



BARBADOS CLIMATE RESILIENT SOUTH COAST WATER RECLAMATION PLANT (BA-L1063)

D2 - ESIA, ESMP AND ESMS

PREPARED FOR:
INTER-AMERICAN DEVELOPMENT BANK
1300 NEW YORK AVENUE,
N.W. WASHINGTON, D.C.
20577, USA

PREPARED BY:
ENVIRONMENTAL SOLUTIONS LTD.
7 HILLVIEW AVENUE
KINGSTON 10
JAMAICA



PROPRIETARY RESTRICTION NOTICE

This document contains information proprietary to Environmental Solutions Ltd. and shall not be reproduced or transferred to other documents, or disclosed to others, or used for any purpose other than that for which it is furnished without the prior written permission of Environmental Solutions Limited.

Further, this proposal is the sole property of Environmental Solutions Ltd. and no portion of it should be used in the formulation of a Request for Proposal for open bid, now or in the future, by the agencies and/or persons who may see it in the process of its review, without written permission of Environmental Solutions Limited.

All rights reserved. Environmental Solutions Ltd.®

Table of Contents

LIST OF FIGURES	I
LIST OF TABLES	II
LIST OF ACRONYMS.....	IV
EXECUTIVE SUMMARY	V
1 INTRODUCTION	1
2 PROJECT OVERVIEW AND BACKGROUND	2
2.1 PROJECT JUSTIFICATION	2
2.2 PROJECT OBJECTIVES AND COMPONENTS	3
2.3 THE SOUTH COAST WATER RECLAMATION PROJECT.....	4
3 LEGAL AND REGULATORY FRAMEWORK	9
3.1 SOCIAL CONSIDERATIONS IN THE LEGISLATIVE AND POLICY ENVIRONMENT.....	9
3.2 IDB ENVIRONMENTAL AND SOCIAL POLICY FRAMEWORK	17
4 APPROACH AND METHODOLOGY	20
4.1 GENERAL APPROACH	20
4.2 DESCRIBING THE EXISTING ENVIRONMENT	20
4.2.1 Site Assessments and Primary Data Collection.....	20
4.2.2 Desktop Research and Literature Review of Available Secondary Data.....	21
4.2.3 Socioeconomic Baseline.....	21
4.3 ASSESSMENT OF IMPACTS AND RISKS	26
4.4 STAKEHOLDER MAPPING, ANALYSIS AND ENGAGEMENT.....	28
4.5 GROSS GREEN HOUSE GAS (GHG) EMISSION CALCULATIONS.....	30
SECTION I – THE ESIA	31
5 DESCRIPTION OF THE EXISTING ENVIRONMENT.....	32
5.1 THE PROJECT SITE AND SITUATION.....	33
5.2 THE PHYSICAL ENVIRONMENT	35
5.2.1 Groundwater Resources	35
5.2.2 Irrigation Management.....	38
5.2.3 Disaster Risk Assessment	40
5.2.4 Climate and Climate Change.....	42
5.2.5 Greenhouse Gas (GHG) Emissions	43
5.3 WATER QUALITY	56
5.3.1 Groundwater quality.....	56
5.3.2 Graeme Hall Swamp.....	56
5.3.3 Coastal Water Quality.....	57
5.3.4 Effluent Quality	57
5.4 AIR QUALITY AND NOISE	58
5.5 BIODIVERSITY ASSESSMENT	58
5.5.1 Flora	59
5.5.2 Fauna	61
5.6 THE EXISTING SOUTH COAST SEWAGE TREATMENT PLANT.....	63
5.6.1 Summary of Operations	63
5.6.2 Labour and Working Conditions	65
5.7 THE SOCIOECONOMIC ENVIRONMENT.....	67
5.7.1 Socio-Demographic Context for the project.....	67
5.7.2 Socio-Economic Data.....	79
5.7.3 Cultural and Heritage Assets	85
5.7.4 Key Observations	91

5.7.5	<i>Key Findings and Conclusions</i>	100
5.8	GENDER ASSESSMENT	105
5.8.1	<i>Gender dynamics in Barbados and project area</i>	105
5.8.2	<i>Key Risks and their Gender Implications</i>	108
5.8.3	<i>Implications for the ESA and ESMP</i>	112
6	IMPACT ASSESSMENT AND PROPOSED MITIGATION MEASURES	113
6.1	COMPONENT 1 - WATER RECLAMATION INFRASTRUCTURE	114
6.1.1	<i>The Construction Phase</i>	114
6.1.2	<i>The Operations Phase</i>	127
6.2	COMPONENT 2 – RECLAIMED WATER USE	140
6.2.1	<i>The Construction Phase</i>	140
6.2.2	<i>The Operations Phase</i>	155
6.3	COMPONENT 3 – CONSTRUCTION OF 7MW SOLAR FACILITY	164
6.3.1	<i>The Construction Phase</i>	164
6.3.2	<i>The Operations Phase</i>	175
6.4	CUMULATIVE IMPACTS	179
7	CONCLUSION	182
	SECTION II – THE ESMP	183
8	ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)	184
8.1	INTRODUCTION TO THE ESMP	184
8.1.1	<i>Objectives of the ESMP</i>	184
8.1.2	<i>Scope of the ESMP</i>	184
8.2	ALIGNMENT WITH THE 2021 NEMUS ESMP	185
8.3	KEY ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION	185
8.3.1	<i>Construction Phase</i>	185
8.3.2	<i>Operational Phase</i>	186
8.3.3	<i>Management Plans</i>	187
9	ENVIRONMENTAL HEALTH AND SAFETY PLAN	187
9.1	WATER QUALITY MANAGEMENT	188
9.1.1	<i>Monitoring Standards</i>	188
9.1.2	<i>Monitoring Equipment and Stations</i>	188
9.1.3	<i>Monitoring Frequency</i>	188
9.1.4	<i>Management and Mitigation Measures</i>	188
9.1.5	<i>Key Performance Indicators</i>	189
9.1.6	<i>Roles and Responsibilities</i>	189
9.1.7	<i>Data Analysis and Reporting</i>	190
9.2	AIR QUALITY MANAGEMENT	190
9.2.1	<i>Monitoring Standards</i>	190
9.2.2	<i>Monitoring Equipment and Stations</i>	191
9.2.3	<i>Monitoring Frequency</i>	191
9.2.4	<i>Management and Mitigation Measures</i>	191
9.2.5	<i>Key Performance Indicators</i>	192
9.2.6	<i>Roles and Responsibilities</i>	193
9.2.7	<i>Data Analysis and Reporting</i>	193
9.3	NOISE MANAGEMENT	193
9.3.1	<i>Monitoring Standards</i>	193
9.3.2	<i>Monitoring Equipment and Stations</i>	194
9.3.3	<i>Monitoring Frequency</i>	194
9.3.4	<i>Management and Mitigation Measures</i>	194
9.3.5	<i>Key Performance Indicators</i>	195
9.3.6	<i>Roles and Responsibilities</i>	195
9.3.7	<i>Data Analysis and Reporting</i>	196
9.4	WASTE MANAGEMENT	196

9.4.1	Monitoring Frequency	196
9.4.2	Management and Mitigation Measures	196
9.4.3	Key Performance Indicators	200
9.4.4	Roles and Responsibilities	201
9.4.5	Data Analysis and Reporting	201
9.5	TRAFFIC MANAGEMENT	202
9.5.1	Monitoring Standards	202
9.5.2	Monitoring Frequency	202
9.5.3	Management and Mitigation Measures	202
9.5.4	Key Performance Indicators	203
9.5.5	Roles and Responsibilities	203
9.5.6	Data Analysis and Reporting	204
9.6	WORKER HEALTH AND SAFETY MANAGEMENT	204
9.6.1	Monitoring Frequency	204
9.6.2	Management and Mitigation Measures	204
9.6.3	Key Performance Indicators	207
9.6.4	Roles and Responsibilities	208
9.6.5	Data Analysing and Reporting	208
9.7	COMMUNITY HEALTH AND SAFETY MANAGEMENT	209
9.7.1	Monitoring Frequency	209
9.7.2	Management and Mitigation Measures	209
9.7.3	Key Performance Indicators	210
9.7.4	Roles and Responsibilities	211
9.7.5	Data Analysis and Reporting	211
9.8	ACCESS TO COMMUNITY MANAGEMENT	211
9.8.1	Monitoring Standards	211
9.8.2	Monitoring Frequency	212
9.8.3	Management and Mitigation Measures	212
9.8.4	Key Performance Indicators	212
9.8.5	Roles and Responsibilities	212
9.8.6	Data Analysis and Reporting	213
9.9	EMERGENCY RESPONSE MANAGEMENT	213
9.9.1	Monitoring Standards	213
9.9.2	Monitoring Frequency	213
9.9.3	Management and Mitigation Measures	213
9.9.4	Key Performance Indicators	215
9.9.5	Roles and Responsibilities	216
9.9.6	Data Analysis and Reporting	216
9.10	BIODIVERSITY MANAGEMENT	216
9.10.1	Monitoring Standards	216
9.10.2	Monitoring Frequency	217
9.10.3	Management and Mitigation Measures	217
9.10.4	Key Performance Indicators	218
9.10.5	Roles and Responsibilities	218
9.10.6	Data Analysis and Reporting	219
9.11	SLUDGE MANAGEMENT PLAN	219
9.11.1	Sludge Characteristics	220
9.11.2	Quantity	220
9.11.3	Improving the Quality	220
9.11.4	Reducing the Volume	220
9.11.5	Treatment Methods	220
9.11.6	Management and Mitigation Measures	221
9.11.7	Key Performance Indicators	222
9.11.8	Roles and Responsibilities	223
9.12	CONSTRUCTION MANAGEMENT PLAN (SOLAR FACILITY)	223
9.12.1	Monitoring Standards	223
9.12.2	Monitoring Frequency	223

9.12.3	Management and Mitigation Measures.....	223
9.12.4	Key Performance Indicators.....	224
9.12.5	Roles and Responsibilities.....	224
10	SOCIAL MANAGEMENT	225
10.1	ENHANCING REPRESENTATION OF WOMEN IN THE PROJECT WORKFORCE.....	225
10.1.1	Monitoring Standards.....	225
10.1.2	Monitoring Frequency.....	225
10.1.3	Management and Mitigation Measures.....	225
10.1.4	Key Performance Indicators.....	226
10.1.5	Roles and Responsibilities.....	227
10.1.6	Data Analysis and Reporting.....	227
10.2	PLAN TO ADDRESS DAMAGE TO PROPERTY AND INFRASTRUCTURE AND ENABLE CONTINUITY OF BUSINESS AND PUBLIC SERVICES IN THE AREA	228
10.2.1	Monitoring Standards.....	228
10.2.2	Monitoring Frequency.....	228
10.2.3	Management and Mitigation Measures.....	228
10.2.4	Key Performance Indicators.....	230
10.2.5	Roles and Responsibilities.....	231
10.2.6	Data Analysis and Reporting.....	232
10.3	WATER SUPPLY MANAGEMENT	232
10.3.1	Monitoring Standards.....	232
10.3.2	Monitoring Frequency.....	232
10.3.3	Management and Mitigation Measures.....	232
10.3.4	Key Performance Indicators.....	232
10.3.5	Roles and Responsibilities.....	233
10.3.6	Data Analysis and Reporting.....	233
10.4	MANAGEMENT OF UNIONS AND GENERAL WORKERS.....	233
10.4.1	Management Measures.....	233
10.4.2	Key Performance Indicators.....	234
10.4.3	Roles and Responsibilities.....	234
10.4.4	Data Analysis and Reporting.....	234
11	SECURITY MANAGEMENT PLAN.....	234
11.1	MONITORING STANDARDS.....	234
11.2	MONITORING FREQUENCY	235
11.3	MANAGEMENT AND MITIGATION MEASURES.....	235
11.4	KEY PERFORMANCE INDICATORS	235
11.5	ROLES AND RESPONSIBILITIES	236
11.6	DATA ANALYSIS AND REPORTING.....	236
12	CONTRACTOR MANAGEMENT PLAN	237
12.1	MONITORING STANDARDS.....	237
12.2	MONITORING FREQUENCY	237
12.3	MANAGEMENT AND MITIGATION MEASURES.....	237
12.4	KEY PERFORMANCE INDICATORS	238
12.5	ROLES AND RESPONSIBILITIES	239
12.6	DATA ANALYSIS AND REPORTING.....	239
13	LABOUR MANAGEMENT PLAN.....	240
13.1	MONITORING STANDARDS.....	240
13.2	MONITORING FREQUENCY	240
13.3	MANAGEMENT AND MITIGATION MEASURES.....	240
13.4	PROPOSED CHECKLIST MATRIX FOR DECENT WORK	241
13.5	CODE OF CONDUCT.....	243
13.5.1	Introduction.....	243
13.5.2	Definitions.....	244

13.6	KEY PERFORMANCE INDICATORS	247
13.7	ROLES AND RESPONSIBILITIES	247
13.8	DATA ANALYSIS AND REPORTING.....	248
14	HERITAGE MANAGEMENT.....	248
14.1	OBJECTIVE OF CULTURAL AND ARCHAEOLOGICAL HERITAGE	248
14.2	POTENTIAL RISKS AND IMPACTS TO CULTURAL/ ARCHAEOLOGICAL HERITAGE FROM THE PROJECT.....	248
14.3	MANAGEMENT AND MITIGATION MEASURES.....	248
14.4	CHANCE FIND PROCEDURE.....	249
14.5	KEY PERFORMANCE INDICATORS	250
14.6	ROLES AND RESPONSIBILITIES	251
14.7	DATA ANALYSIS AND REPORTING.....	251
15	STAKEHOLDER ENGAGEMENT PLAN.....	251
15.1	STAKEHOLDER IDENTIFICATION	251
15.2	STAKEHOLDER ANALYSIS AND ENGAGEMENT STRATEGIES.....	254
15.3	CONSULTATIONS DURING PROJECT PREPARATION.....	258
15.3.1	<i>Introduction.....</i>	<i>258</i>
15.3.2	<i>Method of Consultation.....</i>	<i>259</i>
15.3.3	<i>Advertisement and Invitation</i>	<i>259</i>
15.3.4	<i>Action Plan</i>	<i>259</i>
15.4	STAKEHOLDER ENGAGEMENT DURING PROJECT IMPLEMENTATION.....	266
15.5	STAKEHOLDER ENGAGEMENT DURING PROJECT EXECUTION	269
15.6	KEY PERFORMANCE INDICATORS	270
15.7	ROLES AND RESPONSIBILITIES	270
16	GRIEVANCE REDRESS MECHANISM	271
16.1	GRIEVANCE COLLECTION FORM.....	273
16.2	GRIEVANCE MONITORING FORM	274
16.3	GENDER-BASED VIOLENCE REFERRAL PATHWAY	276
16.4	REFERRAL CONTACTS IN BARBADOS	276
17	SUMMARY OF MONITORING FREQUENCY.....	277
SECTION III – THE ESMS.....		278
18	ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM (ESMS) APPROACH	279
19	ELEMENTS OF THE ESMS	280
19.1	ESMS ELEMENT 1: PROJECT SPECIFIC ENVIRONMENTAL AND SOCIAL (E&S) FRAMEWORK	280
19.1.1	<i>National Policy, Legal and Regulatory Framework.....</i>	<i>281</i>
19.1.2	<i>ESMS Implementation</i>	<i>281</i>
19.1.3	<i>ESMS Document Disclosure and Procedure</i>	<i>281</i>
19.2	ESMS ELEMENT 2: IDENTIFICATION OF RISKS AND IMPACTS.....	282
19.2.1	<i>Step 1: Risk Identification and Assessment.....</i>	<i>282</i>
19.2.2	<i>Impact Identification and Evaluation Process</i>	<i>282</i>
19.2.3	<i>Step 3: Mitigation and Enhancement.....</i>	<i>282</i>
19.2.4	<i>Step 4: Residual Impacts.....</i>	<i>283</i>
19.3	ESMS ELEMENT 3: MANAGEMENT PROGRAMS.....	283
19.4	ESMS ELEMENT 4: ORGANIZATIONAL CAPACITY AND COMPETENCY	284
19.4.1	<i>Responsibilities and Commitments.....</i>	<i>284</i>
19.4.2	<i>The BWA Staffing.....</i>	<i>285</i>
19.4.3	<i>Specialized Consultants</i>	<i>286</i>
19.4.4	<i>Training Programs.....</i>	<i>286</i>
19.5	ESMS ELEMENT 5: EMERGENCY PREPAREDNESS AND RESPONSE	289
19.5.1	<i>Emergency Response Plan</i>	<i>289</i>
19.5.2	<i>Organization Chart and Discussion of Organizational Capacity</i>	<i>291</i>
19.5.3	<i>Engagement with Local Authorities and the Community.....</i>	<i>292</i>

19.5.4	<i>Agreements with Local Authorities</i>	292
19.6	ESMS ELEMENT 6: STAKEHOLDER ENGAGEMENT	293
19.6.1	<i>Stakeholder Mapping and Analysis</i>	293
19.6.2	<i>Stakeholder Engagement Strategies</i>	293
19.7	ESMS ELEMENT 7: MONITORING AND EVALUATION	293
19.7.1	<i>Programme Implementation Monitoring</i>	293
20	REFERENCES	296
21	APPENDICES	298
21.1	APPENDIX I – INTERVIEW INSTRUMENT	298
21.2	APPENDIX II – STAKEHOLDER LIST	301
21.3	APPENDIX III – STAKEHOLDER CONSULTATION RECORD	304
21.4	APPENDIX IV – ENDANGERED SPECIES IN BARBADOS	308
21.5	APPENDIX V – WATER QUALITY MONITORING PARAMETERS	310

LIST OF FIGURES

Figure 2-1: South Coast Water Resource Recovery Facility - Site Layout Preliminary Concept	5
Figure 2-2: Process flow diagram for reclaiming water for aquifer recharge and agricultural reuse	7
Figure 2-3: Route Map of Proposed Pipelines to be Installed and Proposed Catchment Ponds as Components of the Project.....	8
Figure 4-1: 1km Area of Influence around existing SCSTP (top); 1km Area of Influence around overall pipeline route (bottom).....	22
Figure 4-2: Gender Needs Framework	25
Figure 5-1: Map of Barbados showing the SCSTP (west) and Outfall (east) (Source: NEMUS, 2021) ..	32
Figure 5-2: General Project Site and Situation	34
Figure 5-3: Barbados Water Zones as stipulated by the Water Protection Policy.....	38
Figure 5-4: Groundwater Flow Paths in the Project Area	39
Figure 5-5: Decadal Low Rainfall Periods from 1910 – 2016	39
Figure 5-6: : Eastern Caribbean Epicenters 1900-2019/07 (Magnitudes 5.0 and larger).....	42
Figure 5-7: Evidence of ecosystem degradation.....	61
Figure 5-8: Avifaunal species observed in Graeme Hall, January 2024.....	62
Figure 5-9: Red List Index of Species Survival	63
Figure 5-10: Headworks at the Existing SCSTP	64
Figure 5-11: Equipment used in the Material Removal Processes at the Existing SCSTP.....	65
Figure 5-12: Map Showing Communities, Businesses and Areas of Commercial Activities that were included in the Data Collection Process in January 2024	67
Figure 5-13: Number of households within the Parish of Christ Church (Census 2010).....	71
Figure 5-14: Spatial Relationship between the farmers operating close to the Ministry of Agriculture and Food Security and the SCSTP and proposed pipeline route	72
Figure 5-15: Vendors (top-left), Communities (top-right), Businesses (bottom) – Sensitive Receptors Along the ABC Highway and around the Existing SCSTP	73
Figure 5-16: Number of Households in the Parishes of St. Michael, St. George and St. Philip.	77
Figure 5-17: Plantations/Farms (top-left), Communities (top-right) and Businesses and Schools (bottom) - Sensitive Receptors off the ABC Highway and along the Historic Trailway	78
Figure 5-18: Housing Cluster Sensitive to Installation of Pipelines	79
Figure 5-19: 2010 Census – Christ Church Age-Sex Distribution.....	80
Figure 5-20: Map showing spatial relationship between the identified area and the Project pipeline routes (top); Spatial view of a key area of the proposed pipeline including key points where vendors are located (bottom)	81
Figure 5-21: Key activity types in the area of social and or economic relevance	82
Figure 5-22: Key local services accessible in the area	82
Figure 5-23: Description of living conditions from KIIs	83
Figure 5-24: Impacts from 2018 sewage leak and implied sanitation issues	83
Figure 5-25: Concerns about the area	84
Figure 5-26: Cultural Heritage Assets in the Southern part of Barbados	86
Figure 5-27: Satellite Imagery showing Wells (blue), Bridges (green) and Culverts (pink) from Salters to Bulkeley (top), Carmichael to Carrington (middle) and Carrington to Three Houses (bottom).....	88
Figure 5-28: Important Points along Historic Trailway (top); Key Infrastructural Developments along the Demo Stretch of the Historic Trailway (bottom)	90
Figure 5-29: Identified Areas of Cultural and Heritage Importance within Project Area	91
Figure 5-30: Stakeholders view on the type of Impact	94
Figure 5-31: Potential beneficiaries from proposed project.....	95
Figure 5-32: Project Considerations shared by stakeholders.....	96
Figure 5-33: Preferred method of communication.....	96
Figure 5-34: 1 km Sphere of Influence of Proposed Location for Water Reclamation Facility	97

Figure 5-35: Graeme Hall Swamp Sluice Gate	98
Figure 5-36: Access Point to one of the Properties Identified as a Sensitive Receptor	99
Figure 5-37: Section of the Browne's Catchment Pond at the River Plantation	100
Figure 5-38: Key potential impacts for the proposed works	109
Figure 5-39 - Groups expected to be negatively impacted by the proposed works	110
Figure 9-1: Summary of Sludge Management Process	219
Figure 15-1: Stakeholder Priority Mapping	253
Figure 15-2: Stakeholder Mapping Results and Strategy for Engagement	255
Figure 18-1: The seven key elements of an Environmental and Social Management System (Source: IDB)	279
Figure 19-1: General Emergency Procedures	290
Figure 19-2: Emergency Levels	291
Figure 19-3: Technical Contingency Organization for Contractor	291

LIST OF TABLES

Table 3-1: Gender Rating Tool	9
Table 3-2: Relevant Policies for the proposed project and the socio-economic context	10
Table 3-3: IDB ESPS 2020 Standards (ESPS Effective October 31, 2021)	17
Table 4-1: Defining the nature of the potential impacts	26
Table 4-2: Impact Rating Table	27
Table 4-3: Impact Significance or Severity Criteria	27
Table 5-1: Water Zones in Barbados as determined by the Water Protection Policy	35
Table 5-2: Water Quality of Resources in Different Locations	37
Table 5-3: Calculation of GHG emissions associated with the grid-electricity consumption	45
Table 5-4: Calculation of the GHG emissions if enclosed screenings collection is transported by transportation vehicles of one type	46
Table 5-5: IPCC worksheet used to calculate the methane emissions from wastewater treatment	48
Table 5-6: Calculation of indirect GHG emissions from wastewater discharge into the sea	49
Table 5-7: Carbon Footprint of Existing South Coast Sewage Treatment Plant (SCSTP)	50
Table 5-8: Calculation of GHG emissions associated with the grid-electricity consumption	51
Table 5-9: Calculation of the GHG emissions if sludge is transported by transportation vehicles of one type, to Spencers, Christ Church	53
Table 5-10: Calculation of the GHG emissions if sludge is taken to Spencer's Plantation in Christ Church	53
Table 5-11: GHG emissions for SCSTP before and after rehabilitation	54
Table 5-12: List of Business and Institutions and Potential Impact along the ABC Highway and Near to the Existing SCSTP	68
Table 5-13: List of Communities and Distance to the Pipeline	72
Table 5-14: List of Farmers Identified Along the Trailway Route and Potential Impacts	74
Table 5-15: List of Communities Along/Close to the Trailway Route and Distance to the Pipeline	75
Table 5-16: List of Institutions and Businesses and Potential Impact	75
Table 5-17: List of Crops Grown by Affected Farmers	85
Table 5-18 - IDB's Environmental and Social Safeguards and their associated risks for this project ..	104
Table 6-1: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Component 1	114
Table 6-2: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operational Phase of Component 1	127
Table 6-3: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Component 2	140

Table 6-4: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operational Phase of Component 2	155
Table 6-5: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Project Component 5	164
Table 6-6: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operations Phase of Project Component 5	175
Table 9-1: Barbados Marine Water Quality Monitoring Standards	188
Table 9-2: Key Performance Indicators for Coastal Water Quality	189
Table 9-3: Air Quality Standards Extracted from the WHO Air Quality Guidelines 2021	190
Table 9-4: Key Performance Indicators for Air Quality Management	192
Table 9-5: Noise Standards Extracted from the WHO Guidelines on Environmental Noise	194
Table 9-6: Key Performance Indicators for Noise Management	195
Table 9-7: Key Performance Indicators for Waste Management	200
Table 9-8: Key Performance Indicators for Traffic Management	203
Table 9-9: Key Performance Indicators for Worker Health and Safety Management	207
Table 9-10: Key Performance Indicators for Community Health and Safety Management	210
Table 9-11: Key Performance Indicators for Access to the Community Management	212
Table 9-12: Key Performance Indicators for Emergency Response Management	216
Table 9-13: Key Performance Indicators for Biodiversity Management	218
Table 9-14: Key Performance Indicators for Construction Management of the Solar Facility	224
Table 10-1: Key Performance Indicators for Better Inclusion in the Project Workforce	226
Table 10-2: Key Performance Indicators for Damage to Property Management	231
Table 10-3: Key Performance Indicators for Water Supply Management	233
Table 10-4: Key Performance Indicators for Management of Unions and General Workers	234
Table 11-1: Key Performance Indicators for Security Management	235
Table 12-1: Key Performance Indicators for the Security Management Plan	238
Table 13-1: Key Performance Indicators for Labour Management	247
Table 14-1: Key Performance Indicators for Management of Heritage Assets	251
Table 15-1: Importance and Criticality of Identified Stakeholders	256
Table 15-2: Priority Stakeholders to be invited to Town Hall Meeting 1	260
Table 15-3: Priority Stakeholders to be invited to Town Hall Meeting 2	262
Table 15-4: Steps to be taken in the ESIA Consultation Process	264
Table 15-5: Likely Stakeholder Consultations under the Project	266
Table 15-6: Key Performance Indicators for Stakeholder Engagement	270
Table 16-1: Methods for Grievance Receipt, from Least to most formal	272
Table 17-1: Monitoring Frequency Required for Each Parameter Outlined in the ESMP	277
Table 19-1: The BWA's Technical Staff Designated to the Project	285
Table 19-2: Responsibilities of consultants/experts engaged for the Project	286
Table 19-3: Socio-Environmental Training Program	286
Table 19-4: Emergency Risk Assessment	289
Table 19-5: Emergency Response Agreements	292
Table 19-6: Sample Monitoring Template	294

LIST OF ACRONYMS

BWA	Barbados Water Authority
BADMC	The Barbados Agricultural Development and Marketing Corporation
CCCCC	Caribbean Community Climate Change Centre
CLO	Community Liaison Officer
CoC	Code of Conduct
COPD	Chronic Obstructive Pulmonary Disease
DRM	Disaster Risk Management
EHS	Environmental Health and Safety
EHSMP	Environmental Health and Safety Management Plan
ERP	Emergency Response Plan
ESA	Environmental and Social Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
FTC	Fair Trading Commission
GBV	Gender Based Violence
GHG	Greenhouse Gas
GHS	Graeme Hall Swamp
GRM	Grievance Redress Mechanism
IDB	Inter-American Development Bank
IEGE	State of Equality between Women and Men
NGO	Non-governmental Organization
PWD	Persons with Disabilities
SEAH	Sexual Exploitation, Abuse and Harassment
SCSTP	South Coast Sewage Treatment Plant
TSS	Total Suspended Solids
TDS	Total Dissolved Solids
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
UWI	The University of the West Indies
WHO	World Health Organization

EXECUTIVE SUMMARY

The United Nations Office for the Coordination of Humanitarian Affairs ranks Barbados among the top ten most water-stressed countries in the world. Given the limited availability of surface water; the country is almost entirely dependent on groundwater from aquifer sources. A Green Climate Fund preparation project has been developed by the Government of Barbados, the Barbados Water Authority (BWA), and the Caribbean Community Climate Change Centre (CCCCC) with the goal of incorporating climate resilience into Barbados' wastewater systems, with a focus on the South Coast Sewage Treatment Plant (SCSTP).

The general objective of the Project is to increase Barbados' water resilience to Climate Change with a focus on increasing water security and improving environmental conditions through the upgrading of the existing SCSTP, construction of a new water reclamation facility, installation of up to 25km of pipelines, the development of a 7MW solar facility and through institutional strengthening. The proposed strategy to mitigate against the issue of water scarcity in the island would see the tertiary treatment of wastewater to a standard that would allow for the provision of the treated wastewater for irrigational purposes and for aquifer recharge. As the primary beneficiaries of the outcomes of the Project are those in the agricultural industry, in addressing water scarcity, food insecurity would also be offset.

The Project area encompasses the existing South Coast Sewage Treatment Plant located in Graeme Hall, adjacent to Graeme Hall Nature Reserve/Swamp (a protected site in RAMSAR) to the south, the Department of Agriculture Research Station to the north, and Harmony Hall to the east. The BWA has highlighted their intention to pump the treated wastewater from the reclamation plant to a catchment pond, buried storage tank or some other storage mechanism in the Staple Grove area, to then be gravity fed through to the Browne's Catchment Pond at River Plantation to contribute to the irrigation scheme. The disinfected and filtered reclaimed water will be allocated to agricultural users for use on edible food crops and for other agricultural irrigation purposes to support the expansion of agricultural activities and food security in Barbados.

The social assessment conducted targeted communities within 1 km of the Project area to determine how the different components of the Project could prove impactful to nearby communities, even those not directly a part of the sewered area. There was wide acceptance of the intended outcomes of the Project, particularly in the farmer populace and those who acknowledge the issues of water scarcity and food insecurity, as well as inflated consumer costs. The concerns raised regarded the potential disruptions in traffic, particularly as it relates to accessing communities, businesses and places of religious significance. The installation of the pipeline proved to be the most potentially problematic due to the spatial extent of the planned works and the likelihood of the works disrupting not only traffic, but business operations and agricultural activity. Furthermore, as the proposed route of the pipeline runs along the historic railway, the Future Centre Trust who serves as the organization who assumes responsibility of the conservation, restoration and development of the railway and its assets, highlighted the need for appropriate measures to be taken so as to not undo or decelerate the progress of the works that the Trust has undertaken.

These measures, and other measures to mitigate against different physical, ecological and social impacts were constituent of the different management plans prepared. These management plans formulated the Environmental and Social Management Plan (ESMP). The ESMP included the following management plans:

1. Environmental Health and Safety Management Plan
2. Social Management Plan
3. Security Management Plan
4. Workers Health and safety plan

5. Emergency Response Plan
6. Contractor Management Plan
7. Labour Management Plan (including Code of Conduct and GBV Prevention)
8. Heritage Management Plan (including Chance Find Program)
9. Stakeholder Engagement Plan
10. Grievance Redress Mechanism

The abovementioned management plans were prepared to propose the measures to be taken to mitigate against and address issues related to air pollution, noise and vibration pollution, flooding, disruption of biological communities, social conflicts, health and safety of workers, interruption to local businesses and livelihoods, gender inequality in the workforce, community road safety, and utility management and coordination. Common management and mitigation measures proposed included demarcating construction zones, training staff, providing appropriate equipment, and communicating with communities and the public.

1 INTRODUCTION

The Government of Barbados, Barbados Water Authority (BWA) and the Caribbean Community Climate Change Centre (CCCCC) have developed a Green Climate Fund preparation project aimed at building climate resilience into the wastewater systems of Barbados, specifically for the South Coast Sewage Treatment Plant.

The South Coast Sewage Treatment Plant (SCSTP) is located in Graeme Hall, Christ Church, Barbados. This plant was designed to treat approximately 9,000 m³/day of wastewater, through a series of coarse, medium, and fine screens, with “advanced preliminary standards” at the Graeme Hall Wetland. The screened wastewater is pumped through a force main to a marine outfall.

This document constitutes an addendum to the Environmental and Social Impact Assessment Report (ESIA) of the South Coast Water Reclamation Project that was prepared by NEMUS. This assessment was done in the context of the Consultancy for the Development of the Environmental and Social Management System to consist of the updated versions of the Environmental and Social Impact Assessments and Environmental and Social Management Plans for Climate Resilience Wastewater System in Barbados Preparation Project.

Section I of this report seeks to address the gaps that were identified in the assessment conducted and the findings of which constituted the aforementioned ESIA. It will also include different risks and concerns that have been identified during the gap assessment.

Section II of this report constitutes the management plans that include recommended management and mitigation measures to be implemented in response to the potential risks and concerns highlighted in Volume I of this report.

Section III of this report presents the seven elements of the Environmental and Social Management Systems (ESMS) according to the IDB’s Environmental and Social Policy Framework (ESPF). The 7 pillars of the ESMS include pillars: i) Project-specific environmental and social framework, ii) Identification of risks and impacts, iii) Management programs, iv) Organizational capacity and competence, v) Emergency preparedness and response, vi) Stakeholder engagement, vii) Monitoring and evaluation

2 PROJECT OVERVIEW AND BACKGROUND

2.1 Project Justification

Barbados is an independent island republic located in the Lesser Antilles of the West Indies. The country covers 430 square kilometres, stretching 34 kilometres in length and 23 kilometres wide, from east to west. It ranks among the top 10 in the world's most water scarce countries¹, with a reliance on the country's freshwater sources. Barbados is also challenged with the issue of food insecurity - Barbados relies on imports for almost all of its food needs; agriculture accounts for less than 2% of island's GDP. Additionally, Barbados is also notably vulnerable to the impacts of climate change, including Atlantic hurricanes and tropical storms, whose intensity is projected to increase, as well as temperatures leading to droughts and heat waves, and to an increase in evapotranspiration rates thereby reducing soil moisture, infiltration and aquifer recharge. Furthermore, reduced rainfall and sea level rise² have reduced the availability, quality and reliability of fresh water. As a consequence, the country faces water shortages and rationing as well as competition over water between tourism, agriculture and other sectors³.

In light of the water scarcity issue, The Barbados Water Authority (BWA) is the government entity with responsibility for providing the island with potable water, wastewater treatment, and disposal services. BWA also serves as a regulator for water resources management because there is no separate institution with that legal function. The BWA currently operates two Sewage Treatment Plants:

- The Bridgetown Sewage Treatment Plant (BSTP); responsible for the secondary treatment of waste, and
- The South Coast Sewage Treatment Plant (SCSTP); responsible for the primary treatment of waste.

Both of the aforementioned sewage treatment plants discharge effluent water into the sea; the sludge generated from the Bridgetown Plant is disposed of on land, and that of the South Coast Treatment Plant is collected and disposed of in the island's landfill.

Barbados' wastewater management systems have been under pressure due to a combination of factors including climate change and rising demand in the island's sewage-collecting regions. The Barbados Water Authority (BWA) states that in order to raise tolerance to climate change (CC), a transformative shift in wastewater management practices' resilience building is intended to be initiated. For instance, producing green resources from wastewater will lessen the need for fossil fuels; also, cleaned tertiary effluent may be reused for other applications, easing the strain on the world's finite water supplies brought on by climate change.

The systems will be able to operate effectively and efficiently if resilience is increased and the climate hazard that affects these plants is addressed. However, by implementing technologies that improve wastewater systems, the nation can now access water resources that would not have been used for agricultural purposes. This would assist in mitigating certain water scarcity concerns that the island is facing, which are compounded by climate change. These steps will support continuing initiatives to strengthen Barbados' water sector's resilience to climate change, which also would be constituent to the initiative to reduce the impacts of food insecurity partly influenced by the lack of climate resilience in the water sector.

¹ <https://reliefweb.int/report/barbados/barbados-country-profile-may-2022>

² Over 80% of the drinking water resources are linked to shallow coastal aquifers, highly responsive to droughts, and sea level rise.

³ Lifted from the BA-L1063 Project Profile.

2.2 Project Objectives and Components

The project's general goals are to:

- Improve water supply resiliency by increasing the availability of potable water through the reuse of reclaimed wastewater for agricultural irrigation;
- Reduce water insecurity through reuse of reclaimed water to recharge aquifers;
- Strengthen key sector institutions on water resource management, operational efficiency monitoring and gender mainstreaming.

These general objectives should be achieved post the successful implementation of the following Project components⁴:

- **Component 1. Water Reclamation Infrastructure (US\$60 Million)**

This component will finance the construction of the **New South Coast Water Reclamation and Reuse Facility (SCWRRF)** with an average dry weather flow (ADWF) of 9,000 m³/day under a Design Build EPC/Turnkey modality and Operations and Maintenance (O&M) costs for a number of years. It will include all process units and ancillary facilities to provide secondary and tertiary treatment for the liquid stream, followed by an Advanced Water Treatment (AWT) side stream including safe and sustainable treatment and management of the sludge (solid stream) with the aim to reduce GHG emissions and considerations for circular economy. Due consideration will be given to the use of energy efficient equipment, renewable energy sources and Smart Water Infrastructure Technologies. This component will also finance the Upgrade of the existing **South Coast Sewage Treatment Plant (SCSTP)** by refurbishing or replacing equipment in the existing influent lift pump station and headworks including interconnecting piping to the SCWRRF and the design and installation of the odor control system. Due consideration will be given to the use of energy efficient equipment and Smart Water Infrastructure Technologies

- **Component 2: Reclaimed Water Reuse (US\$18.5 million)**

This component will finance:

Sub-component 1 - Agriculture Reuse of Reclaimed Water consisting of the installation of a 25 km pipeline for transporting reclaimed water for irrigation of approximately 160 hectares at River Plantation along the old trainline ("Trailway") and ancillary equipment, and a high-water mark catchment area to allow for the irrigation pipeline.

Sub-component 2 - Aquifer Recharge Infrastructure consisting of the installation of 4 km water pipeline, 5 injection wells, 6 exploratory boreholes, 3 monitoring wells, 3 abstraction boreholes and pumping stations, and ancillary equipment for aquifer recharge, with due considerations of resiliency and adaptation to climate change measures as well as low carbon emissions

- **Component 3: Climate Change and Biodiversity Opportunities (US\$16 million)**

Sub-component 1 – Graeme Hall Swamp Conservation will support the development and implementation of a Monitoring Plan for the Natural Heritage Conservation Area (Land and Marine, inclusive of the Graeme Hall Swamp, associated beach and buffer zone). The coverage of the Monitoring Plan will include biodiversity (such as flora and fauna of the freshwater sedge, mangrove swamp, seagrass bed and coral reef complex), hydrogeology, soils, general land use and community engagement, where climate mitigation and adaptation impacts are crucial, and conservation and biodiversity benefits realized. The Monitoring Plan will guide the development of the Integrated Management Plan for the Natural Heritage Conservation Area, inclusive of the Graeme Hall Swamp, associated beach area and buffer zone.

⁴ As per the BA-L1063 Project Profile

Sub-component 2 – Solar Energy Generation with Battery Storage consisting of 7 MW solar photovoltaic plant and associated energy storage capacity, increasing the sustainability of the Barbados’ power grid, and also fostering the resilience of BWA’s pumping stations, and mitigating the additional carbon footprint of the upgraded wastewater treatment facilities. The solar panels will be co-located with existing solar energy facilities located at BWA’s central pumping stations serving the main population areas

- **Component 4: Institutional Strengthening (US\$1.5 million)**

This component will finance institutional strengthening of the executing structure, including the Fair Trading Commission (FTC), Government Analytical Services (GAS) laboratory, Ministry of Agriculture, Food and Nutritional Security (MAFS), Environmental Protection Department (EPD), Barbados Agricultural Development and Marketing Corporation (BADMC) Irrigation Engineering Unit, and Barbados Water Authority (BWA) to improve governance, efficiency, and sustainable management of water resources. Potential activities include: (i) Improving the governance and project management capacity of BWA through the implementation of an action plan based on AquaRating and training in operations and maintenance of the SCWRRF; (ii) Implementing an Institutional Gender and PwD Action Plan to promote the equal participation of women and PwD within BWA; (iii) Supporting the execution of FTC’s regulatory functions in the water and sewerage sector; (iv) Implementing robust monitoring systems to track water quality, water quantity, soil quality and climate-related parameters; (v) Regulating the abstraction and use of groundwater; (vi) Designing and implementing public awareness and stakeholder engagement campaigns to promote the benefits of wastewater reuse and build community support, with gender and diversity considerations, as well as related studies²⁰. This includes implementation of robust public health and safety measures, including appropriate signage, education programs, and guidelines for the safe use of reclaimed water.

2.3 The South Coast Water Reclamation Project

In order to provide a quality of effluent adequate for aquifer recharge and agricultural crop irrigation, the South Coast Sewage Treatment Plant (SCSTP) will be upgraded from its current advanced preliminary wastewater treatment to a tertiary/advanced treatment plant (Figure 2-1).

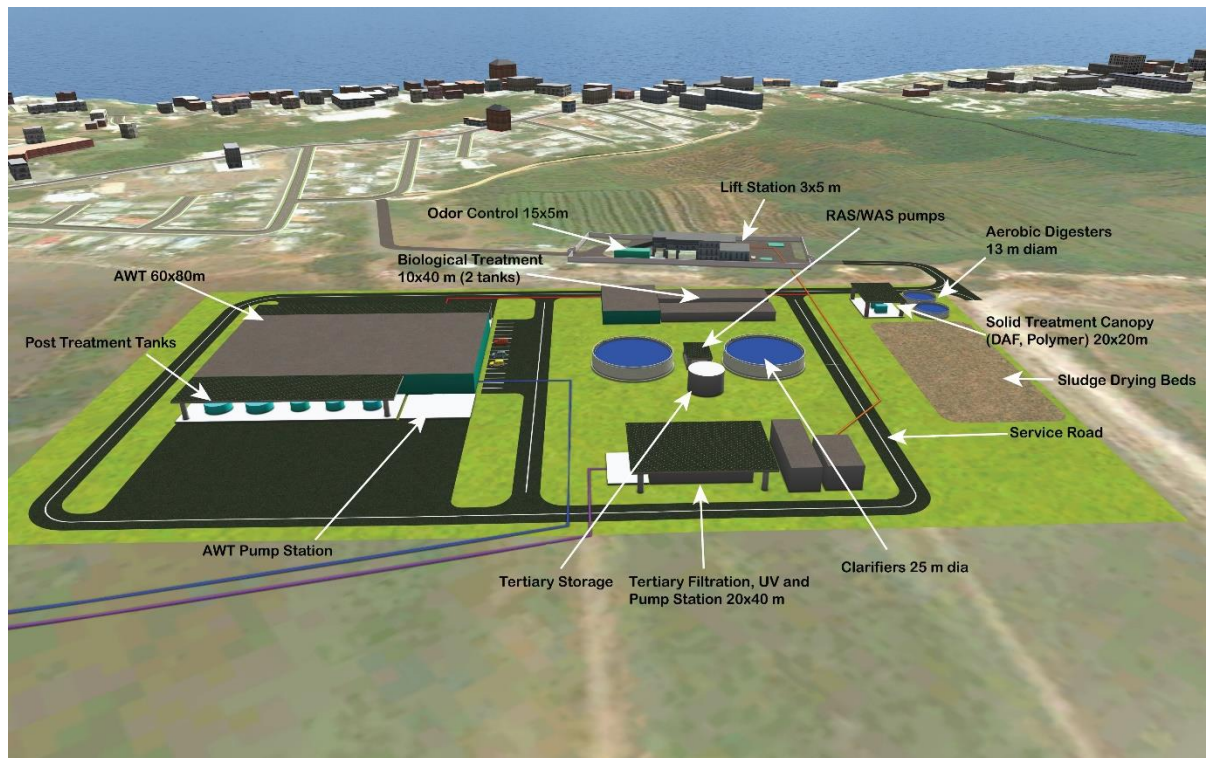


Figure 2-1: South Coast Water Resource Recovery Facility - Site Layout Preliminary Concept

Reclaimed water will be utilized to replenish the Christ Church Aquifer, which is mostly utilized for agricultural abstractions close to Barbados' southern edge. If not being distributed for agricultural use, the reclaimed water will be replenished into the karst limestone aquifer through a maximum of five deep recharge wells that pierce the saturated zone of the aquifer. This process will take place primarily during periods of typical wetness and the demand for irrigation is not as considerable as it is in the dry season. The primary target area for irrigation is the River Plantation. In order to irrigate their crops, some farmers currently utilize potable water from the BWA water supply mains, which would free it up for drinkable usage.

Four screening options were assessed in the feasibility stage of the project:

1. **Scenario A** which includes the following end uses: Potable aquifer recharge in St. Philip Aquifer; Unrestricted agricultural food crop irrigation at River Plantation, Sandford/Mapps, and Golden Grove areas in St. Philip;
2. **Scenario A1** which includes the following end uses: Non-potable aquifer recharged in Christ Church Aquifer; Unrestricted agricultural food crop irrigation at River Plantation, Sandford/Mapps, and Golden Grove areas in St. Philip;
3. **Scenario B** which includes the following end uses: Non-potable aquifer recharged in Christ Church Aquifer; Unrestricted agricultural food crop irrigation at Gibbons Boggs, Fairy Valley and Fairview areas;
4. **Scenario C** which includes the following end uses: Potable aquifer recharge in St. Michael Aquifer; Unrestricted agricultural food crop irrigation at St. George Valley.

The BWA has highlighted their intention to pump the treated wastewater from the reclamation plant to a catchment pond, buried storage tank or some other storage mechanism in the Staple Grove area, to then be gravity fed through to the Browne's Catchment Pond at River Plantation to contribute to the irrigation scheme. As such, Scenario A1 was identified as the preferred option. The water reclamation process is outlined in Figure 2-2 below. Figure 2-3 shows the map of all proposed



important components of the Project, highlighting the possible pipeline routes, storage locations and aquifer recharge points.

BWA South Coast Water Reclamation Process Flow Diagram

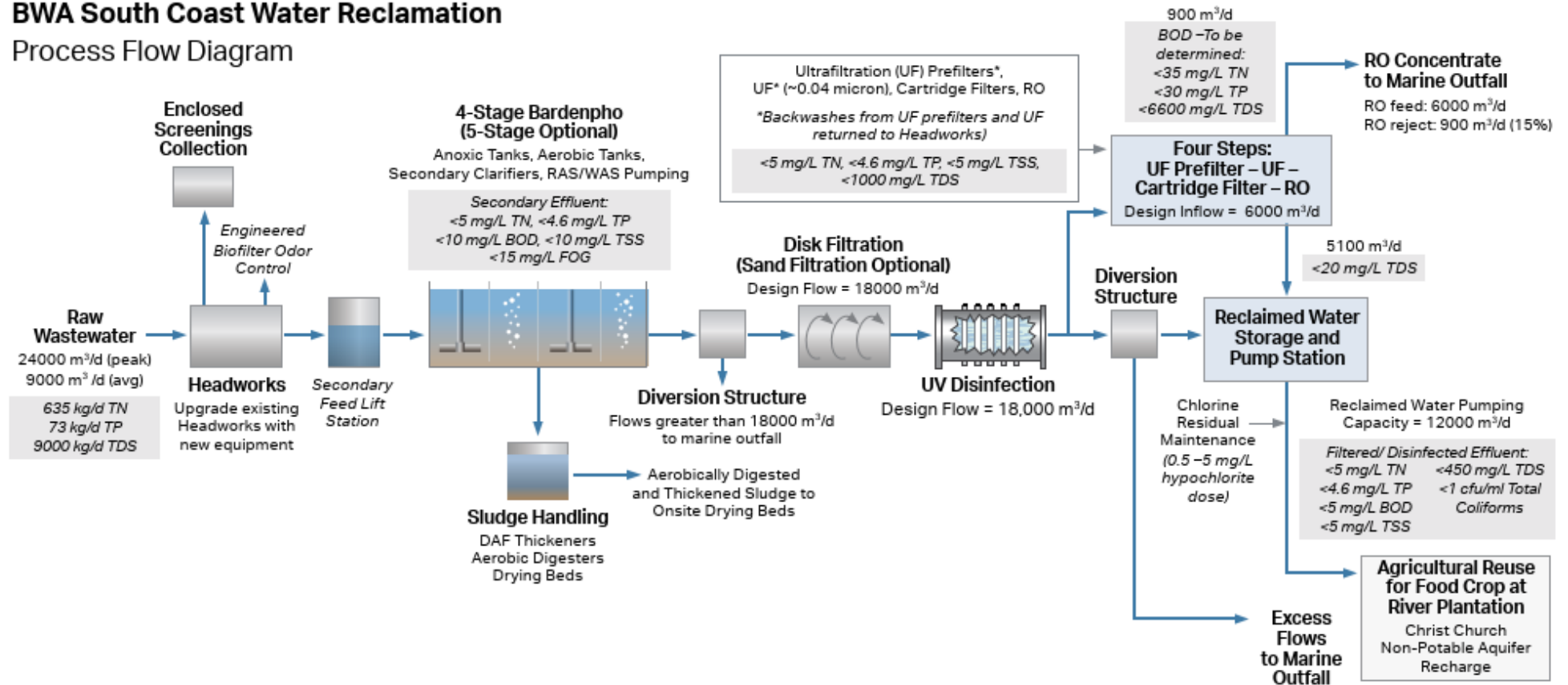


Figure 2-2: Process flow diagram for reclaiming water for aquifer recharge and agricultural reuse

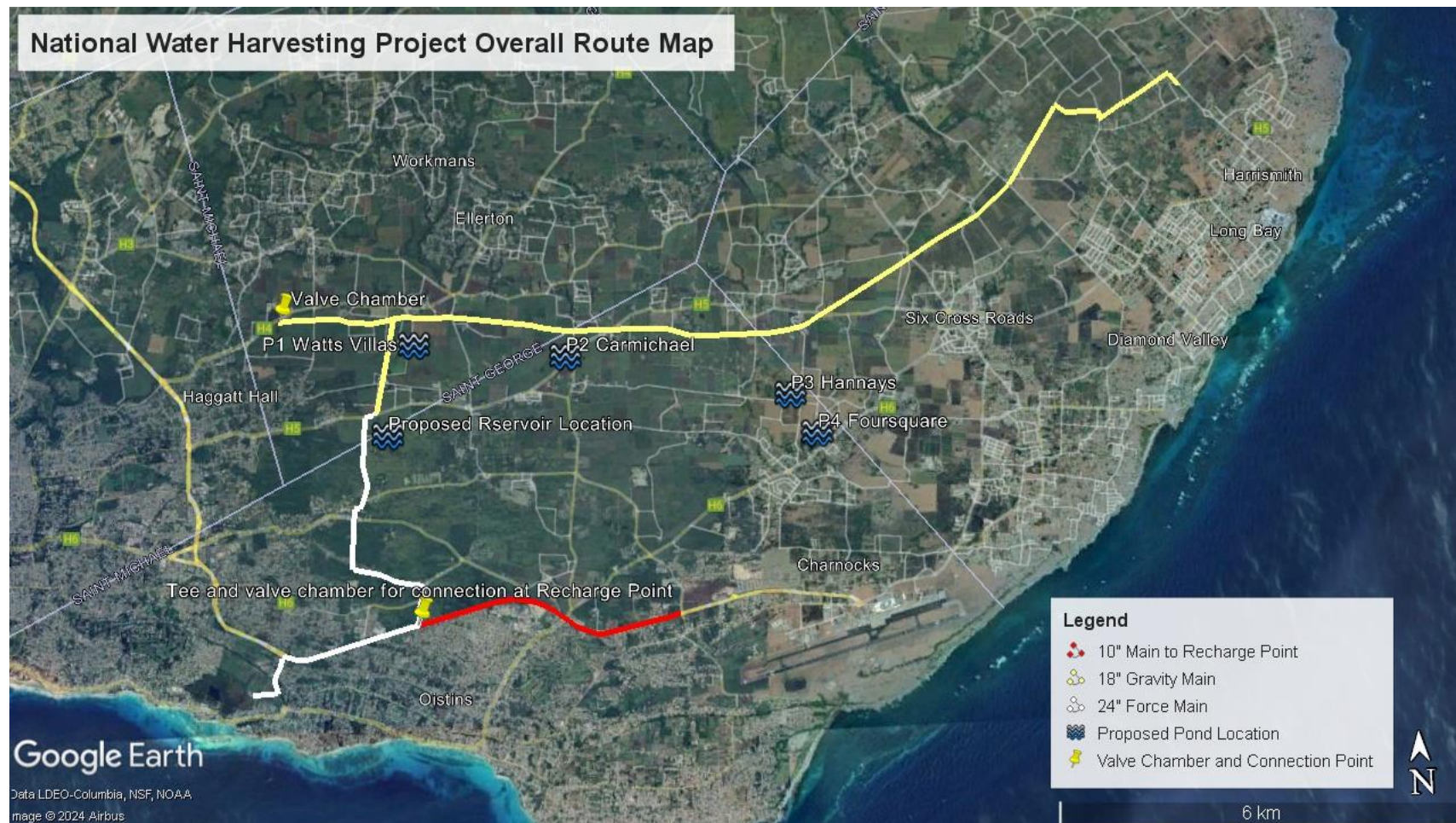


Figure 2-3: Route Map of Proposed Pipelines to be Installed and Proposed Catchment Ponds as Components of the Project

3 LEGAL AND REGULATORY FRAMEWORK

The gap assessment that was conducted by the consulting team, and the findings of which are included in this report, included the review of the existing ESIA. The existing ESIA included an assessment of the relevant legal, regulatory and institutional framework as well as the international standards and guidelines by which the project should comply. With respect to inclusion in the enabling policy environment for gender and marginalized populations, which were a gap in the prior report, these considerations are outlined below.

3.1 Social Considerations in the Legislative and Policy Environment

Table 3-2 shares a list of relevant legislation and policies that frame the enabling policy and legislative environment supporting the execution of the project. Most policies and legislation identified, specifically those for water and sewage management do not provide specific provisions for key vulnerable groups which includes women, youth, the elderly, persons with disabilities, and migrant workers. These gaps in inclusion of various vulnerable groups may imply a less than fully comprehensive assessment of the range of activities and consumption patterns of these groups to gain deeper insight into where potential exposure and risks may emerge. Still, the available information serves to provide sufficient understanding for potential risks and exposure for these vulnerable groups and the tailoring of protection plans to mitigate identified risks. Educating government and project actors on the importance of mainstreaming social inclusion in their work and plan/policy development will be developed later in the report to support the social protection aspects required as it applies to mitigation efforts specific to project works. Further, an assessment of risk is provided in Chapter 4.3 and Chapter 5.7.5 as it applies to community members and vulnerable groups (based on stakeholder engagement) as well as initial consultations to collect key data.

To further understand the gender component of the enabling policy and legislative environment, a gender rating tool has been applied to the following policies and laws. The level of responsiveness of the policy or legislative document toward gender considerations varies from least responsive (neutral) to most responsive (transformative) and is described in Table 3-1.

Table 3-1: Gender Rating Tool

Gender Rating	Description
Gender Neutral	The policy makes no mention or does not reference gender or women.
Gender Aware	Gender specific norms, roles and issues are acknowledged within the policy.
Gender Sensitive	Measures are outlined within the policy to ensure gender inequalities are not exacerbated as a by-product of the policy's actions.
Gender Responsive	The policy acknowledges and identifies differences and inequalities between men and women and sets out actions which seek to rectify these issues.
Gender Transformative	The policy seeks to resolve fundamental structural inequalities and challenges social and cultural norms.

Table 3-2: Relevant Policies for the proposed project and the socio-economic context

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, PWDs, migrant workers)
Water			
Barbados Water Authority (Amendment) Act 2023	The act outlines the functions of the Barbados Water Authority. The amended act includes provisions for: 1)institutional strengthening. 2)water protection zones. 3)well management; and other related matters.	Neutral	No
Water Reuse Act of 2023	The act outlines regulations for the capturing, collecting, treating and reuse of wastewater.	Neutral	No
Prevention of Floods Act, 1998	The act outlines measures for preventing floods in Barbados that may be cause by excessive rain or high tides and that could potentially cause inconvenience or injury to health or property.	Neutral	No
Water Services Regulations, 1982	The act outlines the regulations to the provider and users as per water distribution provided the Barbados Water Authority.	Neutral	No
Better Security Act, 1950	An act providing stipulations for the continued provision of water and light for the safety of human life and property.	Neutral	No

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, PWDs, migrant workers)
Limitation and Prescription Act	The act concerns itself with the validity of claims of prescription to any way, easement, or watercourse or to the use of a watercourse that can be enjoyed, over or from any land or water.	Neutral	PWDs
Irrigation Act, 1967	The act provides provisions for the research of land to determine irrigation or equipment requirements for irrigation as deemed necessary.	Neutral	No
Wastewater Treatment			
Sanitation Service Authority Act, 1997	<p>The act is intended to establish the Sanitation Service Authority. Under this act, the main priorities of the Authority are to:</p> <p>a) to remove refuse from premises as authorised by the Minister;</p> <p>(b) sweep, cleanse and water streets;</p> <p>(c) provide and maintain places, buildings and appliances for the deposit, disposal or destruction of refuse;</p> <p>(d) provide and maintain public baths and public sanitary conveniences; and</p> <p>(e) to provide and maintain cemeteries, burial grounds and crematoria.</p>	Neutral	No

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, migrant workers)
Municipal Solid Waste Tax Act, 2014	The act provides the implementation of a 'Municipal Solid Waste Tax' to assist cost of refuse disposal, assist cost of operating and maintaining refuse disposal sites and preserving and enhancing the environment.	Neutral	No
Sewerage Regulations, 1980	The act provides rules concerning water discharge through the public sewer systems from domestic premises and industries.	Neutral	No
Barbados Water Authority (Water and Sewerage Rates) (Amendment) Regulations, 2019	The regulations provide rates for the supply of water and rates for the supply of sewerage services.	Neutral	No
Utilities			
Utilities Regulation Order, 2014	The order designates utility services and service providers that are to be regulated by provisions of the order. The list includes water supply and sewerage services to be provided by the Barbados Water Authority.	Neutral	No
Utilities Regulation Act, 2002	The act outlines regulations for the provision of utilities. Utilities include any distribution and supply of water or sewerage services.	Neutral	No
Utilities Regulation (Procedural) Rules, 2009	The rules outlines those applying to any proceedings in matters brought to the Trading	Neutral	No

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, PWDs, migrant workers)
	Commission under the Utilities Regulation Act.		
Land Use Planning			
Planning Development (Environmental Impact Assessment) Regulations, 2021	The regulations outline procedural requirements and rules for anyone conducting environmental impact assessments.	Neutral	No
The Planning and Development Amendment Act, 2020	The act outlines requirements for: a) orderly and progressive land development; b) permission to develop land; c) powers for land use regulation and development; and related matters.	Neutral	PWDs
Coastal Zone Management Act, 1998	The act outlines requirements for the effective management of coastal resources in Barbados and for conserving and enhancing these resources.	Neutral	No
Marine Areas (Preservation and Enhancement) (Barbados marine Reserve) Regulations, 1981	The act outlines requirements and violations pertaining to the proper use and operation within marine areas.	Neutral	No
National Biodiversity Strategy and Action Plan for Barbados 2002 (NBSAP)	The strategy is one of the national initiatives in fulfilment of the objectives of the Convention on Biological Diversity (CBD) and	Aware (gender disaggregated statistics included)	Women, PWDs, Migrant Workers, Elderly

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, migrant workers)
	outlines Barbados plan to fulfill those objectives.		
Disaster Risk Management			
Catastrophe Fund Act No. 13 of 2022	The act provides for a fund that will be used to supply financial aid to any eligible persons or qualifying business that are in need of aid in the event of catastrophe.	Neutral	No
Emergency Management (Amendment) Act, 2020	The act outlines rules for declaring and management a public health emergency. It takes into account emergencies as a result of disaster or communicable diseases.	Neutral	No
Labour and Working Conditions			
The National Employment Policy of Barbados, 2014	The policy provides guidance for improving labour opportunities within the country through enhancing the employability of the people, enhancing the labour market and creation of opportunities.	Responsive (addresses the needs of vulnerable workers, including women)	Women, PWDs, Youth, Migrant Workers
Employment (Miscellaneous Provisions) Act, 2005	This Act outlines protections from children from being employed in listed industrial activities and provides the only suitable forms of employment for children. The minimum working age is 16 years old.	Neutral	Youth
Safety and Health at Work Act, 2007	The Act provides provisions for the health, safety and welfare of persons at work, and safeguarding persons from harmful emissions	Sensitive (makes note of women's sanitary requirements on worksites)	Women

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, PWDs, youth, migrant workers)
	and exposure to dangerous substances at work.		
Employment Rights Act, 2012	The Act gives employees rights to minimum notice of termination, wage statements, and avenues to address employment disputes.	Neutral	PWDs
Employment Sexual Harassment (Prevention) Act, 2017	The Act gives employees the right to work in environment free from sexual harassment as defined by the act.	Aware	Women
Health			
Health Services Act, 1969	The act outlines requirements for the preservation and promotion of the health of the inhabitants of Barbados.	Neutral	No
Barbados Strategic Plan for Health, 2002	The plan supports the country's overall national strategic plan, which aims "To make Barbados a fully developed small island state by 2012".	Aware (the plan notes that gender norms play a role in health issues)	Women, Youth, Elderly
National Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2020-2025	The policy outlines the 8 priority areas for the prevention and control of non-communicable diseases in the country.	Responsive (the plan calls for representation by members of vulnerable groups, including women, in consultation processes)	Women, Youth, Elderly, PWDs
Development			
National Strategic Plan of Barbados 2006-2025, 2007	The policy applies a multi-sectoral approach to addressing matters in the areas of cultural	Responsive (the plan calls for the integration of	Women, Youth, Elderly, PWDs

Policy/Plan	Summary	Gender Rating	Reference to Vulnerable Groups (women, elderly, youth, PWDs, migrant workers)
	transformation, improved governance, national development, green economy, economic growth, and global success.	gender mainstreaming across all national plans and policies)	
Barbados National Sustainable Development Policy, 2004	The policy outlines goals for the uptake of development related matters by all members of society in addressing equity, participation, economic efficiency, resource conservation, and quality of life.	Aware (mentions that women are among those groups that are more vulnerable to poverty and suggests rights of women should be considered)	Women, Youth, Elderly, PWDs
Barbados Medium-Term Growth and Development Strategy 2013-2020	The policy applies to matters related to sustained growth of the economy, economic reform, human and social development, and energy and environmental sustainability in the context of a Green Economy.	Responsive (promotes gender equality as a means of reaching long term sustainable development)	Women, Youth, Elderly, PWDs
Governance			
Public Service Act	The Act outlines the management of the Public Service, defines the function of the Service Commission and outlines the Codes and systems that public servant are beholden to.	Neutral	No

Several categories of policies are identified including Labour, Health, Development, Disaster Planning, Land Use Planning, Water, Wastewater Treatment, Utilities that are relevant for a project of this nature. Thirty-three (33) policies and plans were identified which on the whole do not adequately or comprehensively address social and gender concerns. They fail to address in to reference or include vulnerable groups, including their potential unique needs and risks in the context of solid waste management and wastewater treatment (in many cases as seen in the policies under water and waste

treatment for example, do not make mention of women or vulnerable groups at all). Despite these limitations, the enabling environment is underscored by a robust policy and legislative environment in place to ensure that risks and benefits in the identified policy categories can be managed effectively. Utilising the frameworks found within these Acts such as the Employment Sexual Harassment Act or the Public Service Act and supplementing specific plans to address project specific gaps as they speak to more internal organizational (/governmental) environments and procedures and lack a public facing engagement factor (particularly the Employment Sexual Harassment Act) that would be found across multiple stages of this project, could serve to guide the project.

3.2 IDB Environmental and Social Policy Framework

The IDB will only support projects that meet the ESPF's standards in an acceptable manner and timeframe. Of particular relevance to the social component of this Project are ESPS 1, ESPS 2, ESPS 3, ESPS 4, ESPS 5, ESPS 6, ESPS 9 and ESPS 10, which are elaborated in Table 3-3 below.

Table 3-3: IDB ESPS 2020 Standards (ESPS Effective October 31, 2021)

ESPS Performance Standards	CONTENT	RELATIONSHIP TO THE PROJECT
ESPS 1 - Assessment and Management of Environmental and Social Risks and Impacts	<p>This performance standard speaks to the Risk Assessment and Management for health, safety, occupational, environmental and social impacts (direct, indirect and cumulative) during the phases of the project.</p> <p>This project will seek to build climate resilience and reduce the risk of natural disasters and thus follows the ESPS 1 requirement.</p>	<p>The Bank requires that Category A and B operations be subject to Environmental Assessments (EA). This project requires the need for an Environmental and Social Assessment and an Environmental and Social Management Plan (ESMP).</p> <p>This project is required to consider the necessary measures to reduce disaster risk to acceptable levels as determined by the Bank on the basis of generally accepted standards and practices.</p>
ESPS 2 - Labour and Working Conditions	<p>This standard speaks to projects having a constructive worker-employer relationship, treating workers fairly and providing them with safe and healthy working conditions. It is understood that borrowers may create tangible benefits, such as enhancement of the efficiency and productivity of their projects, through this approach.</p>	<p>This project is required to examine a fair hiring process during the construction phase of the development, which will likely require the contract of both skilled and unskilled labour.</p> <p>The project also needs to have management plans to help ensure health and safety of workers during construction and operation.</p>
ESPS 3 - Resource Efficiency and Pollution Prevention	<p>This Standard speaks to pollution prevention methods from project activities in order to avoid or minimize</p>	<p>Pollutants such as PM 10 and PM2.5 may be present during construction activities, which</p>

ESPS Performance Standards	CONTENT	RELATIONSHIP TO THE PROJECT
	adverse impacts on human health and the environment.	will be handled as guided by the established procedures to ensure the release of pollutants into the environment is avoided or minimize where unavoidable. Waste and water pollution will need to be kept at a minimum.
ESPS 4 - Community Health, Safety, and Security	This standard requires the consideration that project activities, equipment, and infrastructure can increase community exposure to risks and impacts, including those caused by natural hazards and climate change.	<p>This project will need to examine the need for measures that can be implemented to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project-related activities, with particular attention to vulnerable groups.</p> <p>Measures to avoid or minimize the risks and impacts to the project itself that may result from natural hazards and climate change are also required. Given Barbados's exposure to tropical cyclone events which can trigger storm surges and coastal flooding, drought, earthquakes, these are risks that the project needs to consider.</p>
ESPS 5 - Land Acquisition and Involuntary Settlement	This standard addresses the possible impacts of project-related land acquisition and involuntary settlement, including restrictions on land use, access to assets and natural resources which may lead to physical and/or economic displacement resulting in a loss or disruption/displacement of income sources and livelihoods.	The proposed pipeline routes that run along the ABC Highway and from the Ministry of Agriculture office will interfere with informal coconut and vegetable vendors. Assessment of the proposed works would determine the probability of their physical or economic displacement.
ESPS 6 - Biodiversity Conservation and Sustainable	This standard requires the protection and conservation of biodiversity, maintaining ecosystem services, and	The STP is in close proximity to the Graeme Hall Swamp (which is a key biodiversity

ESPS Performance Standards	CONTENT	RELATIONSHIP TO THE PROJECT
Management of Living Natural Resources	sustainable management of living natural resources, which are fundamental to sustainable development.	area and part of it is a private reserve) and currently has an effluent outfall in this sensitive environment. Key ecological resources could be impacted and as such mitigation measures to minimize this loss or disturbance is critical under this assessment.
ESPS 9 - Gender Equality	The promotion of gender equality, diversity and prevention of SGBV is a key component of this project. Mechanisms will be established for reporting any such violence or inequality.	This project actively promotes gender equality and the empowerment of women and introduces safeguards to prevent or mitigate adverse impacts on women or men. A Stakeholder Engagement Plan will also be prepared. The ESMP will also consider any of these issues.
ESPS 10 -Stakeholder Engagement and Information Disclosure	The Programme is guided by this performance standard to ensure that stakeholders' right to access information, public participation and justice in environmental matters are safe guarded. This inclusive process will be conducted throughout the project's life cycle.	The report will be required to be made available to the public and Project teams must comply with the Information Disclosure Policy. Meaningful consultations with relevant stakeholders will be conducted. A grievance mechanism will also be prepared and implemented for the project.

4 APPROACH AND METHODOLOGY

4.1 General Approach

The multi-disciplinary team of experienced scientists and environmental professionals conducted data gathering and analysis together to determine the dominant environmental issues relevant to the proposed project and to identify the potential impacts and mitigation measures. As an ESIA was already conducted for the implementation of this project, the team first conducted a gap assessment in which key environmental areas that were not sufficiently discussed were identified. These gap areas were the emphasis of this report. A detailed review of secondary data was used to inform the assessment. Among the key activities were:

- Desktop research
- Analysis of maps and plans
- Review of reports and background documents
- Stakeholder consultations

Other proposed developments and surrounding land use were also reviewed in the context of compatibility with the proposed project including potential positive, negative and cumulative impacts.

The following subchapters describe the approach for assessing the physical, biological and socio-economic environment.

4.2 Describing the Existing Environment

4.2.1 Site Assessments and Primary Data Collection

An initial site visit to the study area conducted on November 22, 2023 facilitated a review and understanding of the general project area. This was supplemented by on the ground social data collection During December 17 to 20, 2023.

During the period January 7 to 12, 2024 a detailed site assessment was conducted of the Graeme Hall Swamp, as well as the existing South Coast Sewage Treatment Plant. The activities conducted at the plant were assessed, along with the working conditions subject to the members of staff. This assessment was done to inform further the Labour Management Plan that has been drafted in Chapter 14 of this document. To supplement the assessment, photographs of the area were taken and integrated into the report. Additional stakeholders that were not yet consulted were consulted with during the first 2 weeks in January via a mixture of virtual and face-to-face meetings. These stakeholders included:

- Leslie Sealy, Representative of the Barbados Agricultural Development and Marketing Corporation (BADMC)
- Keeley Holder, Chief Agricultural Officer in the Ministry of Agriculture
- Wayne Nurse, National Disabilities Unit
- Shonee Howel, Coastal Zone Management Unit (CZMU)
- Lynda Holder, Barbados Transport Board
- Sandra Hunte, Executive Director of the Future Centre Trust
- Barney Gibbs, Director of the Future Centre Trust
- Farmers at the Valley Island Plantation, Edgecumbe Plantation, Sunbury Plantation and River Plantation
- Farmers in Haggatt Hall

It is important to note that whilst some water quality data was provided, the parameters analysed are inadequate for this type of project and the critical nature of the risks that this project poses to the nation. It is recommended that a proper baseline be carried out prior to the start of any construction. The recommendation for the detailed baseline will be presented in the Chapter 5.3 of this report.

4.2.2 Desktop Research and Literature Review of Available Secondary Data

The identified gap areas formed the basis of the description of the existing environment. Secondary data was primarily consulted for the assessment of the area, including reports prepared by Barbadian government agencies, as well as different UN organizations, such as the Food and Agricultural Organization. Information provided by the BWA was also incorporated into the assessment. Along with reports, relevant maps, aerial imagery and scientific papers were consulted. Local knowledge was also used as supplemental material to inform the description of the project area.

A site assessment along with the collection of air and noise baseline data are also a part of the data collection activities. Chapter 4.2.3 below details the methodology utilised to collect updated socioeconomic data for this project.

4.2.3 Socioeconomic Baseline

This social baseline assessment utilised desk-based research and a mix of virtual and in person stakeholder engagement as well as observation through an initial scoping mission. Virtual stakeholder engagement was used to alleviate the demands on the field team as persons not in Barbados can conduct these interviews utilising Zoom and this can also be combined with other direct engagement.

Stakeholder engagement being a major part of the data collection process involved mapping out the relevant stakeholders to be engaged, stakeholders were identified and mapped according to their type (see Annex II). Stakeholders for virtual engagement were divided into three categories: 1) government agency and 2) non-governmental organisations and 3) businesses. Field visit stakeholders were classed as :1) residential 2) local businesses 3) and formal and informal vendors.

Virtual engagements utilised an interview instrument (see Annex 1) to guide discussions with stakeholders around the proposed works and potential social impacts. Field work entailed the use of Kobo Toolbox which had the questionnaire and allowed for data collection and efficient analysis by the platform.

Field visits saw the SAEDI Consulting team traversing along the ABC Highway seeking to engage local vendors on the highway as well as heading to popular business establishments to engage both customers and staff present. In addition to this, the team engaged persons at their homes in nearby communities. Efforts were also expended attempting to call homes in those communities using phone directories.

The approach and presentation findings consider several factors:

- An immediate zone of influence in close proximity to where construction of the proposed reclamation facility are expected to take place and an outer zone of influence which includes a significant surrounding area along the planned pipeline routes. See Figure 4-1 below highlighting the varying zones of influence.

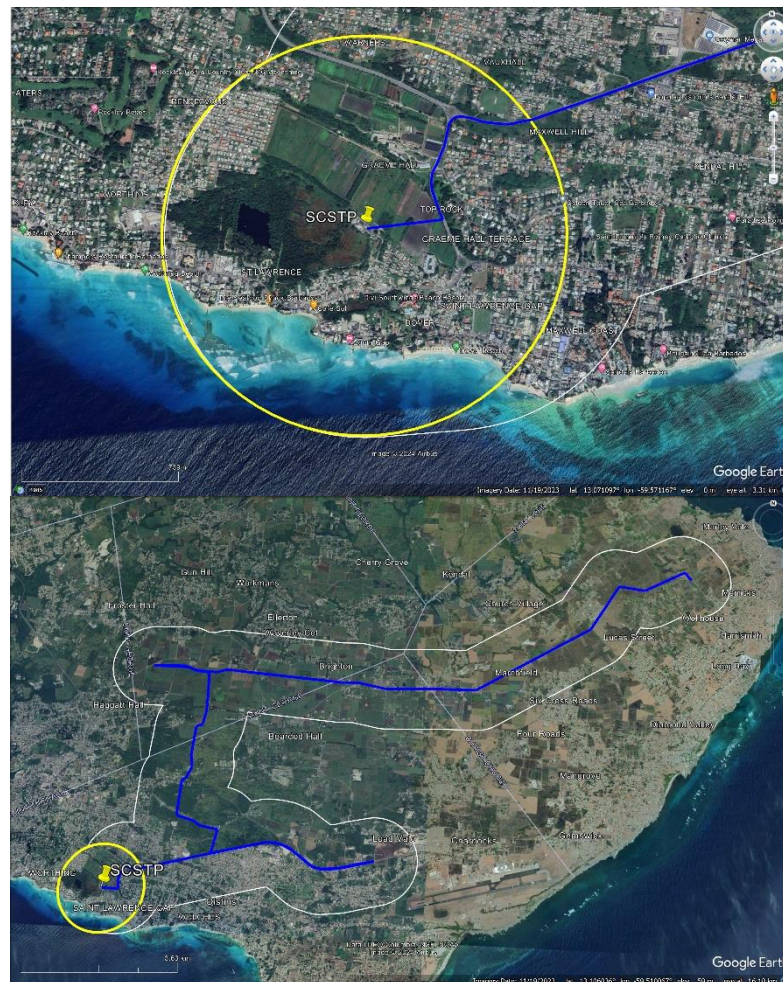


Figure 4-1: 1km Area of Influence around existing SCSTP (top); 1km Area of Influence around overall pipeline route (bottom)

- In Christ Church there is a significant mix of built infrastructure representing residential housing, commercial activities, industrial estates, farming as well as other services. Several mid-size business operations including Popular Supermarket, Kooyman Hardware store, Gildan, Deighton Griffith School, Central Vet and even the Ministry of Agriculture as well as DHL are in the area. The most significant consolidated residential area is Coverly which is likely to expand and place demand on sewage treatment capacity. Coverly, also because of its size, also comprises of several business and facilities which provide varied services including medical.
- There is a varied mix of residential and commercial in the area on the ABC Highway and just beyond it.
- The demographics include not only persons who live in the area but persons employed and working in the area who need to use the Highway and access services in the area. Age, geography and income source/livelihood/employment are key social as well as gender dynamics.
- There is a mix of age groups including a body of persons who are above retirement age and elderly. There is older housing and more recent and newer housing construction.
- There are multiple uses of the road network involving local residents and persons transiting from home to work as well as those who could be using it for economic activity, recreation and tourism.

The team decided to label the front end of the pipeline as the “**immediate zone of influence**”, while the back end was “**outer zone of influence**”, which would be those areas that rest alongside the pipeline but will not be directly affected. To add to this, it was also suggested that areas within these zones should be categorized and separated based on their contextual surroundings, e.g. the use of categories such as commercial, residential, mixed commercial/residential to describe such areas. The use of visual documentation would also be central to this categorization.

Pipeline to river plantation

The areas along the route of the pipeline to the river plantation were less densely populated as compared to the areas in the Christ Church area. These areas were less urban and saw a shift in the economic activities occurring with the main economic activity being farming with a mix of small-scale eateries, mini-grocers, bars and produce stalls. The population in these areas contained a mix of age groups, however the distribution skewed more towards the ages 30 years and older group, particularly as many of the residents are older, retired folks and those working farmlands. The majority of the land in these areas were dedicated for agricultural cultivation either ongoing, being prepared for cultivation or were formerly cultivation lands (wherein this case, persons brought properties with farmland, but they do not conduct farming activities).

The area consisted primarily of residential homes, agro-processing buildings and other farm related infrastructure, a few medical facilities (clinics), and other business infrastructure. These sensitive receptors are discussed further in Chapter 5.7.1.2.

A noted feature running throughout a sizable portion of this area is the historic train line which has been converted to the trailway. The trailway is primarily used for hiking and biking but it must be noted that currently only a section of the trailway has been fully realized and the rest of the trailway remains as an unpaved pathway. Alongside the trailway, farmers utilize the lands for growing crops such as fruit and vegetables like onions, eggplant, pumpkin, tomatoes, lettuce, cucumbers and watermelon, and root crops like cassava and sweet potatoes.

In the vicinity of the treatment plant

The area in the immediate vicinity of the treatment plant is primarily unpopulated with a major portion of the area around the plant being forested as it connects to the Graeme Hall swamp. Moving a bit further away (approximately 1 km) from the plant, there is a mix of commercial (primarily tourist related) and residential properties in the area (See Chapter 5.7). The Graeme Hall swamp serves as a major landmark in the area and has notable influence on the surrounding environment especially pertaining to drainage, flooding and mosquito population. The demographics of the area would include residents, tourists, locals commuting to the area for recreational activities, work and education. The age range is dynamic as there is a primary school located within the area in addition to the existing residences, hotels, guest houses and businesses.

4.2.3.1 Limitations

This assessment utilised desk-based literature review, virtual consultations and on the ground stakeholder engagement for data collection to address the gaps outlined by the IDB. Several limitations were experienced during this process. They are as follows:

For the Data Collection Process Conducted in December 2023

- Time period of the initial assessment (Christmas season) – Barbados was in the midst of the Christmas season and as the season demands, many persons are already preoccupied with preparations for the holiday to come. Additionally, with the festive season and atmosphere, persons (particularly government offices and other organisations) were less inclined to engage in work related affairs as the year comes to an end. Another factor at play during this season

is the fact people are less likely to be at home during the day, reducing the available pool of people to engage for the data collection.

- Safety concerns by residential stakeholders – the field team lacked official badges or letters identifying them and given the seasons, persons had reasonable safety concerns about being engaged at their homes by strangers.
- Limited team size – it is noted that the field data collection process was meant to be conducted by Environmental Solutions Limited (ESL) with the support of the SAEDI Consulting (Barbados) Inc. However, due to unpredictable circumstances, the ESL team were unable to obtain flights to Barbados which left the few members of SAEDI Consulting to conduct the larger part of the field data collection. Given the large target area and the three members of SAEDI Consulting available to conduct the fieldwork, this proved to be quite difficult.
- Poor weather – In person engagement was further thwarted by heavy rain showers and flooding occurring on some of the days, the team was scheduled to go out. These conditions greatly impaired the teams' ability to engage persons on the street and at their homes in the proposed area.
- Due to all the above, the team was limited to physically exploring and consulting stakeholder in only 1 of area identified i.e. the Christ Church area and the findings reflect those results.

For the Data Collection Process in January 2024

The stakeholder engagement and data collection process continued between January 9 – 13, 2024, in which more vendors, businesses, residents and farmers were engaged. However, as the on the ground team comprised of only three individuals, it was difficult to include a large sample of individuals from the potentially impacted communities. This was compounded on by the fact that the data collection process was being conducted during the hours of 9:00 a.m. to 5:00 p.m. when most individuals are away from their homes due to work, business or school. Furthermore, not all individuals who were approached were comfortable being included in the data collection process primarily due to a lack of interest in the Project or because of a lack of proof of association with the Project. However, despite these limitations, the process yielded results from up to 38 individuals from different communities, excluding the different farmers that were also consulted. The process aided in the identification of sensitive receptors and vulnerable groups and to better grasp concerns for the project on lives and livelihoods. The consulting team engaged with persons from the following communities (see Figure 4-2):

- Saint Lawrence Gap
- Top Rock
- Maxwell Hill
- Kingsland
- Newton Terrace
- Providence
- St. Davids
- Stepney
- Bulkeley Close
- Windsor
- Bentleys
- Brereton
- Marchfield
- Areas around River Plantation

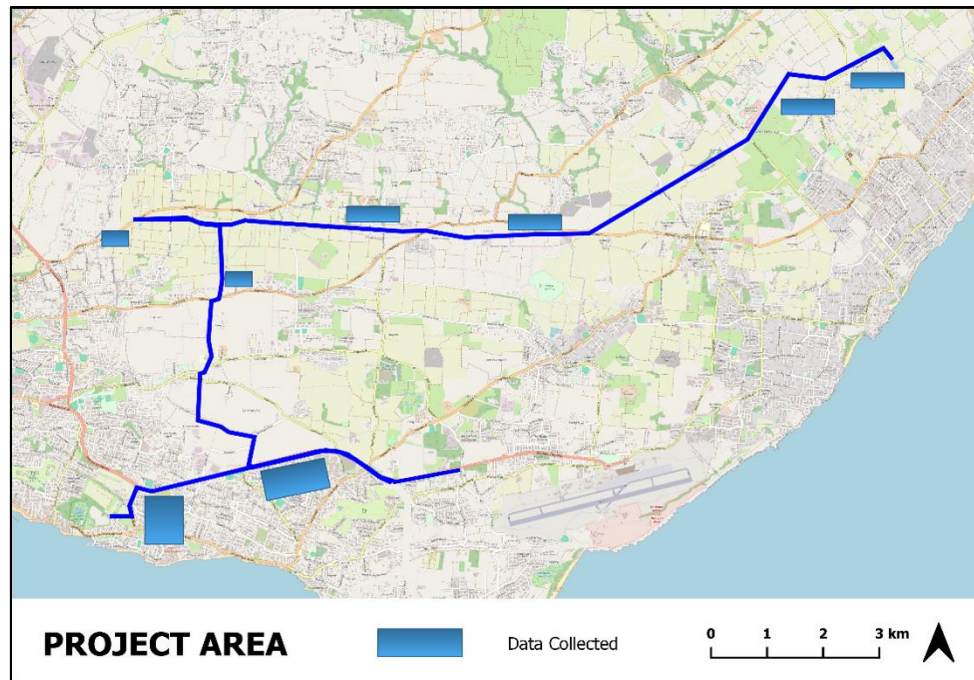


Figure 4-2: Areas where community engagement and data collection was concentrated during the January 2024 Site Visit

4.2.3.2 Gender Assessment

A Gender Assessment was carried out as a part of this consultancy as it seeks to address the gendered risks associated with the project for upgrading the south coast sewage treatment plant and the ensuing the pipeline network to be constructed to supply farmers with water. It used a gender needs assessment to examine the data findings, as well as examine the overall implications for individual and business in the impacted areas.

A total of 46 non-residential and 23 residential stakeholders were engaged as part of the data collection with these stakeholders consisting of government agencies (16), NGOs (11) and businesses (19). Stakeholders were engaged based on their relevance to environmental and biodiversity conservation and management, land management and development, waste and sewage management, water management, and business and economic activities.



Figure 4-2: Gender Needs Framework

SAEDI Consulting's approach to gender analysis, using a Gender Needs Framework, is to use an intersectional lens, allowing for the inclusion of women in all of their diversity and interconnecting roles, as well as the inclusion of the elderly, people with disabilities, youth and other vulnerable groups (Figure 4.3). The framework is used particularly to examine the ways in which the persons most likely

to be impacted by the project might be affected, in what ways and to what degree and also to better understand the gender drivers of these vulnerabilities. By taking this approach, it is also expected that opportunities to give voice and agency as the seek to adapt to the impacts and navigate changes, both positive and negative, will also be considered.

4.3 Assessment of Impacts and Risks

The main goal is to identify the environmental and social impacts associated with the project at and around the site, focusing on both positive and negative impacts and risks as well as bio-physical, chemical, social, economic and cultural components of the environment including, but not limited to:

- Effects on wildlife, terrestrial and marine biodiversity
- Effects on existing or proposed protected areas or other sites of conservation or special management interest
- Effects on surrounding communities (residential and commercial activities)
- Effects on livelihoods

Table 4-1: Defining the nature of the potential impacts

Term	Definition
Positive Impact (Benefit)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative Impact	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct Impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect Impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative Impact	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.

Table 4-2: Impact Rating Table

Criteria used for impact rating	
Extent	<ul style="list-style-type: none"> On-site – Limited to within the site boundaries (plus a 6m buffer to each side of the pipe's centreline); Local – impacts that affect an area in a radius of 2km around the site; Regional – impacts that affect regionally important resources or are experienced at traditional authority or district scale; National – impacts that affect nationally important resources or affect an area that is nationally important/ or have macro-economic consequences; Transboundary/International – impacts that extend beyond country borders or affect internationally important resources.
Duration	<ul style="list-style-type: none"> Temporary – impacts are predicted to be of short duration and intermittent/occasional; Short-term – impacts that are predicted to last only for the duration of the construction period; Long-term – impacts that will continue for the life of the Project, but ceases when the Project stops operating; Permanent – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.
Likelihood	<ul style="list-style-type: none"> Unlikely – The impact is unlikely to occur. Likely – The impact is likely to occur under most conditions. Definite – The impact will occur.
Magnitude	<ul style="list-style-type: none"> Biophysical environment – magnitude can be considered in terms of the sensitivity of the receptor: <ul style="list-style-type: none"> Negligible – the impact is not detectable; Low – the impact affects the environment in such a way that natural functions and processes are not affected; Moderate – where the affected environment is altered but natural functions and processes continue, albeit in a modified way; High – where natural functions or processes are altered to the extent that it will temporarily or permanently cease.

Table 4-3: Impact Significance or Severity Criteria

Significance criteria	
Negligible significance	An impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels.
Low significance	An impact of low significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.

Significance criteria	
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that “moderate” impacts have to be reduced to “minor” impacts, but that moderate impacts are being managed effectively and efficiently.
High Significance	An impact of high significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the ESIA process is to get to a position where the Project does not have any major residual negative impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the Project.

4.4 Stakeholder Mapping, Analysis and Engagement

Building solid, productive, and responsive relationships with stakeholders is the cornerstone of successfully managing a project's environmental and social implications. Stakeholder analysis and planning, information disclosure and distribution, involvement and consultation, and continuous reporting to affected communities are all parts of this continuous process. The nature, frequency, and intensity of stakeholder involvement correspond to the risks and unfavourable effects of the project as well as its stage of development.

This Stakeholder Analysis is a requirement of the IDB's 2020 ESPS and is being conducted from the early stages of the project. With the assistance of the key implementing agency, BWA, the team identified key institutions, government agencies, private sector entities, community groups, non-governmental organizations and community groups to consult with as the various components of the overall Program is rolled out.

For the development of the Stakeholder Engagement Plan, stakeholders were grouped according to who may be impacted, have special interest in, or may influence the proposed project (Figure 4-2). Several of the stakeholders were identified and mapped as per Figure 4-4.

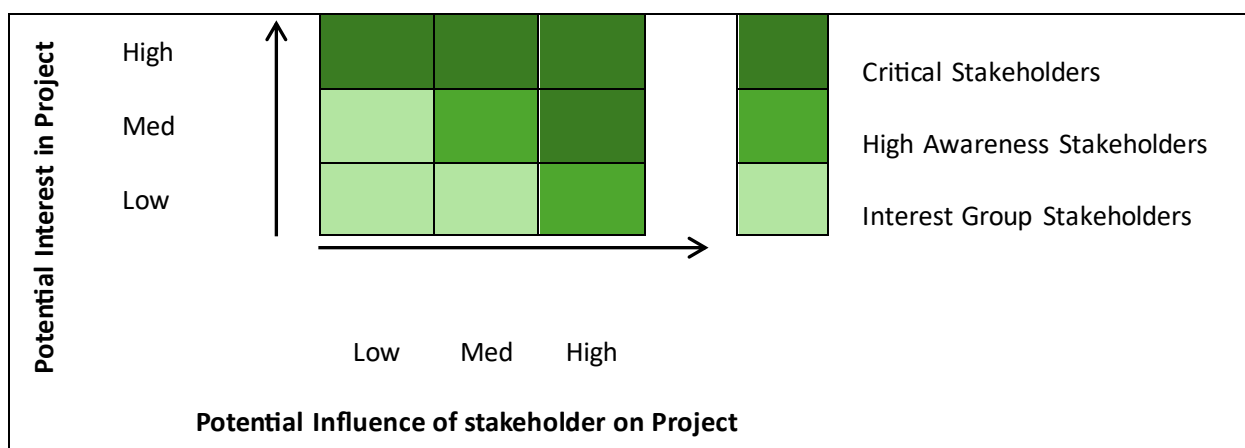


Figure 4-4: Stakeholder Mapping

Medium Interest Stakeholders: Their roles are based on a specific administrative mandate and capability/capacity which is a standard engagement for them.

Stakeholders with Important Interests: These stakeholders have important information or specific action-based deliverables that project implementation must rely on. The Stakeholder Consultation process will not qualify as robust if these entities are not consulted.

Critical Stakeholders: These stakeholders are critical engines of project development both in relation to conceptual planning and actual resource deployment. They must be consulted.

Stakeholders were also disaggregated in the following ways:

- Stakeholders that are involved in the Project's development and planned implementation to include those technical Stakeholders who have a specific interest or implementation responsibility for aspects of the project.
- Affected Stakeholders: Those that may be affected by the different components and phases of the project. The stakeholders contacted will be those assumed to be affected, directly or indirectly, by aspects and effects of Project implementation.
- Stakeholders being able to influence Project implementation.

The stakeholder engagement process is ongoing and as such, the Stakeholder Engagement Plan (SEP) that is included in SECTION II – THE ESMP is a living document and builds on the processes that inform the analysis within this document. Along with the stakeholder engagement process, the consulting team conducted data collection processes in an effort to raise awareness about the project, as well as to inform affected stakeholders of any changes that have been made to the conceptual design that had been previously shared. It targeted members of the Barbadian civil society (NGOs and community groups), institutional groups, government agencies and the general public with emphasis on individuals and businesses within the zone of influence of the project area. The data collection process also provided the opportunity to collect information from the identified key stakeholders on the potential risks and causes for concern of the project, and helped to identify stakeholders that would be deemed key in the Stakeholder Engagement process as per Figure 4.4 above.

The primary modes of engagement and consultation included a virtual session to facilitate the gathering of data to enhance the Environmental and Social Impact Assessment held on Wednesday, the 20th of December 2023, and informal meetings with the general public via expository methods, direct and indirect interrogative methods, and informal dialogue. The process of preliminary informal consultations with community members for the ESIA commenced on Friday, the 15th of December 2023.

The stakeholders approached for the aforementioned data collection activities included:

- | | |
|--|---|
| - Parliamentary Representatives | - Ministry of Agriculture and Food Security |
| - Ministry of Health and Wellness | - Barbados Council for the Disabled |
| - Ministry of the Environment and National Beautification | - Lands and Survey Department |
| - Town and Country Planning Department | - Natural Resources Department |
| - Environmental Protection Department | - Department of Emergency Management |
| - Ministry of Transport, Works and Water Resources | - Coastal Zone Management Unit |
| - Bureau of Gender Affairs | - Constant Plantation |
| - Barbados Transport Board | - Farmers - River Plantation |
| - Sanitation Service Authority | - Buckley Sugar Factory – Barbados Farms |
| - Ministry of Education, Technological and Vocational Training | - Residents in the Project Area (Graeme Hall Swamp) |
| - National Conservation Commission | - Residents Along Pipe Routes |
| | - Graeme Hall Nature Sanctuary |
| | - Barbados National Trust |

- Barbados Tourism Marketing Inc.
- The Barbados Hotel and Tourism Association
- Barbados Chamber of Commerce
- Barbados Workers' Union
- Barbados Environmental Conservation Trust
- National Disabilities Unit
- Future Centre Trust
- Barbados Light and Power Company

Subsequent to this phase of consulting with stakeholders, methods such as workshops and a town hall meeting will be conducted to facilitate exposition, public discussion and debate around the Project in general and specific elements of the proposed works – potential impacts of constructing the reclamation facility and the installation of the pipelines, as well as how both components would be both beneficial and potentially detrimental to the physical, ecological and socioeconomic environment. These will be periodic, held regularly as a predicted time and location, organized to facilitate maximum participation across communities and society including the visible participation of vulnerable as well as directly affected groups.

Chapter 16 of this report details the actions required to undertake a series of consultations with key stakeholders during the Project Preparation Phase as well as the actions the BWA and its contractor will need to undertake to engage with the identified stakeholders that were included in public and informal consultations throughout the Project Implementation phase in compliance with IDB's ESPS 10 – Stakeholder Engagement and Information Disclosure.

4.5 Gross Green House Gas (GHG) Emission Calculations

For various wastewater treatment technologies, biological treatment technologies generate on-site GHG emissions during wastewater treatment processes, but physical, chemical, and physicochemical treatment technologies do not. Off-site emissions refer to emissions from effluent, electricity consumption, production and transportation of chemicals. Off-site emissions refer to emissions from effluent, electricity consumption, production and transportation of chemicals. But we exclude off-site emissions generated by chemicals' production and transportation due to lack of data for each WWTP, and they being negligible compared with electricity consumption. CO₂ emissions from electricity consumption are fossil CO₂, because they come from coal-fired power generation.

The first step to quantify GHG emissions of a WWTP is to judge the applied treatment technology. If the WWTP adopts a biological process, on-site emissions from the biological treatment process are calculated. Otherwise, off-site emissions from electricity consumption and the discharge pathway for each WWTP are quantified. Calculation of GHG emissions from each emission source was based on the multiplication of emission factors and activity data. Currently, the South Coast Sewage Treatment Plant (SCSTP) does not adopt a biological process to treat the wastewater (primary treatment facility) hence is not a source of on-site GHG emissions. However, off-site GHG emissions arising from discharge of effluent, via outfalls, of Needham's Point, GHG emissions from electricity consumption as well as sludge handling and transportation should be estimate for the purpose of this project activity.

The project intervention is meant to upgrade the SCSTP to a tertiary treatment facility whereby the addition of on-site GHG emissions will occur with the adoption of a biological process(es) to treat influent wastewater. Conversely, reductions in off-site emissions and opportunities for gas recovery and flare can counteract and offset the additional on-site GHG emissions from the secondary and tertiary stages of treatment.

SECTION I

THE ESIA

5 DESCRIPTION OF THE EXISTING ENVIRONMENT

The existing ESIA delineated the spatial and temporal boundaries within which the environmental and social settings were considered. Figure 5-1 shows the location of the SCSTP and a section of the proposed overall pipeline route. Figure 2-3 in Chapter 2.3 of this report shows the complete proposed route of the pipelines, including the route that follows the historic railway and branches to the St. George aquifer recharge point and to the River Plantation.



Figure 5-1: Map of Barbados showing the SCSTP (west) and Outfall (east) (Source: NEMUS, 2021)

The pre-existing conditions of the physical, ecological and social environment in the area encapsulated by the project's zone of influence were assessed, with emphasis being placed on the following issues:

- | | |
|--|------------------------------------|
| - Climate | - Air Quality and GHG Emissions |
| - Geomorphology and Geology | - Noise |
| - Groundwater Resources and Hydrogeology | - Waste Management |
| - Surface Water Resources | - Ecology |
| - Coastal Waters | - Urban and Territorial Planning |
| - Soil Resources | - Public Health and Socioeconomics |

This report maintains that the existing conditions of the physical, biological and social environment remain largely relevant and applicable as outlined in the existing ESIA. However, the gap assessment conducted and the stakeholder engagement process pointed to the need for further emphasizing the existing conditions of environmentally sensitive areas of special or unique biophysical, socio-economic, or cultural value. Chapter 5 includes further discussion of the following issues:

- | | |
|---|-------------------------|
| - Ecology Inclusive of the Grame Hall Swamp | - Hazard Considerations |
| - Climate | - Irrigation Management |
| - Greenhouse Gas Emissions | - Groundwater Resources |
| - Waste Management | - Socioeconomics |

5.1 The Project Site and Situation

The project site begins at the South Coast Sewage Treatment Plant located in Graeme Hall, adjacent to Graeme Hall Nature Reserve/Swamp to the south, the Department of Agriculture Research Station to the north, and Harmony Hall to the east. Among them, the Graeme Hall Nature Reserve/Swamp is a protected site in RAMSAR.

The effluent will be transported in underground pipeline running along the ABC Highway to replenish and be stored in a non-potable aquifer, the Christ Church aquifer (Pipeline C in Figure 5-2).

The disinfected and filtered reclaimed water will be allocated to agricultural users for use on edible food crops and for other agricultural irrigation purposes to support the expansion of agricultural activities and food security in Barbados. Pipeline Section D in illustrates the area to be irrigated. The Socioeconomic Assessment in Section 5.7 lists all the communities that are in the impact zone for this project.



Figure 5-2: General Project Site and Situation

5.2 The Physical Environment

5.2.1 Groundwater Resources

Six Groundwater Protection Zones have been identified throughout the island by a policy formulated by the Barbados government. This represented a key step in the process to improve Barbados' water quality by preventing bacterial contamination of public supply wells (Vasquez, 2017). The Water Protection Policy, as outlined by the Planning and Development Department, demarcates six zones – Zone A to Zone F (see Figure 5-3), with policies for each zone determining what can be built in each zone and the waste disposal method to be implemented. Table 5-1 shows the requirements for each of the water zones.

Table 5-1: Water Zones in Barbados as determined by the Water Protection Policy

Water Zone	Referred to as	Prohibitions
Zone A	Exclusion Zone	<ul style="list-style-type: none"> - any development that is not related to the supply, treatment, and management of water in accordance with the development plan for the area; - the land application of a manure-based fertilizer; - the storage and disposal of manure; - the generation of animal waste, manure or other pathogenic chemicals; - waste disposal from sugar factories, rum, plants or other manufacturing or industrial activities; - livestock farming or animal husbandry, the operation of animal sanctuaries or zoos, or other facility for the housing of animals; - the operation of landfills; and the use of suckwells as the primary means of sewage treatment.
Zone B	Pathogen Management Zone	<ul style="list-style-type: none"> - the land application of a manure-based fertilizer; - the storage and disposal of manure; - the generation of animal waste, manure or other pathogenic chemicals; - waste disposal from sugar factories, rum, plants or other manufacturing or industrial activities; - livestock farming or animal husbandry, the operation of animal sanctuaries or zoos, or other facility for the housing of animals; - the operation of landfills; - the use of suckwells as the primary means of sewage treatment; - the storage and handling of fuel and fuel products; - the storage and handling of dry cleaning products; - chemical manufacturing and storage;

Water Zone	Referred to as	Prohibitions
		<ul style="list-style-type: none"> - recycling of metals, automobiles, applications and machinery; - use of chemical based fertilizer on land; - use of chemicals for agricultural purposes on the land; - the storage of more than the stated volume or amount of fertilizers or agricultural chemicals; - the storage of more than the stated volume or amount of domestic or household cleaners, industrial cleaners or types of cleaners; - the operation of crematoriums or landfills
Zone C	Chemical Management Zone	<ul style="list-style-type: none"> - the storage and handling of fuel and fuel products; - the storage and handling of dry cleaning products; - chemical manufacturing and storage; - recycling of metals, automobiles, applications and machinery; - use of chemical based fertilizer on the land; - the storage of a significant volume of fertilizers or agricultural chemicals; - the storage of a significant volume of household, industrial or other domestic cleaners; - the operation of crematoriums or landfills.
Zone D	Aquifer Recharge Contributing Area	<ul style="list-style-type: none"> - waste disposal from sugar factories, rum, plants or other manufacturing or industrial activities; - the storage of a significant volume of household, industrial or other domestic cleaners; - the storage and handling of dry cleaning products; - the storage and handling of fuel and fuel products; - the storage of a significant volume of fertilizers or agricultural chemicals.
Zone E	Non-Recharge Contributing Area	<p>A Zone E area is an area which does not recharge or replenish the aquifer and in each parish where such a zone exists, there shall be no specific restrictions in respect of an area located in a Zone E area unless such restrictions are imposed under the Scotland District Authority Act, Cap. 395B or the Soil Conservation (Scotland District) Act, Cap. 396 or under any other enactment.</p>

Water Zone	Referred to as	Prohibitions
Zone F	Desalination Water Protection Zone	Zone F applies to areas where the feedwater wells for current or future desalination plants would be located.

The parameters that are included in water quality assessments are listed below in Table 5-2. Effective comparisons to the standards outlined by the United States Environmental Protection Agency (US-EPA) could only be conducted provided that the data on water quality resources include the unit of measurements. It is also important to note the US-EPA does not explicitly stipulate quality standards for some of the parameters listed below.

Table 5-2: Water Quality of Resources in Different Locations

Parameter	Groves	Hampton	New Market	Standard (US-EPA)
Alkalinity	176.86	193.91	200.21	20000 µg/L
Ammonia-N	<0.05	<0.05	<0.05	17 mg/L
Amonia-N	<0.05	0.17	0.06	-
Bicarbonate	215.81	237.61	244.25	-
Calcium	227.00	233.57	247.46	-
Chloride	48.78	85.89	32.63	250 mg/L
Copper	<0.005	<0.005	<0.005	1000 µg/L
Electrical Conductivity	671.00	790.77	618.87	800 - 2,500 µS/cm
Iron	0.01	0.41	0.01	0.3 mg/L
Lead	<0.005	<0.005	<0.005	0.015 mg/L
Magnesium	32.24	44.00	25.50	35 mg/L
Manganese	<0.005	<0.005	<0.005	100 µg/L
Nitrate-N	6.99	5.79	6.92	10 mg/L
Nitrite-N	0.01	0.05	0.01	1 mg/L
Ortho Phosphorus	0.06	0.07	0.07	-
pH	7.54	7.39	7.32	6.5 – 8.5
Potassium	3.27	3.50	3.08	-
Sodium	33.90	47.30	23.75	20 mg/L
Sulphate	23.45	26.00	23.68	250 mg/L
Total Dissolved Solids	377.33	435.65	368.09	1,000 mg/L
Total Hardness	257.90	277.45	276.52	-
Total Phosphorus	0.07	0.11	0.07	25 µg/L
Total Suspended Solid	<2	<2	<2	158 mg/L
Turbidity	0.39	0.30	<2	Clarity should not be reduced by 20%
Zinc	0.01	0.01	<0.005	-

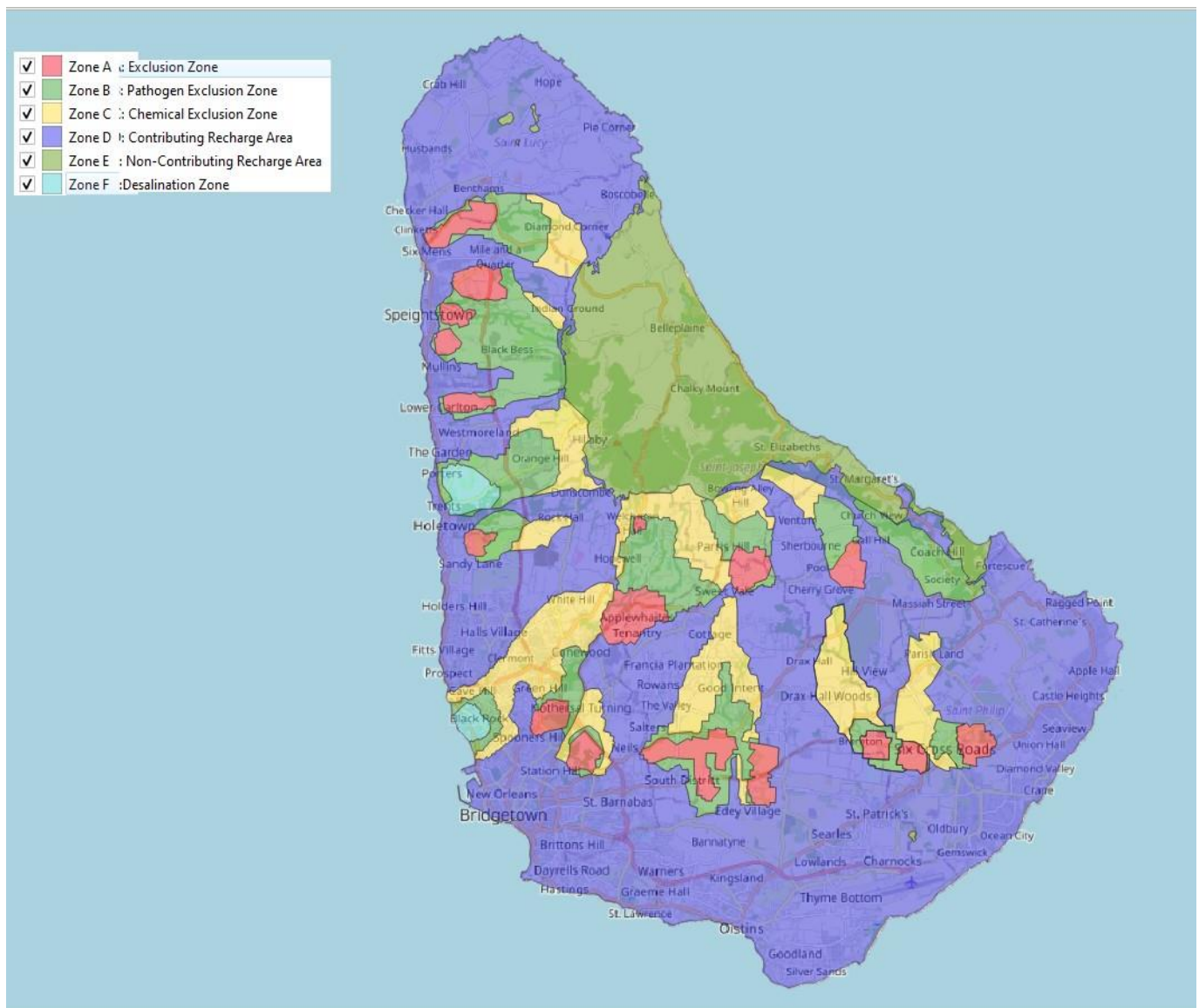


Figure 5-3: Barbados Water Zones as stipulated by the Water Protection Policy

Source: The Planning and Development Department

5.2.2 Irrigation Management

The Food and Agriculture Organization (FAO) claims that 90% of the island's total irrigation area was supplied by groundwater resources in 2000. With the influence of agricultural organizations, such as the Barbados Agricultural Development and Marketing Corporation (BADMIC), and their roles in aiding with irrigation management and supply, the source of irrigation has since diversified. The BADMIC reports their irrigation supply as being sourced from wells and springs.

Figure 5-4 shows the location of irrigation wells in relation to groundwater flow paths in the project area.

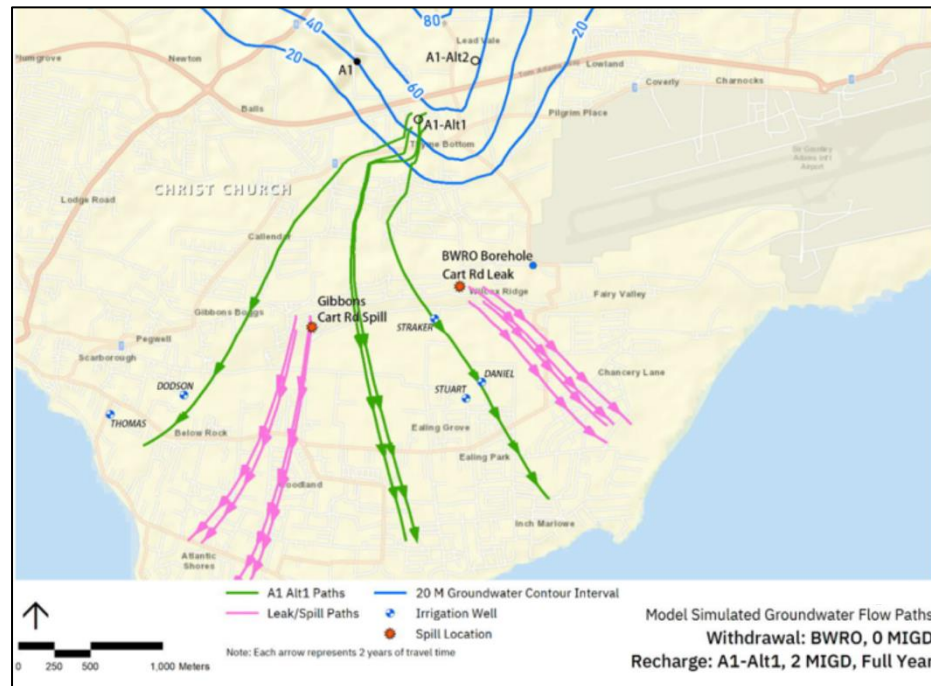


Figure 5-4: Groundwater Flow Paths in the Project Area

Due to the water scarcity that is a consequence of dry spells and droughts, water availability and usage for irrigation and other agricultural activities are restricted. It would, therefore, be beneficial to the farmers that the proposed pipeline would provide for the availability of water due to reclamation. Figure 5-5 shows the frequency of periods of drought experienced in the area over the past century.

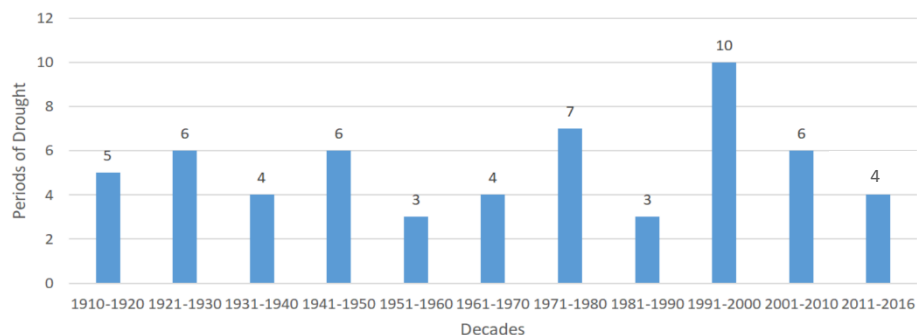


Figure 5-5: Decadal Low Rainfall Periods from 1910 – 2016

The graph above shows the frequency with which drought periods have been experienced in Barbados. There is no evident trend in the frequency of these period. However, it should still be noted that these periods of drought strain the island's water resources and restrict the use of water for irrigation. Not only are agricultural yields and the livelihoods of farmers impacted but low rainfall levels also strain groundwater reserves. The recognized need for more effective management of water resources, and by extension management of irrigation practices, would reduce the extent of the aforementioned impacts.

5.2.3 Disaster Risk Assessment

Considering Barbados' largely low-lying topography and geological makeup, the country experiences earthquakes, small-scale landslides, flash floods, and droughts. Because of the island's size, natural disasters like storms, droughts, and earthquakes tend to have impacts that are felt on a national scale.

The hazards to which Barbados is exposed can be categorized into hydrometeorological hazards, as well as geophysical hazards. The frequency and intensity of these hazards are influenced by the island's existing climatic, geomorphological and geological environment as discussed in the existing ESIA. The hazards that are of paramount relevance to the Barbadian context are flooding, storm surges, hurricanes and seismic activity. The projected changes in climatic conditions, as discussed in Chapter 5.3, as well as the active faults located on the island are identified as drivers for the increased threat of these hazards.

5.2.3.1 Dry Spells and Droughts

The climate of Barbados can be divided into a rainy and a dry season. The dry season typically endures from December to May, a period in which rainfall levels are at a minimum relative to the wet season. With the reduction in precipitation levels that are characteristic of these dry conditions, the effects of droughts are especially detrimental to the agricultural sector and food security. The lack of rainfall compounded by the persistence of high temperatures lead to a reduction in the agricultural yields and productivity, compromising the livelihoods of farmers. High temperatures are also facilitators of pest proliferation, and this could further dent agricultural yields. The water scarcity that is also associated with dry spells would suggest that there would be an overreliance on groundwater resources, necessitating effective management of groundwater reserves.

5.2.3.2 Heavy Rains, Tropical Storms, Hurricanes and Floods

Barbados is susceptible to all of the principal effects of transatlantic hurricanes, including storm surge and floods, because of its location along the hurricane belt where most transatlantic hurricanes pass. However, due to the island's location in the hurricane belt, it is seldom directly impacted by hurricanes. Flooding and storm surges are typically as a result of heavy precipitative activity and high winds that accompany tropical storms, with many hurricanes having passed the small island state as a tropical storm or weaker.

Still, flooding has been shown to be a frequent nuisance due to the drainage problems along Barbados' southern shore. The southern coastal region experiences both little, inconvenient floods and major floods brought on by persistent rain. The United States Agency for International Development -USAID's - Country Resilience Profile on Barbados⁵ credits the country's natural flat and low-lying topography as a main contributor to flooding incidents. This is also compounded by poor drainage and stormwater infrastructure in developed regions. Coastal communities may experience coastal floods more frequently due to the threat of sea level rise brought on by climate change. This kind of flooding would put the island's inland water resources at risk of salinization in addition to negatively impacting coastal economic activity, tourism, and living conditions. Careful considerations should, therefore, be made as the existing SCSTP lies within the southern region and hence, lies in a flood prone area. Such considerations include the prioritization of the preservation of the coastal mangroves and wetlands (i.e., Graeme Hall wetlands), emphasizing their restoration as nature-based solutions by reducing waste disposal and effluent discharge in these areas. As well, it is important that community education and awareness campaigns are conducted to inform on the importance of the conservation of these areas, the risk of flooding, the appropriate responses to early warning systems that should be implemented and other adaptation and mitigation measures that can be implemented on a community level. These measures could complement the Integrated Coastal Zone Management (ICZM)

⁵ https://pdf.usaid.gov/pdf_docs/PA00XHZD.pdf

Programme that is a pillar of the island's environmental conservation, coastal risk management and climate resilience efforts

5.2.3.3 Seismic Activity – Earthquakes

Seismicity in geology term refers to the occurrence of earthquakes. However, as earthquakes are caused by tectonic activity which is also the causal factor for volcanic activity, as both are influenced by the motion of tectonic plates, seismic activity also incorporates volcanic activity. Barbados, being the only island in the Lesser Antilles that was not formed from tectonic activity but via reef formation, is not exposed to volcanic activity. An assessment of the geology of the island has shown that there are active faults located in the island which support earthquake activity.

Despite this, earthquake activity in Barbados has not been a common occurrence, with the most recent spike in seismic activity occurring in July 2015. According to the UWI–SRC, the region experiences 13 earthquakes with a magnitude greater than 2.5 annually on average. In comparison to areas in the northern Leewards, close to Antigua, and Trinidad and Tobago, this is relatively low. Generally, seismicity is at a lower rate in the Barbados Zone than what is seen in the volcanic island arc just west of the island. In general, only the larger magnitude earthquakes along the arc generate shaking that can be felt in Barbados and fewer still cause damage. The infrequency of earthquakes to have directly impacted Barbados is seen in Figure 5-6.

The accompanying tsunami threats, which arise from earthquakes below or near the ocean floor that cause the floor to shift vertically, also pose a threat to small islands. According to the UWI Seismic Research Center, at least four tsunamis have affected Barbados in recorded history.

- 1755, 2 m – An earthquake-generated tsunami following the Lisbon Earthquake. The tsunami travelled from Portugal across the Atlantic with waves recorded in Barbados and Martinique.
- 1762, height unknown – An earthquake-generated tsunami following Azores Earthquake near Portugal.
- 1902, 2-3 m – Tsunami generated by eruption of La Soufriere Volcano in St. Vincent
- 1939, 2 m – Tsunami generated following the eruption of Kick-'em-Jenny submarine volcano off the coast of Grenada.

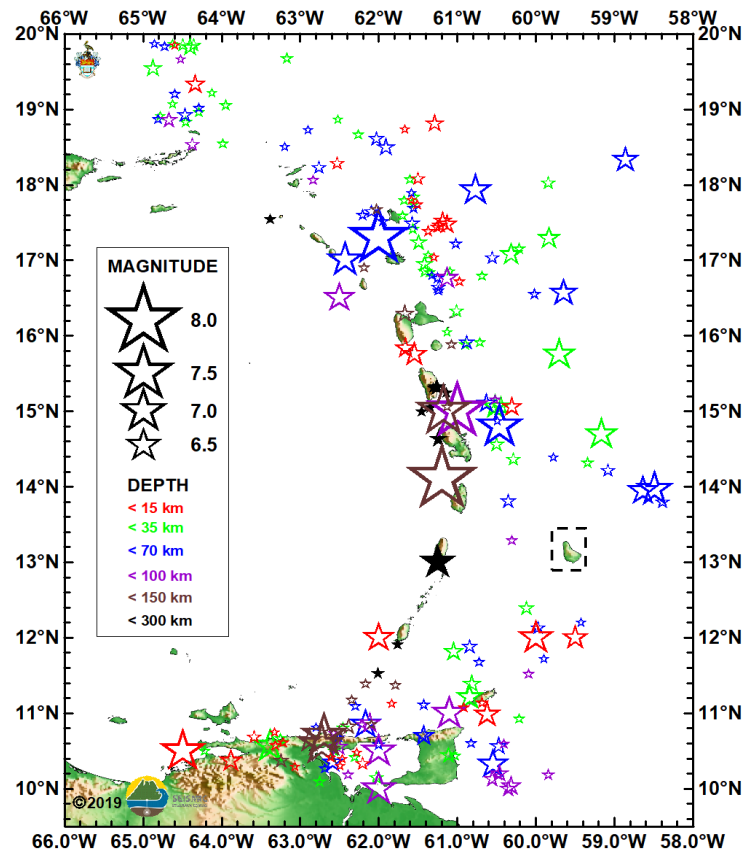


Figure 5-6: : Eastern Caribbean Epicenters 1900-2019/07 (Magnitudes 5.0 and larger)
Seismic Map received from UWI Seismic Research Centre

5.2.3.4 Landslides

Small-scale landslides are linked to coastal escarpments where wave activity undercuts the rock,

causing instability. However, Barbados' primary landslide activity is limited to the northeastern Scotland District. Landslides are seldom experienced in the southwestern regions of the island where the SCSTP is situated. Still, the projected increase in the frequency and intensity of precipitative events can also prove influential to the genesis of more frequent landslides.

5.2.4 Climate and Climate Change

Barbados' vulnerability and exposure to hazards are largely driven by climate change as the island is primarily faced by challenges that are directly or indirectly consequent to hydrometeorological events. Thus, it is important that the projected changes in climatic conditions are established as well as the existing climatic conditions.

The ongoing issue of climate change has the potential to impact Barbados primarily through the increased frequency of more severe weather hazards, such as droughts, inundation induced by heavy rainfall, more intense hurricanes and rising sea levels which threaten saline intrusion of groundwater resources. The existing ESIA summarizes the existing climatic conditions of the study area. However, it is also important that projected changes in climatic conditions are identified and considered in the proposed development. The characterization of projected changes in climatic conditions is based on projections published by the Inter-Governmental Panel on Climate Change (IPCC) in 2007. The climatic parameters of the report which prove relevant to the project range from air and sea surface temperatures to the predictions of extreme weather events.

Barbados is subject to drastic alterations of heavy rainfall and drought conditions and this unpredictability is expected to be exacerbated consequent to a changing climate. Projected models by the IPCC identify air and sea surface temperatures undergoing increases of up to 3.2 degrees Celsius. The increase in these temperatures are typically associated with increases in heavy precipitative events as the increased heating of sea and ocean surfaces leads to an accelerated convection process that fuels precipitation. Heavy rainfall activity has proven hazardous to the Barbados context, as discussed in Chapter 5.5 below. The IPCC further states that there is a 66% certainty that there will be an increase in hurricane intensity with higher wind speed peaks and higher volumes of precipitation. This, therefore, suggests that the Atlantic Hurricane Season which runs from June to November will be dotted with more extreme cyclonic activities. Still, projection models indicate that the summer months of June to August will be characterized by lowered precipitation levels.

As Barbados is largely a relatively flat island with minimal highlands of no notable peak heights, the issue of flooding looms as one of the island's greatest threats. With the projected increase in extreme precipitative events, the issue will also persist.

The IPCC also predicts that sea level rise in the region could be observed at levels as high as 0.59 feet by 2099. This not only threatens the coastal population, infrastructure and resources of small island developing states, such as Barbados, but is also a casual factor for saline intrusion that alters the quality of the islands' groundwater resources. Barbados' groundwater resources are discussed in Chapter 5.3.1. Sea level rise also has the potential to serve as a catalyst for coastal hazards, such as storm surges and erosion, which are issues that threaten Barbadian coastal regions.

Of note is the fact that the unpredictability of climate change could suggest that the aforementioned values of expected changes may experience an increase in their upper boundaries. This is also compounded by the fact that the IPCC projections do not account for changes in polar ice sheets that are instrumental to the rate of sea level rise.

5.2.5 Greenhouse Gas (GHG) Emissions

5.2.5.1 Introduction

In the waste sector, wastewater treatment plants (WWTP) are in the second position after landfills regarding GHG emissions (Bogner et al., 2007) and in the eighth position among stationary sources of biogenic CO₂ emissions (USEPA, 2014). GHG emissions are not usually high but, due to climate change and environmental impact concerns, evaluation of GHG emissions from wastewater became a subject of great interest. For a wastewater treatment plant (WWTP), the carbon footprint represents the amount of emissions associated with the collection, treatment and final disposal of the treated wastewater and of the sludge resulted from wastewater treatment. They include

- Biological processes: Anaerobic digestion, aerobic treatment, and fermentation.
- Energy consumption: Electricity use for pumps, blowers, motors, etc.
- Fugitive emissions: Methane leakage from pipes, tanks, and equipment.
- Chemical processes: Production and use of chemicals such as chlorine or other treatment agents.

It is important to know the carbon footprint of the WWTP because the measures to reduce it are related to the ones for improving energy efficiency, hence resulting in better management of the plant.

Globally, the inadequate disposal practices of sludge as well as the use of rudimentary processes for the treatment of wastewater are being considered as sources of GHG emissions (Larsen, 2015). Global researchers have focused on several stages of wastewater handling structures such as sewerage/effluent transportation, building and operation of wastewater and/or sludge treatment units, and reception or reuse water networks, among others, in the context of GHG emissions, (Ray et al., 2021). It is widely known in the literature that the potential for GHG emissions related with WWTS

is mostly connected with carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) gases, (Liao et al., 2020). The operation of these facilities results in direct emission of greenhouse gases from biological processes such as CO₂, N₂O and CH₄ as well as indirect emissions resulting from energy consumption, transportation etc. which are responsible for CO₂ emissions, (Mannina et al., 2020). Earlier focus of sewage treatment plants was on obtaining good quality effluents, but now due to changed scenario the sustainability of STPs is being considered to ensure economic feasibility and environmental compatibility. As a result, knowing possible GHG sources and their generating methods is required in order to design a strategic mitigation and/control plan. Initially, onsite measurement and mathematical modeling approaches were applied to estimate the GHGs emission from WWTPs, (Hu et al., 2019). Later on, advanced approaches such as carbon footprint analysis (Parravicini et al., 2016), life cycle assessment (Rodriguez-Garcia et al., 2012), mass balance analysis (Lim et al., 2012), and mechanistic dynamic models (Mannina et al., 2020) emerged as potentially viable tools and are frequently used for the prediction of the GHGs emissions potential of WWTPs.

The Government of Barbados, Barbados Water Authority and the Caribbean Community Climate Change Centre have developed a Green Climate Fund project preparation aimed at building climate resilience into the wastewater systems of Barbados, specifically for the South Coast sewage Treatment Plant (ESIA, 2022). According to the ESIA 2022⁶, the project's goals are to identify climate change adaptation upgrade options to achieve tertiary treated effluent quality for the SCSTP and the potential for wastewater reuse, energy recovery and resource recovery options for primary and secondary biosolids and associated by-products; and to identify climate resilient design upgrade options for the wastewater collection system.

This component of the study aims to estimate the carbon footprint for the current configuration of the South Coast Sewage Treatment Plant and after its upgrade to the South Coast Water Reclamation Facility, considering both direct and indirect emissions.

5.2.5.2 Site Description

The South Coast Sewage Treatment Plant (SCSTP) is located in Graeme Hall, Christ Church and was commissioned in 2003. The plant receives sewage from the South Coast sewered districts, which run from the south edge of Bridgetown to Oistins. The plant is designed to treat approximately 9,000 m³/day of wastewater; with maximum weekly flow of 7,500 m³/day; average BOD₅: 1,825 kg BOD/day; average TSS: 2,000 kgTSS/day. There are five Lift Stations connected to the South Coast system which provides sewage treatment to 51,325 population equivalent (PE). The current treatment process is mechanical-biological to treat wastewater through a series of coarse, medium and fine screens, grit and grease removal with "advanced preliminary standard" (screens with a mesh size of 2mm) at the Graeme Hall Wetland. The supernatant "screened wastewater" is separated and pumped via a force main to a marine outfall located at Worthing Beach. The waste for the mechanical separation, during preliminary treatment, is collected and encased before being transported by trucks to Mangrove Pond landfill, the only approved site for the disposal of solid waste from this plant (BWA Wastewater Division).

5.2.5.3 Carbon Footprint Calculations

In order to determine the carbon footprint for South Coast Sewage Treatment Plant, direct and indirect GHG emissions were taken into account. Direct/onsite emissions, for the current plant, are mainly methane generated due to sludge fermentation in primary sedimentation tank. While indirect/offsite emissions are generated by energy consumption for SCSTP supplying, sludge transportation and landfill and degradation of the remaining constituents in the effluent.

⁶ Environmental and Social Impact Assessment and Environmental and Social Management Plan for the R's (Reduce, Reuse, Recycle) for Climate Resilience Wastewater System in Barbados Preparation Project

There are different methodologies used for determining the carbon footprint for WWTPs: IPCC - 2006, WSAA - 2006, LGO - 2008, Bridle – 2008 and NGER – 2009 (Pagilla et al., 2009). Unfortunately, there is no single methodology eligible for the calculations of process-based footprints. As a result, different methods for all the processes of sewage water treatment were employed. In this study, the GHG emissions were calculated using summarized field data during 2019 – August 2023 and the standard methods for GHG emissions from electricity consumption for maintaining wastewater treatment processes – Begak et al (2013); activated sludge process – Cakir and Stenstrom (2005); for the remaining constituents in the effluent and N₂O emissions – IPCC (2006); sludge transportation – IPCC (2006) and chemical use – Parravicini et al. (2016) were utilized. The data was collected filling out scientifically designed questionnaires using field data.

The calculation of corresponding CO_{2 eq} is performed applying the GWP (global warming potential) of 25 kg CO_{2eq}/kg CH₄ and 298 kg CO_{2eq}/ kg N₂O referring to a time period of 100 years, (https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).

5.2.5.4 Carbon Footprint of the Existing South Coast Sewage Treatment Plant (SCSTP)

Carbon Footprint of the Existing South Coast Sewage Treatment Plant (SCSTP)

Off-site GHG emissions due to energy consumption at SCSTP

GHG emissions from energy consumption of the sewage treatment system was computed by energy requirement of SCSTP to operate wastewater, administrative buildings and exterior illumination of the plant. Electricity is import from the national grid. Table 5-3 showcases the power consumption and specific CO₂ emissions for electricity. CO_{2eq} emissions were calculated according to Eq. (1) (Bekag et al., 2013).

$$CO_{2eq, electr} = C_{electr} * EF_{electr} \quad (1)$$

where: CO_{2 eq, elect} is the GHG emissions associated with electricity consumption (tCO_{2 eq} year⁻¹); C_{elect} is the quantity of electricity consumed by the SCSTP in 2023 (MWh/year) (obtained from questionnaire); EF_{electr} is the annual average of CO_{2eq} emission factor for the electricity sources (tCO_{2 eq} GWh⁻¹)

Table 5-3: Calculation of GHG emissions associated with the grid-electricity consumption

Imported electricity (MWh/year)	CO ₂ emission factor for electricity consumed (tCO ₂ /MWh) ⁷	GHG emissions associated with the grid electricity consumption (tCO ₂ /year)
A	B	A*B
422.57	0.675	285

Carbon footprint due to the transportation of the enclosed screenings collection by truck

The enclosed screenings collections are transported, via truck, to the Mangrove Pond Landfill for disposal. The carbon dioxide emissions associated with transportation fuel combustion are taken in account while the emissions of the other GHG gases are ignored. Table 5-4 illustrates the GHG emissions associated with the transportation of the enclosed screenings collections to the final disposal site.

⁷ https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Central-America-and-the-Caribbean/Barbados_Central-America-and-the-Caribbean_RE_SP.pdf?country=Barbados®ionID=&countryID=4b341f83-7a25-49a4-a13a-aed20386e801

The CO₂ emissions are determined by Eq. 2:

$$E_{TR,sl,y} = \sum_j \sum_i N_{i,y} * D_{i,y} * F_{i,y} * NCV_{j,y} * EF_{j,y} \quad (2)$$

Where $E_{TR,sl,y}$ are the CO₂ emissions from transportation of enclosed screenings collection in the year y (tCO₂/year); $N_{i,y}$ is the number of trips (by vehicle type I with similar loading/vehicular capacity) for transportation of sludge in the year y (trips); $D_{i,y}$ is the average distance per trip, travelled by the transportation vehicle of the type I for transportation of enclosed screenings collection in the year y (km); $F_{i,y}$ is the specific fuel consumption of the transportation vehicle of the type I in the year y (mass or volume units of fuel/km); $NCV_{j,y}$ is the net calorific value of the transportation fuel j in the year y (GJ/ mass or volume units); $EF_{j,y}$ is the CO₂ emission factor of the transportation fuel j in the year y (tCO₂/GJ); I is the vehicle type; j is the fuel type used in vehicles. The table below shows how the calculations for GHG emissions from the transportation of sludge would be calculated. Additional data is needed for this and was requested from the BWA.

Table 5-4: Calculation of the GHG emissions if enclosed screenings collection is transported by transportation vehicles of one type

Number of trips made by the transportation vehicle of one type during a year (trips)	Average distance per trip, travelled by the transportation vehicle of one type (km)	Average? Specific fuel consumption of the transportation vehicle (t/km or m ³ /km) ⁸	Average? Net calorific value of the transportation fuel (GJ/t or GJ/m ³) ⁹	CO ₂ emissions factor of the transportation fuel (tCO ₂ /GJ)	GHG emissions from transportation of sludge (tCO ₂ /year)
A	B	C	D	E	A*B*C*D*E

Carbon footprint due to the methane emissions from wastewater treatment

Methane emissions from wastewater treatment occur in those areas of water treatment plants where anaerobic conditions exists, e.g., in deep primary sedimentation tanks and in anaerobic zones of aerobic tanks. As well as, the effluent discharge into the receiving body contains residual organic matter. Under favourable conditions in the receiving body, this organic matter may undergo anaerobic decay with methane emission. The component of the carbon footprint will be assigned to the Barbados Water Authority (BWA) in the case of substandard organic matter of the effluent discharged into the water body. The estimation of CH₄ emissions from Domestic Wastewater is a three-step process as illustrated below, using equations 3, 4, 5:

⁸ http://www.soglasheniemerov.eu/about/convenant-of-mayors_ru.html

⁹ http://www.soglasheniemerov.eu/about/convenant-of-mayors_ru.html

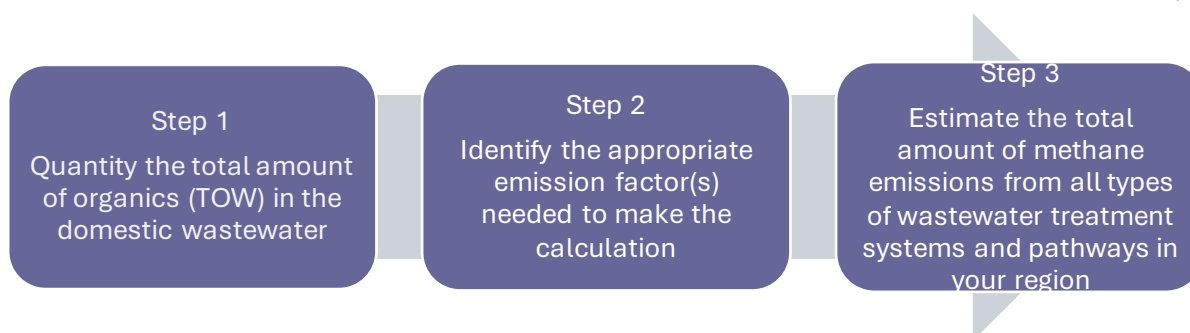


Table 5-5 illustrates IPCC worksheet used to calculate the GHG emissions due to methane emissions from wastewater treatment for the South Coast Sewage Treatment Plant.

Step 1: Quantifying total amount of organics in the domestic wastewater (TOW) (3)

EQUATION 6.3 TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER $TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$

Where:

- TOW = total organics in wastewater in inventory year, kg BOD/yr
 P = country population in inventory year, (person)
 BOD = country-specific per capita BOD in inventory year, g/person/day, See Table 6.4.
 0.001 = conversion from grams BOD to kg BOD
 I = correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00.)

$$TOW = 51,320 * 13,000 * 0.001 * 1.25$$

$$= 833,950 \text{ kg BOD/yr.}$$

Step 2: Identify the Appropriate Emission Factor for preliminary sedimentation tank wastewater treatment (Anaerobic deep lagoon)

(4)

EQUATION 6.2 CH₄ EMISSION FACTOR FOR EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM $EF_j = B_o \bullet MCF_j$

Where:

- EF_j = emission factor, kg CH₄/kg BOD
 j = each treatment/discharge pathway or system
 B_o = maximum CH₄ producing capacity, kg CH₄/kg BOD
 MCF_j = methane correction factor (fraction), See Table 6.3.

$$EF_{\text{preliminary sedimentation tank}} = 0.6 * 0.8 = 0.48 \text{ kg CH}_4/\text{kg BOD}$$

Step 3: Estimate the total amount of methane emissions from preliminary sedimentation tank - (anaerobic deep lagoon) for the South Coast Sewage Treatment Plant (5)

EQUATION 6.1
TOTAL CH₄ EMISSIONS FROM DOMESTIC WASTEWATER

$$CH_4 \text{ Emissions} = \left[\sum_{i,j} (U_i \cdot T_{i,j} \cdot EF_j) \right] (TOW - S) - R$$

Where:

- CH₄ Emissions = CH₄ emissions in inventory year, kg CH₄/yr
 TOW = total organics in wastewater in inventory year, kg BOD/yr
 S = organic component removed as sludge in inventory year, kg BOD/yr
 U_i = fraction of population in income group *i* in inventory year, See Table 6.5.
 T_{i,j} = degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i* in inventory year, See Table 6.5.
 i = income group: rural, urban high income and urban low income
 j = each treatment/discharge pathway or system
 EF_j = emission factor, kg CH₄ / kg BOD
 R = amount of CH₄ recovered in inventory year, kg CH₄/yr

Table 5-5: IPCC worksheet used to calculate the methane emissions from wastewater treatment

Sector		Waste						
Category		Domestic Wastewater Treatment and Discharge						
Category Code		4D1						
Sheet		3 of 3 Estimation of CH ₄ emissions from Domestic Wastewater						
STEP 3								
Income group	Type of treatment or discharge pathway	A	B	C	D	E	F	G
		Fraction of population income group	Degree of utilization	Emission Factor	Organically degradable material in wastewater	Sludge removed	Methane recovered and flared	Net methane emissions
		(U _i)	(T _{ij})	(EF _j)	(TOW)	(S)	(R)	(CH ₄)
		(fraction)	(fraction)	(kg CH ₄ /kg BOD)	(kg BOD/yr)	(kg BOD/yr)	(kg CH ₄ /yr)	(kg CH ₄ /yr)
				Example 2	Example 1			$G = [(A \times B \times C) \times (D - E)] - F$
Urban Low income	Anaerobic deep lagoon	0.4	0.39	0.48	833,950	0	0	62,446.18
Urban high income	Anaerobic deep lagoon	0.6	0.6	0.48	833,950	0	0	144,106.56
Total								206,553

Total amount of CH₄ emissions from preliminary sedimentation tank = 206.53 tCH₄/yr.

$$= 206.53 \times 25$$

$$= 5,163 \text{ tCO}_2 \text{ eq/yr.}$$

Estimating indirect N₂O emissions from wastewater after disposal of effluent, via outfall at Needham's Point

The nitrogen that is not removed during wastewater treatment is discharged into the sea where it becomes nitrified and denitrified under natural environmentally conditions; resulting in N₂O emissions. Such N₂O emissions are calculated based on IPCC (2006) equations 6, 7. Table 5-6 displays the GHG emissions due to nitrogen in the effluent discharged into an aquatic environment.

(6)

EQUATION 6.7 N₂O EMISSIONS FROM WASTEWATER EFFLUENT $N_2O \text{ Emissions} = N_{\text{EFFLUENT}} \cdot EF_{\text{EFFLUENT}} \cdot 44 / 28$
--

Where:

N₂O emissions = N₂O emissions in inventory year, kg N₂O/yr

N_{EFFLUENT} = nitrogen in the effluent discharged to aquatic environments, kg N/yr

EF_{EFFLUENT} = emission factor for N₂O emissions from discharged to wastewater, kg N₂O-N/kg N

The factor 44/28 is the conversion of kg N₂O-N into kg N₂O.

EQUATION 6.8 TOTAL NITROGEN IN THE EFFLUENT $N_{\text{EFFLUENT}} = (P \cdot \text{Protein} \cdot F_{\text{NPR}} \cdot F_{\text{NON-CON}} \cdot F_{\text{IND-COM}}) - N_{\text{SLUDGE}}$

Where:

N_{EFFLUENT} = total annual amount of nitrogen in the wastewater effluent, kg N/yr

P = human population

Protein = annual per capita protein consumption, kg/person/yr

F_{NPR} = fraction of nitrogen in protein, default = 0.16, kg N/kg protein

F_{NON-CON} = factor for non-consumed protein added to the wastewater

F_{IND-COM} = factor for industrial and commercial co-discharged protein into the sewer system

(7)

Table 5-6: Calculation of indirect GHG emissions from wastewater discharge into the sea

Population (no. of people)	Protein (kg/person/year)	F _{NPR} (kg N/kg protein)	F _{NON-CON}	F _{IND-COM}	EF _{effluent} (kg N ₂ O – N/ kg N)	Indirect GHG emissions from wastewater discharge into the sea (tCO _{2eq} /year)
A	B	C	D	E	F	A*B*C*D*E*F*(44/28) *298*0.001
51,320	32.12	0.16	1.1	1.25	0.005	849

To determine the total carbon footprint of the South Coast Sewage Treatment Plant; the individual emissions from each GHG source are added to obtain the total emissions for the SCSTP. Table 5-7 showcases the individual contributions of each GHG emission to the total and yearly carbon footprint, of the existing South Coast Sewage Treatment Plant, based on the summarized data for the year 2023.

Table 5-7: Carbon Footprint of Existing South Coast Sewage Treatment Plant (SCSTP)

Name of wastewater treatment plant	GHG emissions based on energy consumption of SCSTP (tCO _{2eq} /yr.)	GHG emissions from transporting the enclosed screenings collection to Mangrove Pond landfill (CO _{2eq} /yr.)	GHG emissions due methane in wastewater treatment (tCO _{2eq} /yr.)	GHG emissions due nitrogen in the effluent discharge into an aquatic environment (tCO _{2eq} /yr.)	Total GHG emissions due to the treatment of wastewater and sludge treatment processes (tCO _{2eq} /yr.)
	A	B	C	D	A+B+C+D
South Coast Sewage Treatment Plant	285		5,163	849	

Theoretical Carbon Footprint after the upgrade of the South Coast Sewage Treatment Plant (SCSTP) to the South Coast Water Reclamation Facility (SCWRF).

The upgrading of the South Coast Sewage Treatment Plant to the South coast Water Reclamation Facility (SCWTF) is still underway. Therefore, the calculation of the GHG emissions associated with the SCWTF will be based on the design data. The source of this could be found within the pre-feasibility study conducted by the AECOM in 2020.

Off-site GHG emissions due to energy consumption at SCSTP

With the efforts of the Government of Barbados to upgrade the SCSTP to treat wastewater to secondary and tertiary treatment levels, the energy requirement needs will increase due to the anticipated technologies (four-stage Bardenpho conventional activated sludge, disk filtration process, UV disinfection and reverse osmosis) to be employed. Therefore, the theoretical power consumption to operate the anticipated treatment technologies is required; thereby increasing the GHG emissions. However, there is an opportunity to offset this increase in energy needs with the production of biogas, through the anaerobic digestion of the activated sludge produced via the conventional activated sludge treatment. The same equation will be used to calculate the GHG emissions associated with the consumption grid-based electricity and are displayed in Table 5-8.

CO_{2eq} emissions were calculated according to Eq. (1) (Bekag et al., 2013).

$$CO_{2eq, electr} = C_{electr} * EF_{electr} \quad (1)$$

where: CO_{2eq, electr} is the GHG emissions associated with electricity consumption (tCO_{2 eq} year⁻¹); C_{electr} is the quantity of electricity consumed by the SCSTP in a year (MWh/year); EF_{electr} is the annual average of CO_{2eq} emission factor for the electricity sources (tCO_{2 eq} GWh⁻¹)

Table 5-8: Calculation of GHG emissions associated with the grid-electricity consumption

Imported electricity (MWh/year)	CO ₂ emission factor for electricity consumed (tCO ₂ /MWh) ¹⁰	GHG emissions associated with the grid electricity consumption (tCO ₂ /year)
A	B	A*B
9,379.70	0.657	6,163

GHG emissions from the Conventional Activated Sludge process

These emissions are calculated according to Cakir and Stenstrom (2005). The data requirements for such calculations are annual average values influent and effluent COD and BOD₅ (mg/L) as well as average daily flow (m³/day).

Total GHG emission is calculated according equations 8, 9, 10:

$$\text{CO}_{2\text{eq ASP}} = Y_{\text{CO}_2 \text{ ASP}} * O_{\text{ASP}} \quad (8)$$

where: CO_{2eq ASP} is the total GHG emission, for activated sludge process (CO_{2 eq}/day); Y_{ASPCO₂} is the production factor of CO₂ in the aerobic process with activated sludge (= 1.37 kg CO₂/kg BOD₅); O^{ASP} is the amount of O₂ needed for the process with activated sludge (kg O₂/day)

$$O_{\text{ASP}} = Q_{\text{ww inf}} * (\text{BOD}_{5 \text{ inf}} - \text{BOD}_{5 \text{ eff}}) - 1.42 * X \quad (9)$$

where: Q_{ww inf} is the average daily flow (m³ day⁻¹) (data was obtained from the questionnaire); BOD_{5 inf} is the influent BOD₅ (mg l⁻¹); BOD_{5 eff} is the effluent BOD₅ (mg l⁻¹).

X is the biomass production, (kg/day)

$$X = (Y_{\text{obs}} * Q_{\text{ww inf}} * (\text{BOD}_{5 \text{ inf}} - \text{BOD}_{5 \text{ eff}}))/1000 \quad (10)$$

Y_{obs} is the observed biomass yield, g volatile suspended solids (VSS)/g BOD₅

$$Y_{\text{obs}} = y / (1 + k_d * \theta_c)$$

where, Y is the biomass yield, 0.5 mg VSS mg⁻¹ BOD₅; k_d is the degradation rate of BOD₅, 0.06 day⁻¹³⁰; θ_c is the sludge retention time for the activated sludge process. The average value used can be obtained from the questionnaires.

Such emissions are not considered in the final balance for carbon footprint because they include only CO₂ emissions release from organic matter decomposition in activated sludge process which have biogenic origin.

Usually there are no CH₄ emissions from activated sludge processes but they can occur due to improper operation and/or overloading. Oxidation ration, the degree of removal organic matter, is given by eq. 12.

$$\text{Oxidation ratio} = (\text{COD}_{\text{inf}} - \text{COD}_{\text{eff}}) / \text{COD}_{\text{inf}} \quad (11)$$

Considering the current COD_{inf} value (1,491,025 kg COD/yr.) and the theoretical COD_{eff} value after secondary and tertiary treatment (120,450 kg COD/yr.). The oxidation ratio equals 0.91. Since the oxidation ratio is greater than 0.8, methane emissions can be considered zero, Begak et al. (2013).

¹⁰ https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Central-America-and-the-Caribbean/Barbados_Central-America-and-the-Caribbean_RE_SP.pdf?country=Barbados®ionID=&countryID=4b341f83-7a25-49a4-a13a-aed20386e801

GHG emissions from the degradation of the remaining constituents in the effluent from the South Coast Water Reclamation Facility

The nitrous emissions from wastewater will be recalculated for the new plant based on IPCC (2006) guidelines per Eqs. (12,13,14)

Where N_2O_{total} – total N_2O emissions, (kg N_2O /yr.); N_2O_{SCSTP} – total N_2O emission from plant, (kg N_2O /yr.); N_2O_{eff} – total N_2O emissions from remaining nitrogen in the wastewater effluent, (kg N_2O /yr.); N_{eff} – the amount of nitrogen associated with N_2O from plant (removed in wastewater treatment processes), (kg N/yr.); EF_i – emission factor, 3.2 g N_2O /person/yr.)

$$\begin{aligned}
 N_2O_{total} &= N_2O_{SCWRF} + N_2O_{eff} & (12) \\
 &= 205.28 + 2,848.35 \\
 &= 3,054 \text{ Kg } N_2O/\text{yr.} * 298 * 0.0001 \\
 &= 910 \text{ t } CO_{2eq}/\text{yr.}
 \end{aligned}$$

$$\begin{aligned}
 N_2O_{SCWRF} &= PE * EF_i * F_{i-C} & (13) \\
 &= 51,320 * 0.032 * 1.25 \\
 &= 205.28 \text{ kg } N_2O/\text{yr.} \\
 &= 61 \text{ t } CO_{2eq}/\text{yr.}
 \end{aligned}$$

$$\begin{aligned}
 N_2O_{eff} &= N_{eff} - N_{wwt} = \\
 &= (PE * Pr * F_{NPR} * F_{N-C} * F_{i-C} - PE * EF_i * 28/44) * EF_{eff} * 44/28 & (14) \\
 &= [(51,320 * 32.12 * 0.16 * 1.1 * 1.25) - (51,320 * 0.0032 * 1.25 * (28/44))] * \\
 &0.005 * (44/28) \\
 &= 2,848.35 \text{ Kg } N_2O/\text{yr.} \\
 &= 849 \text{ t } CO_{2eq}/\text{yr.}
 \end{aligned}$$

GHG emissions from transportation of the sludge to Spencers, Christ Church

Using the same methodology expressed via equation 2, the hypotheoretical amount of sludge (t/yr.) generated from the secondary treatment process is needed to determine the number of trips required to transport the mass of sludge produced to be used, in some form of land application in Spencers Christ Church. If the type of vehicle(s) used are to be upgraded; then the specific fuel consumption of the transportation vehicles is required along with the type of transportation fuel to determine its net calorific value. The GHG emissions associated with the transportation of sludge to final disposal are displayed in Table 5-9.

Table 5-9: Calculation of the GHG emissions if sludge is transported by transportation vehicles of one type, to Spencers, Christ Church

Number of trips made by the transportation vehicle of one type during a year (trips)	Average distance per trip, travelled by the transportation vehicle of one type (km)	Average? Specific fuel consumption of the transportation vehicle (t/km or m ³ /km)	Average? Net calorific value of the transportation fuel (GJ/t or GJ/m ³)	CO ₂ emissions factor of the transportation fuel (tCO ₂ /GJ)	GHG emissions from transportation of sludge (tCO ₂ /year)
A	B	C	D	E	A*B*C*D*E
34	15	0.0003	37.952	0.0741	0.43

Once provided, the GHG emissions associated with the transportation of the enclosed screenings collection to the Mangrove Pond Landfill should be included in the above calculation.

GHG emissions from sludge disposed at Spencer's Plantation in Spencers, Christ Church

The sludge management system is designed to produce biosolids to meet US EPA CFR 40, Rule 503 Class B for beneficial end use. Hence there are a number of options for the fate of the sludge. Those options include use in restricted agricultural as nutrient rich soil amendment, other land applications, as a landfill cover material, disposed in a landfill or recovery of sludge for the generation of bioenergy. The end use of the sludge is yet to be determined by the Government of Barbados. Fortunately, GHG emissions associated with the transportation of sludge to Spencers, Christ Church would suggest a soil amendment application resulting in emissions attributable to the agricultural sector and not the South Coast Water Reclamation Facility.

However, if the Government of Barbados decides to landfill the sludge but not as a cover material; the hypothetical amount of sludge generated, after the secondary treatment stage, will be needed to calculate the CH₄ emissions generated using equation 15 and results showcased in Table 5-10.

$$E_{CH_4, wwt, sl, y} = M_{sl, dry, y} * MCF_{sl} * DOC_{sl, dry} * DOC_F * F * 16/12 * GWP_{CH_4} \quad (15)$$

Where $E_{CH_4, wwt, sl, y}$ are the methane emissions from decomposition of sludge in the year y (tCO_{2eq}/year); $M_{sl, dry, y}$ is the quantity of sludge dry matter (t/year) (obtained by questionnaire); $MCF_{sl, dry}$ is the methane conversion factor, which depends on the type of sludge disposal site (fraction); $DOC_{sl, dry}$ is degradable organic content in the dry matter of sludge disposed in the year (fraction); DOC_F is the fraction of degradable organic content dissimilated to biogas (fraction); F is the fraction of methane in the gas (fraction); 16/12 is the ratio of molar masses of methane and carbon; GWP_{CH_4} is the Global Warming Potential of methane (tCO_{2eq}/tCH₄).

Table 5-10: Calculation of the GHG emissions if sludge is taken to Spencer's Plantation in Christ Church

Quantity of the sludge disposed to a landfill (dry weight basis)	Methane conversion factor (fraction)	Degradable organic content of sludge (dry weight basis) (fraction)	Fraction of degradable organic content dissimilated to biogas (fraction)	Fraction of methane in the gas (fraction)	GHG emissions if sludge is disposed to a landfill (tCO _{2eq} /year)
A	B	C	D	E	25*A*B*C*D*E*16/12
608	0.5	0.5	0.5	0.5	1,267

For reporting purposes, the GHG emissions associated with sludge taken to Spencer's Plantation in Christ Church will be zero.

GHG emissions due to the use of chemicals at the South Coast Water Reclamation Facility

The theoretical amount (kg) and type of polymer chemicals to be utilized before and after the aerobic digestion of sludge will be needed; to account for the chemical decomposition of such chemical into the generation of CO₂ emissions. The amount of polymer will be multiplied by emission factor ranging from 1.182 to 4.25 kg CO_{2eq} / kg polymer depending on the type of polymer(s) used.

The results for total GHG emissions of the South Coast Sewage Treatment Plant and after the upgrade to the South Coast Water Reclamation Facility are illustrated in Table 5-11.

Table 5-11: GHG emissions for SCSTP before and after rehabilitation

		Before Upgrade to SCSTP	South Coast Water Reclamation Facility
GHG sources (tCO_{2eq}/year)	Electricity	285	6,163
	Enclosed screenings collection/Sludge transportation		0.43
	Enclosed screenings collection/Sludge Landfilling	-	0
	Chemical Usage	-	
	CH ₄ in wastewater treatment	5,163	-
	Remaining constituents in effluent	849	849
	Direct N ₂ O emissions	-	61
Average daily Flowrate (m³/year)		9,000	9,000
CO_{2eq}, normalized, (kg CO_{2eq}/m³)			
CO_{2eq}, normalized, (kg CO_{2eq}/PE and year)			

5.2.5.5 References for GHG Calculations

Begak, M., Guseva, T., Molchanova, Y., Averochkin, E. & Sagaiduk. V. *Methodology for Assessing Carbon Footprint of Wastewater Treatment Plants*. Preprint: <http://ecoline.ru/wp-content/uploads/CFRV-en.pdf> (2013).

Bogner J., Abdelrafie Ahmed M., Diaz C., Faaij A., Gao Q., Hashimoto S., Mareckova K., Pipatti R., Zhang T., (2007), *Waste Management*, In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Metz B., Davidson O.R., Bosch P.R., Dave R., Meyer L.A., (Eds.), Cambridge University Press, Cambridge, United Kingdom and New York, USA.

Cakir FY, Stenstrom MK. Greenhouse gas production: A comparison between aerobic and anaerobic wastewater treatment technology. *Water Res.* 2005; **39**:4197–4203. doi: 10.1016/j.watres.2005.07.042.

Eggleston, S., Buendia, L., Miwa, K., Ngara, T. & Tanabe, K. (eds.). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. (IGES, 2006).

Garrido-Baserba, M., Molinos-Senante, M., Abelleira-Pereira, J.M., Fdez Güelfo, L.A., Poch, M. & Hernandez-Sancho, F. Selecting sewage sludge treatment alternatives in modern wastewater treatment plants using environmental decision support systems. *J. Clean. Prod.* **107**, 410–419 (2015).

Hu W, Tian J, Chen L. Greenhouse gas emission by centralized wastewater treatment plants in Chinese industrial parks: Inventory and mitigation measures. *J. Clean. Prod.* 2019; 225:883–897. doi: 10.1016/j.jclepro.2019.03.311.

Liao X, Tian Y, Gan Y, Ji J. Quantifying urban wastewater treatment sector's greenhouse gas emissions using a hybrid life cycle analysis method-an application on Shenzhen city in China. *Sci. Total Environ.* 2020; **745:141176**. doi: 10.1016/j.scitotenv.2020.141176.

Larsen TA. CO₂-neutral wastewater treatment plants or robust, climate-friendly wastewater management? A systems perspective. *Water Res.* 2015; **87:513–521**. doi: 10.1016/j.watres.2015.06.006.

Lim JJ, Sankarrao B, Oh TS, Kim MJ, Kang OY, Kim JT, Yoo CK. Estimation of nitrous oxide emissions (GHG) from wastewater treatment plants using closed-loop mass balance and data reconciliation. *Kor. J. Chem. Eng.* 2012; **29:1123–1128**. doi: 10.1007/s11814-011-0283-2.

Mannina G, Ekama G, Caniani D, Cosenza A, Esposito G, Gori R, Garrido-Baserba M, Rosso D, Olsson G. Greenhouse gases from wastewater treatment—a review of modelling tools. *Sci. Total Environ.* 2020;**551-552**:254–270. doi: 10.1016/j.scitotenv.2016.01.163.

Parravicini V, Svandal K, Krampe J. Greenhouse gas emissions from wastewater treatment plants. *Energy Proc.* 2016; **97:246–253**. doi: 10.1016/j.egypro.2016.10.067.

Ray SS, Dangayach R, Kwon YN. Surface engineering for anti-wetting and antibacterial membrane for enhanced and fouling resistant membrane distillation performance. *Chem. Eng. J.* 2021; 405:126702. doi: 10.1016/j.cej.2020.126702.

Rodriguez-Garcia G, Hospido A, Bagley DM, Moreira MT, Feijoo G. A methodology to estimate greenhouse gases emissions in life cycle inventories of wastewater treatment plants. *Environ. Impact Assess. Rev.* 2012; **37:37–46**. doi: 10.1016/j.eiar.2012.06.010.

Sharma A, Bhardwaj SK, Aggarwal RK, Sharma R, Agrawal G. Greenhouse gas emission potential of sewage treatment in Himachal Pradesh. *Scientific Reports* 2023; 13: 9675. Doi 10.1038/s41598-023-36825-7

USEPA, (2014), Framework for Assessing Biogenics CO₂ Emissions from Stationary Sources, Online at: [https://www3.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO₂-Emissions.pdf](https://www3.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO2-Emissions.pdf).

Websites:

(https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).

<https://www.fao.org/faostat/en/#country/183>

5.3 Water Quality

5.3.1 Groundwater quality

The existing ESIA indicates that climate change may result in saline intrusion in groundwater; however, based on the data received, the Gibbons Boggs and Pegwell Boggs wells may be already experiencing some amount of saline intrusion. The information presented in the BADMC Quality data set shows where the wells have high levels of TDS and its contributing ions (e.g., sodium, chloride and calcium, magnesium). If the existing conditions are not due to saline intrusion, the cause of these elevated levels needs to be determined to ascertain the current condition of groundwater quality as this can impact irrigation and better inform the treatment process that the STP will employ.

Baseline information over a period of at least two years for parameters including but not limited to total dissolved solids, alkalinity and its various species, chloride, sulfate, nitrate, fluoride, sodium, potassium, calcium, magnesium, iron, copper, E. coli, lead, cadmium, chromium, polycyclic aromatic hydrocarbons, oil & grease, pH, turbidity, conductivity, total coliforms, dissolved oxygen, temperature, biochemical oxygen demand, chemical oxygen demand, ammonia, nitrite, phosphates, boron, arsenic, aluminium, mercury, selenium, faecal coliform, pseudomonas and sodium absorption ratio should be collected. Monitoring should be done in the pre-construction phase in three month intervals for at least two years. Monitoring should also be continued in the Construction and Operations phases in six month intervals – throughout the entire duration of the Construction Phase and for as long as needed in the Operations Phase, as per Section 4.1.3 of the ESMP prepared by NEMUS in 2021.

The existing ESIA also indicates that reports reviewed by the BWA show that the nitrate levels have risen across the entire island. Although the ESIA indicates where this data was taken from, this should possibly be presented in the ESIA or in an Appendix to corroborate the statement made. The data should be presented for third party evaluation for information or decision-making purposes. Data should be shown to qualify data quality.

These factors underscore the importance of establishing a baseline for groundwater quality as explicitly outlined in various chapters of the ESIA and ESMP. This will allow as stated in the ESIA a better understanding of the potential impacts (positive or negative) of the upgraded STP.

The document refers to the lack of knowledge of the aquifer and groundwater quality. The lack of information on the aquifer and groundwater can allow for inadequate preparations and mitigation strategies to implemented, as well as the inaccurate identification of risks and impacts. The prior ESMP identifies a water (groundwater, surface water, coastal water and effluent) monitoring protocol that should be adhered to prior to the construction and operation of the upgraded STP. We believe that this should be strongly adhered to address a major gap present in the ESIA.

5.3.2 Graeme Hall Swamp

On page 4 of the ESIA's Executive Summary, the text mentions that the salinity levels in the Graeme Hall Swamp have evolved from a brackish pond to a near freshwater pond and has increasing levels of nutrient, microbial and other parameters associated with water clarity. The ecology and water quality in the area may be impacted by works and should be considered in light of the proposed project. The impact to the current ecology in the area needs to be properly assessed given the proposed works and its influence on surface drainage and changes in ecological behaviour. This may affect the ecology of the area as the water may shift from fresh to brackish, especially if the sluice gate is reopened.

The raw data mentioned on page 5 of the Executive Summary of the ESIA needs to be presented (at least in an appendix). The data should be presented for third party evaluation for information or decision-making purposes and needs to be shown to qualify data quality. The quality control features of the data set should also be shown. This is a major concern in reviewing and evaluating the existing water quality data available under the project. Additional information on the quality of the Graeme

Hall swamp needs to be done over a predefined period to determine the extent to which successful implementation of the Project would have an impact (positive or negative) on the swamp's water quality. The parameters to be considered for this additional monitoring include those presented in the ESMP (temperature, pH, salinity, conductivity, turbidity, dissolved oxygen, TSS, TDS, BOD, COD, ammonia, nitrate, nitrite, total nitrogen, total phosphorus, chlorophyll a, faecal coliform, faecal enterococci, *E.coli*, volatile and semi-volatile organic compounds, oil and grease, heavy metals and pesticides. Chapter 6 presents the potential impacts identified that may affect the existing conditions of the swamp.

5.3.3 Coastal Water Quality

There is not much water quality data for the coastal areas outside of microbial information. Other parameters may need to be monitored to assess the current quality of the water and the impacts that the STP may have had. The water quality of the bathing beach and its potential impacts on humans and the environment is unknown outside of the microbial impacts. This will also enable the ability to determine if the upgraded STP has had a positive effect on the coastal water quality. Information from the University of the West Indies (UWI) can be sought if possible.

If additional data from UWI is not available, additional water quality monitoring will have to be done at the possible outfall locations and other coastal areas that may be impacted by the operations of the sewage outfall. Parameters that should be measured at all locations include those presented in ESMP (heavy metals, nutrients, microbial parameters, residual chlorine, turbidity), as well as ammonia, suspended solids, biochemical oxygen demand, *E.coli* and chlorophyll.

The cumulative impacts of the BSTP and the SCSTP were determined and presented in Chapter 6.3 since the outfall locations are nearby to each other and may have the potential to result in greater pollution of the surrounding environment (especially in ecologically sensitive areas). If both outfalls are discharged in similar areas, the impacts to the water and ecology in that area may be exacerbated especially given the current issues highlighted in the ESIA.

5.3.4 Effluent Quality

Page 22 of the ESIA (Chapter 2.4.2.2) indicates that the overflow will not be disinfected before it enters the environment. This may result in elevated microbial levels entering the water bodies which can have negative impacts on the environment.

The ESIA also indicates that the water treated through the RO will be mixed with a side stream water to meet a TDS of 450 mg/L. The quality of this water will need to be tested prior to its use for agricultural purposes as the water treated by the RO will be stripped of useful ions which can reduce water pH and have other impacts on the receiving environment. The water may be stripped of other useful ions at this point (e.g., Ca, Mg) which may reduce water pH and have other impacts (reducing the waters' suitability for agricultural use).

The ESIA further indicates that three separate effluents may be discharged into the sea but does not indicate whether these will be mixed or discharged on separate occasions. The separate discharges may have different impacts on the water body and will need to be assessed separately or as a combination depending on the disposal process.

The effluent quality will also need to be tested for the same parameters presented in the groundwater quality to ensure that a system is designed to ensure that the reclaimed water to be used meets the necessary levels for use as an agricultural water source. This will be part of the ESMP for operation.

5.4 Air Quality and Noise

Scenario A1 elaborated in the existing ESIA was selected as the most probable scenario. However, following subsequent conversations this choice may not be used. The final decision on the route of the pipeline has not been concluded in order to properly assess air quality impacts. PM10 and PM2.5 should be assessed. Noise will need to be reassessed dependent on the pipeline route.

A key barrier to managing and monitoring air quality in Barbados, in general, is the fact that there is limited data on the actual levels of ambient air quality pollutants that are present in Barbados' air. This is according to the EDP's 2022 presentation on Ambient Air Quality Management in Barbados¹¹. Still, there have been monitoring projects overseen by the EPD that monitors particulates such as SO_x, NO_x, O₃, and CO. These monitoring projects were undertaken to identify trends in these trends. The closest location to the Project Area where monitoring was done is the Environmental Protection Department Office.

The findings from these monitoring programmes showed that air quality, especially in the developed regions of the island, are impacted by various sources, including power plants, vehicles, manufacturing plants; construction and pesticides. The air quality was also found to be influenced by natural sources, such as the Saharan dust clouds that frequent the island as well as from the rare occurrence of volcanic eruptions in neighbouring Caribbean islands. With Barbados being a small, densely populated country, it was further found that the varying land uses influence air quality, particularly via the use of pesticides in agricultural use. Due to the lack of ambient air quality data, it is the focus of the EPD to enhance the island's capacity to monitor ambient air quality, as well as to develop a more comprehensive ambient air quality legislation.

As it relates to noise, noise management and monitoring in Barbados is similar to that of ambient air quality in that there is limited data and noise generation and a need for a more comprehensive legislation governing the management of noise pollution. Despite the availability of data, it is expected that the greater levels of noise generated would be observed in the more developed areas in the island. Areas neighbouring the existing SCSTP, being a more developed region than the areas through which Pipeline Section B and Pipeline Section D would pass through would generate more noise. This is as there is a greater presence of commercial activities and traffic, two primary sources of noise generation identified by the EPD.

5.5 Biodiversity Assessment

With regard to terrestrial ecology, Barbados has undergone significant land use changes over the past two centuries, resulting in the depletion of native forests and natural areas. Given this context, the remaining natural areas are of paramount importance and must be preserved to effectively address the challenges associated with climate change in Barbados, including (but not limited to) rising temperatures, increased drought periods, and more intense rainfall. According to findings by Helmer et al. (2008), approximately 60% of Barbados' land has been converted to agricultural use, with over 20% designated as urban or built-up areas, and more than 3% classified as barren land. This extensive alteration of the landscape poses inherent risks when assessing adaptation strategies to climate change, particularly concerning water and carbon cycles. For instance:

- Urban or built-up areas, covering over 20% of Barbados' total area, disrupt natural water and carbon cycles. These areas prevent the absorption of water into the ground or its return to the atmosphere, leading to surface runoff.
- Agricultural lands, occupying nearly 60% of Barbados' landmass, primarily absorb water into the organic matter of cultivated crops. However, this process often results in the depletion of

¹¹ <https://globalcleanair.org/wp-content/blogs.dir/95/files/2022/11/Ponencia-3.-Lianda-Chapman.pdf>

soil nutrients, exceeding its natural recycling capacity. Consequently, additional nitrogen and phosphorus inputs are required to sustain agricultural productivity.

5.5.1 Flora

A more recent study from Trotz et al. (2018) indicated the existence of four endangered plant species, all of which are classified as "least concern" by the International Union for Conservation of Nature (IUCN). However, a December 2020 consultation of the official IUCN Red List did not list any plant species for the country. Three of the listed species may have been present in the past but have not been identified in recent surveys conducted in 2010, 2012, and 2018:

Pereskia aculeata (Barbados Gooseberry): Classified as "least concern," this species is widely distributed in the Caribbean and Central America but is not found in Barbados. It typically occurs in forests up to 1,200 meters above sea level and may have been present in Barbados in the past, given its common name, but the remaining forested areas seem unable to support it.

Malpighia glabra (Barbados Cherry): Also classified as "least concern," this species is widely distributed in the Caribbean, Central, and Northern America but is absent from Barbados. Similar to the Barbados Gooseberry, it is a forest species that may have existed in the country in the past, but the limited remaining forest patches cannot sustain it.

Juniperus barbadensis var. *barbadensis* (Barbados Cedar): Classified as Critically Endangered, this species was formerly known in Barbados but is now officially extinct in the country. It was cut down before 1700, and its habitat was converted to sugar cane fields over 280 years ago.

5.5.1.1 Graeme Hall Swamp

Graeme Hall, officially designated as Graeme Hall Swamp (GHS), is a wetland located downstream from the South Coast Sewage Treatment Plant (SCSTP) and adjacent to the shore. It is surrounded by agricultural land and urban areas, making it a vital natural area in Barbados. GHS is particularly significant as it houses the last significant mangrove forest ecosystem in the country, spanning approximately 33 hectares. The wetland comprises two distinct areas: the western portion, covering 13.68 hectares, is privately owned and designated as the Graeme Hall Nature Sanctuary (GHNS), while the eastern portion, covering 19.37 hectares, is owned by the Barbados Agricultural Development and Marketing Corporation.

A notable feature of GHS is a 12-acre (4.86 ha) artificially created lake, which is the largest body of inland water on the island and attracts various species of aquatic birds. The wetland serves as a central drainage point for a 1,158-acre (468.6 ha) watershed. Historically, GHS interacted with marine seagrass beds and shallow nearshore hard coral reef ecosystems, forming a cohesive ecosystem. However, the connection to the marine area is currently controlled by a narrow sluice gate, which has been permanently closed since 2006 due to deterioration. The wetland also features a network of man-made drainage canals intended to regulate water levels and attract birds.

In terms of habitats, GHS comprises mangrove areas, grasslands, shrublands, woodlands, and sedges. These habitats support diverse flora and vegetation, making GHS the last remaining area in Barbados with natural vegetation. Given its natural importance, GHS plays a crucial role in mitigating the effects of climate change, providing resilience against extreme weather events such as droughts and heavy rainfall. An ecosystem assessment conducted in 2010 confirmed the presence of various species and highlighted the importance of preserving these habitats for the well-being of ecosystems and communities. Recognizing its ecological significance, GHS was designated as a RAMSAR site of international importance in April 2006. There have also been proposals to elevate its status to a National Park, along with adjacent agricultural areas, to serve as buffer zones. However, progress on this proposal has been limited.

5.5.1.2 Mangroves

Mangroves serve as the primary natural vegetation within the GHS, with all other species being either exotic or opportunistic, taking advantage of the area's progressive degradation. Initially, the lake was encircled by a dense fringe of red (*Rhizophora mangle*) and white (*Avicennia racemosa*) mangroves, exhibiting classic zonation patterns. Red mangroves predominated in terms of area, while white mangroves dominated in height, reaching heights of up to 20 meters. Recent observations note a redistribution of vegetation within the GHS, with red mangroves concentrated in the center along the artificial lake border and white mangroves scattered across the swamp, particularly in southern and western areas. Notably, a significant patch of white mangrove exists in the southeastern portion of the government property.

Reports on the conservation status of mangroves vary. Earlier assessments indicated healthy mangrove patches within the sanctuary (western area of GHS) in 2010. However, subsequent evaluations in 2019 reported a decline in white mangroves east of the swamp following the construction of the South Coast Sewage Treatment Plant. The health of mangroves in the GHS is compromised by the influx of untreated stormwater, agricultural runoff, and raw sewage discharges into the lake system. Without proper drainage outlets and periodic tidal influences, the environmental integrity of the wetland is compromised. The decline in salinity levels within the mangrove lake further exacerbates habitat degradation, leading to the loss of plant and animal species. The malfunctioning sluice gate, which ceased operation in 2006, has disrupted the natural balance of seawater inflow, contributing to a 77% reduction in average salinity levels since 2002.

5.5.1.3 Sedge

The northern and eastern regions of the government property are characterized by spikerush marshes, periodically managed to promote open habitats for fish populations. Spikerush, indicative of decreased salinity, suggests early mangrove degradation. The South Coast Sewage Treatment Plant lies adjacent to the northeastern corner of the spikerush marsh. *Eleocharis mutata* is the predominant species of spikerush observed within the GHS, found primarily in freshwater marshes on government property and in water lily ponds within the sanctuary.

5.5.1.4 Other Freshwater Species

Freshwater ponds within the GHS harbour both native and exotic water lily species, with different pond sections exhibiting varying dominant species. Additionally, the canal is populated with arrowhead and water lily plants, with Clammy Cherries scattered along the edges. Crab Grass, predominantly found in southwestern pastures and drainage channels, thrives in brackish water and drier areas.



Figure 5-7: Evidence of ecosystem degradation

5.5.2 Fauna

As delineated in preceding sections, Barbados' terrestrial landscape has undergone extensive transformation, leaving few natural areas remaining apart from the mangroves in the Graeme Hall Swamp (GHS). Agricultural activities and urban settlements have pervaded much of the country, resulting in limited refuge for indigenous fauna. Consequently, Baird (2019) asserts that Barbados exhibits a low wildlife biodiversity. Official figures corroborate this assessment:

- **Mammals** - Barbados is home to a total of 12 mammalian species, including 6 bats, 2 rats, 1 mouse, 1 mongoose, 1 hare, and 1 monkey. The mammalian fauna is predominantly composed of exotic or introduced species, with notable representatives being the African Green Monkey (introduced in the 17th century), the Burmese Mongoose (introduced in the 19th century), and rats. These species have adapted to urban and semi-natural agricultural areas and are commonly observed in these habitats. The chiropteran fauna comprises four families, encompassing species with diverse dietary preferences, including piscivores, omnivores, pollenivores/nectarivores, frugivores, and insectivores. None of the 12 mammalian species are protected in Barbados, and none are listed in the IUCN Red List of Threatened Species (2021).
- **Birds** - According to Bird Life International (2020), Barbados hosts 48 resident bird species, including yellow warblers, finches, doves, egrets, herons, and hummingbirds. Threatened species information is sourced from the IUCN Red List, with Bird Life International (2020) reporting that 94% of the 204 bird species in Barbados are classified as "Least Concern," while 5% are classified as "Near Threatened." Globally threatened categories ("Vulnerable," "Endangered," and "Critically Endangered") apply to 2% of the total species. The IUCN Red List website lists only one bird species for Barbados, the Barbados Bullfinch (*Loxigilla barbadensis*), classified as "Least Concern." Barbados is situated along the migratory bird path and boasts several Important Bird & Biodiversity Areas (IBAs), totalling 185 hectares.

- Terrestrial Reptiles - The terrestrial reptile population encompasses 11 species.



Figure 5-8: Avifaunal species observed in Graeme Hall, January 2024

5.5.2.1 Marine Environment

The marine study area encompasses both the Worthing region, where the South Coast Sewage Treatment Plant (SCSTP) discharges, and the Carlisle Bay marine park. These locations are highly popular among tourists for scuba diving, primarily because of the diverse marine environments featuring coral reefs, seagrass beds, and artificial reefs. The coral reefs in the Worthing area play a critical role in maintaining biodiversity, especially for endangered species like *Acropora palmata* and *Acropora cervicornis*. Preserving these reefs is essential not only for the sake of these endangered species but also for the ecosystem services they provide, both to nature and mankind. For instance, coral reefs contribute significantly to climate change resilience by acting as natural barriers, mitigating the impact of storm surges on coastal areas. However, certain sections of the coral reefs in the study area are facing new challenges in 2023, including coral bleaching and degradation.

Sea turtles, crucial to Barbados' marine fauna, are endangered and protected. Their grazing services are important for maintaining coral reefs and seagrass beds, impacting both tourism and the health of these habitats. Negative impacts on their habitats could be devastating for their survival and the health of these critical ecosystems.

The International Union for Conservation of Nature (IUCN) Red List developed a Red List Index (RLI) for "species survival" in each country. This index is weighted by the fraction of each species' distribution occurring within the country. It ranges from 1 (indicating minimal contribution to the global RLI, where all species are classified as Least Concern) to 0 (indicating maximum contribution to the global RLI, where all species are classified as Extinct or Possibly Extinct). The index is based on native mammals, birds, amphibians, reef-building corals, and cycads present in the country. The Red List Index of species survival for Barbados is depicted in the following figure (IBAT, 2020).

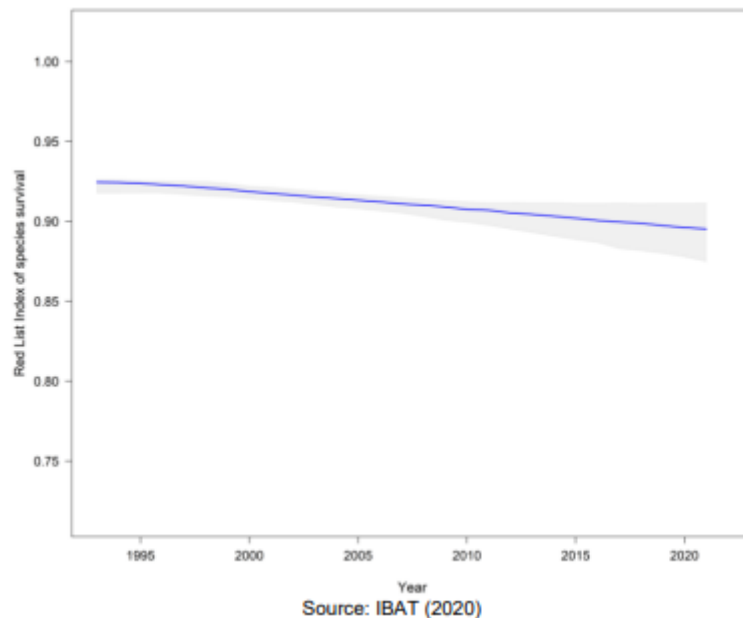


Figure 5-9: Red List Index of Species Survival

While Barbados exhibits relatively low terrestrial fauna diversity for a tropical island, it is home to numerous exotic species. Despite incomplete and imprecise avifaunal data, birds in Barbados seem to have a significant association and dependence on the Graeme Hall wetland. Wetlands like Graeme Hall play a crucial role in not only hosting unique avian life but also providing essential ecosystem services. These services encompass provisioning, such as the use of aquatic plants and fish; regulating, including flood control and water purification; cultural, tied to recreation and spiritual practices; and supporting, like biodiversity maintenance and nutrient cycling. Among the endangered and/or endemic bird species associated with these wetlands in Barbados are the Barbados Yellow Warbler (*Dendroica petechia*), Black-capped Petrel (*Pterodroma hasitata*), Buff-breasted Sandpiper (*Tryngites subruficollis*), and Caribbean Coot (*Fulica caribaea*).

The downward trajectory of the graph indicates not only a current low faunal biodiversity but also a declining aggregate survival probability of the country's species. Low biodiversity implies reduced resilience and capacity to withstand rapid environmental changes, such as those associated with climate change. It is important to note that the current iteration of the proposed development of the SCSTP and associated pipelines will see no pipelines passing through any sensitive area of biodiversity. However, the operational phase of the Project threatens potential impacts on the wetlands, impacts that are further discussed in Chapter 6.3.

5.6 The Existing South Coast Sewage Treatment Plant

5.6.1 Summary of Operations

Figure 5-11 below shows the headworks of the existing SCSTP – where influent wastewater channelled from Oistins and the surrounding areas enter the treatment plant.



Figure 5-10: Headworks at the Existing SCSTP

The plant primarily facilitates the primary treatment of wastewater, via a series of processes that include screening and sediment removal. The first screening process prioritizes the removal of larger materials, such as pieces of wood, by the manual bar screen. Subsequent to that, finer materials that have passed through the bar screen are further filtered out. The finer materials that are removed are transported via a conveyor belt where they are collected in waste bags and removed. The materials accumulated as a result of the aforementioned processes are manually collected and removed.

The equipment used in these processes are seen in Figure 5-12 below.

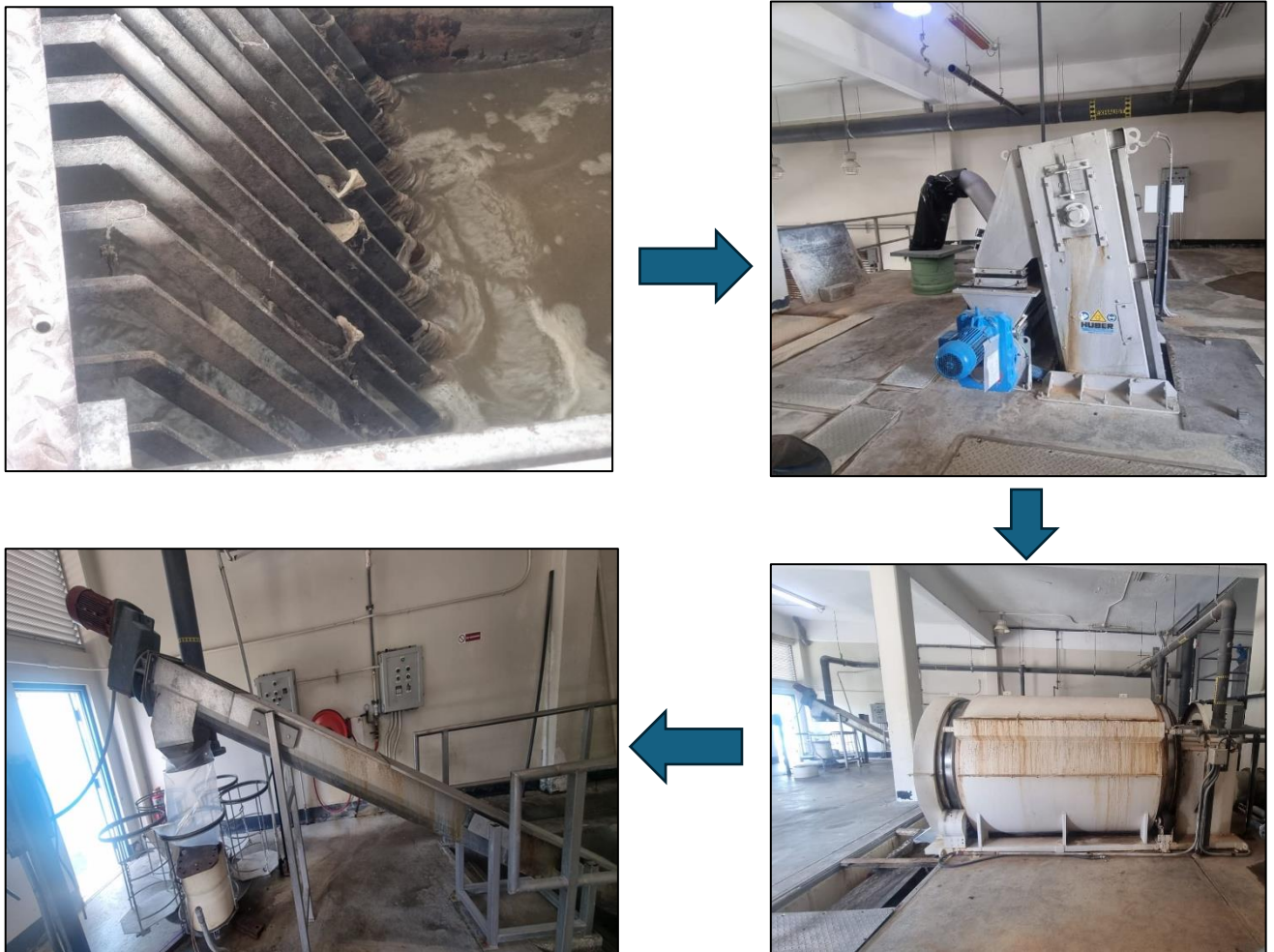


Figure 5-11: Equipment used in the Material Removal Processes at the Existing SCSTP

5.6.2 Labour and Working Conditions

As the SCSTP is currently operated by the BWA, it inherits the Barbados National Employment Policy¹² and the Employment Rights Act¹³ that is observed by the BWA and other government agencies. Employment issues raised in the policy are aggregated around five “pillars”. They are:

1. Creating Employment Opportunities
2. Enhancing Labour Supply
3. Promoting Equality and Equity in the Labour Market
4. Building a Stronger Workforce through Information
5. Cross-cutting Issues

These pillars that govern the BWA’s labour and employment policy emphasize the national effort to promote decent, fair and equal work opportunities for all Barbadians, including those from vulnerable groups (PWDs, youth, women, etc.). Observations made of the operations of the BWA suggest that there is a general adherence to the national employment policy.

¹²[https://labour.gov.bb/pdf/NATIONAL%20EMPLOYMENT%20POLICY%20OF%20BARBADOS%20\(NOVEMBER%202014\).pdf](https://labour.gov.bb/pdf/NATIONAL%20EMPLOYMENT%20POLICY%20OF%20BARBADOS%20(NOVEMBER%202014).pdf)

¹³<http://barbadosparliament-laws.com/en/showdoc/cs/346/se:10>

Operations observed at the SCSTP show that the plant's labour force was dominated by males – of the twenty (20) workers employed at the SCSTP, five (5) were females (the only female worker that was observed at the time of the visit was a guard stationed at the SCSTP's entrance). This gender disparity is also extended in the Wastewater Division which has a total of fifty-four (54) workers, nine (9) of which were females. The average age of the workers at the SCSTP and the Wastewater Division was between 35 and 55 years. The SCSTP currently has no individual employed under the age of 16 years, complying with the Employment Act which makes provisions for the employment of children, who are characterized as individuals who have not yet achieved the age of 16 years.

These workers were subject to generally reasonable working conditions in relation to the conditions stipulated in the Employment (Miscellaneous Provisions) Act. The Act emphasizes the need for:

1. Adequate transportation to and from work that is available to all employees
2. Proper rest room facilities and facilities for eating meals at the place of employment
3. Adequate intervals for rest and mealtime

The Act also makes provisions for working during nights (9:00 p.m. to 7:00 a.m.). Because of the nature of the work, those employed at the treatment plant are sometimes required to address issues associated with the operations of the plant during nights, such as leakages and equipment failure/malfunction, or any other issue that may pose detrimental to nearby communities.

As the handling of the removal of material requires manual labour, there is adequate sanitation facilities accessible to all workers, as well as a break area for gathering and eating meals, complying with the legislation in the Employment Rights Act that stipulates the need for such facilities. As well, no hazardous materials were found to be stored on the compound except for the oils needed for the operation of the equipment. These oils were stored in covered containers in a designated area. Furthermore, there was no evidence of any waste being improperly stored, burned or buried on the property, or any evidence of any loose piece of material or furnishing that may pose as accident risks. Additionally, health and safety guarantors were evidenced by signage warning about possible risks/dangers as well as restricted access to parts of the facility solely by authorized personnel. Such restricted areas included the electrical room that housed most of the power sources for the facility's suite of equipment.

There were indications that health and safety procedures could be implemented and this was evidenced by the emergency response amenities in the facility, such as fire extinguishers strategically placed in the plant in rooms where machinery were located. However, there was no evidence of any signage that indicated emergency routes or assembly points.

Another major issue identified at the plant was the odour emanating from the influent flow and treatment processes. It was noted that this issue was contained mainly to workers operating within the plant structure – the odour typically fails to escape the structure. No worker was observed wearing personal protective equipment (PPE) (i.e., masks) as it was stated that the odour issue subsides with time due to familiarity.

The BWA currently adheres to the Public Service Act Code of Conduct and at the period of assessment, was in the process of preparing a Code of Conduct to be enacted. The draft copy had been prepared but was yet to be agreed upon with the Barbados Workers' Union. In the event of any conflicts, the BWA's Human Resource Department is reportedly responsible for the handling and reporting of all worker conflicts. It is unclear if this mechanism includes a Grievance Redress Mechanism and no evidence of same was identified when asked.

Despite the identified issues associated with the labour policy and working conditions of the SCSTP, the BWA's inheritance of the national employment policy necessitates the organisation's mandate to not only include the provision of fair and equal work opportunities accessible even to vulnerable groups, but to prioritize the education of the labour force and to provide an environment in which

labourers can exercise their constitutional rights, including the right to the freedom of association. This is included as a critical point under the National Employment Policy’s emphasis on the need to “Commit to the Maintenance of a Stable and Harmonious Industrial Relations Climate”, which also prescribes the provision of a mechanism within which a healthy relationship between the employer, labour force and unions can be maintained.

It is recommended that the construction and operation of the proposed water reclamation facility adopt the existing health and safety procedures and maintains the stipulations presented in the National Employment Policy. The ESMP presented in Section II of this report includes management plans that govern worker health and safety, labour, as well as emergency response procedures suggested to enhance the labour and working conditions of the existing SCSTP and the proposed works. To fill the gaps identified in the BWA’s employment policy, it is recommended that the BWA implements the plans outlined in Section II – The ESMP, specifically the:

- i. Labour Management Plan (which constitutes a recommended Code of Conduct),
- ii. Worker Health and Safety Management Plan,
- iii. Plan for the Management of Unions and General Workers,
- iv. Enhancing Representation of Women in the Project Workforce,
- v. Emergency Response Plan, and
- vi. Grievance Redress Mechanism (GRM)

5.7 The Socioeconomic Environment

5.7.1 Socio-Demographic Context for the project

Figure 5-13 shows the general locations in which the Consultants conducted the data collection process to establish the socioeconomic baseline conditions of the Project area.

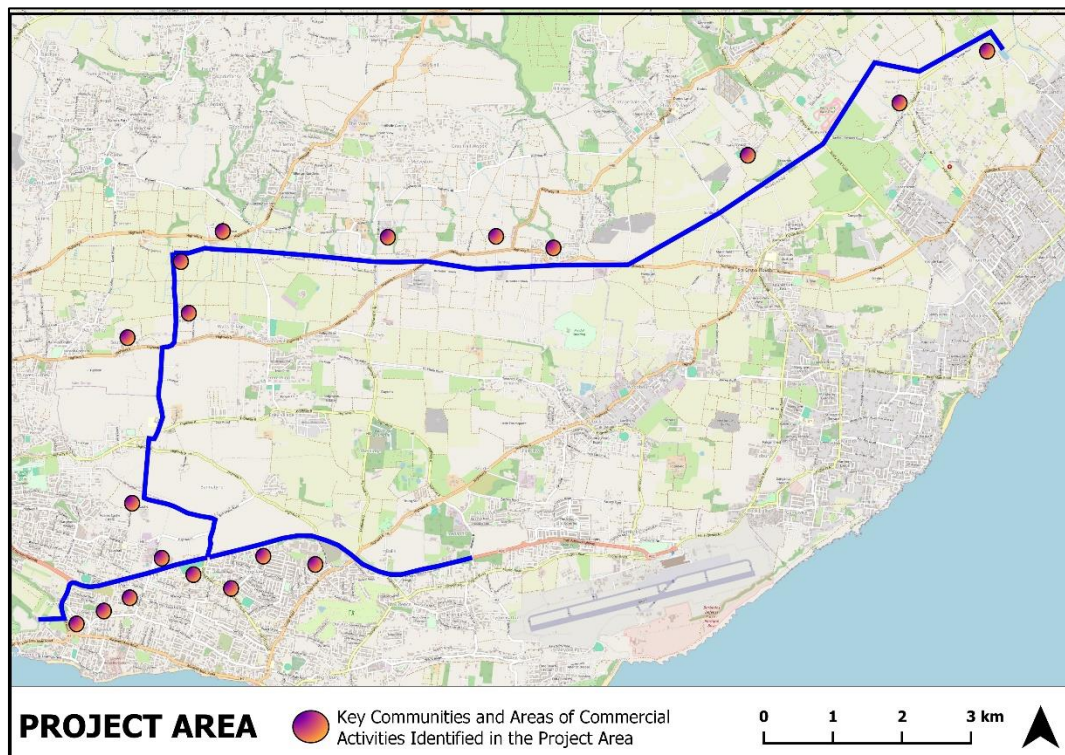


Figure 5-12: Map Showing Communities, Businesses and Areas of Commercial Activities that were included in the Data Collection Process in January 2024

5.7.1.1 Sensitive Receptors Along the ABC Highway and Near to the Existing SCSTP

This chapter explores the socioeconomic conditions in the areas located along the ABC Highway. While located in the wider Christ Church parish, the assessment aimed to narrow in where possible on key locations such as Graeme Hall, Warners, Kendall Hill, Coverley, Kingsland, Providence and Newton. These areas located along the ABC Highway are home to many residential areas and commercial activities and will be most impacted by the construction work. Some of these specific businesses and social amenities are listed in Table 5-12 below:

Table 5-12: List of Business and Institutions and Potential Impact along the ABC Highway and Near to the Existing SCSTP

Institution/Business	Location	Distance to Pipeline	Activity	Impact Description
Central Veterinary Clinic South	Graeme Hall Park, Christ Church	≈23 m	Veterinary Services (e.g. vaccinations and wellness exams, veterinary diagnostic labs, digital radiography and ultrasound, soft and orthopedic surgery, and dental cleaning)	<ul style="list-style-type: none"> • Disruption to access point from Graeme Road • Dust and noise
Briar Hall Pavilion and Resource Centre	Briar Hall, Christ Church	≈10 m (1.0km by road access)	Community Development (e.g. community recreation – football and cricket)	<ul style="list-style-type: none"> • Dust and noise
Rubis Kendal Hill	Kendal Hill, Christ Church	≈ 2m	Petrol and diesel refueling, and limited grocery services	<ul style="list-style-type: none"> • Disruption to access from Tom Adams Highway • Dust and noise
Popular Discounts – Kendal Hill	Kendal Hill, Christ Church	≈ 4m	Supermarket	<ul style="list-style-type: none"> • Disruption to access from Tom Adams Highway • Dust and noise
The Deighton Griffith School	Kingsland Main Road, Christ Church	≈ 1 m (270 m by road access)	Secondary School	<ul style="list-style-type: none"> • Disruption to access from Tom Adams Highway • Dust and noise
Solar Watts Systems Inc.	Barrack Hill, Vauxhall, Christ Church	≈ 260 m	Commercial and residential electrical installations of solar phot	<ul style="list-style-type: none"> • Disruption to access from Tom Adams Highway from Elma Talma Roundabout

Institution/Business	Location	Distance to Pipeline	Activity	Impact Description
				<ul style="list-style-type: none"> Dust
Gordan Ashy Architects	Barrack Hill, Vauxhall, Christ Church	≈ 450 m	Corporate Offices – Architectural Services	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust
Hinds Transport Complex	Kendal Hill, Christ Church	≈ 240 m	Shipping and Transport	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust
TSL Barbados Limited	Hinds Transport Complex, Kendal Hill, Christ Church	≈ 270 m	Technology	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust
Tyre Masters	Kendal Hill, Christ Church	≈ 140 m	Tire Shop	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust
The Oasis	Kendal Hill, Christ Church	≈ 64 m	Sporting	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust and noise
Kooyman Megastore Barbados	Kendal Hill, Christ Church	≈ 3 m	Mega Hardware Store	<ul style="list-style-type: none"> Disruption to access from Tom Adams Highway from Elma Talma Roundabout Dust and noise

Institution/Business	Location	Distance to Pipeline	Activity	Impact Description
Newton Industrial Estate				
Barbados Steel Works	Newton Road, Christ Church	≈ 150 m (352 m by road access)	Hardware Store (Steel and Metal)	<ul style="list-style-type: none"> • Disruption to access and distribution routes from Tom Adams Highway from •
Barbados Bottling Company	Newton Road, Christ Church	≈ 110m (350 m by road access)	Local franchise manufacturers holder for international brands: Coca-Cola, Coca-Cola Light, Coca-Cola Zero, POWERade, Sprite, Sprite Zero, Fanta, Canada Dry and Schweppes Tonic Water.	<ul style="list-style-type: none"> • Disruption to access and distribution routes from Tom Adams Highway from • Smell, dust and noise
Gildan Activewear Barbados	Newton Industrial Park, Christ Church	≈ 5 m	Logistical Hub	<ul style="list-style-type: none"> • Disruption to access and distribution routes from Tom Adams Highway from • Smell, dust and noise • Road safety • Delayed emergency response
Barbados Golf Club	Durants, Christ Church	≈ 6 m	Recreation/Sports – Golf Club	<ul style="list-style-type: none"> • Disruption to access • Smell, dust and noise
Providence Methodist Church	Providence, Christ Church	≈ 64 m	Religious – Methodist	<ul style="list-style-type: none"> • Disruption to access • Smell, dust and noise • Road safety
DHL (Barbados)	Airport Commercial Centre Pilgrim	≈ 1.8 km	Local, Regional and International Delivery	<ul style="list-style-type: none"> • Traffic congestion • Access to customers in project areas

Institution/Business	Location	Distance to Pipeline	Activity	Impact Description
	Road, Christ Church			<ul style="list-style-type: none"> Delayed emergency response
Chick Mount Foods	Balls Plantation, Christ Church	≈ 700 m	Chicken Manufacturing Plant	<ul style="list-style-type: none"> Access to property areas
MegaPower Service Centre	Wilcox Ridge, Christ Church	≈ 900 m	Service Centre for MegaPower (Electric Vehicles)	<ul style="list-style-type: none"> Traffic congestion

In carrying out the assessment, a few communities were identified for both the Christ Church and St. George area although there are more specific findings for the former given the more on-the-ground analysis and engagement that was possible in that areas. A full listing of communities for the Christ Church area in which this work took place included, based on positioning in relating to the pipeline:

To the North of Pipeline Section A - Warners, Sargents, Vauxhall
To the South of Pipeline Section A - Maxwell, Kendal Hill, Cane Hill, Durants, Newton, Lodge Road, Parish Lane, Pilgrim Place, Gibbons Boggs (See Figure 5-14)¹⁴. The shared collective impacts from the project included:

- Road access to homes, commercial and recreational
- Dust, noise and concerns of smell from possible pipeline leakages

However, notably, there are three houses within close proximity to SCSTP, approximately between one and two kilometres. These houses would be directly impacted by the dust, noise and smell during the construction phase. Other impacts would include reduced access to homes as operations take place to upgrade the pipelines. In addition to these impacts in the event of a sewage leak, these houses will be the first requiring evacuation.

Parish and Occupancy Status	Type of Dwelling											
	Total	Separate House	Separate House with Rented room	Rented room in separate house	Flat/ Apt	Flat/ Apt with rented room	Rented room in Flat/ Apt	Townhouse/ Condominium	Part of a commercial Building	Group Dwelling	Other	Not Stated
Christ Church												
Total	19,251	14,231	138	87	4,145	111	64	277	41	26	77	54
Occupied	15,595	12,098	114	76	2,963	81	44	114	30	11	34	30
Unoccupied	3,656	2,133	24	11	1,182	30	20	163	11	15	43	24

Figure 5-13: Number of households within the Parish of Christ Church (Census 2010)

Table 5-13 below shows the communities identified as sensitive receptors to the works and their distance to the pipeline.

¹⁴ General Census for the Christ Church parish used to provide an estimate of households within the project area

Table 5-13: List of Communities and Distance to the Pipeline

Community	Distance to Pipeline
Graeme Hall	≈ 150 m
Lawrence Gap	≈ 700 m
Warners	≈ 1 m
Maxwell Hill	≈ 7 m
Sargents	≈ 5 m
Vauxhall	≈ 5 m
Kendal Hill	≈ 400 m
Newton Terrace	≈ 5 m
Pilgrim Place	≈ 900 m
Gibbons Boggs	≈ 1 km

A group of farmers just north of the Ministry of Agriculture and Food Security practice their trade both in the sphere of influence of the proposed works at the SCSTP and the pipelines – lands farmed in this area are on average ~0.5km from the proposed pipeline route (see Figure 5-14). These farmers would be at greatest risk to potential air and noise pollution, as well as possible contamination of the soil used for agricultural either by improper drainage or by improper waste disposal. It is to be unseen if there would be a concrete risk of a lack of access to these farmlands during the construction phase as there is no clear indication that there is a single point of access to these lands. Impacts on crop health and agricultural practices should be considered during construction activities, and as such it is important that these farmers be engaged throughout the Project life cycle.



Figure 5-14: Spatial Relationship between the farmers operating close to the Ministry of Agriculture and Food Security and the SCSTP and proposed pipeline route

Figure 5-15 below shows the spatial relationship between the key sensitive receptors in relation to the proposed pipeline routes and site for the construction of the reclamation facility.

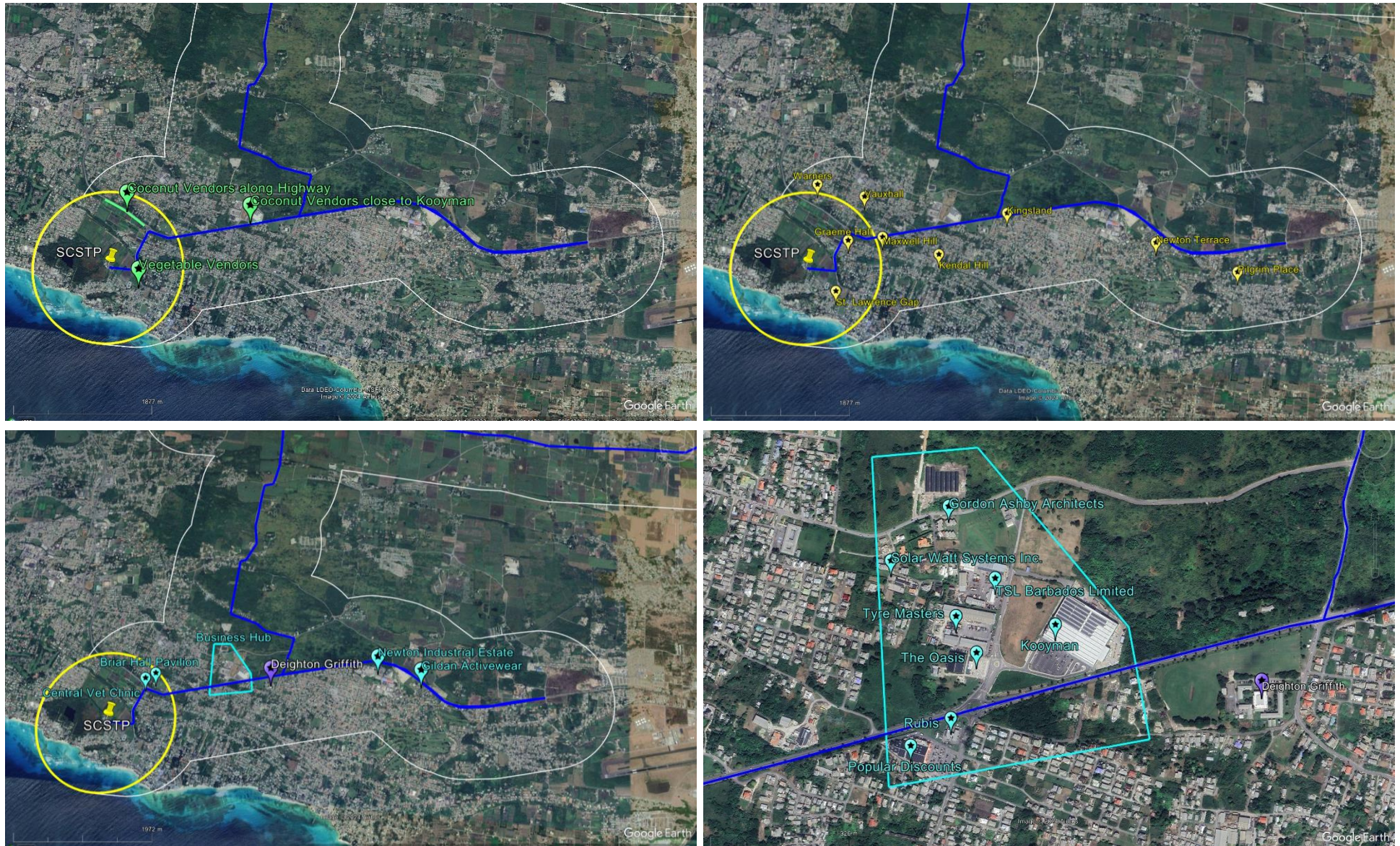


Figure 5-15: Vendors (top-left), Communities (top-right), Businesses (bottom) – Sensitive Receptors Along the ABC Highway and around the Existing SCSTP

5.7.1.2 Sensitive Receptors Along Pipeline Section B and Pipeline Section D

This chapter assesses the socioeconomic conditions of the areas that could possibly be impacted by the installation of pipelines connecting the ABC Highway to the historic railway - Pipeline Section B and Pipeline Section D (see Figure 5-2).

As the historic railway passes through lands primarily used for agricultural purposes, the main receptors identified along that pipeline route were small farmers in nearby communities, as well as farmers from the different plantations, including the Constant, Valley Island, Edgumbe, Sunbury and River Plantation (see Table 5-14). A total of 5 farms and 75 farmers were identified.

Table 5-14: List of Farmers Identified Along the Trailway Route and Potential Impacts

Farm/Farmers	Location	Number of impacted farmers	Activity	Impact Description
Valley Island Farms	Constant (Trailway demo stretch)	15	Mixed of root crops (e.g. cassava and sweet potato), fruit and vegetables (e.g lettuce, tomatoes, cucumbers, watermelons, squash, etc)	Disruption to field work, restricted access to fields, dust and noise
Smallscale (collective)	Constant (across the Trailway demo stretch)	10	Root Crops	Dust and noise
Smallscale (collective)	Constant (Trailway demo stretch)	15	Mixture of root crops, fruit and vegetables (e.g lettuce, tomatoes)	Disruption to field work, restricted access to fields, dust and noise
Sunbury	Marchfield	35	Root crops, sugar cane and breadfruit tree orchards	Disruption to field work, restricted access to fields, dust and noise
Edgumbe	Bentleys/Brereton	N/A	N/A	Disruption to field work, restricted access to fields, dust and noise
Total	75			

Along with the above mentioned farmers, the River Plantation accommodates 82 farms, but only are 17 are reportedly functional due to their having access to water. There was difficulty pinpointing an exact number of farmers operating on these farms. However, there is an estimated 260 farmers that are expected to benefit from the Project along the pipeline route.

Communities such as Haggatt Hall, Rouen, Jackmans, Froster Hall, The Glebe, Thorpes Cottages, Salters, Constant, Dash Valley, Stepney, Flat Rock, Watts Village, Ellerton, Eastlyme, and Waverley Cot

were identified as areas of interest in the assessment (See Figure 5-12a)¹⁵. The Windsor community was found to be especially sensitive as the proposed pipeline route would pass close to a pair of houses and across Highway 5. Oil pipelines are also found in this area. Details of the distance to the planned pipeline are provided in Table 5-15.

Table 5-15: List of Communities Along/Close to the Trailway Route and Distance to the Pipeline

Community	Distance to Pipeline
Bannatyne	≈ 0.19 km
Stepney	≈ 0.4 km
Haggatt Hall	≈ 2.3 km
Eastlynne	≈ 0.5 km
Waverly Cot	≈ 1 km
Brighton	≈ 0.5 km
Windsor	≈ 0.2 km
Brereton	≈ 0.6 km

Additionally, a number of businesses and other activities were identified (see Table 5-16) in the immediate zone of impact as well as sensitive areas. Overall, 22 businesses of various sizes are identified with a diverse range of potential impacts. These include schools to spas, historical landmarks, retail, corporate offices and markets.

Table 5-16: List of Institutions and Businesses and Potential Impact

Institution/Business	Location	Distance to Pipeline	Activity	Impact Description
T Shirt Factory Barbados	Bannatyne, Christ Church	≈ 450 m	Retail Printery	<ul style="list-style-type: none"> • Disruption to access point from Highway 6 • Dust, smell and noise
Thelma Berry Nursery School	Highway R, Christ Church	≈ 5 m	Nursery	<ul style="list-style-type: none"> • Disruption to accessing the building • Dust, smell, noise
Blackman and Gollop Primary School	Staple Grove, Christ Church	≈ 5 m	Primary School	<ul style="list-style-type: none"> • Disruption to accessing the building • Dust, smell and noise
Nancy's Bar	South District, St George	≈ 30 m	Bar	<ul style="list-style-type: none"> • Dust, smell, and noise
Urgent Care Barbados	Highway 5, St. George	≈ 5 m	Medical facility	<ul style="list-style-type: none"> • Emergency response • Dust

¹⁵ General Census (2010) for the parishes of St. Michael, St George and St Phillip used to provide an estimate of households within the project area

Michael Greaves Associates	Carmichael, St. George	≈ 5 m	Corporate Offices	<ul style="list-style-type: none"> • Disruption to accessing the building • Dust, smell and noise
Brighton Farmers Market	Brighton, St. George	≈ 150 m	Market	<ul style="list-style-type: none"> • Dust, smell and noise
Canefield Bar and Grill	Brighton, St. George	≈ 80 m	Bar and Restaurant	<ul style="list-style-type: none"> • Disruption to accessing the building • Dust, smell and noise
Touch by Serenity	Brighton, St. George	≈ 90 m	Spa	<ul style="list-style-type: none"> • Disruption to accessing the building • Dust, smell and noise
Nourish Yoga Therapy	Windsor Plantation, St. George	≈ 300 m	Yoga Instructor	<ul style="list-style-type: none"> • Dust, smell and noise
Wendell's Fruit and Veg. Stall	Campaign Castle, Christ Church	≈ 150 m	Fruit and Vegetable Stall	<ul style="list-style-type: none"> • Dust, smell and noise
SergoisAutoFollow	Brereton, St. Philip	≈ 150 m	Mechanic Shop	<ul style="list-style-type: none"> • Dust, smell and noise
Luv'n Hugs Nursery & Preschool	#1 Brereton Village, St. Philip	≈ 150 m	Nursery and Preschool	<ul style="list-style-type: none"> • Dust, smell and noise
Glossy's Kitchen	Bereton, St. Philip	≈ 250 m	Café	<ul style="list-style-type: none"> • Dust, smell and noise
Level 6 Bar	Brereton, St. Philip	≈ 10 m	Bar and Grill	<ul style="list-style-type: none"> • Disruption to accessing the building from Brereton Village #2 • Dust, smell and noise
Hunte's Quarry	2 nd Avenue, Sunset Ridge, St. Philip	≈ 5 m	Quarry	<ul style="list-style-type: none"> • Dust, smell and noise
G's Exotic Fish and Services & Lynch Properties	Sunbury Tenantry Road, St. Philip	≈ 275 m	Pet Store and Real Estate Office	<ul style="list-style-type: none"> • Dust, smell and noise
Kim's Grill	Marchfield, St. Philip	≈ 250 m	Food Shop	<ul style="list-style-type: none"> • Dust, smell and noise
Mrs. Clarke's Pudding & Souse	Sunbury, St. Philip	≈ 320 m	Food Shop (Pudding & Souse)	<ul style="list-style-type: none"> • Dust, smell and noise
Eastern Veterinary Clinic	Sunbury, St. Philip	≈ 120 m	Veterinary Clinic	<ul style="list-style-type: none"> • Disruption to accessing the

				building from Sunbury Road <ul style="list-style-type: none"> Dust, smell and noise
Sunbury Great House	Sunbury, St. Philip	≈ 340 m	Historical Landmark used for hosting events	<ul style="list-style-type: none"> Disruption to accessing the building from Sunbury Road Dust and smell
Bushy Park Barbados	Bushy Park Christ Church	≈ 75 m	Recreation e.g. hosting events and car racing	<ul style="list-style-type: none"> Dust, and smell

Dwellings in the area are a mix of different types – houses, houses with rented rooms, flat/apartments, townhouse/condominium, commercial and group dwellings, based on available census data. Across the three parishes of St. Michael, St. George and St. Philip, more than 44,000 dwellings were identified with St. Michael being the most densely occupied followed by St. Philip and then St. George. We estimate based on available figures that 86% of these are occupied. The most significant type of dwelling in these areas are separate houses, followed by flat/apartments. The number of dwellings that are part of a commercial building numbered less than 100 but is important to flag in considerations of impacts to commercial properties.

Figure 5-16 below shows the number of households within the parishes of St. Michael, St. George and St. Philip.

Parish and Occupancy Status	Type of Dwelling											
	Total	Separate House	Separate House with Rented room	Rented room in separate house	Flat/ Apt	Flat/ Apt with rented room	Rented room in Flat/ Apt	Townhouse/ Condominium	Part of a commercial Building	Group Dwelling	Other	Not Stated
St. Michael												
Total	27,347	21,730	290	386	4,282	123	109	126	102	21	98	80
Occupied	24,281	19,549	259	312	3,690	93	93	75	73	16	60	61
Unoccupied	3,066	2,181	31	74	592	30	16	51	29	5	38	19
St. George												
Total	6,905	6,088	50	14	699	12	11	10	10	1	7	3
Occupied	6,095	5,408	45	13	580	10	11	10	9	-	6	3
Unoccupied	810	680	5	1	119	2	-	-	1	1	1	-
St. Philip												
Total	10,177	9,200	78	38	718	21	25	28	21	6	15	27
Occupied	8,326	7,629	71	30	500	20	24	12	19	2	3	16
Unoccupied	1,851	1,571	7	8	218	1	1	16	2	4	12	11

Figure 5-16: Number of Households in the Parishes of St. Michael, St. George and St. Philip.

Through conversations held with a representative from the Barbados Transport Board, the Blackman & Gollop Primary School was also identified as a sensitive receptor due to its reliance on the sole road arteries in the area to accommodate commuting students.

See Figure 5-17 below to see the sensitive communities, plantations/farms and school in relation to the proposed pipeline routes.

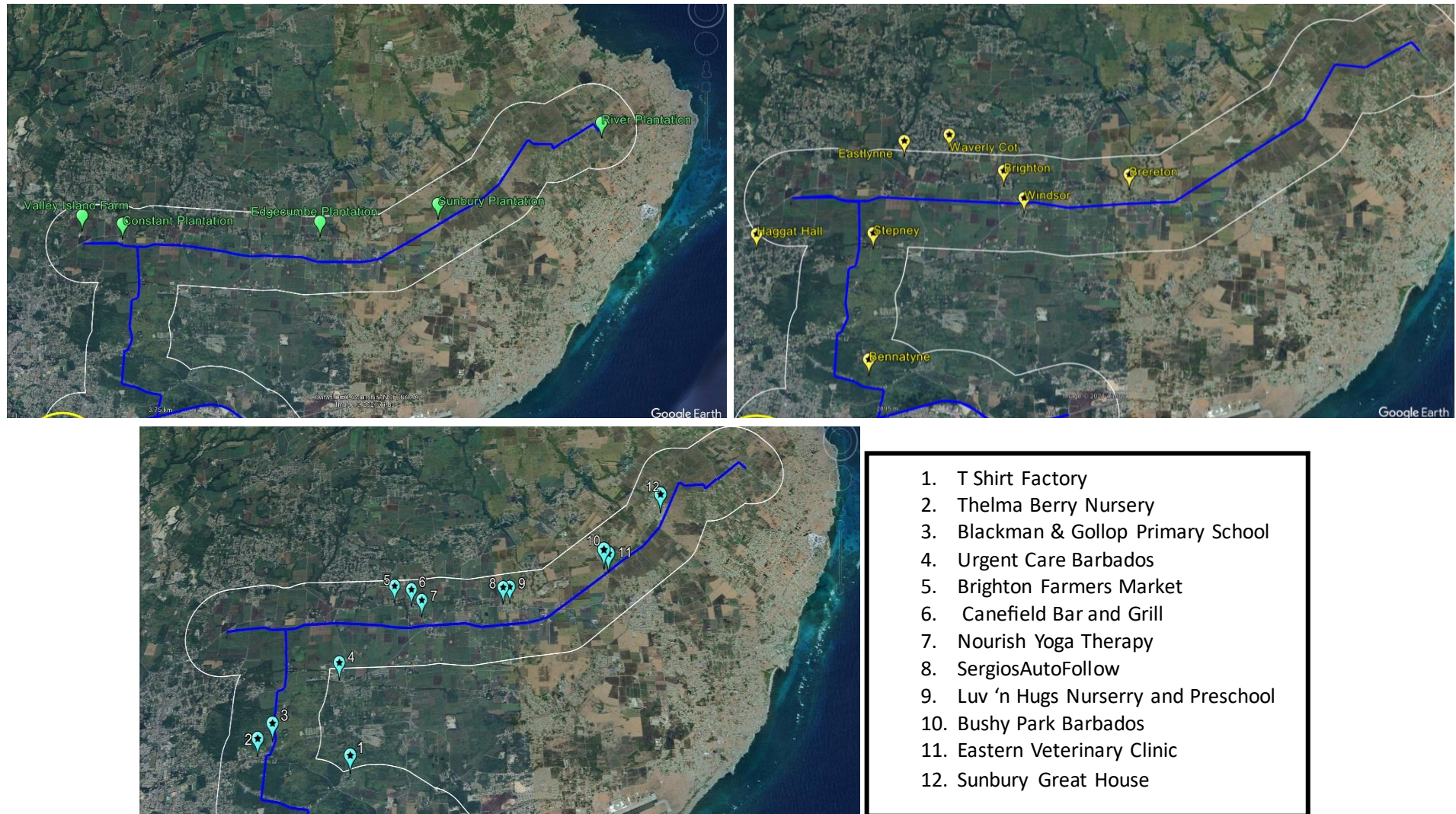


Figure 5-17: Plantations/Farms (top-left), Communities (top-right) and Businesses and Schools (bottom) - Sensitive Receptors off the ABC Highway and along the Historic Trailway

Furthermore, a small cluster of houses located on Highway 6, in the Bannatyne area, were identified as key sensitive receptors due to the possibility the pipeline installation obstructing access to the properties. Conversations with two families consisting of two individuals each (four in total – 2 men and 2 women) living in the area proved that although there are five houses in the area, the two interviewed would be the households most affected as they share the same general entrance to the property that would be obstructed by the proposed pipeline route. The satellite imagery shown in Figure 5-18 shows the location of this cluster of houses in relation to the proposed pipeline route.



Figure 5-18: Housing Cluster Sensitive to Installation of Pipelines

5.7.2 Socio-Economic Data

From the 2010 Population and Housing Census Report, 54,336 persons reside in the Christ Church parish which accounts for 19.6% of Barbados total population of 277, 821.¹⁶ The population of women and girls in the parish is larger than the population of men and boys (Figure 5-19). 77% of homes in the parish are privately owned with 44% of households being female headed. The country has been experiencing a growth rate of 3% per decade since 1990, however it must be noted that the country is predicted to have an ageing population by the Ministry of Youth and Community Empowerment.¹⁷ As the population continues to age, the fertility rate remains constant or even declines, also reducing the proportion of young people in households.

Despite this prediction, Christ Church has a fairly young population with more than 5% of its population being under the age of 40. Nearly 18% are 15 years and younger which 1 in every 5 persons in the parish being under the age of 15. 67% of the parish's population fall within the working age (15-65 years).

¹⁶ Barbados Statistical Service. 2010. 2010 Population & Housing Census. Available at <https://stats.gov.bb/wp-content/uploads/2020/03/2010-PHC-Report-Vol-1.pdf>

¹⁷ Ibid

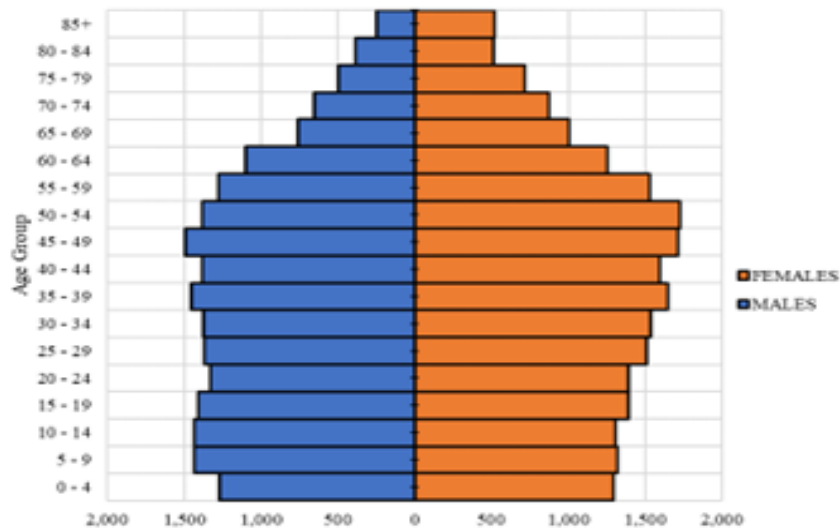


Figure 5-19: 2010 Census – Christ Church Age-Sex Distribution

5.7.2.1 Along the ABC Highway

The housing development at Coverley, Christ Church (also known as The Villages) is home to at least 1000 homes.¹⁸ Many of these homes (an estimated 300 to 400) are used to house students and staff of Ross University.¹⁹

Along the Newton, Christ Church section of the ABC Highway is a popular spot for coconut vendors to conduct business – a focus for informal economic activity. In recent times, there was concern about the safety and wellbeing of users of the highway along that section of the highway as there were complaints about shells from the coconuts were being discarded along the roadway. This poses a potential risk to users of the ABC highway and customers of these vendors as the discarded shells on the road may result in vehicular accidents.²⁰ During the scoping mission, at least 3 main locations were identified in the immediate zone of influence – Top Rock/Graeme Hall, Kooyman and Deighton Griffith Secondary School. A total of 7 sites were identified as follows:

- 3 -Kooymans by the highway (potentially most likely to be economically displaced as a result of Project Component 2) which means they lose access to the location and customers that served as their source of income and results in a disruption in their livelihoods;
- 2- Graeme Hall area (immediate zone of influence of Project Component 1 and may suffer some economic displacement wherein their livelihood activities are disrupted or halted due to the project activities as they have to cease/vacate their usual locations of commercial activity, leading to a loss of income);
- 2 – Deighton Griffith Secondary School (and less likely to suffer physical and economic displacement from any component). The lessened likelihood of physical and economic displacement is tied to the fact that the school is not involved in commercial activities that would be affected by project activities leading to financial losses, and the institution is less vulnerable to the actual physical disruptions as compared to roadside vendors due to its physical nature and its needs and functions are thus more likely easier to plan for and create plans around.

¹⁸ Atlantic Engineering. N.d. Our Projects. Available at <https://www.atlanticengineeringbarbados.com/our-projects-atlantic-engineering-i>

¹⁹ Terra Caribbean. 2019. The Villages at Coverley Then & Now. Available at <https://www.terracaribbean.com/Blog/2019/10/The-Villages-at-Coverley-THEN-and-NOW.html>

²⁰ NationNews. 2023. Newton Coconut Vendors Warned to Clean Up. Available at <https://www.nationnews.com/2023/09/11/newton-coconut-vendors-warned-clean/>

Figure 5-20 gives a visual of the area.

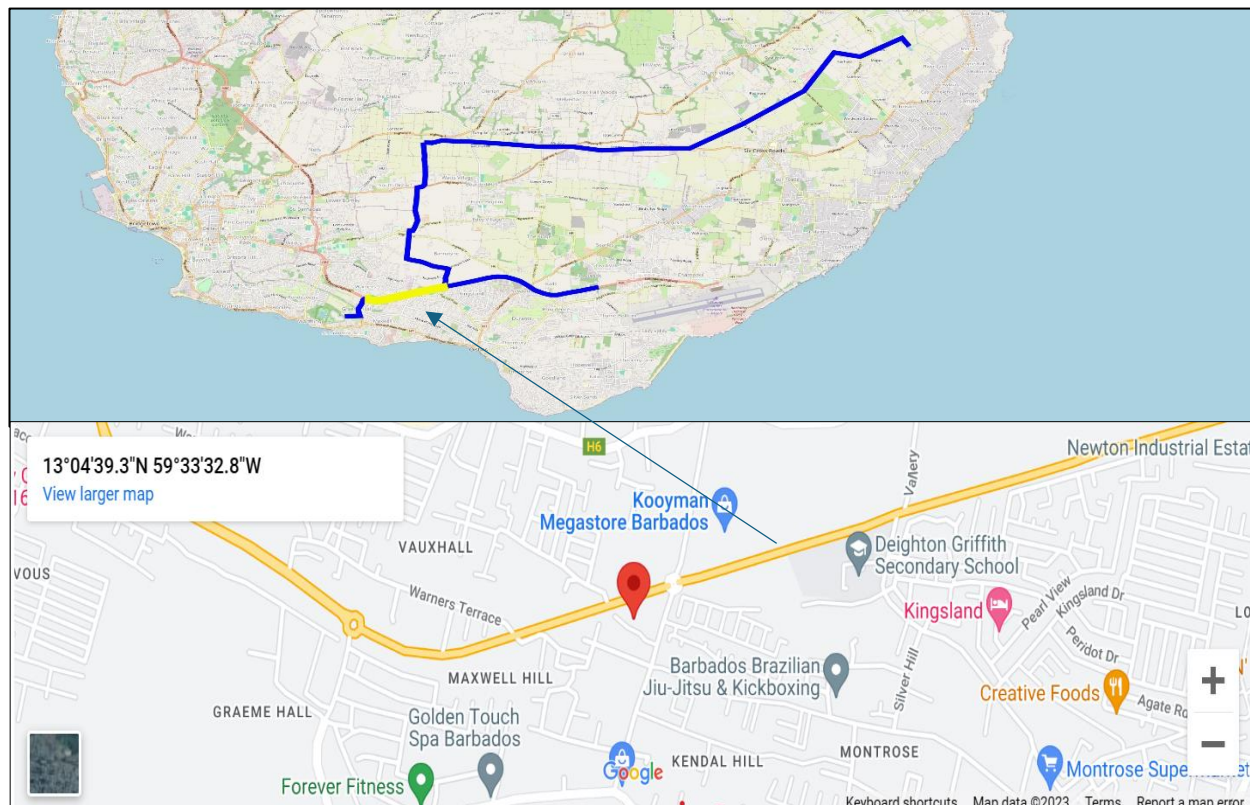


Figure 5-20: Map showing spatial relationship between the identified area and the Project pipeline routes (top); Spatial view of a key area of the proposed pipeline including key points where vendors are located (bottom)

This type of economic activity has also expanded post the COVID-19 pandemic when several persons, mostly women, would have lost employment. Concerns have been expressed about issues relating to these informal vending activities which also serve as a source of convenience for customers. These include the build-up of waste and the likelihood of unmanaged waste to attract vectors including rats.

In 2022, the Minister of Agriculture and Food Security announced measures to curb crop theft on the island. The new measures entailed that vendors selling produce would need to produce a receipt that indicates the source of their goods. Many vendors located on sections of the ABC highway expressed support for the move while many complained that having to procure a receipt would complicate their legitimate business and impair people economic activities. Many vendors noted that often they procure goods informally from public property or persons would invite them to get produce from their properties²¹ for which no records are kept.

In addition to being a hub of informal activity, there are several businesses of various sizes in the area which employ several hundred persons potentially.

The ABC highway, particularly this part of it that is the Adams section of the Highway is a critical artery for transit in the Parish and across the island. It is well trafficked area particularly by vehicles with several points of congestion during the day. It has also been the scene of fatal accidents, at least three between 2018 and 2023. The most recent of these occurred in December (December 4th, 2023) in which there was a four-vehicle accident in the vicinity of the Deighton Griffith Secondary School.²²

²¹ Barbados Today. 2022. Vendors question plan to scrutinise their stock. Available at <https://barbadostoday.bb/2022/04/14/vendors-question-plan-to-scrutinise-their-stock/>

²² Loop News. 2023. Traffic Alert: Multiple vehicles involved in crash by Vallery. Available at <https://barbados.loopnews.com/content/traffic-alert-multiple-vehicles-involved-crash-vallery>

According to stakeholders, the key types of business activities include business, commercial, tourism and recreation with the latter being the least significant and business being the most significant (Figure 5-21). The interview instrument classified “Business” activities as any informal economic activity, such as informal vending or the operation of small community stores, while “Commercial” activities referred to those undertaken by large scale, more formal ventures and plantations.

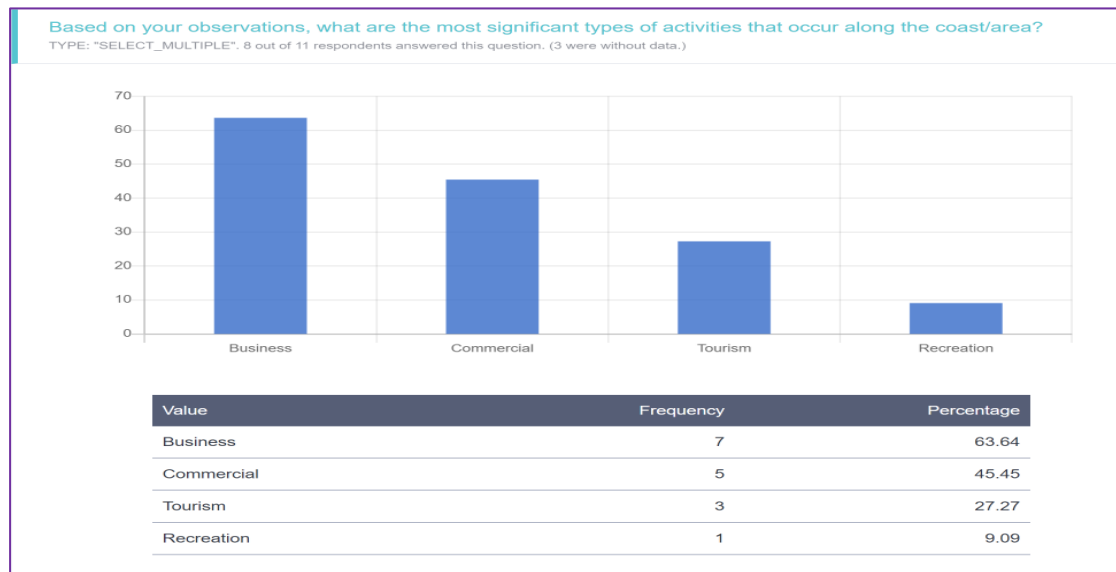


Figure 5-21: Key activity types in the area of social and or economic relevance

In terms of services, stakeholders highlight education followed by health care and public transport (Figure 5-22).

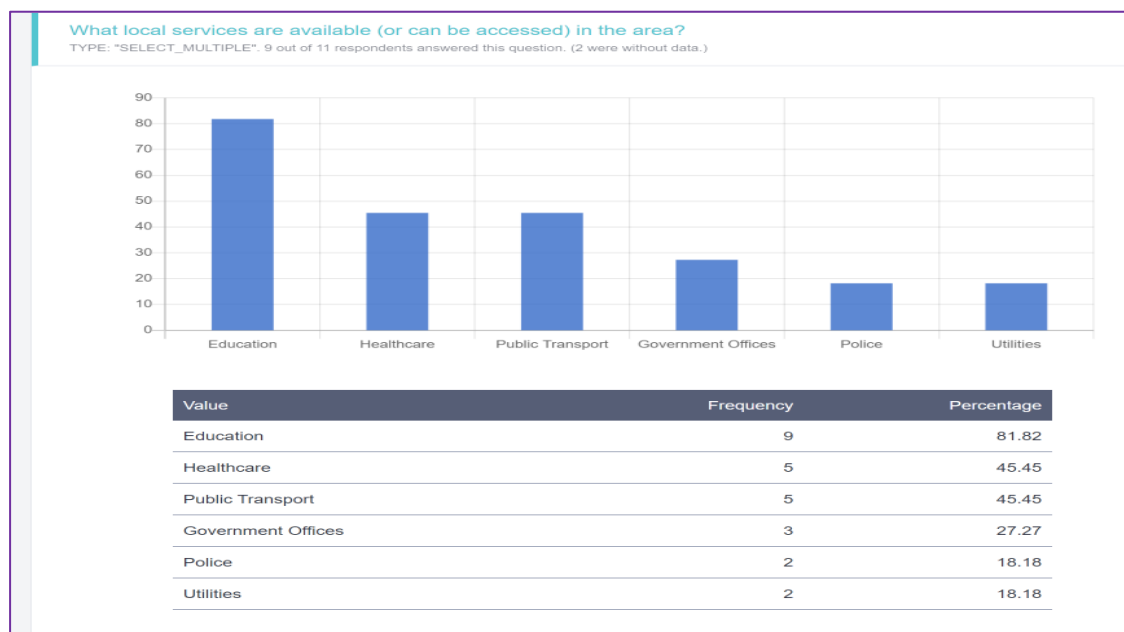


Figure 5-22: Key local services accessible in the area

As regards living conditions in the area, stakeholders provided critical insights suggesting a mix of:

- Retired and pensioned individuals some of whom are living comfortably;
- A fairly solid middle-class cohort combined with working class sub-communities;
- Some more affluent and some less affluent communities; and

- A relatively quiet and safe area.

See also Figure 5-23.

How would you describe your living conditions or the general living conditions you have noticed within the community?

TYPE: "TEXT". 9 out of 11 respondents answered this question. (2 were without data.)

Value	Frequency	Percentage
Comfortable retirees,	1	9.09
Mixed of working and middle class	1	9.09
Middle Class	1	9.09
Working class	1	9.09
Mixed working class & middle class	1	9.09
It's a good neighbourhood, mostly quiet. The issues I experience would be with persons selling coconuts in front of our neighborhood.	1	9.09
The participant is not from the area, they were participating on behalf of their mother who is a vendor at a school along the pipeline.	1	9.09
Middle class community	1	9.09
working class	1	9.09

Figure 5-23: Description of living conditions from KIIs

Based on the limited feedback available, some persons claimed to have experienced frequent water outages while others seemed to experience less of this. Overall, during the Sewage Leak of 2018 which resulted from an overwhelmed SCSTP operational infrastructure, many residents in the Christ Church Area were not affected or significantly affected (Figure 5-24). Business interests reported limited concerns about sewage and also expressed that occasionally water was an issue but, in their case, they had storage capacity.

How has any recent events (Sewage Leak in 2018) impacted on you, economically, socially and environmentally?

TYPE: "TEXT". 9 out of 11 respondents answered this question. (2 were without data.)

Value	Frequency	Percentage
It did not	2	18.18
No impact directly	1	9.09
no	1	9.09
Not me directly but there was definitely a foul odor when passing through or on the wind	1	9.09
No, but there was lots of traffic within the area.	1	9.09
I was not directly impacted but I know that the sewage affected a lot of businesses in the area since people were avoiding the south coast due to the scent from the sewage. This would have also caused some backup with traffic.	1	9.09
I tried to avoid that area because of the scent and use other roads.	1	9.09
Not in my area	1	9.09

Figure 5-24: Impacts from 2018 sewage leak and implied sanitation issues

Digging a little deeper on these issues, there seemed to be less certainty on some issues related to sewage and sanitation. These areas are outside the sewered area but use onsite systems and have

reported no health related concerns related to their sewage and/or sewage treatment. There are more general concerns about the area with the primary concern around mosquitoes and the possible spread of dengue. This was particularly of concern to elderly persons and those who recently had surgery (Figure 5-25). Another source of concern was poor solid waste disposal. All of these potentially have implications for women's time and their care burden as well.

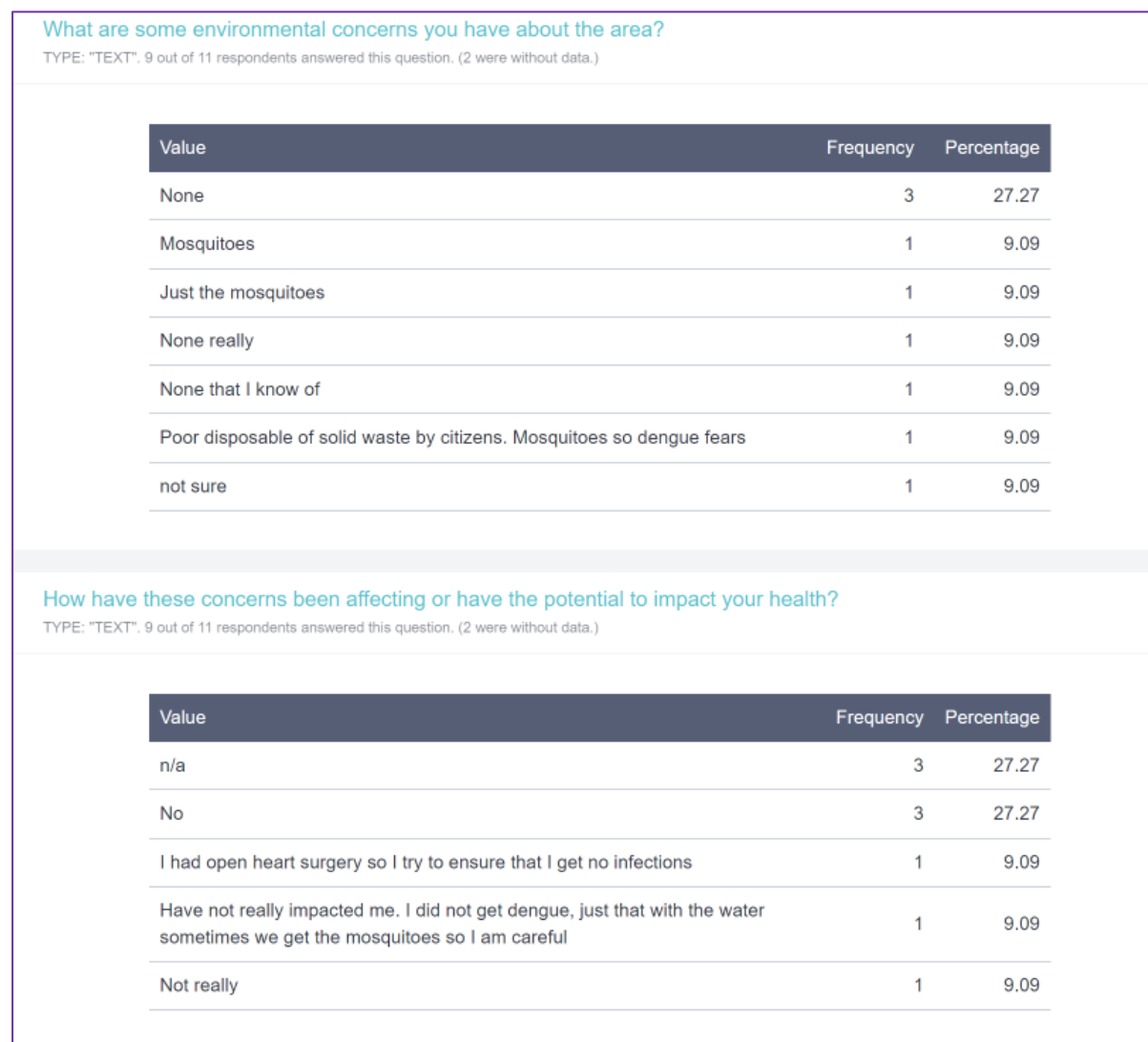


Figure 5-25: Concerns about the area

5.7.2.2 Along the Historic Trailway

Based on observations made and conversations with residents in these areas, agricultural activities made up the bulk of the economic activities that were practiced in the area. Although the proposed pipeline route that follows the path of the railway extends primarily through farmlands, there are still small settlements that are proximal to the proposed pipeline routes where small businesses and small-scaled agricultural activities can be observed.

One plantation farmer who participated in the consulting team's data collection process stated that the outskirts of the Haggatt Hall community accommodated approximately fifteen (15) small farmers. The number of farmers that reportedly worked on the plantations in the area ranged from one (1), as is the case at the Valley Island Plantation, to an estimate of over fifteen (15), such as at the River Plantation where the majority of the farmers were consulted. Based on data gathered from the farmers, the pipeline construction would potentially lead to lower production costs for farmers as well

as greater uptime in productive activity throughout the year for them. The observations and findings from interactions with these farmers are presented in Chapter 5.7.4 and Chapter 5.7.5 respectively.

With the presence of both large-scale and small-scale agricultural activities that can be observed along the railway route, it, therefore, can be said that those areas are dominated by agricultural and recreational activities, with small residential settlements and small-scaled businesses also characterizing the diversity of activities in the area.

Chapter 2.2 highlights one of the main Project objectives to support the agricultural sector with the added supply of reclaimed water. As such, it was important to identify the main types of crops that are grown by the affected farmers. These crops are listed below:

Table 5-17: List of Crops Grown by Affected Farmers

Melons	Cassava
Squash	Eggplant
Cucumber	Pumpkins
Sweet Peppers	Onions
Tomatoes	Sugar Cane
Plantains	Bananas
Sweet Potatoes	Yams

The crops that would be most sensitive to changes in water supply and availability varies, according to the farmers. This is discussed in Chapter 5.7.4. below.

5.7.3 Cultural and Heritage Assets

In the Project Area there are cultural and heritage assets that could be directly and indirectly affected by dust, noise, vibrations and by construction works. The IDB's ESPF defines cultural heritage as the tangible and intangible features of a country that possess some form of historical, cultural, archaeological, artistic or religious value. By this definition, an example of a cultural or heritage asset in the Project Area would be 22 below shows the sole Cultural Heritage Conservation Area in the southern area of the island, as outlined by the Barbados Physical Development Plan 2017.

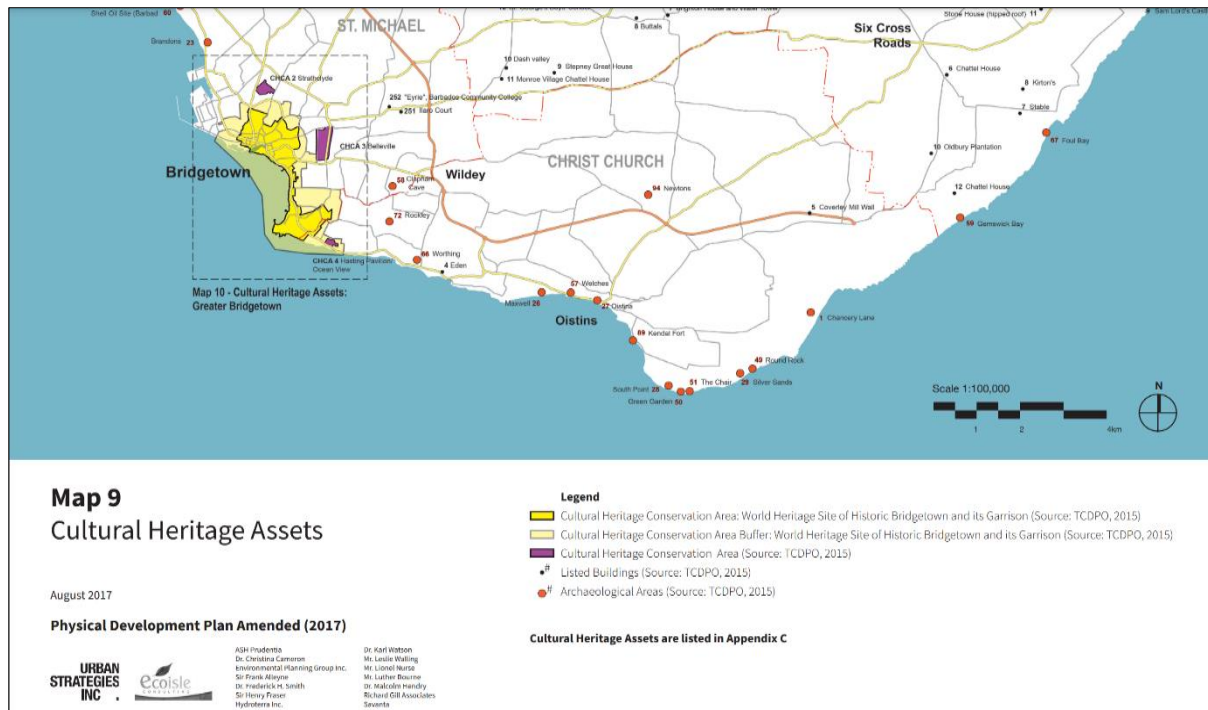


Figure 5-26: Cultural Heritage Assets in the Southern part of Barbados

The IDB's ESPF defines cultural heritage as the tangible and intangible features of a country that possess some form of historical, cultural, archaeological, artistic or religious value²³. By this definition, an example of a cultural or heritage asset in the Project Area would be the Christ Church Parish Church, located in Oistins outside a 1km buffer zone of the proposed pipeline route. The church represents the fifth church constructed on that site where the others have been previously destroyed as a direct effect of disasters. Although the church is approximately 4km away from the treatment plant and would suffer minimal impact as a direct result of the construction of the reclamation facility, due to its location in a region that is dependent on the ABC highway for mass transit, it is possible that the works could affect access routes to the church via restricted road access, traffic congestion or diverted traffic routes. This would also be the case for two other churches that can be found in the SLGRB area: the St. Lawrence Anglican Church in St. Lawrence and the Stream Gospel Hall opposite the SLGRB area, in closer proximity to the treatment plant – within 0.5km and 0.35km of the plant respectively. It is anticipated that the primary threats to these religious assets would be the noise generated from construction works from both Project Component 1 and Project Component 2 that may prove disruptive to religious activities. Restricting access to these assets is identified as a minor threat. The possible impacts are discussed further in Chapter 6 of this report.

Oistins is also home to Barbados' famous Oistins Fish Fry typically held at the Oistins Bay Garden which too is outside of a 1km buffer zone of the proposed works. However, the possible impacts it could incur would mirror those of the Christ Church Parish Church – minor access inconveniences that could affect conventional activities. The event serves as one of the island's greatest exhibitions of its cultural assets. Not only is the community's fishing specialties put on display, but the culinary expertise with which the seafood is prepared, is there to be experienced. The island's premier seafood, flying fish, is also served; a highlight of the culinary heritage experience.

Along with the food, the events occurring at the Oistins Waterfront sheds light on the island's take on craftsmanship as well as their musical heritage, inclusive of songs and dance exemplary of the Caribbean's cultural diversity. Oistins is also known for playing a significant role in the island's political

²³ <https://www.iadb.org/en/story/8-things-consider-when-protecting-cultural-heritage>

history as it was the site where the Treaty of Oistins in 1632 was signed to end the battle between England and Barbados (CARICOM, 2013). Furthermore, Oistins is also home to the Chase Vault that is located to the east of Oistins and is renowned for accounts of moving coffins. This vault is found on the grounds of one of the premier sites of religious significance on the island. Although the Oistins area is unlikely to be directly impacted by the Project works, it is still considered a hotspot for locals and tourists alike, so it is important that the threat to accessing this area is minimized.

The ABC Highway is a crucial road network that allows for transportation along the southern region of the island. Any potential traffic issues induced by the works should be effectively managed to prevent traffic congestion in this high-activity area as well as to allow for the ease of transport, making this area accessible to tourists and locals without much hindrance. This is also the case for St. Lawrence Gap as it is a recognized entertainment area and a gathering spot for locals and tourists particularly on the weekend and includes a number of hotels, restaurants, bars and casinos.

The Graeme Hall Swamp Wildlife Refuge and RAMSAR Site is a 12-acre man-made lake that is the largest body of inland water on the island. It is located in a naturally occurring coastal wetland area with mangrove forests, a seagrass bed, and a shallow nearshore coral reef. The site's Red mangrove (*Rhizophora mangle*) and White mangrove (*Laguncularia racemosa*) stands are the largest healthy mangrove tracts left on the island, and at least 84 bird species, including the Caribbean coot and Yellow warbler, have been identified. More than 20 different freshwater and brackish water fish species have been identified, with the marine species that have isolated themselves from the ocean and established breeding populations in lakes being among the most fascinating²⁴. As it is a hub of ecological significance in the island, it is important that the operations of the proposed reclamation facility do not compromise conservation efforts.

Stakeholder consultations also highlighted that the route to St. Phillips seems to follow the old trailway and as such there will be implications for this heritage feature for the project. The Future Center Trust, the group that is integral in enhancing the trailway as a tourism attraction, is currently restoring that trailway and planting trees and preparing it for recreation under the Barbados Trailway Project. Consultations with the group highlighted the concern for protecting the trees that have been planted, as well as the colonial bridges and wells located along the trailway. The Trust identified twelve (12) wells up to 40 feet deep located within 30 feet either side of the trailway, two (2) coral stone bridges along the route, as well as seventeen (17) culverts (see Figure 5-27).

²⁴ RAMSAR Sites Information Service. 2005. Graeme Hall Swamp. Available at <https://rsis.ramsar.org/rsi/1591>



Figure 5-27: Satellite Imagery showing Wells (blue), Bridges (green) and Culverts (pink) from Salters to Bulkeley (top), Carmichael to Carrington (middle) and Carrington to Three Houses (bottom)

Furthermore, there is reportedly an estimated 8000 seedlings that are being nurtured to then be planted along the trailway, adding to the fruit trees that have already planted along the trailway in Valley. These trees, so far, primarily include various species of native and imported mangoes. Hence, it is important that the works do not compromise the environmental conditions that would allow for the planting of these trees. As well as providing for recreational use, the Future Centre Trust has identified the trailway as a rich source of Barbadian history as its history is linked to periods of pre-emancipation and industrialization. The drainage wells and bridges, in particular, are of key importance – the drainage wells make up a few of the island's extensive network with their primary purpose being to aid in the area's drainage, along with the many culverts, and to recharge the aquifer; the colonial bridges are of a less definitive nature with the Trust stating it is unclear if the bridges were built for the enhancement of the trailway or if the construction of the railway capitalized on the already existing functionality of the bridges. Nevertheless, the colonial bridges are considered by the Trust as routes to the island's past and it is that belief that drove the restoration of the bridges. Additionally, the bridges and wells are considered to be influential to the health and safety of those who use the trailway. Wells close to the Constant and Valley plantations were notably sealed for fear of persons falling in and the successful restoration of the bridges are thought to have the potential to provide safe passage.

The main aim of the Barbados Trailway Project is to preserve the cultural asset that is the trailway and in doing so, transform it into a premier, safe transportation route that would not only ease congestion in the main road network, but also allow pedestrians to observe assets that are directly linked to the island's history, acting as an outdoor, walkthrough museum. It is, therefore, recommended that the installation of the pipelines along the trailway not only avoid the replanted trees, colonial bridges and colonial wells but also prioritize the effective resurfacing and compaction of the trailway post-installation. There is a section of the trailway at the Valley that is paved so it is important that the infrastructural development in that area is maintained.

See Figure 5-28 below showing the locations of the most critical infrastructural points identified by the Future Centre Trust.



Figure 5-28: Important Points along Historic Trailway (top); Key Infrastructural Developments along the Demo Stretch of the Historic Trailway (bottom)

Along the route to the farms that will be supplied with irrigation water (see Figure 5-29), following the trailway, is a community called Sunbury, which is a location before passing Bushy Park that is also of some historical significance. Sunbury is home to the Sunbury Plantation House which now serves as a museum archiving the history of Barbados dating back to the 17th Century. The plantation also houses a Sweet Potato Factory that processes sweet potato grown on the plantation into food items that are sold on the local market. An individual overseeing operation on the plantation expressed concern over the possible disruptions to the access to this area, as well as having operations disrupted due to workers moving through the area. The community around Mapps, St. Phillip that leads toward River Plantation is an area of high historical assets that can be negatively impacted, with structures such as the Bayley's Plantation House, less than 300m from the Browne's Catchment Pond where the pipeline ends. Due to the unlikelihood of any severe instances of environmental degradation or damage to the property, there is no real threat to this asset.

Figure 5-29 shows the spatial relationship between these identified areas of cultural and heritage importance and the proposed pipeline routes.

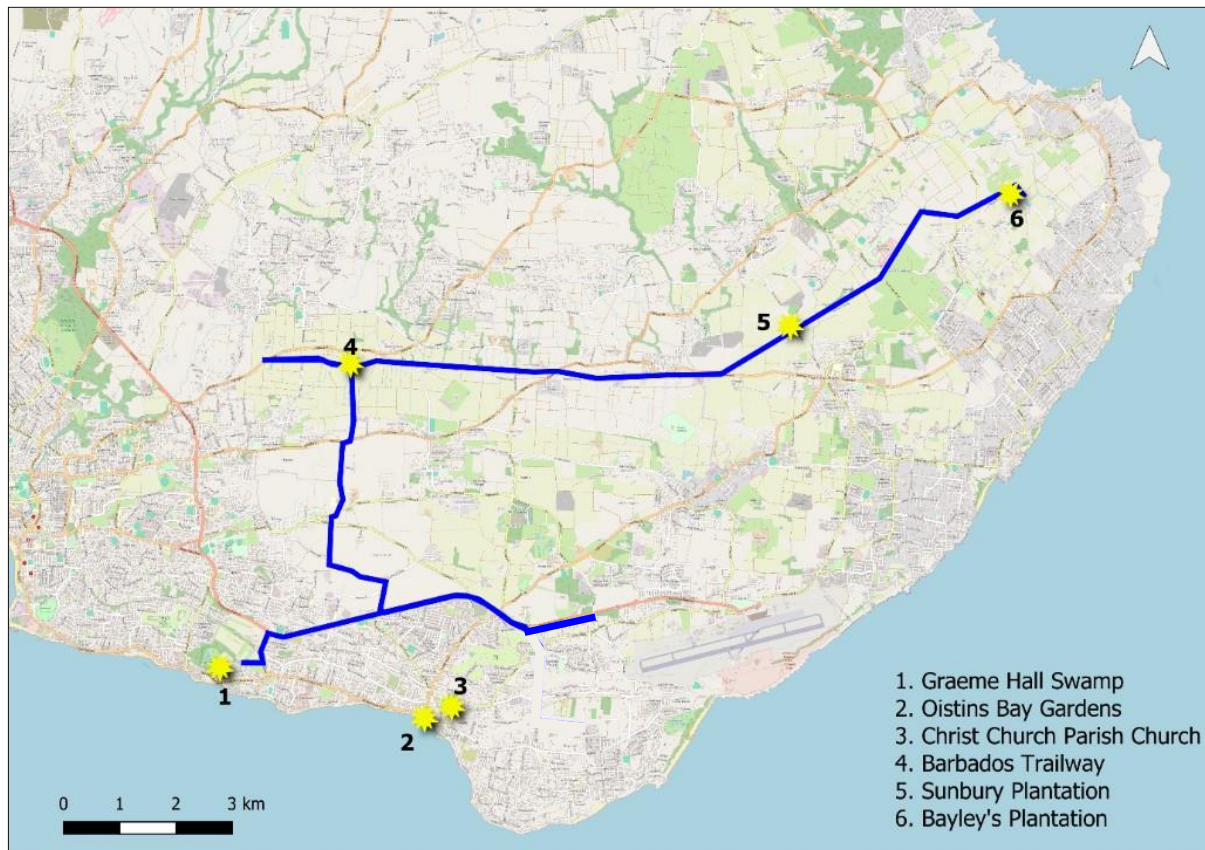


Figure 5-29: Identified Areas of Cultural and Heritage Importance within Project Area

5.7.4 Key Observations

5.7.4.1 December-2023 Data Collection

On December 18, 2023, the team arranged a meeting to conduct a brief walk through of the area to be covered during the data collection process. During this exercise, visual observations were made to develop a clear plan of the approach that the team should take to capture relevant points along the pipeline, Section A to Section D (see Figure 5-2) and as a source of information for the overall assessment. A major concern that was observed by the team was the potential disruption of transportation across the two main arteries (**the ABC Highway and Highway 7**) within the project area as a result of Project Component 2. This disruption can lead to several issues, ranging from:

- **Blockages on the highway due to operations** – As observed, the ABC Highway and Highway 7 are central points for traffic flow across the island and the project will directly impact the daily activities and schedules of Barbadians that use this road to travel to work, school, and other areas.
- **Impact on Socio-Economic Activity** – The highway has been a primary site for informal socio-economic activity for street vendors that sell a variety of products such as vegetables, fruits and beverages. It was also noted that this activity has significantly increased post Covid-19, leading to an influx of vendors on highways. In addition, Highway 7 is the main artery for many businesses in the hotel and hospitality industry. Although it can be stated that the project will lead to a general disruption in socio-economic activity due to potential delays and lateness for

those who utilize this road to go to work, vendors who operate and depend on this stretch for a source of income and sustainability of their livelihoods will be directly affected in this regard.

- **Implications to Public Transport** – It was also noted that the project will have a major impact on the public transport system in terms of the scheduled times for bus routes along this stretch, highlighting the Oistins Terminal which acts as a transport hub for all public transport in the South of the island with island wide connections. Outcomes of this implication will be similar to the issues identified in the first point on **blockages on the highway**. This may also affect a particular subgroup within the population that depend on public transportation due to their socio-economic conditions.
- **Gendered Implications** – The team discussed the gendered elements that may arise from issues relating to transport and highlighted that this may have a specific impact on women or single mothers that take on the role of transporting their children to school.
- **Staging of Equipment** – The storage of vehicles and equipment as also noted as an issue of concern considering that such materials will need to be hosted in a designated space/area during the execution of the project. Other factors such as the security of these materials was also discussed.
- **Incidental Issues** – A concern was raised with regard to the prioritization of emergency management for the personnel that will be working on the pipeline as there will be a need to account and plan for any incidentals that may occur during the execution of the project.

Outside of the issues identified above, the team also identified other environmentally related problems will emerge from the project such as hazards pertaining to sink holes and the limestone nature of the geology in the area. The obstruction of the views of residents, along with noise and vibration that may emerge from the site was also highlighted as a disturbance for persons situated on the **immediate zone of influence** of Project Component 1. Coverley was also flagged as the biggest residential complex within the pipeline that may lead to a potential load on the sewage system.

Other issues which could be flagged included:

- Peak times for pedestrian traffic including cross overs from various places of employment to others and from the school and from other schools to the residential areas; and
- Possible operational risks with two initiatives ongoing at the same time in relatively close proximity to each other and affecting the SLGRB area in particular. These initiatives include the enhancement of coastal resilience in the area as well as the SCSTP project.

Virtual stakeholder interviews conducted in Area 1 generated limited data that informs the diversity of interests in the area. Key elements and concerns arising from stakeholder engagement included:

- **Road access and traffic** – Noted by business stakeholders in this area that access to the highway is vital to their daily operations. Not only for the delivery aspect of their business operations and ensuring they meet their clients' expectations but also having their establishments be accessible to their clients. They foresee impacts to their daily operations depending on how road works are carried out.
- **Disruption to access to critical services** – In conjunction to the impacts to local businesses that may result from traffic and road blockages. The ability to access emergency services (such as emergency ambulance services) and other non-emergency services (such as gas and electricity) may also be hindered due to the road works as in some areas, there are networks of buried gas and electricity lines that could be damaged in during the construction phase if the proper surveying and consultations are not taken prior to commencement and could delay access to life-saving services.

- **Communication** – Given the possible impact that road works may have on these businesses, they expressed that it is critical they receive clear information within ample amount of time before the commencement of road works, to allow them to plan for changes as well as information on the ongoing execution of the project.
- **Smell** – This concern was noted as the possible smells from leakages in the pipeline may act as a deterrent to persons seeking to conduct business in the area which has the potential to negatively impact these businesses and reduce profits and income.
- **Dust** – Dust and other air pollutants from the road works can have health impacts on customers as well as workers in the area.
- **Noise and vibrations** – In some residential areas, there are many nursing homes and the noise and vibrations from the construction work could have serious health implications for the elderly residents of these homes particularly those with poor health. Noise could also disrupt sleep and rest for residents as well.
- **Disruptions to water access** – Some stakeholders noted that water is pivotal to their business operations while for others, it is an important element in day to day usage in their establishments. Construction work may exacerbate existing water access issues and lead to disruptions of supply.

Figure 5-30 shows how stakeholders perceived the likely impacts the proposed work will have on the area. Given the nature of the work, cultural/economic activities were the most noted impact due to the importance of the ABC Highway to both formal and informal vendors. For many informal vendors, conducting their business along the highway is critical to their livelihoods and the potential inability to operate in that area for an extended period of time can have many knock-on effects for these persons who may belong to the low-income bracket of society.

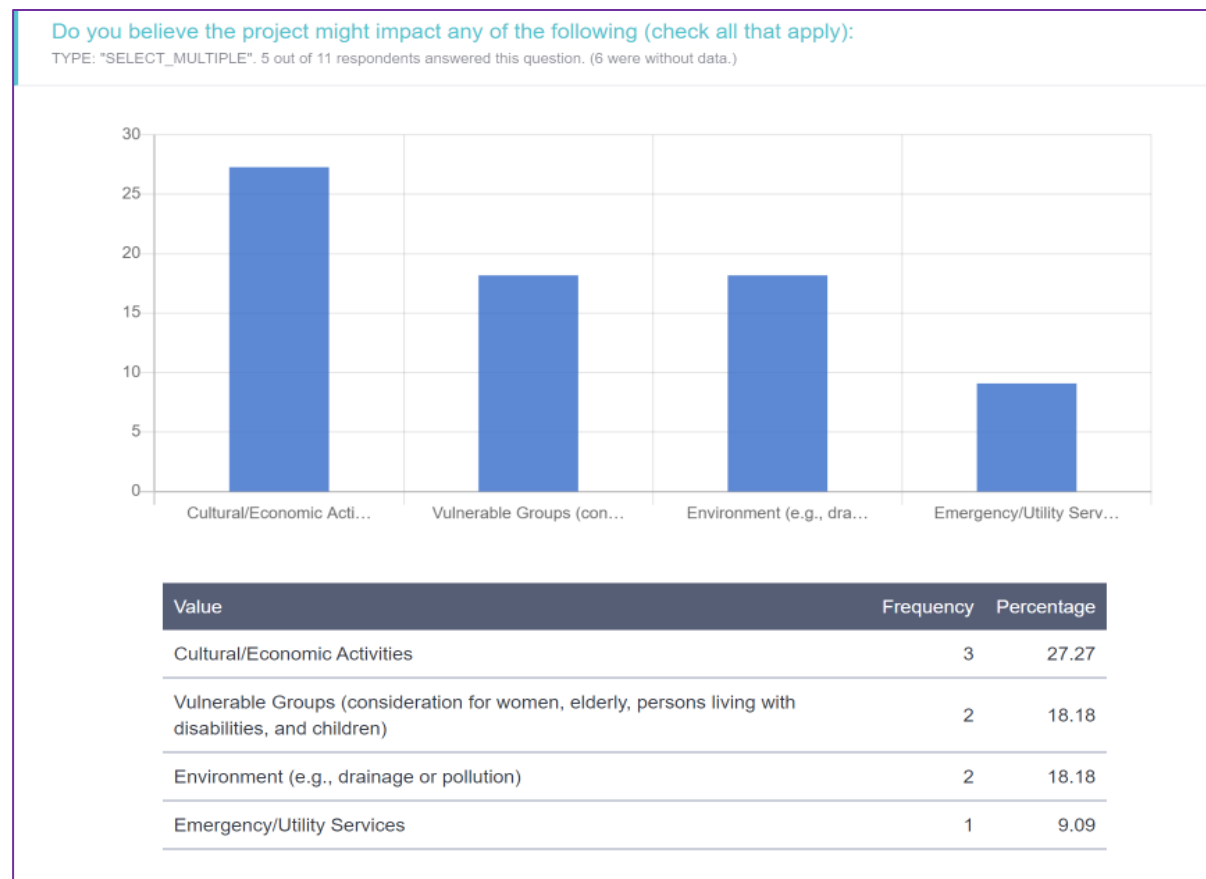


Figure 5-30: Stakeholders view on the type of Impact

Stakeholders further shared their insights, based on the categories outlined, how they foresee these potential impacts, having been asked to share their concerns and considerations they wanted the Project team to make. Business owners/managers were concerned about the potential disruptions to their operations and negative effects for their customers, both for accessing places of businesses as well as delivery-related activities. One business stakeholder shared that the parking lot of their business is often used by teenagers for skateboarding and other activities, barring access to that will have a short- term impact on their ability to gather and their access to a safe space for recreation.

Disruptions to road access raised concerns about accessing critical services such as healthcare, delays in police and fire services as well as over time lost and productivity. Navigating traffic may result in persons having to leave home earlier to accommodate for traffic which cuts into their rest and ability to carry out important tasks outside of work hours.

Given the existing drainage issues (See Chapter 5.2.3.2), there is the potential for the proposed work to exacerbate ongoing flooding issues which can lead to damages to properties and impacts to livelihoods. Additionally, poor drainage can lead to an increase in health impacts in addition to those that may arise from dust, noise and other pollutants, as it could lead to an increase in vectors (mosquitoes) and thus a rise in associated health impacts (e.g. dengue). These health risks are notable concerns for vulnerable groups in the immediate area particularly the nursing homes.

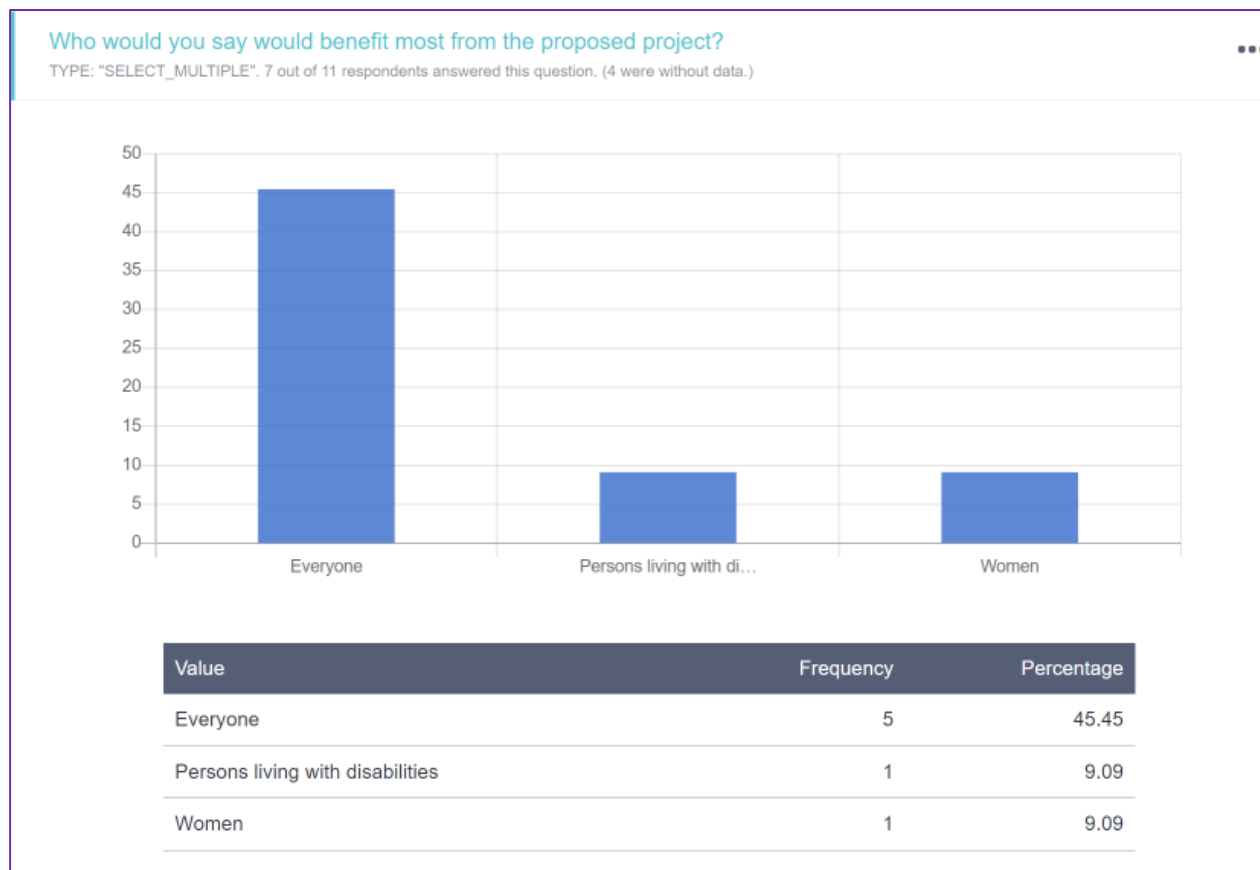


Figure 5-31: Potential beneficiaries from proposed project

From Figure 5-31, it could be observed that most stakeholders note that everyone would benefit the proposed project. These expected benefits include enhanced water supply, support food security and increase sewage treatment which are anticipated to greatly benefit a wide cross-section of society and persons living in the immediate environs. Even so, there will be varying degrees to which these benefits will be felt and distributed as well as the inconveniences that will predate the benefits.

A key consideration shared by many stakeholders (Figure 5-32) was the need for communication. Stakeholders expressed the need for information to come in a timely manner that helps to keep businesses informed as well as residents so they can be abreast about challenges and the timelines for the project.

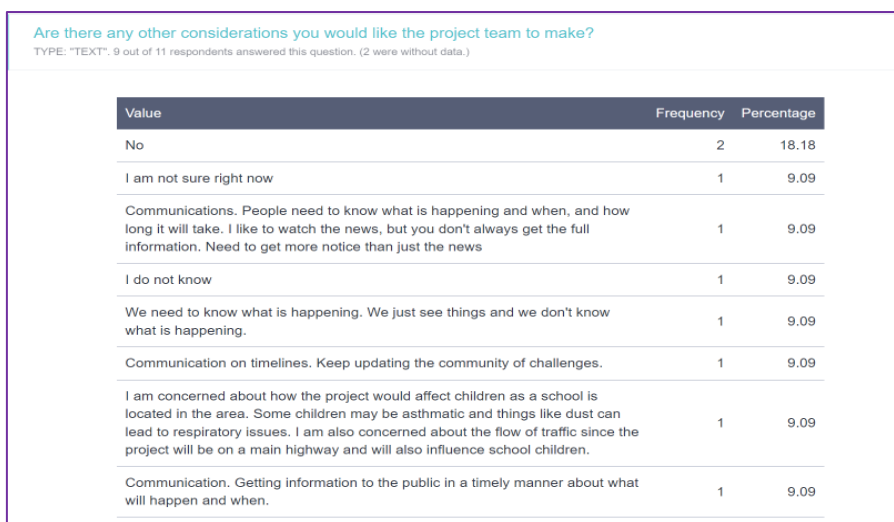


Figure 5-32: Project Considerations shared by stakeholders

Figure 5-33 shows the preferred method of communication for stakeholders to be informed of the project. Traditional media was the most chosen option and as shared by stakeholders would capture a large if not all affected stakeholders. Noting that physical flyers at key points in the project lifespan are great for capturing attention and for dissemination. Radio would allow for a wide reach as stakeholders many listen to the radio on their way to work in the morning and newspaper announcements are key as well. Businesses expressed that emails are a key form of communication for them and this could be distributed the fastest, allowing them ample time for planning. WhatsApp and social media are great for capturing for younger persons and allows persons to disseminate the information to their own channels.

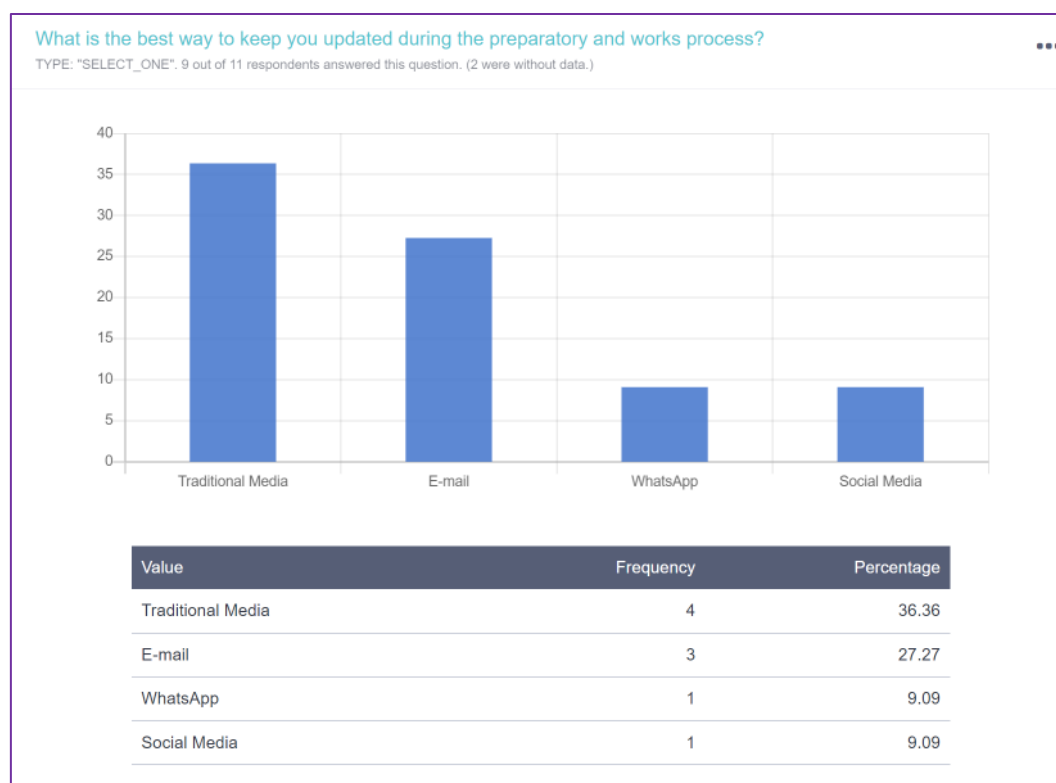


Figure 5-33: Preferred method of communication

5.7.4.2 January-2024 Data Collection

A complete drive-through of the proposed pipeline routes provided the opportunity to also observe the existing socioeconomic conditions of the Project Area, with emphasis being placed on the existing conditions of the areas surrounding the location of the SCSTP and the agricultural farmlands through which Pipeline Section B and Pipeline Section D (see Figure 5-2) would extend.

Within a 1km Sphere of Influence from the Existing SCSTP

The proposed location of the water reclamation facility to be constructed, adjacent to the existing SCSTP, suggests that traffic issues, air and noise pollution, and social conflicts are the primary causes for concern primarily during the construction phase. Figure 5-34 shows the areas that are located within a 1 km sphere of influence of the location of the treatment plant.



Figure 5-34: 1 km Sphere of Influence of Proposed Location for Water Reclamation Facility

While a majority of the persons included in the data collection process acknowledged the importance of the treatment plant and welcomed the potential for an additional supply of water for the local suppliers, there was still concerns for how the construction of the plant would impact the physical environment as well as the socioeconomic environment. Of the fourteen (14) business owners that were consulted with in the St. Lawrence Gap region, seven (7) explicitly raised the concern of traffic coming in and out of the area, impacting on customer flows – the disruption to traffic may prevent persons from accessing businesses and may increase the difficulty of persons moving in the area. Three of the business owners also expressed their concern for how the traffic diversions may hinder their ability to conduct efficient delivery operations.

No individuals in the immediate vicinity of the plant location expressed concern about any damage being done to their property but instead focused on the issues of scent, noise, dust, waste management and drainage. The coconut vendors, in particular, claimed that they are often impacted by dust on the highway that is brought in southerly winds. Of the twenty-four (24) individuals interviewed in the Project Area, only three (3) thought that the general living conditions in the communities surrounding the plant were less than average, stating that the lack of development, drainage, social issues and the proliferation of the mosquito population induced by the development of the existing plant serve as the primary reasons for their verdict.

The majority of the individuals, when asked to state the main environmental concerns in the area, also pointed to persistent odour issues that lead to uncomfortable living conditions. Two of the individuals pinpointed the Graeme Hall Swamp as the source of the odour while others who raised the issue of scent claimed it emanated directly from the plant. Individuals, particularly in the Graeme Hall and St. Lawrence Gap areas voiced their want for the improved conservation of the Graeme Hall Swamp. This is as the swamp was reportedly once a source for recreation and livelihoods – the swamp, which once served as an ideal breeding ground for saltwater fish, supported fishing activities. Additionally, due to the prioritizing of tourism activities along the southern coastal areas, the sluice gate which controls the draining of the swamp is reportedly seldom opened due to the risk of discouraging tourist activities with discharge that would compromise the aesthetic and appeal of the coastal areas. The abovementioned sluice gate is shown in Figure 5-35.



Figure 5-35: Graeme Hall Swamp Sluice Gate

Agricultural Farmlands (Pipeline Section B and Pipeline Section D)

The first major point of observation made was the location of the small cluster of houses located close to where the pipeline would divert from the highway and into the farmlands (see Figure 5-18). The primary cause for concern identified in this area was the possibility of obscuring the entry point to the properties. The four (4) residents interviewed in this area all claimed that there was only one access point to their properties that served as both the entry and exit points. Figure 5-36 shows an access point to one of the properties identified as a sensitive receptor.



Figure 5-36: Access Point to one of the Properties Identified as a Sensitive Receptor

All four residents acknowledged the importance of the Project and welcomed its potential benefits. As such, they were unconcerned about the proposed pipeline routes provided that the installation of the pipelines occur on the side of the roadway opposite to their properties as this would minimize the potential impacts. They identified the area as being subject to controlled wildfires at least once per year and pointed out that the area is also frequented by monkeys. Furthermore, previous works conducted by the BWA in the area were reportedly successful but led to the damage of the roads as they were not adequately resurfaced after the works. Stakeholders reported an increased accident risk in the area due to this and thus recommended that proper care is taken when resurfacing the roads after the installation of the pipelines in the area.

Except for the residents in this identified area, there are no other settlements that would be directly impacted by the installation of the pipelines along Section B and Section D. Instead, primary concerns that were often raised were the loss of farmlands and obstructions to agricultural activities due to the implementation of Project Component 2. The small-scaled farmers that were included in the data collection process would not directly be threatened by the installation of the pipelines although would be beneficiaries to the successful implementation of the Project. Farmers that worked on plantations, on the other hand, felt they would be directly impacted by the installation of the pipelines.

A farmer who claimed he was the sole worker on the Valley Island Plantation welcomed the potential for an additional supply of water, stating the amount of water accessible to him by a lone well on the plantation was not sufficient to satisfy the 200 acres of farmlands. The lands he farmed that were cultivated with sugar cane at the time of the site visit were reportedly going to be cleared and planted with fruit trees, nullifying the potential impact the pipeline installation would have had on those lands. Farmers from the Edgumbe and Sunbury Plantation, however, expressed more concern about the implementation of the Project. As the pipelines would be running through and close to these plantations, both farmers from these plantations worried that the works could affect their ability to access their fields. The farmer from the Edgumbe Plantation, in particular, highlighted the presence of natural gas lines in the area and that should be considered in the final determination of the pipeline routes.

The farmers close to the River Plantation were found to be among the most affected by water scarcity as they were located further downstream compared to other farmers; the water available in the spring are often siphoned by farmers with earlier access so little to no water makes its way to farmers downstream. The Browne's Catchment Pond (see Figure 5-37) serves as one of the main water sources for farmers in this area. However, the farmers lament that the water levels in the pond are often low and inadequate to supply all the farmers in the area.



Figure 5-37: Section of the Browne's Catchment Pond at the River Plantation

A common theme observed through conversations with farmers operating in the Project Area is that water scarcity is a clear hindrance to agricultural productivity. All the farmers included in the data collection process were in favour of this proposed additional supply of water, but many were found weary of the potential impacts the implementation of the Project may have on their livelihoods.

5.7.5 Key Findings and Conclusions

Socio-economic dislocation and possible displacement

- The most directly affected group with the least ability to adapt socio-economically would be the informal vendors especially those in front of Kooyman. Conversations held with the vendors during the Consultant's site visit in January 2024 revealed that there are 10-12 coconut vendors (an estimated that operate along the stretch of the ABC Highway on the busiest days – Wednesday, Saturday and Sunday – with only two vegetable vendors identified in that area. This creates an estimated 12-14 vendors that could be impacted by the construction activities. Their location, in particular those at Kooyman, maybe directly in the area where the pipeline is likely to be installed. Due to this issue, they may need to be moved entirely, which given their informal nature and the lack of permits, has implications for a complex process despite the socio-economic implications for them and their households.
- There therefore exists a possibility that construction activities, particularly for the implementation of Project Component 2 which will see the installation of new pipelines, will lead to the relocation of vendors during the construction period. This would greatly affect their ability to generate income and failure to implement effective mitigation measures, such as establishing an alternative area for vending or establishing alternative routes to access vendors, would prove detrimental to vendor livelihoods. Any relocation/dislocation is expected to be temporary with the option open for vendors to return after construction is completed. There may be resistance to relocation which would need to be accounted for – resulting either in protest, complaints in writing and or social media and negative media attention.
- The anticipated dislocation and disruption and flow of movement and traffic will ultimately affect negatively income and livelihoods – informal and formal – for individuals and businesses including micro, small, medium and large sized businesses.

Disrupted access to services

- There are several services in the area including veterinary clinic, medical as well as other business-related services like computer repair in the area. The potential for disruptions to traffic flow will likely have a moderate to severe impact on the flow of business and access to these services in a timely manner.
- The potential for increased congestion also has implications for the timely delivery of emergency services to the elderly, injured and pregnant persons. This has gender implications due to the fact that most of the traffic accidents reported in the area seemed to affect male drivers, there are both elderly men and women resident in the area and also the fact that women in need of emergency services related to sexual reproductive and health services will also potentially experience delays.
- Depending on the length of the project the potential disruption will intensify challenges already experienced during specific times of the year – August (Cropover), November (Independence) and December (Xmas and New Year periods), Winter Tourist Season (December to April).
- There is some potential although hard to measure that increased frustration relating to these works and resulting delays could lead to conflicts in various forms with some medium-term impacts on quality of life:
 - Between residents as tensions generally rise and those being affected at any one point in time and those not yet being affected;
 - Road rage as tensions flare in traffic and concern about the extent to which these delays will persist which could lead to actual physical conflict between drivers;
 - Conflict between drivers and pedestrians as well as drivers and cyclists as all try to navigate a potentially congested as well as restricted space; and
 - Conflict between drivers, pedestrians and other users including residents and the work teams due to overflowing of frustration with the commute, noise, dust, vibration and other effects.

Ultimately, any extended periods of frustration and stress will have impacts on individual physical health and well-being as well as community health and wellbeing as it leads to tensions and a breakdown of social cohesion.

Noise, dust and vibration

Though the trenching proposed is not expected to be very deep (between 3-6 feet), the trenching will be carried out along the entire route for placement of the pipeline. The related digging will have implications for noise, dust and vibration and these could have potential effects on both physical and mental health of residents and repeat users of the area for transit, the implications being more severe for those with limited mobility and unable to mitigate against the impacts.

Noise could be particularly disruptive to residents and those with sleeping challenges as well as babies and infants. This would prove an issue especially in the Graeme Hall and St. Lawrence Gap areas, the communities that are closest to the proposed location for the construction of the water reclamation facility.

Vibration could be particularly disruptive to those with migraines, mental illness, intellectual challenges including persons affected by autism as well as could potentially cause damage to weakly and poorly constructed buildings and installations. It is noteworthy that there is a gas station with

volatile materials in the vicinity of the highway. Moreover, vibrations could cause sinkholes and other issues in an island well known for these kinds of hazards on a small and large scale.

Dust is one of the most significant hazards that could arise from the works and given wind and dispersion patterns, it is likely to have an effect throughout the entire Project Area if appropriate management measures fail to be effectively implemented. This is potentially problematic for business operations as a nuisance to staff and customers, requiring additional investments and costs related to more frequent cleaning and potentially could affect plants, trees and animals. Dust will have health implications for those with allergies and respiratory conditions, potentially severely so for those with acute allergies but also to those with asthma, for example. This dust, occurring alongside Sahara dust proliferation during specific times of the years e.g. February 2024, will also present challenges to those with respiratory illnesses and those susceptible to such illnesses.

Residents, vendors, children at the school, staff of businesses, customers, passersby, pedestrians, cyclists, drivers (and cars and other vehicles) are all likely to be affected by the dust. The productivity of workers in the farmlands may also be impacted by fugitive dust via not just health and safety risks, but also due to the complication of agricultural activities, blocking irrigation channels for example.

Environmental health issues with social impacts

In addition to the noise and dust related issues raised previously, there is also the potential for poor waste management on work sites and the deepening of existing waste management issues via littering that would then be further exacerbated by the works particularly if mixed with water. Moreover, given that food and coconut vending have been linked to some issues with vectors including rats it will be important that open trenches also be managed in a way that avoid also attracting vectors as well as stray animals.

Furthermore, open trenching during the annual hurricane season (usually June to November each year) can lead to the settlement of water which then can lead to mosquito breeding as well as other issues including the spread of diseases such as dengue, zika and chikungunya. There is already concern from residents on this issue (see previous chapter) and one stakeholder flagged his health status and the need to avoid infection. There are vulnerabilities for other groups of stakeholders including babies and infants, school-age children, other elderly persons, pregnant women, persons with weak immune systems and those affected by non-communicable diseases.

At present, smells are quite contained within the treatment plant, however there is the risk of accidents at the plant that can lead to bad odours escaping from the plant itself. This has the potential to have a deleterious impact on persons residing in the area, affecting their health (both physical and mental) as well as financially as persons would be discouraged from patronizing businesses in the area.

The ongoing persistent of COVID-19, the flu and the cold, particularly between December and March is also an issue to be considered as environmental health issues and allergies can be triggered on top of these pre-existing concerns.

Work crews will tend to attract other forms of informal vending including food and this and poor disposal of food waste is likely to also attract rodents and increase the potential for bites and other diseases to people and other animals.

Accident Risk - Health and Safety of Community Members and Workers

The disruption to conventional traffic flows may lead to some degree of confusion in motorists which poses a significant accident risk. It is, therefore, important that effective traffic management measures are implemented to mitigate against this. These measures include liaising with the relevant transportation authorities to develop a plan for traffic diversion and management, the employment of flag men and traffic wardens, informing the public of the pending works and the alternative routes decided on and restricting access to construction sites to authorize personnel, among others. It is also

important that the construction sites be clearly demarcated, and that proper health and safety procedures are followed on site to ensure the safety of not just workers but also of the affected communities.

It is also important to note that construction work will be concurring adjacent to farmlands, particularly along the railway route and this poses the potential for injury for both farm workers and construction workers via accidents with machinery. There is a risk of receiving injuries due to improper usage of machinery, faulty machinery, improper equipment and protective gear, and improper actions in a construction zone. These risks also apply to those working on these sites and they face additional risks such as those related to working in deep trenches as well. Considering the nature of the work that would have to be done in the installation of the pipelines, activities such as excavating trenches, operating machinery, hauling heavy materials and equipment, interaction with locals (farmers) and working in areas with a general lack of shading all pose a risk, so there is a need to emphasize the health and safety of workers and community members alike. The excavation of trenches reduce the stability of soil, increasing the potential for collapses and this may lead to falls or the engulfment of those working in trenches by loose soil or by water. It is, therefore, important that all workers are fully equipped with personal protective equipment (PPE), such as helmets/hard hats, masks, safety vests, harnesses and gloves and construction boots. It is also important that a safety kit is present during all construction activities and for at least one member of the workforce to be certified/qualified in providing first aid assistance. Heat stress and strokes are also potential risks to workers as they would be working throughout the day in areas that are largely unshaded. These workers should be allowed an adequate amount of time for breaks and water, and any other source of hydration should be easily accessible to all workers.

Potential exploitation and harassment

There are two main issues of potential concerns around possible labour related exploitation particularly for casual and day labourers and the potential for some level, even small, of child labour. The other is the potential of street harassment (a form of gender-based violence) affecting women who due to congestion may be taking the pedestrian option to mitigate against congestion and the same for those who may use cycling as an option. More on both issues is explained below. These issues both also have implications for community security.

- *Child labour:* Work sites particularly in high demand projects, even if temporary and transitory, can be vulnerable to the use of under-age labour and to limited checks of age particularly when delays are experienced. Given that during the data collection issue a potential issue of child labour was already flagged in the vending context and the proximity of a school where young men at 15 years of age are attending, it will be important to be vigilant to the potential for this to occur. This evidences the issue of child labour in Barbados and the region by extension that has been flagged by international labour organizations²⁵.
- *Potential street harassment based on work crew interactions with the public particularly pedestrians:* Barbados is known for persistent harassment on the street and there were high profile cases of this during the COVID-19 pandemic affecting Welcome Stamp visitors²⁶. Even though for some this may seem occasional and in ways that mostly affect pedestrians, it is problematic more broadly in terms of Sexual Exploitation, Abuse and Harassments and the general environment on the street. With the likely increase of pedestrian traffic but also work

²⁵ https://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/---sro-port-of-spain/documents/publication/wcms_308216.pdf.

²⁶ Limited documentation on this is available and is provided here: [Journalist working remotely in Barbados shares her experience of street harassment · Global Voices](#), "[Something like this happens daily in Barbados](#)" | [Stop Street Harassment](#)

crews which will be potentially seeing and or interacting with workers making their way into workplaces, this is also a potential impact that needs to be considered.

- The issue of street harassment occurs within a broader context of gender-based violence that affects women in Barbados as well as women across the Caribbean region²⁷. It can also mean that the working environment itself is at risk of forms of harassment and abuse which may affect workers, particularly female workers and also persons who may be providing limited and occasional services to work crews in the form of food and drinks. This was not an issue raised significantly by stakeholders in interviews but the Sexual Harassment Act is an acknowledgement by government and the public (indirectly) that these are valid risks that need to be considered.
- *Labour segmentation* – labour in Barbados is still somewhat segmented and works related jobs are more likely to be available to men than women and fair access to job and other supplier related opportunities should ideally be fairly and equally access to both men and women.

In summary, based on this limited analysis, the proposed works are likely to trigger the following IDB safeguards from a socio-economic point of view:

- ESPS 1 – Assessment and Management of Environmental and Social Risks and Impacts
- ESPS 2 - Labour and Working Conditions
- ESPS 4 – Community, Health, Safety and Security
- ESPS 5 – Land Acquisition and Involuntary Settlement
- ESPS 9 - Gender Equality

Table 5-18 - IDB's Environmental and Social Safeguards and their associated risks for this project

Safeguard	Associated Risk Factor
ESPS 1- Assessment and Management of Environmental and Social Risks and Impact	<ul style="list-style-type: none"> • Socio-economic dislocation and possible displacement • Disrupted access to services
ESPS 2 – Labour and Working Conditions	<ul style="list-style-type: none"> • Child labour • Labour segmentation
ESPS 4 – Community, Health, Safety and Security	<ul style="list-style-type: none"> • Noise, dust and vibration • Environmental health issues with social impacts • Health and Safety of workers
ESPS 5 – Land Acquisition and Involuntary Settlement	<ul style="list-style-type: none"> • Relocation of informal vendors along ABC Highway • Impeded access to vendors and formal businesses

²⁷²⁷ [Barbados' hidden pandemic – The silence about violence against women in Barbados - Stabroek News.](#)

Safeguard	Associated Risk Factor
ESPS 9 – Gender Equality	<ul style="list-style-type: none"> Potential street harassment based on work crew interactions with the public particularly pedestrians

The gendered implications of the findings in this sector will be more specifically explored in Chapter 5.8 below.

Summary on Child Labour and Solar Energy in context of Barbados for ESL Project

In 2020, solar energy accounted for 38% of renewable energy supply in Barbados.²⁸ In alignment to IADB's ESPF, the executing agency will be required to include in the bidding process for solar panels requirements to prevent and respond to the risk of forced labour.

5.8 Gender Assessment

Gender impact assessment is an evaluation, analysis or assessment of a law, policy or programme that makes it possible to identify, in a preventative way, the likelihood of a given decision having negative consequences for the state of equality between women and men (IEGE).

To expand this definition for the purposes of this exercise, the gender assessment will seek to identify how the implementation of the project to upgrade the South Coast Sewage Treatment Plant, is likely to impact persons who traverse the highway, those who conduct business there, those who live in close proximity to the highway, those who live in the vicinity of where the pipeline for irrigation (both options) and for recharge will be passing and the farmers meant to benefit from this project. The Gender Assessment builds on the preceding socio-economic baseline and assessment ensuring a specific gender lens to that analysis and also an elaboration of initial gendered risks.

This Assessment was limited in a number of ways not least that sufficient time was available to conduct gender analysis given the amount of time required to collect more general and basic social and demographic information. There is a paucity of gender data in general and no accessible information on poverty and living standards except during COVID-19 and those were national rather than local in nature.

5.8.1 Gender dynamics in Barbados and project area

Total population of south coast parishes of Christ Church, St Michael and St. Phillip is 173,527 or 62% of the total population of Barbados. Of this 52% or 90,318 are female. Considering that along with women who live along the south coast, there is the addition of those who come from other communities and parishes to work in businesses and hotels along the south coast, as well as the women in the bordering communities in the St George's parish, we can begin to see the gendered impact expanding.

According to the Continuous Labour Force Survey bulletin for April to June 2023 (BSS, 2023) the total number of employed people is estimated to be 123,400, with women making up 52.9% (approximately 59,600).²⁹ The report also shows that women are more likely to be employed in sectors such as

²⁸ International Renewable Energy Agency (2023) "Energy Profile: Barbados" Retrieved from:

https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Central%20America%20and%20the%20Caribbean/Barbados_Central%20America%20and%20the%20Caribbean_RE_SP.pdf

²⁹ Barbados Statistical Service. 2023. Continuous Household Labour Force Survey: April to June 2023. Available at https://stats.gov.bb/wp-content/uploads/2023/10/LFS_2Q2023.pdf

wholesale and retail (9.9% female to 9.8% male), accommodation and food services (8.6% female and 5.8% male), and that 17.3% of people working in services and shops are female (with 10.7% being male). These concentration of employment of women in the zone of influence can be significant as we consider the number of tourism sector businesses in the area and the likelihood that transit, service disruption, health impacts and harassment are more likely to affect female staff,

Along the ABC Highway

In looking at the nature of businesses along the ABC highway, and the high level of tourist activities in Christ Church, added to the rural/suburban areas of St George and St Phillip including but not limited to areas such as Kendall Hill, Maxwell, Newton, one begins to understand the number of women, and consequently households which can be impacted by the project. This is also linked to the LFS data available and the fact that women tend to dominate in the sectors and businesses identified in the area. While the impacts in areas close to the proposed site of the reclamation facility and areas surrounding the extent of the pipeline route were identified, the impacts can be far-reaching as there are women and men, working and plying their trade in these areas whose lives and livelihoods can be severely impacted due to issues of timely access due to interruptions in traffic flows, and exposure to air pollution for instance.

Women, who may make a living along the ABC highway are more vulnerable than men who do so as well (adding concerns of safety and harassment) due to existing gender inequalities. Women making a livelihood in this area and potentially serving the sole breadwinner of a family bear additional pressures to ensure their families are taken care of. With the potential to be economically displaced, this could have several impacts on these women and their dependents. Noting the impact to their food security and having additional needs met (such as water and light) as well as the added mental and physical effects on these women as they burdened with increase mental stress as they navigate a period of lower or no income.

The proposed upgrade of the South Coast Sewage Treatment Plant implies works running along the ABC Highway for a significant distance. The nature of the work suggests that trenches would need to be dug in that portion of the highway. Construction work on the ABC Highway is expected to generate noise, dust and vibrations that could have variable impacts on women, people with disabilities and the elderly. Most of these are indirect except for those that relate to air quality and immediate physical impacts such as noise and vibration. The nature of scope of this would be hard to estimate since most of the households are expected to be away from home during construction hours, except for those working from home and or with home businesses and those who are elderly. For those with heat conditions, constant vibrations could be problematic. Similarly, vibrations and noise could be disruptive to those with autism. Those suffering with chronic respiratory illnesses would be most affected by dust while those who have laundry on lines external to the house would likely have to redo this work, adding an addition time-burden for women and result in more unpaid care work. The expected impacts for women, persons with disabilities (PWDs) and other vulnerable groups will be heightened by the existing inequalities in the larger society and pre-existing environmental factors. 2017 data suggests that particulate matter in Barbados is already more than twice the recommended level by the World Health Organization (WHO)³⁰. Any additional dust produced would also add to poor air quality generated by annual Sahara Dust proliferation. Available data for LAC suggest that men are more likely to suffer from Chronic Obstructive Pulmonary Disease (COPD).³¹

PWDs have more medical needs than other groups due to various physical health conditions and blockage of a key road and/or extended delays in movement due to increased traffic could have

³⁰ [PM air pollution exposure in Barbados 2017 | Statista](#). A check of the Environmental Protection Department website shows reports on ambient air quality for 2013, 2014 and 2015 but for variable areas across the country and only partially covering the areas in question.

³¹ [Chronic Respiratory Illness \(health.gov.bb\)](#)

detrimental effects on their health care due to loss of access to health facilities, pharmacies and care professionals. In the case of women, who already experience time poverty due to bearing the majority of domestic tasks, time loss due to traffic could have cascading effects on any productive or care work women may have to do. Added to this, are women working informal sector, making their livelihoods along the highway who may experience disruptions to income generating activities as project activities occur and this will have implications on other aspects of their lives including their dependents.

Businesses (such as DHL, Kooyman and Popular) situated along the ABC highway where the pipeline is being proposed to pass, were reasonably concerned about road access and traffic. Blockage of the highway at certain points would prevent entry into these establishments and therefore hinder their business operations. Additionally, increased traffic may deter persons who may have desires to shop at these establishment as they weigh the cost and benefits of dealing with the traffic to get to these stores. The mental health impact of the traffic must also be considered as persons may be less inclined to shop due traffic stress.

Apart from the formal businesses who will be affected by road works along the highway, much consideration must be given to the informal vendors who ply their wares along the highway to motorists. Depending on the work to be done along the highway, these vendors may have to be relocated or have to cease their activities until the end of construction work. This will naturally impact all aspects of their lives and those dependent on them as their livelihoods are disrupted for a period of time.

Along the Proposed route for the Irrigation Pipeline (Stepney, Turnpike, Brereton, Sunbury and Harrow Park)

From engagement with persons with areas such as Stepney (located in the vicinity of Pipeline Section B), they noted that they do not foresee much in the way of impacts outside those expressed by persons along the ABC highway. Interruptions to road access are less likely to occur as in many cases the pipeline will be running along these locations and only a few places actual cross the roadways. For those areas, access to critical services such as health facilities, protective services and general transportation may be disrupted. However, unlike the areas along the ABC highway, residents noted that project actors need to be aware underground power lines in the areas (particularly in Stepney) as construction may damage this vital infrastructure.

While most interviewees expressed enthusiasm and welcomed the proposed initiative, there were a vocal few who expressed adamant objections to the usage of reclaimed water for growing crops. They cited health concerns and poor treatment by the government with regards to the usage of reclaimed water to grow crops to feed the nation. These concerns are important to consider post-implementation of this project as it has implications on the farmers who are targeted to benefit from the reclaimed water. If the general public refuses to purchase crops grown with reclaimed water this impacts the farmers particularly small-scale farmers as well as everyone involved in the agriculture value chain. Key to the success of this project will be transparent, educational campaigns designed to assuage fears over reclaimed water usage, highlight the water scarcity issue in Barbados and outline the benefits of utilizing reclaimed water.

A common concern shared by those experiencing existing flooding and drainage issues was the increase in mosquitoes in their areas and the potential for the project to contribute to this ongoing problem. Residents noted the rising mosquito population and the increase in dengue cases. This reality must be accounted for as the work is conducted to ensure that the work does not exacerbate existing drainage problems and in fact, can help resolve the problem. Vector transmitted diseases pose danger to the elderly, potentially immuno-compromised persons and children in the community. Spikes in vector-transmitted diseases not only impact those affected but also adds to the burden of care for those with care responsibilities which in many cases are women. This increased care duty only further adds to the time deficit women typically deal with as the primary care givers and household managers.

5.8.2 Key Risks and their Gender Implications

The data showed that a large number of women live on the south coast, and are employed in several hotels that operate in the Christ Church Parish. The socio-economic component of this (Part I), highlighted some of the areas of impact. In this section the paper takes a deeper look at what those areas of impact mean from a gender perspective, that is, a closer examination on how women and other vulnerable groups can be affected.

The ABC Highway is a vital road infrastructure in Barbados, connecting the airport, the capital city, and the university, among other places. It is a major artery across the south coast, facilitating access to many business and tourism spots. While there was no assessment of road users for this report, observations during the data collection exercise noted a constant heavy flow of traffic on the highway. Women are likely to be users of this highway as they are carrying out some of their care functions, for example getting children to school. In addition, with high numbers of women working in the hotel sector women will traverse this highway whether as drivers, or users of public transportation. The digging up of the ABC highway to facilitate the upgrade of the sewage treatment plant, can therefore have very specific impacts for women.

Noted the major impacts the proposed works could have on the ABC Highway with it being major artery for the country, lesser but similar impacts could be observed in various parts of the St. George areas. While the roads found here are not as heavily utilised the highway would be, they still serve as vital connection points in areas like Sunbury and Brighton where the roadwork may not have the same level of disruption as blocking parts of the highway but it still causes similar effects as shared above for the ABC Highway.

Livelihoods: With higher percentages of women working in the area as service workers and shop workers, domestic work and retail (which includes vendors along the ABC Highway), it is likely that they are dependent on the public transportation system for movement to and from work and to ply their trade. Disruption in traffic could mean more waiting time in congested traffic or longer alternate routes. This will have significant impact on time, which is a tangible resource for women as they seek to complete household as well as income generation tasks successfully, and often simultaneously. Alternate routes may mean increase fuel consumption, which may lead to increase in cost for commuters. These longer and more expensive commutes can have a significant impact on the livelihoods of vendors, and employees of businesses along the highway, as well as those who need to access to places of employment.

The majority of the informal vendors located along the highway are male coconut vendors, with the vegetable vendors primarily being female (11 males: 2 females). The displacement of these vendors along the highway during project implementation is a real risk, although unlikely risk. This will require time, since getting a vending spot in the informal sector has no real structure and will also mean the added effort of ensuring that the new location facilitates a readily available traffic flow to provide a new set of customers. There is a sort of double whammy for those vendors, in that even if they do not suffer displacement, their numbers of customers may reduce due to interruptions in access to them, leading them to choose other vendors in more easily accessible locations. This means that while they may experience increased transportation cost, it can also be compounded by reduced sales.

The gendered impacts as outlined here, must not be looked at as singular impacts, but instead, while distinct as interlinked and intersecting factors i.e. a series of interactions affected by time, financial limitations, the caring roles of women, and how all of these can affect one person simultaneously, leading to higher levels of frustration, anger and potentially, conflict.

Based on the area and the proposed type of work, Figure 5-38 outlines some of the key potential impacts shared by stakeholders and Figure 5-39 shows the groups most likely to be impacted and who will be impacted the most. Most notable and intricately linked are traffic and business disruption as the ABC Highway is critical to the nation's roadway system, any disruptions to its full usage will have

multiple knock-on effects for all utilising the highway and those living, working or operating businesses in the area. Blockade of the road can impact residents' ability to access resources, particularly emergency health services which is of major concern as there are many nursing homes in the area and the elderly residents may require emergency health services occasionally. Road congestion and blockade can also negatively persons who need to leave or come into this area for work which could have consequences on their livelihoods. Negative impacts on livelihoods may be more greatly felt by the informal vendors along the highway who may have to relocate or cease operations during construction work periods due to safety and a lack of vehicular traffic to sell wares to. The road blockage could have negative impacts on the local economy as well as many businesses are primarily accessible only through the highway as well as the increased traffic may deterred persons from conducting their businesses in these areas and seek alternatives elsewhere.

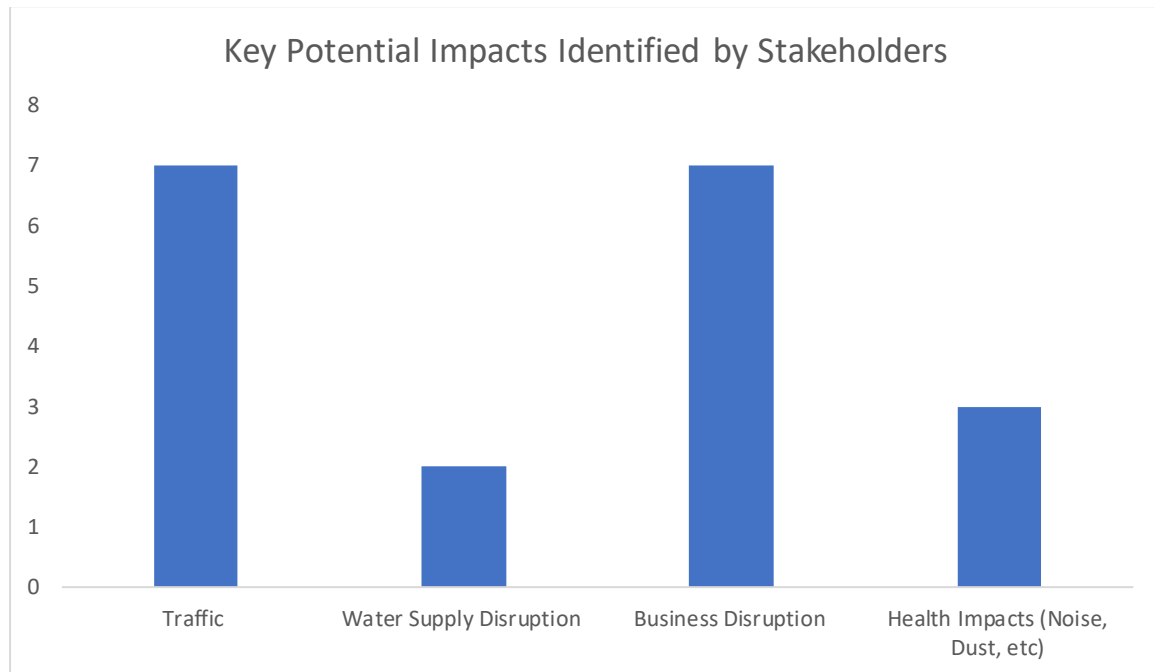


Figure 5-38: Key potential impacts for the proposed works

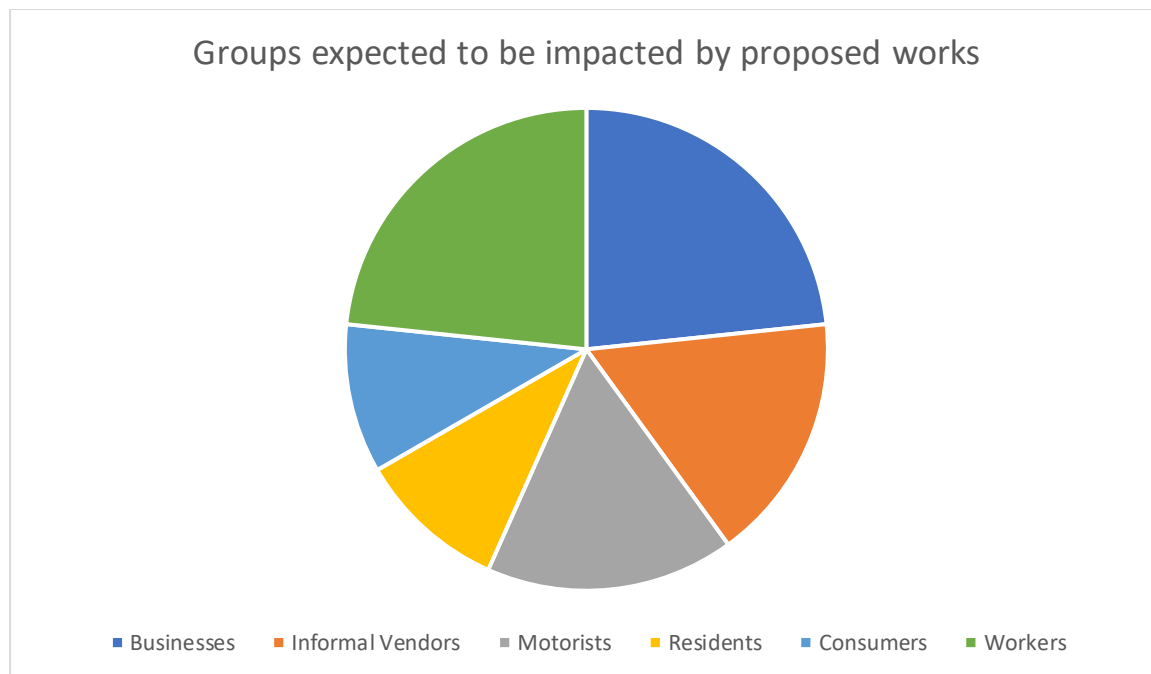


Figure 5-39 - Groups expected to be negatively impacted by the proposed works

A potential aspect of the proposed project that needs to be considered is the reception of produce made using reclaimed water. Without the necessary communication and awareness campaigns by the BWA and ministry of agriculture, there is the potential for major backlash from the general public as it relates to purchasing produce following the commencement of reclaimed water for agricultural purposes. Noting from the stakeholder engagement that some stakeholders shared displeasure and unease about the usage of reclaimed water and the distrust with the government and other authorities. Acknowledging these fears, it is possible that persons would refuse to purchase these products despite potentially being cheaper and this will deeply impact not only the farmers who are growing crops with reclaimed water, the families dependent on these farmers but also those who purchase these crops to create their own secondary and tertiary products.

Health: The health impacts of projects such as these can disproportionately affect the elderly, women and girls, and persons with existing respiratory illness. Interruptions in water supply, or contamination of water by dust and other pollutants from the works can disproportionately impact women and girls who are often responsible for domestic chores and general hygiene of the home and family. Dust pollution can exacerbate health issues for children and elderly parents, as well as necessitate frequent cleaning, thereby increasing the workload of caregivers. Often the elderly are living with chronic compromised health issues, which can be exacerbated by water and air pollutants, as well as the noise and vibration of coming from this type of project. People living with respiratory illnesses such as asthma, COPD and allergies can be severely affected by air pollution, even light levels.

Stakeholder interviews revealed that older residents in the impact zones were particularly concerned about the impact on their health, with one respondent having had heart surgery and needing to be careful about infections. The biggest concern however that currently slow drainage of flood waters after rain, and remaining puddles could give rise to dengue infections.

One business place in the area pointed that the health of the workers can be impacted and leading to impact on operations. This manager noted that in recent times, people have become more aware of environmental impacts on health, and therefore workers may not turn up, or leave the business place if they felt that the dust pollution would have a negative health consequence, thus leading to decrease productivity and sales.

While a major component of this project, is meeting strict water quality standards for the water meant for the irrigation, it must be noted that health risks exist not only for the farmers but also low-income persons who would be reliant on the potentially cheaper crops if water quality standards are not met as planned or in cases of accidents.

Harassment, Sexual and Labour exploitation: The exploitation of women and girls in the vicinity of large construction sites is not to be overlooked. As indicated in the socio-economic component of the report, Barbados has a culture of public sexual harassment, evidenced by men making either subtle or explicit sexual remarks as women walk pass. The concentration of men in one place on projects like these can see an increase in levels of this type of GBV. At the extreme end, projects such as these employ larger portions of men than women, and the consequent impact on livelihoods can leave women and girls financially vulnerable, thus leading to sexual exploitation. Recognising that women are likely to be part of the work team in areas such as engineering for instance, there is also the risk of sexual harassment and assault on job sites.

During the data collection process, children were noticed accompanying their parents while they vend alongside the highway. These children while not actual vendors would potentially assist their parents in small tasks like bagging items or restocking items while the parents would lead on sales and overall businesses activities (the children serve in supportive roles). These children would be on site as their parents work as their parents lack the resources to obtain additional childcare. However, the potential for underage employment does exist. With some children being out of school due to various household related reasons and the potential for the lack of adherence to labour laws and labour plans outlined in this document, there exists the risk of underage boys being hired informally for construction work and or as day/occasional labour, ultimately a form of exploitation. While the risk may be small, it should be still be noted and measures put in place to prevent and mitigate against its occurrence.

Mental well-being: Social networks are important for women as they continue to balance the inequalities around household care-work and employment or income generation activities to support their families. Social networks in this instance speaks to those outside of social media, and would include churches, schools, social clubs, and community activities that serve to provide mental and emotional support, informal knowledge sharing and recreation. Dependence of family and child-care support after school, can be severely impacted by lack of access due to traffic congestion and interruptions, health and hygiene issues due to interruptions or contamination of water supply, and increase health risks due to air and noise pollution. Social networks must not be overlooked as responding to more than physical need, as it is a vital part of our social well-being, and aids those dealing with anxiety, depression and similar mental health issues., all of which can be exacerbated by the stress of physical activities and impact of a project such as this. For people dealing with mental health issues the need for connect with, and support from friends and family as well as social inclusion, such as access to employment, services and community activities³² is essential.

Conflict: As commuters, vendors and businesses in the area face the inconvenience of traffic congestion and interruptions in traffic flow, air pollution by dust, possible interruptions in water supply, and loss of income (or sales in the case of larger commercial enterprises), increased levels of frustration among residents, tourists, commuters, competing vendors and businesses, can lead to verbal and even physical altercations.

³²<https://www.rethink.org/advice-and-information/living-with-mental-illness/information-on-wellbeing-physical-health-bame-lgbtplus-and-studying-and-mental-health/social-inclusion-and-mental-illness-how-can-i-become-more-connected/#:~:text=Social%20inclusion%20can%20help%20improve,help%20promote%20mental%20health%20recovery.>

5.8.3 Implications for the ESA and ESMP

Limited though it was, the stakeholders engagement revealed some important findings, that would impact all those who use the ABC highway whether a business location, a vendor, a customer or a commuter. These risks and potential impacts are detailed in Chapter 6.

To mitigate these impacts, assessments such as this one are vital in understating the zone of impact, paying attention to all economic sectors operating within that zone, as well as the needs of residents. However, mitigating must move beyond this assessment to address some clear actions to be taken for successful project implementation, and continued stakeholder engagement.

Communication: Throughout the data gathering process, the issue of clear and timely communication was raised. Businesses felt that in order to clearly plan for alternate routes as it dealt with receipt and delivery of merchandise, that time information about traffic interruptions and delays would be vital. Largely business houses wanted to be engaged using emails well in advance so that information was available for sharing among teams and for planning purposes.

Individuals also felt that often times projects begin and no information was provided, and so they wanted the project implemented team to pay keep attention to provided accurate and timely information. The older individuals (70+) felt that traditional media (radio, television and newspapers) were their sources of information, but felt that it was necessary to get more than a news item. More details were necessary via these media. For the younger respondents, they wanted the same type of information but wanted social media platforms to be included in the dissemination of information.

This call information by all stakeholders suggests the need for a strategic communication plan, that ensures the right channel of dissemination for appropriate audiences, paying keen attention to the diversity of the population (retired, school-age, and business) within the impact zone.

The communication strategy must also include the need for continuous stakeholder engagement, allowing all impacted and the project implementation to collectively address impacts and mitigation efforts, and agreeing on solutions. It is recommended that this strategy include the development of a website dedicated to the dissemination of all information related to the Project, including project updates, traffic information and any other public service announcements.

Redress mechanisms: The nature of this project requires a formal system for redress of grievances. As revealed from the analysis, the potential of conflicts with labour, stakeholders, and gender issues, means that there must be a mechanism through which employees, businesses and residents can have any challenges arise during implementation, addressed in a fair, transparent and timely manner.

The issue of addressing risks associated with labour, must include the engagement of the workers union, and the department of labour, so as to ensure that terms and conditions are fair and in keeping with the labour laws of the country³³. Ensuring clear communication channels are open and collaboration between these different entities are support is critical to mitigating labour risks. It is important that project actors and all relevant contractors are bound to a code of conduct prior to the commencement of any work. This needs to be supported by sufficient sensitization with actors and contractors to ensure they are properly versed in the plans and other mechanisms and have the capacity to act upon them. In addition, there needs to be oversight by the BWA as well as the Bank to ensure adherence to and compliance with outlined plans and mechanisms set forth in the ESMP.

It must be noted that redress on issues around sexual exploitation or assault must give due consideration to the nature of the power dynamics of relations of gender, and therefore ensuring that neither party feels coerced or disempowered by the process, and that outcomes are fair. It should be noted that some members of the BWA including the HR department were exposed to training under

³³ The workers union were not engaged in the consulting team's data collection process so it is recommended that they are included in the Stakeholder Engagement process undertaken by the BWA.

the 3RCReWS project on January 31st relating to SEAH as well as GRM specific needs in the context of SEAH. This is a foundation that can be built on during project execution and there is a potential to leverage this capacity for the training and passing on of knowledge to other members of the project team and via engagements with contractors. Additionally, existing and future GRM mechanisms will amplify and reinforce measures outlined in the report.

When address both communication and grievance redress, it is important to be cognisant of the laws of the country, and just as importantly the social and cultural norms around relations of gender, and social engagement in general.

6 IMPACT ASSESSMENT AND PROPOSED MITIGATION MEASURES

This section presents an assessment of the potential environmental and social impacts for the Barbados Climate Resilient South Coast Water Reclamation Plant Project during the construction and operational stages. The detailed mitigation measures, however, are included in Section II - The Environmental and Social Management Plan (ESMP) of this report. The analysis considers the physical, ecological and socio-economic impacts and assesses the probability and magnitude of impacts from project activities on the receiving physical environment, ecological resources and social environment broken down to a project phase basis. The various activities within each phase are then analysed and impacts evaluated based on their probability, magnitude, duration, reversibility and net positive or negative impact.

The potential impacts identified and the recommended mitigation measures were assessed for two of the Project Components – Component 1 and Component 2 – as these components consisted of the bulk of the activities with the potential to lead to a physical alteration of the Project area's physical and social environment.



6.1 Component 1 - Water Reclamation Infrastructure

6.1.1 The Construction Phase

Table 6-1: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Component 1

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Poor drainage resulting in flooding and mosquito proliferation	Likely	Except that due care is taken, the already poor drainage situation across Barbados can be made worse by this project, creating situations of stagnant water as breeding grounds for mosquitoes leading to possible increase in dengue, chikungunya and zika.	Negative	Reversible	Major	Short-term to Long-term	<ul style="list-style-type: none">- Establish proper onsite drains during the construction period. Limit length of time small sections of the trenches are open- Install silt traps to reduce the amount of silt runoff from construction area.- Workers must be trained on proper site clean-up activities and proper storage of construction material to minimize exposure of material available for contaminating the runoff.	Drainage Management Plan Pest Management Plan integrated within the Biodiversity Management Plan	BWA and Contractor
Disruption to Existing SCSTP	Likely	The land area to be used for the development of the reclamation facility is adjacent to the existing treatment plant but is also slightly upslope. Failure to	Negative	Reversible	Major	Short-term to Long-term	<ul style="list-style-type: none">- The installation of silt fences would contribute to the control of sediment run off and erosion	Drainage Management Plan	BWA and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		implement effective measures could lead to sediment or surface water runoff onto the property of the existing plant and this could disrupt the activities undertaken at the plant and possibly the health and safety of its workers.					- Drains should be constructed on site such that surface water runoff is channelled away from the existing plant		
ECOLOGICAL									
Alteration/ Destruction of Terrestrial, Coastal and Marine Habitats	Likely	The increase in noise levels due to machinery operation and construction activities may affect sensitive fauna. Excavation may impact organisms that live in the soil.	Negative	Reversible	Minor	Long-Term	<ul style="list-style-type: none"> - All vegetation clearing activities should be remedied by the replanting of trees. - Any identified sensitive ecological sites should be clearly demarcated. - All workers should be sensitized to the area's ecology and conscious of how to maintain the ecological environment, minimizing pollution and habit destruction 	Biodiversity Management Plan	Barbados Water Authority and the Contractor
Contamination of Terrestrial, Coastal and Marine Habitats	Likely	Contamination of terrestrial habitats including the Graeme Hall Swamp as a result of construction activities with silty run off or hazardous chemicals such as fuel. This can result in the death of wildlife.	Negative	Irreversible	Major	Short-term	<ul style="list-style-type: none"> - A spill management procedure needs to be written and implemented within the Emergency Response Plan to reduce the risk of contamination from chemicals used on site. 	Biodiversity Management Plan Waste Management Plan	Contractor Barbados Water Authority



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> - Drainage design and management during and after construction are critical to reduce contamination from silty runoff. 	Emergency Management Plan Drainage Management Plan	
Disturbance of Terrestrial, Coastal and Marine Faunistic Communities	Likely	Disturbance of faunal species and their nesting or breeding ground within the Graeme Hall Swamp could result in the relocation of fauna from the Swamp area in a search of a less disturbed area can result in nuisance to nearby residents and businesses	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Establish a barrier between the construction area and the Graeme Hall Swamp to reduce the dust, noise and people disturbance in the area. - Sensitisation of workers to the faunal species within the area and the steps they are to take is certain species are found. The need to understand who to contact for assistance and how to relocate nests or species out of harms ways during the construction period 	Biodiversity Management Plan	Contractor and Barbados Water Authority
Environmental Pollution from soil waste (soil contamination)	Likely	Construction waste if not disposed properly, when introduced into the environment could lead to degradation and habitat disruption. Pollution would reduce the aesthetic	Significant	Reversible	Moderate	Long-Term	<ul style="list-style-type: none"> - Ensure there are designated areas for construction waste. - Waste collection containers should be clearly labelled and not be accessible or 	Waste Management Plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>capacity of the environment and would impact businesses that rely on the environment for operations.</p> <p>With precipitation events frequenting Barbados, the improper disposal of waste from construction activities would potentially be transported via stormwater drainage, possibly seep into and pollute groundwater reserves as well as be emptied into sea, affecting the coastal ecosystem.</p> <p>The removal of large amounts of soil for borrow pits can result in increased erosion, impacting the stability of nearby slopes and water bodies. Excavation activities may also expose underlying groundwater, leading to potential contamination from pollutants present in the extracted materials.</p>					<p>attractive to pests or vermin</p> <ul style="list-style-type: none"> - Tracking of waste produced and disposal method, no burning of trash - Borrow pits- sand, gravel will be needed for construction and impacts of the borrow pits will need to be managed, ensure only approved borrow pits are used, that have mitigation plans 		
Environmental pollution	Likely	Construction and landscaping activities could	Negative	Reversible	Moderate	Medium-Term	- Construct silt fences to reduce the likelihood of	Waste Management Plan	BWA and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
(water contamination)		<p>result in sediment runoff that could be washed into any nearby water bodies. The erosion of the soil during these activities, if not controlled, reduces the integrity of the area leading to instability and further risks to health and safety on the construction site.</p> <p>ChemicalThe absence of toilets on construction sites may lead to the introduction of human waste into the environment. However, chemical or portable toilets, which use chemicals to break down waste, are commonly used on construction sites. If, and if the contents of these toilets—including human waste and chemical additives—are not properly disposed of, groundwater and soil may get contaminated.</p>					<p>soil erosion as well as the run off of sediments into any nearby water bodies, particularly the Graeme Hall Swamp.</p> <ul style="list-style-type: none"> - Ensure that there are sufficient mobile toilets on site for workers to prevent human waste being introduced directly into the environment. - Proper waste management practices should be implemented, including regular emptying and servicing of toilets, proper disposal of waste and chemical additives. 	Drainage Management Plan	
Pest Proliferation	Not likely	The potential for still collection of water in either	Negative	Reversible	Minor to Moderate	Short to Medium Term	<ul style="list-style-type: none"> - Ensure that no open containers are kept on 	Biodiversity Management Plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		open containers on site or ponding in construction zones could catalyse the rapid growth of pests, especially mosquitos which have been identified in the stakeholder engagement process					<ul style="list-style-type: none"> site that could be used for the storage of water Empty, drain or cover all open containers containing water 		
SOCIAL									
Traffic Congestion	Very Likely	<ul style="list-style-type: none"> Works will cause disruption to routine traffic routes Congestion caused by construction activities, material transport, etc. Possible accidents 	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> Ensure that proper signage and traffic wardens are in place Identify alternate routes Inform public of proposed works and the possibility for traffic congestion and disruption As best as possible, limit works in peak traffic hours 	Traffic Management Plan	Contractor in liaison with the Ministry of Transport and Police
Disruptions to mobility, movement and traffic	Very Likely	<ul style="list-style-type: none"> Any disruption to movement, mobility and traffic flow is likely to affect access to and from local services including education and health services for local residents and other users. There will also potential disruption to 	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> Engage businesses and residents in the area to discuss how they will function during the period of disruption and determine alternative solutions to the foreseen issues. 	Traffic Management Plan Stakeholder Engagement Plan	Contractor in liaison with the Ministry of Transport



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>commercial activities for several small and medium sized businesses.</p> <ul style="list-style-type: none">- As businesses noted this has implications for their customers and ultimately income flow. For DHL, specifically this has implications for their greater mobility in the area across Barbados and could potentially require them to change routes and or have to bring on additional staff to address the additional time deliveries may take.					<ul style="list-style-type: none">- Proper signage and engagement of traffic wardens.- Engage the Ministry of Transport and the local Police to work with Contractor to address the issue of mobility for all road users.		
Business Disruption	Likely	<p>The disruption of main transportation routes limit access to businesses in the project area.</p>	Negative	Reversible	Moderate	<p>For the duration of the Construction Phase</p>	<ul style="list-style-type: none">- Ensure that alternative routes are identified and shared with the public so community access is not largely restricted- Establish a line of communication between the works and business owners in the communities (including project landing page)	<p>Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area</p> <p>Access to Community Management Plan</p>	<p>BWA and Contractor</p>



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> Promote the use of the Grievance Mechanism to ensure there is a means by which business owners, and the general public can share opinions and concerns 	Grievance Redress Mechanism	
Available Employment	Very Likely	Construction activities may require the hiring of skilled local labour	Positive	Reversible	Moderate	For the duration of the Construction Phase	<ul style="list-style-type: none"> Ensure that all genders are represented in the labour force A code of conduct should be implemented and observed. Mechanisms should be in place to address any issues of gender related violence or worker conflicts 	Labour Management Plan Code of Conduct	BWA and the Contractor
Poor Worker Health and Safety	Likely	Dust, noise and vibrations from construction activities and from the use of heavy machinery and equipment both on site and for material transport could prove a nuisance to workers in the project area. Operating heavy machinery and equipment can result in accidents, especially if	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> Ensure that all workers are trained on effective health and safety procedures Ensure all vehicles are frequently maintained Ensure all workers are provided with the necessary personal protective equipment (PPE) First aid kit on site 	Worker Health and Safety Management Plan Noise Management Plan Accident/incident response plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>proper safety protocols are not followed. Other accidents are also a possibility on site, related to trench collapse, over heating, diseases on site, etc</p> <p>Extreme weather conditions, especially a spike in temperatures, pose a health hazard to workers</p> <p>Failure to use or inadequate use of PPE, such as hard hats, gloves, and safety glasses, can increase the risk of injuries.</p> <p>High risk activities (welding, working at heights, working in confined spaces)</p> <p>High risk activities (welding, working at heights, working in confined spaces).</p> <p>Unstable slopes and edges of borrow pits can pose risks of collapse, leading to accidents and injuries. As well, the excavation of trenches pose several risks</p>					<ul style="list-style-type: none">- Accident/incident response plan- Shade and water provided to workers- mobile toilets- Implement a rotational schedule to prevent workers from being overly exposed to dust and noise- Proper signage should be present to identify health and safety risks and procedures		



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		to workers – risk of collapse if there is a lack of adequate support, risk of being struck by falling objects (i.e., tools, equipment, loose soil), risk of being engulfed by loose soil or water and being exposed to hazardous fumes from machinery and equipment.							
Damage to health injuries and safety issues to nearby residents and business owners	Likely	<p>There is a chance that members of the public could enter the construction site without permission and suffer harm. Therefore, these activities may have an effect on the health and safety of locals, and businesses in the area.</p> <p>There is also the possibility that construction equipment, as well as things falling from it, will accidentally cause serious or minor injuries to pedestrians and motorists.</p>	Negative	Reversible	Significant	Short-term	<ul style="list-style-type: none">- Where necessary, members of the surrounding communities must be informed of the works and the associated health and safety risks- Proper signage must be present to identify health and safety risks and procedures- Fencing around sites, only authorized personal can enter the construction site area	<p>Community Health and Safety Management Plan</p> <p>Noise Management Plan</p>	Barbados Water Authority and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		Risk of people falling into the trenches							
Air and Noise Pollution	Very Likely	<p>Fugitive dust nuisance as a result of the construction works at the Plant as well as on the pipeline routes.</p> <p>Noise pollution from excavation, landscaping and other related general construction activities would prove a nuisance to the residents in the community surrounding the construction site.</p>	Negative	Reversible	Significant	Short-Term	<ul style="list-style-type: none"> - Frequent wetting should be done in the event of excavation and/or land clearing to prevent mass fugitive emissions - Ensure all vehicles are frequently maintained - Cover any stockpiles of material being used on the construction sites. - Covering of truck transporting fine material to the site. - Stakeholder engagement is critical before construction activities start to discuss with locals what to expect and how they can be mitigated. - Erection of barriers in between construction areas and sensitive receptor such as wetlands and communities where possible. 	<p>Air Quality Management Plan</p> <p>Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area</p>	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> - Monitoring of noise levels throughout construction period. - Restriction of noisy activity within the daytime hours 8am to 8pm. 		
Access hindered for businesses and residents to operate normally	Very Likely	The lack of access to business and to vendors would impact sales for both. In addition, with women possibly facing longer commutes to get children to school before starting work, vendors may miss peak times in sales (when their customers are on their way to work), and business sales can also decline, due to female staff members being late because of care responsibilities.	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Engage community stakeholders both residents and businesses and discuss access for them during construction period. 	Access to Community Management Plan Stakeholder Engagement Plan	Barbados Water Authority and Contractor
Disruption in water supply	Likely	Disruption in water supply can affect residents and businesses in the area. A disruption in the water supply can affect staff and customer hygiene needs, particularly women staff and their specific needs, again leading to women	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Stakeholder engagement prior to construction and discuss with residents and business the grievance mechanism to address all concerns. - Engage the water supply regulators and discuss 	Stakeholder Engagement Plan Community Grievance Mechanism	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		have to leave the place of employment, and affecting sales, and consequently wages for hourly paid employees.					mitigation measures to minimize the risk of water supply disruption.		
Disruption in telecommunication lines	Likely	Disruption in telecommunication lines can affect residents and businesses in the area. Impacting both phone connections and internet which can negatively impact residents and businesses	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none">- Stakeholder engagement prior to construction and discuss with residents and business the grievance mechanism to address all concerns.- Engage the telecommunication providers who have lines under the roadway and discuss mitigation measures to minimize the risk of telecommunication disruption.	<p>Stakeholder Engagement Plan</p> <p>Community Grievance Mechanism</p>	Barbados Water Authority and Contractor



6.1.2 The Operations Phase

Table 6-2: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operational Phase of Component 1

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Wastewater Overflow	Likely (Conditional to flooding)	The SCSTP is located in a flood prone region so overflow could occur on site	Negative	Irreversible	Moderate to Significant	Long-Term	<ul style="list-style-type: none">- Installation of a detention pond which will serve to hold the overflow, which can be put back into the system for treatment once the plan is up and running again. The retention pond should be sized to accommodate the peak flow rates expected during overflow events. This requires analysis of historical flow data and consideration of factors such as rainfall intensity, watershed characteristics, and urbanization.- Regularly inspect, maintain, and rehabilitate wastewater infrastructure to prevent leaks, blockages, and system failures. This includes cleaning sewer lines, repairing damaged	Sludge Management Plan	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<p>pipes, and upgrading aging infrastructure to ensure reliable and efficient operation.</p> <ul style="list-style-type: none">- Implement water conservation measures to reduce overall wastewater generation. This can include promoting water-efficient fixtures, implementing reuse and recycling programs, and educating the public on water-saving practices.		
Contamination of the aquifer and farms being irrigated	Likely	Possible malfunctioning of the plant is possible and can result in contamination of the underground aquifer and farms with untreated sewage. This can results in sickness and death to users of the contaminated water. Bioaccumulation on vegetable crops is also a possibility resulting in illnesses spread to customers	Negative	Irreversible	Significant	Short, medium and Long-term	<ul style="list-style-type: none">- The plant will typically be designed with parallel flow streams and usually 50%, so that only a portion of the plant is taken out for servicing and the other section continues treatment albeit temporarily at a reduced effluent quality.- An emergency discharge from any STP is a	<p>Water Quality Management Plan</p> <p>SCSTP Operations and Maintenance Plan</p> <p>Emergency Response Plan</p>	Barbados Water Authority



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		and the wider Barbados.					<p>necessary component of the design and in this case the emergency outfall should be retained.</p> <ul style="list-style-type: none"> - Stringent water quality monitoring programme is required, which will need to include parameters such as total and faecal coliform, heavy metal among others. 		
Sludge management	Very Likely	<p>Effective management of sludge could result in the sludge being used as either fill material, landfill cover or a resource for a private enterprise to make a soil conditioner/fertilizer (used for agricultural purposes).</p> <p>Unmanaged sludge can contain various pollutants, including heavy metals (from</p>	Positive	Irreversible	Moderate to Significant	Long-Term	<ul style="list-style-type: none"> - A sludge plan is necessary whether to become fill material, landfill cover or a resource for a private enterprise to make a soil conditioner or fertilizer. - Avoid open dumping or uncontrolled disposal of sludge. - Engage with local communities to provide information about sludge management practices, potential impacts, and mitigation measures. 	Sludge Management Plan	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>urban runoff and household products), pathogens, and chemicals. If not properly treated and disposed of, these contaminants can leach into water bodies, leading to water pollution. This is also the case for soil contamination and air pollution, where harmful, odorous substances released into the atmosphere may affect communities close to the treatment plant.</p> <p>Untreated sludge may contain harmful pathogens, including bacteria, viruses, and parasites. Improper handling or disposal can lead to the spread of these pathogens, posing risks to public health.</p>	Negative				<ul style="list-style-type: none">- Establish a regular monitoring program to assess the quality of sludge and ensure compliance with regulatory standards.- Conduct soil and water testing in areas where sludge has been applied to assess potential impacts.- Provide training for personnel involved in sludge management to ensure that they are aware of proper procedures and safety protocols.		



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		Improperly managed sludge can result in unsightly conditions, with visible pollution in water bodies or on land. This aesthetic degradation can impact the enjoyment of outdoor spaces and reduce property values.							
Greenhouse Gas Emissions (GHG)	Likely	The process of wastewater reclamation leads to the production of biogases such as methane. These gases are also greenhouse gases which contribute to the global warming effect.	Negative	Irreversible	Moderate to Significant	Long-Term	<ul style="list-style-type: none">- A sludge plan is necessary whether to become fill material, landfill cover or a resource for a private enterprise to make a soil conditioner/fertilizer.- Biogas production is possible but compost material and point of use of the biogas would need to be close.- Development of a renewable energy business operation to utilise solid and sludge waste to produce renewable energy.	Sludge Management Plan Renewable Energy Recovery Management Plan	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> The design of the WWTP should take into consideration the reduction of the impacts of NOx and CO through scrubbers or other alternate means. 		
Aquifer Recharge	Expected	<p>The reclamation of wastewater to then be used for aquifer recharge</p> <p>If the rate at which the aquifer is recharged exceeds the extraction rate, groundwater levels are likely to rise. This can help replenish depleted aquifers and restore water levels to healthier conditions.</p>	<p>Positive</p> <p>Positive</p>	Reversible	Significant	Long-Term	<p>N/A</p> <ul style="list-style-type: none"> Implement a monitoring programme that monitors the aquifer levels so aquifer recharge and extraction can be controlled. 	Aquifer monitoring plan	BWA
Contamination of aquifer	Likely	The effluent quality may not always be consistent due to malfunctioning equipment or other reasons. This can result	Negative	Irreversible	Significant	Long-term	<ul style="list-style-type: none"> The plant will typically be designed with parallel flow streams and usually 50%, so that 	<p>Water Quality Management Plan</p> <p>SCSTP Operations and Maintenance Plan</p>	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>in the contamination of the aquifer from coliform and heavy metals.</p> <p>This contamination can also impact farmers using the water for irrigation and the bioaccumulation that is likely in especially vegetable crops. Persons working and consuming these can get sick or even die as a result.</p>					<p>only a portion of the plant is taken out for servicing and the other section continues treatment albeit temporarily at a reduced effluent quality.</p> <ul style="list-style-type: none">- An emergency discharge from any STP is a necessary component of the design and in this case the emergency outfall should be retained.- Stringent water quality monitoring programme is required, which will need to include parameters such as total and faecal coliform, heavy metal among others.- An emergency shut down mechanism is going to be necessary in the design to cease the effluent from being transported to the	<p>Emergency Response Plan</p>	



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							aquifer and the irrigations sites. - A generator or another alternative power source should be considered in the event of power failure.		
ECOLOGICAL									
Artificial Lights from Reclamation Facility	Very Likely	With the reclamation facility operating at a higher level, the additional artificial lights it will emit could disrupt the behaviour and distribution of different species. This is especially significant for nocturnal species who rely on natural conditions to forage, navigate and communicate. Some organisms perceive lighting as an indication of safety and so may be attracted by the artificial lights, pulling them from their natural habitats and	Negative	Irreversible	Moderate	Long-term	- The construction design of the reclamation facility should include shielded or directing lighting fixtures that would aid in the minimization of light spillage and glare. - Use warm-colored (e.g., amber or red) lights with lower color temperatures, as they are less disruptive to wildlife compared to cool-colored (e.g., blue or white) lights. Warm-colored lights are less attractive to insects and are less likely to disorient nocturnal animals.	Biodiversity Management	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		potentially placing them at risk.					<ul style="list-style-type: none">- Reduce the intensity and duration of artificial lighting, especially during nighttime hours when it can disrupt natural cycles and behaviours of nocturnal species. This can be achieved through the use of timers, motion sensors, and dimmers to control when and how much light is emitted.		
Cumulative impacts in Graeme Hall Swamp	Very Likely	The ecology of the swamp is at risk both to possible waste being injected into the wetlands through ineffective drainage management and in the event that the swamp has to be utilized as a temporary outlet for effluent in the event of overflows. The ecology is further threatened by the artificial lighting that potentially could disrupt the behavioural patterns of some	Negative	Irreversible	Moderate to Significant	Long-term	<ul style="list-style-type: none">- See proposed mitigation measures for Artificial Lights from Reclamation Facility	Biodiversity management plan	



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		organisms that are photoreceptive.							
SOCIAL									
Odour Emanating from Plant	Not Likely	Failures in the odour control mechanisms at the SCSTP place may lead to the emission of foul odours to cause discomfort in neighbouring communities. Along with discomfort, these odours may also lead to ailments in some individuals and may affect business operations by deterring customer flows.	Negative	Reversible	Moderate to Significant	Short-Term	<ul style="list-style-type: none">- A mechanism should be in place to ensure that the odour control systems are operational. This mechanism should include some form of monitoring system to detect odour emissions outside of the plant.- Prioritize the regular maintenance of equipment and infrastructure at the plant to minimize the likelihood of failures in odour control systems.- Maintain a good community engagement mechanism that allows for the receipts of complaints to be addressed in a timely manner. Constant communication with affected communities is necessary to provide for the exchange of	Air Quality Management Plan Sludge Management Plan Stakeholder Engagement Plan	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							information in such events.		
Increased irrigation to offset dry spells	Very Likely	Dry spells typically see farmers relying on groundwater resources for irrigation purposes. The reclamation facility and its intended purpose of increase the amount of water to be piped for irrigation purposes would reduce the impact of dry spells and periods of drought.	Positive	Reversible	Moderate to Significant	Long-Term	N/A	N/A	BWA
Reduce strain on using potable water	Very Likely	The issue of water scarcity has seen potable water being used where just non-potable water would be required. Increasing the water availability would reduce this.	Positive	Reversible	Moderate to Significant	Long-Term	N/A	N/A	BWA
Water affordability issues with farmers being supplied water	Likely	A decision has been taken to charge a single price for the cost of water to be supplied to farmers. A review of this price will be	Positive	Reversible	Significant	Long-term	N/A	N/A	Barbados Water Authority



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		conducted to arrive at equitable price							
Water Access and Safety of Treated Wastewater	Likely	The increased water supply to the catchment pond at the River Plantation to improve the reliability and reach of the irrigation scheme should result in the increase in the amount of high quality water available to all farmers in the area.	Positive	Reversible	Significant	Long-Term	<ul style="list-style-type: none">- Improve the irrigation schedule that the farmers are familiar with to ensure that there is sufficient water for all farmers- Provide farmers with training on water-efficient farming practices and technologies.		Barbados Water Authority
		If the treatment of wastewater is not to the set standards, the quality of water being supplied for irrigation may influence the quality of agricultural produce which could pose a health hazard to consumers.	Negative						
		In the wet seasons when the treated wastewater is being used to recharge aquifers, there may still							



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		persist the existing issue of farmers downstream of the Three Houses Spring getting limited access to that source of water due to the farmers upstream capitalizing on their early access.							



6.2 Component 2 – Reclaimed Water Use

6.2.1 The Construction Phase

Table 6-3: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Component 2

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Poor drainage resulting in flooding and mosquito proliferation	Likely	Except that due care is taken, the already poor drainage situation across Barbados can be made worse by this project, creating situations of stagnant water as breeding grounds for mosquitoes leading to possible increase in dengue, chikungunya and zika.	Negative	Reversible	Major	Short-term to Long-term	<ul style="list-style-type: none">- Establish proper onsite drains during the construction period. Limit length of time small sections of the trenches are open- Install silt traps to reduce the amount of silt runoff from construction area.- Workers must be training on proper site clean-up activities and proper storage of construction material to minimize exposure of material available for contaminating the runoff.	Drainage Management Plan Pest Management Plan integrated within the Biodiversity Management Plan	Barbados Water Authority and Contractor
ECOLOGICAL									
Alteration/ Destruction of Terrestrial, Coastal and	Likely	The possible clearing of vegetation lining the major roadway and along the trailway	Negative	Reversible	Minor	Long-Term	<ul style="list-style-type: none">- All vegetation clearing activities should be remedied by the replanting of trees.	Biodiversity Management Plan	Barbados Water Authority and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
Marine Habitats		<p>The increase in noise levels due to machinery operation and construction activities may affect sensitive fauna, disrupting their natural tendencies and behaviours</p> <p>Excavation may impact organisms that live in the soil, bringing them closer to the surface where they are more vulnerable</p> <p>Borrow pit excavation has the potential to destroy aquatic and terrestrial ecosystems, among other natural environments. The area's biodiversity can be decreased and wildlife habitats might be upset by clearing plants and disturbing the soil.</p>					<ul style="list-style-type: none"> - Any identified sensitive ecological sites should be clearly demarcated. - All workers should be sensitized to the area's ecology and conscious of how to maintain the ecological environment, minimizing pollution and habit destruction 		
Contamination of Terrestrial, Coastal and Marine Habitats	Likely	Contamination of terrestrial habitats including the Graeme Hall Swamp as a result of construction activities with silty run off or hazardous chemicals such as fuel. This can result in the death of wildlife.	Negative	Irreversible	Major	Short-term	<ul style="list-style-type: none"> - A spill management procedure needs to be written and implemented within the Emergency Response Plan to reduce the risk of contamination from chemicals used on site. 	<p>Biodiversity Management Plan</p> <p>Waste Management Plan</p>	<p>Contractor</p> <p>Barbados Water Authority</p>



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> - Drainage design and management during and after construction are critical to reduce contamination from silty runoff. 	Emergency Management Plan Drainage Management Plan	
Disturbance of Terrestrial, Coastal and Marine Faunistic Communities	Likely	Disturbance of faunal species and their nesting or breeding ground within the Graeme Hall Swamp could result in the relocation of fauna from the Swamp area in a search of a less disturbed area can result in nuisance to nearby residents and businesses	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Establish a barrier between the construction area and the Graeme Hall Swamp to reduce the dust, noise and people disturbance in the area. - Sensitisation of workers to the faunal species within the area and the steps they are to take is certain species are found. The need to understand who to contact for assistance and how to relocate nests or species out of harms ways during the construction period 	Biodiversity Management Plan	Contractor and Barbados Water Authority
Environmental Pollution from soil waste (soil contamination)	Likely	Construction waste if not disposed properly, when introduced into the environment could lead to degradation and habitat disruption. Pollution would	Significant	Reversible	Moderate	Long-Term	<ul style="list-style-type: none"> - Ensure there are designated areas for construction waste. - Waste collection containers should be 	Waste Management Plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>reduce the aesthetic capacity of the environment and would impact businesses that rely on the environment for operations.</p> <p>With precipitation events frequenting Barbados, the improper disposal of waste from construction activities would potentially be transported via stormwater drainage, possibly seep into and pollute groundwater reserves as well as be emptied into sea, affecting the coastal ecosystem.</p> <p>In particular, if the excavated areas are not adequately stabilized or reclaimed following extraction, borrow pits may exacerbate soil erosion. The sedimentation of adjacent water bodies due to soil erosion can have an impact on aquatic ecosystems and water quality.</p>					<p>clearly labelled and not be accessible or attractive to pests or vermin.</p> <ul style="list-style-type: none">- Tracking of waste produced and disposal method, no burning of trash.- Ensure borrow pits that are used have management plans and are permitted.		



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
Pest Proliferation	Not likely	The potential for still collection of water in either open containers on site or ponding in construction zones could catalyse the rapid growth of pests, especially mosquitos which have been identified in the stakeholder engagement process	Negative	Reversible	Minor to Moderate	Short to Medium Term	<ul style="list-style-type: none"> - Ensure that no open containers are kept on site that could be used for the storage of water. - Empty, drain or cover all open containers containing water. 	Biodiversity Management Plan	Contractor
SOCIAL									
Traffic Congestion	Very Likely	<ul style="list-style-type: none"> - Works will cause disruption to routine traffic routes - Congestion caused by construction activities, material transport, etc. - Possible accidents 	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that proper signage and traffic wardens are in place. - Identify alternate routes. - Inform public of proposed works and the possibility for traffic congestion and disruption. - As best as possible, limit works in peak traffic hours. 	Traffic Management Plan	Contractor in liaison with the Ministry of Transport and Police
Disruptions to mobility,	Very Likely	- Any disruption to movement, mobility and traffic flow is likely	Negative	Reversible	Moderate to Significant	For the duration of the	- Engage businesses and residents in the area to discuss how they will	Traffic Management Plan	Contractor in liaison with the



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
movement and traffic		<p>to affect access to and from local services including education and health services for local residents and other users. There will also potential disruption to commercial activities for several small and medium sized businesses.</p> <ul style="list-style-type: none"> - As businesses noted this has implications for their customers and ultimately income flow. For DHL, specifically this has implications for their greater mobility in the area across Barbados and could potentially require them to change routes and or have to bring on additional staff to address the additional time deliveries may take. 				Construction Phase	<p>function during the period of disruption and determine alternative solutions to the foreseen issues.</p> <ul style="list-style-type: none"> - Proper signage and engagement of traffic wardens. - Engage the Ministry of Transport and the local Police to work with Contractor to address the issue of mobility for all road users. 	Stakeholder Engagement Plan	Ministry of Transport
Restricted access to businesses and cultural/	Likely	<ul style="list-style-type: none"> - The disruption of main transportation routes limit access to businesses in the project area. 	Negative	Reversible	Moderate	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that alternative routes are identified and shared with the public so community access is not largely restricted. 	Plan to Address Damage to Property and Infrastructure and Enable Continuity	BWA and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
heritage assets		<ul style="list-style-type: none"> - The ABC Highway serves as a main mode of transport along the southern coast. Works being done along the highway may lead to congestion and diversions which may then lead to reduced access to the different cultural/heritage assets identified along the southern coast. - Works along the historic trailway would limit its usage for recreation and would disrupt activities on some plantations, such as the Sunbury Plantation. 					<ul style="list-style-type: none"> - Establish a line of communication between the works and business owners in the communities (including project landing page). - Promote the use of the Grievance Mechanism to ensure there is a means by which business owners, and the general public can share opinions and concerns 	of Business and Public Services in the Area Access to Community Management Plan Grievance Redress Mechanism	
Improved Infrastructure of Trailway	Very Likely	The successful installation of pipelines along the trailway would be expected to be followed by an effective method of resurfacing and compaction. This surfacing	Positive	Irreversible	Significant	Post-construction benefits		N/A	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		of the trailway would provide an additional minor route for safe transportation and recreational purposes. This would also reduce the difficulty of maintaining the pipelines and would reduce the risk of damages incurred to the pipelines by agricultural machinery, like tractors.					N/A		
Available Employment	Very Likely	Construction activities may require the hiring of skilled local labour	Positive	Reversible	Moderate	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that all genders are represented in the labour force. - A code of conduct should be implemented and observed. - Mechanisms should be in place to address any issues of gender related violence or worker conflicts 	Labour Management Plan Code of Conduct	BWA and the Contractor
Poor Worker Health and Safety	Likely	Dust, noise and vibrations from construction activities and from the use of heavy machinery and equipment both on site and for material transport could	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that all workers are trained on effective health and safety procedures. - Ensure all vehicles are frequently maintained. 	Worker Health and Safety Management Plan Noise Management Plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>prove a nuisance to workers in the project area.</p> <p>Operating heavy machinery and equipment can result in accidents, especially if proper safety protocols are not followed. Other accidents are also a possibility on site, related to trench collapse, over heating, diseases on site, etc</p> <p>Extreme weather conditions, especially a spike in temperatures, pose a health hazard to workers</p> <p>Failure to use or inadequate use of PPE, such as hard hats, gloves, and safety glasses, can increase the risk of injuries.</p>					<ul style="list-style-type: none"> - Ensure all workers are provided with the necessary personal protective equipment (PPE). - A first aid kit should always be on site and should be fully stocked. - Implement the Accident/incident response plan. - Shade and water should be provided to workers, as well as mobile toilets. - Implement a rotational schedule to prevent workers from being overly exposed to dust and noise. - Proper signage must be present to identify health and safety risks and procedures. 	Accident/incident response plan	
Damage to health injuries and safety issues	Likely	There is a chance that members of the public could enter the construction site without	Negative	Reversible	Significant	Short-term	<ul style="list-style-type: none"> - Where necessary, members of the surrounding communities should be 	Community Health and Safety Management Plan	Barbados Water Authority and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
to nearby residents and business owners		<p>permission and suffer harm. Therefore, these activities may have an effect on the health and safety of locals, and businesses in the area.</p> <p>There is also the possibility that construction equipment, as well as things falling from it, will accidentally cause serious or minor injuries to pedestrians and motorists.</p> <p>Risk of people falling into the trenches</p>					<p>informed of the works and the associated health and safety risks.</p> <ul style="list-style-type: none"> - Proper signage should be present to identify health and safety risks and procedures. - Fencing around sites, only authorized personal can enter the construction site area. 	Noise Management Plan Grievance Mechanism	
Poor air quality	Very Likely	<p>Fugitive dust nuisance as a result of the construction works at the Plant as well as on the pipeline routes.</p> <p>Odour from open sewage pipes, and dust from digging of the roads, would affect the vendors, as well as the bigger businesses.</p> <p>Employees are likely to call in sick because existing illness is being exacerbated,</p>	Negative	Reversible	Significant	Short-Term	<ul style="list-style-type: none"> - Frequent wetting should be done in the event of excavation and/or land clearing to prevent mass fugitive emissions. - Ensure all vehicles are frequently maintained. - Cover any stockpiles of material being used on the construction sites. 	<p>Air Quality Management Plan</p> <p>Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area</p>	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>or for the fear of becoming ill from the pollution.</p> <p>Livelihoods of vendors as well as waged and salaried workers of business and tourism establishments can be impacted. With the significant number of women in the services and retail sectors this can also severely impact business operations and profits.</p> <p>Residents and business can possibly see an increase in cost of cleaning whether through purchase of specific cleanings, or having to engage additional cleaning staff or services.</p>					<ul style="list-style-type: none">- Covering of truck transporting fine material to the site.- Stakeholder engagement is critical before construction activities start to discuss with locals what to expect and how they can be mitigated.		
<p>Access hindered for businesses and residents to operate normally</p>	<p>Very Likely</p>	<p>The lack of access to business and to vendors would impact sales for both. In addition, with women possibly facing longer commutes to get children to school before starting work, vendors may miss peak times in sales (when their customers are on their way to work), and business sales</p>	<p>Negative</p>	<p>Reversible</p>	<p>Major</p>	<p>Short-term</p>	<ul style="list-style-type: none">- Engage community stakeholders both residents and businesses and discuss access for them during construction period.	<p>Access to Community Management Plan</p> <p>Stakeholder Engagement Plan GRM</p>	<p>Barbados Water Authority and Contractor</p>



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		can also decline, due to female staff members being late because of care responsibilities.							
Noise pollution	Very Likely	Noise pollution from excavation and laying of sewage pipes would affect the vendors, as well as the bigger business. Employees are likely to call in sick because existing illness is being exacerbated, or for the fear of becoming ill from the pollution. Livelihoods of vendors as well as waged and salaried workers of business and tourism establishments can be impacted. With the significant number of women in the services and retail sectors this can also severely impact business operations and profits.	Negative	Reversible	Significant	Short-term	<ul style="list-style-type: none"> - Erection of barriers in between construction areas and sensitive receptor such as wetlands and communities where possible. - Monitoring of noise levels throughout construction period. - Restriction of noisy activity within the daytime hours 8am to 8pm. 	Noise Management Plan Stakeholder Engagement Plan	Barbados Water Authority and Contractor
Disruption in water supply	Likely	Disruption in water supply can affect residents and businesses in the area. A disruption in the water supply can affect staff and customer hygiene needs, particularly women staff	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Stakeholder engagement prior to construction and discuss with residents and business the grievance mechanism to address all concerns. 	Stakeholder Engagement Plan Community Grievance Mechanism	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		and their specific needs, again leading to women have to leave the place of employment, and affecting sales, and consequently wages for hourly paid employees.					- Engage the water supply regulators and discuss mitigation measures to minimize the risk of water supply disruption.		
Disruption in telecommunication lines	Likely	Disruption in telecommunication lines can affect residents and businesses in the area. Impacting both phone connections and internet which can negatively impact residents and businesses	Negative	Reversible	Major	Short-term	<ul style="list-style-type: none"> - Stakeholder engagement prior to construction and discuss with residents and business the grievance mechanism to address all concerns. - Engage the telecommunication providers who have lines under the roadway and discuss mitigation measures to minimize the risk of telecommunication disruption. 	Stakeholder Engagement Plan Community Grievance Mechanism	Barbados Water Authority and Contractor
Disruption in gas lines	Likely	The proposed pipeline routes may interfere with existing gas lines that are present along the trailway. Disruption in gas lines may lead to gas leaks which are fire and explosion hazards, significant health and safety	Negative	Irreversible	Significant	Long-term	<ul style="list-style-type: none"> - Conduct thorough utility locates and surveys before starting any excavation work. - Collaborate with local utility companies to obtain accurate 	Utilities Management/ Coordination plan Emergency Response Plan	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>risks. Interference may also lead to the permanent destruction of existing gas lines.</p> <p>Gas leaks could result in the release of harmful substances in the environment that may be detrimental to the vegetation and agricultural practices in the area, as well as any communities and services in the area.</p> <p>Dealing with the incident of disruption in the gas lines would lead to a significant delay in the progression of the Project.</p>					<p>information about the location of gas lines.</p> <ul style="list-style-type: none">- Communicate with utility providers to coordinate construction activities and identify potential conflicts with existing infrastructure.- Provide comprehensive safety training for all construction workers involved in the project.- Develop and enforce strict safety procedures, including guidelines for working near gas lines and handling potential gas leaks.- Install physical barriers or protective systems to prevent accidental damage to gas lines.- Clearly mark the location of gas lines using color-coded flags, paint, or other appropriate markers.	<p>Plan to address damage to property and infrastructure and enable continuity of business activities and public services in the area</p>	



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none">- Implement continuous monitoring of gas levels during construction activities, especially in areas where gas lines are present.		



6.2.2 The Operations Phase

Table 6-4: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operational Phase of Component 2

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Contamination of the aquifer and farms being irrigated	Likely	Possible malfunctioning of the plant is possible and can result in contamination of the underground aquifer and farms with untreated sewage. This can results in sickness and death to users of the contaminated water. Bioaccumulation on vegetable crops is also a possibility resulting in illnesses spread to customers and the wider Barbados.	Negative	Irreversible	Significant	Short, medium and Long-term	<ul style="list-style-type: none">- The plant will typically be designed with parallel flow streams and usually 50%, so that only a portion of the plant is taken out for servicing and the other section continues treatment albeit temporarily at a reduced effluent quality.- An emergency discharge from any STP is a necessary component of the design and in this case the emergency outfall should be retained.- Stringent water quality monitoring programme is required, which will need to include parameters such as total and faecal coliform,	Water Quality Management Plan SCSTP Operations and Maintenance Plan Emergency Response Plan	Barbados Water Authority



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							heavy metal among others.		
Aquifer Recharge	Expected	The reclamation of wastewater to then be used for aquifer recharge	Positive	Reversible	Significant	Long-Term	N/A	N/A	BWA
Contamination of aquifer	Likely	<p>The effluent quality may not always be consistent due to malfunctioning equipment or other reasons. This can result in the contamination of the aquifer from coliform and heavy metals.</p> <p>This contamination can also impact farmers using the water for irrigation and the bioaccumulation that is likely in especially vegetable crops. Persons working and consuming these can get sick or even die as a result.</p>	Negative	Irreversible	Significant	Long-term	<ul style="list-style-type: none"> - The plant will typically be designed with parallel flow streams and usually 50%, so that only a portion of the plant is taken out for servicing and the other section continues treatment albeit temporarily at a reduced effluent quality. - An emergency discharge from any STP is a necessary component of the design and in this case the emergency outfall should be retained. - Stringent water quality monitoring programme is required, which will need to include 	<p>Water Quality Management Plan</p> <p>SCSTP Operations and Maintenance Plan</p> <p>Emergency Response Plan</p>	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<p>parameters such as total and faecal coliform, heavy metal among others.</p> <ul style="list-style-type: none">- An emergency shut down mechanism is going to be necessary in the design to cease the effluent from being transported to the aquifer and the irrigations sites.- A generator or another alternative power source should be considered in the event of power failure.		
Changes in Soil Quality/ Characteristics	Likely	Nutrients like nitrogen, phosphorus, and potassium found in treated wastewater can be applied to soil as fertilizers. This nutrient enrichment may occasionally increase soil fertility and encourage plant development. As well, increased organic matter and microbial	Positive	Reversible	Moderate - Significant	Long-Term	<ul style="list-style-type: none">- Conduct regular soil and treated water testing to determine pH and salinity levels, as well as potential contaminants.- Encourage the use of effective irrigation practices, such as drip irrigation, to help prevent over-irrigation and waterlogging, reducing the risk of soil	Water Supply Management	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>content can enhance soil structure, water retention, nutrient availability and overall soil health.</p> <p>However, treated wastewater may still contain trace amounts of heavy metals and other contaminants which can accumulate in soil and affect human and plant health. The different salts, dissolved solids and metals suggest the water supplied may be of a different pH to the receiving soil and this could affect soil chemistry, nutrient availability, and microbial activity, potentially impacting plant growth and soil health.</p> <p>Improper irrigation practices (over-irrigation for example) can lead to soil</p>	Negative				<p>compaction, erosion, and salinity buildup. This can be achieved through public awareness and education campaigns that target farmers and agricultural workers. These campaigns should inform about potential risks associated with treated wastewater use in agriculture, as well as proper management practices to mitigate risks.</p>		



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		compaction, degradation of soil structure and erosion which can lead to the degradation of soil quality by removing nutrient-rich topsoil and reducing soil fertility.							
ECOLOGICAL									
Change in Hydrology of the Graeme Hall Swamp	Likely	Without the added pollution of the wetlands from effluent discharge during emergencies or improper waste disposal the quality of the water would be improved. It is not anticipated that there will be any drying of the swamp due as rainfall and surface runoff would flow to the wetlands.	Positive	Reversible	Significant	Long-term	N/A	N/A	BWA
SOCIAL									
Increased irrigation to offset dry spells	Very Likely	Dry spells typically see farmers relying on groundwater resources for irrigation purposes.	Positive	Reversible	Moderate to Significant	Long-Term	N/A	N/A	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		The reclamation facility and its intended purpose of increase the amount of water to be piped for irrigation purposes would reduce the impact of dry spells and periods of drought.							
Reduce strain on using potable water	Very Likely	The issue of water scarcity has seen potable water being used where just non-potable water would be required. Increasing the water availability would reduce this.	Positive	Reversible	Moderate to Significant	Long-Term	N/A	N/A	BWA
Water affordability issues with farmers being supplied water	Likely	A decision has been taken to charge a single price for the cost of water to be supplied to farmers. A review of this price will be conducted to arrive at equitable price .	Positive	Reversible	Significant	Long-term	N/A	N/A	Barbados Water Authority
Water Access and Safety of Treated Wastewater	Likely	The increased water supply to the catchment pond at the River Plantation to improve the reliability and reach of the irrigation scheme	Positive	Reversible	Significant	Long-Term	- Improve the irrigation schedule that the farmers are familiar with to ensure that there is sufficient water for all farmers.	Irrigation schedule and monitoring plan	Ministry of Agriculture Barbados Water Authority



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>should result in the increase in the amount of high quality water available to all farmers in the area.</p> <p>If the treatment of wastewater is not to the set standards, the quality of water being supplied for irrigation may influence the quality of agricultural produce which could pose a health hazard to consumers.</p> <p>In the wet seasons when the treated wastewater is being used to recharge aquifers, there may still persist the existing issue of farmers downstream of the Three Houses Spring getting limited access to that source of water due to the farmers upstream capitalizing on their early access.</p>	Negative				<ul style="list-style-type: none">- Provide farmers with training on water-efficient farming practices and technologies.	Water Quality Management	



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
Pipeline Leakages	Not Likely	Any potential leakages in the installed pipelines would reduce the amount of water being supplied to farmers.	Negative	Reversible	Major to Significant	Medium-term to Long-term	<ul style="list-style-type: none">- Implement a comprehensive maintenance program to ensure that the pipeline's integrity is consistently maintained.- Implement corrosion protection measures, such as applying protective coatings or using corrosion-resistant materials.- Use high-quality materials during the construction of pipelines to minimize the risk of corrosion and other forms of degradation.	N/A operation and maintenance plan	BWA
Pseudomonas Development	Likely	Pseudomonas in pipelines over time could create a biofilm to facilitate the growth of pathogens and other harmful organisms in the pipeline. This could lead to compromising the quality of water being supplied and	Negative	Reversible	Significant	Long-Term	<ul style="list-style-type: none">- Use effective water treatment methods, such as chlorination, ozonation, or UV disinfection, to reduce bacterial loads, including Pseudomonas, in water systems.	Water Supply Management	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		lead to corrosion of the pipelines. The development of these harmful organisms threaten the health and safety of the consumers of the water being supplied as well as the agricultural produce that utilized the supplied water.					<ul style="list-style-type: none">- Regularly monitor and adjust the water treatment process to ensure its effectiveness.- Regularly clean and maintain water storage tanks and reservoirs to remove accumulated organic material.- Implement routine water quality monitoring programs to detect changes in microbial populations- Minimize water stagnation in pipelines and storage facilities, as stagnant water can create conditions favorable for bacterial growth.		



6.3 Component 3 – Construction of 7MW Solar Facility

6.3.1 The Construction Phase

Table 6-5: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Construction Phase of Project Component 5

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Poor drainage resulting in flooding and mosquito proliferation	Likely	Except that due care is taken, the already poor drainage situation across Barbados can be made worse by this project, creating situations of stagnant water as breeding grounds for mosquitoes leading to possible increase in dengue, chikungunya and zika.	Negative	Reversible	Major	Short-term to Long-term	<ul style="list-style-type: none">- Establish proper onsite drains during the construction period. Limit length of time small sections of the trenches are open.- Install silt traps to reduce the amount of silt runoff from construction area.- Workers must be trained on proper site clean-up activities and proper storage of construction material to minimize exposure of material available for contaminating the runoff.	Drainage Management Plan Pest Management Plan integrated within the Biodiversity Management Plan	BWA and Contractor
ECOLOGICAL									
Alteration/ Destruction of Terrestrial, Coastal and	Likely	The increase in noise levels due to machinery operation	Negative	Reversible	Minor	Long-Term	<ul style="list-style-type: none">- All vegetation clearing activities should be remedied by the replanting of trees.	Biodiversity Management Plan	Barbados Water Authority and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
Marine Habitats		and construction activities may affect sensitive fauna. Excavation may impact organisms that live in the soil.					<ul style="list-style-type: none"> - Any identified sensitive ecological sites should be clearly demarcated. - All workers should be sensitized to the area's ecology and conscious of how to maintain the ecological environment, minimizing pollution and habitat destruction 		
Environmental Pollution from soil waste (soil contamination)	Likely	Construction waste if not disposed properly, when introduced into the environment could lead to degradation and habitat disruption. Pollution would reduce the aesthetic capacity of the environment and would impact businesses that rely on the environment for operations. With precipitation events frequenting Barbados, the improper disposal of waste from construction activities would potentially be transported via stormwater drainage, possibly seep into	Significant	Reversible	Moderate	Long-Term	<ul style="list-style-type: none"> - Ensure there are designated areas for construction waste. - Waste collection containers should be clearly labelled and not be accessible or attractive to pests or vermin. - Tracking of waste produced and disposal method, no burning of trash. - Borrow pits- sand, gravel will be needed for construction and impacts of the borrow 	Waste Management Plan	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>and pollute groundwater reserves as well as be emptied into sea, affecting the coastal ecosystem.</p> <p>The removal of large amounts of soil for borrow pits can result in increased erosion, impacting the stability of nearby slopes and water bodies. Excavation activities may also expose underlying groundwater, leading to potential contamination from pollutants present in the extracted materials.</p>					pits will need to be managed, ensure only approved borrow pits are used, that have mitigation plans		
Environmental pollution (water contamination)	Likely	<p>Construction and landscaping activities could result in sediment runoff that could be washed into any nearby water bodies. The erosion of the soil during these activities, if not controlled, reduces the integrity of the area leading to instability and further risks to health and safety on the construction site.</p> <p>The absence of toilets on construction sites may lead</p>	Negative	Reversible	Moderate	Medium-Term	<ul style="list-style-type: none"> - Construct silt fences to reduce the likelihood of soil erosion as well as the run off of sediments into any nearby water bodies, particularly the Graeme Hall Swamp. - Ensure that there are sufficient mobile toilets on site for workers to prevent human waste being introduced directly into the environment. 	<p>Waste Management Plan</p> <p>Drainage Management Plan</p>	BWA and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		to the introduction of human waste into the environment. However, chemical or portable toilets, which use chemicals to break down waste, are commonly used on construction sites. If, and if the contents of these toilets—including human waste and chemical additives—are not properly disposed of, groundwater and soil may get contaminated.					<ul style="list-style-type: none"> - Proper waste management practices should be implemented, including regular emptying and servicing of toilets, proper disposal of waste and chemical additives. 		
Pest Proliferation	Not likely	The potential for still collection of water in either open containers on site or ponding in construction zones could catalyse the rapid growth of pests, especially mosquitos which have been identified in the stakeholder engagement process	Negative	Reversible	Minor to Moderate	Short to Medium Term	<ul style="list-style-type: none"> - Ensure that no open containers are kept on site that could be used for the storage of water. - Empty, drain or cover all open containers containing water. 	Biodiversity Management Plan	Contractor
SOCIAL									
Traffic Congestion	Very Likely	Works will cause disruption to routine traffic routes and there is the potential for congestion caused by	Negative	Reversible	Moderate to Significant	For the duration of the	<ul style="list-style-type: none"> - Ensure that proper signage and traffic wardens are in place. 	Traffic Management Plan	Contractor in liaison with the Ministry of



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		construction activities, material transport, etc. As well, alterations in traffic routines can lead to possible accidents.				Construction Phase	<ul style="list-style-type: none"> - Identify alternate routes. - Inform public of proposed works and the possibility for traffic congestion and disruption. - As best as possible, limit works in peak traffic hours. 		Transport and Police
Disruptions to mobility, movement and traffic	Very Likely	<p>Any disruption to movement, mobility and traffic flow is likely to affect access to and from local services including education and health services for local residents and other users. There will also potential disruption to commercial activities for several small and medium sized businesses.</p> <p>As businesses noted this has implications for their customers and ultimately income flow. For DHL, specifically this has implications for their greater mobility in the area</p>	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Engage businesses and residents in the area to discuss how they will function during the period of disruption and determine alternative solutions to the foreseen issues. - Proper signage and engagement of traffic wardens. - Engage the Ministry of Transport and the local Police to work with Contractor to address the issue of mobility for all road users. 	<p>Traffic Management Plan</p> <p>Stakeholder Engagement Plan</p>	Contractor in liaison with the Ministry of Transport



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		across Barbados and could potentially require them to change routes and or have to bring on additional staff to address the additional time deliveries may take.							
Business Disruption	Likely	The disruption of main transportation routes limit access to businesses in the project area.	Negative	Reversible	Moderate	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that alternative routes are identified and shared with the public so community access is not largely restricted. - Establish a line of communication between the works and business owners in the communities (including project landing page). - Promote the use of the Grievance Mechanism to ensure there is a means by which business owners, and the general public can share opinions and concerns. 	Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area Access to Community Management Plan Grievance Redress Mechanism	BWA and Contractor
Available Employment	Very Likely	Construction activities may require the hiring of skilled local labour	Positive	Reversible	Moderate	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that all genders are represented in the labour force. 	Labour Management Plan Code of Conduct	BWA and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							<ul style="list-style-type: none"> - A code of conduct should be implemented and observed. - Mechanisms should be in place to address any issues of gender related violence or worker conflicts. 		
Poor Worker Health and Safety	Likely	<p>Dust, noise and vibrations from construction activities and from the use of heavy machinery and equipment both on site and for material transport could prove a nuisance to workers in the project area.</p> <p>Operating heavy machinery and equipment can result in accidents, especially if proper safety protocols are not followed. Other accidents are also a possibility on site, related to over heating, diseases on site, etc</p> <p>Extreme weather conditions, especially a</p>	Negative	Reversible	Moderate to Significant	For the duration of the Construction Phase	<ul style="list-style-type: none"> - Ensure that all workers are trained on effective health and safety procedures. - Ensure all vehicles are frequently maintained. - Ensure all workers are provided with the necessary personal protective equipment (PPE). - A first aid kit must always be present on site and fully stocked. - Implement the Accident/incident response plan. 	<p>Worker Health and Safety Management Plan</p> <p>Noise Management Plan</p> <p>Accident/incident response plan</p>	Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		<p>spike in temperatures, pose a health hazard to workers</p> <p>Failure to use or inadequate use of PPE, such as hard hats, gloves, and safety glasses, can increase the risk of injuries.</p> <p>High risk activities (welding, working at heights, working in confined spaces)</p>					<ul style="list-style-type: none"> - Shade and water should be provided to workers, as well as mobile toilets. - Implement a rotational schedule to prevent workers from being overly exposed to dust and noise. - Proper signage should be present to identify health and safety risks and procedures 		
Damage to health injuries and safety issues to nearby residents and business owners	Likely	<p>There is a chance that members of the public could enter the construction site without permission and suffer harm. Therefore, these activities may have an effect on the health and safety of locals, and businesses in the area.</p> <p>There is also the possibility that construction equipment, as well as things falling from it, will accidentally cause serious or minor injuries to pedestrians and motorists.</p>	Negative	Reversible	Significant	Short-term	<ul style="list-style-type: none"> - Where necessary, members of the surrounding communities must be informed of the works and the associated health and safety risks. - Proper signage must be present to identify health and safety risks and procedures. - Fencing around sites, only authorized personal can enter the construction site area. 	<p>Community Health and Safety Management Plan</p> <p>Noise Management Plan</p>	Barbados Water Authority and the Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		Risk of people falling into the trenches							
Air and Noise Pollution	Very Likely	<p>Fugitive dust nuisance as a result of the construction works at the Plant as well as on the pipeline routes.</p> <p>Noise pollution from excavation, landscaping and other related general construction activities would prove a nuisance to the residents in the community surrounding the construction site.</p>	Negative	Reversible	Significant	Short-Term	<ul style="list-style-type: none"> - Frequent wetting should be done in the event of excavation and/or land clearing to prevent mass fugitive emissions. - Ensure all vehicles are frequently maintained. - Cover any stockpiles of material being used on the construction sites. - Covering of truck transporting fine material to the site. - Stakeholder engagement is critical before construction activities start to discuss with locals what to expect and how they can be mitigated. - Erection of barriers in between construction areas and sensitive receptor such as 	<p>Air Quality Management Plan</p> <p>Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area</p>	Barbados Water Authority and Contractor



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							wetlands and communities where possible. - Monitoring of noise levels throughout construction period. - Restriction of noisy activity within the daytime hours 8am to 8pm.		
Access hindered for businesses and residents to operate normally	Very Likely	The lack of access to business and to vendors would impact sales for both. In addition, with women possibly facing longer commutes to get children to school before starting work, vendors may miss peak times in sales (when their customers are on their way to work), and business sales can also decline, due to female staff members being late because of care responsibilities.	Negative	Reversible	Major	Short-term	- Engage community stakeholders both residents and businesses and discuss access for them during construction period.	Access to Community Management Plan Stakeholder Engagement Plan	Barbados Water Authority and Contractor
Child Labour/ Forced Labour	Very Likely	Materials essential for producing solar panels, including quartz and metallurgical grade silicon are often extracted using	Negative	Reversible	Major	Long-Term	- Ensure that a detailed review is done of the supply chain via which the parts required for the construction of the	-	-



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		forced compulsory labour associated with “detention camps, re-education, and human rights abuses” affecting indigenous and religious minority groups.					solar plant would be transported. Identify and avoid the importation of parts from areas notorious for high incidences of child and/or forced labour.		



6.3.2 The Operations Phase

Table 6-6: Impacts, Proposed Mitigation Measures, Management Plans and Responsible Party for the Operations Phase of Project Component 5

RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
PHYSICAL									
Storage of Waste Generated due to Expired Batteries and Panels	Likely	The improper disposal and storage of waste generated when the life cycles of batteries are expired could lead to the release of toxins into the environment. these chemicals can leach into the soil and groundwater, leading to the contamination of the environment.	Negative	Reversible	Moderate to Significant	Long-Term	<ul style="list-style-type: none">- Any expired batteries, panels, or other equipment at the solar facility should be stored in a designated area- The designated area for waste storage should be clearly demarcated and should restrict unauthorized access.- An approved contractor should be responsible for the collection and disposal of the waste generated and stored at the facility. Waste collection should be done in a timely manner to reduce the likelihood of chemicals leaching into the soil.	Waste Management Plan	BWA
Greenhouse Gas Emissions (GHG)	Likely	The operation of a solar plant would reduce the need for fossil fuel combustion for energy production. This would reduce the overall	Positive	Reversible	Significant	Long-Term	-	-	-



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		greenhouse gas emission of the area.							
ECOLOGICAL									
Artificial Lights from Solar Plant	Very Likely	<p>Any artificial lights it will emit could disrupt the behaviour and distribution of different species. This is especially significant for nocturnal species who rely on natural conditions to forage, navigate and communicate.</p> <p>Some organisms perceive lighting as an indication of safety and so may be attracted by the artificial lights, pulling them from their natural habitats and potentially placing them at risk.</p>	Negative	Irreversible	Moderate	Long-term	<ul style="list-style-type: none">- The construction design of the solar plant should include shielded or directing lighting fixtures that would aid in the minimization of light spillage and glare.- Use warm-colored (e.g., amber or red) lights with lower color temperatures, as they are less disruptive to wildlife compared to cool-colored (e.g., blue or white) lights. Warm-colored lights are less attractive to insects and are less likely to disorient nocturnal animals.- Reduce the intensity and duration of artificial lighting, especially during nighttime hours when it can disrupt natural cycles and	<p>Construction Management Plan (Solar Facility)</p> <p>Biodiversity Management</p>	BWA



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
							behaviours of nocturnal species. This can be achieved through the use of timers, motion sensors, and dimmers to control when and how much light is emitted.		
SOCIAL									
Panel Glare/Glint	Likely	The solar panels installed could induce visual impacts that affect nearby communities via glare and glint.	Negative	Reversible	Moderate	Medium-Term	<ul style="list-style-type: none">- Prioritize the planting of trees along the site boundary to act as a screen. This should be done in conjunction with preserving the existing vegetation found along the site boundary.- Source panels that are not prone to producing glare and glint.	Construction Management Plan (Solar Facility)	BWA and Contractor
Improved Energy Usage	Very Likely	Solar plants contribute to increasing access to clean and reliable energy. The reduced reliance on fossil fuels for energy generation is a step towards sustainable development –	Positive	Reversible	Significant	Long-Term	-	-	-



RISKS	PROBABILITY OF IMPACT	POTENTIAL IMPACTS	DIRECTION OF IMPACT	PERMANENCE	MAGNITUDE OF IMPACT	IMPACT DURATION	PROPOSED MITIGATION MEASURES	MANAGEMENT PLANS REQUIRED	RESPONSIBLE PARTY
		reducing the island’s carbon footprint.							
Health Benefits	Very Likely	Reducing the reliance on fossil fuels help to mitigate against air pollution, leading to public health benefits, particularly as it relates to respiratory illnesses and heat stress/stroke.	Positive	Reversible	Significant	Long-Term	-	-	-
Available Employment	Very Likely	Operation of the solar plant may require the hiring of skilled local labour.	Positive	Reversible	Moderate	For the duration of the Operations Phase	<ul style="list-style-type: none">- Ensure that all genders are represented in the labour force.- A code of conduct should be implemented and observed.- Mechanisms should be in place to address any issues of gender related violence or worker conflicts.	Labour Management Plan Code of Conduct	BWA and the Contractor

6.4 Cumulative Impacts

It must be recognised, however, that while the project implementation phase can have several negative impacts on lives and livelihoods, this project can realise some very positive and cumulative outcomes for the community and Barbados on the whole. In the short-term, the project will provide employment for labourers, engineers and contracts, and in the long term, Barbados would have a climate resilient and sustainable sewage system thus enhancing public health.

In particular, the proposed improvements would have several social and economic benefits:

- Improvement of the sewage system and the sanitation in Barbados, reducing the risk of waterborne diseases, avoiding the proliferation of solid and liquid waste and thus creating long-term benefits for public health and sanitation.
- The creation of employment and income opportunities for the contractors, engineers, and labourers involved in the project, as well as the suppliers of materials and equipment will be generally short-term benefits immediately associated with and derived from the contracted works activities. These will also have knock-on effects on the movement of people in the area, increased consumerism of local services including for those selling food and benefits to informal vendors in the vicinity.
- The expansion of the pipeline will contribute to a continued modernization and enhancement of the road infrastructure, potentially increasing some features, if the works are well connected and coordinated with the Ministry of Transport and Works, in terms of efficiency, and safety. For these benefits to be derived, any planned works for this portion of the ABC highway and the historic trailway should be integrated and aligned with the planned timing and scope of the pipeline.
- Possible disruptions to vehicular traffic in particularly may enable or foster alternative forms of mobility and modes of transportation including the use of public transport, cycling and walking which would have benefits for economic health, social engagement and also the reduction of greenhouse gas emissions, as well as pressures from vehicular use that usually speed up the road maintenance cycle.

Along with the expected benefits, the different components of the Project would suggest that there are also expected negative consequences of the different activities required for the actioning of each Project component when compounded by some of the existing environmental and social conditions of the Project area.

The Graeme Hall Swamp has been disconnected from the sea due to the rarity with which the sluice gate is opened. There is, therefore, minimal interaction during high tide and this affects the biodiversity of the area. The swamp, which once was the breeding grounds for many saltwater fish, has since been deprived of its ability to perform that specific function due to its overgrown shrubbery and vegetation. With there also being a temporary outfall point in the swamp, the most recent sewage leak of 2018 exemplified the negative effects continual discharge into the swamp, leading to the loss of fishes and a notable change in the physical characteristics of the vegetation, with locals emphasizing their observations of the change in colour of the mahogany trees. The swamp retaining its role as a temporary outfall for discharge during the implementation of this Project and beyond would continue the alteration of the area's biodiversity. Furthermore, the additional artificial lighting of the reclamation facility would threaten the disruption of the behavioural patterns of organisms in the area, including in the swamp. Many simple organisms are photoreceptive in that they use light as an indicator of safety, food or reproductive opportunity, so may

be attracted from their habitats by artificial lighting. It is, therefore, important that mitigation measures are implemented to reduce the significance of the lighting and ultimately to reduce the compounding effect the operations of the treatment facilities may have on the swamp. Along with the environmental impacts that the Project may have, influencing the swamp's ecological state would prove to be a social issue as the swamp possesses cultural and socioeconomic significance, especially to those in proximal communities. Fishing is just one of the economic activities that was practiced in the swamp before conservation efforts drastically lessened. With the intention to emphasize conservation, the Project seeks to retain the swamp's cultural, ecological and socioeconomic importance.

Project Component 1, in particular, would prove the most threatening to the socioeconomic environment of the developed areas along the southern coast, in both the construction and operations phases. Considering the topographical nature of the area and the existing drainage issues, it is anticipated that the inability to manage drainage and waste on the construction site would contribute to environmental degradation and exacerbate the flooding issue. That improper waste collection and disposal could lead to the blocking of drains is an example of how failure to effectively manage waste on site could affect surrounding communities. Additionally, being located in a densely populated area, construction of the reclamation facility in particular would contribute to air pollutant emissions and noise – the large scale emissions of fugitive dust and noise generated by excavation and the operation of machinery and construction equipment would add to the emission of pollutants and noise generated from traffic and commercial activities that characterize the area. Both air and noise pollution may lead to severe health risks in workers and community members, so it is important that mitigation measures are effectively implemented, such as the provision of protective equipment to workers and community members, the constant wetting of the site where necessary and to avoid conducting works during early morning and late evening hours.

The potential for odours, as well as the proliferation of mosquitoes are both significant social impacts. With residents in the area already claiming to be suffering from a mosquito issue, the construction of the reclamation facility and installation of the pipelines could exacerbate the issue. It is important that during the works, no water is stored in open containers or is allowed to settle in pits on excavated lands as these prove to be prime environments conducive to the breeding of mosquitos. Unpleasant odours have also been reported as a source of discomfort with many pointing to the swamp, and others to the SCSTP as the source from which the odours emanate.

But perhaps one of the most highlighted potential impacts by stakeholders consulted and individuals included in the data collection process was the issue of traffic congestion and traffic diversion. Construction activities in both Project Component 1 and Project Component 2 would affect standard traffic flows, that are already considered less than ideal, and would require strategic planning to identify and disclose alternative routes and to restrict works to times outside of peak traffic hours. The ABC Highway in particular serves as the primary road network for transportation in the area and so any disruptions along the highway is bound to lead to congestion and confusion if effective measures fail to be implemented. Poor traffic management would also restrict access to essential services, businesses and cultural/heritage assets throughout the Project Area. However, despite these potential negative impacts, the Project will oversee positive changes, not just in the water and agricultural sector, but also to infrastructure. The installation of the pipeline along the trailway should be followed by the resurfacing and compaction of the route. This would provide a safe route for recreation and transportation, and would also be of socioeconomic benefit as more persons would be attracted to the use of the trailway for recreational purposes.

Other activities of the Project may also prove impactful to the social environment of the Project area. With the primary aim of the Project to reduce the impact of water scarcity and food insecurity by extension, the innovative management of sludge as a by-produce of wastewater treatment could further improve the island's capacity to produce sufficient, high quality agricultural products. Effectively managing sludge allows for the possibility of using it as fertilizing material to improve the quality of agricultural yields. Implementing such a tactic would reduce the frequency of the practice in which sludge is discharged into the environment, facilitating pollution and degradation. Because of the reliance on the environment by many Barbadian livelihoods, effective sludge management would not only prove beneficial to the physical environment but also to the social environment.

With both the BSTP and SCSTP having outfall points in coastal areas along the southern and southwestern coasts of the island, the compounded effect of effluent on coastal environments can be observed. Coastal environments in Barbados are home to critical coral species and endangered turtle species that would be at risk to untreated effluent introducing pollutants into the nearshore environment. It was reported by the BWA that the effects are minimized by nearshore currents that effectively sweep discharged effluent further offshore. However, it is still expected that a prolonged period of discharge into the coastal environment would be accompanied by adverse environmental impacts. As well, the disconnection between the sea and the Graeme Hall Wetlands due to the semi-permanent closure of the sluice gate is also culpable of affecting marine environments. This is as the disconnection leads to the disruption of crucial water and organism exchange between the freshwater and marine environments. With the Graeme Hall Wetlands serving as a temporary discharge point for the SCSTP, and the closure of the sluice gate, the degradation of the mangroves in the wetlands are exacerbated. The discharge into the wetlands are reportedly primarily done in the event of overflows, and the sluice gate is kept closed to prevent disruption to the tourism activities conducted in the area. As tourism is a significant contributor to the island's economy, it is beneficial that the Project seeks to reduce discharge into marine environments but instead treat effluent to a point where the treated wastewater can be used to recharge aquifers when not being distributed for agricultural purposes – maximizing the use of water in a period of water scarcity. However, while there still is the possibility that effluent would be discharged into coastal environments, it is important that a monitoring programme be implemented to identify key species and habitats, and how the operation of the treatment plant would have an impact on them.

The overall impacts of the Project will be beneficial upon successful implementation. However, it is important that management and mitigation measures are observed to minimize the effects of the potential negative impacts. Section II – The ESMP presents the different management plans that include recommended mitigation measures that if implemented should reduce the likelihood and magnitude of the identified potential impacts.

With the acknowledgement that different Projects may be ongoing within, close to or may include activities with identifiable impacts in the BA-L1063 Project area, it is important that effective coordination between Executing Agencies be established. This coordination must first emphasize the establishment of communication channels between these agencies that would facilitate the identification of overlapping risks and resource requirements, and would be the responsibility of the Project managers or coordinators. Stakeholder engagement is also recommended to better understand the cumulative impacts, both negative and positive, of potentially affected residential and economic communities. The nature of the proposed Project works may require the need for coordinating timelines to avoid the exacerbation of issues related to traffic, community and business access, heritage, utility disruptions, and health and safety risks (air, noise and water pollution). Coordination of this nature would ensure that project activities do not negatively influence each other or increase the risks to sensitive receptors identified for each Project.

7 CONCLUSION

The designation of the Republic of Barbados as one of the top ten water scarce countries in the world precipitates a need to create innovative ways to maximize the usage of its water resources to its fullest potential. Therefore, the construction of a water reclamation facility and the associated installation of over 30 km of pipelines would prove beneficial in multiple ways. Food insecurity in the island republic is also a well-documented concern that is intimately linked to the water scarcity issue. The facilitation of secondary and tertiary treatment of the influent wastewater would provide an additional supply of high-quality water, treated to identified international standards, for use in the agricultural sector in particular. As well, successful implementation of the Project will see periods in which the reclaimed water will be used to recharge aquifers. These components of the Project initiate a solution to the water scarcity issue, as well as the associated issue of food insecurity.

With emphasis being placed on ensuring that the physical and social environment remains uncompromised, it is acknowledged that the many benefits that would be reaped post successful implementation would be accompanied by potential negative impacts. The potential negative impacts or risks can be categorized in several thematic areas:

1. Disruptions to mobility, movement and traffic
2. Socio-economic dislocation and possible displacement
3. Disrupted access to services
4. Noise, dust and vibration
5. Environmental health issues with social impacts
6. Potential exploitation and harassment

The most anticipated impact from the Project activities is the disruption to road use and traffic flows brought on by the extent of the route along which pipelines will be installed as well as the proposed location of the reclamation facility. It is also recommended that special considerations be made to how waste from construction activities are managed to prevent their direct introduction to the environment. With the Project recognizing the ecological importance of the Graeme Hall Swamp, it is imperative that these management controls consider the possible impacts on the conservation of the swamp. In many cases, the aforementioned potential negative impacts cannot be completely prevented. Hence, the mitigation measures proposed should serve as limiters to the magnitude of the different impacts.

If all management controls are adhered to as best as possible, successful implementation of the Project will serve as one of the island republic's most notable step towards achieving water security, food security and climate resilience, whilst ensuring the development of the physical infrastructure does not compromise the existing physical and social environment.

SECTION II

THE ESMP

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 Introduction to the ESMP

The Environmental and Social Management Plan (ESMP) outlined in this chapter presents all the guidelines necessary to direct the environmental and social management and occupational health and safety of the Project, including, but not limited to: (i) the different environmental and social plans or programs that will comply with the environmental, social and health and safety requirements that are necessary to carry out the activities of the project works, complying with the policies and regulations of both the IDB and the national government, (ii) institutional obligations and responsibilities for the elaboration and implementation of the required measures, (iii) description of the environmental and social monitoring plan in the construction, operation, closure and post-closure stages of the project, identifying the expected results, the parameters to be measured, the places of measurement, the methods and tools used and the periods/frequency in which the measurements will be made, the costs, and the responsible institutions, (iv) implementation schedule of each of the proposed measures, define responsibilities and reference budget.

8.1.1 Objectives of the ESMP

The plan's overall goals are to:

- Describe the measures required to implement management and mitigation commitments made in relation to the construction and operational impacts identified in the ESIA;
- Specify the additional steps necessary to achieve good practice and approval conditions set forth by international funding organizations (IDB, etc.) and the Environmental Protection Department;
- Define the duties and responsibilities of the Project's environmental and social management organization;
- Ensure that the entire project team is aware of the environmental and social expectations and requirements.

All contractors and subcontractors shall comply with the provisions of the plan, as applicable, to the tasks they are employed to undertake.

8.1.2 Scope of the ESMP

This chapter presents the structure of the ESMP, which follows on from the identification of the potential environmental and social impacts and proposed mitigation actions identified in the ESIA for the proposed development of a reclamation facility.

The Environmental and Social Management Plan (ESMP) is made up of environmental and social management tools that satisfy the criteria outlined in the IDB's Environmental and Social Policy Framework as well as specific Environmental Management Plans (EMPs) that outline the systems and procedures that will be put in place over time by the IDB project team to ensure compliance with local and international standards. They outline precise action plans for waste management, emergency preparedness, community involvement, and environmental health and safety.

8.2 Alignment with the 2021 Nemus ESMP

The 2021 ESMP presented an overall assessment of the project's expected social and environmental impacts and risks. It outlined the measures to be taken during project implementation, the actions required for implementation, the allocation of institutional responsibilities and costs showing links with the overall project implementation plan as well as the performance monitoring and reporting procedures, in order to eliminate the identified environmental and social impacts and to mitigate risks. Thus, the ESMP presented several monitoring programmes:

1. Groundwater Monitoring Programme
2. Upgraded SCSTP Influent and Effluent Monitoring Programme
3. Marine Water Monitoring Programme
4. Odours Monitoring Programme
5. Grame Hall Wetland's Water Monitoring Programme
6. Grame Hall Wetland Ecological Monitoring Programme
7. Coral Reef Monitoring Programme
8. Rehabilitation Plan of the Graeme Hall Swamp
9. Occupational Health and Safety Plan
10. Disaster Management Plan
11. Waste Management Plan
12. Public Consultation – Internal and External Communication

These monitoring programmes include the methodology of sampling, registering and data processing as well as the indicators to be used for monitoring, the frequency with which they should be monitored and the party with responsibility for monitoring and preparing the relevant reports.

The ESMP that constitutes SECTION II of this document presents management plans that propose management and mitigation measures to be implemented to reduce the risk of the identified potential negative impacts of Project implementation. The management plans presented in the ESMP account for risks that were not explicitly identified and accounted for in the 2021 Nemus ESMP, with the exception of the Waste Management Plan (Chapter 9.4) and the Worker Health and Safety Plan (Chapter 9.6) that were substantiated by the integration of key aspects pulled from the associated 2021 monitoring programmes. As such, it is recommended that the Project considers the implementation of all the monitoring programmes presented in the 2021 ESMP, as well as the management plans presented in Section II of this report.

This method of integration and the accounting of previously unassessed risks was designed to ensure that all possibly identified risks were accounted for, leaving no gaps in the Environmental and Social Impact Assessment.

8.3 Key Environmental and Social Impacts and Mitigation

8.3.1 Construction Phase

The mitigation measures proposed for the Construction Phase primarily surround the following risks:

- Air Pollution
- Noise and Vibration Pollution
- Flooding

- Disruption of biological communities
- Social Conflict
- Health and Safety of Workers
- Interruption to Local Businesses and Livelihoods
- Gender Inequality in Workforce
- Community Road Safety
- Utility management and coordination

The ESMP for the construction phase includes the following plans to guide compliance with standards and policies as discussed above:

Environmental Health and Safety Management Plan - This comprehensive plan complies with IDB environmental and social policy framework. Additionally, it complies with Barbados' 2005 Safety and Health at Work Act. It gives special consideration to environmental and worker health and safety regulations, resource efficiency, and pollution control. It comprises every necessary requirement to keep track of the efficiency of the mitigating actions taken to lessen the negative effects of the activities carried out during the construction phase. All project components will be covered under this plan, and it outlines how construction waste, including any liquid and hazardous wastes, should be managed in compliance. Regarding the scope of its job, the Contractor will be accountable, but it is the Implementing Agency's responsibility to make sure the Contractor is in compliance with the plan.

- **Stakeholder Engagement Plan** - This plan is intended to manage social conflict that may occur as a result of the projects. It meets IDB's ESPS 1 and 10.
- **Security Management Plan** - This plan is intended to manage security during construction and operation. It meets IDB's ESPS 4.
- **Contractor Management Plan** - This plan is intended to guide how contracts are administered and managed. It meets IDB's ESPS 1.
- **Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area** - This plan is intended to manage impact on livelihoods while construction and maintenance works are carried out and to facilitate their success after the project is completed. It meets IDB's ESPS 1, 5 and 10.
- **Labour Management Plan** – This plan is intended to provide support for the hiring and management of labourers that is responsive to the local community and vulnerable groups. It meets IDB's ESPS 2 and 9.
- **Consultation and Participation Strategy and Grievance Mechanism** – This presents measures to be used for community engagement, dissemination of project information and grievance management and will be utilised as a key element in all the proposed management, monitoring and mitigation measures. It meets IDB's ESPS 1, 9 and 10.
- **Emergency Response Plan**
- **Utility Management/Coordination plan**

8.3.2 Operational Phase

It is not anticipated that the project's operating phase will have significant adverse effects. Results are anticipated to be mostly favourable after the project's construction phase is over. The ESMP for the operations phase of the project includes the Environmental Health and Safety Management Plan, the Consultation and Participatory Strategy and Grievance Mechanism which had been previously discussed in the Construction Phase of the project.

8.3.3 Management Plans

The following plans have been prepared for the identified environmental aspects and risks to the project:

1. Environmental Health and Safety Management Plan
2. Social Management Plan
3. Security Management Plan
4. Workers Health and safety plan
5. Emergency Response Plan
6. Contractor Management Plan
7. Labour Management Plan (including Code of Conduct and GBV Prevention)
8. Heritage Management Plan (including Chance Find Program)
9. Stakeholder Engagement Plan
10. Grievance Redress Mechanism

9 ENVIRONMENTAL HEALTH AND SAFETY PLAN

Chapters 9 to 16 present the Environmental and Social Management Plan (ESMP), which follows on the identification of the potential environmental and social impacts and proposed mitigation actions as detailed in the ESA.

The following plans have been prepared for the environmental health and safety risks identified:

- a) Water Quality Management
- b) Air Quality Management
- c) Noise Management
- d) Traffic Management
- e) Worker Health and Safety Management
- f) Community Health and Safety Management
- g) Access to the Community Management
- h) Emergency Response Management
- i) Biodiversity Management
- j) Sludge Management

An Operations and Maintenance Plan as well as Decommissioning of the STP would also need to be properly developed by the engineers as these all form an important part of the environmental health and safety management plan. These should be deliverables of the construction contract.

9.1 Water Quality Management

In addition to the existing ESMP, the following chapters below can be considered for water quality management.

9.1.1 Monitoring Standards

A review of the Barbados Environmental Protection Departments' requirements for marine water quality pollution prevention was completed. The EPA's Marine Pollution Control Act, CAP. 392A prescribes a list of pollutants and their prohibited concentrations. Standards for the list of pollutants have been proposed based on a comprehensive review of current international standards. Some of the proposed criteria are based on the Australian and New Zealand Environment Conservation Council Guidelines for Fresh and Marine Water Quality (2000). Table 9-1 illustrates the ambient marine water quality standards applicable to Barbados.

Table 9-1: Barbados Marine Water Quality Monitoring Standards

PARAMETER	STANDARD
Temperature (degrees Celsius)	15 - 35
pH	6.5 - 8.5
Conductivity ($\mu\text{S}/\text{cm}$)	800 - 2,500 $\mu\text{S}/\text{cm}$
Total Dissolved Solids ($\mu\text{g}/\text{L}$)	1,000,000
Total Suspended Solids (mg/L)	-
Salinity ($\mu\text{S}/\text{cm}$)	-
Dissolved Oxygen ($\mu\text{g}/\text{L}$)	> 6.5 (> 80% saturation)
Total Phosphorus ($\mu\text{g}/\text{L}$)	25
Turbidity	Clarity should not be reduced by 20%
Manganese ($\mu\text{g}/\text{L}$)	100
Copper ($\mu\text{g}/\text{L}$)	1000
faecal coliform (organisms/100 mL)	< 150
enterococci (organisms/100 mL)	< 35

* '-' suggests there is no recognized standard outlined in the referenced guidelines.

The prior ESIA and ESMP also outlines effluent quality standards which should be adhered to.

9.1.2 Monitoring Equipment and Stations

Monitoring should be done from source areas twice per month and should be taken offshore from primary construction and operation activities. The results at the end of the sampling period will be compared to the EPD standards.

9.1.3 Monitoring Frequency

During construction, monitoring will be carried out randomly twice per month during the first month or as stipulated by the EPD only along the sections that are under construction at the time. After the first month, once per month is recommended until the end of construction or maintenance activities.

9.1.4 Management and Mitigation Measures

In addition to the monitoring procedures, the Contractor will ensure that these measures are followed:

- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules, action by the Environmental Authority

- Record complaints and relevant responses
- Enforce the proper disposal of solid waste, hazardous materials and otherwise recyclable materials
- Ensure walkways are kept clean to prevent runoff discharge
- Ensure there is continuous monitoring and maintenance of STP and pipeline infrastructure

9.1.5 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the water quality monitoring system.

Table 9-2: Key Performance Indicators for Coastal Water Quality

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Equipment maintenance log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Twice per month or as stipulated by the EPD
Notice to stakeholders	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Effluent Quality and receiving Water Quality parameters within EPD standards	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

9.1.6 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR

for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.1.7 Data Analysis and Reporting

The sampled data will be compared to the EPD's standard for coastal water quality and included in the environmental monitoring report prepared and submitted to EPD. If there are any exceedances, this will be reported immediately to the EHS Manager to allow for the implementation of corrective measures or adjustment in management strategies based on the results and where practicable to the operations.

9.2 Air Quality Management

9.2.1 Monitoring Standards

Ambient air quality in Barbados is regulated using the Health Services (Nuisances) Regulations, 1969 and the Marine Pollution Control Act CAP. 392A, (MPCA). The EPD references international standards such as the World Health Organization guideline values and the United States Environmental Protection Agency National Ambient Air Quality Standards for the air pollutants: particulate matter, sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide and lead. These standards are outlined in Table 9-3.

Table 9-3: Air Quality Standards Extracted from the WHO Air Quality Guidelines 2021

POLLUTANT	STANDARD *µg - micrograms (One-millionth of a gram)
Particulate Matter (PM _{2.5})	10 µg*/m ³ annual mean 25 µg/m ³ 24-hour mean
Particulate Matter (PM ₁₀)	20 µg/m ³ annual mean 50 µg/m ³ 24-hour mean
Ozone (O ₃)	100 µg/m ³ 8-hour mean
Nitrogen Dioxide (NO ₂)	40 µg/m ³ annual mean 200 µg/m ³ 1-hour mean
Sulphur Dioxide (SO ₂)	200 µg/m ³ 1-hour mean 20 µg/m ³ 24 hour mean 500 µg/m ³ 10-minute mean
Carbon Monoxide (CO)	100 µg/m ³ 15-minute mean 60 µg/m ³ 30-minute mean 30 µg/m ³ 1-hour mean 10 µg/m ³ 8-hour mean
Lead (Pb)	0.5 µg/m ³ annual mean

9.2.2 Monitoring Equipment and Stations

Samples for particulate matter should be collected using calibrated pumps. The pumps should be placed at the approximate respiratory height of the individual(s) for a 24-hour period. The data obtained from the analyses of the filter should be expressed as the exposure levels of particulate matter (PM₁₀) using a Time Weighted Average (TWA). The results at the end of the sampling period will be compared to the EMA standards.

The Monitoring stations will be changed as the activities progress. The monitoring stations established will be based on the prevailing winds and most sensitive human receptors. Monitoring will be required both at the renovation of the South Coast Sewage Treatment Plant as well as along all the pipeline routes shown in Figure 5-2 during construction as well as maintenance activities.

9.2.3 Monitoring Frequency

Prior to the construction, a monitoring baseline will be established for both particulate matter and noise. This will involve continuous monitoring for a 24-hour period along the length of the proposed site.

During construction, monitoring will be carried out randomly twice per month during the first month or as stipulated by the EPD only along the sections that are under construction at the time. After the first month, once per month is recommended until the end of construction or during maintenance activities.

9.2.4 Management and Mitigation Measures

In addition to the monitoring procedures, the Contractor will ensure that these measures are followed:

General measures

- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules, action by the Environmental Authority
- Record complaints and relevant responses

Fugitive Dust Control Measures

- Cover haulage vehicles transporting aggregate, soil and cement
- Cover and/or wet onsite stockpiles of aggregate, soil etc., especially during windy and dry conditions
- Locate sources of dust away from sensitive receptors
- Ensure proper stock piling/storage and disposal of solid waste
- Wet cleared land areas regularly
- Wet dust suppression methods on unsealed roads must be implemented to prevent generation of nuisance dust.
- Provide workers with the necessary PPE e.g. dust masks, and ensure that they are worn correctly
- There must be strict speed limits on dust roads to prevent dust entrainment into the atmosphere.
- Restrict the dropping of material from height during loading and unloading
- Revegetate cleared areas immediately following construction to prevent loose soil from being blown away

Emissions Control Measures

- Operate well maintained vehicles and equipment
- All earth moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability.
- Backs of trucks transporting waste debris, soil need to be covered
- Construction vehicles and machinery shall not be left to idle when not in use.
- Maintain all generators, vehicles, and other equipment in good working order to minimise exhaust fumes.
- Limit use of roads in populated areas.

Odour Control

- Implement an effective odour control system. This mechanism should include some form of monitoring system to detect odour emissions outside of the plant. Scrubbers should be included in the construction design to facilitate the removal of odour-inducing particles from exhaust streams.
- The maintenance of equipment and infrastructure at the plant to minimize the likelihood of failures in odour control systems should be prioritized. Ensure workers are trained on the appropriate maintenance techniques.
- Ensure that a good community engagement mechanism that allows for the receipts of complaints to be addressed in a timely manner is maintained. There should be constant communication with affected communities is necessary to provide for the exchange of information in such events.

9.2.5 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the air quality monitoring system.

Table 9-4: Key Performance Indicators for Air Quality Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Equipment maintenance log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Twice per month or as
Notice to stakeholders	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Air parameters Quality within EPD standards	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Log of wetting frequency	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	stipulated by the EPD
Use of personal equipment gear	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of Complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly

9.2.6 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.2.7 Data Analysis and Reporting

The sampled data will be compared to the EPD's standard for air quality and included in the environmental monitoring report prepared and submitted to EPD. If there are any exceedances, this will be reported immediately to the EHS Manager to allow for the implementation of corrective measures or adjustment in management strategies based on the results and where practicable to the operations.

9.3 Noise Management

9.3.1 Monitoring Standards

There is no noise regulation in Barbados; however the Cabinet of Barbados accepted the Barbados Noise Policy, which essentially embraced the Community Noise Guidelines of the World Health Organization as

benchmarks. The Guidelines list the decibel levels at which people would be only minimally affected by noise. Table 9-5 below illustrates some of these recommended values.

Table 9-5: Noise Standards Extracted from the WHO Guidelines on Environmental Noise

SPECIFIC ENVIRONMENT	NOISE LIMIT/ L_{EQ} dBA	
Residential	Daytime: 55	Nighttime: 45
Commercial	24 hours: 70	
Industrial	24 hours: 70	

9.3.2 Monitoring Equipment and Stations

At the same stations where air quality samples are taken during construction, ambient noise measurements will be made concurrently. Noise will be measured using a sound level meter that has been calibrated. Before each survey, the meter will be calibrated, and the equipment's model will be made explicit.

The monitors will be placed 1.5 meters above the ground and no closer than 3 meters away from any reflective surface (such as a wall). The background or ambient noise levels that would exist in the absence of the facility or the source(s) of noise under examination serve as a broad representation of the noise level limit. Additionally, a calibrator that has been factory calibrated will be used to examine the instrument both before and after the survey.

9.3.3 Monitoring Frequency

Over the course of two to three minutes, noise level readings will be obtained, and the average (geometric mean) noise level will be recorded in decibels (dBA). During the building phase or the maintenance phase, these readings will be taken at the same time as the air samples.

9.3.4 Management and Mitigation Measures

In addition to the monitoring procedures, the Contractor will ensure the following noise reduction options are implemented where necessary:

- Provide workers with the necessary PPE e.g., hearing protection and ensure that they are worn
- Sensitize residents in the area to the types of activities that will take place ahead of the works and assign a liaison person with whom the residents can relate
- Ensure project activities are scheduled during working hours of 8:00 a.m. to 8:00 p.m.
- Maintain all equipment in proper working order to avoid excessive noise generation
- If complaints regarding noise are received from residents, consider installing partial screening around the noisiest activities and/or mufflers on noisy equipment
- Limit implementation of noisy works simultaneously and time intervals
- Frequent change of personnel that are employed for noisy works
- In case of complaints, they should be recorded, and appropriate action should be taken.

- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules, action by the Environmental Protection Department

9.3.5 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the noise monitoring system.

Table 9-6: Key Performance Indicators for Noise Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Equipment maintenance log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Twice per month or as stipulated by the EPD
Notices to stakeholders	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Noise parameters within EPD standards	Results Certificate	Contractor; Results to be presented to the Implementing Agency	
Log of complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Use of personal equipment gear	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

9.3.6 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform

the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.3.7 Data Analysis and Reporting

The sampled data will be compared to the EPD's standard for noise as well as the baseline data and the analysis will be included in the environmental monitoring report prepared and submitted to EPD. If there are any exceedances, this will be reported immediately to the EHS Manager to allow for the implementation of corrective measures or adjustment in management strategies based on the results and where practicable to the operations.

9.4 Waste Management

The primary goal of a Waste Management Plan is to enable proper waste management by identifying and categorizing waste intended for construction and operation stages, as well as specifying the tasks to be performed and responsibilities. Waste management includes operations such as waste disposal, storage, collection, transportation, sorting, and treatment, as well as its monitoring and planning. The Contractor is primarily responsible for the administration and supervision of waste management. The definitions used in solid waste management are listed below:

The IDB Guidelines for Community Health, Safety and Security (ESPS 4) outlines that hazardous materials and substances may include: explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; corrosive substances; chemical fertilizers; soil amendments; chemicals, oils, and other hydrocarbons; paints; pesticides; herbicides; fungicides; asbestos; hospital and pharmaceutical waste; used batteries; radioactive medical waste; some types of fluorescent light bulbs and ballasts; and polychlorinated biphenyls (PCBs) in electrical equipment, among others. These all present a risk to human health, community, and the environment due to their physical, chemical, or biological characteristics. The best way to mitigate against the effects of hazardous waste is to refrain from the use of hazardous materials.

9.4.1 Monitoring Frequency

In the anticipation that waste will be collected on a weekly basis, the monitoring of waste should be done weekly to ensure that all measures are being implemented and followed.

9.4.2 Management and Mitigation Measures

Metal, wood, old oil, lubricants and other oil derivatives, tires, plastic, paper and cardboard, glass, and organic waste are examples of the types of waste that are expected to be generated during construction yard operation and management. The waste generated during the operation phase is primarily due to the wastewater treatment plant's activities, specifically waste from preliminary and primary treatments, as well as sludge from secondary treatment. Other types of waste, including urban solid waste and hazardous waste, may be generated as a result of the operation and maintenance of the new SCSTP or pipeline.

While the Contractor will ensure that every effort is made to abide by the following mitigation measures during construction or operations in order to lessen the potential negative effects of inappropriate waste disposal and management, it is important that the project proponent identify, in an early phase, the waste

that construction works and the construction site will produce, to guarantee the correct implantation of waste management measures.

General Solid Waste Management

- Contain garbage and construction debris onsite until disposal at the approved municipal disposal site
- Prohibit burning of solid waste on project sites
- Create green areas and/or plant trees around the perimeter of the site to act as a visual screen, where possible. This could be applied to the SCSTP.
- Develop and implement waste management plan during construction phase
- Avoid solid waste becoming habitats for disease vectors
- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules, as required by the environmental authority – the Environmental Protection Department (EPD).
- Create a viable waste management system including worker training on storage, handling and disposal of wastes
- Consult local environmental and waste management authorities on applicable waste management practices and available companies for correct pickup and deposition. Waste produced through the life cycle of the project should be sent to an appropriate final destination, taking into account the solutions provided by the Barbados' entities and by licensed operators in the region, namely:
 - o Environmental Protection Department (EPD)
 - o Sustainable Barbados Recycling Centre (SBRC)
 - o Other private entities that may be required to contract
- Create a specific, clearly identified, waste collection area on the construction yards
- Ensure that containers have lids to prevent odours and to protect from natural events like rain

Spill Prevention and Hazardous Waste Management

- Environmental conditions must be included in any construction contracts, thereby making contractors accountable for preventing accidental spillages
- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules and action by the Environmental Authority
- Conduct preventive maintenance for vehicles and machinery to ensure integrity and reliability and reduce/avoid leaks
- Conduct any on site repairs on impervious surfaces.
- Ensure proper handling, use and storage of all chemical and hazardous waste according to best practices:
 - o Provide spill containment and cleanup equipment on site

- Personnel handling chemicals and hazardous substances must be trained in the use of spill prevention measures
- Personnel handling chemicals and hazardous substances must be trained in the correct use of the appropriate Personal Protective Equipment (PPE)
- Utilise the proper dispensing equipment
- Storage areas must be well marked with appropriate signage.
- All hazardous substances must be stored on an impervious surface in a designated bunded area, able to contain 110 % of the total volume of materials stored at any given time.
- Fuel and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. There shall be no storage fuel on the project site. Fuel must be brought to the project site each day that Work is performed.
- Clean up any spills (including existing spills) immediately, through containment and removal of product and appropriate rehabilitation or disposal of contaminated soils
- All hazardous waste must be disposed of at a registered hazardous waste disposal facility, which is under the Barbados Sanitation Service Authority or stored in designated, lined and bunded areas as approved by the Environmental Protection Department
- Handling and disposal of hazardous waste is only conducted by trained personnel wearing the correct PPE
- Any spilling incidents must be reported as soon as possible.
- Ensure proper handling and disposal of asbestos material:
 - Asbestos material, such as can be found in old pipelines, is a deadly carcinogen that should only be handled by licensed asbestos abatement professionals.
 - When handling asbestos trained personnel must seal off the work area with plastic sheeting to prevent contamination outside. Surfaces that do not need abating must be covered in plastic sheeting.
 - Warning signs must be posted to alert others that an asbestos project is underway.
 - Wear Personal Protective Equipment such as an N-100 or P-100 respirator and protective clothing to prevent asbestos exposure.
 - Asbestos-containing materials should be wetted prior to any removal efforts. Once removed it should be double bagged in 6-millimeter plastic bags and enclosed in a plastic, leak-tight container with a lid and proper labelling. It can only be disposed of in an appropriate way at the designated landfill as advised by the Sanitation Service Authority.
 - Decontamination enclosure areas must be provided to allow workers to remove contaminated clothing, shoes and tools.

Pesticide Use

- Refrain from the use or the promotion of the use of Class 1A and Class 1B pesticides for pest control or vegetation maintenance.
 - o Class 1A pesticides are classified as extremely hazardous by WHO as they are highly toxic to humans and pose a significant risk of acute poisoning, even at low levels of exposure. Examples of these pesticides include some organophosphates and carbamate insecticides.
 - o Class 1B pesticides are classified as highly hazardous by WHO. While not as toxic as Class 1A pesticides, they still pose significant risks to human and environmental health. Examples include some organophosphates and pyrethroid insecticides.
- Regulate the use of Class 2 pesticides that are classified as moderately hazardous by WHO.
 - o Ensure compliance with the use regulations of this type of pesticide as stipulated by the EPD or other relevant regulatory bodies.
 - o Favour pesticides with lower environmental toxicity and persistence where possible. Factors to be considered include active ingredients, formulation, method of application and potential for runoff.
 - o Ensure appropriate PPE are provided for use in conjunction with the use of this type of pesticide.
 - o Avoid pesticide use during windy and/or rainy periods which would increase the risk of environmental contamination.
 - o Establish no-use zones of pesticides around sensitive areas, such as water bodies, wildlife habitats and residential areas.
 - o Maintain accurate records of pesticide use and application schedules to prevent overuse.
 - o Provide training for workers on effective and appropriate use of pesticides.

Sludge Handling, Disposal and/or Recovery

- To assess the better way to manage sludge from the new SCSTP activity, a cost-benefit analysis should be carried out to assess which is the best economic investment with environmental benefits (lower footprint carbon and GHG emissions).
- Consult local environmental organizations and waste management authorities on applicable waste management practices and available companies for correct handling and disposal.
- Consider a solution that allows the harnessing of energy from the primary solids and waste secondary biomass.
- See Sludge Management Plan: Chapter 9.11.

Waste Generated at Solar Facility

- Any expired batteries, panels, or other equipment at the solar facility should be stored in a designated area
- The designated area for waste storage should be clearly demarcated and should restrict unauthorized access.
- An approved contractor should be responsible for the collection and disposal of the waste generated and stored at the facility. Waste collection should be done in a timely manner to reduce the likelihood of chemicals leaching into the soil.
- Collaborate with waste management companies, recycling facilities, and other stakeholders to optimize waste management processes and explore innovative solutions for waste reduction and recycling.
- Provide training and education to staff and contractors on proper waste management practices. This can include instruction on waste segregation, handling hazardous materials, and ensuring compliance with waste management regulations.
- Implement a system to monitor waste generation, recycling rates, and disposal practices regularly. This allows for the identification of areas for improvement and ensures accountability in waste management efforts.

9.4.3 Key Performance Indicators

The following Key Performance Indicators (KPIs) have been selected in order to evaluate the effectiveness of the solid waste management system.

Table 9-7: Key Performance Indicators for Waste Management

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
No construction waste deposited on the roadways or in nearby vegetated areas (waste disposal in proper containers , no waste on the ground in the site)	Site Inspection	Contractor; Results to be presented to the Implementing Agency	Twice per month
No leakages or spills	Monitor possible spills Inspection of site by Contractor	Contractor; Results to be presented to the Implementing Agency	
Limited sediment-laden run-off during heavy rain	Monitor nearby/downstream wells and water bodies for significant sediment deposits	Contractor; Results to be presented to the Implementing Agency	

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Approved Contractors	Inspection of licenses and documentation	Contractor; Results to be presented to the Implementing Agency	
Re-siting, Stockpiling/Storage	Less construction waste being delivered to the dump	Contractor; Results to be presented to the Implementing Agency	
Sludge managed properly	Inspection of site by Contractor	Contractor; Results to be presented to the Implementing Agency	
Pesticide Log and Schedule	Inspection of site by Contractor	Contractor; Results to be presented to the Implementing Agency	Bi-annual
Recycling Rates	Inspection of recycling records	Contractor; Results to be presented to the Implementing Agency	Annual

9.4.4 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted, or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.4.5 Data Analysis and Reporting

If there are any exceedances, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.5 Traffic Management

9.5.1 Monitoring Standards

Recommendations received from the Ministry of Transport, Works and Water Resources will serve as the standards to be adhered to during activities that will impact the normal flow of traffic.

9.5.2 Monitoring Frequency

Monitoring will be carried out by the Ministry of Transport, Works and Water Resources according to the frequency that is stipulated in their authorization.

9.5.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to manage potential traffic disruptions:

General Measures

- Work should only be carried out in sections.
- “Work Ahead” / ‘Detour’ Signs should be used ahead of potential traffic disruptions.
- Material delivery to the site should be limited in peak traffic times during weekdays:
 - o 6-9 am
 - o 4-7 pm
- Advertisements should be placed in the media before the roadworks will take place. Notices should also be posted/shared as regularly as possible or when required to communicate on any issue that may lead to disruptions in traffic flow.
- Avoid blocking entrances to businesses.
- Cuts in the road should be filled as soon as works in the area is completed so as to avoid disruptions in movement of traffic and erosion in case of heavy rains.
- Dirt/ debris should not be stored on sidewalks or roadways.
- Wherever works are taking place pedestrian and vehicular traffic must not be completely obstructed. The use of flag men will be required.
- Before the start of construction works, develop and distribute an initial project information packet to business owners and community leaders.
- Alert businesses about local construction works two weeks in advance (or a stipulated time frame as agreed between local businesses and the Contractor) and of any changes in the initial scheduling.
- Promote the efficient and effective use of the Grievance Redress Mechanism including timely responses linked with the use of a Community Interaction Form signed off on by all parties including the contractor and the person who engages.
- Implement the use of proper signage; construction vehicle speed limits; training of drivers; maintenance of construction vehicles, and use of traffic wardens.

- Establish procedures for the transport of equipment and heavy loads, a protocol for reporting vehicle accidents and a log for traffic related incidents.
- Establish a Project community road safety awareness for residents living close to the road and for workers and a monitoring mechanism to ensure effective implementation of the plan.

Mitigating Impacts to Informal Vendors and Businesses

- Ensure that all the informal vendors and businesses identified as being at risk to Project activities are appropriately engaged with, informing them of said activities and the proposed plans to protect their livelihoods.
- Identify and reserve areas where vendors could be relocated to if necessary.
- Establish walkways to ensure pedestrian access to businesses along the route.
- Liaise with formal businesses (such as the Kooyman Megastore) to assess and develop alternative entry and exit routes to ensure they can be accessed without much difficulty.

9.5.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the traffic management system.

Table 9-8: Key Performance Indicators for Traffic Management

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Detour signs	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	As stipulated by the MTWWR
Advertisements in the media	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Flag Men	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	
Accidents/ near misses	Inspection of site and review of incident log	Contractor; Results to be presented to the Implementing Agency	Weekly

9.5.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.5.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.6 Worker Health and Safety Management

The nature of the activities to be undertaken during the implementation of this Project typically presents occupational health and safety hazards, especially to those primarily involved in the construction activities. Exposure to these risks can result in physical injuries and pain, chronic respiratory diseases (e.g., asthma, COPD), musculoskeletal disorders, noise-induced hearing loss, and skin problems, among other things. These pose a significant threat to the overall well-being of workers. Thus, in order to reduce such risks and preserve workers' health, the current chapter focuses on the management and mitigation measures that are recommended to be followed to reduce risk to worker health and safety.

9.6.1 Monitoring Frequency

Monitoring will be carried out by the Contractor daily to minimize possible incidents.

9.6.2 Management and Mitigation Measures

The mitigation measures presented in this chapter addresses the risks posed by different occupational health and safety hazards, as outlined in the 2021 Nemus ESMP. These hazards include:

- ❖ falling from heights or into pits and trenches,
- ❖ injuries from the projection of fragments of rocks or falling objects,
- ❖ slips/trips and falls (especially while carrying heavy loads),
- ❖ musculoskeletal injuries (especially of the back) resulting from lifting and moving heavy loads,
- ❖ injuries caused by the circulation of vehicles,
- ❖ hearing impairment/loss,
- ❖ exposure to dust and air pollution,
- ❖ chemical hazards from exposure to various chemicals,
- ❖ injuries from the operation of heavy machinery, medical health cases and electrocution,
- ❖ exhaustion and/or dehydration.

The Contractor will ensure that these mitigation measures are followed during construction and operational activities:

- The contractor must have a health and safety policy that is known and understood by all workers. It must be visible to the workers on site.
- It is recommended that a workers code of conduct be developed and a training program for workers on the Code of Conduct be implemented.
- The health and safety policy must explicitly state a minimum working age of 18 years, especially for those responsible for conducting hazardous work, such as the removal of old pipelines, handling chemicals and operating heavy machinery.
- Clearly stipulate the key principles in operation at key areas on site.
- Provide fair compensation and treatment of workers for work done.
- Establish a reasonable and adequate work schedule.
- Provide equitable and ethical terms and conditions of employment for workers.
- Provide safe and acceptable working conditions, including securing worker health and safety.
- Inform the employees of the occupational risks and preventative measures that must be taken to address these risks.
- Inform workers of their legal rights and obligations and provide them with the necessary training on Project occupational health and safety.
- Ensure all workers have the required personal protective equipment required of them to work on the Project and to regularly monitor to ensure compliance.
- Perform routine checks of health and safety equipment to ensure that they proper functioning.
- Assign an officer with responsibility for worker health and safety.
- Construction areas should be clearly demarcated with safety signs and barriers to prevent possible incidents.
- Clear labelling of hazard risks on the construction site will be critical.
- Workers should be properly trained in the proper use of construction equipment.
- All workers must be trained in the proper use of all health and safety equipment.
- Contractor has procedures for high-risk work activities, working at heights, working in trenches, working in heat, hot works, confined spaces, etc.
- All workers must be trained in the proper handling and management/ disposal of all types of waste.
- Workers should be protected from all forms of exploitation, abuse as well as harassment and have access to tools and systems to seek redress.
- The contractor EHS Manager/ Officer shall maintain a register of all EHS related incidents that have occurred as a result of the activities associated with the contract. EHS incidents that should be

recorded include fires, accidents, spills of hazardous materials that contaminate soil or water resources, stop-order notices issued by any Regional Corporation or any other relevant agency, non-compliance with this ESMP.

- The CONTRACTOR must promptly report in writing to the EMPLOYER all accidents whatsoever arising out of, or in connection with, the performance of the Work, whether on or adjacent to the Site, which caused death, personal injury or property damages, giving full details and statements of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately, to the EMPLOYER.
- EHS incident reports will include as a minimum, a description of the incident, actions taken to contain any damage to the environment, personnel or the public, and the corrective actions to repair/remediate any damage;
- All construction plant and equipment, tanks and machinery shall be maintained in a good state of repair throughout the construction period
- Equipment maintenance will be carried out on an impermeable surface
- Leakage from equipment will be prevented by regular inspection and repair
- Areas under construction should be clearly demarcated.
- Emergency medical supplies must be available and easily accessible in the case of an incident.
- In the event that the onsite medical supplies are not adequate, the incident needs to be escalated to the hospital – an accident/incident response plan should be easily accessible to all workers
- Ensure adequate mobile toilets are easily accessible for workers.
- Ensure drinking water and access to shade for breaks.
- In the event that a worker is exposed to hazardous material they should immediately be taken for medical attention.
- Label and isolate exposed electrical wires, keeping them far from busy areas.
- At least two persons will always be present when work is being carried out on electrical equipment. No attempt will be made to service or adjust unless another person capable of rendering first aid and CPR is also present.
- Irrigate construction work sites frequently.
- Arrange for initial and periodic medical examinations.
- Define and delineate road access routes.
- In the event of a road accident involving BWA employees or contractors:
 - o The EHS Manager and the Police will be contacted immediately with details of the location and nature of the incident,
 - o The accident site will be cordoned off to keep the public at a safe distance from the scene and to allow easy access for first responders and emergency services,

- If it is safe to do so, first responders under the guidance of the EHS Manager will remove victims of the crash and place them in an area where they can receive first aid treatment and assessment. Victims should be moved as little as possible until the extent of their injuries is determined,
- Vehicles involved in the crash are not to be moved until the Police arrive,
- Victims will be moved to a hospital or medical centre if required,
- If members of the public are involved in an accident which has occurred as a result of a BWA employee or contractor, the injured persons will either be given first aid and/or taken to the nearest hospital for treatment, depending on their injuries, and
- Details of the accident including how it was caused, number of persons involved, police reports, etc. will be recorded by the EHS Manager.

9.6.3 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the health and safety management system.

Table 9-9: Key Performance Indicators for Worker Health and Safety Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONIORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Health and Safety Policy including workers code of conduct and procedures for high risk activities (working at height, working in trenches, hot works etc)	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Daily
Health and Safety Signs	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	
Training log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Register of all EHS related incidents	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Equipment maintenance log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONIORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Emergency Kit (one in each site office)	Inspection of site offices	Contractor; Results to be presented to the Implementing Agency	
Accident/incident response plan	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
GRM for workers	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

9.6.4 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that the health and safety management policy is clearly understood by all workers and that all mitigation measures are carried out and that monitoring reports are prepared. The Contractor should ensure that an Environmental Health and Safety (EHS) Manager is employed to oversee the specific requirements of this plan.

It is the responsibility of the EHS Manager to ensure that the health and safety requirements are clearly communicated with all workers. The EHS Manager will serve as the duty-bearer for the site.

It is the responsibility of the workers to ensure that they understand the health and safety requirements and that they abide by them.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed non-compliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.6.5 Data Analysing and Reporting

If there are any violations, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.7 Community Health and Safety Management

Major health concerns were raised by residential stakeholders based on the proposed works. Many noted, particularly those residing in the Graeme Hall area that mosquitoes are a major concern. Existing drainage issues could potentially be exacerbated by the proposed construction. This could enhance the environmental conditions to increase mosquito populations in these areas. Rising mosquito populations could have proportional rise in vector transmitted diseases like dengue among these populations.

While mosquitoes were the primary concern for residents, dust and noise were also noted. The impact from both were more concerning for the more vulnerable members of these areas such as babies, the elderly and the infirmed as there is the possibility to exacerbate undergoing or underlying ailments and conditions.

9.7.1 Monitoring Frequency

Monitoring will be conducted daily by the Contractor to minimize possible incidents.

9.7.2 Management and Mitigation Measures

The Contractor will ensure that the following mitigation measures are followed during construction and operational activities:

- Perform routine checks of health and safety equipment to ensure that they are properly functioning to prevent accidents that can negatively impact the public.
- Regular communications made on tv/radio and via signs of the ongoing works and possible risks including mosquito and other vector-borne risks.
- Assign an officer with responsibility for community health and safety.
- Construction areas should be clearly demarcated with safety signs and barriers to prevent possible incidents including information to report any issues or incidents that may occur.
- The contractor EHS Manager/ Officer shall ensure that they utilize the consultation plan to inform community members of planned activities and safety protocols that must be adhered to. This should take place before the start of construction or maintenance works. The community and workers should be informed of the grievance redress mechanism that is to be utilized if there are any issues or complaints.
- The contractor EHS Manager/ Officer shall maintain a register of all EHS related incidents that have occurred as a result of the activities associated with the contract. EHS incidents that should be recorded include fires, accidents, spills of hazardous materials that contaminate soil or water resources, stop-order notices issued by any Regional Corporation or any other relevant agency, non- compliance with this ESMP.
- Each EHS related incident will be investigated by the client's EHS officer and an incident report forwarded to the contractor. An incident report will be presented within five working days.
- EHS incident reports will include as a minimum, a description of the incident, actions taken to contain any damage to the environment, personnel or the public, and the corrective actions to repair/remediate any damage.
- All construction plant and equipment, tanks and machinery shall be maintained in a good state of repair throughout the construction period.

- Equipment maintenance will be carried out on an impermeable surface.
- Leakage from equipment will be prevented by regular inspection and repair.
- Areas under construction should be clearly demarcated and restricted access to members of the community.
- Emergency medical supplies must be available and easily accessible in the case of an incident.
- In the event that the onsite medical supplies are not adequate, the incident needs to be escalated to the hospital.
- In the event that a community member is exposed to hazardous material they should immediately be taken for medical attention.
- Any holes dug and depressions caused by equipment or supplies are addressed in a timely manner to avoid creating opportunities for the breeding of vectors such as mosquitoes. Barbados is known to have incidence of several vector-borne diseases such as dengue, zika and chikungunya and in 2023 there were suspected carrier mosquitoes of malaria in selected areas.
- Grievance Redress Mechanism to address community concerns and to report issues of concern.

9.7.3 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the health and safety management system.

Table 9-10: Key Performance Indicators for Community Health and Safety Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Health and Safety Policy	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Monthly
Health and Safety Signs	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	
Log of Complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Register of all EHS related incidents	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Equipment maintenance log and schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Project landing page with relevant information for the community	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Emergency Kit	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly

9.7.4 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that the community is aware of planned activities and the health and safety protocols that they need to abide by for their protection and safety. It is important that all mitigation measures are carried out and that monitoring reports are prepared.

It is the responsibility of the designated Community Liaison Officer to act as a bridge between the project team and the community. This officer should always be aware of the project activities and the diversity of the community and should be linked to relevant local authorities, such as the People Empowerment Councils or the Ministry of Community Development, or an established and trusted NGO.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.7.5 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.8 Access to Community Management

9.8.1 Monitoring Standards

The works will be monitored by the Contractor.

9.8.2 Monitoring Frequency

Monitoring will be carried out by the Contractor as work progresses in the community.

9.8.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to manage access into the community and not disrupt the community from their normal daily routines:

- Prior to the start of works proper signage and safety guidelines with respect to site access and community access should be provided to the community in areas where works are planned, in accordance with the consultation plan.
- Appropriate location points should be identified and properly marked for the transfer and storage of construction material.
- The community should be given prior notice if access will be restricted.

9.8.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the community access.

Table 9-11: Key Performance Indicators for Access to the Community Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Inspection log and notes	Review inspection and of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly
Signage	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	
Notices	Review inspection and	Contractor; Results to be presented to the Implementing Agency	
Log of complaints	Review inspection and	Contractor; Results to be presented to the Implementing Agency	Daily

9.8.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that access to communities is not disrupted. If there is a potential challenge with access due to planned works, the contractor must ensure that all workers and community members are adequately aware and the alternative location points are clearly marked.

It is the responsibility of the Community Liaison Officer be assigned to review and respond to community feedback.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.8.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager and any incidents logged.

9.9 Emergency Response Management

This plan takes into account the multi-hazard exposure of the Project and recommends specific measures to be followed to minimize the potential impacts of the most threatening and likely to occur hazard. The plan consists also of measures fitting of an effective disaster risk management (DRM) approach.

9.9.1 Monitoring Standards

The works will be monitored by the Contractor based on adherence to the EPD's guidelines.

9.9.2 Monitoring Frequency

Monitoring will be carried out by the Contractor daily.

9.9.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place for effective emergency response: including have identified first responders for incidents and emergency numbers clearly visible on the site.

Hurricane

- Stay informed about hurricane forecasts and warnings.
- Store loose materials, equipment, and debris in a secure location or tie them down.
- Develop and communicate a hurricane emergency plan for all workers.
- Ensure there are first aid supplies, communication equipment, and emergency power sources available on-site.
- Regularly trim and maintain vegetation near the reclamation and solar facilities to reduce the risk of falling debris, wind damage and fire hazards during a hurricane. Ensuring tree limbs make no contact with electrical wires is also essential for the latter risk.

- Erosion control techniques (e.g., silt traps) would help with reducing the impacts of stormwater runoff and flooding. Where possible, retention ponds and permeable surfaces at these facilities would also reduce the risk of stormwater runoff and flooding.
- Have a clear plan for temporary shutdown or evacuation of the construction site in advance of a hurricane's arrival; ensure workers are informed of the plan and evacuation routes.
- The following measures should be considered in the design of the reclamation and solar facilities:
 - o Capitalize on the availability of natural resources and landscape for resilience. Such resources include elevated lands.
 - o Installing backup power systems, such as generators and battery storage, would ensure continuous operation of critical equipment and facilities during possible power outages during hurricanes.
 - o Hurricane-resistant features, such as reinforced roofs, impact-resistant windows and storm shutters should be considered in the design of the facilities to enhance structural integrity and resilience to wind and debris damage.

Fire

- In the event of a fire- there should be sufficient, available and well-maintained firefighting equipment.
- If the fire is too large, the fire brigade shall be called to extinguish it.
- Implement vegetation management techniques, such as creating firebreaks, to reduce the likelihood of fires and to allow for easy response in the event of one.
- Flammable materials must be stored in designated areas where access is restricted to authorized personnel only. These areas should be clearly demarcated and identified.
- Implement proper waste disposal techniques (see Waste Management Plan) and minimize the combustible materials stored on site and at facilities.
- The following measures should be considered in the design of the reclamation and solar facilities:
 - o Where possible, include fire-resistant materials and fire-rated construction techniques to reduce the risk of fire damage.
 - o Installing ember-resistant vents and non-combustible roof coverings would prevent fires from entering buildings and igniting combustible materials.
 - o Include in the design of the facilities fire suppression systems such as automatic sprinklers, fire alarms, smoke detectors and fire extinguishers to detect and suppress fires. Water storage tanks and maintaining easy access to allow for easy access to a water supply and external emergency response efforts would also reduce fire risks.

Heavy rainfall and Flood Prevention

- As much as possible work should not be done during the torrential rain.
- In the event of pending heavy rainfall, all equipment should be removed from near drains and rivers where it could be washed away.

- Electrical equipment should be stored at a level elevated above potential flood levels to minimise the risk of electrocution or flood damage.
- Workers must be trained in the requirements of the emergency preparedness and response plan.
- The following measures should be considered in the design of the reclamation and solar facilities:
 - o Facilities should be designed with flood-resistant infrastructure, included elevated buildings, flood barriers, retention ponds and vegetative buffers to reduce the risk of flood damage.
 - o Stormwater conveyance systems, such as culverts and storm drains, would aid in the safe conveyance of water away from facilities.
 - o Areas designated for the storage of pumps, generators or other electrical systems must be elevated above flood levels to prevent water infiltration and equipment failure.
 - o Flood monitoring and early warning systems at each facility, such as automated alerts in the event of heavy rainfall, to detect rising water levels would provide timely warnings to workers at these facilities so emergency response procedures can be actioned.

Earthquakes

- Use of flexible pipe joints and penetrations into tanks to prevent breakage from earthquake movements.
- Workers should be trained on effective response techniques to seismic activity, and drills should be conducted for the best practical simulation of these response techniques.
- All works should be done to local and international building codes and standards where possible.
- An emergency preparedness and response plan must be in place to cover man-made and natural hazards. Workers must be trained in the requirements of the emergency.
- In the design phase of the reclamation and solar facilities:
 - o Geotechnical assessments are recommended to identify potential seismic hazards, such as fault lines, liquefaction zones and soil instability.
 - o It is recommended that facilities be designed with earthquake-resistant features, such as reinforced concrete foundations and steel frame structures to withstand seismic forces. Construction of the facilities should be in compliance with seismic building codes and regulatory requirements.

Utility Disruption

- As much as possible, works should be done away from essential utility lines identified in the site assessment.
- In the event of any water disruptions: see Chapter 10.3.

9.9.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the emergency response measures.

Table 9-12: Key Performance Indicators for Emergency Response Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Maintenance Log	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Daily
Incident Log	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Employee Training Schedule	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Bi-annually

9.9.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that the emergency response measures are clearly understood by all workers and that all management and mitigation measures are carried out and that monitoring reports are prepared.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.9.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.10 Biodiversity Management

9.10.1 Monitoring Standards

The works will be monitored by the Contractor based on adherence to the EPD's guidelines.

9.10.2 Monitoring Frequency

Monitoring will be carried out by the Contractor (via a qualified environmental specialist) according to the frequency that is stipulated in the EPD's guidelines.

9.10.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to manage the flora and fauna in the construction area:

- Wetland areas should not be cleared and drainage into the Graeme Hall Swamp should be managed with silt traps and other mechanisms to reduce the impact of poor water quality and siltation on the protected area.;
- All construction sites should be clearly demarcated; no clearing of vegetation, storage of materials or other construction related activities shall be permitted outside the demarcated construction area.
- Areas where priority plant species are growing must be demarcated as no-go zones; in the event that the uprooting of trees (such as the palms lining sections of the ABC Highway and fruit trees planted along the historic railway), replantation must be prioritized to conserve the biodiversity of the area. Temporary physical protection measures around the base of the trees, such as tree guards or fencing, to prevent damage from construction activities should be considered.
- Establish an appropriate drainage network to prevent further runoff into the Grame Hall Wetlands.
- Effective implementation, monitoring and enforcement of National Environmental Policy, and the National Pollution Rules, and the National Biodiversity Strategy and Action Plan
- Avoid indiscriminate habitat destruction and localise the proposed development as much as possible (including support areas and services).
- Ensure that proper handling, use, storage and disposal of all chemicals are done according to best practices and are not near or at water courses or waterbodies
- Have spill containment and clean-up equipment on site and dispose of waste in accordance with best practices
- Report and clean accidental spills immediately; contaminated soils must be removed and disposed of at a registered disposal site.
- Properly maintain and service equipment.
- Refuelling should not be done near vegetated areas.
- Limit activities that may prove a nuisance to animals to short time frames.
- Appropriate lighting fixtures and shades be included in the construction design of the reclamation facility to limit light spillage and glare that may disrupt behavioural patterns of nocturnal animals.
- The use of timers, motion sensors, and dimmers to control when and how much light is emitted should also be included in construction design to control light spillage.
- Engage with the local communities and stakeholders to raise awareness about the importance of biodiversity conservation.

- Implement biodiversity monitoring programs to assess the impacts of the treatment plant on local ecosystems, including the Graeme Hall Wetlands. Schedule training sessions for workers at the treatment plant focused on awareness and best practices for biodiversity conservation.

9.10.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the community access.

Table 9-13: Key Performance Indicators for Biodiversity Management

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
No major losses to priority species	Review and inspection of documentation/ ecological monitoring reports	Contractor; Results to be presented to the Implementing Agency	As outlined in EPD Guidelines
Signage	Inspection of the site	Contractor; Results to be presented to the Implementing Agency	
No overspill into wetland areas	Inspection of site	Contractor; Results to be presented to the Implementing Agency	
Tracking of status of wetlands	Weekly inspection of wetlands	Contractor; Results to be presented to the Implementing Agency	

9.10.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure all workers are made aware of the importance of following the management and mitigation and that monitoring reports are prepared.

The Implementing Agency: Barbados Water Authority is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding wetland will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

9.10.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager to allow for management strategies to be changed according to the results.

9.11 Sludge Management Plan

Figure 9-1 summarizes the sludge management process and Class B Biosolids, via this process, are expected to be the product of the process. This class of biosolids are a category of treated sewage sludge that meets the regulatory requirements for land application due to their nutrient-rich organic material content. However, Class B Biosolids contain higher levels of pathogens when compared to Class A Biosolids and so effective measures must be implemented to reduce the risk of pathogen transmission in humans and animals, contaminating surface and groundwater, and affecting soil and ecosystem health.

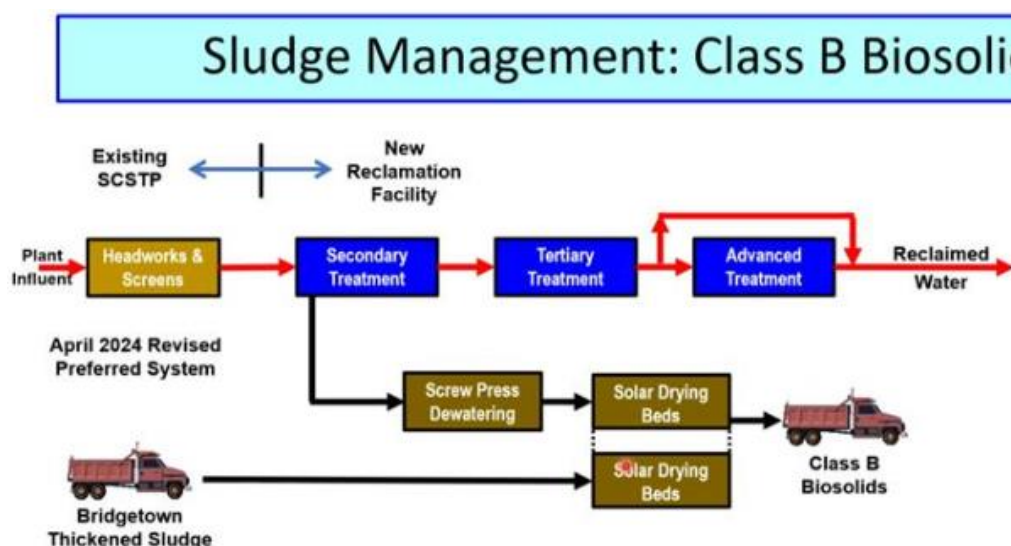


Figure 9-1: Summary of Sludge Management Process

The purpose of the Sludge Management Plan (SMP) is to develop a system by which the sludge generated at the plant is treated to best reduce the volume and improve the quality such that it can be safely disposed of or utilized as a biosolid. The resulting treated sludge should conform to the relevant local standards and regulations.

Six Basic Steps:

1. Determine the Quality/Characteristics
2. Determine the Quantity
3. Improving the Quality
4. Reducing the Volume
5. Treatment Method
6. Determine End Use/Reuse

9.11.1 Sludge Characteristics

This initial stage is dependent on whether it is a new facility or a facility in operation. For a new facility, determining the characteristics requires calculations, projections using industry standards or extrapolations from similar facilities to predict the sludge characteristics.

For an existing facility, samples of the sludge are taken and analysed to determine the characteristics. These samples should be taken periodically over a representative operational period which could be determined by seasons of the year, time (weekly/monthly/quarterly/annually) or change in product being processed as the circumstances dictate.

It is important that a reputable facility determine the quality of the sludge including the pathogens that are present as this will be important for the selected treatment process and ultimate disposal method.

9.11.2 Quantity

The volume of sludge is critical to the management process and therefore the sizing of the facilities for drying, treatment and temporary storage. This can also be determined by calculation based on the projected wastewater outflow and the expected wastewater characteristics. Again for an operating facility the volume can be measured this can be done using a meter where the sludge is pumped as a slurry or measured as it is passed through a measuring flume.

Where volumes are variable then the treatment process must be designed to handle variable loads and changing quality. This usually can be achieved using an equalization tank which homogenises the varying sludge quality and quantity before it is sent through the treatment process.

9.11.3 Improving the Quality

The first objective is to reduce the volume of sludge generated. This is to be the priority of the management Plan and requires an understanding of the production of the wastewater and thereby putting in place systems to reduce the amount of sludge that is generated.

Inorganics should be removed from the wastewater flow but those that pass through the process should be removed from the sludge itself by mechanical means. Gratings or mechanical rakes are typical to achieve this.

Dewatering will be necessary in many cases, and we will see this in some of the treatment methods for the sludge.

9.11.4 Reducing the Volume

The sludge will be wet and as above dewatering will reduce the volume of sludge to be handled. The dewatering may be a simple draining process where the sludge is allowed to drain and the liquid fraction treated as wastewater i.e. recycling it back to the wastewater treatment stage. The remaining sludge is still wet but with a much lower liquid content. This slurry or paste is now easier to manage and occupies a smaller volume.

Hydraulic presses can also be utilized but requires much more maintenance and energy use.

9.11.5 Treatment Methods

The Sludge can be treated by various methods including but not exclusively;

1. Sludge thickening
 - a. Gravity thickening

- b. Dissolved air flotation
- 2. Solar drying and disposal as solid waste
- 3. Anaerobic digestion and disposal as solid waste
 - a. Sludge digestion tank (anaerobic)
- 4. Biosolids reuse
 - a. Soil conditioner
 - b. Animal feed additive

As it is intended for the treated sludge to be used as a Class B Biosolid, the subsequent chapter outlines recommended measures to be implemented to mitigate against the potential risks of biosolid use for land application.

9.11.6 Management and Mitigation Measures

General Measures

- In general, the sludge should be considered as harmful to health and is to be handled and managed with this in mind. Gloves should be utilized, and equipment should be periodically scraped and cleaned to not have anoxic sludge build up in the treatment facility.
- The personnel are to be appropriately trained and have a clear understanding of the process and the purpose of the process.

Biosolid Application

- The anaerobic and aerobic digestion that class B biosolids have undergone may not completely eliminate all pathogens present in the sludge. Therefore, it is important that monitoring is done to ensure that the biosolids used for land application meet the specified level of indicator organisms, such as faecal coliforms or Salmonella bacteria. These levels should be determined in consultation with the EPD or other relevant regulatory bodies.
- Proper application rates and management practices are necessary to minimize risks of nutrient runoff, groundwater contamination and potential exposure to pathogens. These practices include undergoing a process of screening sites for application. Application sites must meet regulatory requirements and should consider soil type, slope, proximity to water bodies, groundwater depth and potential for runoff or erosion.
- Conduct soil testing and analysis to determine baseline conditions of soils to inform the biosolid application rates. Analysis should be done for nutrient levels, pH, and other soil characteristics.
- Biosolid application should be done outside of periods of heavy rainfall, high winds or soil saturation to reduce runoff, nutrient loss or contamination of soil and groundwater resources.
- Use appropriate methods of application such as surface spreading, injection or incorporation. The method should also be informed by the conditions of selected sites and regulatory requirements. The even distribution of biosolids are recommended to optimize nutrient utilization and minimize nutrient runoff.

- Establish buffer zones or setbacks around sensitive areas such as water bodies, well, residential areas and public facilities to minimize the risk of contamination and human exposure.
- Maintain detailed records of biosolid applications, including application rates, dates, locations and weather conditions. Regular monitoring of soil, water and crop quality is also recommended to assess the effectiveness of biosolids application.

Sludge Disposal

- In the event that the treatment process will not yield sludge that can be beneficially reused for land application or other purposes, sludge disposal must be done at approved sites by an approved Contractor. Permitted landfills are potential sites of disposal but this should not be habitual due to possible space limitations, leaching and long-term management requirements.
- Sludge incineration is another method of sludge disposal but should only be done for sludge with high moisture content or organic content. This method would require careful management of air emissions and ash disposal.

9.11.7 Key Performance Indicators

The following Key Performance Indicators (KPIs) have been selected in order to evaluate the effectiveness of the sludge management process.

Table 9-14: Key Performance Indicators for Sludge Management

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
No leakages or spills	Monitor possible spills Inspection of site by Contractor	Contractor; Results to be presented to the Implementing Agency	Annually
Limited sediment-laden run-off during heavy rain	Monitor nearby/downstream wells and water bodies for significant	Contractor; Results to be presented to the Implementing Agency	
Approved Contractors	Inspection of licenses and documentation	Contractor; Results to be presented to the Implementing Agency	
Sludge managed properly	Inspection of site by Contractor	Contractor; Results to be presented to the Implementing Agency	Monthly
Biosolid Application Log and Schedule	Inspection of licenses and documentation	Contractor; Results to be presented to the Implementing Agency	

9.11.8 Roles and Responsibilities

It is the responsibility of the BWA to ensure all workers are made aware of the importance of following the management and mitigation and that monitoring reports are prepared. It is also the responsibility of the BWA to ensure that the proposed sludge management process are done in compliance with regulatory requirements.

9.12 Construction Management Plan (Solar Facility)

This management plan accounts for the risks identified in the EIA prepared by Stantec Consulting Caribbean Ltd (2023). Mitigation measures provided in this plan should also include those presented in the Air Quality, Noise, Waste, Traffic, Worker Health and Safety, Community Health and Safety, Emergency Response and Biodiversity Management Plans.

9.12.1 Monitoring Standards

The works will be monitored by the Contractor.

9.12.2 Monitoring Frequency

Monitoring will be carried out by the Contractor throughout the Construction Phase.

9.12.3 Management and Mitigation Measures

The mitigation measures that are presented in this Chapter are intended to mitigate against the potential impacts of the following risks:

- ❖ **Land Use Degradation**
- ❖ **Drainage**
- ❖ **Noise, Glint and Glare**
- ❖ **Solid Waste Disposal**

These measures include:

- It is important to keep construction equipment well-maintained and muffled. As well, any noise-generating activities should be conducted between the hours of 9:00 a.m. to 5:00 p.m. (avoid nighttime activities).
- Encourage the use of low-impact mechanisms for land clearing (applicable for the construction of the reclamation facility). These include the use of manual tools and controlled grazing of animals. If machinery use is unavoidable, the use of lightweight machines that can selectively cut through brush and small trees is recommended. Clearing land in phases rather than all at once to reduce environmental impact and allow for natural regeneration is also recommended.
- Refer to the Waste Management Plan (Chapter 9.4) to mitigate against improper solid waste and hazardous waste handling and management.
- Incorporate the use of silt screens to restrict and impede the removal of topsoil and silt from specific regions where construction activities are bound to result in the widescale removal of grassed surfaces.
- Prioritize the establishment of tree screens along the boundaries of the construction site to minimize the effects of glint and glare from panels on neighbouring communities. As such, it is important that existing vegetation along the boundary of the construction site be left undisturbed and protected.
- Inherit the mitigation measures presented in the:

- Noise Management Plan
- Waste Management Plan
- Traffic Management Plan
- Worker Health and Safety Management Plan
- Community Health and Safety Management Plan
- Emergency Response Management Plan
- Biodiversity Management Plan
- Ensure an Operations and Maintenance Management Plan is developed for the post-Construction Phase to include measures that will ensure:
 - Wastewater shall be generated on site consequent to the cleaning of panels with clean water; wastewater disposal on site is prohibited
 - Workers are provided with adequate sanitation, health and safety and toilet facilities
 - Implement effective vegetation management that will ensure the site retains a grassed surface that will also aid in the reduction of flooding and ponding on site
 - Complaints/Grievances from community members, particularly as it relates to glare from the installed panels, are addressed in a prompt manner; panels should be replaced with non-glare producing panels where necessary
 - Monthly monitoring of the facility is conducted

9.12.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the plan to minimize the potential impacts of the construction of the solar facility:

Table 9-14: Key Performance Indicators for Construction Management of the Solar Facility

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Equipment/Machinery Maintenance Log	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Daily
Incident Log	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Post-Construction Monitoring Report	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Monthly

9.12.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that the recommended mitigation measures are implemented. In the event of any complaints or grievances, it is the responsibility of the Community Liaison Officer, assigned by the Contractor, to ensure that all complaints are documented along with the measures taken to address each complaint.

It is the responsibility of the Client to employ an expert consultant to undertake monthly Post-Construction Monitoring. The employed consultant will be responsible for preparing the Post-Construction Monitoring Report to be presented to the Implementing Agency.

10 SOCIAL MANAGEMENT

The following plans have been prepared for the identified social risks:

- a) Enhancing Representation of Women in the Project Workforce
- b) Water Supply Management
- c) Plan to address damage to property and infrastructure and enable continuity of business activities and public services in the area
- d) Management of Unions and General Workers
- e) Impacts on businesses and informal vendors resulting from pipeline construction
- f) Impacts on nearby communities resulting from upgrade of SCSTP and construction of new plant

10.1 Enhancing Representation of Women in the Project Workforce

10.1.1 Monitoring Standards

The works will be monitored by the Contractor.

10.1.2 Monitoring Frequency

Monitoring will be carried out by the Contractor as work progresses in the community.

10.1.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to ensure there is adequate representation of women in the project workforce:

- As part of the Implementing's agency contractual arrangements with the construction contractor, encourage the construction contractor to maximise local employment opportunities and to work with the local communities (and their leaders) in establishing a fair and transparent system for local worker recruitment.
- Inform the Community Development Department of Barbados, the Samuel Jackman Prescod Institute of Technology, the Barbados Community College and the Regional Corporations of the types of job opportunities that will be available through the Project to influence the types of semi-skilled training programmes offered in the Project area during pre-construction and construction phases.
- Ensure good communication as well as coordination with unions,
- Emphasis should be placed on training women as well as men to improve their recruitment prospects for semi-skilled positions. A 5%-15% quota for women as beneficiaries is suggested. This will require necessary trainings and collaboration with the Gender Affairs Bureau.

- Take steps to ensure that qualified women are afforded equal access to job opportunities from the Project (linked to the first mitigation measure) including promoting their participation, ensuring information is posted in relevant sites and media and ensuring that selection processes are bias and discrimination-free.
- All applicants will be made aware of the grievance mechanism to report any complaints associated with gender-biased or unfair treatment.
- Implement measures to ensure zero tolerance of SEAH that may be gendered in nature. These measures must include: a) Include in the Code of Conduct for employees and contractors the prohibition of sexual and gender-based violence and include a protocol with the steps to take to respond and provide assistance to victims in cases when these situations occur; b) Implement training programs to raise awareness and prevent sexual and gender-based violence addressed to project employees and contractors; c) Ensure the GRM can channel and respond to Sexual and Gender-based Violence (SGBV) complaints relating to incidents at the worksite and between workers and pedestrians and other users of the area. This includes measures to raise complaints anonymously, ensure confidentiality, and ensure referral and access to health and psychological services for complainants;

10.1.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness the plan to minimize the under-representation of women in project works.

Table 10-1: Key Performance Indicators for Better Inclusion in the Project Workforce

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Local worker recruitment policy	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly
Training log and schedule	Review and inspection of documentation; Assessment of worker performance	Contractor; Results to be presented to the Implementing Agency	
Register of all workers employed by sex and age	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of complaints including on SEAH and SGBV issues	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Inclusion in the Code of Conduct of the prohibition of sexual and gender-based violence	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Monthly

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
and a response protocol for incidents			
Training programs to prevent sexual and gender-based violence for employees and contractors	Review and inspection of documentation; Training schedules and attendance sheet	Contractor; Results to be presented to the Implementing Agency	
Establishment and use of GRM to facilitate anonymous complaints, confidentiality and referral to support services.	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

10.1.5 Roles and Responsibilities

It is the responsibility of the Contractor to manage social conflicts as well as related social risks. The contractor must adhere to the local worker recruitment policy to be free from gender biases. The contractor must also ensure that all workers and community members are adequately aware of the grievance mechanism to log complaints that need to be addressed.

There should be constant liaison with relevant NGOs and the Gender Bureau as necessary. A referral pathway for referring GBV incidents or suspected cases to the police and other relevant authorities should also be established using the existing guidance in place in the country. These cases will only be acted upon provided the victim's consent is formally ascertained.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

10.1.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager and any complaints logged.

10.2 Plan to Address Damage to Property and Infrastructure and Enable Continuity of Business and Public Services in the Area

10.2.1 Monitoring Standards

The works will be monitored by the Contractor.

10.2.2 Monitoring Frequency

Monitoring will be carried out by the Contractor as work progresses in the Community.

10.2.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to prevent or mitigate against damage to property that could occur during project execution:

- Ensure that the ownership of lands, structures and other assets are completely identified and mapped before any construction-related activities commence. This process should include engagement with owners to inform of the potential risk to their assets and the measures that will be implemented to mitigate any negative impacts on their assets.
- Provide compensation for loss of assets (property – land and structures) to private landowners (persons with legal rights to land or recognisable claims under Barbados law, such as letters of comfort) and persons occupying property.
- Promote the use of the grievance redress mechanism to address project related complaints and issues
- Promptly repair any damage to vital infrastructure and services in consultation with, or by the service provider.
- Ensure continuity of businesses and services in the area during construction. This can entail the placement of signage for displaying alternative routes to access services and businesses in the area, signage indicating periods when roads will be inaccessible and creating alternative pathways for pedestrian mobility in the area.
- To limit the disruptive effects of construction work, it is suggested that most of the work occur during off-peak road usage hours. This would minimise disruptions to road access particularly for community residents who may need to leave the area for work.
- Alternative access routes to key facilities need to be identified prior to the commencement of work or at least there should be key hours where work is not done to allow persons access to the facilities to ensure there is not a total cessation of livelihood activities dependent on these facilities, particularly on the Newton stretch of the ABC Highway where coconut vending and other forms of vending are prominent.
- Before the commencement of work, businesses and the informal vendors in the area should be given reasonable notice (at least four weeks prior to commencement) of the upcoming work to allow sufficient time to implement measures to adapt to the potential disruptions from the construction work and inform customers of any necessary adjustments to business. Evaluate potential economic impact and create compensation packages including appropriate economic analysis that is gender sensitive and considers the needs of business owners, staff and workers as

well as vendors by sex, age, income and geography (where they live and the transit to the project area). The needs of affected persons who are female-heads of households that are the single source of income for a household of 3 or more dependents should be specifically considered in designing compensation packages.

- Ensure appropriate signage, notices and public announcements in English of possible dangers in and around the site for passers-by, to allow for easy comprehension by both locals and visitors.
- Alert businesses about local construction works a minimum of four weeks prior (or a stipulated timeframe as agreed between local businesses and the Contractor or as defined by standard practice by the BWA) and of any changes in the initial scheduling including any warnings on likely effects or impacts.
- Ensure regular updates via various media – radio, TV, social media, MMS on possible increases or decreases in the intensity of work and possible disruptions thereby allowing formal and informal businesses a better chance to adapt their schedules and minimize disruption to livelihoods and income generation caused by traffic diversions and road closures to facilitate the work of the project. This is in keeping with the Access to Information as well as Public Consultation and Disclosure Policies of the IDB and other project parties.
- Proactively address any community health, safety and security issues that may arise on an ongoing basis including reports of incidents and crimes in the surrounding areas and reducing any risks that the project or project operations might elevate in this context. Additionally, ensuring that risk prevention for SGBV and SEAH in the context of any disruptions is minimized³⁴.
- In the case of concerns and explicit grievances, residents and users (recreational or otherwise) can also share their complaints with the project team as well as contractors via the proposed GRM for the project. For engagements which flag issues outside of the more formal GRM, a community engagement form could be used which then based on the content would be picked up the GRM officer and then advanced through the process. The determination for relevance to the GRM would be decided upon by the GRM officer and the Supervising Engineer.

For informal vendors specifically,

A specific strategy for informal vending should be developed and implemented following these outlined guidelines:

- Differentiated gender needs amongst vendors including dependencies – social and economic – from this income: it will be important in engaging with the vendors collectively and individually to understand their specific circumstances, needs and concerns to identify an appropriate strategy for their possible relocation and the restoration of their livelihood activities in the post-works period. This may take the form of an interim strategy as well as long-term strategy to ensure that temporary effects are also considered. In terms of gender needs, though livelihoods is the main driver of

³⁴ A more chaotic environment with the significant movement of persons, equipment and vehicles could reduce attention, vigilance and prevention measures for SGBV and SEAH as attention is placed elsewhere. Additionally, tensions created by the situation could result in conflict and a rise in different forms of violence. The vulnerability of some workers and vendors may expose them to risks of exploitation.

concern, issues such as education and assets as well as access to and control over resources will also need to be considered.

- Conduct a rapid gender-sensitive economic assessment of the potential income impact and ensure that alternative locations and reinitiation of their businesses in the original location is calibrated to minimize economic losses. It should be considered in this rapid assessment that a majority of households in Barbados are female headed with one main source of income and some vendors may fit in this category.
- Assess the differentiated operating needs for the different vendors including exposure to the heat in determining alternative temporary locations and or protective measures from the works to be carried out.
- Continued engagement with the Barbados Association of Retailers, Vendors and Entrepreneurs (BARVEN) on appropriate strategies and to ensure that the rights and participation of vendors, even informal vendors, are respected and protected.
- Beneficiaries of this plan, as designated, should be 18 years and over and/or in keeping with the laws of Barbados. The necessary verifications should be identified, implemented and reported by the contractor as necessary and linked to other elements of the ESMP and in keeping with ESPS 2.
- Consider any seasonal implications for vending and climate that may affect implementation of the plan in keeping with Natural Disaster Risk Management Policies and Guidelines including those of the IDB. Equally, give consideration to heat stress given the increasing temperatures/heatwave effects³⁵ currently being experienced in the Caribbean region and the extensive period during which these ambient air temperatures are likely to persist up to six months or more.
- Consider the safety and security of locations to which vendors may be relocated to temporarily including issues of safe access, lighting, clean environmental health conditions and ensuring/encouraging vendors to maintain the same in terms of their operations thus reducing negative effects on surrounding communities in keeping with ESPS 4.

Ongoing stakeholder engagement via the stakeholder engagement plan is also a key mitigation measure which can allow for an updating of information on the context as well as new and emerging issues including new livelihood activities that may arise during the construction works.

10.2.4 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness the plan to manage property damage.

³⁵ [Caribbean Climate Outlook Warns of Extreme Heatwave Effects for Upcoming Six Months \(viconsortium.com\)](http://viconsortium.com)

Table 10-2: Key Performance Indicators for Damage to Property Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Log of Complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly
Assessment of cost of damage	Review and inspection of documentation	Implementing Agency	When/if there is damage to property
Preparation of compensation package	Review and inspection of documentation	Implementing Agency	When/if there is damage to property
Creation of alternative pathways to services	Review of plans and inspection of constructed measures/signage	Implementing Agency	When/if there is a disruption to service/business
Number of affected individuals or businesses who benefited from mitigation measures or received compensation for livelihood disruptions/ Total number of individuals affected by livelihood disruptions	GRM log of complaints and grievances	GRM officer/ Supervising Engineer	Monthly

10.2.5 Roles and Responsibilities

The contractor must adhere to mitigation measures to prevent or reduce the likelihood of damage to property. In the event of damage to property, compensation should be provided. The grievance mechanism should be utilized to log complaints and the Community Liaison Officer will be responsible for the operation of this mechanism without bias.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The Site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

10.2.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager, as well as any complaints logged.

10.3 Water Supply Management

10.3.1 Monitoring Standards

The supply of reclaimed water will be monitored by the BWA.

10.3.2 Monitoring Frequency

Monitoring will be carried out daily by the BWA.

10.3.3 Management and Mitigation Measures

The BWA will ensure that the following measures are put in place to mitigate against the potential impacts of any possible disruption of the water supply:

- Communicate planned water shutdowns well in advance to affected communities. Implement scheduled shutdowns during times of lower demand and provide alternative water sources if necessary.
- Identify and plan for alternative water sources that can be used during construction to minimize dependence on the existing water supply. This may involve utilizing temporary wells, importing water, or using recycled water.
- Implement temporary water storage solutions to store water before construction activities begin. This can help maintain water supply during interruptions and prevent shortages.
- Plan and execute construction activities in phases to minimize the duration and extent of disruptions. Prioritize critical water supply infrastructure to be addressed first.
- Install temporary bypass systems to redirect water flows around construction areas, allowing uninterrupted water supply to downstream users.
- Implement water conservation programs within affected communities to reduce overall demand during construction. Educate residents about the importance of water conservation practices.
- Develop and communicate clear emergency response plans to address unforeseen disruptions promptly. This includes defining roles and responsibilities, communication protocols, and coordination with local authorities.
- Implement measures to control dust and sediment generated during construction to prevent contamination of water sources. Use barriers, sediment basins, and other erosion control techniques.
- Use high-quality materials during the construction of pipelines to minimize the risk of corrosion and other forms of degradation to prevent leakages.

10.3.4 Key Performance Indicators

The following KPIs in Table 10-23 have been selected in order to evaluate the effectiveness of the plan to manage water supply.

Table 10-3: Key Performance Indicators for Water Supply Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Log of Complaints	Review and inspection of documentation	BWA	Weekly
Planned Shutdowns Schedule	Review and inspection of documentation	BWA	
Log of Disruptions	Review and inspection of documentation	BWA	

10.3.5 Roles and Responsibilities

It is the responsibility of the CONTRACTOR to ensure that any construction activities that is foreseen to possess the potential to disrupt the existing water supply is communicated with the BWA in advance so a plan of action can be promptly developed.

It is the responsibility of the BWA to ensure that a supply of water to the general public is maintained throughout the duration of the Project. In the event that there is an unavoidable or unforeseen disruption to the supply, the BWA is responsible for communicating with the public on the best plan of action, maintaining constant communication on the status of the disruption and providing, when possible, alternative supplies of water.

10.3.6 Data Analysis and Reporting

Any disruption to the existing water supply should be documented, as well as the course of action taken, the duration and the effects.

10.4 Management of Unions and General Workers

This management plan presents the strategy recommended to address various aspects of the employment relationship, promoting communication, fostering a positive work environment, and ensuring fair and transparent practices. This plan will be monitored throughout the entire duration of the Project to ensure that a positive environment and relationship is maintained between BWA and its contractors, inclusive of both unionized and non-unionized workers.

10.4.1 Management Measures

- Establish regular communication channels with unions and non-unionized workers. For unions, establish a line of communication with a union representative.
- Clearly communicate policies, procedures, and any changes affecting workers.
- Implement mechanisms for employee feedback, such as suggestion boxes, regular surveys, or town hall meetings.
- Include workers in decision-making processes that affect their work conditions.
- Provide conflict resolution training for managers and employees.
- Provide opportunities for skill development and career advancement.
- Regularly assess workplace hazards and implement preventive measures.

- Train employees on safety protocols and emergency procedures.
- Implement policies to prevent discrimination and promote equal opportunities, in keeping with the Barbados National Employment Policy as well as the Sexual Harassment Act.
- Regularly evaluate and update the management plan based on feedback and changing circumstances.

10.4.2 Key Performance Indicators

The following KPIs in Table 10-24 have been selected in order to evaluate the effectiveness of the plan to manage unionized and non-unionized workers.

Table 10-4: Key Performance Indicators for Management of Unions and General Workers

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Log of Complaints / Grievances	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly
Employee Turnover Rate	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Log of Worker Conflicts	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Training Schedule and Attendance Sheets	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

10.4.3 Roles and Responsibilities

It is the responsibility of the CONTRACTOR to ensure that the recommended management measures are taken to foster a positive working environment and relationship with all workers employed over the duration of the Project, both unionized and non-unionized. The CONTRACTOR must maintain a positive relationship with any unions represented in the Project's labour force and must communicate any plans, activities or changes that may affect any workers employed to the Project.

10.4.4 Data Analysis and Reporting

All conflicts, incidents, and trainings should be documented.

11 SECURITY MANAGEMENT PLAN

11.1 Monitoring Standards

The safety and security of the workers and equipment would be the responsibility of the Contractors. They should coordinate with the Barbados police services when operating in areas with high risk to ensure the safety of equipment and all stakeholders.

11.2 Monitoring Frequency

Monitoring for safety and security should be carried out throughout all phases of the project.

11.3 Management and Mitigation Measures

The Contractor will be responsible for the following measures to ensure the safety and security of personnel and equipment during all phases of the project. The risk level and impact to the site(s) will have to be assessed and the appropriate mitigation measures devised. Some mitigation measures include:

- Creation of site-specific security plan based on an assessment of the security risk.
- Liaise and communicate with the Barbados Police Service (BPS) to assess the risk associated with each site for every stage of the project.
- Contact the BPS for the area to advise of areas where work will be conducted prior to commencement of work.
- Ensure that key assets and property are secured or removed to a secure location when not in use.
- Where possible ensure perimeter of areas has appropriate security fencing and areas are well illuminated.
- Control site access by ensuring limited access points and controlled entry.
- Engage with community members and encourage them to report suspicious activities to the BPS.
- Encourage security awareness among employees and ensure security supervisor is always at the site.
- Maintain a security risk register and periodically review the security risk plan to update the security mitigation measures.
- Contract licensed security services to guard and patrol sites where necessary. Security personnel should be unarmed and properly trained in de-escalation techniques.
- Consider the use of technology, such as tagging, GPS tracking and video surveillance to detect and alert for any security issues or treats.
- Ensure that police forces and/or private security guards safeguarding the project area comply with the project's Code of Conduct provisions regarding the prohibition of SEAH.
- Ensure the participation of police force/private security guards in trainings related to the prevention of sexual and gender-based violence.

11.4 Key Performance Indicators

The following KPIs in Table 11-1 have been select in order to evaluate the effectiveness of the plan to mitigate against treats to security.

Table 11-1: Key Performance Indicators for Security Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Security Risk Register	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Daily
Incident Log	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Number of Police Officers or Private Security Guards that participated in trainings to prevent sexual and gender-based violence / Total number of Police Officers and Private Security Guards safeguarding the project	Review of training schedules and attendance sheets	Contractor; Results to be presented to the Implementing Agency	Monthly

11.5 Roles and Responsibilities

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection Plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

11.6 Data Analysis and Reporting

If there are any security incidents, these are to be reported to the Implementing Agency and the BPS within 24 hours. The implementing agency will be required to ensure the appropriate mitigation measures are implemented and the BPS will be responsible for investigating the incident.

12 CONTRACTOR MANAGEMENT PLAN

12.1 Monitoring Standards

The works will be monitored by the Implementing Agency.

12.2 Monitoring Frequency

Weekly monitoring will be carried out by the Implementing Agency during both construction and operational phases.

12.3 Management and Mitigation Measures

The Implementing Agency will ensure that the following measures are put in place to manage all contractors throughout the project:

- The Implementing Agency will provide the Contractors Management Plan with attributes for all parts, requirements to Contractors and also a Work Statement for the various phases of work including models for standard documents.
- The Contractor is expected to abide by this Contractors Management Plan.
- The Contractors will enter into a business partnership with the Implementing Agency after completing a successful tender process following the government procurement guidelines.
- Each contractor will have a legally binding, written contract that defines specific terms and conditions including workers code of conduct
- The Contractor will provide the integrated solution for execution of the work phases, including the economic, environmental and social approach.
- The Contractor will abide by the management actions and mitigations measures provided in the Environmental and Social Management Plan associated with the project.
- The contractor will follow IDB guidelines regarding sourcing of materials (ensuring proper sourcing from borrower pits and for solar panels).
- The Contractors will present to the Implementing Agency, all the information for all subcontractors and the procedures for verification and validation services.
- Each Contractor will have a single point of contact to the Implementing Agency for contractual matters. The contact points, for each site, will monitor the activities.
- The Point of Contact will ensure compliance of the Project against the General Commitments Register. Weekly they will report about achievements and problems and the current situation to the Implementing Agency.
- Each Contractor/Subcontractor will identify the responsibilities and authorities of the Project staff. This information will be published in a project contact sheet and approved by the Implementing Agency.
- Each Contractor will have requirements for quality assurance clearly identified within the Statement of Work, including the requirement to allow independent quality inspections of materials and work processes;
- Each subcontract will contain appropriate terms and conditions;

- The Contractor is responsible for project management, for control and monitoring activities regarding constructors' actions and has overall responsibility for environmental, social, health and safety, and cultural heritage aspects of the project.
- The Contractors will prepare work plans in compliance with the project's requirements and submit to the Implementing Agency for their Approval. These workplans should include site specific method statements for work in protected areas and sensitive habitats.
- Contractors must nominate the following employees:
 - o representative for site coordination;
 - o representative for traffic management and coordination
 - o representatives for EHS responsibilities;
 - o representatives for technical execution, budget, Project phases;
 - o first aid competent person;
 - o representative for waste management;
 - o team for guarding the site; and
 - o team responsible for intervention on accidental pollution events.
 - o Representative for communication/stakeholder holder engagement
- All Contractors are also required to comply with all relevant national regulatory requirements.
- Each week, the Contractors will prepare and deliver to the Implementing Agency a weekly progress report for each aspect of the work.
- Each week, the Contractors will prepare and deliver to the Implementing Agency weekly progress reports on environmental, social and health and safety performance including reports on the KPIs presented in the Environmental and Social Management Plan.

12.4 Key Performance Indicators

The following KPIs in the following table have been selected in order to evaluate the effectiveness of the contractor management process.

Table 12-1: Key Performance Indicators for the Security Management Plan

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Weekly Report on achievements and problems	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly
Project contact sheet	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

KEY PERFORMANCE INDICATOR	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Reports on quality inspections	Quality inspections of materials and work processes	Contractor; Results to be presented to the Implementing Agency	
Work plan	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Weekly progress reports on each aspect of the work	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	
Weekly progress reports on environmental, social and health and safety performance	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	

12.5 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that there is compliance with all contractual requirements.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The site and surrounding environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

12.6 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the Implementing Agency.

13 LABOUR MANAGEMENT PLAN

13.1 Monitoring Standards

The works will be monitored by the Contractor.

13.2 Monitoring Frequency

Weekly monitoring will be carried out by the Contractor, prior to and as work progresses in the Community until the end of activities.

13.3 Management and Mitigation Measures

The Contractor will ensure that the following measures are put in place to manage labourers throughout the proposed works:

General Measures

- It is imperative that the labour management benefits the local community in terms of providing jobs for local workers, particularly in the Barbados context where youth under-employment is an issue. The labour management plan should support local hires, particularly those populations for which employment is less available, namely women and youth.
- Given the size and scale of the project, opportunities should be encouraged for the local population, including the mentioned groups, if not only in the form casual labour supporting the project.
- At the largest site at any given time, further consultations with the Barbados Water Authority will outline how many workers are expected onsite at the SCSTP as well as working along the pipeline routes during the Construction phase. Additional consultations will outline the nature of the work and skillsets desired for elaborating in this section.
- Across all sites, it is critical to ensure minimum requirements and quotas for hiring to ensure both gender equity and social inclusion:
 - o 35 per cent quota for local Barbados citizens and residents;
 - o 10 percent work substitution opportunities for those whose work have been impacted negatively by the works;¹³ and
 - o 5-15 per cent qualified skilled youth, women, migrant populations and persons with disabilities.
- This equitable hiring framework should be honoured by project contractors where possible and supported by the Project Team and Supervising Engineer.
- The contractor should work with local government and agencies to encourage participation from vulnerable groups (particularly women and youth) and small business owners in providing services to sites, food services for example, where relevant.
- Local media, radio and social media (Facebook, Instagram etc.) could be used to disseminate equal opportunity hiring notices, as well as provide information on available related skills training opportunities.

- In meeting these commitments, the SEP can be used for guidance as well as the Decent work checklist.
- In keeping with social and gender standards in this context, principles for ensuring fair and equal access to employment as well as non-discriminatory hiring practices that avoid Sexual Exploitation and Abuse (SEA) and or forced labour is key.
- It is essential to ensure that work is decent, fairly paid, non-discriminatory and also free of all forms of violence, abuse and exploitation. These should be included in the Code of Conduct as stipulated by the National Employment Policy of Barbados.³⁶
- The labour management plan will adhere to all provisions as outlined in the labour policy and the draft sexual harassment policy, including any provisions that exist regarding migrant labour (a risk, but not a high one given the Barbadian context) or forced labour.
- The Code of Conduct is to be followed, with training for all site workers on the Code of Conduct being done prior to the commencement of construction works.

Avoiding the Enabling of Child Labour

Due to the recognized risk of child labour in countries where key components of a solar facility (e.g., materials for panels and cells), it is important that specific measures be taken to reduce the probability of the Project enabling/fostering child labour or any other form of forced labour. These measures include:

- Explicitly stating in the Project's employment policy the minimum working age of 18 for the Project's workforce.
- Conducting an analysis and mapping exercise of supply chains for raw materials and labour to identify risks of child labour.
- Conducting a labour audit of potential suppliers to ensure their compliance with laws and regulations related to child and forced labour. This audit should also assess the labour certification potential suppliers by a competent agency, or a sworn statement given by suppliers that declares compliance with labour laws and regulations.

13.4 Proposed Checklist Matrix for Decent Work

Decent Work Areas of Focus	Checklist Questions	Checklist Responses			Score
		Yes (1)	No (0)	Unsure (0.5)	
Equal Work Opportunities	Are work opportunities open to women, youth, and PWDs?				
	Are opportunities advertised in multiple media				

³⁶ [NATIONAL EMPLOYMENT POLICY OF BARBADOS \(NOVEMBER 2014\).pdf \(labour.gov.bb\)](#)

Decent Work Areas of Focus	Checklist Questions	Checklist Responses			Score
		Yes (1)	No (0)	Unsure (0.5)	
	and in diverse languages/dialects ?				
	Is there a documented employment process that provides basic work protections?				
	Is labour inspection carried out?				
Loss of Access to Work	Are there anticipated works or activities that will lock off access to work for communities and or specific groups for more than a few hours?				
	Are mitigation actions in place to address that loss of access to work e.g. compensation ?				
Risk of Forced Labour	Are there appropriate checks in place to for employee age requirements, documentation as well as compliance with labour laws? Including for casual labour?				
	Should a labour inspection be carried out, is it				

Decent Work Areas of Focus	Checklist Questions	Checklist Responses			Score
		Yes (1)	No (0)	Unsure (0.5)	
	likely that the site and any other related areas would pass?				
	Does a visible and simple mechanism/ set of instructions exist for a worker or a community member to report possible labour code violation or suspicions of a violation? Are these regularly communicated?				

13.5 Code of Conduct

13.5.1 Introduction

The project is committed to ensuring a work environment which minimizes any negative impacts on the local environment, communities, and its workers. The project also strongly commits to creating and maintaining an environment in which Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH) have no place, and where they will not be tolerated by any employee, sub-contractor, supplier, associate, or any representative of the company implementing the proposed works.

The purpose of this *Code of Conduct* is to:

1. Create a common understanding of what constitutes acceptable and unacceptable forms of conduct during work and in any interactions with the community and beneficiaries. This includes the prohibition of sexual exploitation and abuse, and sexual harassment including their forms, the reasons behind their prohibition and the sanctions to be deployed.
2. Create a shared commitment to fair, appropriate and socially responsive behaviors and guidelines for company employees as well as contractors/third-party suppliers to prevent, report, and respond to SEA and SH, and
3. Create understanding that breach of this code of conduct will result in disciplinary action.
4. Frequency and content of the training for the prevention of sexual exploitation and abuse.

13.5.2 Definitions

Sexual Exploitation and Abuse (SEA)³⁷

Is defined as any actual or attempted abuse of a position of vulnerability, differential power, or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another³⁸.

- **Sexual Abuse:** “The actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions.” **Usually between project team members and beneficiaries.**
- **Sexual Harassment:**³⁹ Unwelcome sexual advances, request for sexual favors, and other verbal or physical conduct of sexual nature. **Usually between members of the project team, within the BWA and between project team and contractors.**

Sexual Harassment versus SEA⁴⁰

SEA occurs against a beneficiary or member of the community. Sexual harassment occurs between personnel/staff of an organization or company and involves any unwelcome sexual advance or unwanted verbal or physical conduct of a sexual nature. The distinction between the two is important so that agency policies and staff trainings can include specific instruction on the procedures to report each.

Consent is the choice behind a person’s voluntary decision to do something. Consent for any sexual activity must be freely given, ok to withdraw, made with as much knowledge as possible, and specific to the situation. If agreement is obtained using threats, lies, coercion, or exploitation of power imbalance, it is not consent. **Under this Code of Conduct⁴¹ consent cannot be given by anyone under the age of 18, regardless of the age of majority or age of consent locally. Mistaken belief regarding the age of the child is not a defense.**

There is no consent when agreement is obtained through:

- the use of threats, force or other forms of coercion, abduction, fraud, manipulation, deception, or misrepresentation
- the use of a threat to withhold a benefit to which the person is already entitled, or
- a promise is made to the person to provide a benefit.

While all forms of violence against a community resident or a co-worker are forbidden, this code of conduct is particularly concerned with the prevention and reporting of sexual exploitation and abuse (SEA) and sexual harassment which constitute gross misconduct, is grounds for termination or other consequences related to employment and employment status:

1. **Examples of sexual exploitation and abuse** include, but are not limited to:

³⁷ As defined in the UN Secretary’s bulletin – Special Measures for protection from sexual exploitation and abuse October, 9, 2003 ST/SGB/2003/13

³⁸ In the context of World Bank Financed operations exploitation occurs when access to, or benefit from a World Bank Financed good or service is used to extract sexual gain.

³⁹ Inter-Agency Standing Committee *Protection against Sexual Exploitation and Abuse (PSEA): Inter-agency cooperation in community based complaint mechanism. Global standard Operating Procedures*. May 2016

⁴⁰ Ibid

⁴¹ In accordance with the United Nations Convention on the Rights of the Child.

- A project worker tells women in the community that he can get them jobs related to the work site (cooking and cleaning) in exchange for sex.
- A worker that is connecting electricity input to households says that he can connect women headed households to the grid in exchange for sex.
- A project worker gets drunk after being paid and rapes a local woman.
- A project worker denies passage of a woman through the site that he is working on unless she performs a sexual favor.
- A manager tells a woman applying for a job that he will only hire her if she has sex with him.
- A worker begins a friendship with a 16-year-old girl who walks to and from school on the road where project related work is taking place. He gives her moto rides to school. He tells her that he loves her. They have sex. In this case, even though the age of consent for the country maybe be 16 this is still illegal for the purposes of the project as the acceptable age of consent in this case is 18 years of age.

2. **Examples of sexual harassment in a work context** include, but are not limited to:

- Male staff comment on female staffs' appearances (both positive and negative) and sexual desirability.
- When a female staff member complains about comments male staff are making about her appearance, they say she is "asking for it" because of how she dresses.
- A male manager touches a female staff members' buttocks when he passes her at work.
- A male staff member tells a female staff member he will get her a raise if she sends him naked photographs of herself.

Individual signed commitment (example):

I, _____, acknowledge that sexual exploitation and abuse (SEA) and sexual harassment, are prohibited. As an (*employee/contractor*) of (*contracted agency / sub-contracted agency*) in (*country*), I acknowledge that SEA and SH activities on the work site, the work site surroundings, at workers' camps, or the surrounding community constitute a violation of this *Code of Conduct*. I understand SEA and SH activities are grounds for sanctions, penalties or potential termination of employment. Prosecution of those who commit SEA and SH may be pursued if appropriate.

I agree that while working on the project I will:

- Treat all persons, including children (persons under the age of 18), with respect regardless of sex, race, color, language, religion, political or other opinion, national, ethnic or social origin, gender identity, sexual orientation, property, disability, birth or other status.
- Commit to creating an environment which prevents SEA and SH and promotes this code of conduct. In particular, I will seek to support the systems which maintain this environment.
- Comply with the laws governing the land with regards to employment and will strive to provide equal opportunities to all, ensure work environments are safe and compensate those employed under me with fair wages.
- **Not** participate in SEA and SH as defined by this *Code of Conduct* and as defined under (*country*) law (*and other local law, where applicable*).
- **Not** use language or behavior towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate.

- **Not** participate in sexual contact or activity with anyone below the age of 18. Mistaken belief regarding the age of a child is not a defense. Consent from the child is also not a defense. I will not participate in actions intended to build a relationship with a minor that will lead to sexual activity.
- **Not** solicit/engage in sexual favors in exchange for anything as described above.
- Unless there is the full consent by all parties involved, recognizing that a child is unable to give consent and a child is anyone under the age of 18, I will not have sexual interactions with members of the surrounding communities. This includes relationships involving the withholding or promise of actual provision of benefit (monetary or non-monetary) to community members in exchange for sex—such sexual activity is considered “non-consensual” under this Code.

I commit to:

- Adhere to the provisions of this code of conduct both on and off the project site.
- Attend and actively partake in training courses related to preventing SEA and SH as requested by my employer.

If I am aware of or suspect SEA and SH, at the project site or surrounding community, I understand that I am encouraged to report it to the Grievance Reporting Mechanism (GRM) or to my manager. The safety, consent, and consequences for the person who has suffered the abuse will be part of my consideration when reporting. I understand that I will be expected to maintain confidentiality on any matters related to the incident to protect the privacy and security of all those involved.

Sanctions: I understand that if I breach this Individual Code of Conduct, my employer will take disciplinary action which could include:

- Informal warning or formal warning
- Additional training.
- Loss of salary.
- Suspension of employment (with or without payment of salary)
- Termination of employment.
- Report to the police or other authorities as warranted.

I understand that it is my responsibility to adhere to this code of conduct. That I will avoid actions or behaviors that could be construed as SEA and SH. Any such actions will be a breach this Individual Code of Conduct. I acknowledge that I have read the Individual Code of Conduct, do agree to comply with the standards contained in this document, and understand my roles and responsibilities to prevent and potentially report SEA and SH issues. I understand that any action inconsistent with this Individual Code of Conduct or failure to act mandated by this Individual Code of Conduct may result in disciplinary action and may affect my ongoing employment.

Signature: _____

Printed Name: _____

Title: _____

Date: _____

13.6 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the Labour Management Plan.

Table 13-1: Key Performance Indicators for Labour Management

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Decent Work Matrix	Review and completion of the Decent Work Matrix	Contactor; Results to be presented to the Implementing Agency	Monthly
Sensitization and Gender Risk Management Training	Sensitization training completed (including training on GRM/GBV) for key stakeholders as well as contractors and employees on the Project (2 sessions held – in person or hybrid)	Social and Gender Advisor/Consultant	Prior to commencement of construction works
Gender Sensitive Monitoring Training	1-2 sessions for contractors/project management staff/CLO	Social and Gender Advisor/Consultant	Prior to commencement of construction works
Code of Conduct Training	1-2 training sessions provided to site workers	Contractor	Prior to commencement of construction works

13.7 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that the Labour Management Plan is sufficiently implemented and monitored. If there is a potential challenge due to planned works, the contractor must ensure that all workers and community members are adequately aware and the alternatives are clearly expressed to minimize social impacts.

The Implementing Agency is responsible for assigning the ENGINEER and the CONTRACTOR as the responsible parties for undertaking the monitoring required and for implementing the mitigation measures necessary.

The site and surrounding marine environment will be monitored by the ENGINEER for negative impacts caused by the construction Works. The ENGINEER will notify the CONTRACTOR in writing of any observed noncompliance with local environmental laws regulations, permits, and other elements of the CONTRACTOR's Environmental Protection plan. The CONTRACTOR shall, after receipt of such notice, inform the ENGINEER of the proposed corrective action and take such action when approved by the Contracting Officer.

The ENGINEER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the CONTRACTOR

for any such suspensions. This is in addition to any other actions the ENGINEER may take under the Contract, or in accordance with applicable laws.

13.8 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the EHS Manager and any incidents logged.

14 HERITAGE MANAGEMENT

14.1 Objective of Cultural and Archaeological Heritage

The IDB Environmental and Social Performance Framework (ESPF), under its Environmental and Social Performance Standard 8 (ESPS 8) also recognizes the importance of cultural heritage and aims to ensure the protection of cultural heritage in the course of project activities. AS such, this project will explore and identify the risks to the heritage assets identified in Chapter 5.6.3 of this document and outline appropriate mitigation measures for the Barbados Water Authority and their Contractor to adhere.

14.2 Potential Risks and Impacts to Cultural/ Archaeological Heritage from the Project

Precautions should be taken to preserve any encountered artifact or other cultural heritage element. Potential risks and impacts related to this program are:

- a) The project may undertake activities that are located in the vicinity of a cultural heritage site and cause damage and/or disturbance to such sites;
- b) Restricted access to sites of cultural, heritage and religious significance due to works disrupting traffic flows and standard routes.
- c) There is a possibility of archaeological finds during during excavation and installation of the pipelines. However, the project will not involve any deep excavation, demolition, movement of earth, flooding areas, or changes in the physical environment; and
- d) No negative impacts on intangible cultural heritage are envisaged.

14.3 Management and Mitigation Measures

The following management and mitigation measures should be taken:

- A comprehensive documentation and inventory of heritage sites, artifacts, and resources should be prepared and should include the significance, condition, and vulnerability of all identified assets.
- Restrict works to hours that would not conflict with any cultural/religious activities - avoid working on Saturdays/Sundays to prevent disruption of religious activities by noise or traffic congestion.
- Implement and disclose effective traffic management measures to limit traffic disruptions by identifying alternative routes and limiting works to non-peak hours. See also Traffic Management Plan (Chapter 9.5).
- Consult with the Future Centre Trust to ensure works do not hinder greatly the Barbados Trailway Project. Avoid destruction to bridges and shelters, and the blocking of culverts. Ensure the trailway is effectively resurfaced subsequent to the installation of the pipelines.
- Avoid, as best as possible, the destruction of any trees planted along the trailway.
- Inform workers of all wells in the project area and the threat of falls.

- Communicate with farmers on plantations through which the railway runs about the actions that would need to be taken to handle wells (covering wells to prevent accidents)
- Ensure no waste is disposed in any wells or on farmlands. Proper waste collection should be prioritized. See also the Waste Management Plan (Chapter 9.4).
- Notify farmers two weeks in advance of workers needing to access plantations.
- Establish a channel of communication with the National Conservation Commission and the Future Center Trust to preserve cultural/heritage assets in keeping with the National Conservation Commission Act.
- Initiate the Chance Find Procedure, when necessary. See Chapter 15.4.
- Consult with qualified cultural heritage experts to conduct real-time monitoring of construction activities.
- Conduct training sessions with workers with emphasis being placed on the importance of heritage conservation and appropriate practices to achieve such.
- Implement a monitoring programme to ensure construction activities are compliant with heritage management.

14.4 Chance Find Procedure

Chapter 5.7.3 lists the historical and cultural assets within the project area. While it is not expected that the program will have adverse impact on tangible cultural heritage, there is a possibility that cultural heritage artifacts and assemblages may be discovered or identified during excavation and construction activities. This Chance Find Procedure is intended to manage impacts to known, probable and unknown cultural sites.

Consultations and communication with the legal and regulatory institutions, such as the Barbados National Trust and Future Center Trust, should be held and procedures and protocols for assessing any unanticipated cultural heritage sites or materials encountered during the project construction phase should be developed and implemented as outlined in this document.

Essentially there are several main protocols involved in the implementation of a Chance Find Procedure. These include:

- This Chance Find Program includes the following procedures:
 - i. A local specialist or archaeologist should remain on call and shall provide oversight of the entire Chance Find Program.
 - ii. The on-call specialist should be used on an as-needed-basis and will monitor the Chance Find Program.
 - iii. The on-call specialists are only required to conduct field monitoring in the case of unusual or highly sensitive and important chance finds.
- A stop work authority/procedure should be affected in the immediate area for the protection of cultural heritage materials encountered during construction activities.
- Document and assess Chance Finds to determine if additional investigations are required.
- Adhere to any established protocols established in consultation with project management of Implementing Agency, Contractors, cultural heritage specialists, local regulatory bodies (for the design and implementation of additional investigations, if needed).
- Identify the roles and responsibilities of the various stakeholders involved.
- The archaeologist must be present during all ground disturbing works conducted within culturally sensitive areas.

- Ground works in other areas should be monitored by at least one member of the project staff who has previously received cultural heritage training.
- Considering that a chance find can be reported by any member of the project staff, it is important that cultural training be provided to all project staff and subcontractors.

If a Chance Find is encountered, the following steps should be undertaken:

1. Issue a stop work order in the vicinity of the find.
2. Inform the site supervisor or project manager.
3. Install temporary site protection measures such as warning tape or avoidance signs.
4. Inform all personnel of the Chance Find if access to any part of the work area is restricted.
5. Establish a localized no-go area needed to protect the Chance Find.
6. Arrange for the specialists to perform a preliminary evaluation to determine whether the Chance Find is cultural heritage and if so, whether it is an isolate or part of a larger site or feature.
7. Leave artefacts in place if possible; if materials are collected, they will be placed in bags and labelled by an archaeologist and transported to the relevant agency. Artefacts should not be allowed to be taken by any project personnel as personal possessions.
8. Document the finding via the use of photography, notes, GPS coordinates and maps as appropriate.
9. If the Chance Find proves to be an isolated find or not of cultural heritage, the specialist will authorize the removal of the site protection measures and activity in the area.

If, however, the specialist confirms the Chance Find as a cultural heritage of artefact or site of significance, inform the Barbados National Trust on all matters and the Future Center Trust where it relates to the Trailway, and initiate discussions about treatment as follows:

1. Prepare and retain archaeological monitoring records including initial reports whether they are later confirmed or not. The record shall include coordinates of all observations to be retained;
2. Develop and implement treatment plans for confirmed finds using the services of qualified cultural heritage experts;
3. If a Chance Find is a verified cultural heritage site, prepare a final Chance Find report once treatment has been completed; and
4. While investigation is ongoing, co-ordination with onsite personnel is needed so as to keep them informed of the status and schedule of the investigations and inform them of when construction will resume.
5. Coordination with the National Heritage Department is also needed to keep them informed and for guidance on recommended procedures.

In the event that mitigation is required, then expedient rescue excavations should be undertaken by the relevant archaeological specialists unless the chance find is of international importance. If this is the case, then special care should be taken and archaeologists with the appropriate expertise in addressing the find should be appointed.

14.5 Key Performance Indicators

The following KPIs in Table 14-1 have been selected in order to evaluate the effectiveness of the heritage management.

Table 14-1: Key Performance Indicators for Management of Heritage Assets

Key Performance Indicators	How will it be Monitored and Measured	Responsibility
Heritage Inventory	Review and inspection of documentation.	Contractor
Monitoring Records	Review and inspection of documentation of Archaeological Screening Report, Consultation Report and Monitoring Report	Contractor. Results to be presented to the Implementing Agency

14.6 Roles and Responsibilities

It is the responsibility of the Contractor to ensure that there are losses to heritage assets. The BWA is responsible for monitoring the contractor to ensure that monitoring is being undertaken and mitigation measures are being enforced.

14.7 Data Analysis and Reporting

If there are any violations, this will be reported immediately to the Contractor and the BWA.

15 STAKEHOLDER ENGAGEMENT PLAN

This plan should outline the measures to be used for community engagement, dissemination of project information and grievance management and will be utilised as a key element in all the proposed management, monitoring and mitigation measures outlined in this document. This plan would be responsibility of the Implementing Agency and Contractor.

15.1 Stakeholder Identification

For the purpose of the analysis, stakeholders are grouped within the following broad categories:

1. Affected communities including community members living adjacent to the construction works – families, individuals and social structures and networks including formal or informal community organisations;
2. Sensitive human receptors in the vicinity of the construction works, including schools, health facilities (hospitals), nurseries and early childhood care and educational facilities, care facilities for older adults, persons who at home during the day, etc.;
3. Local businesses and their representative organisations;
4. Local persons seeking employment;
5. Tourist Interests;
6. Heritage Interests;
7. Local Government – MENB, EPD, Municipality;
8. Politicians (Local Government Councillors, Members of Parliament and Representatives of the Opposition);
9. Residents of the affected municipalities;
10. Project contractors and sub-contractors;
11. Central government agencies (including regulatory agencies);
12. National civil societies (e.g. environmental NGOs);

13. The media; and
14. The general public.



Figure 15-1: Stakeholder Priority Mapping

15.2 Stakeholder Analysis and Engagement Strategies

Figure 15-1 ranks stakeholders based primarily on their level of importance (those who may be directly or indirectly affected by project activities) and their level of concern regarding the outcome of the project. The key local stakeholders (high priority stakeholders), those whose participation in the project is critical to achieving the project objectives, are the following:

- Affected communities including CBOs and local NGOs;
- Individual and families living adjacent to the construction works;
- Sensitive human receptors in the vicinity of the construction works;
- Landowners and informal occupants in the footprint of the project;
- Local businesses and their representative organisations;
- Farmers;
- Local persons seeking employment;
- Tourist Interests; and
- Heritage Interests.

A second figure also maps stakeholders against their level of influence and their degree of interest in the project. This second figure also presents the recommended communication/engagement strategy as the project rolls-out. The level of interest is defined as the degree to which a stakeholder is concerned about the outcomes of the Barbados Water Reclamation Project. A key question here is, “Will stakeholders be positively or negatively affected?” The level of influence looks at the degree to which a stakeholder can make or break the project, for example, through the provision of funding, their cooperation, protest action, or through legal means, etc. Six stakeholder groups fall within the high influence and high interest category who should be managed thoroughly (engaged and consulted) throughout the project. Among them are the first six stakeholder groups listed above. The list of stakeholders at the community and institutional level with whom the project should engage and consult throughout the project is provided in Figure 15-2.

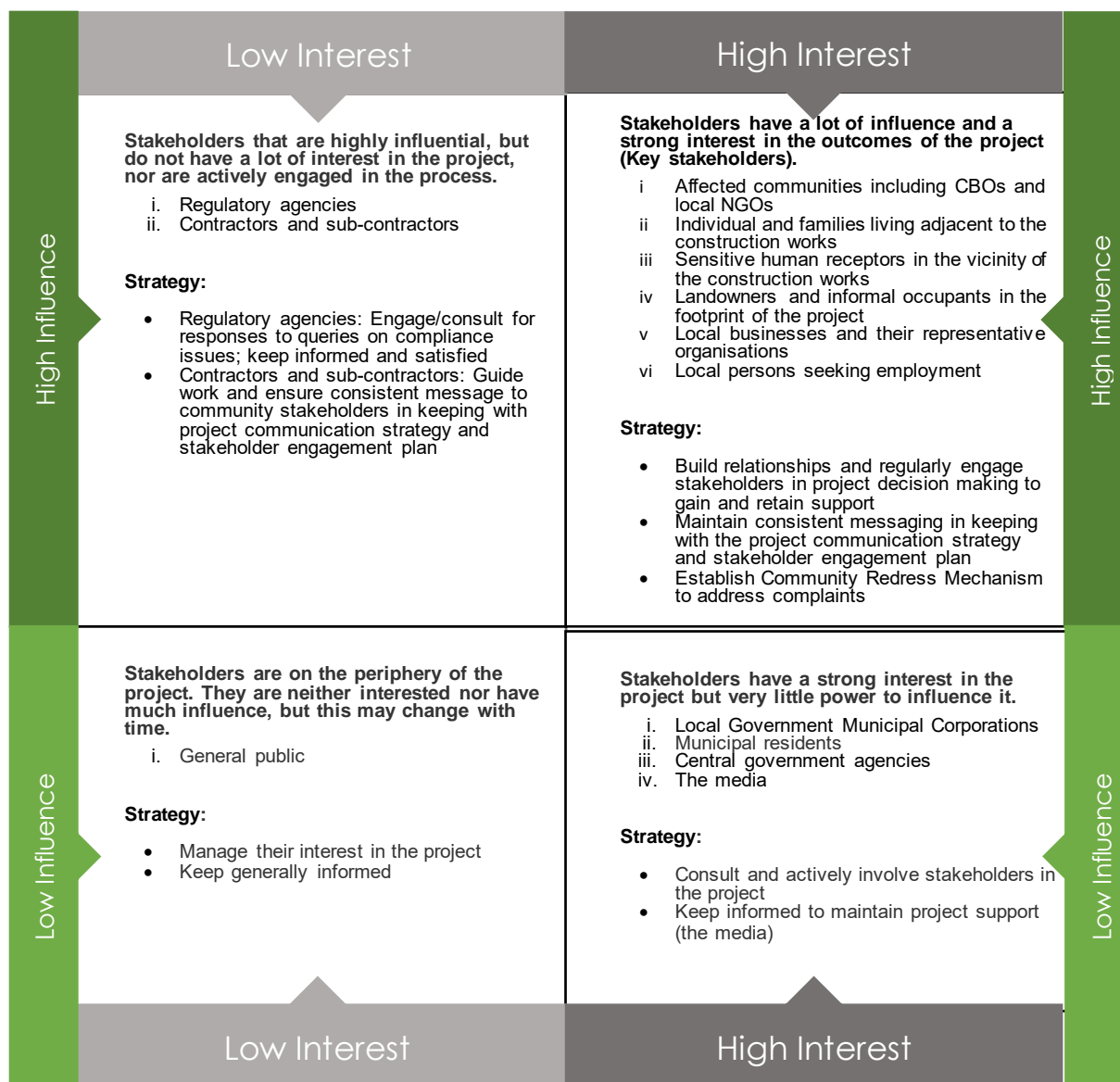


Figure 15-2: Stakeholder Mapping Results and Strategy for Engagement

Table 16-1 lists the stakeholders identified as important to the implementation of the Project and their criticality. The criticality of the stakeholders in the engagement process was categorized as follows:

- **Critical:** stakeholders who would be most directly affected by the works and the outcomes of the project
- **Important:** stakeholders with the potential to be impacted and whose responsibility, concerns or mandate are important to inform the decision making process
- **Interested:** stakeholders who are of little threat to the works and outcomes of the Project that act as either a regulatory agency, contributor to the works or a source of data.

Table 15-1: Importance and Criticality of Identified Stakeholders

STAKEHOLDER	IMPORTANCE TO THE PROJECT/INTEREST IN THE PROJECT	CRITICALITY
Communities identified close to the SCSTP, along the ABC Highway and close to the Historic Trailway	The communities close to the Project area are most at risk to the potential impacts of the works and the operations of the Project components. It is important that these communities are included in the engagement process, informed of all Project updates and expectations, and the redress mechanism to be implemented to address all concerns.	CRITICAL
Farmers (Plantations and small farmers in communities)	One of the primary objectives of the Project is to supply treated wastewater to farmers for irrigational and other agricultural purposes. The quantity and quality of water to be supplied will influence agricultural activities, as well as any disruption to farming activities during any works – pipelines run through some farmlands.	
Businesses and Vendors	The works may lead to restricted access to some businesses and vendors, affecting livelihoods. There may be need for a livelihood protection plan so it is important that business and vendors are included throughout the engagement process to minimize the impacts on livelihoods.	
Tourists, Hotels, and other Tourism Related Entities	The location of the treatment plant is within 1 km of coastal areas where tourism activities are concentrated. As tourism is a primary contributor to the island's GDP, it is important that the effects on tourism activities (either through restricted access to eateries or hotels, or the degradation of the physical environment) are communicated and mitigation measures shared.	
Graeme Hall Nature Sanctuary	These wetlands are of paramount ecological importance in the island so its conservation is necessary. It is important that the potential impacts (both positive and negative) are effectively communicated to protect the ecology of the area.	
Future Centre Trust	This entity is responsible for the restoration of the cultural assets located along the Historic Trailway. Their efforts have led to the successful restoration of some bridges and wells, as well as the planting of some fruit trees. It is important to collaborate with this	

	entity to ensure the works do not compromise restoration efforts.	
Labourers and Workers Unions (National Union of Public Workers and Barbados Workers' Union)	Labourers are at risk to any accidents that may occur while doing works. It is important that their health and safety are prioritized and that unions are engaged to ensure fair and reasonable working conditions for all labourers on the Project.	
Schools (e.g., Deighton Griffith Secondary and Blackman & Gollop Primary)	With minimal routes leading to some schools, it is important that the works do not restrict access to schools. The safety of students is also a top priority.	IMPORTANT
Ministry of Education, Technological and Vocational Training	Government entity overseeing schools. Important to collaborate with to identify impacts on schools and to inform mitigation measures.	
Ministry of Transport, Works and Water Resources and the Barbados Transport Board	Government entity responsible for transportation. Important to collaborate with to ensure road works are communicated with the public, are restricted to acceptable hours and to identify and communicate alternative routes.	
Ministry of Tourism and International Transport	Government entity responsible for tourism activities. It is important to collaborate to minimize the impacts on any tourism related activities.	
Ministry of Agriculture and Food Security	Responsible for the protection of agricultural interests.	
Ministry of Health and Wellness	Community and worker health and safety are priorities of the Project, so effective communication with responsible experts are needed to guide health and safety practices to reduce impacts on health and wellbeing.	
Gender Bureau Affairs Barbados Professional Women	Concerned with gender affairs, representing one vulnerable group. Collaboration is important to ensure that gender rights are protected, and that both genders can be equally represented in the Project's labour force.	
National Disabilities Unit Barbados National Organisation For The Disabled Barbados Council for the Disabled	Represents a vulnerable group that may be affected by Project activities.	

Ministry of Environment and National Beautification	Government agency responsible for the protection of the natural environment.	INTERESTED
Environmental Protection Department	Regulatory body that ensures that the physical environment is protected and that environmental standards are adhered to.	
Coastal Zone Management Unit	Responsible for the protection of coastal areas, regulating possible discharge into coastal areas.	
National Conservation Commission	Responsible for the preservation of the natural and man-made environment.	
Barbados Sanitation Authority	Responsible for waste collection and disposal.	
Barbados Light and Power Company	Utility company	
Drainage Division	Responsible for the drainage conditions of an area.	
Environmental Health Department	Responsible for the protection of the natural environment.	
Planning and Development Department	Responsible for the progressive development of land in urban and rural areas.	
Barbados Statistical Department	Responsible for the provision of statistical data to inform the social baseline.	
Barbados Chamber of Commerce	Concerns itself with the protection of the business community.	

Appendix II outlines the list of stakeholders under this project that have been engaged under this consultancy and will need to continuously be engaged throughout the project. All identified stakeholders will also be invited to the public consultation to be executed under this project. The following chapters present the proposed consultation schedule for engaging stakeholders throughout the life of the project.

15.3 Consultations During Project Preparation

15.3.1 Introduction

This chapter presents the framework and approach that the Consultant recommends the BWA undertake to satisfy the requirements for the IDB's ESPS 10 - Stakeholder Engagement and Information Disclosure. The plan details the processes of stakeholder identification and mapping and recommends an appropriate methodology to implement to effectively engage all identified stakeholders. This plan acknowledges and embraces inclusivity and anonymity as a fundamental principle guiding the consultation process, ensuring that all voices and perspectives are valued and considered. As such, the recommendations presented in the subsequent sub-chapters are tailored to ensure the affected communities, beneficiaries and vulnerable groups have equal opportunity to be included in the process along with government and regulatory entities. By fostering an open, inclusive and transparent environment conducive to dialogue, the aim of this process is to harness a culture of collaboration that would ultimately enhance the project's outcomes through insights that could inform the Project design and scope.

15.3.2 Method of Consultation

Recognizing the critical importance of establishing a setting where persons are able to convene on their own volition to be briefed on all aspects of the Project – scope, objectives, justification, environmental and social risks, management plans inclusive of mitigation measures for risks via a presentation prepared by the Consultants– and share real-time feedback, recommendations and concerns, Town Hall Meetings to be held in March 2024 is sufficient. This inclusive approach would ensure that stakeholders are empowered to contribute meaningfully to the ongoing development and refinement of the project through diverse perspectives and insights.

As the Project spans a wide area, it is difficult to pinpoint a single location where all the identified stakeholders would have equal access. Therefore, it is recommended that multiple meetings are held to provide the opportunity for as many of the affected population to attend. The selected locations for the Town Hall Meetings should be located close to the critical stakeholders and there should exist the possibility for virtual attendance to accommodate those who are unable to attend physically. In keeping with ensuring equal access for all stakeholders, it is recommended that the day and time of the Town Hall Meetings avoid temporal conflicts with the established schedules of key stakeholders. For example, it is pertinent that the time chosen for the meetings avoid conflicting with the time that farmers would usually be in their fields.

15.3.3 Advertisement and Invitation

It is recommended that a diverse range of communication methods be employed to maximize public reach and ultimately maximize public attendance. With over thirty (30) years of experience in conducting Environmental and Social Impact Assessments, including participating in the organization of public consultation sessions, the Consultants will assume the responsibility of aiding in the preparation of advertising material in the form of a poster to be published in the public media. It is also that this method of advertisement be supplemented with the circulation flyers, emails and by uploading an advertisement on the BWA's website. The BWA may also seek to employ additional methods of advertisement. In that event, other methods that could be implemented include social media posts, public media announcements, press releases, postings on local community websites and by delivering letters to individuals in the Project Area. The latter method may require the BWA to contract some entity responsible for letter delivery.

15.3.4 Action Plan

It is recommended that one town hall meeting be held to accommodate those identified as key stakeholders close to the location of the existing SCSTP and along the ABC Highway, and another meeting be held to accommodate those identified as key stakeholders along the route that branches from the ABC Highway and along the historic railway. Both town hall meetings should allow for virtual attendance, via Zoom or any other preferred virtual meeting platform. This option of virtual attendance should be included on all advertising material and should include clear steps to achieving virtual attendance. An example of this would be the inclusion of a Zoom attendance link.

Furthermore, it is essential that the advertising process targets vulnerable groups – women, elderly/youth and the disabled as examples. This is to be done by issuing advertising material directly to the relevant NGOs or civil society organizations concerned with the inclusion of these vulnerable groups. This would increase the likelihood of these vulnerable groups being made aware of the public sessions. As well, special provisions must be made at each meeting to accommodate vulnerable groups, particularly the elderly and the disabled. These measures include:

- Ensuring easy access to the venue via manual assistance, ramps, railings, adequate seating, lighting, etc.
- Ensure the presentations are palatable to all age groups – use non-stimulating colours (neutral tones) and images.
- Provide transportation, where necessary.
- Targeted inclusion of these vulnerable groups in the Questions and Answers segment of the session.

15.3.4.1 Town Hall Meeting for Stakeholders Close to the SCSTP and Along the ABC Highway

To accommodate as best as possible the working class of the population, as well as those doing business on a weekday, the town hall meeting should be scheduled at least three weeks subsequent to the disclosure of the finalized ESIA. As such, the meeting could be scheduled for **Saturday, March 23, 2024** at the **Christ Church Foundation School/Christ Church Parish Church Hall** at **6:00 p.m. AST**. This is to ensure that the meeting avoids conflicting with typical work hours, business hours as well as any religious constraints. The meeting should last for no longer than 1.5 hours to allow attendees the opportunity to return to their homes, or other desired destinations at a reasonable time. This time period should see the presentation of the findings of the ESIA, including the potential impacts identified and recommended mitigation measures outlined in the different management plans. The primary stakeholders who should be targeted as desired attendees at this meeting include:

Table 15-2: Priority Stakeholders to be invited to Town Hall Meeting 1

STAKEHOLDER	CRITICALITY
Community Members <ul style="list-style-type: none"> • Graeme Hall • St. Lawrence Gap • Warners • Sargeants • Vauxhall • Maxwell Hill • Kendall Hill • Bennatyne (cluster of households identified in Chapter 5.7.1.2) • Kingsland • Newton Terrace • Oistins • Gibbons Boggs • Other surrounding communities <p>(Community members can be reached via different Neighbourhood Watch Groups, Constituency Offices and Citizens Associations which serve as the primary community groups in the affected area)</p>	Critical Stakeholders <p>These communities house residents that would potentially be impacted by the construction of the reclamation facility and the installation of the pipeline along the ABC Highway. Feedback required on foreseen impacts on cultural/heritage/religious assets in different communities (e.g., churches)</p>
Businesses and Vendors	Critical Stakeholders

<ul style="list-style-type: none"> • Coconut vendors • Vegetable vendors • Kooyman's • Newton Industrial Estate • DHL • Barbados Bottling Company • Gildan Active Wear • Popular Discounts 	<p>The works may affect the operations of some businesses via restricted access caused by disruption in traffic flows and the blocking of some access routes. The vendors may need to be relocated.</p>
Graeme Hall Nature Sanctuary	<p>Critical Stakeholders</p> <p>Works and the operations of the Project Components may affect the ecology of the wetlands and the nature sanctuary.</p>
<p>Educational Institutions and Authorities</p> <ul style="list-style-type: none"> • Deighton Griffith Secondary School • Ministry of Education, Technological and Vocational Training 	<p>Important Stakeholders</p> <p>Disruption in traffic flows may affect access to the school, Works along the ABC Highway may pose a safety risk to students.</p>
<p>Transport Authorities</p> <ul style="list-style-type: none"> • Barbados Transport Board • MTWWR 	<p>Important Stakeholders</p> <p>Inputs needed to inform the decisions to be made regarding traffic disruptions and identifying alternative routes.</p>
<p>NGOs, Civil Society Organizations and Unions</p> <ul style="list-style-type: none"> • Caribbean Conservation Association • Barbados National Organisation For The Disabled • Barbados Council for the Disabled • Barbados Elderly Care Association • Barbados Association of Retired Persons • Barbados Association of NGOs • Barbados National Trust • Barbados Road Safety Association • Barbados Bureau of Gender Affairs • Barbados Professional Women • National Union of Public Workers • Barbados Workers' Union 	<p>Interested Stakeholders</p> <p>Civil society organizations work in a number of fields, including gender issues, health, agriculture, and environmental heritage and conservation.</p> <p>Different NGOs establish management programmes to preserve the country's natural and cultural resources.</p> <p>Workers' unions lobby for the collective interests of labourers, prioritizing ideal working conditions and compensation.</p>
<p>Other Government/Regulatory Agencies</p> <ul style="list-style-type: none"> • Ministry of Environment and National Beautification • Coastal Zone Management Unit • Environmental Protection Department • Ministry of Tourism and International Transport • Barbados Sanitation Authority • Barbados Light and Power Company 	<p>Interested Stakeholders</p> <p>No potential direct impact on agencies but important as regulatory agencies to be informed of the project and provide feedback that could inform the decision making process.</p>

- Ministry of Agriculture and Food Security
- National Conservation Commission
- Drainage Division
- Environmental Health Department
- Bureau of Gender Affairs
- Barbados National Disabilities Unit
- Planning and Development Department

15.3.4.2 Town Hall Meeting for Stakeholders off the ABC Highway and along the Historic Trailway

For similar reasons provided in the previous chapter, the second town hall meeting could be held on **Saturday, March 30, 2024** at the **Blackman and Gollop Primary School** at **6:00 p.m. AST**. The purpose of this meeting is also similar in that the findings of the ESIA will be shared, as well as the management plans that include the measures proposed to mitigate against the potential impacts in the Project area. The stakeholders to prioritize will also include the government and regulatory agencies listed in Table 16-2 as their role in the project, albeit minor in some cases, extends throughout the entire Project area. As such, Table 15-3 below shows the complete list of the stakeholders to be invited to this town hall meeting:

Table 15-3: Priority Stakeholders to be invited to Town Hall Meeting 2

STAKEHOLDER	CRITICALITY
Community Members <ul style="list-style-type: none"> • Haggatt Hall • Rouen • Jackmans • Froster Hall • The Glebe • Thorpes Cottages • Salters • Windsor (residences where pipeline passes adjacent to) • Constant • Dash Valley • Stepney • Flat Rock • Watts Village • Ellerton • Eastlyme • Waverley Cot • Other surrounding communities <p>(Community members can be reached via different Neighbourhood Watch Groups, Constituency Offices and Citizens Associations which serve as the primary community groups in the affected area)</p>	Critical Stakeholders <p>These communities house residents that would potentially be impacted by the installation of the pipeline along the Historic Trailway. Feedback required on foreseen impacts on cultural/heritage/religious assets in different communities (e.g., churches).</p>
Farmers	Critical Stakeholders

<ul style="list-style-type: none"> • Constant Plantation • Valley Island Plantation • Edgumbe Plantation • Sunbury Plantation • River Plantation • Farmers from the communities listed above • Ministry of Agriculture and Food Security 	<p>The works may affect farming activities as the pipeline route passes through farmlands. Ultimately, the aim of the Project is to supply treated wastewater to farmers so they are considered among the most sensitive receptors.</p>
<p>The Future Centre Trust Barbados Trailway Project</p>	<p>Critical Stakeholders Responsible for the restoration of the cultural assets along the trailway (wells and bridges). Critical to inform on the impact of these assets and the impact on restoration activities.</p>
<p>Educational Institutions and Authorities</p> <ul style="list-style-type: none"> • Blackman and Gollop Secondary School • Ministry of Education, Technological and Vocational Training 	<p>Important Stakeholders Disruption in traffic flows may affect access to the school. There are minimal access routes to the school so disruptions to normal traffic flows may prove problematic.</p>
<p>Transport Authorities</p> <ul style="list-style-type: none"> • Barbados Transport Board • MTWWR 	<p>Important Stakeholders Inputs needed to inform the decisions to be made regarding traffic disruptions and identifying alternative routes.</p>
<p>NGOs, Civil Society Organizations and Unions</p> <ul style="list-style-type: none"> • Caribbean Conservation Association • Barbados National Organisation For The Disabled • Barbados Council for the Disabled • Barbados Elderly Care Association • Barbados Association of Retired Persons • Barbados Association of NGOs • Barbados National Trust • Barbados Road Safety Association • Barbados Professional Women • Barbados Bureau of Gender Affairs • National Union of Public Workers • Barbados Workers' Union 	<p>Interested Stakeholders Civil society organizations work in a number of fields, including gender issues, health, agriculture, and environmental heritage and conservation.</p> <p>Different NGOs establish management programmes to preserve the country's natural and cultural resources.</p> <p>Workers' unions lobby for the collective interests of labourers, prioritizing ideal working conditions and compensation.</p>
<p>Other Government/Regulatory Agencies</p> <ul style="list-style-type: none"> • Ministry of Environment and National Beautification • Coastal Zone Management Unit • Environmental Protection Department • Ministry of Tourism and International Transport 	<p>Interested Stakeholders No potential direct impact on agencies but important as regulatory agencies to be informed of the project and provide feedback that could inform the decision making process.</p>

- Barbados Sanitation Authority
- Barbados Light and Power Company
- Ministry of Agriculture and Food Security
- National Conservation Commission
- Drainage Division
- Environmental Health Department
- Bureau of Gender Affairs
- Barbados National Disabilities Unit
- Planning and Development Department

15.3.4.3 Summary of Actions to be Taken

The following table highlights the different steps to be taken in the ESIA Consultation process.

Table 15-4: Steps to be taken in the ESIA Consultation Process

Action	Content	Timeline	Budget
Preparing and Issuing Invitations	<p>The invitations to be prepared include:</p> <ul style="list-style-type: none"> - Invitation Letter to be emailed - Posters and Flyers - Posts on social media, community websites and the BWA Website - Advertisements in the local media <p>These invitations should include the purpose of the meetings –</p> <p><i>“To disclose the findings of the ESIA conducted for the Project and to receive/address questions, concerns and feedback of the affected population.”</i></p> <p>The invitations should also include the dates, times and the venues at which the meetings will be held.</p>	<p>Invitations should be extended three (3) weeks before the date of the first Town Hall Meeting</p> <p>In the week of February 18 – 24, 2024.</p>	<p>The Consultant assumes responsibility for the preparation of the posters/flyers and the drafting of the invitation letters that the BWA will circulate.</p> <p>Approximately \$20,000 BBD.</p>
Town Hall Meetings	<p>The content presented at these meetings should include:</p> <ul style="list-style-type: none"> - Project Background and Components - Project Area - Project Aims/Objectives 	<p>Town Hall Meeting 1 (SCSTP and Along ABC Highway) : March 16, 2024 at 6:00 p.m. AST</p>	<p>The cost of the public meetings will vary depending on the selected venue as well as the anticipated stakeholder outcome.</p>

	<ul style="list-style-type: none"> - Overview of the Existing Environment (Physical, Socioeconomic, Ecological) - Potential Impacts Identified - Management Plans prepared, including recommended mitigation measures <p>These should be included in the presentation that the Consultant will prepare and Deliver. The BWA will be responsible for hosting the sessions, including the delivery of the expressions of welcome and participating in the Q&A session.</p> <p>The recommended agenda of the meeting is as follows:</p> <ul style="list-style-type: none"> - Welcome and Registration (15 mins) - Presentation of ESIA Findings (30 minutes) - Questions and Answers Session (45 minutes) 	<p>Town Hall Meeting 2 (Along Historic Trailway to River Plantation): March 23, 2024 at 6:00 p.m. AST</p>	<p>The cost should include:</p> <ul style="list-style-type: none"> - Renting the venue; - Providing refreshments; - Providing transportation, where necessary
Preparation of Consultation Report	<p>The results of engagement activities conducted throughout the project must be presented by the Consultant. Engagement activity summaries should include the following information:</p> <ul style="list-style-type: none"> - Stakeholder engaged (name and contact details) - Date and location of meeting (photo if possible) - Topic of meeting - Feedback received from stakeholder - Answers from Implementing Agency - If the Implementing Agency, commits to something, the commitment should be recorded as part of a commitment register identifying a responsible entities/person, and a deadline as appropriate. 	<p>A Consultation Report should be completed in each phase, after each engagement activity has been completed.</p>	<p>It is a part of the Consultant's mandate to prepare the Consultation Reports.</p>

15.3.4.4 Specific Measures for Vulnerable Group Inclusion

While public advertisement will be conducted, it is recommended that invitations be extended directly to NGOs and Civil Society Organizations concerned with the welfare of vulnerable groups. It is expected that a channel of communication be established with these organizations so the process of information dissemination can be undertaken without significant setbacks. It should be explicitly declared to these organizations of the intention to include these vulnerable groups in the Consultations during Project Preparation Phase. The organizations with which this type of relationship should be established include:

- Barbados National Organisation For The Disabled
- Barbados Council for the Disabled
- Barbados Elderly Care Association
- Barbados Association of Retired Persons
- Barbados Professional Women
- Barbados Bureau of Gender Affairs

Proceedings at the recommended Town Hall Meetings should also exercise inclusivity of these vulnerable groups. It is important the presentation shared is palatable to all ages and gender as it relates to themes, visuals and delivery. It is also recommended that the elderly and the disabled be seated appropriately and close to the presenters. The Q&A Session of the presentation to be delivered should include these vulnerable groups via targeted prompts to attain inputs.

15.4 Stakeholder Engagement During Project Implementation

A schedule should be developed for the consultations intended to facilitate disclosure of information on the project. It is anticipated that engagement will help to build and maintain over time a constructive relationship with all stakeholders.

The sample consultation schedule is presented in the table below that shows likely communication required while executing the Project. It outlines the communication needs, timing and method for the stakeholders relevant for each management plan.

Table 15-5: Likely Stakeholder Consultations under the Project

#	Plan	Content	Sessions	Method	Target Audience
1	Worker Health and Safety Plan	Health and safety procedures and personal protective gear that need to be worn during construction activities.	1. Prior to Implementation 2. During the Works	Training and sensitisation sessions with contract workers on site. Bulletins on the notice board on site as reminders, safety signs.	Workers Project Management
2	Community Health and Safety Plan	Health and safety precautions and protocols that need	1. Prior to Implementation	Meetings and sensitisation sessions with	Community Members

#	Plan	Content	Sessions	Method	Target Audience
		to be adhered to during construction and operation activities.	2. During the Works	community members. Bulletins on the community notice board and signage at site boundaries as reminders, safety signs.	Local Hospitals / Authorities Project Management
3	Traffic Management Plan	Traffic Management Plans and impediment mitigation efforts.	1. Prior to Implementation 2. During the Works	Meetings and sensitisation sessions with community members. Bulletins on the community notice board and signage at site boundaries as reminders, safety signs.	Community Members Affected Groups Local Authorities / Traffic Wardens
4	Management of Access to Communities	Temporary alternative routes or restrictions to access during construction activities.	1. Prior to Implementation 2. During the Works	Meetings and sensitisation sessions with community members. Bulletins on the community notice board and signage at site boundaries as reminders, safety signs.	Community Members Affected Groups Local Authorities / Traffic Wardens
5	Waste Management Plan	Plans to receive and remove solid and hazardous waste offsite to appropriate off-site disposal. Procedures for handling and disposing of solid and hazardous waste material.	1. Prior to Implementation 2. During the Works	Collectors to be advised via letter and telephone conversation. Worker sensitisation sessions	Waste Authorities Project Management and Relevant Staff
6	Social Management Plan	ESMP Sensitisation	1. Prior to Implementation	Direct engagement at the individual level	Community Members

#	Plan	Content	Sessions	Method	Target Audience
			2. During the Works		Affected Groups NGOs
7	Security Management Plan	Communication to all security contractors and subcontractors during project activities as well as workers regarding proper security protocols.	1. Prior to Implementation 2. During the Works	Direct engagement at the individual level	Community Members Affected Groups NGOs Project Management Local Authorities
8	Contractor Management Plan	Management Processes and Procedures	1. Prior to Implementation 2. During the Works	Direct engagement at the individual level	Contractors Subcontractors Project Management
9	Heritage Management Plan	Mitigation and Preservation	1. Prior to Implementation 2. During the Works	Direct engagement at the individual level	Priority Stakeholders NGOs Project Management
10	Labour Management Plan	Human rights policies, labour protocols, code of conduct and prevention of GBV crimes.	1. Prior to Implementation 2. During the Works	Direct engagement at the individual level	Workers Project Management

15.5 Stakeholder Engagement During Project Execution

Stakeholder Engagement is a continuous process intended to last the entire duration of the Project lifeline. That is, engagement activities should be conducted in all phases of the project: pre-construction, construction and operations phase. The nature of the engagement process is important for this Project particularly due to the continued concerns that the public may have based on past experiences with the wastewater sector on the island. The following are measures recommended to ensure that the engagement process is continual into the operational phase of the Project and is effective as a reliable method of communication between the Project and stakeholders:

- The list of stakeholders identified as per Chapter 15.1 and Chapter 15.2 must be retained throughout the Project's life cycle. This list should be updated at least annually to account for the change in dynamics of the island's demography and broader socioeconomic environment.
- Key roles identified in the SEP and other management plans, such as the CLO and EHS Officer, must be retained and occupied for the Project's life cycle to ensure reliable points of contact for engagement and to foster healthy relationships with the residential, socioeconomic and civil society communities.
- Clear communication channels and mechanisms should be established for stakeholder engagement, such as project meetings, workshops, newsletters, email updates, website updates, social media platforms, and dedicated hotlines. These channels should allow for dissemination of key project updates and information and how these would affect stakeholders and should allow for the receipt of stakeholder feedback. Communication channels and methods should be tailored to meet the needs of different stakeholder groups.
- These channels and methods of communication should provide frequent updates on project status, milestones achieved, issues encountered, upcoming activities, and updated project schedules, when necessary. To build trust and credibility, these channels should also address anticipated concerns. For example, the public fear of a repeat of the 2018 overflow incident should be addressed by outlining the safeguards that are in place and that will be introduced as an outcome of the Project to prevent a repeat of this incidence. Also, the end-use and management measures for the sludge should be addressed in the information disclosure activities.
- As it relates to the supply of reclaimed water, stakeholders should be made aware, via one or more of the aforementioned channels, of the method of distributing water, including price, targets and eligibility. It is recommended that stakeholders are first engaged on this particular issue so a fair method of distribution and price be settled on.
- Generally, two-way communication channels with stakeholders are encouraged. These channels are to actively solicit feedback, input and suggestions on Project decisions and plans. Open dialogue, criticism and collaborative problem-solving are encouraged to address stakeholder concerns and arriving at a consensus on sensitive and potentially controversial issues.
- The use of the GRM is recommended throughout the Project life cycle, through all Project phases.

15.6 Key Performance Indicators

The following KPIs have been selected in order to evaluate the effectiveness of the stakeholder engagement plan.

Table 15-6: Key Performance Indicators for Stakeholder Engagement

KEY PERFORMANCE INDICATORS	HOW WILL IT BE MONITORED AND MEASURED	RESPONSIBILITY	FREQUENCY
Log of and Timely Response to Complaints	Review and inspection of documentation	Contractor; Results to be presented to the Implementing Agency	Weekly (complaints to be addressed withing 10 working days)
Town Hall Meeting Attendance	Attendance/Registration Sheet	BWA; Results to be presented to the Implementing Agency	Date of Town Hall Meeting

15.7 Roles and Responsibilities

It is the shared responsibility of the Consultant and the BWA to identify and engage stakeholders during the Project preparation phase. The Consultant assumes responsibility for the preparation of invitational and advertising material which the BWA is charged with issuing/publishing to any public consultations scheduled in the Project preparation phase (for example, posting/circulating flyers).

It is the responsibility of the BWA that the Contractor is effectively sensitized on appropriate health and safety procedures, emergency procedures, waste management procedures and all other applicable standard procedures to maintain environmental, worker and community health and safety. The Contractor shall ensure that all training and sensitization sessions are accessible to its workers and that an effective channel of communication is established with the communities. It is the responsibility of the Contractor to manage social conflicts and project concerns that may arise. The contractor must ensure that all workers and community members are adequately aware of the grievance mechanism to log complaints that need to be addressed.

A Community Liaison Officer should be employed to lead out in the consultation activities as well as operate the grievance redress mechanism (GRM) without bias.

It is the responsibility of the Consultant to prepare the Consultation Report in each phase of the Project to be presented to the Implementing Agency.

16 GRIEVANCE REDRESS MECHANISM

A Grievance Redress Mechanism (GRM) will have to be in place prior to the start of construction and operational activities in the western coastal zones of Barbados. This mechanism will allow for concerns/complaints to be received and to facilitate resolutions of the affected individuals. It will require the project proponent and/or the Contractor to respond within a specified time. This mechanism offers affected communities/ stakeholders an alternative to external dispute resolution processes. The GRM is also available to workers on the project sites that experience an incident warranting and requiring the use of the GRM to log their incident or complaint. The Grievance Collection Form and Grievance Monitoring Form provided may be used for both community/stakeholder and site worker complaints.

If the grievance being submitted is received from a site worker, the Code of Conduct (CoC) for the project sites will apply. The CoC will be required to be developed with BWA and should govern both conduct and a detailed processes for how situations of misconduct occurring on the work sites will be addressed and what mechanisms to mediate or mitigate risk should be applied. The CoC would act as a guiding document to be followed to identify and limit the impact of potential risks, to mitigate risks that are not entirely avoidable given considerations of social norms, cultural beliefs, and human behaviour, and that will serve to provide appropriate actions in the case that following and adherence to the CoC has been breached.

As soon as the full details of the finished project are known and accepted, it will be the Implementing Agency's obligation to update and change this procedure or complaint mechanism.

Both the construction and operation phases are covered by the grievance procedure that is described below. The Implementing Agency will be responsible for receiving complaints and assisting in the resolution of grievances and concerns regarding the environmental and/or social performance from impacted communities or individual members.

The grievance mechanism allows for the addressing of issues raised by the affected due to the foreseen impacts of the project through the use of the Grievance Collection Form (see Chapter 16.1). It makes it possible for immediate issues including any form of GBV to be addressed in a way that is transparent, relevant for the Barbados scenario, and easily reachable by all groups within the impacted populations (See GBV Referral Pathways in Chapter 16.3).

The mechanism is without direct costs to access and use it and does not prejudice other forms of remedial action and or justice. These mechanisms will not prevent people from using administrative or judicial remedies. The Implementing Agency shall discuss the mechanism with the impacted communities during its community engagement process and as necessary to protect the Project's interests.

Specific to both internal and external stakeholders is the suggested course of action listed below. Internal and external stakeholders shall use the suggested mechanism to file any complaints.

Step 1

The process of accepting grievances is the first step which can take on varying levels of formality as outlined in Table 166-1 below. The following chapter outlines the Grievance Collection Form (see Chapter 16.1) that complainants will first need to complete. Grievances can be recorded at the temporary facility. Grievances can also be logged anonymously based on the nature of the problem.

Table 166-1: Methods for Grievance Receipt, from Least to most formal

LEVEL OF FORMALIZATION	EXAMPLES
Least Formal: Oral complaints received face-to-face	Staff charged with collection of grievances writes down complaints at group or individual meetings, during field visits, or at designated locations.
Somewhat formalised: Oral complaints received through remote-access methods	Staff accepts grievances through a designated telephone line.
More formalised: Written complaints received face to face	Staff accepts written submissions from an individual or a group at groups or individual meetings, during site visits, or at designated locations.
Most formalised: Written complaints received through remote access methods	<p>Complaints come in via regular mail, internet, or grievance collection boxes (consider having multiple locations).</p> <p>Complainants submit written grievances to third parties (to be forwarded to the local Contractor or the third party designated to administer the grievance redress mechanism).</p>

While oral complaints are accepted from both internal and external stakeholders, a grievance collection form provided in the following section should be completed by the stakeholder following oral face to face or remote communication. This form will be made available at the Implementing Agency's office.

Step 2

The logging and addressing of complaints rests with the local Contractor or Project Coordinator. Following the logging of a complaint, the grievance will be addressed at this level. The grievance log will include all the steps taken to address the grievance as well as maintain a report on the current status of the grievance. A response must be prepared for the grievant. Appropriate attention should be given to gender-based grievances. The CONTRACTOR must ensure that the grievance is monitored frequently and is up to date.

Should the grievant not be satisfied with the response provided, then move on to step 3.

Step 3

Grievances that cannot be handled in Step 2 will be taken to the designated authority within or assigned by the Implementing Agency. A further root cause analysis should be done to identify another appropriate corrective action and complete the Grievance Monitoring Form (see Chapter 16.2) in the following chapter.

The complainant will then be informed in writing of the decision to correct the action within a forty (40) working day period.

Step 4

If the complainant does not feel that the grievance has been adequately addressed, they would go to court if the complainant so desires. Local non-governmental organisations (NGOs) also provide support for victims and persons affected by gender-based violence and can be accessed by the complainant.

16.1 Grievance Collection Form

(Used by Stakeholder)

Case No. _____

Applicant's Name _____

Sex: [Male] [Female] [Other] [Prefer not to say]

Applicant description: ☐ community member ☐ site worker

Age: _____

☐ I wish to submit complaint anonymously (in a way that prevents identification by name)

☐ I demand that none of my personal details be disclosed without my consent

Address: _____

Telephone: _____

Email: _____

Description of Comment/Complaint: (Subject of case, when did it occur, location, who is involved, effects of situation)

Date of Incident: _____

☐ One-time incident/complaint (date _____)

☐ Happened more than once (indicate how many times: _____)

☐ Ongoing (a currently existing problem)

According to the applicant, what measures would provide solution to the problem?

Signature: _____

Date: _____

Note: Please forward this form to: Project Office - Implementing Agency

Telephone: _____

Email: _____

16.2 Grievance Monitoring Form

(Used by Grievance Manager)

This Form is the responsibility of the Grievance Officer.

Case No. _____

Applicant's Name _____

Sex: [Male] [Female] [Other] [Prefer not to say]

Applicant description: ☐ community member ☐ site worker

Age: _____

Address: _____

Telephone: _____

Email: _____

Complaint

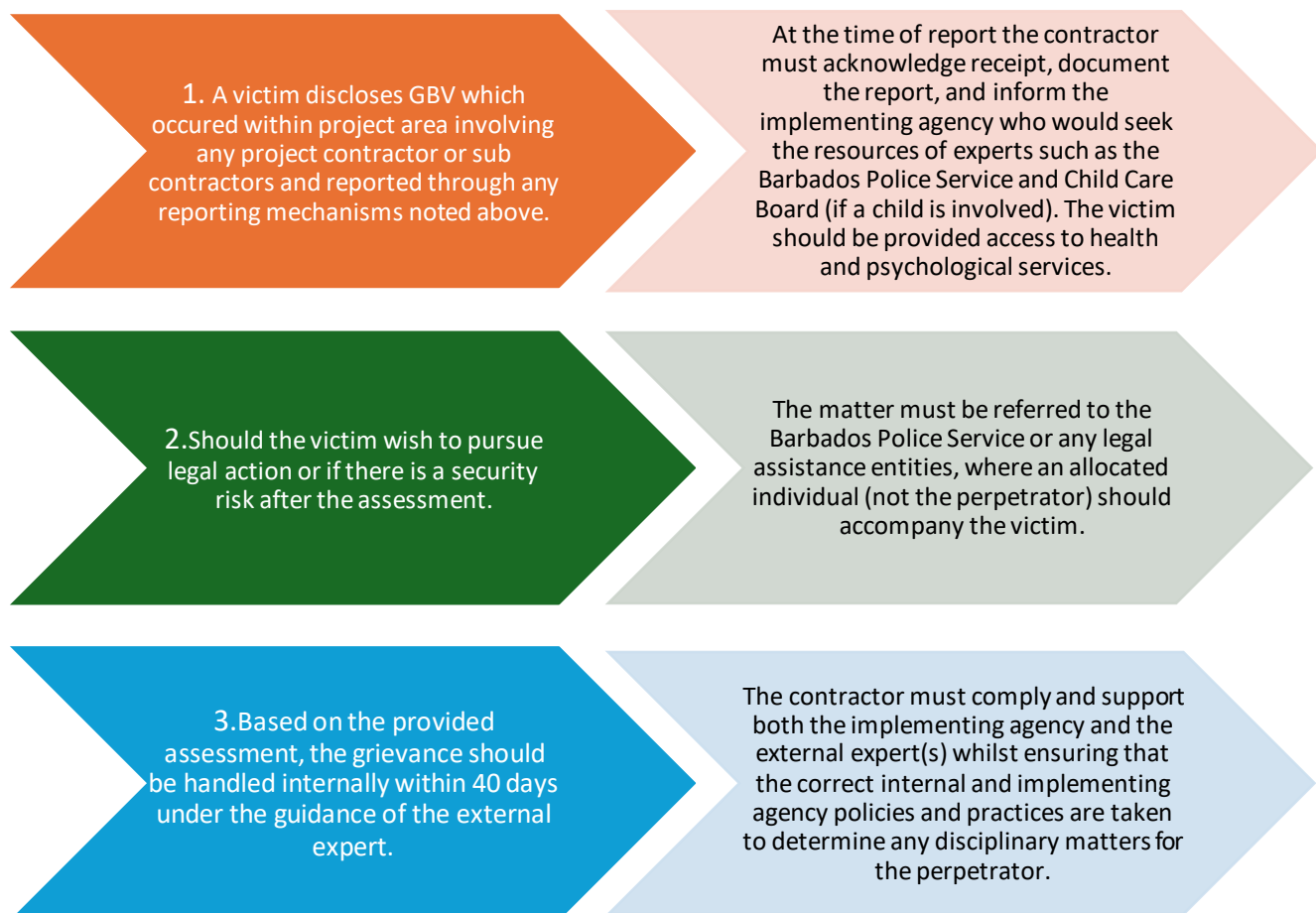
Root Cause Analysis

- List all the possible contributing factors
- Identify most probable reason

Corrective Action

Preventative Action if problem can re-occur

16.3 Gender-based violence Referral Pathway



NO INFORMATION ABOUT THE VICTIM OR OF THE CASE OF THE VICTIM’S GRIEVANCE SHOULD BE SHARED UNLESS FORMALLY PERMITTED BY THE VICTIM

16.4 Referral Contacts in Barbados

Barbados Child Care Board

8:30 AM to 4:30 PM - 246 535 2800

Barbados Professional Women’s Club of Barbados

(24/7) Crisis Hotline (Women) – 246 435 8222

Queen Elizabeth Hospital

(24/7) Emergency Ambulance – 211 or 511 or 246 436 6450 Ext. 5540

Barbados Police Service

(24/7) Emergency – 211

District E Police Station - 246 419 1730

17 SUMMARY OF MONITORING FREQUENCY

The following table summarises the monitoring frequency required for each area described previously:

Table 17-1: Monitoring Frequency Required for Each Parameter Outlined in the ESMP

PARAMETER	FREQUENCY
Marine Water Quality	Twice per month or as stipulated by the EPD
Air Quality	Twice per month or as stipulated by the EPD
Noise	Twice per month or as stipulated by the EPD
Waste	Twice per month
Traffic	As stipulated by the MTWWR
Worker Health and Safety	Daily
Community Health and Safety	Daily
Access to the Community	Weekly
Emergency Response	Monthly
Biodiversity	Weekly
Social Management	Weekly
Security Management	Daily
Contractor Management	Weekly
Livelihood Restoration	Consistent throughout all Project phases
Labour Management	Weekly

SECTION III

THE ESMS

18 ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM (ESMS) APPROACH

This chapter describes the 7 elements that make up an ESMS, tailored to the BWA, who are responsible for executing the Project. The documentation of the ESMS has been developed according to the structure in Figure 18-1.



Figure 188-1: The seven key elements of an Environmental and Social Management System (Source: IDB)

The ESMS is aligned with the elements of the IDB's ESPF. The ESMS provides guidance on how to integrate environmental and social requirements in our operations during the lifecycle of the Program. In particular, the ESMS sets up requirements covering the following areas.

Environment: to avoid and minimize adverse impacts on the environment by avoiding or minimizing pollution from the Program's activities as well as promoting resource efficiency and conservation of biodiversity.

Biodiversity: avoid developing projects in critical habitats and promote the protection, conservation, management and sustainable use of biodiversity, natural resources, and ecosystem services, in compliance with local environmental regulations.

Natural disasters and climate change: minimize the adverse effects of climate change and natural hazards, both in the form of physical damage and environmental, social, and economic losses that are often concentrated in the most vulnerable populations. As well as reducing or avoiding, whenever possible and feasible, the generation of greenhouse gas emissions.

Community and Heritage Management: to avoid adverse impacts on the communities where the BWA operates by protecting their cultural heritage and respecting their human rights and livelihoods, as well as contributing to the development of the communities through the supply of reliable and affordable energy and creating local employment.

Gender: to promote gender equality by ensuring that people enjoy equal conditions and opportunities to exercise their rights and duties.

Health & Safety: to avoid incidents with impact to workers and people of the near community, improving and providing a safe and healthy workplace for their workers, and other people under the BWA's control and vicinity, implementing fair labour practices and promoting the BWA's values including honesty, equity and integrity with our employees, contractors, and clients.

Land acquisition and Involuntary Settlement: to mitigate and compensate the impacts of involuntary resettlement. This has to be handled with careful planning and engagement of project-affected people and key government entities to result in the most cost-effective, efficient, and timely implementation as well as incorporation of innovative approaches to improving the livelihoods of those affected by resettlement.

Labour and Working Conditions: to protect the fundamental rights of workers as well as foster sound and constructive worker-employer relationship together these two ingredients can facilitate project sustainability and enhance the efficiency and productivity of projects.

19 ELEMENTS OF THE ESMS

19.1 ESMS Element 1: Project Specific Environmental and Social (E&S) Framework

The Project is committed to the development of its operations in an ethical and responsible manner, promoting a commitment to society through a positive impact on both people and the environment. Therefore, it promotes a set of policies and procedures that are reflected in this Environmental and Social Management System (ESMS). The Project-Specific Environmental and Social Framework is aligned with the following principles:

1. Ensure compliance with national legislation and international standards related to environmental, social, labor, health and safety and cultural aspects corresponding to the Project.
2. Ensure the technical, operational, and financial capacity of the Project and its contractors for the effective development and implementation of the Project ESMS, including the training of those responsible for implementing the ESMS in environmental and social management.
3. Periodically report to the IDB and stakeholders on the environmental and social performance of the Project and the ESMS.
4. Continuously evaluate and improve the effectiveness and correct implementation of the ESMS.
5. Establish an external communication mechanism so that the communities affected by the Project can communicate any complaint, claim or risk identified.
6. Incorporate environmental and social clauses in contracts to ensure the integration of the ESMS of the Project in the operation of the contractor in charge of the work.

Environmental Protection, Safety and Health at Work Policy

The Project, in compliance with its institutional mission intends to develop all its activities considering the protection of the environment and safety and health at work, so it has established Plans for the Protection of the Environment, Safety and Health at Work with the following commitments:

1. Promote and encourage in each worker the culture of environmental protection. Safety and Health at work, as well as its integrated management, inducing the perception of risk, continuous learning, and innovation.
2. Ensure compliance with environmental regulations and current labor requirements, as well as established internal regulations, considering operational policies and/or environmental safeguards in coordination with the financing entities.
3. Periodically evaluate the performance of the actions carried out in favor of the Environment, Safety and Health at work and notify in a timely manner the results obtained to the interested parties.
4. Adopt the necessary measures to minimize and prevent negative impacts on the environment, occupational risks, implementing the corresponding improvement measures and considering all the necessary aspects to guarantee the protection of the environment and protect the welfare of the worker.
5. Establish objectives and goals for continuous improvement, through agile processes of adaptation to change.

This policy will be strictly complied with at all organizational levels, as well as the companies providing services, being responsible for their own safety and contributing to the protection of the Environment.

19.1.1 National Policy, Legal and Regulatory Framework

All activities carried out under the Grant by the BWA, and its contractors or subcontractors must comply with the applicable local laws and regulations of Barbados, as well as with the international E&S standards and guidelines identified in Chapter 3. The BWA will include this requirement in all future contracts or agreements.

19.1.2 ESMS Implementation

The BWA understands that the implementation of the ESMS is a shared responsibility across its organizational structure. While day-to-day management of ESMS implementation is assigned to specific positions in the organization, the BWA will designate a team that will be responsible for E&S risk management and is committed to supporting and allocating sufficient resources to implement the ESMS (hereinafter the “ESMS Team”).

19.1.3 ESMS Document Disclosure and Procedure

Once the ESMS Team has been designated, they will develop a disclosure procedure to ensure the ESMS Document will be communicated to all relevant levels of the organization, contractors and/or subcontractors. This section will be updated once the disclosure procedure has been developed by the ESMS Team.

19.2 ESMS Element 2: Identification of Risks and Impacts

The BWA will develop a procedure for the ongoing identification and assessment of environmental and social (E&S) risks in relation to its activities, and a procedure for the ongoing identification and assessment of compliance with its environmental and social obligations.

The scope of the identification and assessment of E&S risks includes both direct and indirect risks from activities or processes over which the BWA does or does not have direct management control. The methodology to assess the E&S risks takes into consideration the applicable E&S obligations and prioritizes and defines mitigation measures (controls) to the risks that are significant according to severity and probability levels. The aim of the controls is to reduce significant risks to an acceptable level.

19.2.1 Step 1: Risk Identification and Assessment

The risk assessment process has been defined as a process that evaluates the probability or likelihood that adverse physical, ecological and social effects will occur (or have occurred or are occurring) as a result of exposure to stressors from various existing human activities, natural hazard exposures and planned activities of the Programme.

The risk assessment considers the human health risks, safety risk, natural hazard and climate-related risks, ecological risks, and combinations thereof. These considerations are identified based on the nature of the project area being along coastal regions.

In the case of the social risks a conceptual risk analysis is completed considering the environmental and social context and the project affected people and be in keeping with the IDB's environmental and social requirements. Based on the risk factors identified above the contextual risk levels will be classified as low, medium, and high risk based on the criteria below:

- Low risk – few salient issues identified.
- Medium risk – may have pockets of issues identified.
- High risk – significant and multiple issues identified.

Based on the contextual risk analysis, only those risks that have been identified to be medium or high would be carried forward and integrated into the impact analysis as elaborated in Chapter 20.2.2 below.

19.2.2 Impact Identification and Evaluation Process

The ESA process outlined above identifies the risks that are likely based on planned project activities. Following these assessments of the existing environment and risks, various environmental and social aspects and possible impacts associated with the various project components is assessed. The construction and operation phases of the proposed activities were also analysed. These impacts were assessed with respect to their direction, duration, magnitude, and type, and as outlined in Chapter 4.3.

19.2.3 Step 3: Mitigation and Enhancement

The Project aims to ensure that decisions are made in full knowledge of their likely impacts on the environment and society. Therefore, this process involves identifying where potentially significant impacts could occur and identifying ways of mitigating those impacts as far as reasonably possible. To do so, the mitigation hierarchy is applied in which preference was given to trying to avoid or minimize the impact before considering other types of mitigation (i.e., remedy, compensate, offset):

Avoid —remove the source of the impact.

Minimize —reduce the magnitude of the impact.

Mitigate — “repair” the results of the impact after it has occurred.

Compensate/offset—address the loss or change to a resource by replacing the loss/change in kind or with a different resource of equal value.

19.2.4 Step 4: Residual Impacts

Once mitigation measures are determined, the next step in the impact assessment process is to determine the residual impact significance. Residual impacts are the impacts that are predicted to remain after both embedded controls and committed mitigation has been taken into consideration. In most cases, the sensitivity/vulnerability/importance of a receptor is unaffected by proposed mitigation measures: the mitigation measure is typically intended to reduce the magnitude of a predicted impact, thereby reducing its overall significance.

19.3 ESMS Element 3: Management Programs

The BWA will develop and implement management programs, plans, and procedures to manage the potential E&S risks and impacts of its activities based on the mitigation hierarchy, i.e., avoidance, minimization, or compensation measures. The following plans and programs were included in the Environmental and Social Management Plan (ESMP) for the Project (Section II of this report, Chapters 8 to 18). The following plans have been prepared for the identified environmental aspects and risks to the project according to the ESPS Standards 1 to 10:

1. Environmental Health and Safety Management Plan (EHSMP)
 - ✓ Water Quality Management
 - ✓ Air Quality Management
 - ✓ Noise Management
 - ✓ Traffic Management
 - ✓ Waste Management
 - ✓ Worker Health and Safety Management
 - ✓ Community Health and Safety Management
 - ✓ Access to the Community Management
 - ✓ Emergency Response Management
 - ✓ Biodiversity Management
 - ✓ Sludge Management
 - ✓ Construction Management for Solar Facility
2. Social Management Plan
 - ✓ Enhancing Representation of Women in the Project Workforce
 - ✓ Plan to Address Damage to Property and Infrastructure and Enable Continuity of Businesses and Public Services in the Area
 - ✓ Water Supply Management
 - ✓ Management of Unions and General Workers
3. Security Management Plan
4. Contractor Management Plan
5. Labour Management Plan

6. Heritage Management Plan
7. Stakeholder Engagement Plan
8. Grievance Redress Mechanism

19.4 ESMS Element 4: Organizational Capacity and Competency

19.4.1 Responsibilities and Commitments

It is the overall responsibility of the BWA to ensure the guidelines outlined in this document are followed. The ESA completed presents as a part of the evaluation, the review of the institutional framework that governs the overall project. The BWA will seek assistance and guidance where needed from the Environmental Protection Department (EPD) and the Ministry of Transport, Works and Water Resources.

The BWA will have the responsibility of the transformation of agencies and regulating bodies in terms of changes in their governance structures enabling institutions that support sector governance. It is therefore the responsibility of the BWA to ensure the institutional strengthening activities under the project are implemented.

The BWA will oversee and manage all project activities of the Project and will ensure compliance with IDB and EPD's environmental requirements. All contractors will report to the BWA. As the Project is implemented in coastal and agricultural areas in the south and central regions of the island, BWA would be committed to its environmental policy as outlined below.

The BWA will focus on:

a. Organisation Priority

Recognizing environmental management as among the highest corporate priority and as a key determinant in sustainable development; establishing policies, programs and practices in conducting operation in an environmentally sound manner.

b. Integrated System

Integrating these policies, programs and practices fully into each area of activity/facility as an essential element of management in all its functions.

c. Employee Education

Educating, training and motivating employees to conduct their activities in an environmentally responsible manner.

d. Environmental Assessment

Assessing the environmental impacts before implementing any new project and before decommissioning any facility or leaving/abandonment a site.

e. Precautionary Approach

Minimizing any significant adverse impacts of new projects by use of new technologies and design.

f. Emergency Preparedness

Developing and maintaining, where significant hazards exist, emergency preparedness plans along with the Department of Emergency Management (DEM).

g. Compliance

Complying with all applicable laws, regulations and guidelines; employing appropriate resources to implement proactive programs and procedures to assure compliance. Adherence to Environmental Standards will be a key ingredient in training and incentives to employees.

h. Pollution Prevention

Preventing pollution by employing management systems and procedures specifically designed to prevent activities and/or conditions that pose a threat to human health, safety or the environment; minimizing risk and protecting employees and the communities in which operations are conducted; setting and reviewing environmental objectives and targets that will minimize the amount of toxicity and waste generated; ensuring the safe treatment and disposal of waste generated and promoting the use of environmentally safe materials and technologies.

i. Continuous Improvement of Sites

Committing to continual improvement and continuously seeking opportunities to improve adherence to these principles; periodically rewarding progress and setting new targets, and communicating and reinforcing this policy throughout the organization.

j. Review

In consideration of the legal mandate and the Authority's environmental policy as well as the vision and mission statements, the Authority's Environmental objectives will be:

- To development and maintain an Environmental Management System (EMS);
- To comply with respective environmental legislations, policies and standards;
- To facilitate and promote institutional strengthening between other regulatory and government agencies;
- To promote environmental awareness and education;
- To continuously monitor, review and update environmental plan, procedures and policies.

19.4.2 The BWA Staffing

The BWA has established an organizational structure and has designated personnel with specific responsibilities within the ESMS. Their roles have been communicated across the organization through this document, corresponding directives, and other ESMS documents, as well as through training and awareness activities.

The BWA will designate personnel responsible for compliance with environmental legislation and the requirements of the IDB, to eliminate, reduce, remedy, or compensate for negative E&S impacts, as well as monitor and control the programs and plans proposed in the Project documents. **Error! Reference source not found.**1 below, will include a list of the BWA's technical staff responsible for monitoring the project's environmental and social performance.

Table 19-1: The BWA's Technical Staff Designated to the Project

Name	Job Title
X	Environmental Specialist
X	Social Specialist

19.4.3 Specialized Consultants

For this Project, the BWA may engage consultant/experts and assign them specific responsibilities. If the BWA engages consultants/experts during the execution of the Project, **Error! Reference source not found.**2 will be updated to describe the responsibilities assigned.

Table 19-2: Responsibilities of consultants/experts engaged for the Project

Specialization	Contracted (yes/no)	Responsibilities	Terms of Reference [link]
Health & Safety			
Human rights			
Biodiversity			
Heritage			
Community Liaison Officer			
Security			
Other			

19.4.4 Training Programs

The BWA recognizes that training contributes to the development of staff skills and knowledge and reinforces the successful implementation of project management programs. The key elements in the development and delivery of the Project's training program are as follows:

- Identification of the training needs of all relevant personnel in the E&S performance of the Project.
- Development of a training plan.
- Verification of ongoing and future training to ensure consistency in the level of detail of content across all trainings.
- Record of training given and received (photos, videos, attendance records, copy of training materials).
- Monitor and review the effectiveness of training.

Error! Reference source not found. below, outlines the socio-environmental training program that is required for the Project and is also presented in the ESMP. This program incorporates all the management plans associated with the Project and fully aligns with ESPS 1 to 10. This table will be updated periodically to ensure all stakeholders receive the trainings required to successfully implement the project management programs.

Table 19-3: Socio-Environmental Training Program

No.	Name of Management Plan	Applicable Personnel or Project Stakeholders to be trained	Phase or Frequency
1	EHSMP - Water Quality	BWA Contractor	Construction

No.	Name of Management Plan	Applicable Personnel or Project Stakeholders to be trained	Phase or Frequency
		Managers and Supervisors Skilled and unskilled workers	
2	EHSMP - Air Quality	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
3	EHSMP – Noise	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
4	EHSMP – Waste	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
5	EHSMP – Traffic	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
6	EHSMP - Worker Health and Safety	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
7	EHSMP - Community Health and Safety	BWA Contractor	Construction
8	EHSMP - Access to Community Management	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
9	EHSMP - Emergency Response	BWA Contractor Managers and Supervisors Skilled and unskilled workers	All phases
10	EHSMP - Biodiversity	BWA Contractor Managers and Supervisors	All phases

No.	Name of Management Plan	Applicable Personnel or Project Stakeholders to be trained	Phase or Frequency
		Skilled and unskilled workers	
11	EHSMP - Heritage	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
12	SMP - Stakeholder Engagement	BWA Contractor Managers and Supervisors Skilled and unskilled workers	All phases of the project
13	SMP – Enhancing Representation of Women in the Project Workforce	BWA Contractor	Construction
14	SMP – Plan to Address Damage to Property and Infrastructure and Enable Continuity of Businesses and Public Services in the Area	BWA Contractor Managers and Supervisors Skilled and unskilled workers	Construction
15	Labour Management	BWA Contractor Managers and Supervisors Skilled and unskilled workers	All phases
16	Security Management	BWA Contractor Managers and Supervisors Skilled and unskilled workers	All phases
17	Contractor Management Plan	BWA Contractor	All phases
18	Grievance Redress Mechanism	BWA Contractor Managers and Supervisors Skilled and unskilled workers	All phases

19.5 ESMS Element 5: Emergency Preparedness and Response

19.5.1 Emergency Response Plan

The Emergency Response Plan developed and implemented by the BWA is aligned with the risks and impacts of the Project. The plan also considers the provisions and requirements established in local legislation of Barbados and in the IDB's ESPF.

The BWA regularly evaluates and adjusts emergency preparedness and response activities, as needed, based on changing conditions in the work area. To do so, the BWA will monitor contextual risk, if and when needed to complete a contextual risk assessment.

Next, the evaluation of the different emergency risk scenarios identified is presented, specifying the probability and consequences, as well as clearly identifying the possible causes and measures to prevent them.

Table 19-4: Emergency Risk Assessment

RISK	CAUSE	PREVENTION MEASURES
Protests at regional or national level that result in paralysis of regions (civil unrest)	General disagreement of a sector with certain provisions of the national government	Establishing adequate communication between the BWA, the Contractor, workers and communities in the area
Possible fire in work site(s), warehouses and depots of fuel or other flammable materials	Poor electrical connections or deterioration of materials, etc. That can produce sparks. People smoking in areas not allowed. Sabotage by third parties	Comply with the safety standards established for electrical installations and perform maintenance periodically Comply with fuel handling and storage standards No smoking on construction sites Periodic inspection of areas Inventory and periodic inspection of firefighting equipment Attend scheduled trainings Perform practices for updating
Flooding	Natural causes	Have a contingency plan in case of this type of eventualities, comply with the emergency response plan that is presented in the ESMP.

The Emergency Response Plan and Worker Health and Safety Plan includes general actions to be taken into consideration in case of emergencies during project construction. The hazards covered in the contingency plan include: natural hazards, including flooding; operational emergencies, such as fires, falling machinery, and spills; industrial accidents of personnel or contractors, caused by unsafe acts or conditions or as a consequence of the natural phenomena or operational emergencies; and social

phenomena, such as sabotage, terrorism, and robberies. While each specific type of hazard has its own response procedures, the general set of processes is included in **Error! Reference source not found.**

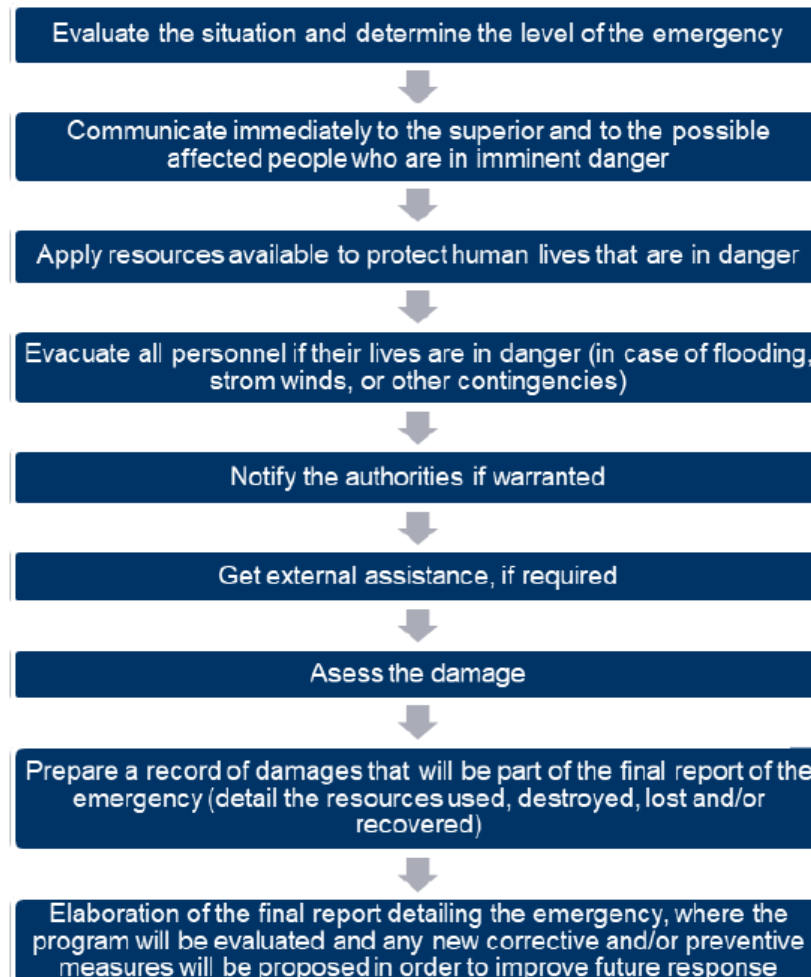


Figure 19-1: General Emergency Procedures

Depending on the gravity of a given situation, the emergency levels will vary. The levels of emergency are detailed in **Error! Reference source not found.** below.

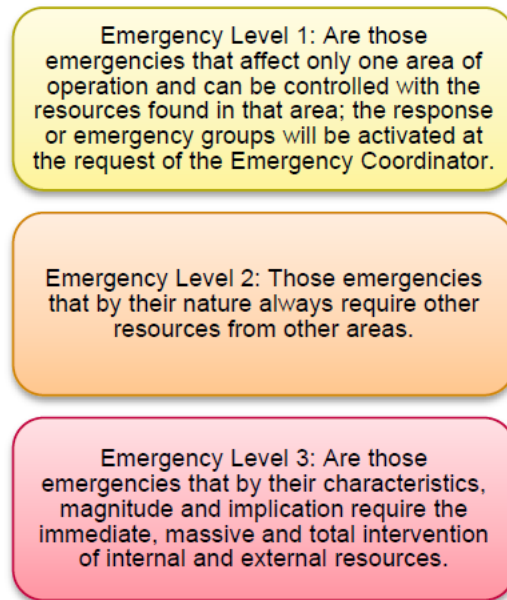


Figure 19-2: Emergency Levels

A risk assessment was conducted as a part of the ESA conducted and an Emergency Response Plan developed as a part of the ESMP, and include general actions that should be taken prior to and during an emergency. These are outlined in Chapter 9.9.

19.5.2 Organization Chart and Discussion of Organizational Capacity

The Contractor is responsible for executing the actions to deal with the different emergency situations that may arise (e.g., work accidents, fires, spills, etc.). The Contractor presents the technical organization of the contingencies, with the name of those responsible and the functions of each. Likewise, the Contractor, through its technical organization, coordinates with the competent authorities the realization of drills to adopt action routines to manage an emergency. The following flow chart in **Error! Reference source not found.** below is an example of the functions of a technical contingency organization.

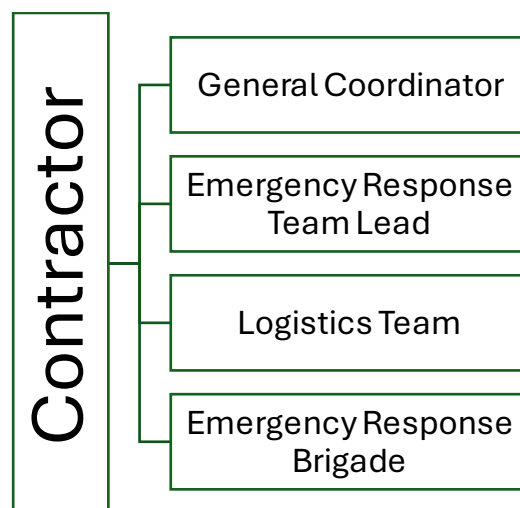


Figure 19-3: Technical Contingency Organization for Contractor

In addition, the Contractor is responsible for the following activities:

- Adapt the Contingency Plan according to the organizational structure of the contractor company (organizational chart, site location, names, addresses, contacts, contracted medical insurance, nearby medical centers, and others), complying with the guidelines of the ESMP and then submit it to the relevant authority for approval.
- Distribute documents on contingency control practices or training and action plans to each of the subcontractors.
- Give workshops on the Contingency Plan and on issues of industrial safety and occupational health.
- Contract a full-time doctor in each project site, who will oversee medical care within the project site and must respond immediately in case of any emergency.
- General emergency prevention measures are the responsibility of the Contractor. The Contractor is expected to:
 - Provide and regulate the use of Personal Protective Equipment (PPE).
 - Conduct trainings on health and safety, and environment risks for all workers.
 - Establish an adequate signage system within all work areas, to prevent any risk to the health of workers, passers-by, and neighbors.
 - Equip all facilities with manual fire extinguishing devices.
 - First aid kits should be available in all work areas.
 - In case of serious accidents, provide primary care in the project site and then transfer to the nearest local health centers.
 - Use of vehicles equipped with a first aid kit, reflective emergency signage, and a manual fire extinguisher.

19.5.3 Engagement with Local Authorities and the Community

External communication and managing the concerns of any affected party in an emergency will be conducted based on the BWA's stakeholder engagement plans and the Project's external grievance mechanism. This section will be updated to describe the process for the Project.

19.5.4 Agreements with Local Authorities

The BWA maintains relations with local authorities and the beneficiary communities of the Project through face-to-face meetings, virtual meetings, written notes, emails, and public consultations. In collaboration with the Project Contractors, the following agreements are maintained with local authorities under the project ERP:

Table 19-5: Emergency Response Agreements

Agreement [link]	Local Authority	Summary	Theme
[X]	Ambulance service	X	Medical emergencies
[X]	Police	X	Civil unrest
[X]	Fire Department	X	Fire

19.6 ESMS Element 6: Stakeholder Engagement

19.6.1 Stakeholder Mapping and Analysis

The main objective of a stakeholder analysis exercise is to identify and map stakeholders who may be affected by or contribute to the Project. Stakeholders are mapped with a view to assessing the importance of each stakeholder to the success of the project and their power or influence over the project. Chapter 4.4 describes the approach taken for the process of stakeholder mapping and analysis for engagement.

19.6.2 Stakeholder Engagement Strategies

The SEP presented in Chapter 15 outlines the measures used for community engagement, dissemination of project information and grievance management to be utilized as a key element throughout the duration of the Project. The SEP would be the responsibility of the BWA and the Contractors.

The GRM is a key constituent of stakeholder engagement strategies and so is intended to be used throughout the duration of the Project to receive complaints/feedback from stakeholders to be addressed in a timely manner. The details of the GRM are outlined in Chapter 16.

19.7 ESMS Element 7: Monitoring and Evaluation

19.7.1 Programme Implementation Monitoring

Establishing the baseline, setting the targets, and monitoring of the achievement of each target are critical elements to monitoring and evaluating the performance of a project. In the case of the BA-L1063 Project, the BWA will be responsible for this activity and be responsible for implementation of the Governance, Policy and Institutional Reformulation. At minimum, the BWA will be comprised of a Programme Manager, a policy/institutional specialist, two engineers, a communications specialist, a procurement specialist, a legal specialist, and a financial specialist.

The BWA will be responsible for monitoring the performance and progress of Project execution. Monitoring will be against the Project's result matrix that will establish the baseline and the projected annual targets of the Project. The KPI identified in any Management Plan developed should be pulled out and used in the monitoring and evaluation of project implementation. The BWA will collate monthly status reports on the progress of the Programme. The BWA will submit to the IDB two semi-annual progress reports throughout the life of the Project execution, within 90 days after the end of the calendar year or half year. Additionally, with the Bank's resources, independent evaluators will be hired to conduct a midterm and final evaluation of the Programme.

Sample monitoring templates have been presented in **Error! Reference source not found.** which can be used to monitor the implementation of the Project.



Table 19-6: Sample Monitoring Template

Project Phases	Tasks	Subtasks/Activities	Baseline	Target	Indicator	Status	Comment
Phase 1: Pre-Construction Activities;	Task 1 – Air, Noise and Marine Water Quality Baseline Assessment	TBD	TBD	TBD	TBD	TBD	TBD
	Task 2 – Prepare tender documents and complete tendering process, assuming competitive procurement of a performance-based supply/install contractor	TBD	TBD	TBD	TBD	TBD	TBD
	Task 3 - Review and update studies, designs and tender package for the programme	TBD	TBD	TBD	TBD	TBD	TBD
	Task 4 - Prepare request for proposals and Performance-Based Contract (PBC)	TBD	TBD	TBD	TBD	TBD	TBD
	Task 5 - Educational Campaign	TBD	TBD	TBD	TBD	TBD	TBD
Phase 2: Construction Phase	Task 1 – Carry out rehabilitation exercises	TBD					
	Task 2 – Drafting legal mandate in a parliament ready format	TBD					
	Task 3 – Develop masterplan and zoning plan	TBD					
Phase 3: Financial Strategies	Task 1 – Develop and implement Income generation schemes	TBD	TBD	TBD	TBD	TBD	TBD
			TBD	TBD	TBD	TBD	TBD
			TBD	TBD	TBD	TBD	TBD
	Task 2 – Develop special incentive packages to promote private investment in revitalisation projects	TBD	TBD	TBD	TBD	TBD	TBD
			TBD	TBD	TBD	TBD	TBD
			TBD	TBD	TBD	TBD	TBD

Evaluation of the Project is expected to be results based and as such the following evaluation criteria should be considered.

1. Relevance - The extent to which the aid activity is suited to the priorities and policies of the target group, recipient and donor.
2. Effectiveness - A measure of the extent to which an aid activity attains its objectives.
3. Efficiency measures the outputs - qualitative and quantitative – in relation to the inputs. It is an economic term which signifies that the aid uses the least costly resources possible in order to achieve the desired results.
4. Impact - The positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended.
5. Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn.
6. Projects need to be environmentally as well as financially sustainable.

A process of both self-evaluation as well as independent evaluation should be considered to evaluate the Programme. The evaluability instruments, monitoring indicators, and evaluation instruments are essential tools to be drawn on as follows.

- (i) Evaluability instruments, that measure whether the evaluation and results proposed for a product are robust enough to be able to demonstrate results at completion of that intervention.
- (ii) Monitoring Indicators, a set of indicators that allows managing the product implementation, to ensure that activities and outputs are being generated in with expected costs and timeframe.
- (iii) Evaluation instruments, which define clear and objective metrics, analytics and processes by which to report results that can be independently validated.

The evaluation standards should also seek to determine if the performance activities were environmental and socially sustainable, it should evaluate the quality of work and the determine the efficient, equitable, and sustainable use of its human, financial and natural resources.

20 REFERENCES

- Begak, M., Guseva, T., Molchanova, Y., Averochkin, E. & Sagaiduk. V. *Methodology for Assessing Carbon Footprint of Wastewater Treatment Plants*. Preprint: <http://ecoline.ru/wp-content/uploads/CFRV-en.pdf> (2013).
- Bogner J., Abdelrafie Ahmed M., Diaz C., Faaij A., Gao Q., Hashimoto S., Mareckova K., Pipatti R., Zhang T., (2007), *Waste Management*, In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Metz B., Davidson O.R., Bosch P.R., Dave R., Meyer L.A., (Eds.), Cambridge University Press, Cambridge, United Kingdom and New York, USA.
- Cakir FY, Stenstrom MK. Greenhouse gas production: A comparison between aerobic and anaerobic wastewater treatment technology. *Water Res.* 2005; **39**:4197–4203. doi: 10.1016/j.watres.2005.07.042.
- Eggleston, S., Buendia, L., Miwa, K., Ngara, T. & Tanabe, K. (eds.). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. (IGES, 2006).
- Garrido-Baserba, M., Molinos-Senante, M., Abelleira-Pereira, J.M., Fdez Güelfo, L.A., Poch, M. & Hernandez-Sancho, F. Selecting sewage sludge treatment alternatives in modern wastewater treatment plants using environmental decision support systems. *J. Clean. Prod.* **107**, 410–419 (2015).
- Hu W, Tian J, Chen L. Greenhouse gas emission by centralized wastewater treatment plants in Chinese industrial parks: Inventory and mitigation measures. *J. Clean. Prod.* 2019; 225:883–897. doi: 10.1016/j.jclepro.2019.03.311.
- Liao X, Tian Y, Gan Y, Ji J. Quantifying urban wastewater treatment sector's greenhouse gas emissions using a hybrid life cycle analysis method-an application on Shenzhen city in China. *Sci. Total Environ.* 2020; **745**:141176. doi: 10.1016/j.scitotenv.2020.141176.
- Larsen TA. CO₂-neutral wastewater treatment plants or robust, climate-friendly wastewater management? A systems perspective. *Water Res.* 2015; **87**:513–521. doi: 10.1016/j.watres.2015.06.006.
- Lim JJ, Sankarrao B, Oh TS, Kim MJ, Kang OY, Kim JT, Yoo CK. Estimation of nitrous oxide emissions (GHG) from wastewater treatment plants using closed-loop mass balance and data reconciliation. *Kor. J. Chem. Eng.* 2012; **29**:1123–1128. doi: 10.1007/s11814-011-0283-2.
- Mannina G, Ekama G, Caniani D, Cosenza A, Esposito G, Gori R, Garrido-Baserba M, Rosso D, Olsson G. Greenhouse gases from wastewater treatment—a review of modelling tools. *Sci. Total Environ.* 2020;**551-552**:254–270. doi: 10.1016/j.scitotenv.2016.01.163.
- Parravicini V, Svoldal K, Krampe J. Greenhouse gas emissions from wastewater treatment plants. *Energy Proc.* 2016; **97**:246–253. doi: 10.1016/j.egypro.2016.10.067.
- Ray SS, Dangayach R, Kwon YN. Surface engineering for anti-wetting and antibacterial membrane for enhanced and fouling resistant membrane distillation performance. *Chem. Eng. J.* 2021; 405:126702. doi: 10.1016/j.cej.2020.126702.
- Rodriguez-Garcia G, Hospido A, Bagley DM, Moreira MT, Feijoo G. A methodology to estimate greenhouse gases emissions in life cycle inventories of wastewater treatment plants. *Environ. Impact Assess. Rev.* 2012; **37**:37–46. doi: 10.1016/j.eiar.2012.06.010.
- Sharma A, Bhardwaj SK, Aggarwal RK, Sharma R, Agrawal G. Greenhouse gas emission potential of sewage treatment in Himachal Pradesh. *Scientific Reports* 2023; 13: 9675. Doi 10.1038/s41598-023-36825-7

USEPA, (2014), Framework for Assessing Biogenics CO₂ Emissions from Stationary Sources, Online at: [https://www3.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO₂-Emissions.pdf](https://www3.epa.gov/climatechange/downloads/Framework-for-Assessing-Biogenic-CO2-Emissions.pdf).

Websites:

(https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html).

<https://www.fao.org/faostat/en/#country/183>

21 APPENDICES

21.1 Appendix I – Interview Instrument

Below is the interview instrument used with business type stakeholders.

Project Background

The Barbados Climate Resilient South Coast Water Reclamation Plant Project, funded by the Inter-American Development Bank, aims to upgrade the South Coast Sewage Treatment Plant (SCSTP) in Barbados. Data collected through this instrument would be used to conduct a baseline social assessment which will inform the Social Impact Assessment and Social elements of an Environmental and Social Management Plan which would better enable provide a sustainable and socially friendly upgrade to the plant and its pipelines in a matter that is more sustainably beneficial for the community, livelihoods and lives.

Purpose of this Interview

This interview is part of the broader stakeholder engagement for this project, and it aims to support the ongoing work of conducting an Environmental and Social Impact Assessment and developing an Environmental and Social Management Plan for the project. The interview aims to uncover how existing and future socio-economic conditions and impacts of the proposed work may have on the users (both human and animal life) of this location to further enhance the provisions made within the Environmental and Social Management Plan

Initial Guideline

In the context of keeping sound ethical practices for engaging in stakeholder interviews, obtaining explicit consent from the interviewee before collecting data and engaging in the interview is critical.

Interviewees **must** be notified that their data will be anonymized and if direct quotes are needed, they will be contacted to obtain their permission for usage of the quote.

Stakeholders' socio-demographic data

Name	
Pronouns e.g. He/Him, She/Her, They/Them	
Gender	
Type of Stakeholder [Resident, Tourist, Employee, Business Owner, Business]	
Organization or Industry	
Position or Profession	
Age Range	
[Optional] Vulnerable Group ⁴² [Low Income, Youth, Elderly, Persons with Disabilities, LGBTQ+ Persons]	
Date of Interview	
Time of Interview	
Location	
Interviewee Contact Number/Email	

⁴² Data under the Age Range and Q1 can be used to classify this category.

Guidelines for Tallying⁴³

- Use good observation skills.
- Follow the Tally Chart Method when completing the Table.
- Be ready to query about the building or structure if unsure.
- Be sure not to double-count.
- Take note [in summary] of the types of buildings observed.

Residential Buildings	
Entertainment Businesses	
Food Businesses	
Accommodation Businesses	
Offices	
Utilities	
Nature or Open Spaces	
Recreational Areas	

Guidelines for Interview Questions

- Take notes regarding the person's body language.
- Be inclusive in the language being used (including asking interviewees how they would like to be referred to in the interview).
- Avoid Yes/No questions and answering a question for the interviewee (probing questions can be used).
- You may want to ask the interviewee for permission to record the interview.
- Be ready to explain specific terms such as gender for interviewees.
- Keep the language simple and inclusive. Ensure to relate to the stakeholder considering their experiences and backgrounds.
- If it is easy to communicate with stakeholders in the Barbados dialect, feel free to do so.
- Where possible engage in group interviews (2 or more persons).

Key Terms

Gender – This refers to the social attributes and opportunities associated with being male and female and the relationships and power dynamics between women and men and girls and boys.

Social Inclusion – This is the process of improving the terms of participation in society, particularly for people who are socially and historically marginalized/disadvantaged through enhancing opportunities, access to resources and agency.

⁴³ Tallying refers to keeping a record or count of a number of items. For this data collection we would be using a Tally Chart System for this collection.

Stakeholder Questions for Local Businesses

No.	Questions	Stakeholder Response
Q1	What is the diversity of activities occurring on the coast of the area? [Business, Recreation, Tourism, Industry, Cultural, Conservation, Commercial]	
Q2	How could the project negatively impact your operations [in and outside of the area]?	
Q2A	How can the project positively impact operations in the area?	
Q3	Is there any conflict which should be noted that impacts your operations? [Outside of the project]	
Q4	What are the major issues within the area as it pertains to water, drainage, and sewage? Which are the most urgent of these?	
Q5	Are there any natural habitats or green spaces areas within proximity to the project area that need to be considered in project design?	
Q6	Could you describe any health and safety risk that can result from this project?	
Q7	How are pipelines generally maintained? And by whom? And how often?	
Q8	What are some environmental concerns you have about the area?	
Q8A	How have environmental concerns been affecting or have the potential to impact your operations within the area?	
Q9	How have environmental concerns been affecting or have the potential to impact your employee's health?	
Q10	How do you believe the project might impact in positive and/or negative ways in any of the following: [cultural/economic activity,	
	services (emergency /utility services),	
	the environment (drainage, pollution),	
	the community and community activity (consideration for women, elderly, persons living with disabilities, and children)]	
Q11	Are there any undergoing or planned works, activities or decisions by your Ministry that may impact the project within the designated areas? If so, in what way?	
Q12	Are there any other considerations you would like the project team to consider?	
Q13	What are the business' health issues/concerns and how would the project impact these existing issues/concerns?	
Q14	What should the project consider reducing noise and air pollution?	
Q15	For the area, what are some of the best ways to engage the local community within the project area? And keep them regularly engaged?	

21.2 Appendix II – Stakeholder List

List of Virtual Stakeholders Contacted

Stakeholder	Contact	Type
Ministry of Health and Wellness Chief Environmental Health Officer	info@health.gov.bb (246) 536-3854	Government Agency
Ministry of the Environment and National Beautification Permanent Secretary	(246) 535-1201 ps.menb@barbados.gov.bb (246) 535-4354	Government Agency
Barbados Water Authority Dr. Charles Leslie (Director of Engineering)	(246) 434-4292 customercare@bwa.gov.bb	Government Agency
Environmental Protection Department Mr. Anthony Headley (Director)	epd.secretary@epd.gov.bb (246)535-4601	Government Agency
Ministry of Transport, Works and Water Resources Mr. Andrew Gittens (Permanent Secretary)	(246) 535-1201 psmtwm@barbados.gov.bb (246) 536-0024	Government Agency
Bureau of Gender Affairs Director Executive Secretary	genderbureau@barbados.gov.bb (246) 535-0102 (246) 535-0103	Government Agency
Barbados Transport Board	+1246-535 3500 customerservice@transportboard.com	Government Agency
Ministry of Education, Technological and Vocational Training	(246) 535-0600 info@mes.gov.bb	Government Agency
National Conservation Commission	(246) 535-1201 ncc@caribsurf.com	Government Agency
Lands and Survey Department	(246) 536-5200	Government Agency

Stakeholder	Contact	Type
	LSDept@barbados.gov.bb	
Natural Resources Department	(246) 535-2500	Government Agency
Mr. Jamar White	info@energy.gov.bb	
(Director)	(246)535-2507	
	jamar.white@barbados.gov.bb	
Department of Emergency Management	(246) 438-7575	Government Agency
	deminfo@barbados.gov.bb	
Coastal Zone Management Unit	(246) 535-5700	Government Agency
Dr. Leo Brewster	info@coastal.gov.bb	
(Director)		
Graeme Hall Nature Sanctuary GRH	(246) 435-9727	NGO
Ms. Barbara Garcia	query@graemehall.com	
Barbados National Trust	(246) 426-2421	NGO
	info@barbadosnationaltrust.com	
Barbados Tourism Marketing Inc.	246-535-3700	NGO
	btmiinfo@visitbarbados.org	
The Barbados Hotel and Tourism Association	(246) 622-5041	NGO
	info@bhta.org	
Barbados Chamber of Commerce	Phone: (246) 434-4750	NGO
	bcci@barbadoschamber.com	
Barbados Workers' Union	(246) 573-5000	NGO
	admin@bwu.org.bb	

Stakeholder	Contact	Type
Barbados Environmental Conservation Trust	info@barbadosenvironment.org	NGO
National Disabilities Unit	(246) 535-3600	NGO
Mr. John Hollingsworth (Director)	disabilities.unit@barbados.gov.bb (246) 535-3601	
Future Center Trust - Trailway	(246) 625-2020 or (246) 836-6187 info@futurecentretrust.org	NGO
Chickmont Foods Limited	ccollymore@chickmontfood.com	Business
Kooymans	spotthoff@kooymanbv.com	Business
Gildans	ehackett@gildans.com	Business
DHL Operations Manager	Philip.king@dhl.com	Business
Central Veterinary Clinic	centralvet.bb@gmail.com	Business
Barbados Chamber of Committees on their Green Committee John Marshall		Government Agency
The Land Conservancy in with interest in the Graeme Hall Swamp and Barbados and UWI – Centre of Resource Management and Environmental Studies in Barbados. Robin Mahon		NGO
Barbados Transport Board Gina Boyes		Government Agency
Sustainable Ocean Alliance and also works along with the Barbados Land Conservancy Travis Gardiner		NGO
Executive Director of the Land Conservancy in Barbados Lani Edghill		Government Agency
South Coast Communities Christ Church East Constituency Office Christ Church West Central Constituency Office		Government Constituency Offices
St. George / St . Phillip Communities <ul style="list-style-type: none"> • St George South Constituency Office • St Phillip West Constituency Office 		Government Constituency Offices

21.3 Appendix III – Stakeholder Consultation Record

Barbados Climate Resilient South Coast Water Reclamation Plant (BA-L1063) - Environmental and Social Management System (ESMS, ESA, ESMP)

Virtual Stakeholder Consultation held on Wednesday December 20, 2023 at 1:00pm

Attendees

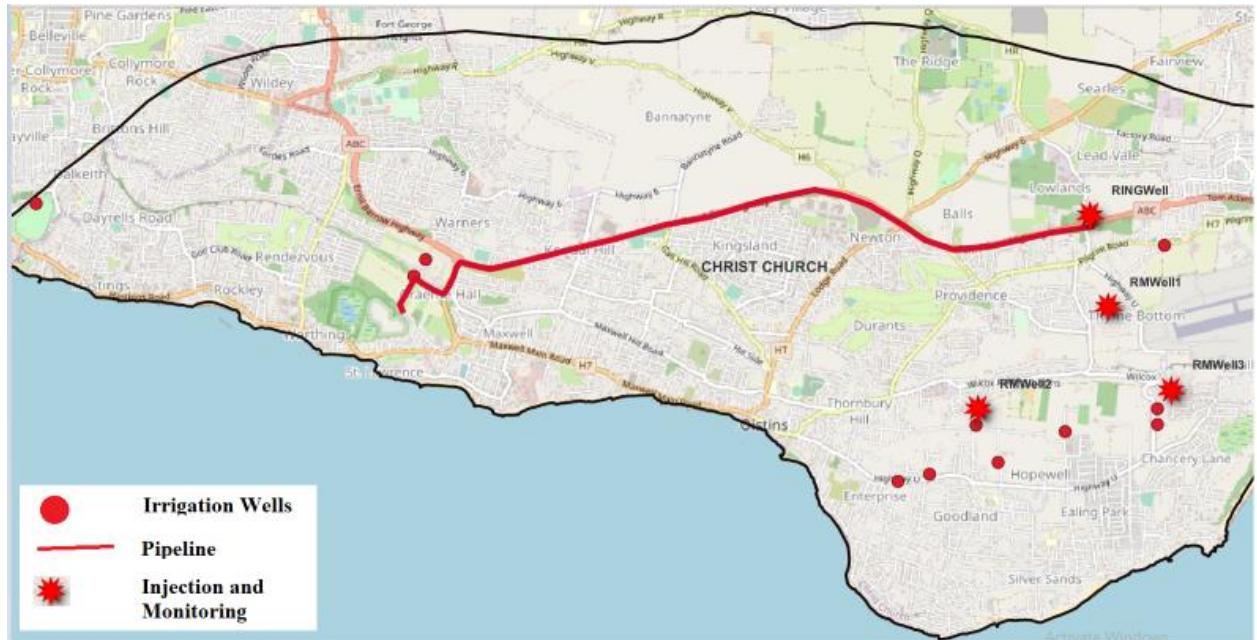
1. John Marshall – Barbados Chamber of Committees on their Green Committee
2. Robin Mahon – The Land Conservancy in with interest in the Graeme Hall Swamp and Barbados and UWI – Centre of Resource Management and Environmental Studies in Barbados.
3. Gena Boyce – Barbados Transport Board
4. Travis Gardiner – Sustainable Ocean Alliance and also works along with the Barbados Land Conservancy
5. Lani Edghill - Executive Director of the Land Conservancy in Barbados

Project Overview Shared

A project overview was shared with the stakeholders present and the maps showing the pipeline routes as illustrated in the figure below.

This project consists of upgrading of the South Coast Sewage Treatment Plant (SCSTP) from an existing advanced preliminary wastewater treatment to a tertiary/advanced treatment plant to produce a quality of effluent suitable for aquifer recharge and irrigation of agricultural crops.

The reclaimed water will be used to recharge the Christ Church Aquifer near the southern tip of Barbados which is predominantly used for agricultural abstractions. Reclaimed water will be recharged into the aquifer through up to five deep recharge wells that penetrate the saturated zone of the karst limestone aquifer after it will be abstracted for agricultural use, especially during the 6 to 9 months of the year when the weather is generally dry and irrigation demand is significant. Gibbons Boggs, Fairy Valley and Fairview agricultural sites are the main target areas. Some of these farmers currently use potable water from the BWA water supply mains to irrigate their crops, which would then be freed up for potable uses.



Pipeline from the South Coast Sewage Treatment Plant to Recharge Aquifer in Christ Church



Pipeline Showing Route from SCSTP to Irrigation area and Aquifer Recharge area

Discussion Points and Concerns Raised

1. Due to the short notice for the meeting as well as the timing of the start of the consultation process right before Christmas it is a very bad time to engage with stakeholders many of whom were not available to participate.
2. There will not be enough water from the treated effluent to meet irrigation needs. It is recommended that water from the plant go into the Graeme Hall Swamp as it could be a benefit there.
3. There was a discussion in the last ESIA consultation about the contingency plans that are in place in case the plant runs into difficulties and also what would happen to the pipelines upstream if the plant runs into difficulty.
4. In the last ESIA consultation the plan was to have the STP discharge sewage effluent into the Graeme Hall Swamp and this was not a popular choice in the meeting.
5. Are there other mitigation measures such as a retention pond and a buffer between the plant and the wetland being integrated into this modified design?
6. In the last ESIA meeting it was discussed that there was going to be a forced main put in place out at Needham's Point and there is a temporary outfall that is outdated and needs to be replaced. Is this in the scope of this project?
7. There is a proposal into the newspaper requesting bids to be put into the government for a forced main to take effluent from the sewage treatment plant to the Needham's Point. This is now public knowledge and so now this information needs to be clarified to the public.
8. Recognising the current situation with the plant and that there was the stop gap measure that was implemented maybe 2 years ago following the malfunction of the plant and effluent pipelines ran from out of the plant, went across Sandy Beach and then out to sea. What is going to become of these pipelines because it is essentially a part of the problem. Are these lines going to remain or be removed are questions of concern that persons would like an answer to since it was envisaged as a stop gap measure and not a permanent solution.
9. There are questions about the volume of outflow from the sewage treatment system? Are there any other outflows from the process apart from the treated effluent going to the aquifer and irrigation areas. The issue of sludge and solid waste management was flagged as a concern and it going to the landfill.
10. There is a request from persons for the details of the engineering process to be shared with all the definitive decisions on each output from the process and their volumes and how each output stream will be treated.
11. It sounds from is shared in this meeting that there is no longer an intention to have an outfall to the ocean anymore, which has a major environmental implication, because if the plant fail, even for a few days or a week then the outflow of raw sewage will have to go into Graeme Hall Swamp. I would be surprised if they did not plan to keep the emergency outfall for emergency purposes even if they do not build the outfall to Needham's Point. However, to have no outfall at all is to condemn Graeme Hall to further sewage dumping and so this is a major concern.
12. There should be some containment in the design to hold untreated effluent for a period of time if the plant fails, before the STP is back up and functioning. The capacity for storage on site is not clear.
13. This project has a climate adaptability component and the solids would create a large amount of methane if it went to the landfill. Has any consideration been given to energy generate

because this could create an opportunity for a business to set up a biogas generator an income earning opportunity.

14. There are concerns about the pipeline going all the way out to River Plantation. This is a very long pipeline and a costly venture. This is not considered to be very environmental and efficient. An analysis needs to be done on this. Also, who will be paying for this, will the farmers be paying for the water or will it be subsidised?
15. What is the exchange in terms of the extraction versus the input. It is important to understand the use of the input by the farmers versus the storage mechanism and the variability of the season. If you are generating more water than is being used, then where is that extra water going. Also noting that the aquifer also has a capacity and the plant will be operational 24/7. What other measures are in place if the aquifer is full and all is not used up by the farmers.
16. Other participants understood that this particular aquifer, will just flow out to the sea if it gets too full, and most aquifers in Barbados operate like this.
17. The previous ESIA raised that a treatment plant cannot run 100% of the time and it has to be shut down for maintenance purposes. How will the treatment of water occur at that time and how long is maintenance downtime expected to be? This applied also as a part of the contingency and the emergency plant.
18. The swamp has encountered several challenges over the years because of the STP. Does the scope of the study look at any rehabilitation activities for the wetland in the short or medium term. This may need to be recommended as a part of the project. This was a large component of the previous EIA to have rehabilitation of the Graeme Hall Swamp, which is a Ramsar Site, it is in a really terrible state and it is the only Mangrove forest on the island and participant would like to see this remain as a key part of this project.
19. Will there be a townhall meeting?
20. There are quite a few communities that the pipeline project passes through and so it's a big area for consideration. Each of these communities that the pipeline passes through would have their own unique issues that would need to be considered.
21. The route to St. Phillips seems to follow the old railway and so getting the issues associated with that would be important for the project. There is a group that is helping to restore that railway and planting trees and preparing it for recreation and so it would be important for the consultants to meet with these persons, the Barbados Trailway Project.
22. Sunbury is a historical location and past Bushy Park will be impacted and so the heritage and social impacts are crucial. The community around Maps, St. Phillip that lead toward River Plantation is there is a section that is a small paved area that leads into that section and so the infrastructure issues to consider. Further stakeholder consultations with these groups area necessary.

Adjournment.

21.4 Appendix IV – Endangered Species in Barbados

	Species Name	Scientific Name	Group	Range
1.	Acropora Coral	Acropora palmata	Corals, Jellyfish, and Sea Anemones	Central America, Gulf of Mexico, North America (United States Territory)
2.	Acropora Coral	Acropora cervicornis	Corals, Jellyfish, and Sea Anemones	Central America, Gulf of Mexico, North America (United States Territory)
3.	American Mahogany	Swietenia mahagoni	Plants	Central and South America, Florida
4.	Barbados Racer	Liophis perfuscus	Reptiles	West Indies (Barbados)
5.	Barbados Yellow Warbler	Dendroica petechia petechia	Birds	West Indies (Barbados)
6.	Bigeye Tuna	Thunnus obesus	Fishes	Africa, American Samoa, Asia, Australia, Central America, Europe, Middle East, North America - Including United States (Hawaii), Oceanic, South America
7.	Black Grouper	Epinephelus nigritus	Fishes	Central and South America, Mexico, United States
8.	Black Rockfish	Mycteroperca bonaci	Fishes	Central America, North America (including United States), Oceanic, South America
9.	Black-capped Petrel	Pterodroma hasitata	Birds	Central America, Europe, North America (United States Territory), Oceanic, South America
10.	Brown Pelican	Pelecanus occidentalis	Birds	Coastal Central and South America, USA (Carolinas to Texas, California, Oregon, Washington), West Indies
11.	Buff-breasted Sandpiper	Tryngites subruficollis	Birds	Africa, Australia, Central America, Europe, Middle East, North America (including United States Territory), Oceanic, South America
12.	Caribbean Coot	Fulica caribaea	Birds	Central America, North America (United States Territory), South America
13.	Caribbean Reef Shark	Carcharhinus perezi	Fishes	Central America, North America (including United States), Oceanic, South America
14.	Cigar-box Wood	Cedrela odorata	Plants	Central America, North America, South America
15.	Commoner Lignum Vitae	Guaiacum officinale	Plants	Central and South America, Puerto Rico, Thailand, Virgin Islands (British and US)
16.	Crossband Rockfish	Mycteroperca interstitialis	Fishes	Central America, North America (including United States), Oceanic, South America
17.	Cubera Snapper	Lutjanus cyanopterus	Fishes	Central America, North America (including United States), South America
18.	Donkey Fish	Dermatolepis inermis	Fishes	Central and South America, North America (including United States), Oceanic
19.	Elliptical Star Coral	Dichocoenia stokesii	Corals, Jellyfish, and Sea Anemones	Central America, Europe, North America (including United States), Oceanic, South America
20.	Eskimo Curlew	Numenius borealis	Birds	Alaska and Northern Canada to Argentina
23.	Great White Shark	Carcharodon carcharias	Fishes	Africa, Asia, Australia, Central America, Europe, Middle East, North America (including United States and Hawaii), Oceanic, South America
24.	Hogfish	Lachnolaimus maximus	Fishes	Central America, North America (including United States), Oceanic, South America
25.	Lamarck's Sheet Coral	Agaricia lamarcki	Corals, Jellyfish, and Sea Anemones	Central and South America, Europe, North America (including United States)
26.	Large Ivory Coral	Oculina varicosa	Corals, Jellyfish, and Sea Anemones	Central America, North America (including United States), Oceanic, South America
27.	Least Tern	Sterna antillarum	Birds	Bahamas, Central America (winters), Greater and Lesser Antilles, Mexico, Northern South America, USA (California, including the Miss. R. Basin), Atlantic Gulf Coasts
28.	Montastraea franksi	Montastraea franksi	Corals, Jellyfish, and Sea Anemones	Central America, North America (including United States Territory), Oceanic, South America
29.	Montastraea faveolata	Montastraea faveolata	Corals, Jellyfish, and Sea Anemones	Central America, North America (including United States Territory), South America
30.	Montastraea annularis	Montastraea annularis	Corals, Jellyfish, and Sea Anemones	Central America, North America (including United States Territory), South America
31.	Mutton Snapper	Lutjanus analis	Fishes	Central America, North America (including United States), Oceanic, South America
32.	Nassau Grouper	Epinephelus striatus	Fishes	Central and South America, United States (Florida, Minor Outlying Islands)

33.	Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	Fishes	Africa, American Samoa, Asia, Australia, Central America, Europe, Middle East, North America (including United States and Hawaii), Oceanic, South America
34.	Orinoco Goose	<i>Neochen jubata</i>	Birds	Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, Jamaica, Paraguay, Peru, Venezuela, West Indies (Barbados)
35.	Pillar Coral	<i>Dendrogyra cylindrus</i>	Corals, Jellyfish, and Sea Anemones	Central America, Europe, North America (including United States), South America
36.	Poey's Grouper	<i>Epinephelus flavolimbatus</i>	Fishes	Central America, North America (including United States), South America
37.	Queen Triggerfish	<i>Balistes vetula</i>	Fishes	Africa, Asia, Central America, North America (including United States), Oceanic, South America
38.	Rainbow Parrotfish	<i>Scarus guacamaia</i>	Fishes	Central America, North America (including United States), Oceanic, South America
39.	Red Grouper	<i>Epinephelus morio</i>	Fishes	Central America, North America (including United States), Oceanic, South America
40.	Rough Cactus Coral	<i>Mycetophyllia ferox</i>	Corals, Jellyfish, and Sea Anemones	Central America, North America (including United States), South America
41.	Schwartz's Myotis	<i>Myotis martiniquensis</i>	Mammals	West Indies
42.	Seabass	<i>Epinephelus niveatus</i>	Fishes	Central America, North America (including United States), Oceanic, South America
43.	Sooty Shearwater	<i>Ardenna grisea</i>	Birds	Africa, Antarctica, Asia, Australia, Central America, Europe, Middle East, North America (United States Territory), Oceanic, South America
44.	Spotted Eagle Ray	<i>Aetobatus narinari</i>	Fishes	Africa, Asia, Australia, Central America, Middle East, North America (including United States and US

21.5 Appendix V – Water Quality Monitoring Parameters

PARAMETER	Units
Temperature	Degrees Celsius
pH	-
Conductivity	µS/cm
Total Dissolved Solids	µg/L
Total Suspended Solids	mg/L
Salinity	µS/cm
Dissolved Oxygen	µg/L
Total Phosphorus	µg/L
Turbidity	-
Manganese	µg/L
Copper	µg/L
faecal coliform	organism/ 100 mL
enterococci	organisms/100 mL
Ammonia	µg/L
Biochemical Oxygen Demand	mg/L
E.coli	cfu per 100 mL
Chlorophyll	µg/L
Suspended Solids	mg/L