Supervision of Expressways and Highways as Independent Engineer, Authority Engineer, Safety Auditor, Quality Auditor, etc. <ul style="list-style-type: none"> ☐ Issue/ Review of Good for Construction Drawings ☐ Supervision of construction of pavement, structures, interchange, intersections, bus bays, pedestrian facilities, traffic signs and pavement markings, etc. ☐ Quality Assurance /Quality Audit during Construction ☐ Traffic Diversions, Barricading, PPE, HSE during construction ☐ Provision of facilities for pedestrians and slow moving traffic ☐ Pavement markings, traffic signs and ITS ☐ Tolling and Road User Facilities, pre-opening safety Audit ☛ Well familiar with modern techniques of traffic and Safety management, design and Knowledge of MS Word, MS Excel, MS PowerPoint, HDM IV, Asset Management Systems, Maintenance Planning Systems, etc.

Publications:

- **Popli, Sudershan K**, Presentation on “Road Safety Audit- A case study of NH-1”, workshop on “Safety Traffic Management of National Highways” at Karnal, May 2003.
- **Popli, Sudershan K.**, *Traffic Calming on Highways- An Overview*. Presented at Safety Convention in Transportation from 27-29 September 2005 at New Delhi. The Institution of Engineers, New Delhi
- **Popli, Sudershan K, & .Sharad Mohindru**, *Safety Aspects in Road Features Design*, paper was presented at National Conference on Sustainable Urban Transportation(SUTRIMS 07) at NIT Surat, India
- **Popli, Sudershan K.**, *Intelligent Transport System (ITS) Applications for Safety on Highways*, presented at Safety Convention on Ensuring Safety in Transportation Sector for Sustainable Economic Growth, 11-13 September 2008 at New Delhi., Oorganized by Safety and Quality Forum, The Institution of Engineers.
- **Popli, Sudershan & K. Gupta, K.K** “*Safety Audit of National Highways – Application of Geospatial Technologies*”, presented at International Conference of India Geospatial Forum 2012 from 7 – 9 February, India.
- **Popli Sudershan K.**, “*Road Safety Experiences and best practices from South Asia and Other Regions*”. The paper was presented in **International Seminar on Road Safety, organised by Roads Board Nepal and Nepal Integrated Research and Development Foundation on Jan 5, 2014, Kathmandu**
- **Popli Sudershan K., Janwari Mohsin, GeetamTewari & Mir S M – Traffic Analysis of Srinagar City**. The paper was presented at 11th TPMDC International Conference at IIT Bombay from Dec 10-11, 2014, Mumbai
- **Popli Sudershan K.**, “*Pavement Maintenance Management to Enhance Safety on PPP Projects*” *presented at International Conference on Trace 2016, August 11-12, 2016, Amity University Uttar Pradesh, Noida, India*
- **Popli Sudershan K & Bains Manraj Singh**, “*Safety Audit of Pedestrian Safety Measures at T-junction, at IUT conference on “Planning Mobility for City’s Sustainability” November 8-11, 2016 at Ahmadabad, India*
- **Popli Sudershan K.**, “*Accident Prevention on Toll Roads by Intelligent Transport System*” *presented during “Workshop on Intelligent Transport System-A Game Changer “by Whiz Abstractsat New Delhi on January 18, 2017*
- **Popli Sudershan K.**, “*Safe Working at Height during Construction of Highway Structures*” *presented on March 18, 2017at “Workshop on Safety during Working at Heights”, The Institution of Engineers (India)*
- **Popli Sudershan K. & Krishnamurthy V** “*Safety Audit of Multi Lane Highways*” *presented during “All India Seminar on Road Safety Challenges & Solutions, The Institution of Engineers (India) on June 24-25, 2017*
- **Popli Sudershan K.**, “*Black Spots Management*” *published at National Conference on “Challenges on Road Sector and New Technology”, 8-9 December 201, Lucknow*
- **Popli Sudershan K.**, “*Traffic Management –A challenge in EPC mode of Project Implementation*” *published at All India Seminar on Application of EPC Contract in Highways: Opportunities & Challenges, IEI, 21-22, July 2018*

Language Skills: English, Hindi and Punjabi

Projects Undertaken: June 1987 to Present

Sl #	Project Title
1.	Consultancy Services for Feasibility Study, Detailed Design and preparation of Detailed Project Report for East Bank-East Coast Road Linkage Project , Georgetown, Guyana- In Progress
2.	Project: Consultancy Services for Feasibility Study, Detailed Design and Preparation of Detailed Project Report of selected road NH stretches (i) Bagdora on NH 27 – Mirik – Darjeeling – Kalimpong – Redong – Thode – Metali – Chalsa near NH-31C (238) (ii) RajabhatKhawa near NH 317 – BuxaDuar (15km), (iii) Kakdwip (NH 12) – Gangasagar (28 km) (Package- NHAI/2TR/26)
3.	Study on Development of 50 years National Master Transport Plan for Kenya (World Bank Funded)
4.	Consultancy Services for preparing Detailed Project Report (DPR) for 2/4/6 laning of under Tamil Nadu Road Sector Project – II (TNRSP II) Contract PPC01: 413 km
5.	Preparation of Feasibility cum Preliminary Design report and to provide Technical Assistance to develop Ahmedabad-Dholera six lane Expressway (Greenfield Development)- 116 km
6.	Consultancy Services for Detailed Design and Preparation of Detailed Project Report including Bid Documents for Chaungma – Lingadaw section (Length – 73km) of Trilateral Highway in Myanmar
7.	Detailed Design of Automotive Test Tracks at NATRAX/Pithampur (Automotive Test Tracks for 55km length) GARC/Chennai (Automotive Test Tracks for 12.55km length, and ICAT/Manesar Centres of NATRiP, India
8.	Consultancy Services for Feasibility and Pre Tender activities for Construction of 8-lane Versova – Bandra Sea Link Project in Mumbai, Maharashtra (approx. Length 10Km) as BOT (Toll)
9.	Construction Supervision as Project Management Services (PMS) for Civil and Utility works at GARC/Chennai (Automotive Test Tracks for 12.55km length, NATRAX/Pithampur (Automotive Test Tracks for 55km) and ICAT/Manesar Centres of NATRiP, India
10.	Preparation of Feasibility and DPR of 4 laning of Varanasi-Hanumanha-NH-7, 125.5Km on DBFOT mode (on EPC mode)

11.	Preparation of Feasibility and DPR of 4 laning of Unnao to Lalganj of NH-232A (68Km), on DBFOT mode (on Hybrid Annuity mode)
12.	Preparation of Feasibility and DPR of 4 laning of Lucknow to Raibareilly-NH24B, 82km on DBFOT mode (on Annuity mode)
13.	Preparation of Feasibility and DPR of 2 laning of laning of Narsinghpur – Harrai – Amarwara Road Section of NH 26 B, 89 km on DBFOT mode (on Annuity mode)
14.	Preparation of Feasibility and DPR for 4 laning of NH- 28A (Piprakothi – Molinari Raxaul 67 km) and NH – 57 A (Forbeshganj – Jogbani 13 km) and Access Road 7 km to ICP at Raxaul on DBFOT Basis (on Annuity mode)
15.	Preparation of Feasibility& DPR report for 6 laning of Walahjpet to Poonamlee road section of NH-4 (92 km) in the state of Tamilnadu on DBFO pattern (PPP Mode of execution), India
16.	Preparation of Feasibility and Preliminary Design for 4/6 Laning of, Kandla – Mundra Port road section of NH-8A-Extn (70 km)
17.	Construction Supervision as Independent Engineer of Outer Ring Road (ORR) from Km. 0+000 (Vandalur) to Km. 29+650 (Nemilicheri) on Design, Build, Finance, Operate and Transfer (DBFOT) Annuity basis at Chennai in the State of Tamil Nadu
18.	Construction Supervision as Independent Engineer for construction of 4/6 Laning of NH 47 Salem to Kumarapalayam from Km.0.00 [Km 203.96 on NH-7] to Kumarapalayam (Km 53.00) of length 53.00 on BOT Toll Basis), India
19.	Traffic modelling for Delhi-Gurgaon Expressway to determine the fee to be paid for collection of MCD tax on Toll Plaza at km 24
20.	Feasibility Study, Bid documents and Selection for Project development Consultant partner for setting up a Project Development Special Purpose Vehicle (SPV) for Development of 8-lane fully access controlled Ganga Expressway with closed tolling from Greater Noida to Ghazipur -Balai.(1047Km)
21.	Construction Supervision as Project Advisory Consultant for Construction of Yamuna Expressway from Noida to Agra in the state of Uttar Pradesh, India 165km (BOT basis)
22.	Consultancy Services for Feasibility Study, Detailed Design, Materials Investigation, Pre-contract services and Construction Supervision of Tshesebe-Masunga Road, 58 km, Botswana
23.	DPR for Asian Highway 2 (13km) in plain/rolling in Nepal (ITEC Funded)
24.	DPR for Rajmargs and Feeder Roads for a total length of 656 Km (20 nos. of independent road links) in plain/rolling and hilly terrain in Nepal (ITEC Funded)
25.	Preparation of Detailed Project Report for 4 laning of Naranpur – Harichandanpur – Brahmanipal - Dubri Road (82 km)
26.	Consultancy Services for Detailed Project Report preparation and Construction Supervision of 217 independent project roads of total length of 650 Km Special Rural Connectivity programme in KBK district of Orissa, India
27.	Consultancy Services for Feasibility Study and Detailed Project Report for Four Laning of Harangajo to Maibong(104 km) of NH-54
28.	Project Preparation, Construction Supervision for Road Infrastructure & Planning of Rail Network in Kalinganagar Industrial Complex in Orissa(47 km)
29.	Feasibility study and Detailed Project Report Preparation of 4 laning of 506 km length of NH sections in Gujarat State, India (Asian Development Bank Funded)
30.	Consultancy Services for Evaluation of IDTR Setup during 10 th and 11 th five year Plan and Preparation of Driving Training Manuals
31.	Construction Safety Audit of 4 Laning of Gwalior-Shivpuri Section of NH 3 (110 km)
32.	Design and Construction Safety Audit of 4 Laning of Shivpuri-Guna Section of NH 3 (96 km)
33.	Design and Construction Safety Audit of 4 Laning of Guna-Biaora Section of NH 3 (94 km)
34.	Construction Safety Audit of 4 Laning of Indore-MP Border Section of NH 59 (160 km)
35.	Design and Construction Safety Audit of 4 Laning of Chitradurgah-Hospet Sec of NH 13 (120 km)
36.	Construction Safety Audit of 4 Laning of Chhattisgarh/Odisha Border-Aurang section from Km 88/000 to Km 239/000 of NH-6 (new NH-53) (151 km)
37.	Construction Safety Audit of 2-Lanes+PS of Kanpur-Kabrai Section of NH-86 (122 km)
38.	Design and Construction Safety Audit of 6-Laning of Delhi-Agra Section of NH 2 (179 km)
39.	Design and Construction Safety Audit of 6-Laning of Panipat-Jalandhar Section of NH 1 (296 km)
40.	Design and Construction Safety Audit of 4-Laning of Bahrapore –Farakka sec. of NH-34 (103 km)
41.	Design and Construction Safety Audit of 4-Laning Jaipur-Deoli section of NH-12 (146 km)
42.	Design and Construction Safety Audit of 6-Laning of Kishangarh-Beawer section of NH-8 (90 km)
43.	Design and Construction Safety Audit of 4-Laning Ahmedabad-Godhra section of NH-59 (118 km)
44.	Design and Construction Safety Audit of 6-Laning of Varanasi-Aurangabad Sec. of NH-2 (192 km)
45.	Design and Construction Safety Audit of 4-Laning of MP/NH Border-Dhule of NH-3 (97 km)

46.	O &M Stage Safety Audit of 6 Lanes Dewas-Indore Section and Indore Bypass Section of NH 3 (48 km)
47.	O &M Stage Safety Audit of 4 Lanes Borkhedi - Jam - Wadner Section NH- 7(57 km)
48.	O &M Stage Safety Audit of 4 Lanes MP/MH border to Dhule section of NH 3 (98 km)
49.	O &M Stage Safety Audit of 2 Lane + PS of Meerut-Karnal Section of SH 5 (25 km)
50.	O &M Stage Safety Audit of 2 lane + PS of Durg Bypass section of NH 3 (18 km)
51.	O &M Stage Safety Audit of 4 lanes of NH 1 from Delhi Border to Ambala (183 km)
52.	Third Party Quality Inspection for Construction of Elevated Road over Barapullah Nallah from Sarai Kale Khan to Mayur Vihar, New Delhi (10 km)
53.	Third Party Quality Inspection for Construction of Elevated Road over Barapullah Nallah from INA Market to JLN Stadium, New Delhi (5 km)
54.	Third Party Quality Inspection for Construction of 6 lanes Agra- Lucknow (305 km)
55.	Technical Expert Services to World Bank Projects Division and Corridor Management Division of National Highways Authority of India
56.	Project Coordinating Consultant for North-South corridor phase-II in Delhi, Harayana, Punjab and J & K. for Eight/four laning of NH-1
57.	Preparation of Detailed Project Report for rehabilitation of existing 2 lanes and widening to 4 lanes (15 km) of Tumkur Bypass (NH-4) in the State of Karnataka
58.	Detailed Engineering study including Project preparation for 4-Laning of Chennai – Ranipet – Krishnagiri for a total length of 250 Km of NH 4 & 46
59.	Feasibility, detailed engineering and project preparation for 4 laning of Trindivanam – Tiruchi section for 200 km of NH 45 funded by World Bank
60.	Construction Supervision of 21 major bridges including design (length up to 800m) in the State of Tamil Nadu
61.	Feasibility study report for 600 km long greenfield North – South Expressway in Kerala state
62.	Network Improvement Study for State highways and major district roads for a total length of 2500 Km for the State of Kerala funded by World Bank
63.	Techno-economic feasibility and detailed engineering study for greenfield Ghoti – Sinner expressway (55km) near Nasik, Maharashtra
64.	Network Improvement Study for State highways and major district roads for a total length of 2300 Km for the State of West Bengal funded by World Bank
65.	Detailed project report for strengthening and four laning of Dewas-Indore section (18 km) of NH 3 & 32km long Indore Bypass (Rigid pavement) in Madhya Pradesh funded by World Bank
66.	Construction supervision of bridge across river Sirsiya, rehabilitation of main road & construction of service roads at Birganj, Nepal
67.	Techno-economic feasibility study for Bombay - Pune Expressway (92 km), India's first six-lane concrete, high-speed, access controlled toll highway starts at Kalamboli (near Panvel), and ends at Dehu Rd. (near Pune)
68.	Detailed Engineering study for upgradation from single lane to two lane of NH-51 in Meghalaya in 40 km mountainous terrain
69.	Feasibility and detailed engineering study of Guwahati – Shillong section of NH-40 in Meghalaya (40 km) mountainous terrain
70.	Feasibility study for Moradabad – Kashipur – Ramnagar section of SH in UP, 67 km, Asian Development Bank funded
71.	Feasibility study and detailed engineering for 2-lane to 4-lane including preparation of bidding documents for Chilakaluripet – Vijayawada section of NH-5 in Andhra Pradesh (80 km) funded by World Bank
72.	Feasibility study and detailed engineering for 2-lane to 4-lane including preparation of bidding documents for Visakhapatnam – Anakapalle section of NH-5 in Andhra Pradesh, 46 km, Asian Development Bank funded
73.	Techno-economic feasibility study for upgradation of state highways and MDR(649 km) in U.P., Asian Development Bank funded

Rudy Small, BS, RN, BSN, MS, PMP

Lot 1 Freeman Street, East LaPenitence, Georgetown; Tel: 666-8778; E-mail: Rudy2425@gmail.com

OBJECTIVE

My objective is to secure a position in Environmental Management/Consulting in a high growth industry with advancement opportunities. As a consummate team player, I enjoy working in a fast paced, highly motivating position where I can assist others while challenging and expanding my knowledge and understanding of the task at hand. I am seeking a position that will utilize my skills and offer the chance for advancement as well as allow me the opportunity to gain additional skills and experience.

WORK EXPERIENCE

- 2016-2017** Inter-American Development Bank (IDB)
PROJECT CONSULTANT – Georgetown, Guyana
- 2008 -2016** USHHS – IMMIGRATION AND CUSTOMS ENFORCEMENT (ICE)
ENVIRONMENTAL & SAFETY COORDINATOR – New York Field Office
- 2005-2008** DSSM NURSING & REHAB. CENTER – SAFETY AND OPERATIONS
ASSOCIATE DIRECTOR
- 2003-2005** HARLEM HOSPITAL CENTER – ENVIRONMENTAL MANAGEMENT/
SAFETY
ASSOCIATE EXECUTIVE DIRECTOR (ACTING)
- 2002-2003** HARLEM HOSPITAL CENTER – FACILITIES OPERATIONS
ASSOCIATE DIRECTOR
- 2000-2002** GENERATIONS+ HEALTH NETWORK – REGULATORY AFFAIRS
ASSOCIATE DIRECTOR
- 1997-2000** GEORGETOWN PUBLIC HOSPITAL CORPORATION, GUYANA
DIRECTOR, FACILITIES MANAGEMENT/SAFETY MANAGEMENT
- 1995-1997** MONTEFIORE MEDICAL CENTER – WELER HOSPITAL
INDUSTRIAL HYGIENIST TO THE SAFETY COMMITTEE

1990-1995 **NEW YORK CITY DEPARTMENT OF HEALTH
BUREAU OF DISEASE INTERVENTION
HEALTH AND SAFETY COMPLIANCE OFFICER**

EDUCATION

2004 **POST-GRADUATE DIPLOMA, LEGAL NURSE CONSULTANT
American Association of Legal Nurse Consultants – Chicago, Illinois**

2000 **B.S. NURSING
Dominican College – Orangeburg, New York**

2002 **POST-GRADUATE DIPLOMA, PROJECT MANAGEMENT
University of Pittsburgh – Katz Graduate School of Business**

1995 **MLS. ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES
City University of New York – Hunter College**

1994 **Completed course requirements for M.A., COMMUNITY HEALTH
City University of New York – Brooklyn College**

1989 **B.S. BIOLOGY
Morehouse College – Atlanta, Georgia**

PROFESSIONAL SKILLS

- Project management for a range of environmental processes undertaken for developmental projects
- Identification and assessment of potential negative environmental impacts and benefits through the review and manipulation of data
- Working knowledge of Environmental Planning processes, policies, regulatory frameworks legislation
- Identification of practical and achievable mitigation and management measures and the development of appropriate management plans
- Compilation and review of environmental reports in accordance with relevant environmental legislative requirements
- Undertaking public participation processes for a variety of projects
- Environmental compliance monitoring
- Site investigations, environmental management, strategy and guideline formulation

FELLOWSHIPS

1994-1995 Trainee, National Institute for Occupational Safety and Health
1990 Fellow, Prudential Foundation, Harvard University (HIID)

PROFESSIONAL TRAINING/CERTIFICATION

2018 RCS – PROJECT MANAGEMENT (CPM IN PROCESS)
2002 PROJECT MANAGEMENT PROFESSIONAL (PMP)
2000 FAHD – HEALTH SECTOR DISASTER CONTINGENCY PLANNING
1997 FAHD – PROJECT MANAGEMENT
1995 CERTIFIED HAZARDOUS MATERIALS MANAGER (CHMM)
1990 APPLIED EPIDEMIOLOGY TRAINING, CDC, ATLANTA, GA.

ACCOMPLISHMENTS

- As a result of my Monitoring and Evaluation activities all New York IGSA contracts met stipulated benchmarks for five consecutive years
- Projects managed by me in both the US and Guyana were all delivered on time and within budget
- Managed the successful implementation of the IDB-funded Maternal Child Health Improvement Project, advancing the start date by six months
- Successfully completed a Graduate Fellowship at Harvard University's Institute for International Development (HIID)

COMPUTER SKILLS

MICROSOFT: Word, Excel, Access, Project, PowerPoint

PRESENT ADDRESS: 15 High Ground Park, Cummings Lodge, Greater G/F
MAILING ADDRESS: 21 New Road, Chertsey, Essequibo Coast.

PHONE: 992-626-8198, 992-621-6212, 992-771-5973
E-MAIL: praveen@rites.com

GAFOOR, Safiya

Qualifications:

2015 Advance Learning Interactive Systems Online
Galway Technology Park, Ireland.

Diploma - Project Management

2014 Instituto Mexicano de Tecnología del Agua
Julipec, Morelos, Mexico.

Credited Certificate - Soil and Water Conservation

2013 School of Earth and Environmental Sciences, University of Guyana
Turkeyen Campus, Greater Georgetown, E.C.D.

Postgraduate Diploma – Environmental Management (Natural Resource)

2012 Arthur Lok Jack Graduate School of Business, University of the West Indies
Church Street, Georgetown

Certificate – Project Management for the Construction Industry

2011 University of Guyana
Turkeyen Campus, Greater Georgetown, E.C.D.

Bachelor of Engineering Degree - Civil Engineering

2009 Essequibo Technical Institute
Anna Regina Industrial Site

Certificate in Computer Aided Drafting (AutoCAD) – Foundation Level

2008 University of Guyana
Turkeyen Campus, Greater Georgetown, E.C.D.

Diploma in Technology – Engineering (Civil)

2005 Anna Regina Secondary (Multilateral) School
Cotton Field, Anna Regina, Essequibo Coast

CXC Certificate: 10 Subjects

Education:

- 2014 Soil and Water Conservation (*Instituto Mexicano de Tecnología del Agua*)
- 2013 Natural Resources Management (*University of Guyana*)
- 2013 Leadership in Action (*University of the West Indies*)
- 2013 Water Sanitation & Hygiene: Hygiene Promotion Training (*WASH Cluster-HP Project*)
- 2012 Project Management for the Construction Industry (*University of the West Indies*)
- 2012 Agro Meteorology Instrumentation & Irrigation Scheduling (*University of McGill*)

- 2012 Conservation of Agricultural Biodiversity (*Caribbean Council for Higher Education in Agriculture*)
- 2011 Monitoring and Evaluation (*International Programme for Development Evaluation Training*)
- 2011 Civil Engineering (*University of Guyana*)
- 2009 Foundation Level AutoCAD (*Essequibo Technical Institute*)
- 2008 Basic Electrical Installation (*Essequibo Technical Institute*)
- 2008 Civil Engineering Technology (*University of Guyana*)
- 2006 Introductory AutoCAD (*Essequibo Technical Institute*)
- 2005 Advance Level Information Technology (*Essequibo Technical Institute*)

Workshops/Training:

- 2013 Reduced Impact Logging Training Programme
University of Guyana, Guyana Forestry Commission
- 2013 Core Commitments for Children in Humanitarian Action eLearning for
Emergency and Preparedness Response
United Nations Children's Fund, Civil Defence Commission
- 2013 Integrated Livelihood Baselines and Damage and Loss Assessments for Disaster
Risk Management in Agriculture
Food Agriculture Organization of the United Nations, Ministry of Agriculture
- 2013 National Stakeholder Workshop on the Development of the Disaster Risk
Management Plan for the Agriculture Sector in Guyana
Food Agriculture Organization of the United Nations, Ministry of Agriculture
- 2013 Design of a National Integrated Disaster Risk Management Plan and Strategy for
Guyana Workshop
Inter-American Development Bank, Civil Defence Commission
- 2012 FLOODGATE 2012: CDC's National Flood Disaster Exercise
United Nations Development Programme, Civil Defence Commission
- 2012 Country Risk Disaster Indicators and Flood Risk Evaluation
Evaluacion de Riesgos Naturales-America Latina, Civil Defence Commission
- 2012 Comprehensive Approach to Probabilistic Risk Assessment Software Workshop
Evaluacion de Riesgos Naturales-America Latina, Civil Defence Commission
- 2012 Disaster Risk Management for Guyana: Minimum Preparedness Actions
Workshop
Inter-Agency Standing Committee, Civil Defence Commission
- 2012 Planning, Meeting & Simulation Exercises: Upper Mahaica Communities
CARICOM/Japan International Cooperation Agency, Civil Defence Commission

- 2011 Career Coach Workshop
Republic Bank Guyana Ltd, University of Guyana
- 2009 Regional Maintenance Training Program
Basic Need Trust Fund, Ministry of Local Government
- 2008 Student Internship Workshop on Workplace Etiquette
University of Guyana

Work Experience:

1) January 2014- Present, *Lecturer*

Guyana School of Agriculture; Ministry of Agriculture, Anna Regina, Essequibo Coast.

2) September 2011- September 2013, *Engineer (civil)*

National Drainage & Irrigation Authority; Ministry of Agriculture, Brouda, Georgetown.

3) September 2008- September 2009, *Superintendent of Works II*

Operations & Maintenance Department, Regional Democratic Council; Region No. 2, Anna Regina, Essequibo Coast.

4) July 2007- November 2007, *Engineering Technician*

E&A Consultants, 274 Peter Rose & Forshaw Street, Queenstown, Georgetown.

Major Projects involved in:

- Construction of the East Demerara Water Conservancy Northern Relief-Head Regulator
- Rehabilitation of the East Demerara Water Conservancy-Component 2
- Construction of the Aurora Land Development Project-Inception Study
- Conservancy Adaption Project-Equipment Installation
- Construction of Supplementary Drainage Canals for the East Black Bush Forder-Environmental Assessment (graduate project study)

Computer Skills: Operations in Microsoft Package (Word, Excel, Publisher, PowerPoint), AutoCAD, ArcGIS

Interest and activities: Reading, Poetry, Travelling, Cricket, Music, Modelling, Art

References:

- (1) Mr. Maxwell Jackson: Head of Dept., Faculty of Technology, University of Guyana
Contact #: Office #: 661-7640
- (2) Mr. Maurice Veacock: Senior Lecturer, Faculty of Technology, University of Guyana
Contact #: Mobile #: 661-7640
- (3) Mr. Lionel Wordsworth: CEO, National Drainage and Irrigation Authority
Contact #: Mobile #: 617-0260

CURRICULUM VITAE

1. Family name: Ennis
2. First names: Glenroy Everard
3. Passport Holder: Jamaican/Canadian
4. Residence: Canadian
5. Education:

Institution Date from - Date to	Degree(s) or Diploma(s) obtained:
College of Agriculture, St. John's - St. John's	BSc. Agricultural Science
University of the West Indies, St. John's - St. John's	BSc. Agricultural Science
University of the West Indies, St. John's - St. John's	MPhil, Agricultural Economics
York University - St. John's - St. John's	Ed.S. Diversity in Education

6. Language skills: Indicate competence on a scale of 1 to 5 (5 - excellent, 1 - basic)

Language	Reading	Speaking	Writing
English	5	5	5
Spanish	2	2	2

7. Membership of professional bodies: Caribbean Agricultural Economics Society, Ontario College of Teachers; Jamaica Society for Agricultural Scientists
8. Training and other skills: Certificate, Project Formulations, Appraisal and Management; Diploma, Conversational Spanish, Venezuelan Institute, Kingston, Jamaica; Efficient User of MS Office Suite
9. Present position: Independent Consultant/Educator

10. Key qualifications:

- More than 30 years experience applying cross-cutting knowledge in Agriculture; Economics; Project Formulation, Appraisal, Evaluations, Management; Cost Benefit Analysis; Strategic Planning; Climate Change; Value Chains; Marketing and Gender Equality primarily to SMEs and other levels of business, rural and sustainable development initiatives.
- Some key features include:
 - Conduct situation analyses and generate position papers which ultimately lead to project identification,
 - Extensive ex-post and ex-ante project evaluations and analyses; review project proposals and provide technical reports and guidance to stakeholders.
 - Critically analyse community development projects and on-farm adaptive research data and reliably inform stakeholders on cost-benefit and productivity measures.
 - Develop project formulation and evaluation guidelines consistent with project goals and objectives; reliably inform stakeholders on strategies to prioritize the allocation of project funds;
 - Conduct economic and social impact assessment on rural development projects and provide recommendations for moving forward.
 - Served extensively on investment committees of traditional export agriculture, standardizing policies and establishing protocols for sustainable development and transformation of various sub-sectors.
 - Work extensively coaching entrepreneurs on programme designs and strategies to employ best practices in order to attract venture capital.
 - Analyse Food Security issues, prepare draft strategy plans for development of agricultural sectors and rural development as commissioned by local and international funding organizations.
 - Led several agricultural, environmental and rural development project and study teams.
 - Significant research and reporting on production and market linkages of fresh agricultural produce, sustainable development and climate change with a view to design projects and develop strategies to improve income levels of rural poor.
 - Very familiar with the vernaculars of regional and international funding organizations including the EC.
- Institutions and organizations served include the European Commission (EC), Food and Agricultural Organization of the United Nations (FAO/UN), Inter-American Institute for Cooperation on Agriculture (IICA), United Nations Economic Commission of Latin America and the Caribbean (UNECLAC), Caribbean Development Bank (CDB), Technical Centre for Agriculture and Rural Cooperation (CTA), Caribbean Agricultural Development Institute (CARDI), University of the West Indies and Environmental Foundation of Jamaica (EFJ).

11. Specific Experience in the region

Country	Date from – Date to
India	July 2010
St Kitts and Nevis	March 2013 – December 2013
India	March 2013 – December 2013
Armenia	February 2012 – March 2012
Azerbaijan	February 2012 – March 2012
Georgia	February 2012 – March 2012
Kenya	August – November 2011
Comoros	September 1 to 6, 2011
St. Vincent and the Grenadines	August 28, 2011 – September 1, 2011
Grenada	August 28 to 28, 2011
Georgia	April 22 – 24, 2010; May, 2011 – Present; July, 2011
Comoros Republic	September 14, 2010 – September 21, 2010
St. Lucia	August 25, 2010 – August 26, 2010
Paraguay	August 18 – 24, 2010; March, 2011 & 2011 to May, 2011 – Present
Jamaica	Sept. 2008 – May, 2009, Dec, 2009 – Jan 2010; May, 2010 – Present
Tanzania and Uganda	April 2002 – May 2002; Jan 2003 – April 2003; Mar, 2010 – Present

13. Professional experience (selected projects)

Date from - Date to	Location	Company reference/ person ¹ (name & contact details)	Position	Description
Dec. 2014 to Aug. 2016	Trinidad, Guyana, Jamaica & St. Vincent and the Grenadines	Inter-American Institute for Cooperation on Agriculture (IICA) (Gregg Maxwell) Country Representative, Trinidad and Tobago (gregg.maxwell@iica.int)	Agricultural Economist (Family Farm Specialist)	Conducted a study on "Characterization of Family Farming in the Caribbean Region," with a view to understand the productivity and sustainability of family agriculture for food security and the rural economy. The broad objective was to deepen the understanding of family agriculture within the Caribbean context with the hope to influence or reform the ways that regional policies are formulated and directed to affect the development of this farming system.
Sept to Nov 2013	Guyana	EUHTSP/ Dr. Nitesh Pabera, Programme Manager, +94(9)1112 20100, Nitesh.Pabera@holpe.com	Agricultural Expert	Conducted a Scoping Study and a Strategic Environmental Assessment (SEA) Study relating to implementation of the Accompanying Measures for Sugar Protocol Countries Affected by the Reform of the EU Sugar Regime in the Cooperative Republic of Guyana. Reviewed the GRAP, policy documents, plans and programs to determine the extent to which crucial sustainable development, food security and natural resource management issues were addressed and advised multi-stakeholder processes on enhancement and mitigating strategies where necessary.
Mar 2013 to 2014	Selected Caribbean States	CARDICTA, Dr. Arington Chetty, UNL, Trinidad WJ (868) 618 1267	Value Chain Specialist	A project to contribute to food and nutrition security in the Caribbean Region through the enhancement of agricultural value chains; Responsibilities include: identify and analyse agricultural value chains of the Caribbean and provide an understanding of the extent to which information and communication technology (ICT) are used at the different nodes; design strategies to enhance adaptation of innovative ICT models, projects and make recommendations that can be later shared within the region and with other ACP states; generate several technical reports.
Feb 2012 to Mar 2013	America, Azerbaijan and Georgia	UNEP/WHO, Dr. May Mathews, Tbilisi, Georgia, +1 708 621 7871 m.mathews@unep.org	International Economist	Contributed to methodological development of Integrated Water Resources Management (IWRM) economic evaluation strategy for the Rura-Arae River Basin; provided support to national experts in data collection and information assimilation, and reviewed national and regional level IWRM economic evaluation in "Reducing Trans-boundary Degradation in the Rura Arae River Basin" project.
Oct 2011 to Jan 2013	Selected Caribbean States	PRODA, Dr. Cedric Laxson, Georgetown, Barbados B.L. 1-800-028-0787 cedric.laxson@proda.org	Livestock Farmer' Association Consultant	Provided an update on the status of livestock organizations/associations within the Caribbean region via consultations with stakeholders, data review and analysis; assessed the impact of livestock associations on regional livestock development and livestock sector policies at the national and regional levels; Reviewed constraints that militate against effective formation and operation of livestock associations; identified success criteria for progressive livestock associations; prepared a comprehensive report highlighting key features of existing livestock associations within the region and made recommendations on criteria necessary for successful operation of livestock associations.

Date from - Date to	Location	Company reference person ¹ (name & contact details)	Position	Description
		David.Duffy@trinidad.gov.tt T-868-786-1173		Trinidad and Tobago. Conducted a comprehensive assessment of the likely significant environmental challenges, considerations, effects and impacts of the tenets outlined in the restructuring process of the NAG to be implemented. Reviewed policy documents, plans and programs to determine the extent to which crucial sustainable development, food security and natural resource management issues were addressed and advised multi-stakeholder processes on enhancement and mitigating strategies where necessary.
Oct 2008 - Feb 2009	Jamaica	Jamaica Social Investment Fund Ms. Stephanie Hutchinson-Finnell, T-878-888-8881 stephanie.finnell@socialifund.gov.jm	Agricultural Expert/Rural Development Specialist	A project of the Government of Jamaica and the International Bank for Reconstruction and Development, The Jamaica Second National Community Development Project (nCDP2) geared towards improvement of rural incomes in poor rural communities of Jamaica; conducted extensive analyses of the Jamaican fresh agricultural produce industry, with particular emphasis on understanding the linkages along the value chain of selected agricultural commodities; advised stakeholders on effective ways that research findings could inform policy and strategic development relating to food security, poverty alleviation and sustainable development issues.
Sept 2008 - Jan 2009	Trinidad and Tobago	University of the West Indies Dr. David Duffy, Academic Director, T-868-786-1173 duffyd@uwi.edu.tt	Agricultural Consultant	Designed and advised on the progress of special projects for the University of the West Indies, leading to strategies for the establishment of a Technical Vocational Program that fosters training in sustainable development. Example developed a program that seeks to attract youth to the potentially lucrative and environmentally astute Cocoa industry of Trinidad and Tobago; Designed a strategic plan, showcasing the University's strategic support in strengthening the Government of Trinidad and Tobago social safety net program by way of incorporating tangible agricultural activities.
Sept 2007 - May 2008	Canada	Tech University Ms. Sari Dook, Program Coordinator, sari@techu.ca	Team Leader, Urban Diversity Education Community Program	Led team in development of community schooling programme; designed strategy to incorporate community members and parents in the teaching and learning process of students and engaged them in activities that promoted holistic approaches developing more effective schooling.
Sept 2007 - Jan 2008	Canada	FRSBC/Computer Learning Institute, Dr. Shirley Peters, Executive Director T-867-933-6333 speters@frsbc.ca	Program Manager/ Revision Consultant	Managed all daily activities of the institution, to include budgeting, succession planning, curriculum and program development; maintained linkages with stakeholders, boards and legal authorities; served on various advisory committees; provided regular updates to Government on the general performance of community programs;
May 2007 - Aug-2007	Jamaica	Jamaica (H) Cuba/Caribbean (H) Council Mr. Linwood Fulton Executive Director T-878-927-6000	Executive Director/ Manager/ Economic Development	Managed the portfolio of the Organization with 80 staff members and over 30,000 youths; supervised the efficient running of 12 major enterprises; pioneered re-engineering exercises of the organization, and determined the institutional needs of the various enterprises in light of the capacity of the organization to satisfy those needs; designed and implemented programmes to reform and strengthen the organization as needed; produced financial analyses to determine whether new products add value to existing business strategies; provided cost benefit analysis of new

Date from - Date to	Location	Company reference person ¹ (name & contact details)	Position	Description
Aug 16 Nov 2011	Kenya	UNDP/WFP, Dr. David Duffy, SL Representative, Trinidad/W.I T-868-786-1173 duffyd@uwi.edu.tt	Technical Expert	Contributed towards the developmental framework of the International Conference on "Innovation in Extension and Advisory Services – Linking knowledge, Policy and action for Food and Livelihoods" provided technical support in the review, collation and assimilation of information at national and regional levels. A key outcome of the conference was the Nairobi's Declaration on Extension.
Aug 2011 to Dec 2011	Selected Caribbean States	Caribbean Development Bank, Ms Valerie Piggin, SL, Barbados, Barbados, T-266-337-1920, valerie.piggin@caribdb.com	Project Appraiser	Reviewed proposals and prepared appraisal reports for project in the CARIFund project pipeline for consideration by the Bank's selection committee. Critically assessed clients' applications and recommended modifications where necessary; engaged in field missions as a part of the Bank's delegation to visit project location on validation exercises and to coordinate discussions with clients on project design strategies. Prepare final appraisal reports including design of monitoring frameworks, consultants' Terms of Reference and detailed budget.
Jan to Aug 2011	Caribbean	UNEP/EC, Mr. Sherman Gomez, Part Of Spain, Trinidad/West Indies, T-868-822-8888	Economic Reviewer/ Climate Change Specialist	Reviewed consultants' reports on the economic impact of climate change on the agricultural sector of the Caribbean; determined the accuracy and relevance of literature cited and data used in each study and made recommendations to improve data accuracy as well as enhance the quality of the reports; provided comments inclusive of recommendations for sourcing and, if necessary, more accurate information; assessed models used by consultants and test each model for relevance and accuracy and made recommendations for changes where necessary; critiqued the results to determine accuracy in interpretation; ascertained if results are synchronized with the interpretations and made recommendations for improvement; assisted in the collation of summary report for the Caribbean and Latin America; ensured that the agriculture section of the report is simple to understand and interpret by policymakers and stakeholders; wrote chapter on the agricultural sector of summary report for publication.
July 2010 - Jan. 2011	Caribbean and Beyond	European Union/HTMPE Mr. David Mitchell, Programme Manager david.mitchell@htmp.eu.com +359-02 321 655	Caribbean Regional Expert	Represent the Caribbean on an EC project "Identification and Formulating – Support to Agriculture and Rural Development Policies for Small and Isolated Counties project in the Caribbean and Pacific Counties". Provide the EC with the necessary analytical data and project identification materials for the design and programming of support to the agricultural sectors of the developing states of the Caribbean and Pacific regions. Assist with the design of a format of an inter-continental programme intervention, synergistically representing both regions.
Oct 2010 - Jan 2010	Caribbean	CARICOM Secretariat Dr. David Beersford, Team Leader david.beersford@caricom.org T-868-877-8883	Development Strategist	Member of a team of Consultants who prepared a preliminary plan to advise CARICOM on "Growth and Development of Intra-regional Agricultural Production and Trade - Provision of Regional Public Goods." This is to inform the development of a policy framework and a comprehensive strategic plan for the Region's Agricultural Sector with a natural resource management and sustainable development slant.
Feb. 2009 - June 2009	Trinidad and Tobago	European Union/ERAF Ms. Kathie Revier, Programme Officer	Agreement/Supervision Sector Expert	Provided services in connection with preparation of a Strategic Environmental Assessment relating to implementation of the National Adaptation Strategy (NAS) and the European Commission response strategy to the NAS, with special emphasis on the transformation of the sugar sector of

Date from - Date to	Location	Company reference/papers? (name & contact details)	Position	Description
				product/projects to determine the extent of value added; prepared and managed annual budgets, monthly board reports, strategic, corporate and operational plans; served on several boards and selected Government planning committees; Board member of the Commissioner of Lands, with responsibility for land-use management in accordance with Government regulations; assisted in the formulation of land-use policies, allocation of land for economic development, a foreman, agricultural development, mining, housing and manufacturing, among other.
Sept 1999 – April 2001	Jamaica	Inter-American Institute for Cooperation on Agriculture Dr. Christian Bruchstein, Country Representative christian.bruchstein@iaia.org	Agricultural Economist / Rural Development Specialist	Conducted situational analyses and generated position papers on different types of farming systems; conducted market research analyses for several small business enterprises; Assisted with development of several capacity building, environmental and community development projects; critically analyzed on-farm adaptive research data and reliably informed stakeholders on cost-benefit and productivity measures; spearheaded feasibility studies of several community and sustainable development projects, including integrated farming systems and developed cropping systems geared towards maximizing the returns per acre on coffee plantations in Jamaica; administered training in agronomy, soil conservation, extension services and business development to various agricultural specialists; participated in several workshops geared towards establishing relevant indicators for environmental impact analysis, generated several publications and brochures on different aspects of Caribbean agriculture.
May 1999 – Sept 2001	Jamaica	Food and Agriculture Organization of the United Nations Mr. Gladstone Barrett, Country Rep., T-880-333-6600 gbarrett@corns.org	Agricultural Economist	Extensive analysis of Food Security issues in Jamaica and prepared a ten year draft strategy plan for development of agricultural sector as commissioned by the FAO/UN; conducted situation analyses and generated position papers on the Jamaica Cocoa Industry; submitted country paper on the agricultural sector and presented findings to Government delegations at Caribbean regional conferences;
Jan. 1999 – Aug 2001	Jamaica	Environmental Foundations of Jamaica Mr. Albert Cahly Program Director, T-876-336-6883 alcahly@efj.org.jm	Agricultural Economist / Community Development Specialist	Administered ex-post evaluation of several community development and environmental projects, providing advice to stakeholders on sustainability and impact on beneficiaries; Conducted Environmental Impact Assessments on several projects to determine whether built capacity was sustainable and advised the organization on relevant modifications to projects or the extent to which support to developmental initiatives should be continued; designed developmental strategies for rotunde communities to mitigate the use of illicit drugs; critically analyzed on farm adaptive research data and reliably informed stakeholders on cost-benefit and productivity analyses; Advised community organizations regarding suitable business alternatives and best practices; generated several technical reports for submission to contractor.
Mar – Sept 1998	Jamaica	European Commission Mr. Leslie Grant, T-876-336-6837	Agricultural Economist / Consultant	Conducted feasibility studies for Portland (see Farmers Association and Yallahs Grape farmers as a part of the Mount Yallahs Agricultural Development Project; Administered training in entrepreneurship to farmers and community group leaders.
Dec	Jamaica	CARDI	Agricultural	Conducted cost benefit analysis of hot pepper grown under different ecological zones across

Date from - Date to	Location	Company reference/papers? (name & contact details)	Position	Description
				product/projects to determine the extent of value added; prepared and managed annual budgets, monthly board reports, strategic, corporate and operational plans; served on several boards and selected Government planning committees; Board member of the Commissioner of Lands, with responsibility for land-use management in accordance with Government regulations; assisted in the formulation of land-use policies, allocation of land for economic development, a foreman, agricultural development, mining, housing and manufacturing, among other.
Sept 1999 – April 2001	Jamaica	Inter-American Institute for Cooperation on Agriculture Dr. Christian Bruchstein, Country Representative christian.bruchstein@iaia.org	Agricultural Economist / Rural Development Specialist	Conducted situational analyses and generated position papers on different types of farming systems; conducted market research analyses for several small business enterprises; Assisted with development of several capacity building, environmental and community development projects; critically analyzed on-farm adaptive research data and reliably informed stakeholders on cost-benefit and productivity measures; spearheaded feasibility studies of several community and sustainable development projects, including integrated farming systems and developed cropping systems geared towards maximizing the returns per acre on coffee plantations in Jamaica; administered training in agronomy, soil conservation, extension services and business development to various agricultural specialists; participated in several workshops geared towards establishing relevant indicators for environmental impact analysis, generated several publications and brochures on different aspects of Caribbean agriculture.
May 1999 – Sept 2001	Jamaica	Food and Agriculture Organization of the United Nations Mr. Gladstone Barrett, Country Rep., T-880-333-6600 gbarrett@corns.org	Agricultural Economist	Extensive analysis of Food Security issues in Jamaica and prepared a ten year draft strategy plan for development of agricultural sector as commissioned by the FAO/UN; conducted situation analyses and generated position papers on the Jamaica Cocoa Industry; submitted country paper on the agricultural sector and presented findings to Government delegations at Caribbean regional conferences;
Jan. 1999 – Aug 2001	Jamaica	Environmental Foundations of Jamaica Mr. Albert Cahly Program Director, T-876-336-6883 alcahly@efj.org.jm	Agricultural Economist / Community Development Specialist	Administered ex-post evaluation of several community development and environmental projects, providing advice to stakeholders on sustainability and impact on beneficiaries; Conducted Environmental Impact Assessments on several projects to determine whether built capacity was sustainable and advised the organization on relevant modifications to projects or the extent to which support to developmental initiatives should be continued; designed developmental strategies for rotunde communities to mitigate the use of illicit drugs; critically analyzed on farm adaptive research data and reliably informed stakeholders on cost-benefit and productivity analyses; Advised community organizations regarding suitable business alternatives and best practices; generated several technical reports for submission to contractor.
Mar – Sept 1998	Jamaica	European Commission Mr. Leslie Grant, T-876-336-6837	Agricultural Economist / Consultant	Conducted feasibility studies for Portland (see Farmers Association and Yallahs Grape farmers as a part of the Mount Yallahs Agricultural Development Project; Administered training in entrepreneurship to farmers and community group leaders.
Dec	Jamaica	CARDI	Agricultural	Conducted cost benefit analysis of hot pepper grown under different ecological zones across

Date from - Date to	Location	Company reference person ¹ (name & contact details)	Position	Description
1997 - Mar. 1998		Dr. Joseph Lindsey, 1-876-388-0301 jlindsey@carici.com.jm	Consultant	Jamaica; Provided technical advice on resource use efficiency to farmers and other stakeholders; Generated technical reports for submission to the management of CARICI; Assessed the institutional needs of the Jamaica Agribusiness Council and provided strategies to streamline the management and regulations of essential services in line with changing physical environment.
Mar. 1998 - May 1998	Jamaica	Jamaica Agricultural Development Foundation Mr. Yusef Evans Executive Director 1-876-383-7176	Senior Project Officer- Registral Services	Managed the technical services/loan application system of the organization with an average annual budget of more than US\$ 10 million; pre-screened prospective investors to ensure efficient loan allocations; developed project formulation and evaluation guidelines; supervised 5 project officers; provided technical advice to staff and investors, with a view to encourage environmentally friendly practices, improved productivity and sustainability; reliably informed the company on strategies to prioritize the allocation of project funds; extensive investigation into the feasibility of projects and assisted in their approval and timely implementation.
Sept 1997 - Feb 1998	Jamaica	Ministry of Agriculture Ms. Julietta Bullfinch, Principal Director, 1-876-627-1128-60 jbullfinch@mosa.gov.jm	Agricultural Economist - Planning and Policy Division	<p>Significant representation of the Ministry of Agriculture in several planning and development activities, including:</p> <p>(1) Delegate on Government's Sugarcane Investment Programme Committee - Cuba: Attended bi-weekly meetings and led deliberations and discussions on all agronomic, environmental and other agricultural related matters concerning diversification and sustainable development of the sugar industry; established criteria for eligibility of investors, reviewed and approved applications, tabled privatization of sugarcane lands, standardized policies and established protocols to foster sustainable development of the sugarcane sector; provided technical advice to sugarcane farmers and other key stakeholders on strategies to effectively control or eliminate sugarcane borers and other pests, using non-chemical methods such as biological control (indigenous parasitoids) and good cultural practices; organized periodic training for sugarcane farmers on essential agronomic principles including soil conservation practices; assisted new investors with sustainable development plans.</p> <p>(2) Planning and Policy Development: Assisted with the tabling of major policy documents; prepared national annual budget presentations for Agricultural Ministers; developed and updated cost benefit analyses for several agricultural enterprises; conducted feasibility studies, economic, social impact analyses and evaluations for rural development projects and made recommendations for approval; designed training programs and conducted workshops and seminars for extension and field officers; critically analyzed projects done by consultants and advised the Ministry accordingly; conducted economic research and presented results on behalf of the Ministry of Agriculture.</p> <p>(3) Agricultural Trade: served on the Ministry's Cabinet approved Dairy Committee to investigate alleged dumping of milk and other dairy products on the Jamaican market; reviewed WTO regulations against actual market behaviour; examined protocols of trading counterparts against</p>

13. Other Relevant Information:

RESEARCH ACTIVITIES

1998, Thesis, Master of Philosophy, "Efficiency in the use of Resources of Small Banana Farm Holdings, A Case Study in the Rio-Grande Valley, Portland, Jamaica", University of the West Indies

1999, Final Year Project, "Response of Phosphorus on Maize in the Bauxite Soils of Jamaica", University of the West Indies

TECHNICAL PAPERS AND CONSULTANCIES

2017, Characterization of the Family Farming System in the Caribbean, Caribbean Food Crop Society, University of Puerto Rico

2012, Assessment of Livestock Organizations in the Caribbean Region, Food and Agricultural Organization of the United Nations (FAO/UN)

2011, Strengthening the Productive Capacity of Domestic Agriculture in North Leeward (St. Vincent), Caribbean Development Bank (CDB)

2011, Economic Impact of the Climate Change on the Agricultural Sector of the Caribbean, the United Nations Economic Commission for Latin America and the Caribbean, (UNECLA/C)

2011, Identification and Formulating – Support to Agriculture and Rural Development Policies for Small and Isolated Countries of the Caribbean and Pacific Countries, European Union (EU)

2010, Growth and Development of Intra-regional Agricultural Production and Trade – Provision of Regional Public Goods, CARICOM Secretariat, Guyana

2009, From Courtship to Marriage: Would the Arranged Marriage between Agriculture and Tourism Last Forever, Conference on "Food Security and Agricultural Development in the Americas", The University of the West Indies, Mona Campus, Kingston, Jamaica.

2009, Strategic Environmental Assessment (SEA) of the Implementation of the National Sugar Adaptation Strategy for Trinidad and Tobago, European Commission

2009, Analysis of the Jamaica Fresh Agricultural Produce Industry – Market Analysis, Jamaica Social Investment Fund

2009, Analysis of the Jamaica Fresh Agricultural Produce Industry – Supply Analysis, Jamaica Social Investment Fund

2009, Strategic Action Plan - Mobilizing Youths Towards Cocoa Production in Trinidad And Tobago Through a Technical Vocational Programme – University of the West Indies, St. Augustine

2008, Red Bull Energy Drink: Opportunities Among Ethnic Groups in Canada, Focus Group Report, Environica Research Group, Toronto, Canada

1999, Conducted study on "Institutional Analysis of the Agribusiness Council of Jamaica"

1997, Country paper, "Strategy for National Agricultural Development - Horizon 2015", Jamaica, commissioned by Food and Agricultural Organization of the United Nations

1996, Country paper, "Situation and Outlook Report" on the agricultural sector, Jamaica, commissioned by the Inter-American Institute for Cooperation on Agriculture

ACADEMIC AWARDS

1992, Jamaica Agricultural Research Program/Jamaica Agricultural Development Foundation Scholarship, to pursue the Master of Philosophy degree

1987, United States Agency for International Development scholarship, to pursue Bachelor of Science degree

1987, College of Agriculture Science and Education, Awarded prize for best agronomy student

Curriculum Vitae

Dr Surendra Pal Singh
M.Tech (Geomatics), PhD (IIT-Roorkee)

Assistant Professor,
Faculty of Engineering and Technology
Department of Civil & Geomatics Engineering
Wachemo University,
Hosana City, Ethiopia, (East Africa).

E-mail: surendra.geomatics@gmail.com
Mobile: +251-968654233



Career Objective:

My aim is to become a good academician cum researcher in reputed university. I am looking forward for a dynamic career in the teaching & research field of Civil Engineering, Geomatics Engineering, Surveying & Mapping, Digital Photogrammetry, Remote Sensing & Geographical Information System (GIS), Global Positioning System (GPS), Laser Remote Sensing, Environmental Science and Engineering related fields.

Academic Qualifications:

- PhD -** Department of Civil Engineering, Geomatics Section, Indian Institute of Technology, Roorkee, 2015. Thesis title is "Virtual 3D City Model by using Geomatics Techniques". (PhD Viva-Voce successfully completed on Date- Feb 27, 2015).
- M.Tech. -** Geomatics Engineering, from Indian Institute of Surveying and Mapping (Survey of India) and Jawaharlal Nehru Technological University (JNTU), Hyderabad, India – 2008. Thesis title on "Generation of Fly-through model by Digital Photogrammetry", Department of Space, (NRSA-Hyderabad).
- M.Sc. -** Environmental Science, University of Allahabad, Allahabad, India – 2004, M.Sc thesis on "Hospital Waste Management: Allahabad city - A case study".

Teaching Experience:

More than two year teaching experience for Civil engineering, Geomatics engineering techniques such as Surveying, Advance Surveying, Geomatics, Remote sensing and GIS, Global Positioning System (GPS), Photogrammetry, Environmental Science etc., related subjects.

Industrial Experience:

One month working experience as Senior Manager (Survey & GIS), at Briket Instruments Pvt Ltd, Noida and leading the most prestigious project of India. The project is under the supervision of RITES and funded by Japan. The name of project is "Survey, Alignment and Bridge Study for Mumbai-Ahmedabad High Speed Railway-Establishment of DGPS Control Points and Topography Survey". This survey work will be useful for high speed bullet train from Mumbai to Ahmedabad.

Teaching Interest:

Courses taught for

A) Undergraduates:

1. Basic Surveying,
2. Advanced Surveying,
3. Environmental Study,
4. Water Treatment
5. Sewage Disposal & Treatment

B) Postgraduates: 1.Environmental Ecology 2. Environmental Remote Sensing.

Research Interest:

1. Geomatics techniques,
2. Photogrammetry,
3. Laser scanning,
4. GIS,
4. Geodesy,
5. 3D City modeling.

Professional Trainings:

S.No.	Organisation	Period	Details of Training
1	Center for Environmental Education(CEE), Ministry of Environment & Forest, Govt. of India.	10.02.04 11.02.04	Biomedical waste management status-Analysis & Planning for future.
2	Central Ground Water Board, Ministry of water Resources, Govt. of India.	23.03.04 24.03.04	Artificial recharge to ground water.
3	Biological Product lab Allahabad University, Allahabad.	18.12.04 21.12.04	Organic Farming.
4	Center for Social Society & Eco Rehabilitation(CSSEER)Allahabad, Ministry of Environment & Forest, Govt. of India.	22.03.05 23.03.05	Research & development project on Intrapedia plant.
5	Survey of India, Hyderabad; Ministry of Science & technology, Govt. of India.	20.09.06 22.09.06	Photogrammetry & Remote Sensing – Overview for policy makers.
6	Survey of India, Hyderabad; Ministry of Science & technology, Govt. of India.	09.10.06 13.10.06	Modern survey instruments & techniques.
7	Jawaharlal Nehru Technological University (JNTU) Hyderabad &NRIDMS (Dept. of Science & Technology)-Govt. of India.	12.02.07 24.02.07	Two weeks short term program on Geospatial Technologies.
8	Advanced Training Institute, Hyderabad; Ministry of Labour & Employment, Govt. of India.	14.03.08 29.03.08	Two weeks Advanced training in "Assembling and maintenance of P.C.Hardware.
9	Omanya University- Hyderabad (AP).	17.06.09 07.07.09	Three week SERC school on "Atmospheric Effect on GPS and Local Area Augmentation System (LAAS)".
10	Indian Institute of Technology-Roorkee (IITR), Uttarakhand, India.	23.08.2010 27.08.2010	One week short term course on "Advance Geoinformation System"
11	Indian Institute of Technology-Roorkee (IITR), Uttarakhand, India.	05.11.2012 10.11.2012	Short term training course on "Prediction and mitigation of climate change impacts using space and agrometeorology based techniques".
12	Indian Institute of Technology-Roorkee (IITR), Uttarakhand, India.	11.11.2013 16.11.2013	Training programme on "Modeling sustainable agriculture under changing climate"
13	Indian Institute of Technology-Roorkee (IITR), Uttarakhand, India.	30.05.2014	3D Modeling with FARO Focus 3D Laser Scanner
14	Indian Institute of Remote Sensing (IIRS), Indian Space Research Organization (ISRO), Dehradun, Uttarakhand, India.	27.01.2015 27.03.2015	14 th IIRS Outreach Programme on "Applications of Remote Sensing and Geographical Information System for Natural Resources"

Publications

Peer-reviewed Journals

1. Kamal Jain, V. Ravibabu Mandla, J.A. Staff, & Surendra Pal Singh "Using Rational Polynomial Coefficients (RPC) to generate digital elevation models – a comparative study", (2009), , *Applied GIS*, Vol.05, Issue 02, pp. 1-11.
2. Mandla V. Ravibabu, Kamal Jain, Surendra Pal Singh, Naga Jyothi Meeriga "Accuracy Improvement of ASTER Stereo Satellite Generated DEM Using Texture Filter", (2010), December, *Geo-spatial Information Science*, Vol. 13, Issue 04, pp. 257-262.
3. A. Chaudh, Vinod Chaudh, Surendra P. Singh, Ajay K. Tomar, Himanshu Chaudh "A Text to Speech System for Hindi using English Language", *International Journal of Computer Science and Technology (IJCSIT)*, Vol. 02, Issue 03, September 2011, ISSN: 2229- 4033(Print), ISSN: 0976- 8491(Online).
4. Surendra Pal Singh, Kamal Jain,V. Ravibabu Mandla, "Design and Calibration of Multi Camera setup for 3D City modeling," (2013), *International Journal of Engineering Research & Technology (IJERT)*, Vol.02, Issue 05, May.
5. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla, "Image Based 3D Modeling of Campus (Department of Civil Engineering, IIT Roorkee, Uttarakhand, India) by Using SketchUp"(2013), *International Journal of Advanced Civil Engineering and Architecture Research*, September, Vol.02, Issue 01, pp. 65-71, Article ID Tech-168.
6. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla "Virtual 3D Campus Modeling by using Close Range Photogrammetry", (2013), *American Journal of Civil Engineering and Architecture*, Vol.01, No. 06, pp. 200-205, December, doi: 10.12691/ajcea-1-6-0.
7. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla "3D Scene Reconstruction from Video Camera for Virtual 3D City Modeling" (2014), *American Journal of Engineering Research (AJER)*, Vol.03, Issue 01, January, pp-140-148.

8. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla, "Image based Virtual 3D Campus modeling by using CityEngine", (2014), *American Journal of Engineering Science and Technology Research*, Vol. 02, No.01, January, pp- 01-10, ISSN: 2327-8269 (Online).

9. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla, "Virtual 3D City Modeling : Techniques and Applications", (2013), *ISPRS International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XL-3/W2, pp. 73-81, doi:10.5194/isprsarchives-XL-3-W2-73-2013.

10. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla, "Image based 3D City modeling: Comparative study", (2014), *ISPRS International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XL-5, 537-546, doi:10.5194/isprsarchives-XL-5-537-2014.

11. Surendra Pal Singh, Kamal Jain, V. Ravibabu Mandla, "A New Approach towards Image Based Virtual 3D City Modeling by using Close Range Photogrammetry", (2014), *ISPRS International Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. II-5, pp. 329-337. doi:10.5194/isprsannals-II-5-329-2014.

Conferences

1. Surendra Pal Singh, V.Ravibabu Mandla, Kamal Jain, "3D Building Modeling from Close Range Photogrammetry", (2012), *International conference in Geomatics-II*, Feb 26-29, CSRE, Indian Institute of Technology-Bombay, India. (The Best Poster award)

2. Surendra Pal Singh, V. Ravibabu Mandla, Kamal Jain, "Virtual 3D City model for G-governance", (2011), *Regional Conference on "Good governance problems and solutions"* at the University of Kashmir, Srinagar from 13-14 September.

3. T.Ranga Vital, Surendra Pal Singh, "Web-GIS in School education for G-Governance". (2011), *Regional Conference on "Good governance problems and solutions"*, at the University of Kashmir, Srinagar from 13-14 September.

Membership of Professional Societies:-

S.No.	Name of Professional societies	Type of Membership	Membership Number
1	Indian National Cartographic Association (INCA), Hyderabad.	Life Member	(I.N.I._2209)
2	Indian Society of Remote Sensing, (ISRS), Dehradun.	Life Member	(I._3834)
3	Indian Society of Geomatics, (ISG), Ahmedabad.	Life Member	(ISG-L_1517)
4	Indian Water Resources Society (IWRS) WRD&M, IIT-Bombay.	Life Member	(I.N.I._11-7331)
5	International Global Navigation Satellite Systems Society (IGNSS)	Annual Member	For 2011

Personal Profile:

Father Name: Shri Govind Singh
Mother Name: Smt Babba Devi
Date of Birth: 07/06/1977
Sex: Male
Marital Status: Married
Nationality: Indian
Passport Number: G1343176

Permanent Address:

Dr. Surendra Pal Singh
 Shri Govind Singh
 Muhalla: Hanasayana
 Village & Post: Samthar
 District: Jhansi
 PIN: 284204 (U.P), INDIA.
 Mobile: +91-9452838301

REFERENCES

- 1. Prof. Kamal Jain**
Geomatics Engineering Section,
Department Of Civil Engineering,
Indian Institute of Technology- Roorkee,
Roorkee, PIN: 247667
(Uttarakhand), INDIA.

E-mail: kjaince@itr.ernet.in, k.jain_jun@rediffmail.com
Mobile: +91- 9997962862, +91- 9760026284
Phone: +91- 1332-285465 (C), +91-1332-285027 (R)
- 2. Dr. Venkatesh Ravilshabha Mandla,**
Professor, EWEET Division, SMDS
VIT-University, Vellore, PIN: 632 014,
Tamil Nadu, (INDIA)
Email: ravi.mandla@vit.ac.in
ravi.mandla@gmail.com
Mobile: +91-96 2983 5050
- 3. Prof. S.K. Tripathi**
Department of Water Resources Development and Management
Indian Institute of Technology- Roorkee
Roorkee, PIN: 247667,
(Uttarakhand), INDIA
Email: sanku1971@gmail.com
sanku1971@itr.ernet.in
Ph: +91-1332-285780 (C)
+91-1332-285786 (R)
Mobile: +91-9897134234

Appendix 5: TIN, DEM, Contour and GIS Maps,

- Triangulated Irregular Network (TIN) Map;
- Digital Elevation Model (DEM) Map;
- Contour Map:
- Geographic Information System Maps for Main Alignment and Connector (Scale 1:2000 to 1:3000)

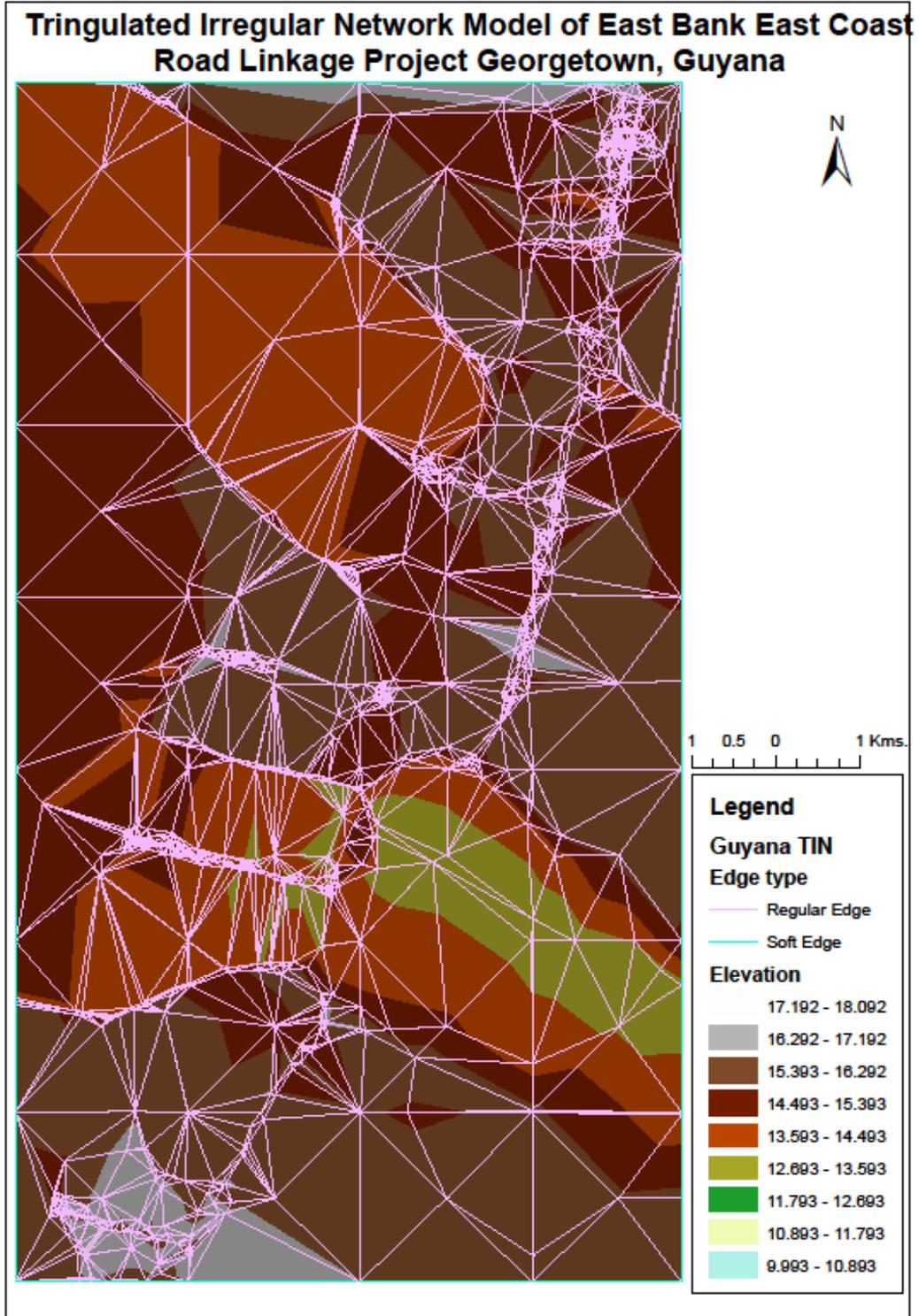


Figure 33. – TIN Map for EB-EC Road Linkage Project

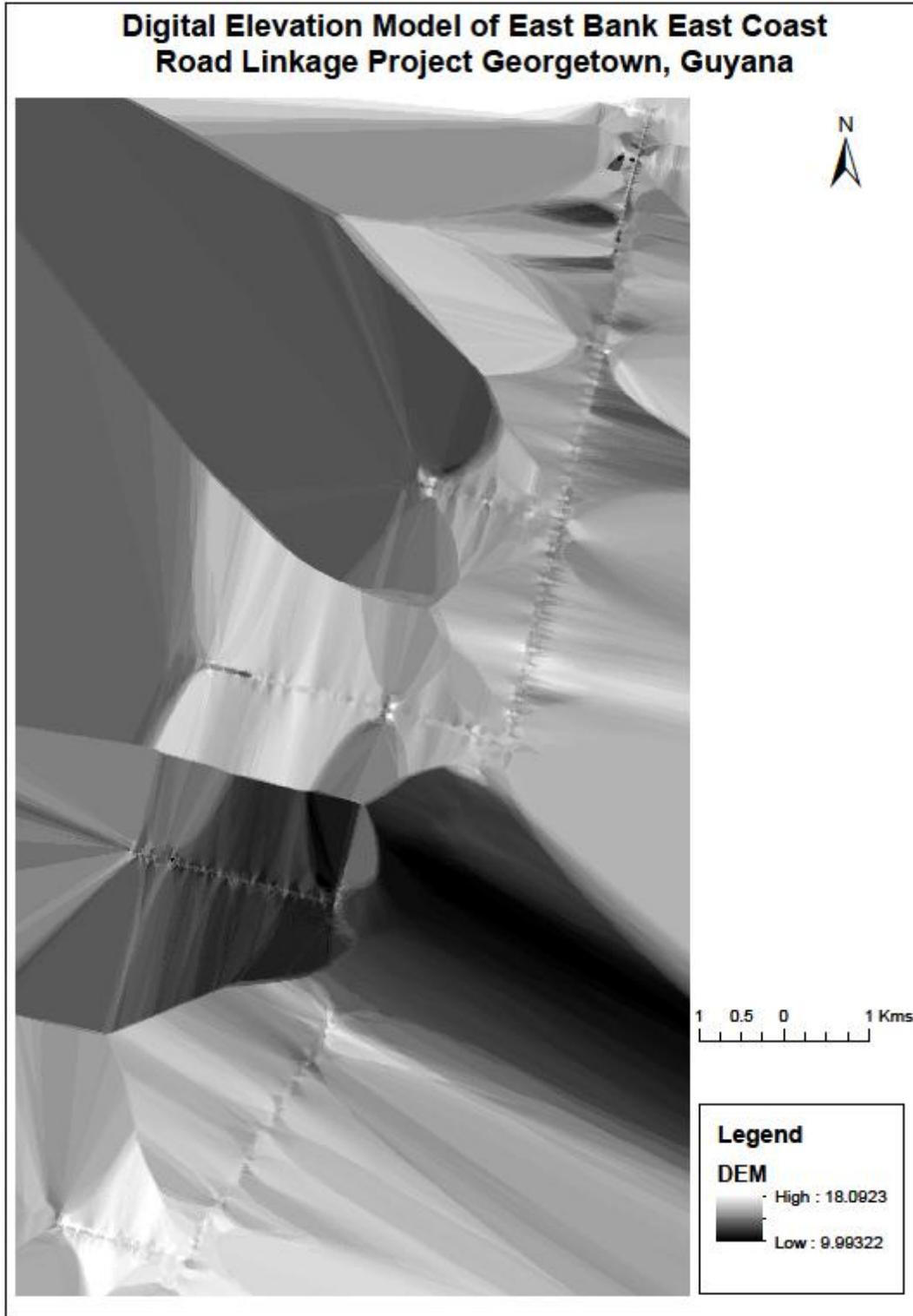


Figure 34. : Digital Elevation Models (DEMs) Map for EB-EC Road Linkage Project

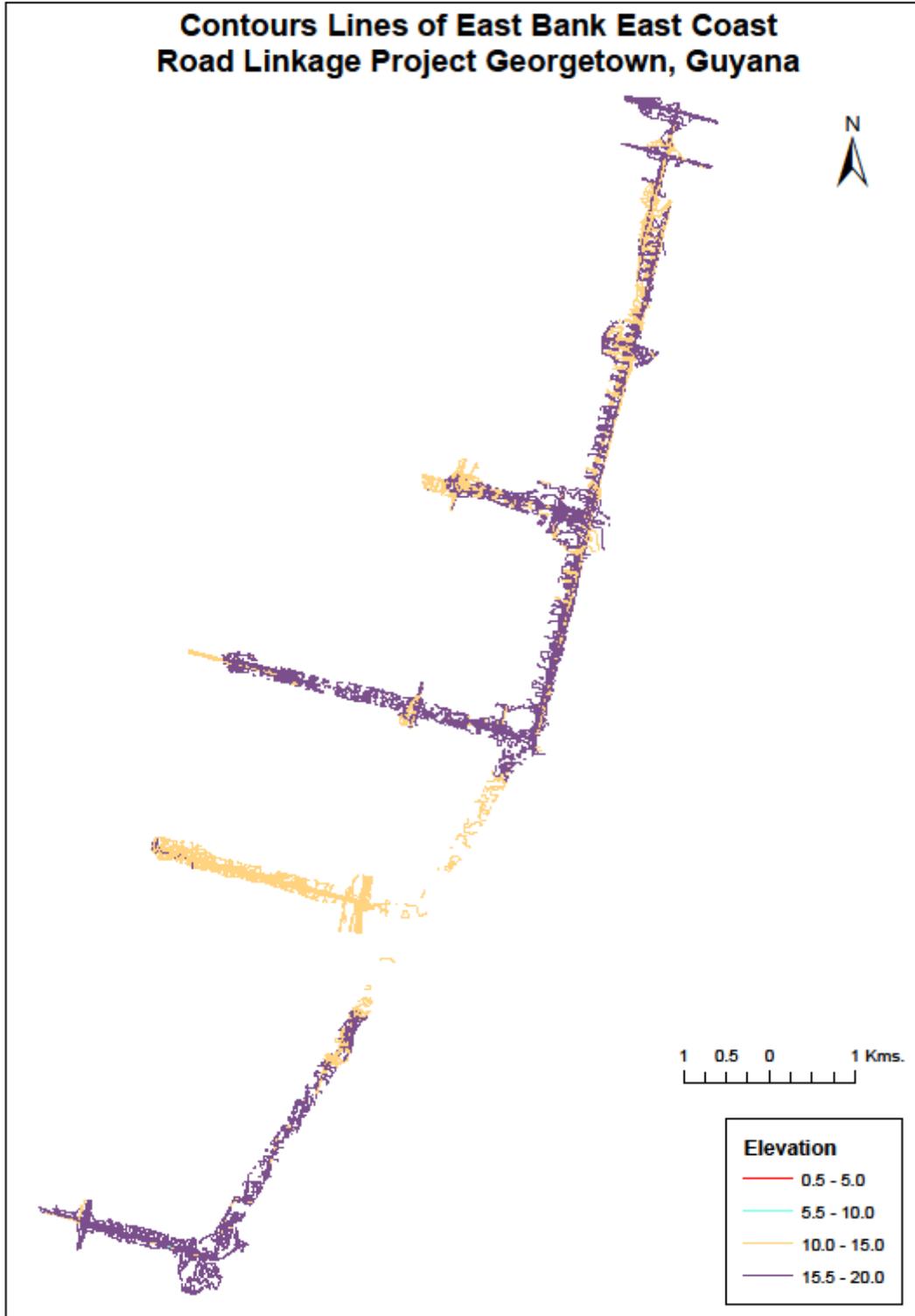


Figure 35. : Contour Map for EB-EC Road Linkage Project

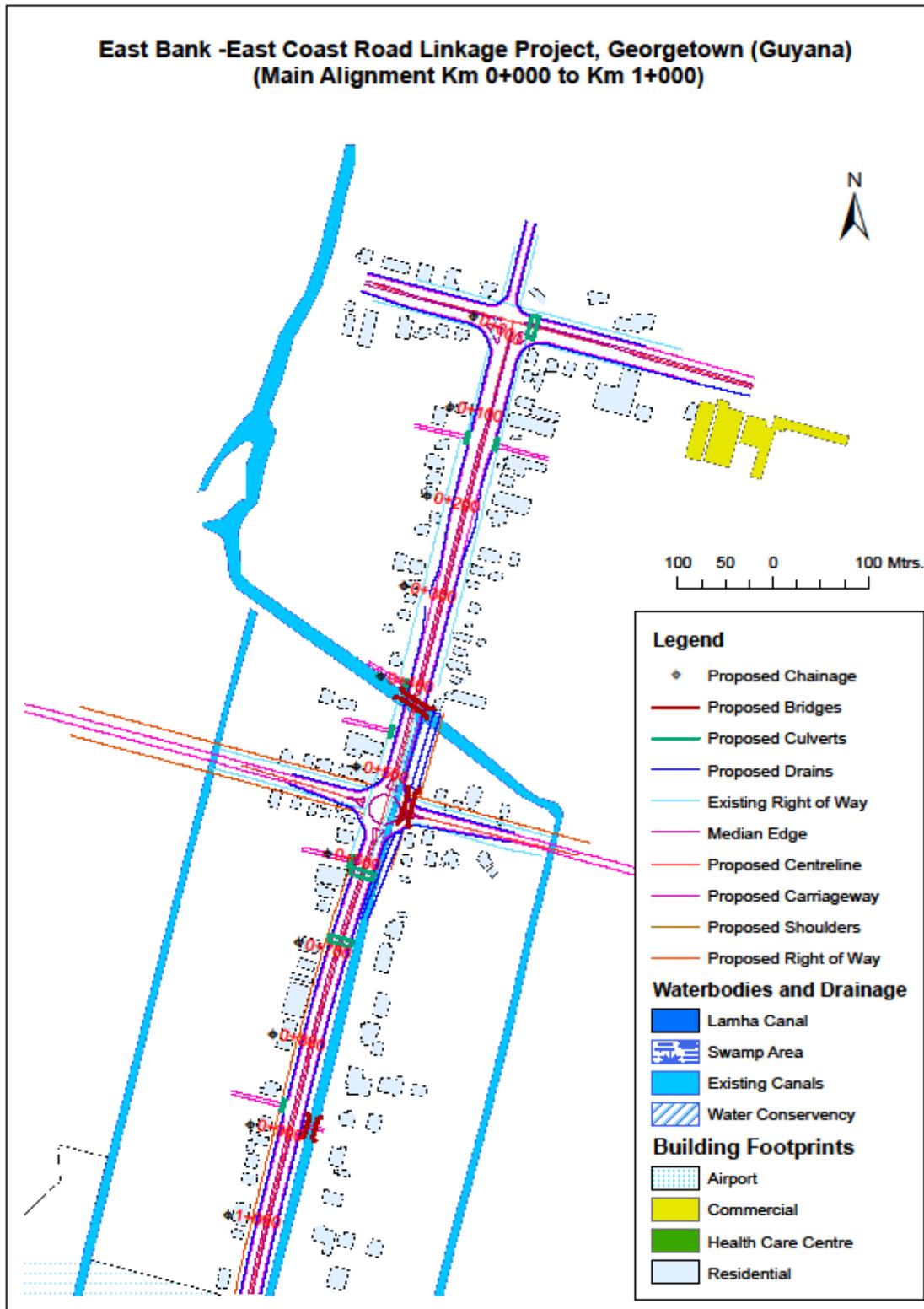


Figure 36. : GIS Map for Main Alignment From Km 0+000 to Km 1+000

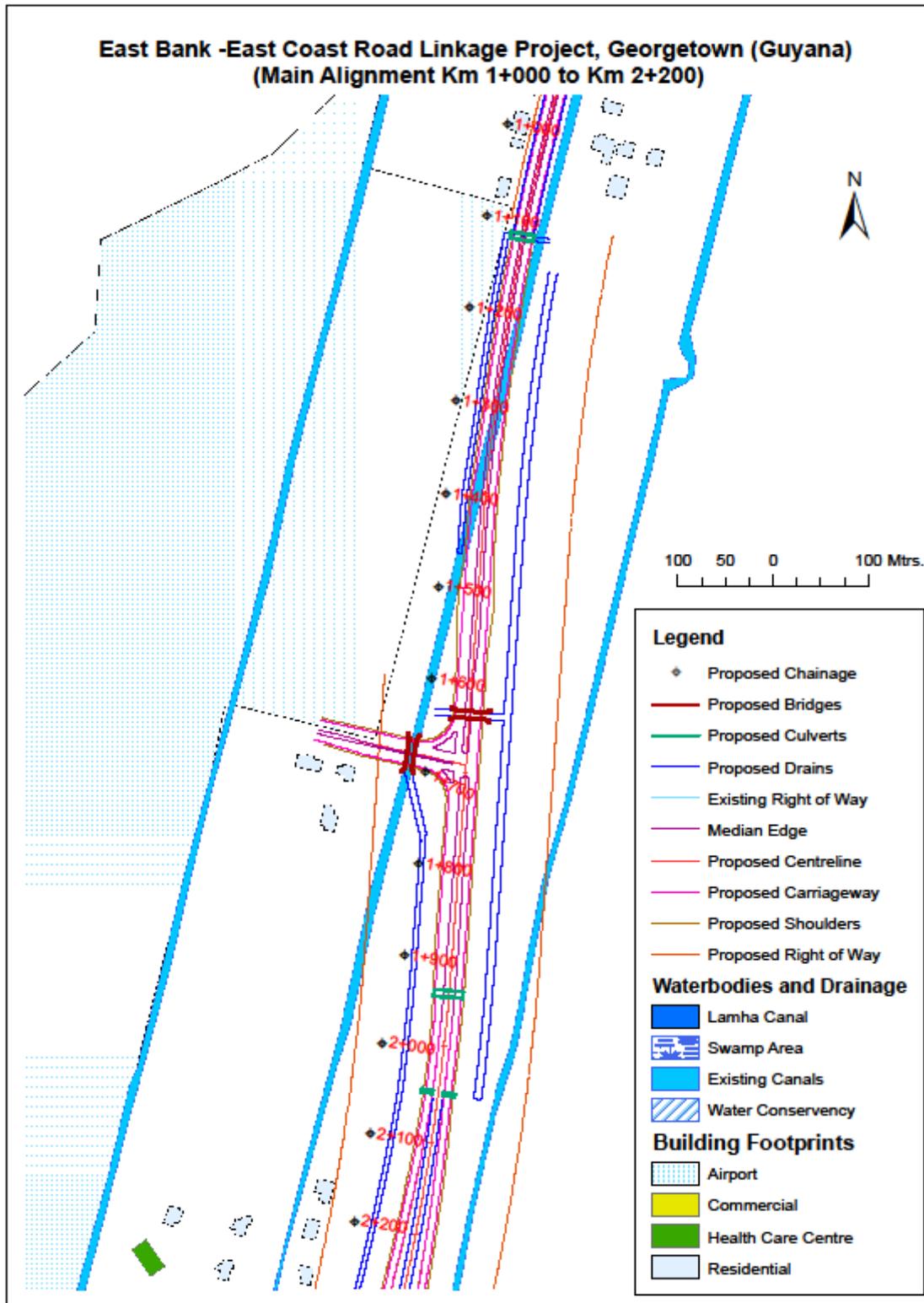


Figure 37. : GIS Map for Main Alignment From Km 1+000 to Km 2+200

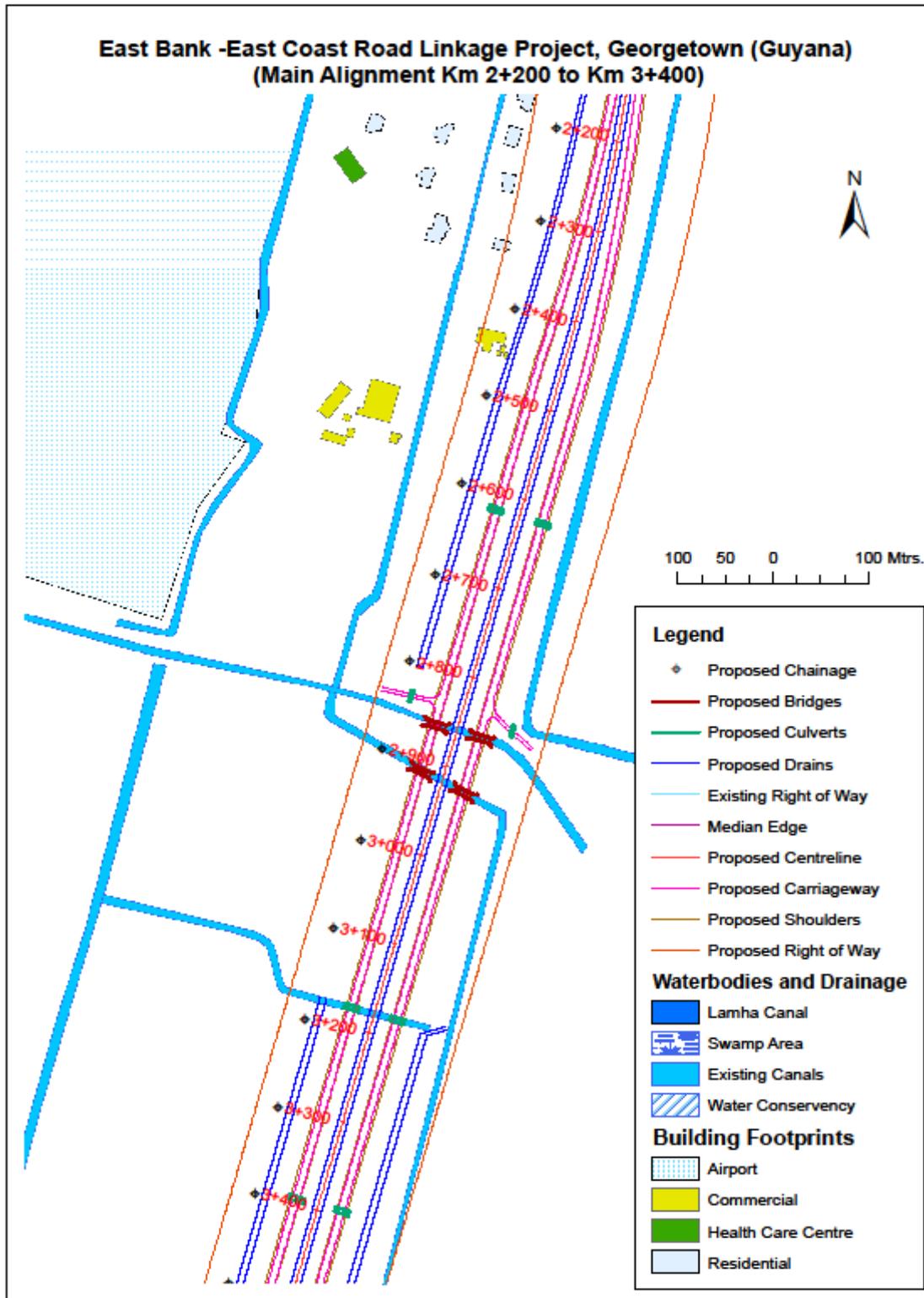


Figure 38. : GIS Map for Main Alignment From Km 2+200 to Km 3+400

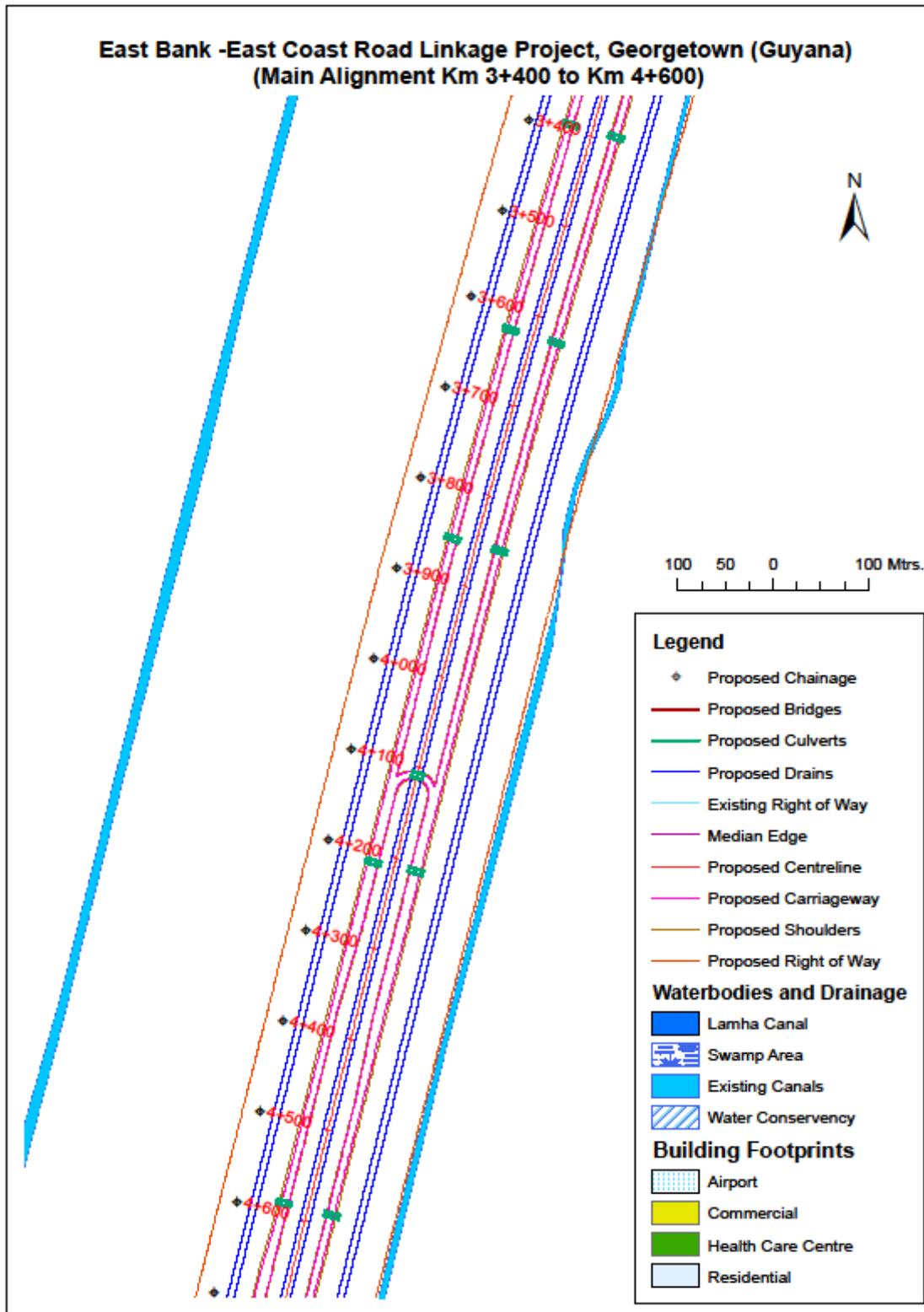


Figure 39. : GIS Map for Main Alignment From Km 3+400 to Km 4+600

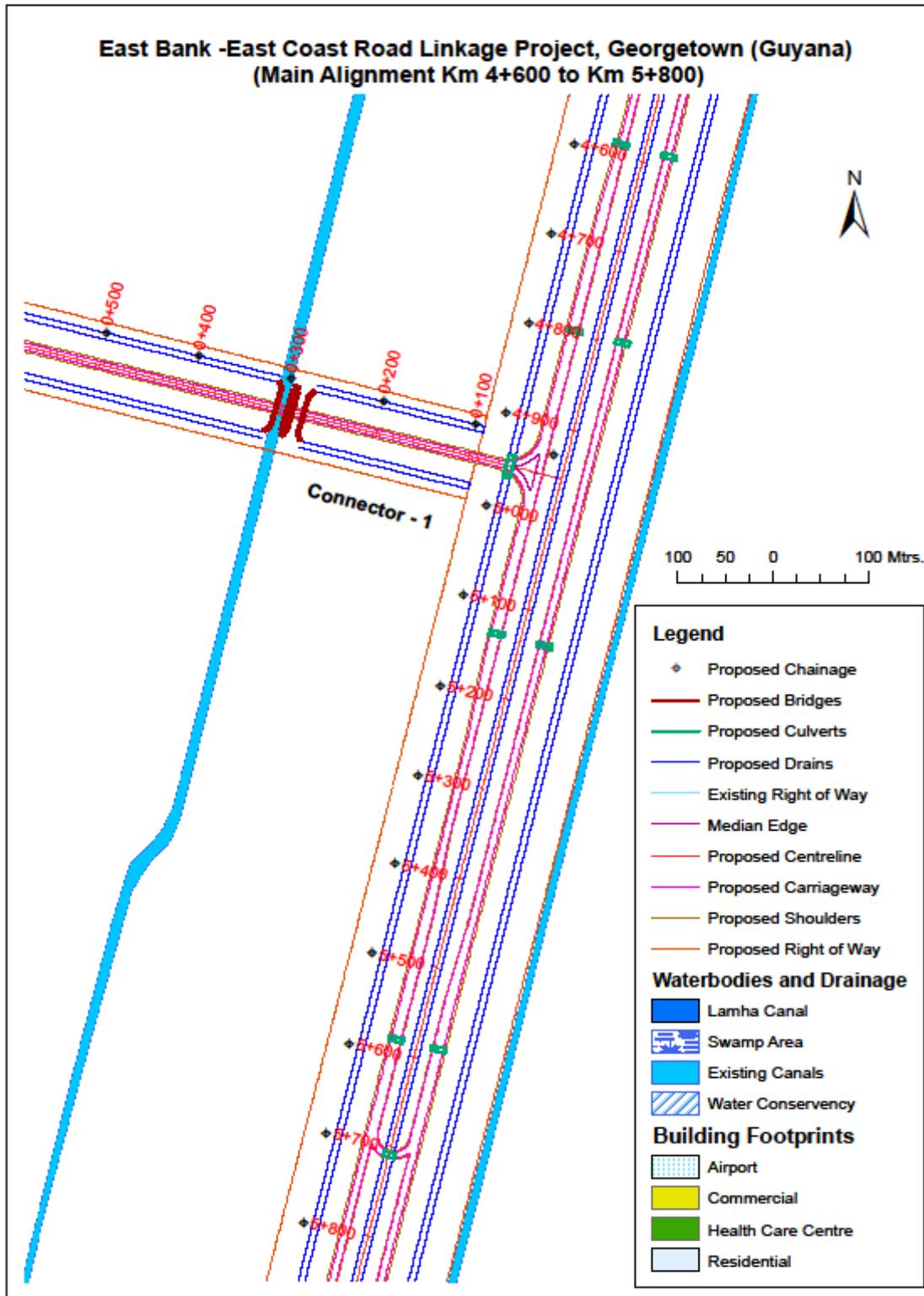


Figure 40. : GIS Map for Main Alignment From Km 4+600 to Km 5+800

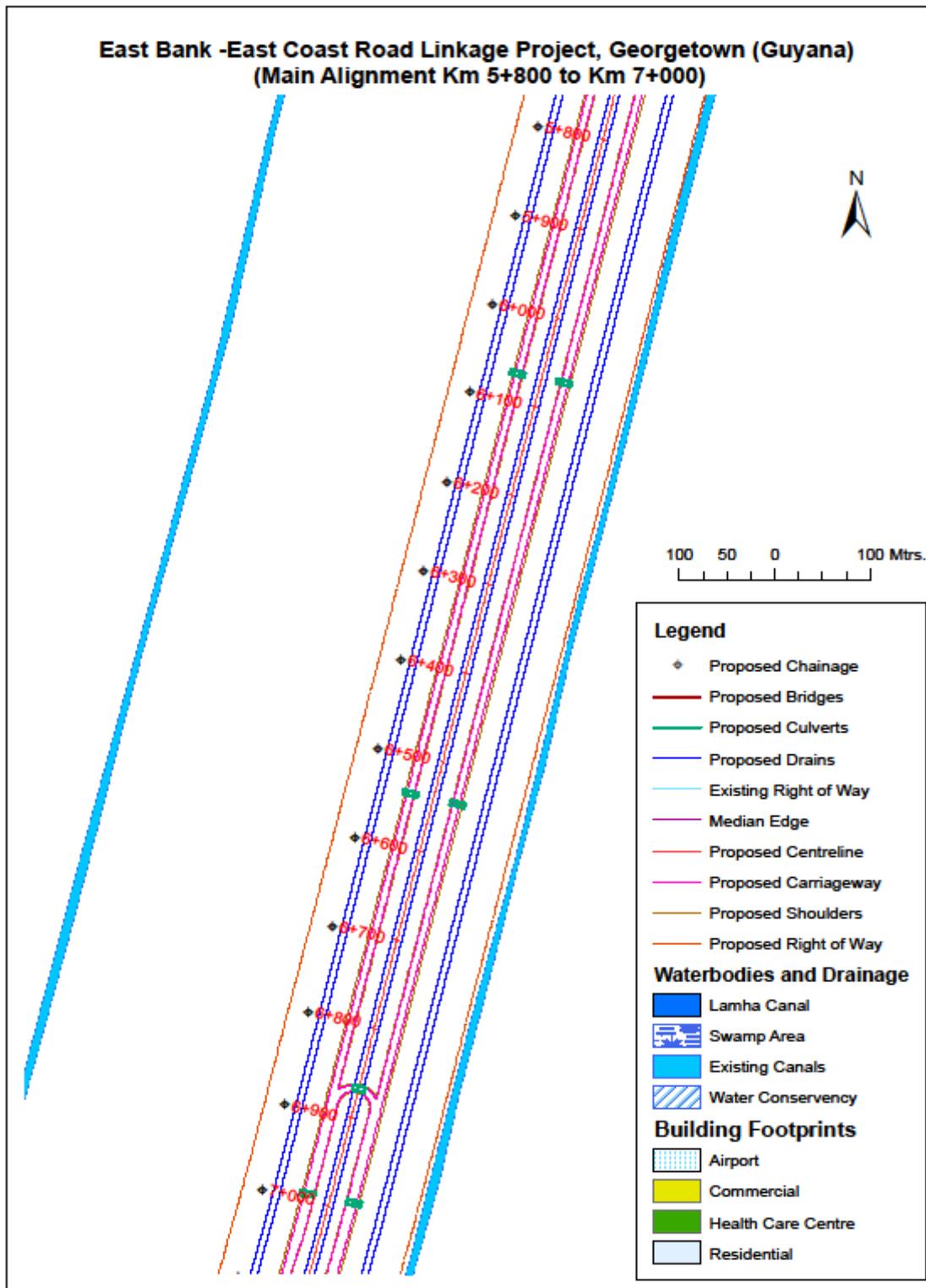


Figure 41. : GIS Map for Main Alignment From Km 5+800 to Km 7+000

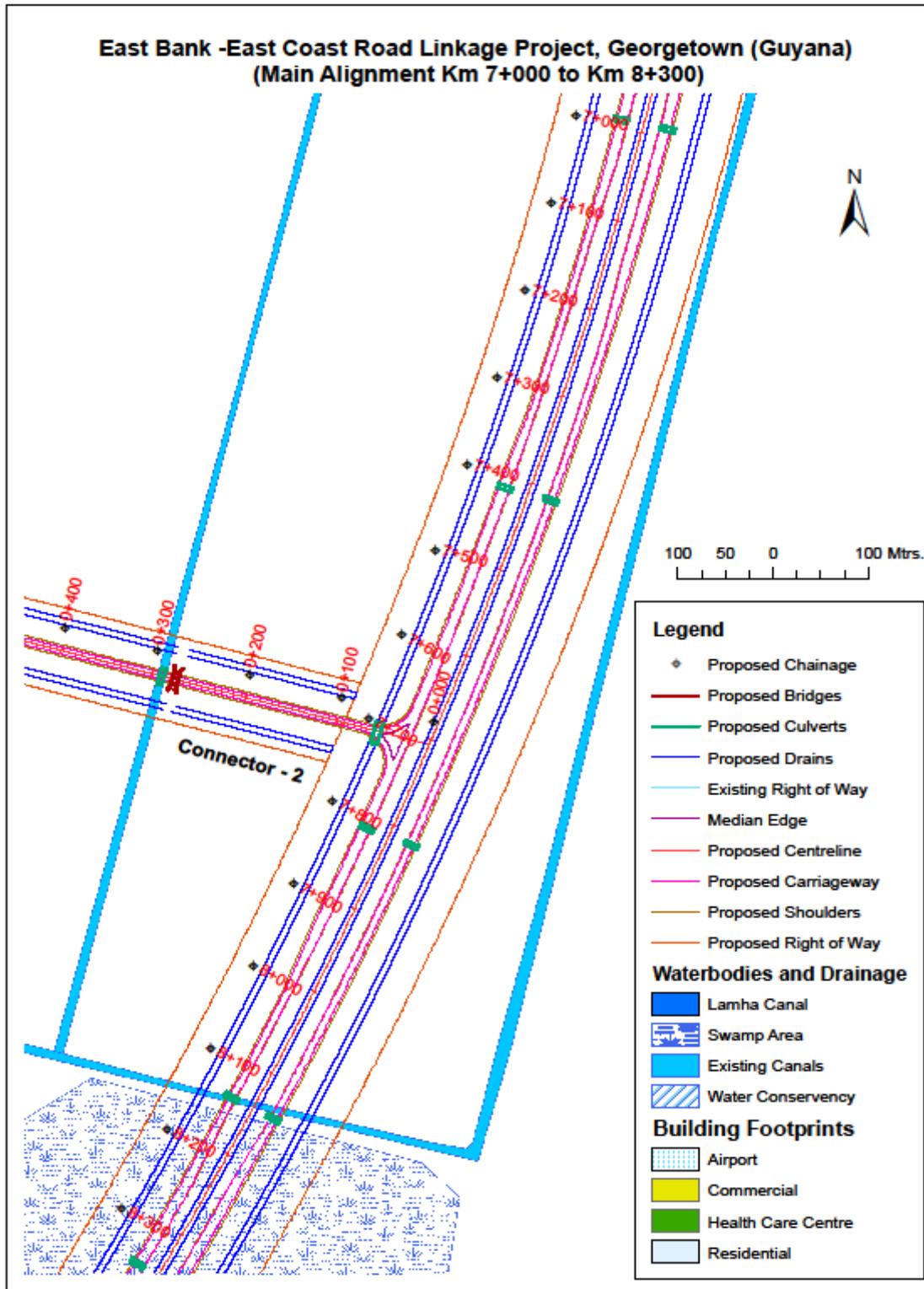


Figure 42. : GIS Map for Main Alignment From Km 7+000 to Km 8+300

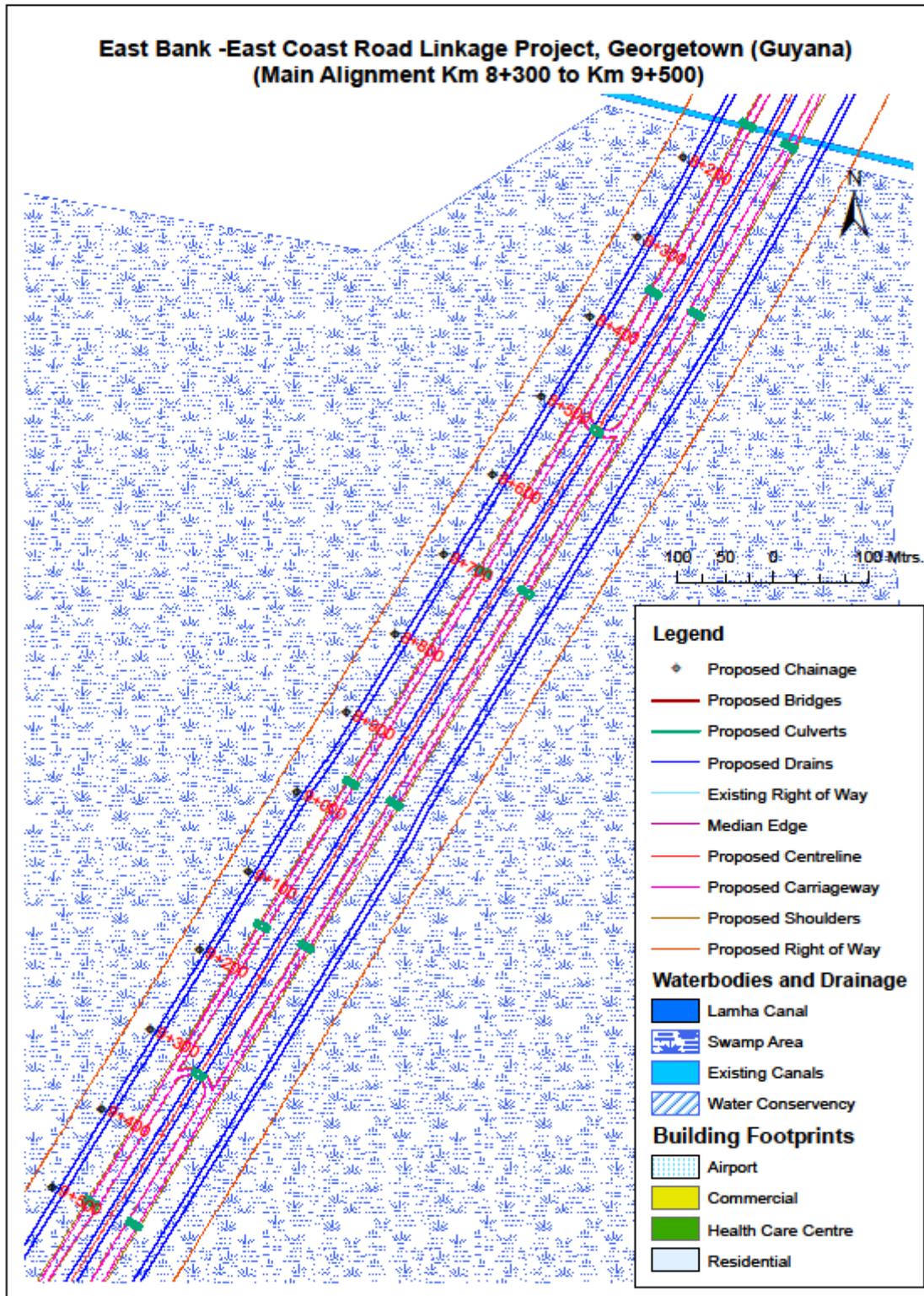


Figure 43. : GIS Map for Main Alignment From Km 8+300 to Km 9+500

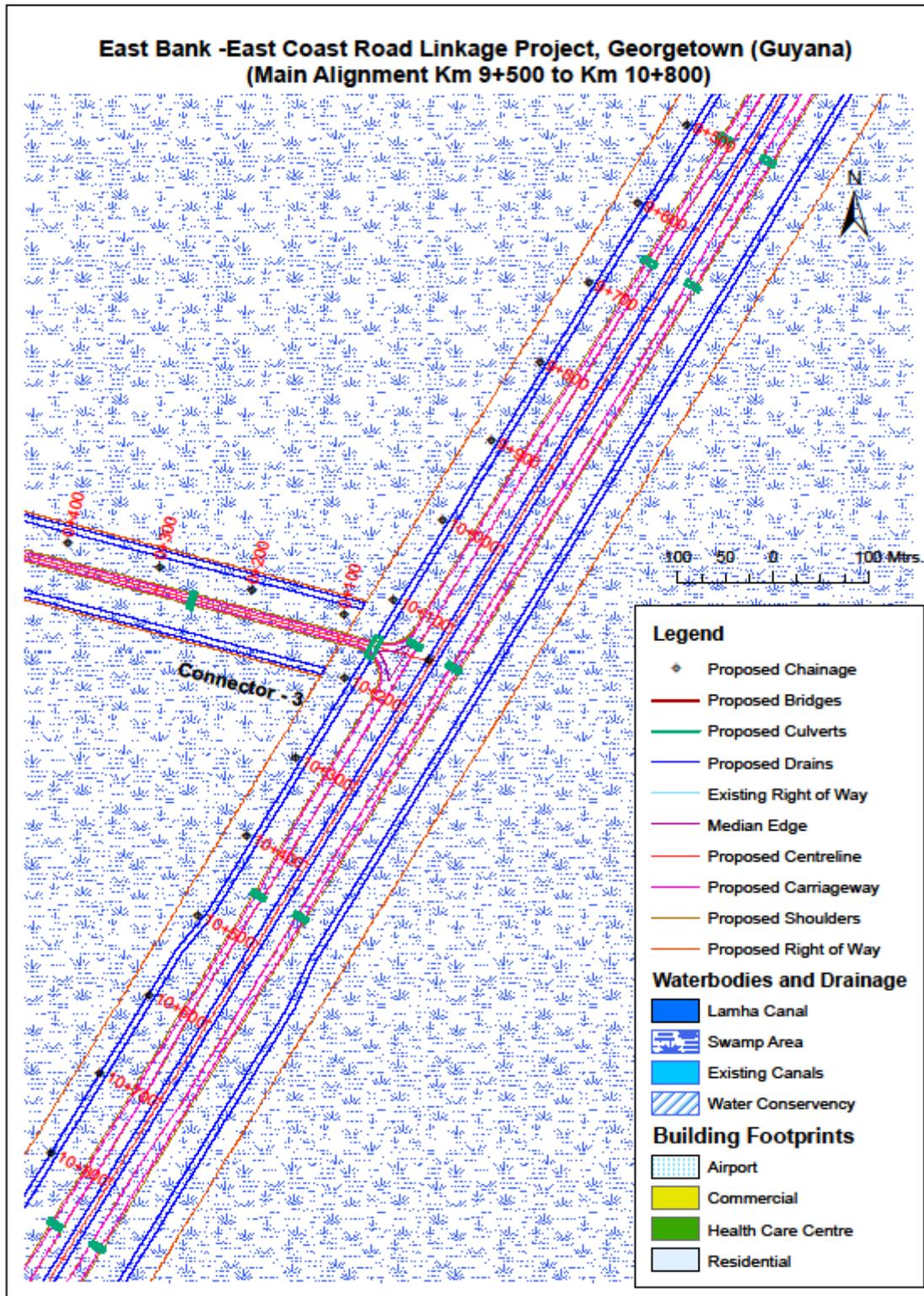


Figure 44. : GIS Map for Main Alignment From Km 9+500 to Km 10+800

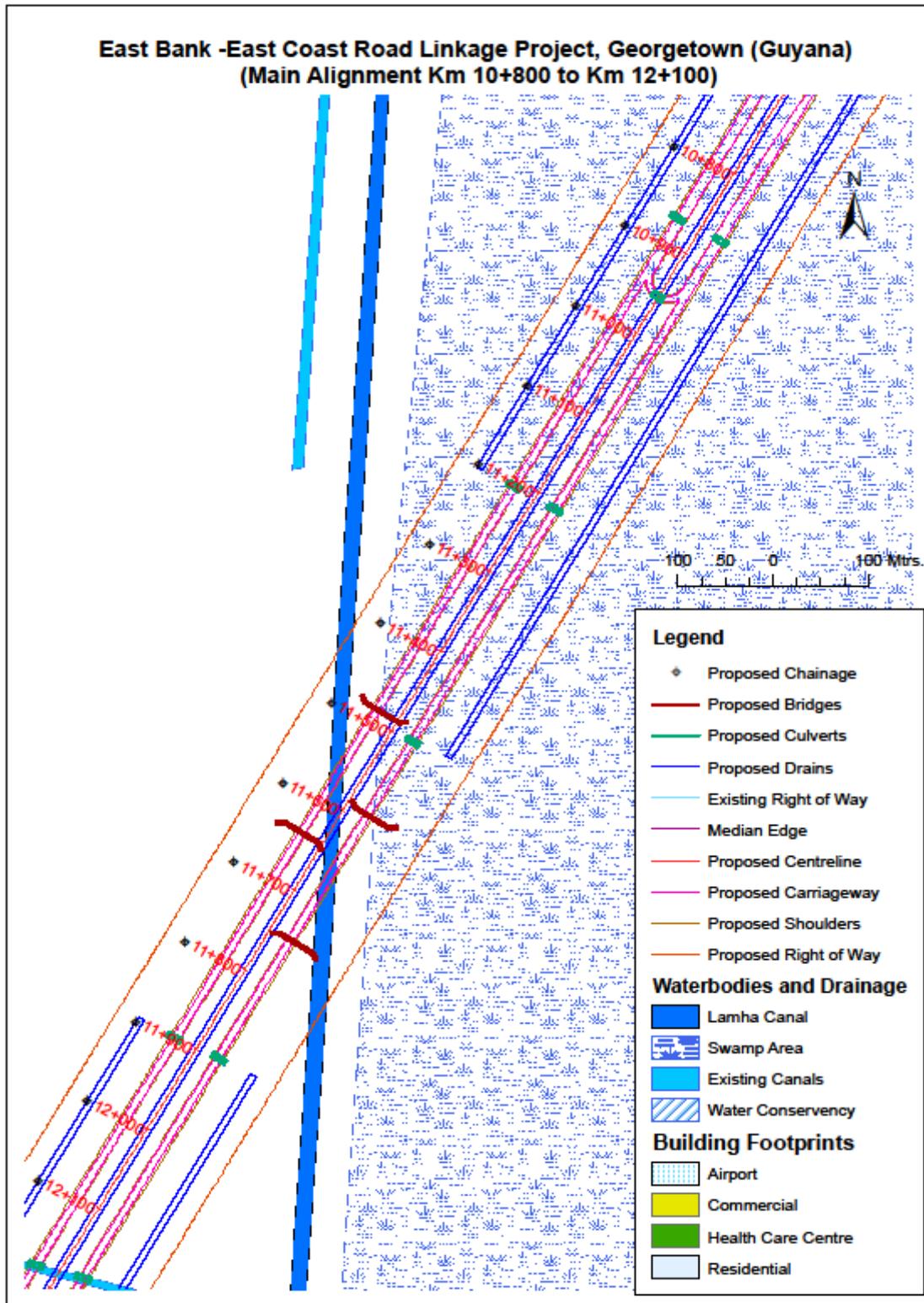


Figure 45. : GIS Map for Main Alignment From Km 10+800 to Km 12+100

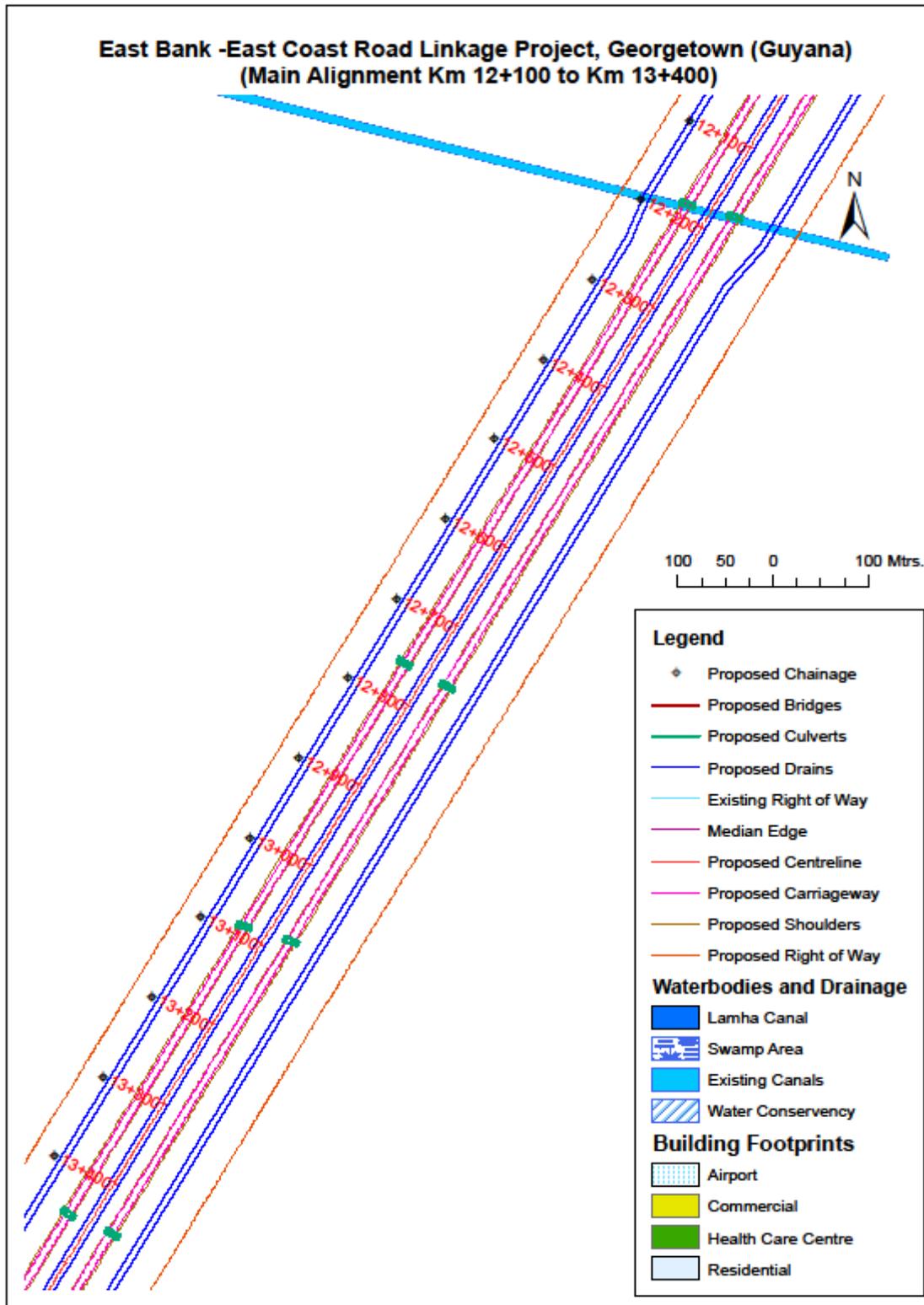


Figure 46. : GIS Map for Main Alignment From Km 12+100 to Km 13+400

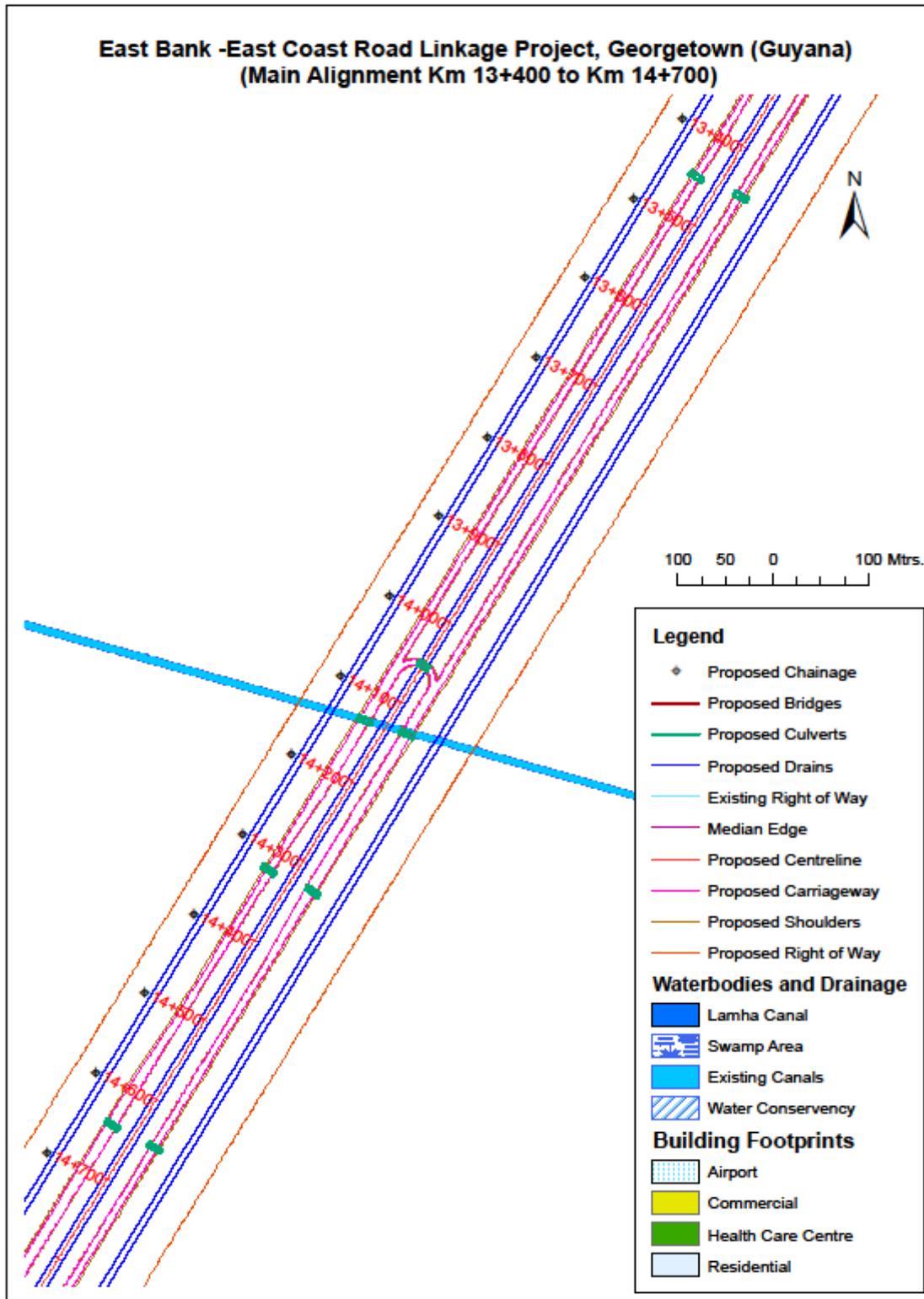


Figure 47. : GIS Map for Main Alignment From Km 13+400 to Km 14+700

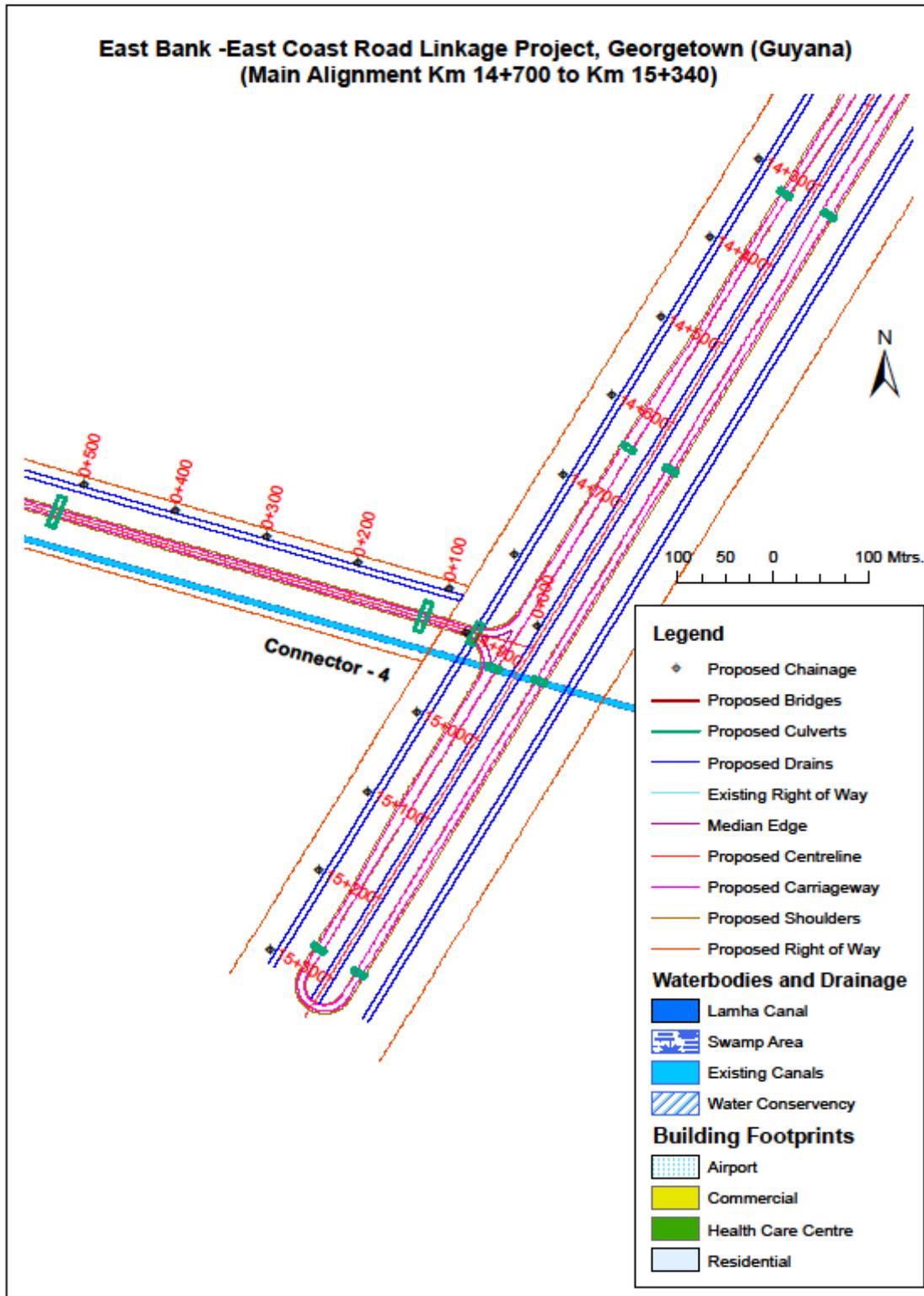


Figure 48. : GIS Map for Main Alignment From Km 14+700 to Km 15+340 (end)

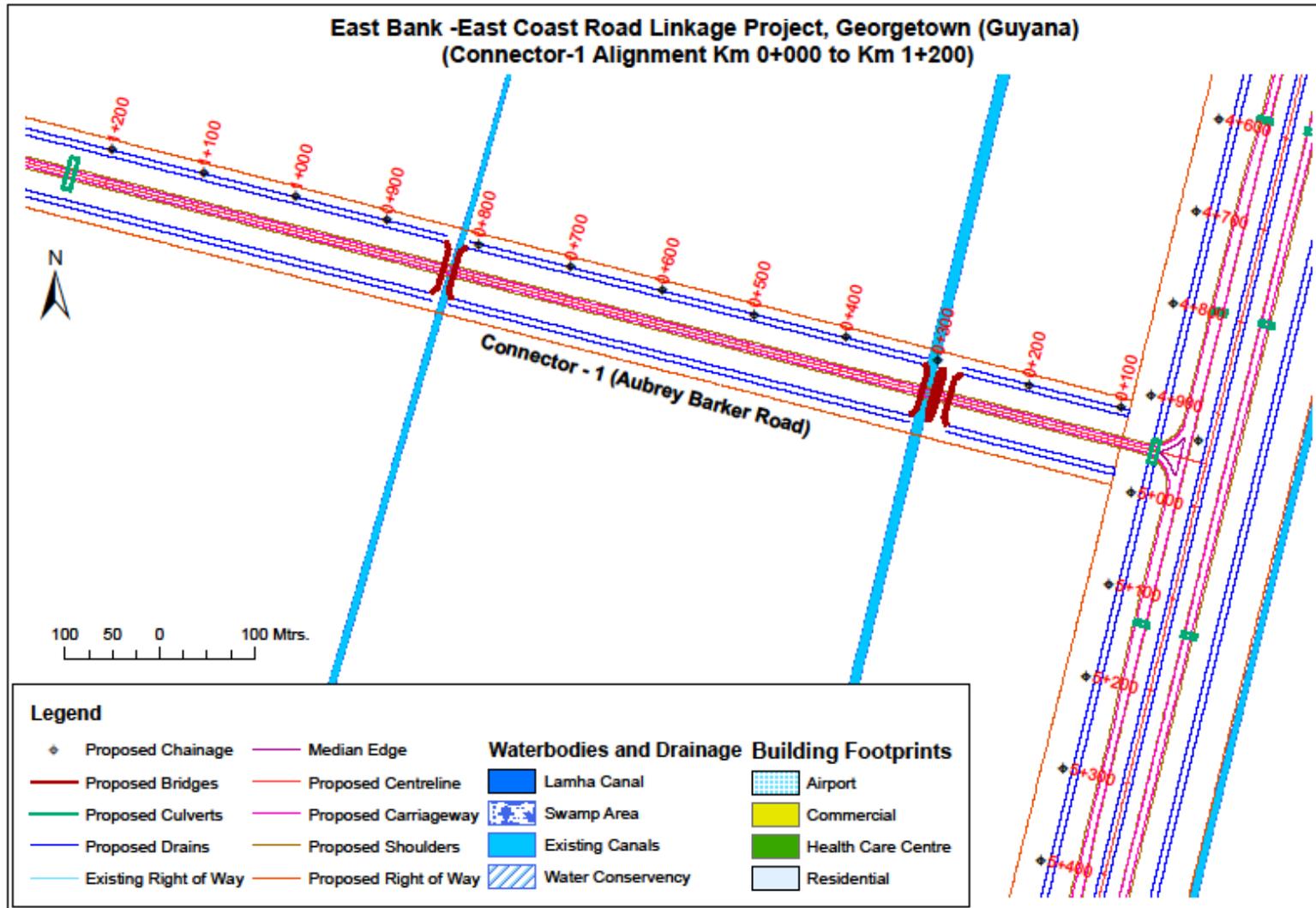


Figure 49. : GIS Map for Connector - 1 Alignment From Km 0+000 to Km 1+200

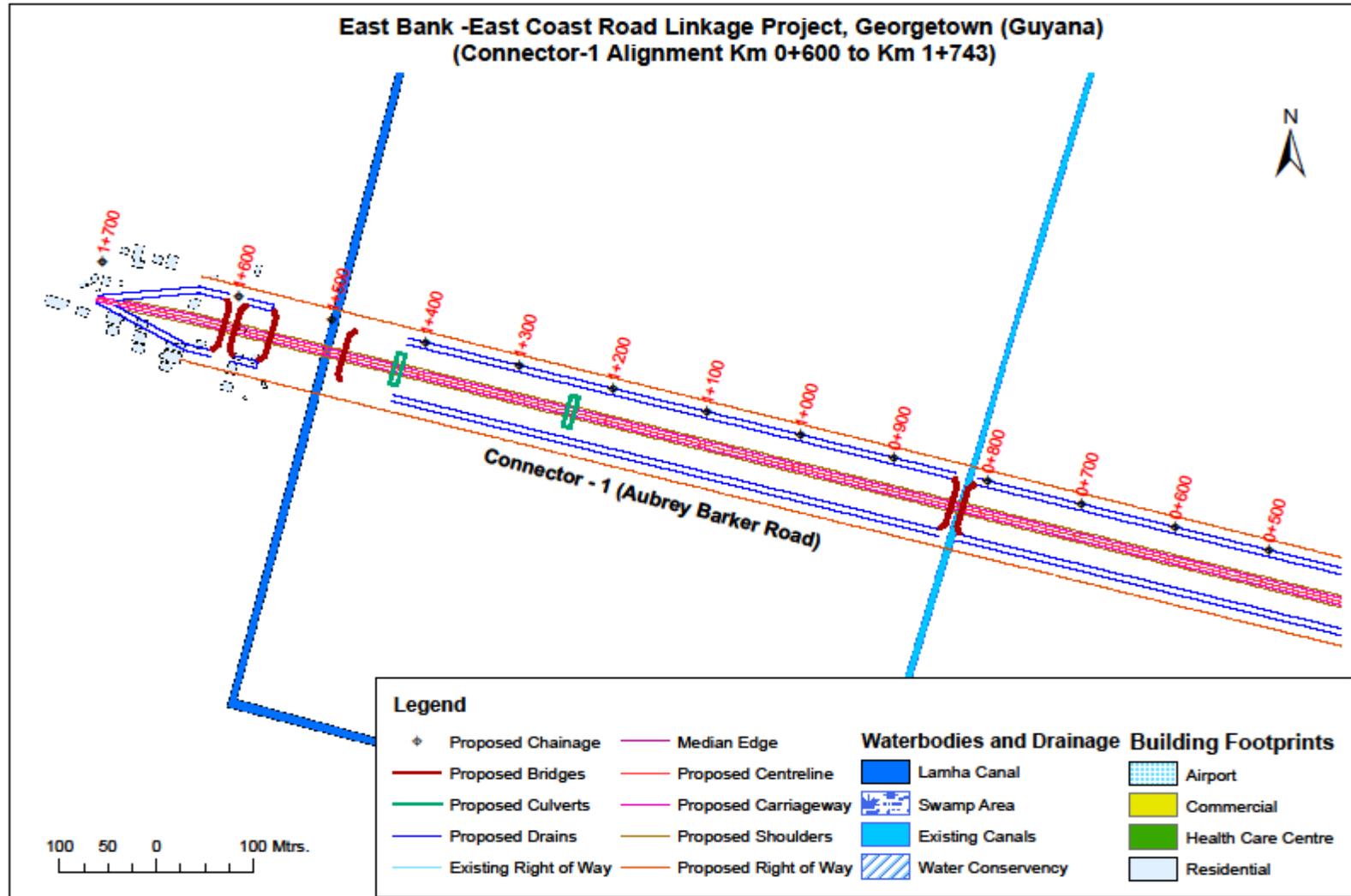


Figure 50. : GIS Map for Connector - 1 Alignment From Km 0+600 to Km 1+743 (end)

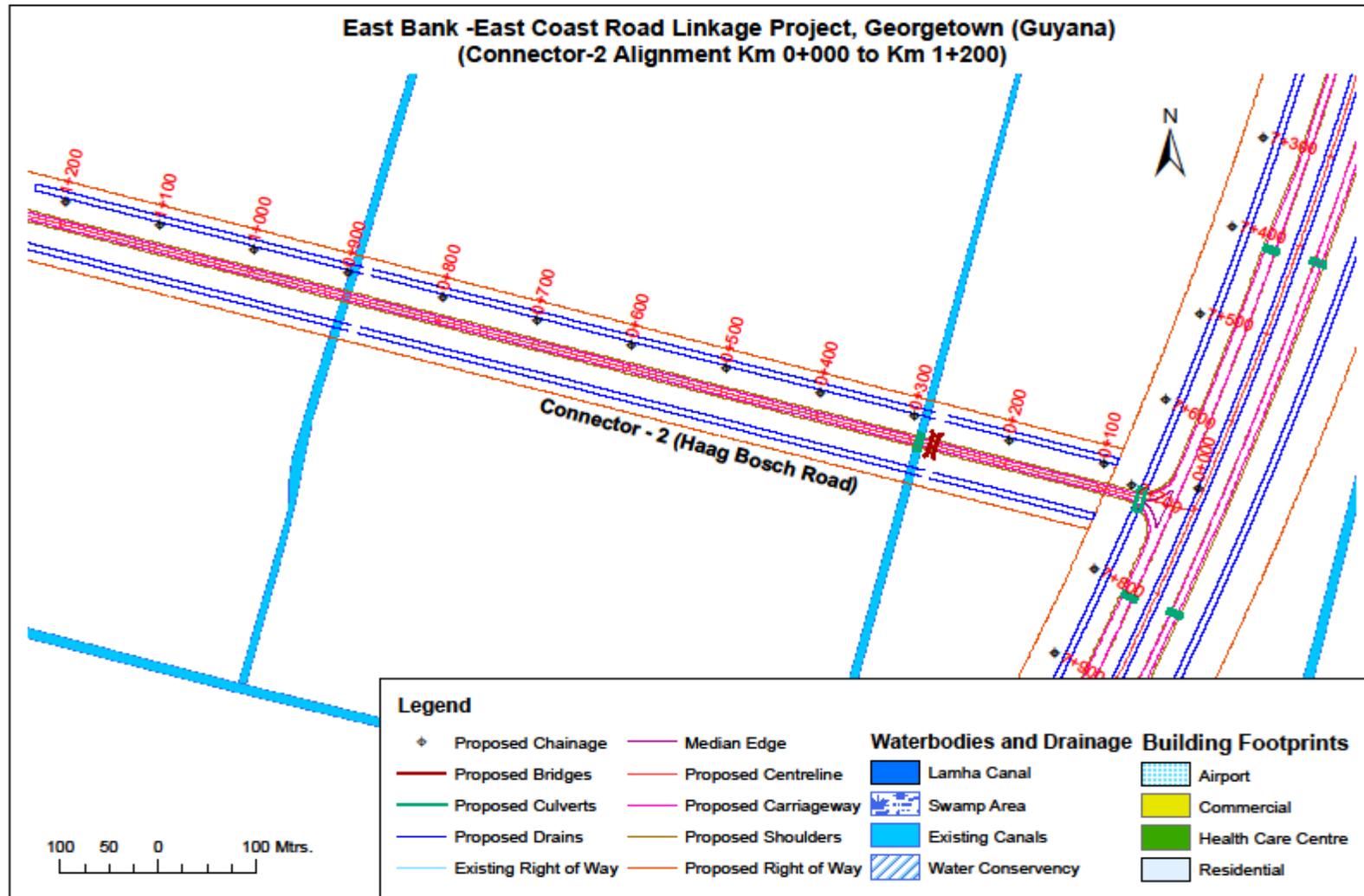


Figure 51. : GIS Map for Connector - 2 Alignment From Km 0+000 to Km 1+200

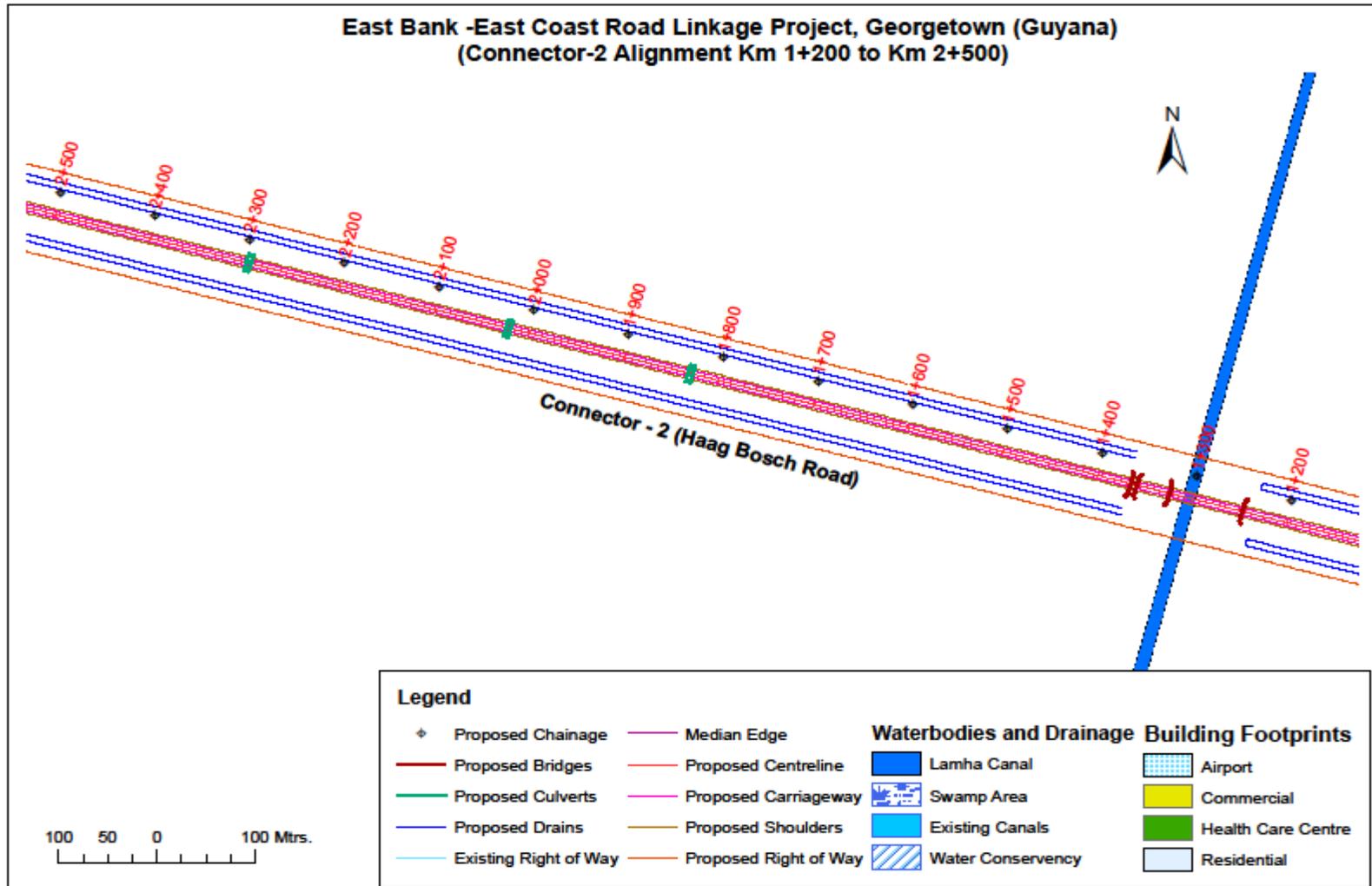


Figure 52. : GIS Map for Connector - 2 Alignment From Km 1+200 to Km 2+500

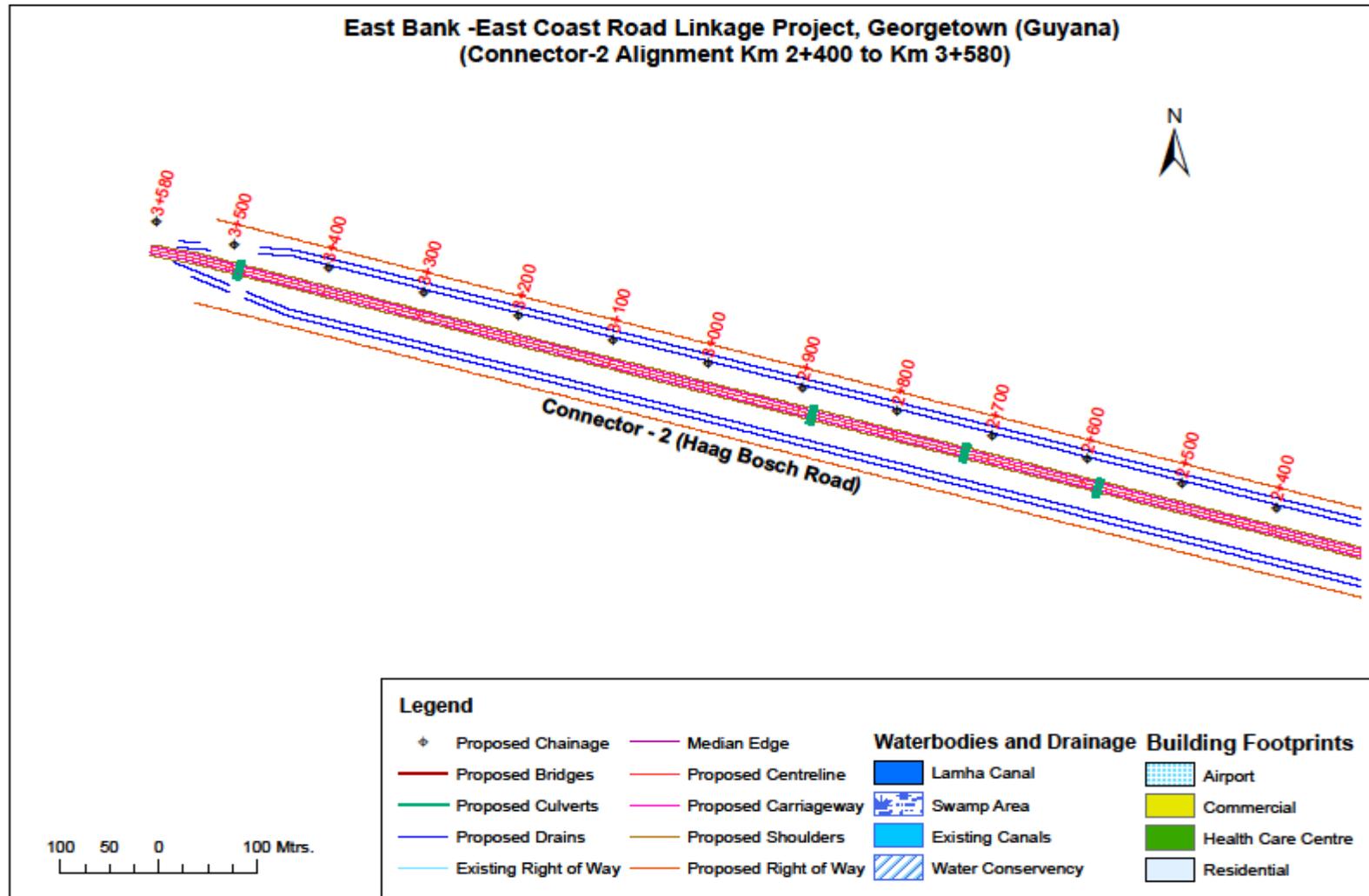


Figure 53. : GIS Map for Connector - 2 Alignment From Km 2+400 to Km 3+580 (end)

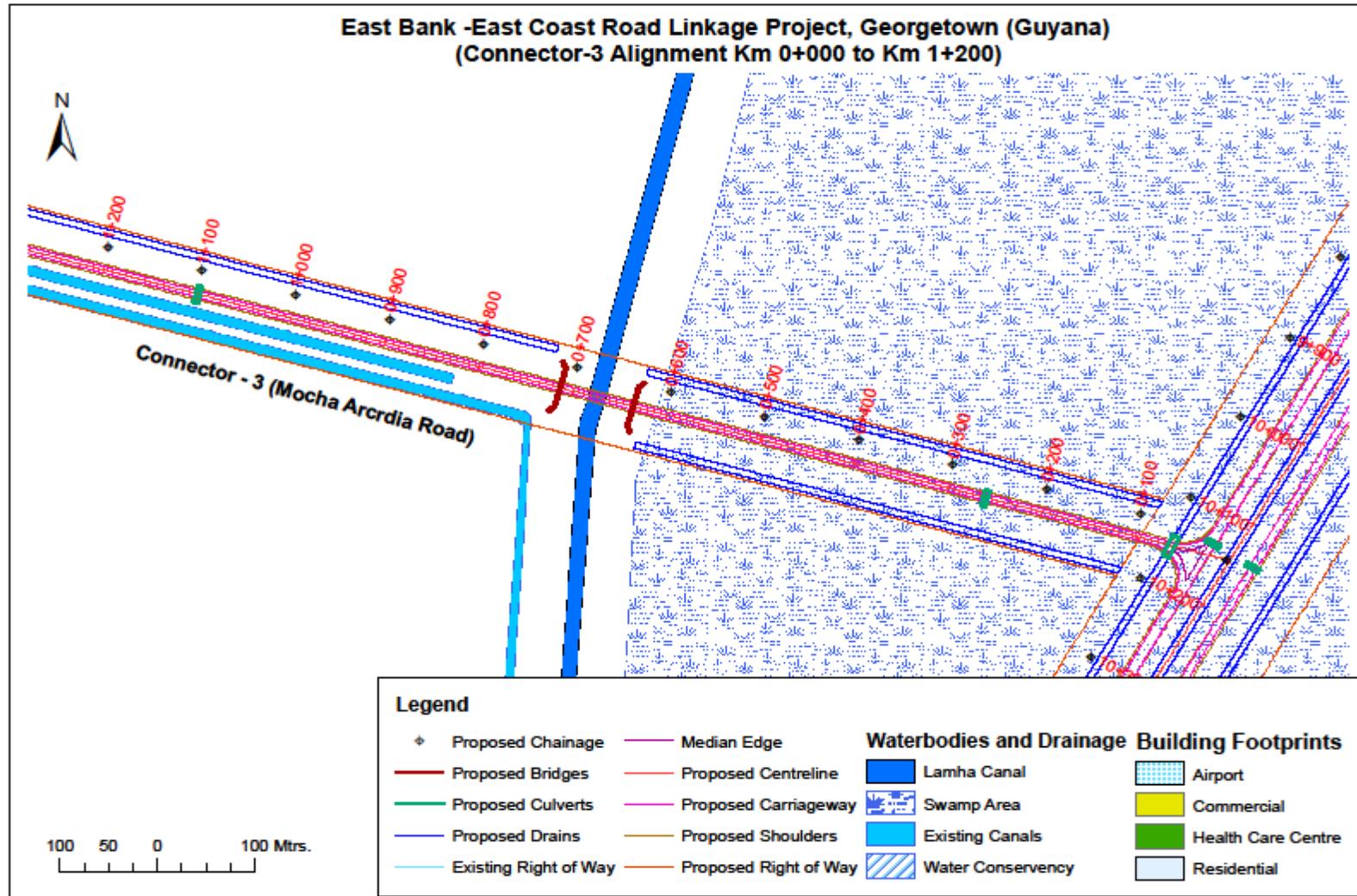


Figure 54. : GIS Map for Connector - 3 Alignment From Km 0+000 to Km 1+200

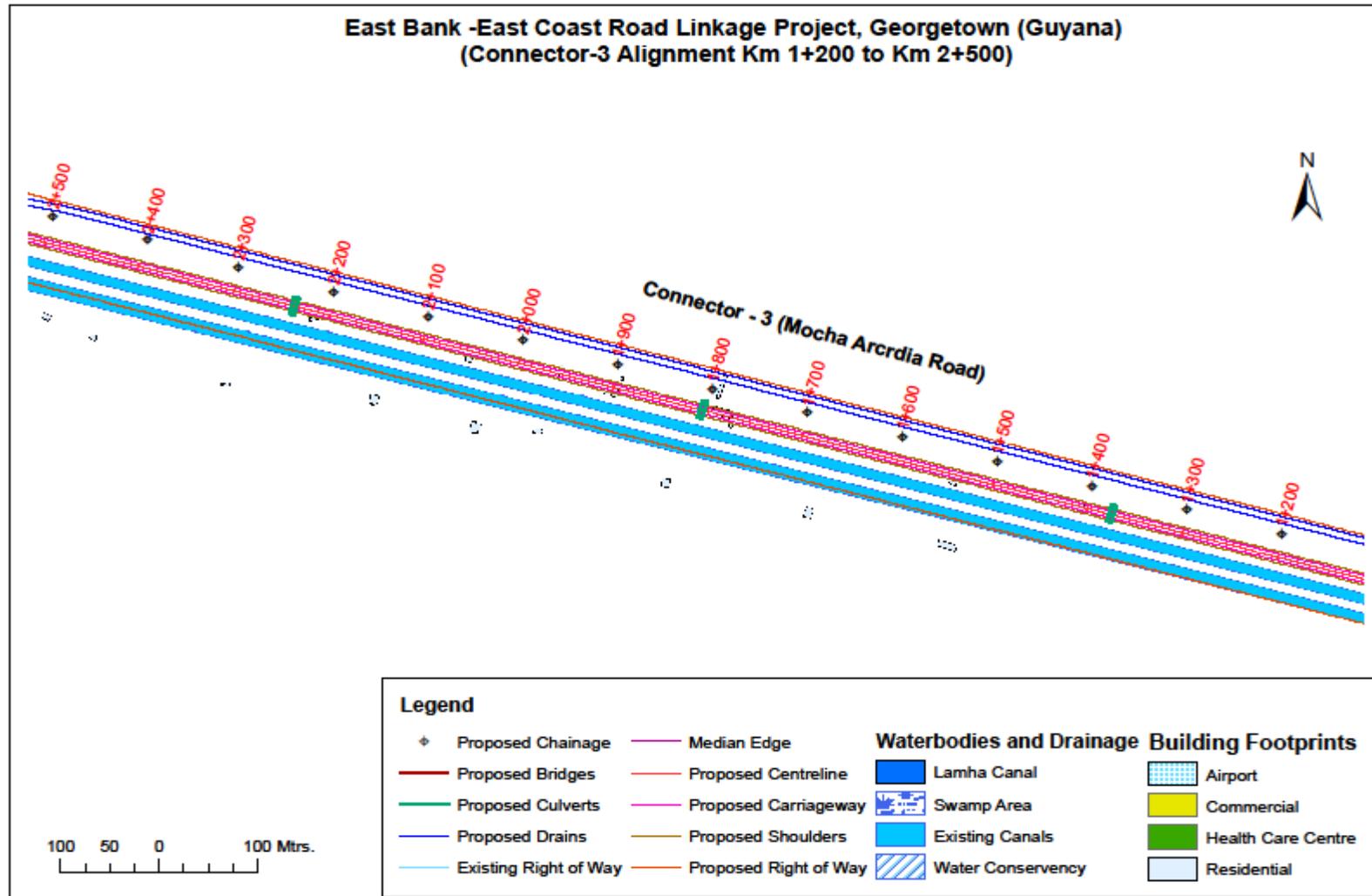


Figure 55. : GIS Map for Connector - 3 Alignment From Km 1+200 to Km 2+500

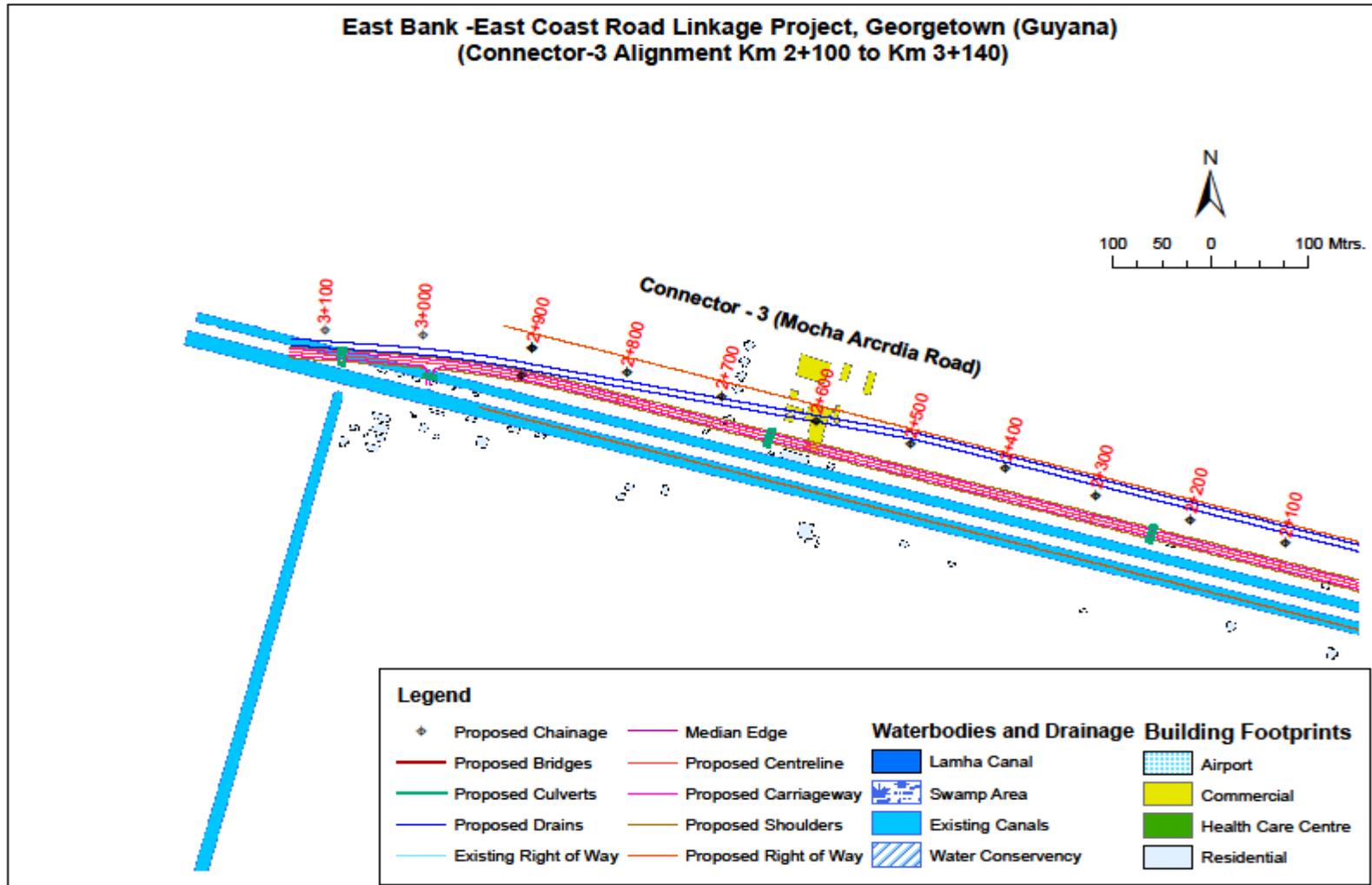


Figure 56. : GIS Map for Connector - 3 Alignment From Km 2+100 to Km 3+140 (end)

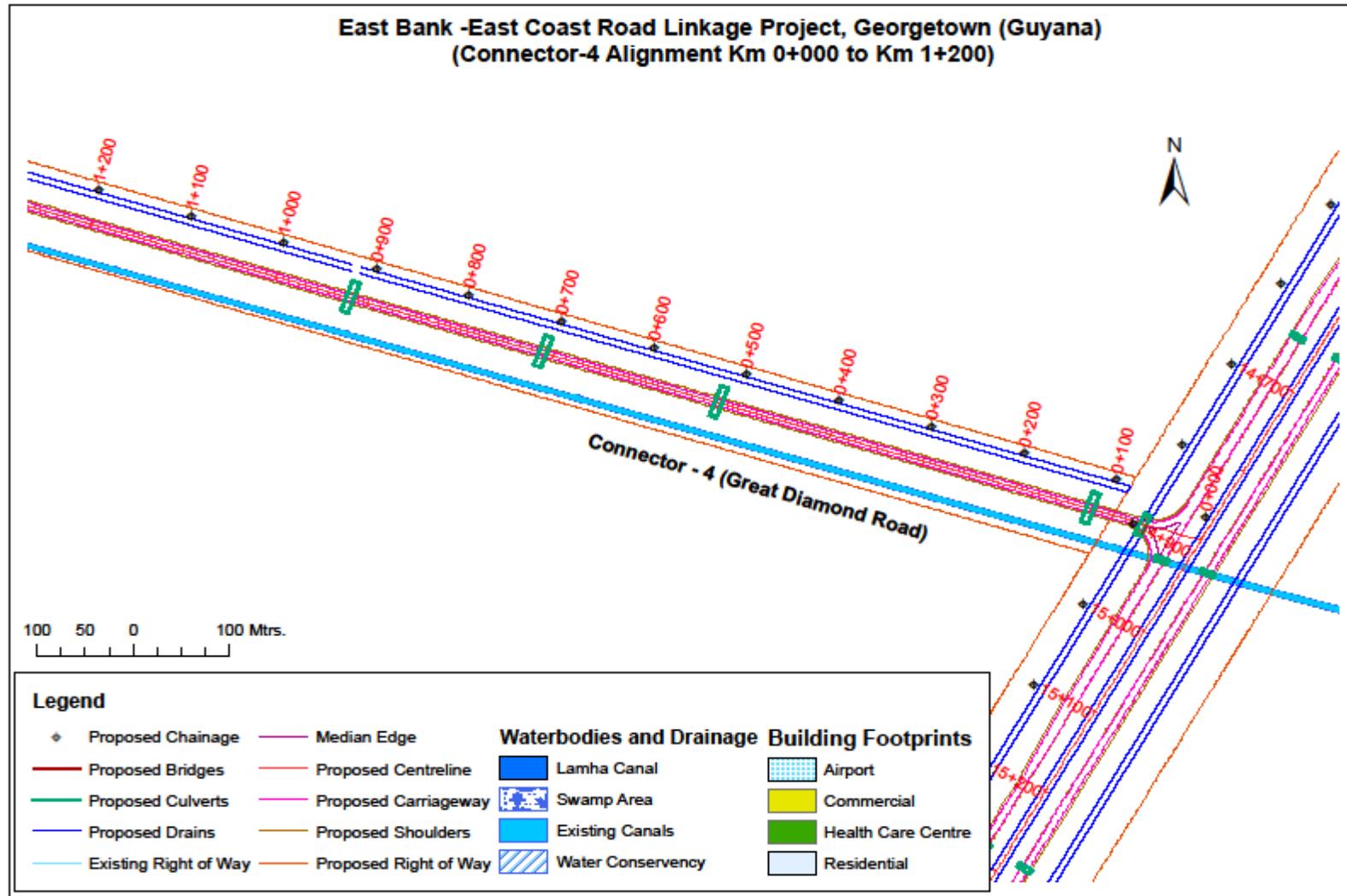


Figure 57. : GIS Map for Connector - 3 Alignment From Km 0+000 to Km 0+200

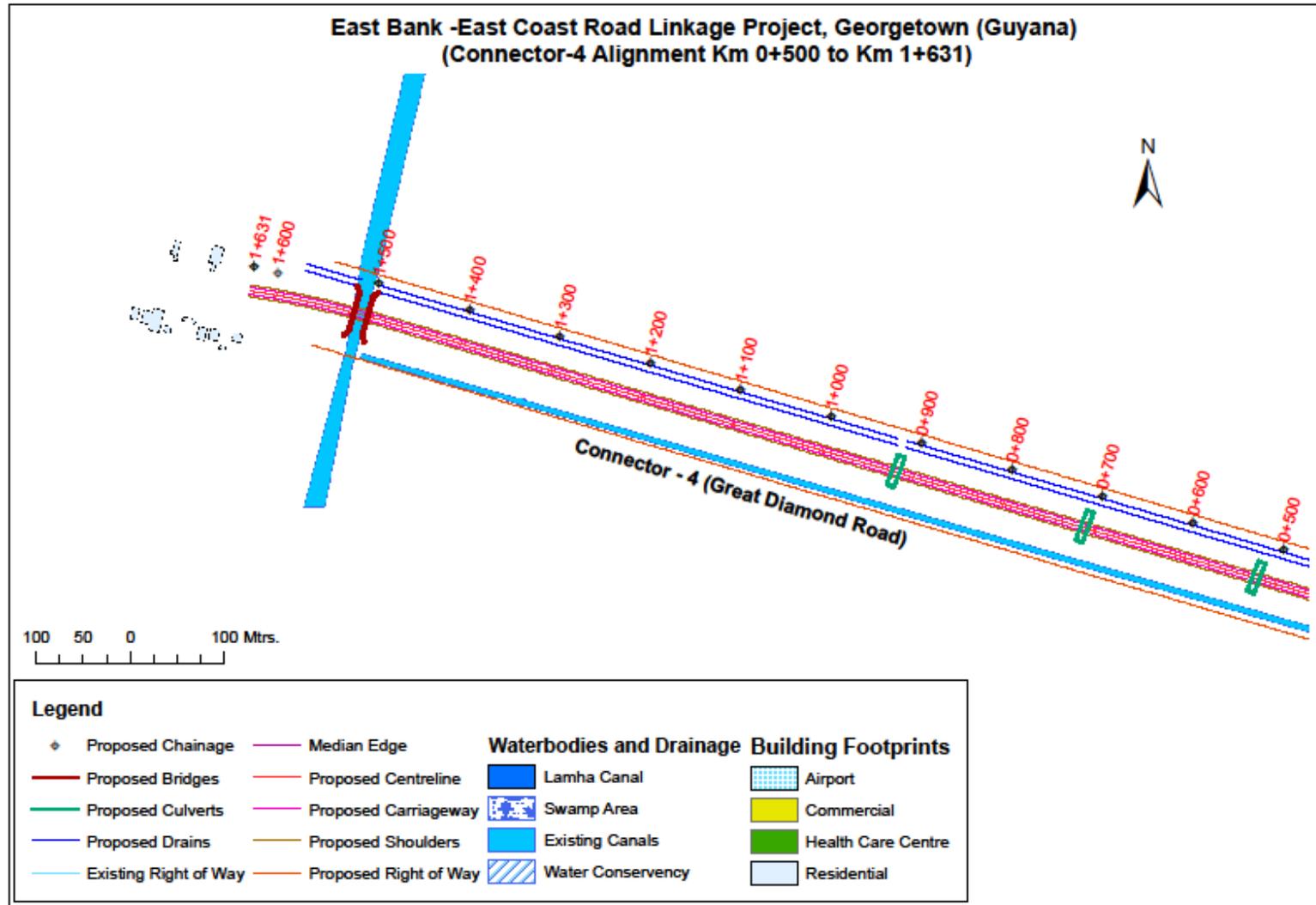


Figure 58. : GIS Map for Connector-4 Alignment From Km 0+500 to Km 1+631 (end)

