



*Prepared For:*



**ENVIRONMENTAL ASSESSMENT**  
*Sustainable Energy Investment Program*  
**SMART FUND II**  
*Barbados*

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## LIST OF ACRONYMS

BNSI	Barbados National Standards Institute
BWA	Barbados Water Authority
CFC	Chlorofluorocarbon
CO <sub>2</sub>	Carbon dioxide
dB	Decibel
dBA	A-weighted decibels
EA	Environmental Assessment
ECLAC	Economic Commission for Latin America and the Caribbean
EE	Energy Efficiency
EGFL	Enterprise Growth Fund Limited
EHD	Environmental Health Department
EIA	Environmental Impact Assessment
EPD	Environmental Protection Department
ESMS	Environmental and Social Management System
ESMP	Environmental and Social Management Plan
ETD	Energy and Telecommunications Division
EA	Environmental Assessment
ESMP	Environmental and Social Management Plan
GHG	Greenhouse gases
GOB	Government of Barbados
HCFC	Hydrochlorofluorocarbons
IDB	Inter-American Development Bank
Km	Kilometers
KW	Kilowatts
Leq	Equivalent continuous sound pressure level over a given period
m	Meters
MCPA	Marine Pollution Control Act
µg/m <sup>3</sup>	microgram per cubic meter
mph	miles per hour
mm	Millimeter
ODS	Ozone depleting substances
PEU	Project Execution Unit
PM	Particulate matter
PM <sub>10</sub>	Particulate matter with diameter less than 10 micrometers
PM <sub>2.5</sub>	Particulate matter with diameter less than 2.5 micrometers
PPE	Personal protective equipment
PV	Photovoltaic
RE	Renewable Energy
SBRC	Sustainable Barbados Recycling Center

SEFB	Sustainable Energy Framework for Barbados
SFTC	Smart Fund Technical Committee
SWPU	Solid Waste Project Unit
TA	Technical Assistance
TCPA	Town and Country Planning Act
TCPDO	Town and Country Planning Development Order
WHO	World Health Organization

## **EXECUTIVE SUMMARY**

### **Introduction**

The Government of Barbados is seeking a loan for the Smart Fund II Program which would continue to use the Smart Fund program as the basis to promote renewable energy (RE) and energy efficiency (EE) projects (the Project) in Barbados, aimed at reducing electricity costs for end users, and improving energy security and environmental benefits. The Executing Agency of the Smart Fund II would be the Energy and Telecommunications Division (ETD) of the Office of the Prime Minister of Barbados. The Government of Barbados is the formal borrower under the Sustainable Energy Investment Program.

### **Project Description**

The objectives of the individual Smart Fund II Projects covered under this EA are to design, prepare, and implement commercially and economically viable RE and EE technologies. Although the Projects have not been clearly defined, they are limited to:

- Energy efficient lighting replacement in approximately 50 Government owned businesses and facilities,
- Replacement of existing air conditioning units with higher efficiency units in approximately 50 Government owned businesses and facilities,
- Sealing and tinting windows to improve building energy efficiency, and
- Replacement of government vehicles with electric cars.

### **Agency Meetings and Regulatory Requirements**

ERM conducted meetings with pertinent regulatory agencies and governmental entities in Barbados to discuss the project and obtain their opinion on the potential project impacts and regulatory requirements.

In regards to environmental and social issues, the Project triggers the following directives of the Environment Safeguard Policy (OP-703):

- B.1, Bank Policies: The Bank will only finance operations and activities that comply with the directives of this policy, and are consistent with the relevant provisions of other Bank policies.
- B.2, Country Laws and Regulations: depending on Project activities, local requirements could include a development permit from Town and Country Planning Office (see Section 2.3.1 above). No EA or EIA is required. Applicability will be determined once Project activities are clearly defined.
- B.3, Screening and Classification: The proposed Project will have negligible impacts on the environment or the community. However, the generation and handling of

hazardous wastes involves potential risks, which merits that the Project be classified as Category “B”. In accordance with OP-703, Category B projects “are likely to cause mostly local and short-term negative” impacts, for which “effective mitigation measures are readily available”. Appendix A presents the Environmental and Social Management Plan (ESMP) of the Project.

- B.5, Environmental Assessment Requirements: This EA addresses the requirement for environmental assessment for the project.
- B.6, Consultations: a public consultation has not been carried out because the Project has not been clearly defined. Consistent with the Bank’s Disclosure of Information Policy (OP-102), this EA will be made available to the public prior and a public consultation will be carried out prior to Project execution (see Section 2.3.5).
- B.7, Supervision and Compliance: A monitoring plan will be implemented for the project as part of the Environmental and Social Management Plan of the Project (see Appendix A).
- B.8 Transboundary Impacts: The Project will result in the generation of hazardous materials that cannot be disposed of in Barbados. The Project will comply with the Basel Convention.
- B.10, Hazardous Materials: The Project will result in the generation of hazardous wastes, such as air conditioning unit refrigerants, used batteries, used oils, and fluorescent light bulbs. Management of hazardous materials is addressed in the ESMP (see Appendix A).
- B.11, Pollution Prevention and Abatement: Besides the hazardous wastes mentioned above, Project activities have a minimal risk of pollution. Pollution prevention is addressed in the ESMP of the Project (see Appendix A).

Additionally, the Project triggers the IDB’s Access to Information Policy (OP-102) and the Policy on Natural and Unexpected Disasters (OP-704). It is the intent of the Bank to be as clear and transparent as possible when it comes to financing projects, and by clear communication with the stakeholders, improve the quality of its operations. Because the Project is financed by IDB funds, the Access to Information Policy is also relevant. Although the Projects will not include any new development or construction, the Policy on Natural and Unexpected Disasters applies during the transfer and storage of hazardous materials/hazardous waste that could result from Project Activities.

## **Environmental and Social Baseline**

### General Conditions

Although the Projects have not been clearly defined, based on the information provided by the ETD, they will take place inside already constructed government owned buildings. There will be no purchase or development of additional land. Activities will be mostly conducted inside, although air conditioning unit replacements activities could also take place on the roofs or the sides of buildings. These buildings are located in urbanized/developed city areas.



## Physical Environment

Barbados has a mild subtropical climate with average temperatures that range from 24 to 28 °C and humidity that ranges from 71 to 76% (Evanson 2014). There is a dry season from January to June and a wet season that starts in late June and goes thru December.

The island of Barbados is the most eastern island of the English Caribbean chain of islands (Lesser Antilles). Topographically the island is relatively flat, composed of coral limestone, crossed with deep river-bed gullies that accommodate the movement of water during heavy rain.

Although the Projects will take place in urbanized areas where ambient noise levels are high due to city traffic, there is the potential for disposal activities at the island's landfill located in Saint Thomas Parish.

## Natural Hazards and Risks

The main natural hazard for Barbados is the occurrence of hurricanes. Approximately 12 hurricanes and several tropical storms have crossed the island of Barbados from 1851 to 2010.

The main risks associated with the Project are related to the transportation of wastes generated.

## Biological Environment

Barbados is in the Windward Islands Xeric Scrub ecoregion and is included in the Caribbean islands biodiversity hotspot. The biodiversity of Barbados has been influenced since the island was settled in 1627. Numerous species of plants and animals have been introduced, competing against indigenous species. In addition, habitats were altered and fragmented as the island was settled.

## Socioeconomic Environment

Barbados is one of the mostly densely populated countries in the world, having a population density of 646 people per square kilometer at the most recent census (2010). In 2010, the population of Barbados was 277,821, of which 47.9% were male and 52.1% female.

There was a general decline in the unemployment rate in Barbados from 1995 when it was 19.7% until 2007 when it was 7.4%. In 2010, the unemployment rate was 10.8% and in 2015 it was estimated at 11.3%. There has been a decline in employment in the agricultural and manufacturing sectors and a rise in employment in the services sector.

A survey conducted in 2010 indicated that 15% of households and 19.3% of individuals in Barbados were below the poverty line. The data indicate that the poverty gap (the extent to

which the poor existed below the poverty line) and the severity of poverty compare favorably with those in other Caribbean countries.

### **Impacts and Mitigation**

Project activities will be confined to inside existing government owned buildings, with no disturbance to new, undeveloped areas. There will be no operational changes once the project activities are implemented, so impacts are strictly limited to the implementation phase and no negative impacts are expected during the operational phase. Project operation will have positive impacts from increased energy efficiency and reduced operation costs.

The negligible impacts of the project will be mitigated and managed with the application of industry-standard best practices. An Environmental and Social Management Plan prepared for the project summarizes these best practices. Any contractor that may be involved in the project will be required to incorporate the proposed mitigation measures and management controls within their own working procedures and plans.

### **Project Impact Category**

The proposed Project will have negligible impacts on the environment or the community. However, the handling of hazardous wastes involves potential risks, which merits that the Project be classified as Category "B". In accordance with OP-703, Category B projects "are likely to cause mostly local and short-term negative" impacts, for which "effective mitigation measures are readily available".

In 2012, The Government of Barbados (the Government) established a Smart Fund to provide financial and technical support to renewable energy (RE) and energy efficiency (EE) projects in Barbados. This Smart Fund was capitalized by a loan from the Inter-American Development Bank (IDB), under an agreement for the Sustainable Energy Investment Program. The Government is now seeking a loan for the Smart Fund II which would continue to use the Smart Fund program as the basis to promote renewable energy (RE) and energy efficiency (EE) projects (the Project) in Barbados.

The objective of the Smart Fund was to increase the use of viable RE and EE technologies in Barbados in order to decrease energy costs of the population, increase the country's energy security by reducing its dependency on imported fossil fuels, and increase local and global environmental sustainability by reducing emissions of polluting substances, particulate matter, carbon dioxide (CO<sub>2</sub>) and other greenhouse gases (GHG). This objective is consistent with that of the Government's Sustainable Energy Framework for Barbados (SEFB), the comprehensive policy framework within which the Smart Fund was implemented (ETD 2012).

The Smart Fund II program would include: (i) retrofitting of public buildings using performance based contracts; (ii) promotion of EE and RE through a lending sub program executed by the Enterprise Growth Fund Limited (EGFL) targeting mainly hotels and other SMEs; (iii) demonstration and innovative programs promoting RE and EE such as: (a) smart grids, (b) energy storage; (c) electric mobility, and (d) other innovative forms of renewable energy generation to meet Barbados RE and EE targets.

The Executing Agency of the Smart Fund II would be the Energy and Telecommunications Division (ETD) of the Office of the Prime Minister of Barbados. The Government of Barbados is the formal borrower under the Sustainable Energy Investment Program. Under the ETD, a Program Manager will lead the Project Execution Unit (PEU), in the operationalization of the Smart Fund. In addition, a Smart Fund Technical Committee (SFTC) assesses eligibility for Smart Fund support and assists the PEU in other technical matters. The Enterprise Growth Fund Limited (EGFL) is the sub-executing agency for the Smart Fund's facilities that issue grants: Technical Assistance (TA) Facility, Pilot Consumer Finance Facility, EE Lighting Distribution Facility, A/C Rebate Trade-In Facility, and loans: EE Retrofit and RE Finance Facility (ETD 2012).

This Environmental Assessment (EA) addresses the potential impacts associated with the implementation of the Project.

## 2.0 *PROJECT DESCRIPTION*

### 2.1 *SMART FUND I AND SMART FUND II*

The Smart Fund is comprised of six facilities organized under two components based on the entity that executes them. The EGFL executes Component One and the ETD of the Office of the Prime Minister of Barbados executes Component Two.

Component One is comprised of:

1. TA Facility – provides grants to businesses for funding pre-investment studies of RE and EE projects, to assess their technical and financial viability and support their implementation.
2. EE Retrofit and RE Finance Facility – provides subsidized loans to businesses for financing the implementation of viable RE and EE projects (including, but not limited to, projects assessed by studies funded by the TA Facility).
3. Pilot Consumer Finance Facility – provides interest rate rebates or rebates on retail prices (subsidies) to selected retailers that have experience in the ‘hire-purchase’ consumer finance scheme, and that thanks to the rebates offer better hire-purchase terms to their customers for purchasing RE and EE equipment at their stores.
4. EE Lighting Distribution Facility – provides free EE Lights to a limited number of residential customers of Barbados Light and Power, through the issuance of vouchers.
5. A/C Rebate Trade-In Facility – provides a 50 percent instant rebate for households and businesses to purchase energy efficient air conditioners (provided they dispose of old air conditioners), also through the issuance of vouchers.

Component Two:

6. Discretionary Grant Facility – provides funds for the ETD to use on a discretionary basis for institutional support to execute the Smart Fund. This includes paying for awareness programs, paying for the issuance of vouchers and A/C disposal certificates, paying for the PEU, and monitoring the Smart Fund’s performance. At the ETD’s discretion, this facility may also provide grants to households or private businesses for purchasing small RE systems and EE equipment, replicating the activities of the SEF Pilot Program (which is a separate initiative under the SEFB,

funded by the Government and by the IDB through the Global Environment Facility).

The individual Smart Fund II Projects covered under this EA are those that fall under Component Two to be executed by the ETD. These Projects are limited to:

- Energy efficient lighting replacement in approximately 50 Government owned businesses and facilities,
- Replacement of existing air conditioning units with higher efficiency units in approximately 50 Government owned businesses and facilities,
- Sealing and tinting windows to improve building energy efficiency, and
- Replacement of government vehicles with electric cars.

## **2.2 INDIVIDUAL PROJECT ACTIVITIES**

### **2.2.1 *Tinting and Sealing Windows***

Although the Project has not been clearly defined, if window tinting is performed, it will consist of placing premade film on windows. Window sealing will likely be done with the application of caulk or sealant around the windows.

### **2.2.2 *Replacing Air Conditioning Units***

The ETD intends to replace air conditioning unit with more energy efficient units in approximately 50 existing government owned buildings. The old units can either be disposed of or sold if in working condition. Specific information about the types of units or the quantities are not yet defined; however during the site visit, smaller older facilities were observed having both individual wall mounted air conditioning units, whereas larger, newer building had roof mounted central air conditioning units.

### **2.2.3 *Vehicle Fleet Replacement***

According to the ETD, the proposed Project could include the replacement of currently used diesel vehicles with electric cars; however, this activity would not be carried out in the immediate future. It is unknown if the former vehicle fleet would be sold or disposed of.

#### **2.2.4 *Replacing Fluorescent Light Bulbs***

The final Project activity described by the ETD was the replacement of fluorescent light bulbs with energy efficient LED light bulbs. The exact number of buildings and or light bulbs to be replaced is currently unknown.

### **2.3 *REGULATORY REQUIREMENTS, SCOPING, AND PUBLIC CONSULTATION***

#### **2.3.1 *Barbados Regulatory Requirements***

This section describes the environmental laws and regulations in Barbados which could apply to the Project. Barbados is governed by the 1966 Constitution of Barbados (as amended up to 2007). Environmental and health monitoring and enforcement is mostly done through the Ministry of Environment and Drainage and the Ministry of Health. The Ministry of the Environment and Drainage consists of a number of agencies and departments with the combined focus of maintaining the viability, productivity and quality of the various ecosystems on this island. These include the Coastal Zone Management Unit, the Drainage Division, the Environmental Protection Department, the National Conservation Commission, the Natural Heritage Department, the Policy Research and Planning Information Unit, and the Sanitation Service Authority.

Development in Barbados is governed by the Town and Country Planning Act (TCPA, Chapter 240), and its subsidiary legislation, the Town and Country Planning Development Order (TCPDO) of 1972. This Act ensures environmental protection during new and expanded developments. The TCPA requires that new developments and changes to existing developments (i.e., addition of buildings), as well as specific criteria for air emissions and water discharges, be reviewed by the Chief Town Planner. During review of applications for developments, the Chief Town Planner may request an environmental impact assessment (EIA), which should follow the EIA Guidelines and Procedures for Barbados (1998) prepared by the Government of Barbados, Ministry of Health and the Environment. The Health Services (Building) Regulations, 1969 require persons wishing to construct, extend, alter or change the use of a building to obtain the permission of the Minister of Health via the Director of the Environmental Protection Department (EPD). This legal requirement is independent of that requiring permission from the TCDPO. In the case of proposals that do not require approval from TCDPO, such as internal renovations or alterations to approved structures, an application must be submitted directly to the EPD (MOED 2009).

The main government policies and plans that concern sustainable development and biological resources include the:

- Barbados Sustainable Development Policy - outlines strategies for achieving sustainability in a number of sectors
- National Physical Development Plan – has placed emphasis on sustainable development and the protection of natural, environmental, and cultural heritage resources, the containment of damage cause by scattered urban development, the protection of agricultural land forms, the maintenance of Central Bridgetown as a financial and commercial center, tourism experience and modernization of beach front properties, diversification of the economy, and procedures for EIAs
- Coastal Zone Management Plan - to provide for the more effective management of the coastal resources of Barbados, for the conservation and enhancement of those resources, and the
- National Strategic Plan (2005-2025) - whose fourth goal is to build of a green economy which requires advancement and protection of the environment, resources, infrastructure while advancing social and economic development.

Applicable legislations by resource area are described in the sections below.

#### 2.3.1.1. *Water and Wastewater*

Although the project does not intend to use fresh water sources, depending on the type of activities, fresh water resources could be indirectly affected by the Project. Fresh water resources are managed under the following statutes:

- Three-Houses Spring Act, 1713 - allows inhabitants in the Parish of St. Phillip to retain water for use, provided it does not have negative effects downstream.
- Porey's Spring Act, 1864 - allows the vestry of the parish of St. Thomas to construct and maintain works for the collection and delivery of water to persons other than the inhabitants of the parish.
- The Underground Water Authority Act 1953 [Chapter 283] - stipulates that a license is needed for the abstraction of underground water
- The Barbados Water Authority Act, 1980 [Chapter 274A] – stablished the Barbados Water Authority (BWA) to manage, allocate and monitor Barbados water resources, to ensuring their best development, utilization, conservation and protection.
- The Town and Country Planning Development Order, 1972 (described above); and



- The Marine Pollution Control Act, 1998 - established discharge standards for all waste water into the groundwater as well as the marine environment.

The BWA is a Statutory Body established by the Barbados Water Authority Act, on October 8, 1980 which commenced operations on April 1, 1981 (replaced the Waterworks Department of Government). The BWA is charged with supplying potable water as well as wastewater treatment and disposal services to the sewered areas of Bridgetown and the South Coast. The BWA is legally responsible for ensuring water quality is protected (BWA 2017).

Groundwater is protected by the National Groundwater Protection Zoning Policy of 1963, which sets up Zones with restrictions and prohibitions for development. These Zones are incorporated into the Town and Country Planning Development Order under the TCPA. Source monitoring is undertaken by the EPD and BWA, as well as via distribution system monitoring by the Environmental Health Department (EHD) and the BWA. The EPD and EHD act as regulators of the BWA (UNEP 2010a).

#### 2.3.1.2. *Energy*

The Energy Division, within the Ministry of Finance, Economic Affairs and Energy, was established in 1978, and is responsible for decision-making in this area. It is comprised of an Administrative Unit, a Legal and Regulatory Unit, the Natural Resources Department, the Renewable Energy and Energy Conservation Unit and the Research and Planning Unit (MOE 2017).

In February 2009, the GOB entered into a Technical Assistance Agreement with the IDB for assistance in developing a Sustainable Energy Framework for Barbados with the objective of promoting renewable energy and energy efficiency (MOE 2017). The GOB then developed the Draft National Sustainable Energy Policy of 2010, consistent with Barbados' Sustainable Energy Framework and geared towards promoting energy conservation practices and the use of renewable energy technologies where possible, and reducing dependency on fossil fuels (UNEP 2010a; GOB 2013). Barbados is committed to reducing its oil dependency with a mandate with a renewable energy target of 29% by 2029 (MOE 2017).

The legislations governing the energy sector in Barbados include:

- The Electricity Act of 1965, Chapter 277 – regarding the supply of electricity;

- The Electric Light and Power Act, Chapter 278, 2013 – promotes the generation of electricity from sources of renewable energy and enhances the security and reliability of the supply of electricity;
- The Fair Trading Commission Act of 2002, Chapter 326B - to regulate, monitor, and investigate utility services; and
- The Utilities Regulation Act of 2002, Chapter 282 – to provide for the regulation of utility services.

#### 2.3.1.3. *Waste Management*

Although there is no comprehensive solid waste management legislation, solid waste management and disposal in Barbados are governed by the Health Services Act (Chapter 44) of 1969. This Act was established to promote and preserve of the health of the inhabitants of Barbados by managing waste, including its Chapter 10: Nuisance Regulations (prohibit nuisance including illegal solid waste disposal) and Disposal of Offensive Matter Regulations (restrict disposal to approved sites only), and the Collection and Disposal of Refuse Regulations (1975) (MOED 2009, UNEP 2010a). These policies are further clearly reinforced by the Barbados Sustainable Development Policy which specifically highlights the issue of waste management (MOED 2009).

Solid Waste is primarily the responsibility of EPD, the Sanitation Service Authority (SSA), and the Solid Waste Project Unit (SWPU):

- The EPD (with its Solid Waste and Hazardous Substances Section) regulates and monitors solid waste management and government operated solid waste disposal facilities; and develops policies for the regulation of solid waste management.
- SSA is responsible for the collection and disposal of non-hazardous solid waste from homes and government agencies around the island. There is also a commercial arm which offers services to the private sector. The SSA was established by the Sanitation Service Authority Act (Chapter 382), amended in 2015.
- The Solid Waste Project Unit (SWPU) is responsible for the implementation solid waste management and education.

There are no hazardous waste treatment or disposal facilities in Barbados; therefore hazardous waste must be transported off the island. The EPD is under mandate to characterize sources of pollution and to develop initiatives geared towards the prevention, reduction and control of pollution (MOED 2009, UNEP 2010a). It is the responsibility of the EPD to undertake characterization of the types of waste generated via environmental audits on a sector by sector basis. The audit process should include a review of practices and procedures,

assessment of waste streams and pollution control equipment. Hazardous waste must be exported offshore for treatment and disposal following the requirements of the Basel Convention (see Section 2.3.2).

#### 2.3.1.4. *Coastal Zone Management*

Although current Project activities do not take place on Coastal Zones, should Project activities change, the following Acts may need to be considered:

- Marine Pollution Control Act (MPCA) of 1998 - this regulation was enacted to control the release of pollutants to the sea by requiring monitoring by the discharger, and establishing regulations prescribing environmental standards and requirements such as effluent criteria (UNEP 2010a).
- The Coastal Zone Management Act of 1998 - covers the management of coastal resources such as the development on shoreline and activities that will impact the beach and the marine environment.

#### 2.3.2 *Applicable International Treaties and Conventions*

In addition to national regulatory requirements, the Project and ESIA process will be consistent with all relevant international standards and requirements. These include international treaties and conventions to which Barbados is a signatory relating to environmental management and community rights (see Table 2-1).

**TABLE 2-1 APPLICABLE BARBADOS SIGNATORY INTERNATIONAL TREATIES AND CONVENTIONS**

Agreement/Convention	Notes/Comments	Status
<b>Climate Change/Air Quality</b>		
Vienna Convention for the Protection of the Ozone Layer, 1985	Protection of the ozone layer.	Barbados acceded in 1992.
Montreal Protocol on Substance that Deplete the Ozone, 1989	Protection of the ozone layer.	Barbados acceded in 1992.
United Nations Framework Convention on Climate Change (UNFCCC), 1992	Control of greenhouse gas emissions.	Ratified by Barbados in 1994.
Kyoto Protocol, 1977	Greenhouse gas emissions targets.	Ratified by Barbados in 2000.
<b>Hazardous Chemicals/Hazardous Wastes</b>		
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Signed 1989, effective 1992	To protect human health and the environment against the adverse effects of hazardous wastes.	Ratified by Barbados in 1995.

<b>Agreement/Convention</b>	<b>Notes/Comments</b>	<b>Status</b>
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Signed 1998, effective 2004	To protect human health and the environment from certain hazardous chemicals.	Signed by Barbados in 1998.
Stockholm Convention on Persistent Organic Pollutants, Signed 1998, effective 2004	To protect human health and the environment from persistent organic pollutants.	Accepted by Barbados in 2004.
<b>Biodiversity/Bio-safety, Traditional Knowledge</b>		
International Plant Protection Convention, Rome, 1951	Prevention and control of non-native plants, plant products, pests, and diseases.	Adherence by Barbados in 1976.
United Nations Convention on Biological Diversity, 1992	Promotes development of national strategies for the conservation and sustainable use of biological diversity. Often seen as the key document regarding sustainable development.	Ratified by Barbados in 1993.
Cartagena Protocol on Bio-Safety	Protection of biodiversity from living modified organisms.	Barbados acceded in 2002.
<b>Wildlife/Conservation</b>		
Convention of International Trade in Endangered Species, 1972 (CITES)	To ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.	Barbados acceded in 1992.
Convention on Wetlands of International Importance especially as Waterfowl Habitats (RAMSAR), 1971	The conservation and sustainable utilization of wetlands, i.e. to stem progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.	Ratified by Barbados in 2005.
Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean, 1983	Protection of rare and fragile ecosystems and habitats.	Barbados acceded in 1992.
United Nations Convention to Combat Desertification, 1994	To combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.	Barbados acceded in 1997.

Agreement/Convention	Notes/Comments	Status
<b>Marine Protection and Safety</b>		
Convention on the Protection and Development of the Marine Environment in the Wider Caribbean, 1983 (Cartagena Convention)	Protection and development of the marine environment.	Barbados acceded in 1985.
Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean, 1983	Protection of the marine environment from oil spills.	Barbados acceded in 1987.
United Nations Convention on the Law of the Sea, 1982	Protection of the marine environment.	Ratified by Barbados in 1993.

Of particular concern to this Project are the Basel Convention because of the transport of hazardous wastes off the island, the Vienna Convention and the Montreal Protocol in regards to Ozone depleting Substance (ODS), and the Kyoto protocol for greenhouse gas emissions.

As stipulated by the Basel Convention, shipments of hazardous waste must be individually assessed. The EPD monitors shipment of hazardous waste and mandates that a 3 stage protocol (Initial Notification, Pre-Shipment Notification and Post Shipment Notification) be followed. There is an Environmental Management Bill and associated regulations have been drafted which make provisions for the management of hazardous wastes for individuals and commercial entities. The Draft EMA has a section addressing toxic substances from import to disposal (UNEP 2010a).

### 2.3.3 *Agency Meetings and Regulatory Requirements*

ERM conducted a fact-finding visit to meet with the Project sponsor, pertinent regulatory agencies and other pertinent governmental entities in Barbados to discuss the scope of the investment program – Smart Fund II - and obtain an understanding on how the collection, separation and disposal of solid waste, hazardous waste, and recycling is conducted on the island.

The visit was aimed to identify information sources and availability, the regulatory climate, and key issues to be addressed to ensure the correct application of the IDB's Environmental and Social Safeguards (see Table 2-2).

**TABLE 2-2 AGENCY AND OTHER PERTINENT ENTITIES MEETINGS**

Entity	Meeting Date	Comments
Ministry of Health	August 29, 2017	Regulations (the Health Services Act) were provided. Deferred to the Sanitation Service Authority for waste management information.

Entity	Meeting Date	Comments
Sustainable Barbados Recycling Centre Inc. (SBRC)	August 29, 2017	A Public Private Partnership entity that receives and processes the islands solid waste, diverting at least 60-70% that would have gone to the Mangrove Sanitary Landfill. Provided information on their process (collection, separation and disposal).
Subzero Services Ltd.	August 30, 2017	Stated no waste generation. Refrigerant and nitrogen gas supplies are outsourced. Any copper and/or metal waste is sent to Scrap Man Recycling Facility.
Environmental Protection Department (EPD)	August 30, 2017	No regulations for Environmental Protection in Barbados. They still implement the 1969 Legislation – Services Act. For hazardous waste, packing, transportation, and shipping, they must comply with international standards (e.g. Basel Convention), and any applicable regulation in the Physical Development Plan under the Town Planning of Barbados.
Caribbean E-Waste Management Inc.	August 30, 2017	Recycle electronic waste, exclusively. All waste is properly packed and shipped off the island to the U.S. under international regulations provided by exporting companies used by e-Waste (e.g. e-Stewards, and Elemetal Recycling).
Megapower Ltd Barbados	August 30, 2017	Work mainly with electric cars. At least 47% of the batteries material can be reusable. Batteries for electric cars have a good life of 5 years, after this time, they reuse the same batteries for additional 10 – 15 years in PV Panels equipment, and/or golf cars.
Sanitation Service Authority (SSA)	August 31, 2017	Developing a Draft Solid Waste Management Plan for Barbados. All the waste collection from their fleet of trucks (municipal waste) is sent to SBRC.
Caribbean LED Lighting Inc.	August 31, 2017	Followed EPA Regulations. Process all their hazardous waste using the appropriate equipment to separate and pack. Ship waste to the U.S.
Division of Energy and Telecommunication (DET)	August 31, 2017	Project sponsor – discussed existing status (work in progress) of the buildings to be retrofitted, in addition of the inefficient equipment to be replaced (e.g. HVAC systems, lighting bulbs, sealing and tinting windows/glass, and replacement of vehicle fleet for electric cars over the long term).
Ministry of Environment and Drainage (MOED)	August 31, 2017	Developing a draft Solid Waste Management Plan for Barbados (with the SSA). Provided information related to an ongoing solid waste management outreach program.
TMR Sales and Service Ltd.	September 1, 2017	Stated no waste generation. Refrigerant and nitrogen gas supplies are outsourced. Any copper and/or metal waste is sent to Scrap Man Recycling Facility.
Barbados Agricultural Development & Marketing Corp. (BADMC)	September 1, 2017	No information provided on waste management. Deferred to EPD for information.
RTEK Refrigeration	September 1,	Stated no waste generation. Refrigerant and nitrogen

Entity	Meeting Date	Comments
and Air Conditioning Services Ltd.	2017	gas supplies are outsourced. Any copper and/or metal waste is sent to Scrap Man Recycling Facility, and sometimes B's Recycling.

#### 2.3.4 *IDB Policies*

The IDB has established its own policies and safeguards in order to ensure that Projects financed by the IDB group are sustainable. These environmental and social policies are guided by international best practices, and are relatively consistent with widely used International Finance Corporation (IFC) guidelines with regards to environmental, health and social management.

In regards to environmental and social issues, the Project triggers the following directives of the Environment Safeguard Policy (OP-703):

- B.1, Bank Policies: The Bank will only finance operations and activities that comply with the directives of this policy, and are consistent with the relevant provisions of other Bank policies.
- B.2, Country Laws and Regulations: depending on Project activities, local requirements could include a development permit from Town and Country Planning Office (see Section 2.3.1 above). No EA or EIA is required. Applicability will be determined once Project activities are clearly defined.
- B.3, Screening and Classification: The proposed Project will have negligible impacts on the environment or the community. However, the handling of hazardous wastes involves potential risks, which merits that the Project be classified as Category "B". In accordance with OP-703, Category B projects "are likely to cause mostly local and short-term negative" impacts, for which "effective mitigation measures are readily available". Appendix A presents the Environmental and Social Management Plan (ESMP) of the Project.
- B.5, Environmental Assessment Requirements: This EA addresses the requirement for environmental assessment for the project.
- B.6, Consultations: a public consultation has not been carried out because the Project has not been clearly defined. Consistent with the Bank's Disclosure of Information Policy (OP-102), this EA will be made available to the public prior and a public consultation will be carried out prior to Project execution (see Section 2.3.5 below).
- B.7, Supervision and Compliance: A monitoring plan will be implemented for the project as part of the Environmental and Social Management Plan of the Project (see Appendix A).

- B.8 Transboundary Impacts: The Project will result in the generation of hazardous materials that cannot be disposed of in Barbados. The Project will comply with the Basel Convention as described in Section 2.3.2 above and in the ESMP of the Project (see Appendix A).
- B.10, Hazardous Materials: The Project will result in the generation of hazardous wastes, such as air conditioning unit refrigerants, used batteries, used oils, and fluorescent light bulbs. Management of hazardous materials is addressed in the ESMP (see Appendix A).
- B.11, Pollution Prevention and Abatement: Besides the hazardous wastes mentioned above, Project activities have a minimal risk of pollution. Pollution prevention is addressed in the ESMP of the Project (see Appendix A).

Additionally, the Project triggers the IDB's Access to Information Policy (OP-102) and the Policy on Natural and Unexpected Disasters (OP-704). It is the intent of the bank to be as clear and transparent as possible when it comes to financing projects, and by clear communication with the stakeholders, improve the quality of its operations. Because the Project is financed by IDB funds, the Access to Information Policy is also relevant. Although the Projects will not include any new development or construction, the Policy on Natural and Unexpected Disasters applies during the transfer and storage of hazardous materials/hazardous waste that could result from Project Activities.

The IDB has additional Policies that will not be triggered as a result of Project activities. These Policies include:

- The Policy on Indigenous peoples (OP-765) is not triggered as Project activities will take place inside (or on the roof) of already constructed government facilities where there are no Indigenous peoples.
- Policy on Gender Equality in Development (OP-270) is not triggered as this is not a development Project and the facilities affected by the Project have already been constructed.
- The Policy on Involuntary Resettlement (OP-710) is not triggered as land will not be acquired as part of the Project activities.

### 2.3.5 *Public Consultation*

A public consultation has not been carried out because the Project has not been clearly defined. Consistent with the Bank's Disclosure of Information Policy (OP-102), this EA will be made available to the public prior and a public consultation will be carried out prior to Board action.



## 2.4

### *INSTITUTIONAL FRAMEWORK AND EXECUTING AGENCY CAPACITY*

The proposed Project will be overseen and developed by the ETD Manager following the Smart Fund Operating Guide developed in August 2012 (ETD 2012) and this EA and associated ESMP. It will be the responsibility of the ETD Manager to ensure compliance with the requirements listed in this EA and ESMP during the execution of the individual projects.

### 3.0 *ENVIRONMENTAL AND SOCIAL SETTING*

Due of the nature of the type of activities involved with this Project (mostly internal facility/infrastructure upgrades to improve energy efficiency and decrease environmental impacts), the Baseline Section of this EA discusses only the relevant existing physical, biological, and socioeconomic environment within Project, as well as the current methods for material management and disposal in Barbados. Because Project activities will be located within already constructed facilities/buildings in highly urbanized areas of Barbados the baseline conditions for the following resources are only discussed in general for the entire island: Flora, Fauna, Geology, Topography, and Soils.

#### 3.1 *CONDITIONS AT THE SITE*

The exact locations of the individual Projects are still unknown; however, activities will take place inside existing government owned buildings within highly developed areas of Barbados. As an example of the types of facilities that will form part of the Project, during the site visit for this EA, four facilities proposed for improvements were described and included a school, an office tower building, a hospital and the airport. The following figure shows the location of these four facilities.

**FIGURE 3-1 FACILITIES PROPOSED FOR IMPROVEMENTS DURING THE SITE VISIT**



### 3.2 CLIMATE AND AIR QUALITY

Barbados has a mild subtropical climate with average temperatures that range from 24 to 28 °C and humidity that ranges from 71 to 76 % (Evanson 2014). There is a dry season from January to June and a wet season that starts in late June and goes thru December. Barbados is on the southern edge of the West Indian hurricane zone and the hurricane season starts in late June and ends in November (The Commonwealth 2015; Government of Barbados 2002b). During this time period there is increased tropical storm activity and the island gets most of its rainfall.

Meteorological data for the area are available from the weather station at Grantley Adams Airport in Christ Church. The airport is 12.9 km from the center of Bridgetown (see Figure 3-1 above). Table 3-1 shows the monthly and average air temperature and precipitation for the weather station. Precipitation averages approximately 1,270 millimeter (mm) annually (Miller 2012).

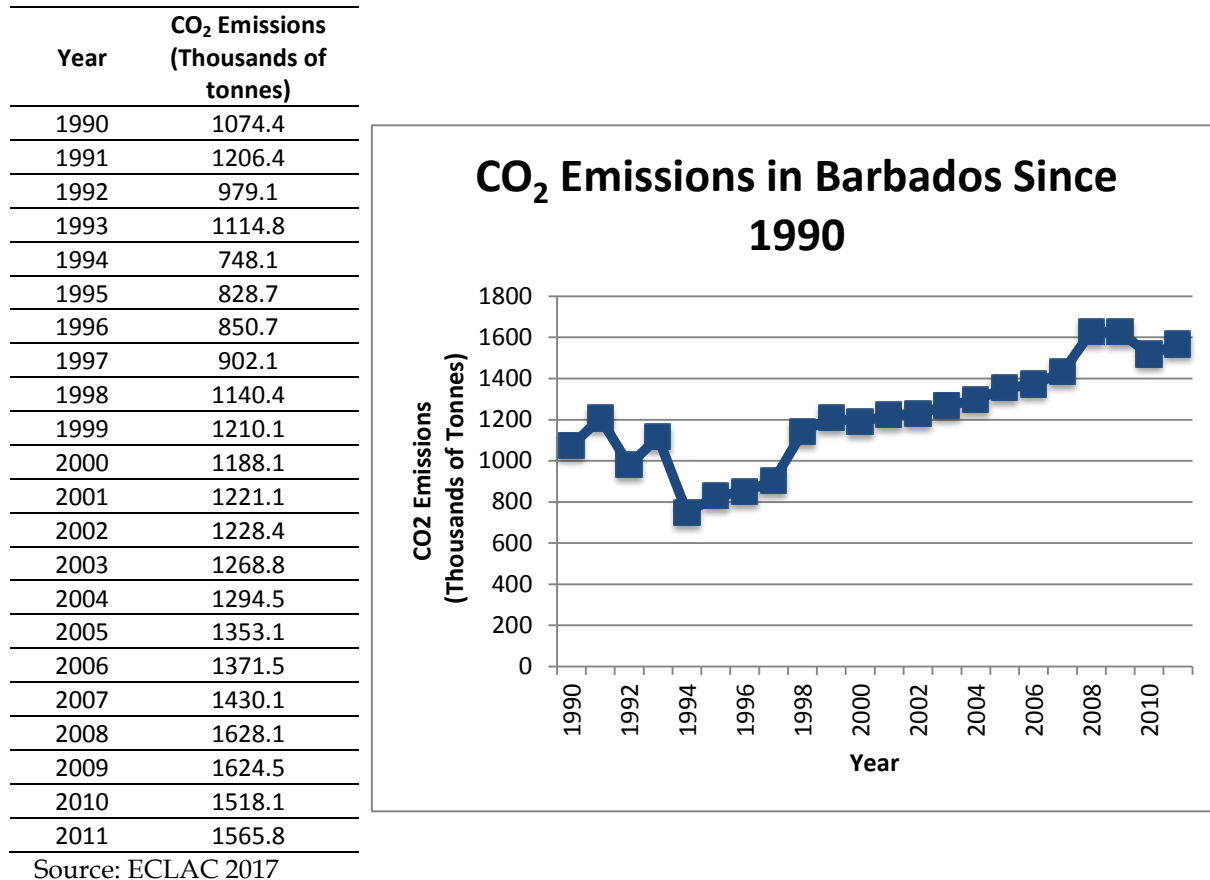
**TABLE 3-1 MONTHLY MEAN AIR TEMPERATURE AND PRECIPITATION AT GRANTLEY ADAMS AIRPORT (1981-2010)**

Month	Mean Wind Speed (Knots)	Mean Relative Humidity (%)	Mean Temperature (°C)	Mean Rainfall (mm)	Mean Rain Days (Days)
January	11	77	25.8	70.1	11
February	11	77	25.7	41.3	8
March	11	75	26.2	37.4	8
April	11	77	26.8	60.8	8
May	12	78	27.6	79.0	8
June	12	80	27.7	103.0	11
July	11	81	27.6	132.9	15
August	9	81	27.8	141.9	15
September	8	81	27.7	157.6	14
October	9	82	27.5	185.1	16
November	9	83	27.0	171.6	14
December	9	79	26.4	89.6	12

Source: Miller 2012

There is limited air quality data available for Barbados. Existing regulations in Barbados do not provide specific levels or standards for air emissions, including those from vehicles. The Ministry of Transport and Works, in collaboration with the EPD and the Barbados National Standards Institute (BNSI), is conducting research in order to establish a policy with actual numerical standards (UNEP 2010a). According to the Economic Commission for Latin America and the Caribbean (ECLAC) (ECLAC 2017), carbon dioxide (CO<sub>2</sub>) emissions have generally increased since the 1990s (see Figure 3-2 below).

**FIGURE 3-2 CARBON DIOXIDE EMISSIONS IN BARBADOS**



Source: ECLAC 2017

The World Health Organization (WHO) has guidelines for air quality that are designed to reduce the health impacts of air pollution. The guidelines relate to four common air pollutants including particulate matter (PM). The mean annual concentration of PM of less than 2.5 microns in diameters (PM<sub>2.5</sub>) is a common measure of air pollution. The WHO guidelines state that mean concentrations of PM<sub>2.5</sub> should not exceed 10 microgram per cubic meter (µg/m<sup>3</sup>) annually or 25 µg/m<sup>3</sup> in a 24-hour period. These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95 % confidence in response to long-term exposure to PM<sub>2.5</sub> (WHO 2005). In 2014, in Barbados the mean annual PM<sub>2.5</sub> concentration was 14 µg/m<sup>3</sup> (WHO 2014), which exceeds the WHO guideline value.

Other air contaminants of concern relevant to the Project include ozone depleting substances (ODS). As mentioned in Section 2.3.2 above, the Government of Barbados is signatory to the Montreal Protocol on Substances that Deplete the Ozone Layer. This Protocol was designed to reduce the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer.

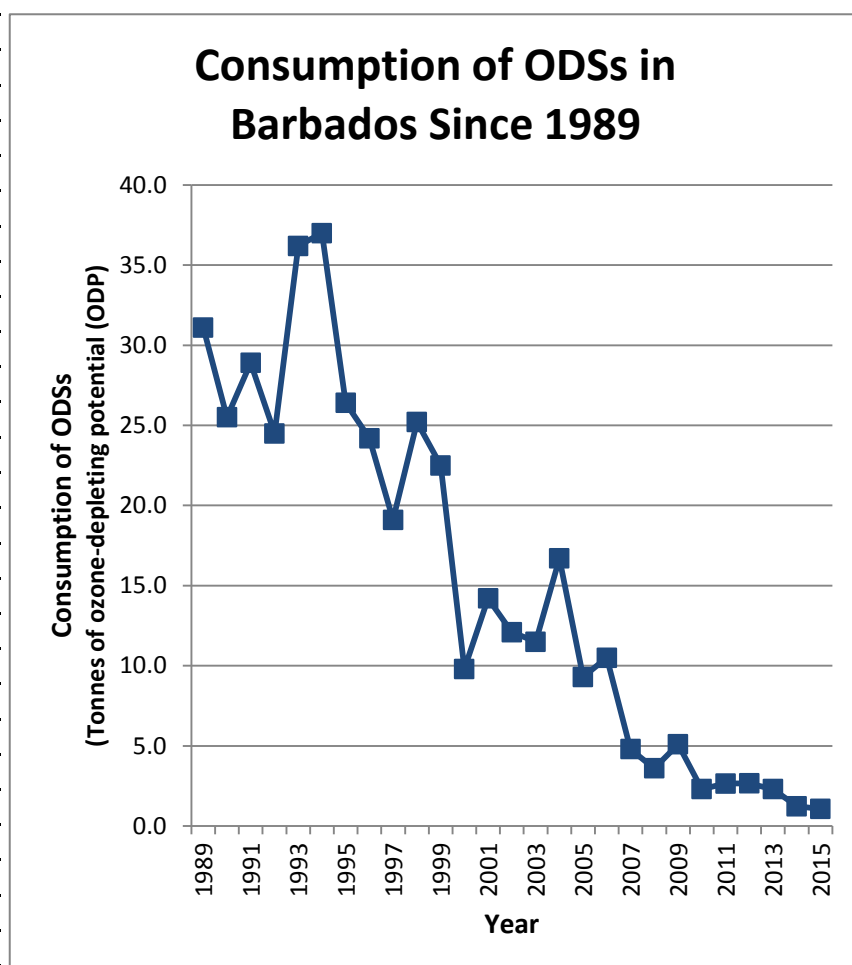
In the U.S., ODS are regulated as class I or class II controlled substances. Class I substances, chlorofluorocarbons (CFCs), have a higher ozone depletion potential and have been completely phased out in the U.S.; with a few exceptions, this means no one can produce or import class I substances. Class II substances are all hydrochlorofluorocarbons (HCFCs), which are in the process of being phased out by 2020 (USEPA 2017). Worldwide, parties to the Montreal Protocol accelerated the phase-out schedule for these HCFCs through Decision XIX/6 in September 2007 (UNEP 2010b). Developing countries operating under Article 5 of the Protocol (Article 5 countries includes Barbados) now have to freeze by 2013 their HCFC production and consumption to the average of their 2009-2010 levels, followed by a 10 percent reduction by 2015, a 35 percent by 2020, a 67.5 percent by 2025, and a 100 percent phase-out by 2030 (with 2.5 percent allowed, if necessary, for servicing existing equipment until 2040) (UNEP 2010b).

Historically, refrigerants used in air conditioning units were typically CFCs and HCFCs, both of which are known ODCs. They are now being replaced with non-chlorine containing refrigerants that have no ozone depleting potential such as ammonia, carbon dioxide and hydrocarbons (ethane, propane, butane, isobutene, and propylene) (AGDOE 2013). According to the statistics published by ECLAC, ODS consumption in Barbados has been on a relatively steady decline since 1989 (see Figure 3-3 below).

**FIGURE 3-3 CONSUMPTION OF ODSs IN BARBADOS**

Year	Consumption of ODSs (Tonnes of ozone-depleting potential (ODP))
1989	31.1
1990	25.5
1991	28.9
1992	24.5
1993	36.2
1994	37.0
1995	26.4
1996	24.2
1997	19.1
1998	25.2
1999	22.5
2000	9.8
2001	14.2
2002	12.1
2003	11.5
2004	16.7
2005	9.3
2006	10.5
2007	4.8
2008	3.6
2009	5.1
2010	2.3
2011	2.7
2012	2.7
2013	2.3
2014	1.2
2015	1.1

Source: ECLAC 2017



### 3.3

### HYDROLOGY

Barbados has a network of ephemeral streams, which flow from the highest parts of the island towards the western coast. The streams are connected through fractures in the carbonated rock, which covers the majority of the island, and in combination with surface runoff and infiltration into aquifers and underground caverns, they form the main hydrological system of the island (Evanson 2014). While aquifer recharge in Barbados is rapid (15 to 30% of average rainfall) due to infiltration, it only takes places during the wettest 1-3 months of each year (Jones et al., 1998).

### 3.3.1 *Potable Water Supply*

There are three potable waters sources utilized by the BWA (BWA 2014):

- Springs: two (2) spring sources – Codrington College Spring & Benn Spring.
- Wells: A network comprised of 22 wells (17 sheet and 5 stream water wells) and 8 boreholes, all ranging in depth from 119.5 to 322 feet.
- Desalination Plant: Water produced at the Desalination Plant using a reverse osmosis process is mixed with the groundwater from wells to complement BWA's general supply.

Approximately 99% of the public supply of water in Barbados is groundwater extracted from large reservoirs within the aquifers (Evanson 2014). The remaining percentage although not directly connected have access to potable water. Groundwater quality is good and a reasonably effective disinfection system provides a biologically safe water supply (UNEP 2010a). Generally, groundwater extraction wells in Barbados are located as far inland as possible, since ground water quality decreases rapidly towards coastline supply wells and the coastline also supports the greatest density of residential and tourism facilities.

Barbados is one of the world's most water scarce countries (i.e., less than 1,000 cubic meters/person/year) and the Barbados Water Authority pumps near maximum capacity to meet demand (Evanson 2014; GOB, 2014). Available water resources are currently rated at 390 cubic meters/person/year (BWA 2017). Barbados' freshwater supply is primarily a function of rainfall and the island's geomorphology - that is, a low-lying coral-based island where groundwater supplies, located in aquifers, are protected only by a thin layer of permeable soil. The wet season replenishes the aquifers (UNEP 2010a).

A zoning system is used to protect ground water against bacterial contamination; however the zones are not protected against chemical pollution. This system divides the island into five water protection zones---Zone 1 to Zone 5---with Zone 1 being the most restrictive with respect to 'allowed' physical development, and Zone 5 having no such restrictions (UNEP 2010a).

### 3.3.2 *Wastewater*

There are currently two Sewage Treatment Plants on the island, one in Bridgetown and another in Graeme Hall on the South Coast, although the entire island is not connected to the sanitary sewer system. Other disposal methods include underground septic tanks, and well or earth pits. Effluent from the



treatment plants are to the sea or underground via a well after primary treatment (BWA 2017).

### 3.4 *GEOLOGY, TOPOGRAPHY, AND SOILS*

The island of Barbados is the most eastern island of the English Caribbean chain of islands (Lesser Antilles) and topographically the island is a relatively flat. The island is the top of a seamount that rises 300 meters above sea level (masl) from the Barbados Ridge and was formed as an accreted wedge created by the movement eastwards of the Eastern Caribbean plate over the South American plate. The highest elevation point in the island is located in Mount Hillaby at approximately 340 masl in the Parish of Saint Andrew. The gradient at this location increases in a series of terraced tablelands until reaching the mount.

In the northeast region, the terrain is characterized as eroded and rocky with steep broken slopes; the rocks are sedimentary. In the rest of the island, the terrain is relatively flat composed of coral limestone, crossed with deep river-bed gullies that accommodate the movement of water during heavy rain. The coral limestone area composed of a series of gently sloping, step-like terraces. There are no permanent rivers in Barbados (Government of Barbados 2002a).

The coral limestone layer varies in thickness from approximately 10 to 100 meters (m) and consists of coral and coralline limestone bedrock with sporadic occurrences of sand deposits. Beneath the coral limestone layer are oceanic beds consisting of marl and ash covering the "Wedge Cover Unit" comprised of mudstones, sandstones and marls that weather to form silty clay to sandy clay soils. The most frequent soil type is fertile clay or clayey loam (Donovan 2005).

### 3.5 *NOISE*

The Project is located within the city in already existing government owned facilities (industrial/commercial/residential). The baseline noise levels in the vicinity of the Project are expected to be high, consistent with noise levels in highly populated cities. The major source of ambient noise at the Project area is from vehicular traffic on the neighboring roadways.

Typical outdoor sound level by land use category is presented in Table 3-2. Ambient day-night noise levels in areas with some commerce or industry are expected to range from 55 to 65 A-weighted decibel (dBA). Ambient day-night noise levels in rural and suburban towns with infrequent traffic are expected to range from 40 to 45 dBA.

**TABLE 3-2 TYPICAL OUTDOOR SOUND LEVELS BY LAND USE CATEGORY**

<b>Land Use Category</b>	<b>L<sub>d</sub> (dBA)<sup>a</sup></b>	<b>L<sub>n</sub> (dBA)<sup>b</sup></b>	<b>L<sub>dn</sub> (dBA)<sup>c</sup></b>
Wilderness areas	35	25	35
Rural and outer suburban areas with negligible traffic	40	30	40
General suburban areas with infrequent traffic	45	35	45
General suburban areas with medium density traffic or suburban areas with some commerce or industry	50	40	50
Urban areas with dense traffic or some commerce or industry	55	45	55
City or commercial areas or residences bordering industrial areas or very dense traffic	60	50	60
Predominantly industrial areas or extremely dense traffic	65	55	65

Source: Cavanaugh and Tocci 1998; Bies and Hansen 2009

dBA = A-weighted decibel

<sup>a</sup> L<sub>d</sub>, or daytime L<sub>eq</sub>, is the average equivalent sound level for daytime (7 a.m. to 10 p.m.).

<sup>b</sup> L<sub>n</sub>, or nighttime L<sub>eq</sub>, is the average equivalent sound level for nighttime (10 p.m. to 7 a.m.).

<sup>c</sup> L<sub>dn</sub>, or day-night average sound level, is the average equivalent A-weighted sound level during a 24-hour time period with a 10-dB weighting applied to equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m.

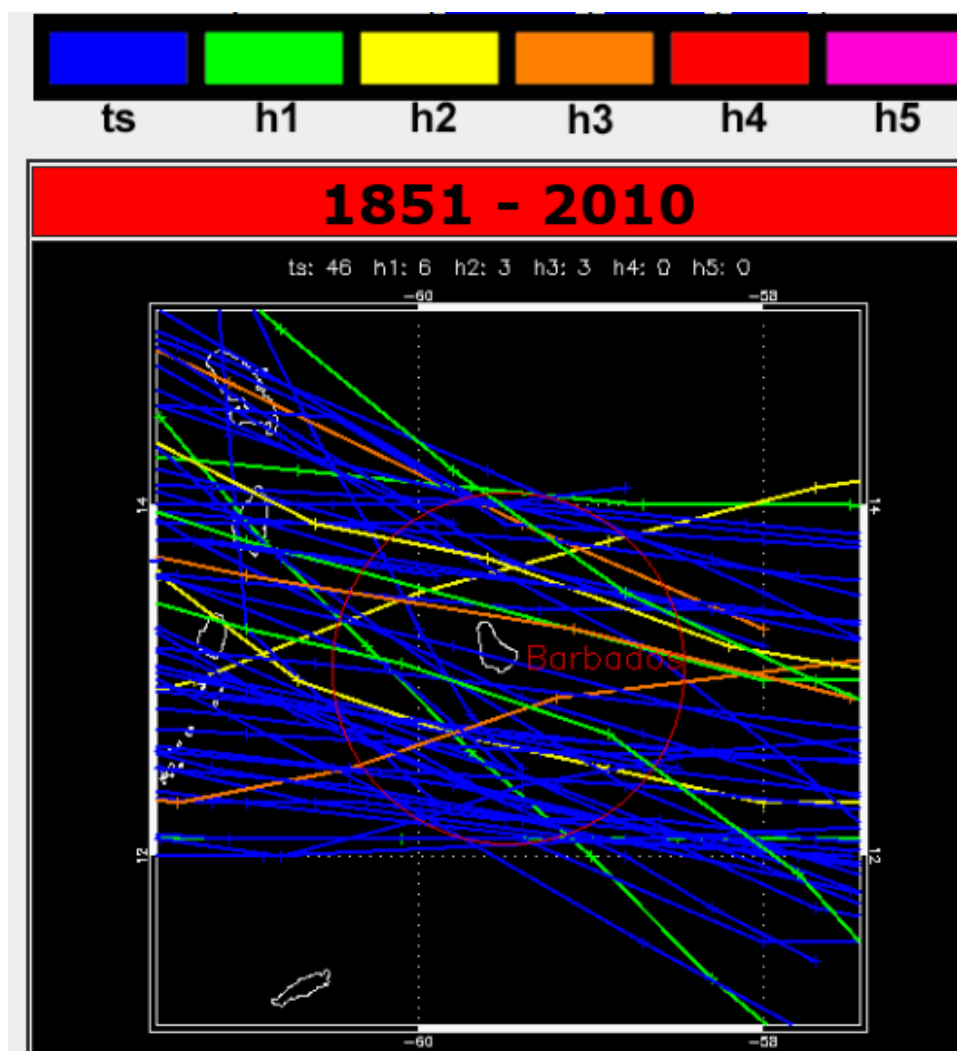
$$L_{dn} = 10 \log_{10} \left( \frac{15}{24} 10^{L_d/10} + \frac{9}{24} 10^{(L_n+10)/10} \right)$$

The International Finance Corporation (IFC) recommends that noise levels in residential areas should not exceed 55 dBA during the daytime or 45 dBA during nighttime. In industrial/commercial areas, the World Bank recommends noise levels not exceed 70 dBA during daytime or nighttime (IFC 2007).

There is limited air noise data available for Barbados. The existing noise environment at properties in the Parish of Saint Lucy at the northern end of the island was characterized by sound level measurements taken for another project in May 2006 (AMEC 2006). Baseline noise measurements taken at four sites near the Parish of Saint Lucy ranged from 45 to 60 dBA at residences during daytime hours and 37 to 55 dBA overnight. Measured sound levels at these four sites correspond to general suburban areas with medium density traffic or suburban areas with some commerce or industry (as presented in Table 3-3). It is expected that noise levels in Bridgeport are similar or higher than those at the Parish of Saint Lucy.

In the Caribbean, there are three hurricane tracks. The Island of Barbados is located within the Eastern Caribbean track (CHN 2011). The Eastern Caribbean track includes the Lesser Antilles. Approximately 12 hurricanes and several tropical storms have crossed the Island of Barbados from 1851 to 2010 (see Figure 3-4). Hurricane Janet, a category h3 (moderate to extreme), passed just south of Barbados with 121 miles per hour (mph) winds from east to southeast on 22 September 1955, impacting the southern of Barbados while Hurricane Allen, also a category h3, passed north of Barbados and made landfall with 127 mph winds on 4 August 1980. Allen heavily affected Barbados, causing \$US 6 million in damages and destroying over 500 homes.

**FIGURE 3-4 HURRICANES AND TROPICAL STORMS AFFECTING BARBADOS (1851-2010)**



Source: CHN 2011

### 3.7 *FLORA AND FAUNA*

Barbados is in the Windward Islands Xeric Scrub ecoregion and is included in the Caribbean Islands biodiversity hotspot. The biodiversity of Barbados has been influenced since the island was settled in 1627. Numerous species of plants and animals have been introduced, competing against indigenous species. In addition, habitats were altered and fragmented as the island was settled. The proposed Projects will all take place inside already existing government owned facilities where there are no flora and fauna.

### 3.8 *SOCIOECONOMICS*

Barbados is one of the mostly densely populated countries in the world, having a population density of 646 people per square kilometer at the most recent (2010) census. In 2010, the population of Barbados was 277,821, of which 47.9 % were male and 52.1 % female. Bridgetown, where the Projects will be located, is in the Parish of St. Michael, which has the highest population (88,529) of the parishes (see Table 3-3). Within the productive population (15 - 64 years) there are 187,095 persons, while there are 54,757 within the 0 - 14 age group and 35,969 at 65+ years. The median age is 38 years (Barbados Statistic Service 2013).

**TABLE 3-3 POPULATION OF BARBADOS CENSUS (2010)**

<b>Parish</b>	<b>Population</b>	<b>Percent of Total (%)</b>
St. Michael	88,529	31.9
Christ Church	54,336	19.6
St. George	19,767	7.1
St. Philip	30,662	11.0
St. John	8,963	3.2
St. James	28,498	10.3
St. Thomas	14,249	5.1
St. Joseph	6,620	2.4
St. Andrew	5,139	1.8
St. Peter	11,300	4.1
St. Lucy	9,758	3.5
<b>Total Barbados</b>	<b>277,821</b>	<b>100</b>

Source: BSS 2017

For the past five decades Barbados has been able to control its rate of population growth through the successful implementation of an island-wide family planning program. This has contributed to the attainment of an average rate of population growth of 0.3 % between 1980 and 2008, which is comparable with that of most developed countries (GOB 2014).

The population of Barbados is predominantly black (92.4 %) or mixed (3.1 %) and 2.7 % of the population is white and 1.3 % is South Asian. The remaining population includes East Asians (0.1%) and Middle Easterners (0.1 %) (BSS 2017).

There was a general decline in the unemployment rate in Barbados from 1995 when it was 19.7 % until 2007 when it was 7.4 %. In 2010, the unemployment rate was 10.8 % and in 2015 it was estimated at 11.3 % (CBD 2012; GOB 2012; BML 2016). There has been a decline in employment in the agricultural and manufacturing sectors and a rise in employment in the services sector. There has also been an improvement in the educational attainment of the labor force with a decline in the number of adults with no certification from 60 % in 1990 to 57 % in 2000 and an estimated 54 % in 2009. In Barbados there is universal primary and secondary education and the adult literacy rate is 99.7 % (CBD 2012; GOB 2012).

A survey conducted in 2010 (2,425 households and 6,973 individuals with 5,618 of them being adults 15 years and over) indicated that 15 % of households and 19.3 % of individuals in Barbados were below the poverty line of BDS\$ 7,861 (annual). For all individuals reporting some form of income (employment and other sources), monthly income averaged BDS \$2,496, with 50 % of the people surveyed having a monthly income of BDS \$2,000 or less. The data indicates that the poverty gap (the extent to which the poor existed below the poverty line) and the severity of poverty compare favorably with those in Caribbean countries that conducted poverty assessments around the same time. In general, over the 1995 to 2010 period living conditions in Barbados have improved with steady but moderate economic growth and a decreasing unemployment rate (CDB 2012; GOB 2012).

### **3.8.1**      *Energy Use*

Barbados has universal access to electricity generated using a number of fuel sources comprised of approximately 92% Bunker C, 7% diesel and less than 1% natural gas (UNEP 2010a). The Energy Division has stated that the energy intensity in Barbados has been falling as the country shifts to GDP growth sectors that rely less and less on energy, however despite the reduced use of energy, factors of population growth and the increased cost of fossil fuels have increased the percentage of the import bill spent on fossil fuels. These are resources that could be employed elsewhere to combat other development issues (UNEP 2010a).

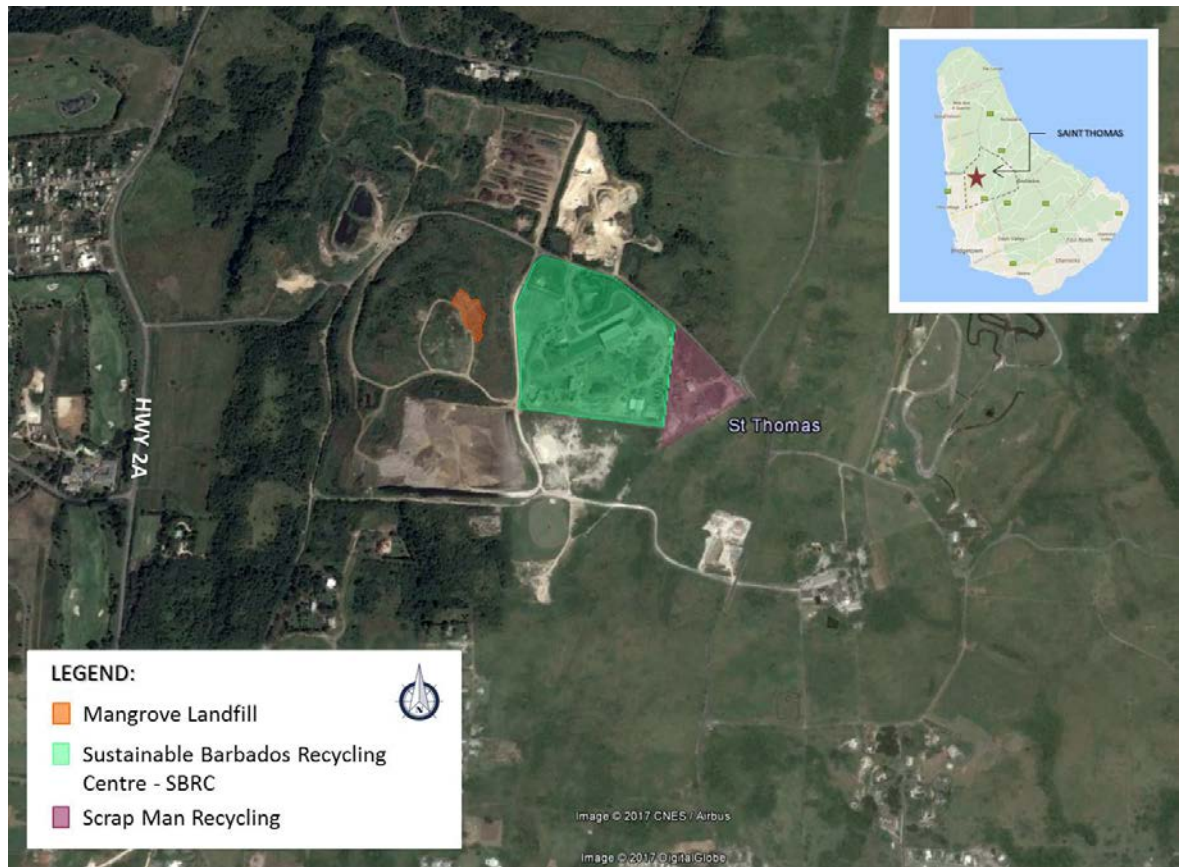
### 3.8.2 *Waste Management*

The main method of solid waste disposal in Barbados is by sanitary landfill at a main facility in Mangrove, Saint Thomas Parish (see Figure 3-5). In spite of an established system of waste management comprising several government programs, private entities and business initiatives, according to interviews, waste management has been a major challenge with illegal dumping taking place in gullies, quarries and on roadsides around the island. The SSA is responsible for the collection and disposal of non-hazardous solid waste from homes and government agencies around the island, and also operates the four Government solid waste disposal sites:

- Mangrove Pond Landfill (main disposal site);
- Bagatelle Bulky Waste Disposal Site;
- Rock Hall Asbestos Disposal Site; and the
- Lonesome Hill Blood and Grease Disposal Site.

The Mangrove Facility is fitted with a clay liner and a leachate collection system. However, this facility is nearing the end of its useful life and a new landfill facility is being constructed at Greenland (Elias and Elias 2010).

**FIGURE 3-5 LOCATION OF THE MANGROVE LANDFILL AND RECYCLING CENTER**



In addition to the Mangrove Landfill, there is also a recycling center at this location, the Sustainable Barbados Recycling Center SRL (SBRC) which is under a Public Private Partnership Agreement with the Government of Barbados (GOB). The Centre is divided into two compounds, the compound housing the facilities operated by SBRC and the Northern Depot of the Sanitation Service Authority. The SBRC was originally supposed to include a storage facility for hazardous waste (UNEP 2010a); however, it is unable to accept or process hazardous waste. Acceptable wastes include all household/municipal solid waste (msw); construction and demolition waste, green waste, and rocks and soil.

Information on potential impacts generated from the proposed Projects was obtained from various sources, including consultation with the DET and EPD and local sources, discussions with pertinent local agencies, and literature review. To assess the impacts associated with or resulting from the proposed Projects the project team used professional judgment, fieldwork, stakeholder meetings, and desktop analysis. The significance of potential impacts of the project was determined.

The proposed Projects will affect environmental and socioeconomic conditions in the project area. Project effects on physical, biological, and socioeconomic resources are summarized in this Section and in Table 4-2 (at the end of this Section). The table provides the significance of potential Project impacts on environmental and social resources, assuming that proposed and recommended mitigation measures, industry best management practices and embedded controls, and management plans are implemented.

Project activities will be confined to inside existing government owned buildings, with no disturbance to new, undeveloped areas. There will be no operational changes once the Project activities are implemented so impacts are limited to the implementation phase and no negative impacts are expected during the operational phase. Project operation will lead to positive impacts from increased energy efficiency and reduced operation costs.

The negative impacts of the project will be mitigated and managed with the application of industry-standard best practices. Table 3-1 of the Environmental and Social Management Plan, prepared for the project and attached to this EA as Appendix A, summarizes these best practices. Any contractor or supplier that may be involved in the project will be required to incorporate the proposed mitigation measures and management controls within their own working procedures and plans.

#### **4.1.1 *Potential Impacts by Activity***

##### **4.1.1.1. *Tinting and Sealing Windows***

Window tint will consist of placing premade film on windows. This process does not produce residual materials and application is easily done without the use of chemicals or equipment; therefore no impacts are expected from the installation of window tints.



Window sealing will likely be done with the application of caulk or sealant around the windows. Because the Projects have not been defined, the exact materials to be used are unknown. Although there is no waste generated from this activity, there could be leftover unused sealant which can either be used elsewhere or may need to be disposed of. Typical sealants used include silicone sealants/adhesives. Silicone sealants can be land-filled once cured or burned in a chemical incinerator equipped with afterburners and scrubbers. As far as impacts to human health with regards to air quality, as long as sealants are applied in well ventilated areas (typically applied to the window on the outside of the building), there should not be any impacts. Personal protective equipment (PPE) such as gloves and protective glasses should be worn to prevent any other impacts to human health.

If the appropriate mitigation measures are in place with regards to material handling and disposal, tinting and sealing windows should have a **negligible** impact.

#### 4.1.1.2. *Replacing Air Conditioning Units*

The ETD has indicated that approximately 50 existing government owned buildings will have their air conditioning units replaced to more energy efficient units. Although the exact activities have not been defined, if the old units need to be disposed (an alternative would be to sell them if they are still functioning), refrigerant contents need to be extracted, contained, and disposed of accordingly.

As previously discussed in Section 3.2 above, the commonly used refrigerants are ODSs and they cannot be vented to the atmosphere for disposal. Used refrigerants can be reclaimed and reused or they must be disposed via incineration or chemical separation/treatment; however, there are currently no treatment or disposal facilities in Barbados. Used refrigerants must be collected in gas cylinders and shipped off the island for appropriate disposal. There are multiple companies in Barbados that install and repair heating, venting, and air conditioning (HVAC) units; however, during interviews, their disposal practices for spent refrigerants were unclear and their final destinations were either unknown or long term storage.

According to the U.S. Environmental Protection Agency (USEPA), household refrigerators and freezers manufactured before 1995 typically contain chlorofluorocarbon (CFC) refrigerant and many window air-conditioning units and dehumidifiers contain HCFC refrigerant (USEPA 2016b). Commonly used refrigerants in older wall mounted units include refrigerant (R)-134A (1,1,1,2-Tetrafluoroethane) or R-22 (Chlorodifluoromethane). Although most

refrigerants can be recycled, HCFCs (also known as Class II) are in the process of being phased out in some countries and can therefore not be reused, this includes R-22 (USEPA 2016a). The only option for these types of ODCs is disposal. It is important to note that due to the phase out of CFCs and HCFCs (see Section 3.2), there are restrictions on the types of refrigerants and units that can be imported, so if the new units are going to be purchased internationally, they must comply with the requirements in the Montreal Protocol and not contain any of the refrigerants on the phase out list.

Typical wall mounted air conditioning units contain approximately 1-2 pounds of refrigerant (see Figure 4-1). Larger roof mounted air conditioning units can contain approximately 20-30 pounds of refrigerants (see Figure 4-1 below). In order to dispose of the refrigerants, refrigerant recovery equipment is used to evacuate the system into a recovery gas cylinder.

Removal of the refrigerants can take place on site prior to removal of the unit, or at a recovery facility if the unit can be moved safely without damaging the containers (for individual wall units). Recovery gas cylinders are typically either 50 or 30 pounds and can recover approximately 40 and 24 pound of refrigerant respectively. Recovery cylinders must be used and handled appropriately and only by those familiar with the hazards and who are trained in proper handling techniques.

If the refrigerant needs to be shipped for disposal, international regulations for controlled substances must be followed. Under the Montreal Protocol, ODSs are considered a “controlled substance.” Although the Protocol controls trade in virgin ODS, it provides recommendations for the control of trade in recovered, recycled and reclaimed ODS (UNEP 2008). Decision IV/24 of the Montreal Protocol defines these key terms:

**TABLE 4-1 MONTREAL PROTOCOL - DEFINITIONS OF USED, RECOVERED, RECYCLED AND RECLAIMED ODS BASED ON DECISION IV/24**

Title	Definition
Used ODS	Recovered, recycled or reclaimed ODS.
Recovery	Collection and storage of ODS from machinery, equipment, containment vessels and so forth during servicing or prior to disposal.
Recycling	Re-use of a recovered ozone-depleting substance following a basic cleaning process such as filtering and drying. For refrigerants, recycling normally involves recharge back into equipment; it often occurs on-site.
Reclamation	Re-processing and upgrading of a recovered ozone-depleting substance through mechanisms such as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance. It often involves processing off-site at a central facility.

Source: UNEP 2008

Decision VII/31 (1995) of Montreal Protocol had a direct bearing on the Basel Convention (Section 2.3.2). The Parties decided that international transfers of Protocol-controlled ODS that are recovered but not purified to usable purity specifications by international or national standards should occur only if the recipient country has recycling facilities that can process the received controlled substances to these specifications or has destruction facilities incorporating technologies approved for that purpose (UNEP 2008). Additionally, the receiving country must be a party to the Protocol. Because the refrigerants recovered by the project will not be purified, this requirement must be complied with.

Exporters must have an export license or permit and approval from the receiving country in order to export ODSs. The approval should state the chemical, the quantities and the country of destination. Exporters should keep records and report exported quantities of each substance to the Government of Barbados (UNEP 2010b). International shipping requires following both the regulations of the country of origin and the destination country, which vary. Because of these varying regulations, depending on the mode of transportation, international standards are codified in the International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air<sup>i</sup> and the International Maritime Dangerous Goods (IMDG) Code<sup>ii</sup>, for transport by vessel.

Based on the information provided by the ETD, if all 50 retrofitted buildings have roof top units, it would amount to an estimated 1,500 pounds of refrigerant to be disposed of in approximately 38 (50 pound) gas cylinders. Based on our observations, it appears most facilities have individual wall mounted air conditioning units. Assuming a 3-story government facility has approximately 50 offices per story, it would amount to 150 individual units per building, or an estimated total of 15,000 pounds of refrigerant to be disposed of in approximately 375 (50 pound) gas cylinders for all 50 buildings.

Because of the nature of these chemicals, the release of these gases would affect the ozone layer and not to the immediate surroundings. Prolonged exposure to released refrigerants can be hazardous to humans; however, leaks from the small individual air conditioning units would dissipate quickly and the larger

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<sup>i</sup> ICAO Technical Instructions For The Safe Transport of Dangerous Goods by Air (Doc 9284): <https://www.icao.int/safety/DangerousGoods/Pages/technical-instructions.aspx>

<sup>ii</sup> IMDG Code, 2016 Edition Amendment 38-16: <http://www.imo.org/en/Publications/IMDGCode/Pages/Default.aspx>

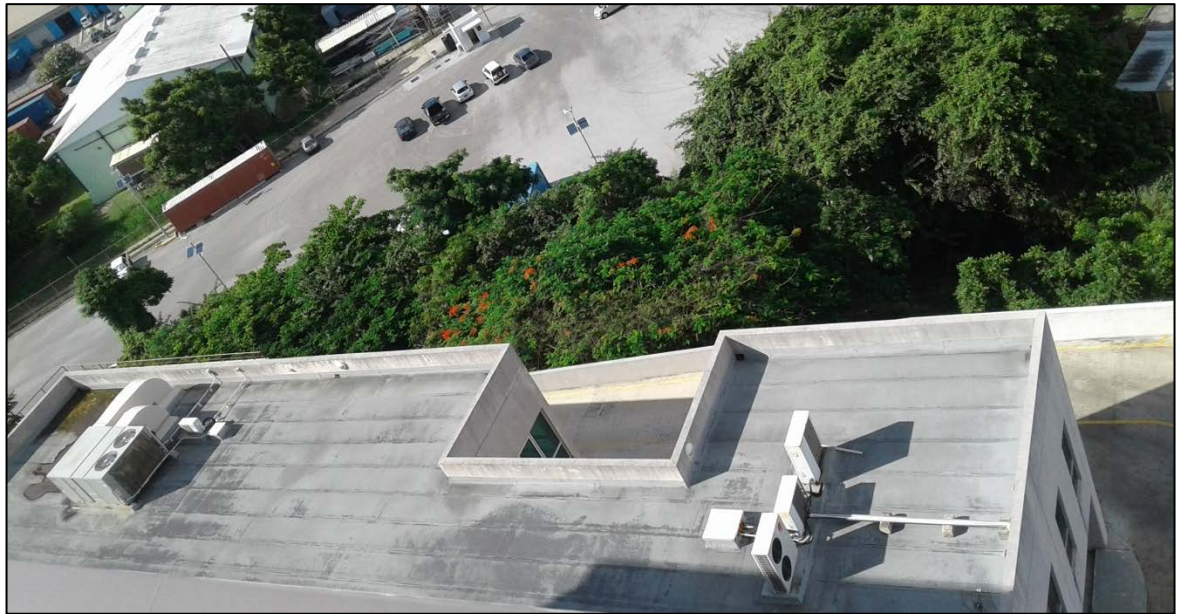
units are located outside, so impacts to human health are **negligible**. These chemicals are also flammable so there is a risk associated with handling these chemicals.

If appropriate mitigation measures are in place with regards to material handling and disposal, the negative impacts associated with the replacement of air conditioning units are considered **negligible**. Positive impacts from the unit replacement include less energy consumption for the buildings retrofitted with new units.

***FIGURE 4-1 TYPICAL WALL MOUNTED INDIVIDUAL AIR CONDITIONING UNIT***



**FIGURE 4-2 ROOF MOUNTED CENTRAL AIR CONDITIONING UNIT AT THE BAOBAB TOWER**



**4.1.1.3. *Replacing Vehicles***

According to the ETD, the proposed Project could include the replacement of currently used diesel vehicles with electric cars; however, this activity would not be carried out in the immediate future. If the vehicles are disposed of, there is a potential for impacts from the improper disposal of used batteries and used oil.

Used batteries can be recycled and there are companies in Barbados that will accept used batteries (and will pay to receive them). Batteries contain a mixture of chemicals that can include cadmium, lead, zinc, manganese, nickel, silver, mercury, lithium, as well as various acids.

Used oil can also be recycled on the island. The chemicals in used oil include hydrocarbons, heavy metals such as zinc, lead, copper and cadmium, as well as small amounts of gasoline, antifreeze, and chemicals that come from gasoline when it burns inside the engine. If improperly disposed, used batteries and used oils have the potential to contaminate soils and groundwater, a precious resource for Barbados. Battery contents and oils and fuels are hazardous to humans and if improperly managed or disposed could impact human health. Personal protective equipment (PE) such as gloves and protective glasses should be worn to prevent any other to human health while handling the used oils.

If these items are not disposed in Barbados and need to be shipped elsewhere for disposal, then Basel Convention requirements must be followed (Section

2.3.2). The Convention requires that the exporting country notify the receiving country and any transit countries of the proposed shipment and can only ship the waste once consent has been given. The Convention also requires that an international movement document<sup>iii</sup> accompany the waste shipment from its point of origin to its final recycling or disposal location (USEPA 2017).

In addition, shipments of waste must be packaged, labeled, and transported in accordance with international rules. In the event that an accident occurs during the shipment of the waste, Basel requires that the responsible parties inform the potentially affected countries of the accident. Finally, parties to the Convention must submit an annual report to the Basel Secretariat summarizing the amounts and types of hazardous waste exported or imported and the destination and disposal methods (USEPA 2017).

Because both used batteries and oils can be recycled, if the appropriate mitigation measures are in place with regards to material handling and disposal, the impacts associated with the replacement of the vehicle fleet are **negligible** if all materials are recycled. Using electric vehicles will lead to a positive impact from reduced dependency on fuels and reduced vehicle emissions and GHGs.

#### 4.1.1.4. *Replacing Fluorescent Light Bulbs*

The final Project activity described by the ETD was the replacement of fluorescent light bulbs with energy efficient LED light bulbs. The exact number of buildings and or light bulbs to be replaced is currently unknown.

Fluorescent lightbulbs contain a low pressure mercury-vapor that uses fluorescence to produce visible light. With time, the mercury is slowly adsorbed onto the glass, phosphor, and electrodes, until such small quantity is left in the gas that it no longer functions. At the end of its useful life, because of the absorption of the mercury, the entire light bulb is considered hazardous (even if the gas is no longer present).

If improperly disposed, fluorescent light bulbs have the potential to contaminate soils, groundwater, and air (gas and fine particulate matter that can go airborne if broken) as well as impact human health (see Figure 4-3 below). As far as impacts to human health with regards to air quality, as long as the bulbs remain

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<sup>iii</sup> Basel Convention Movement Document for exporting and importing of hazardous wastes: <http://www.basel.int/Procedures/NotificationMovementDocuments/tabid/1327/Default.aspx>



intact, there should not be any impacts. PPE such as gloves and protective glasses should be worn to prevent any other impacts to human health.

**FIGURE 4-3 HAZARD WARNING AT BULB DISPOSAL FACILITY**



There are facilities in Barbados that will receive, properly breakdown, and package fluorescent tubes for shipment off the island for proper disposal in the U.S. in compliance with all transboundary movement of hazardous waste requirements as well as final treatment and disposal requirements (See Figure 4-4). As previously mentioned in Section 4.1.1.3 above, the transboundary movement of hazardous waste must comply with Basel Convention requirements.

Because fluorescent bulbs can be properly disposed of by companies on the island, if the appropriate mitigation measures are in place with regards to material handling and disposal, the impacts associated with the replacement of these bulbs are **negligible**.

*FIGURE 4-4 FLUORESCENT BULB BREAKDOWN EQUIPMENT*





**TABLE 4-2 SUMMARY OF PROJECT POTENTIAL IMPACTS AND RECOMMENDED MITIGATION/MANAGEMENT MEASURES**

Resource	Source of the Impact and Existing Vulnerability	Recommended Mitigation/ Management Measure	Impact Significance After Mitigation
<i>Physical</i>			
Climate and Air Quality	<ul style="list-style-type: none"> <li>Accidental release of refrigerants into the environment during air conditioning unit removal.</li> <li>Inappropriate disposal of refrigerants.</li> </ul>	<ul style="list-style-type: none"> <li>Use the appropriate refrigerant recovery equipment and only trained professionals to remove the refrigerant from the units.</li> <li>Prepare an ESMS that describes the requirements for removal of refrigerants, their containment, and disposal instructions so that they are handled appropriately. Implement a “cradle-to-grave” approach where documentation for accountability is maintained from removal all the way to final disposal (noting quantities, types of materials, and names of people and companies handling the material).</li> <li>Monitor documentation to ensure the appropriate disposal of refrigerants (ETD)</li> </ul>	Negligible
Climate and Air Quality	<ul style="list-style-type: none"> <li>Reduction of the use of ODS.</li> <li>Reduction of the emission of greenhouse gases.</li> </ul>	No additional mitigation measures are proposed.	Positive
Hydrology, Geology, Topography, and Soils	<ul style="list-style-type: none"> <li>Accidental release of hazardous materials into the environment during transportation and/or storage.</li> <li>Inappropriate disposal of hazardous materials.</li> </ul>	<ul style="list-style-type: none"> <li>Prepare an ESMS that describes the requirements for transportation and disposal instructions so that they are handled appropriately. Implement a “cradle-to-grave” approach where documentation for accountability is maintained from removal all the way to final disposal (noting quantities, types of materials, and names of people and companies handling the material).</li> <li>Monitor ESMS implementation (ETD).</li> <li>Monitor documentation to ensure the appropriate disposal of hazardous materials (ETD).</li> </ul>	Negligible
Natural Disasters	<ul style="list-style-type: none"> <li>Hurricanes and natural fires.</li> </ul>	<ul style="list-style-type: none"> <li>Prohibit the transportation of any hazardous materials during a hurricane.</li> </ul>	Negligible

Resource	Source of the Impact and Existing Vulnerability	Recommended Mitigation/ Management Measure	Impact Significance After Mitigation
<b>Biological</b>			
Flora and Fauna	<ul style="list-style-type: none"> <li>Accidental release of hazardous materials</li> <li>Inappropriate disposal of hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>Prepare an ESMS that describes the requirements for transportation and disposal instructions so that they are handled appropriately. Implement a “cradle-to-grave” approach where documentation for accountability is maintained from removal all the way to final disposal (noting quantities, types of materials, and names of people and companies handling the material).</li> <li>Monitor ESMS implementation (ETD).</li> <li>Monitor documentation to ensure the appropriate disposal of hazardous materials (ETD).</li> </ul>	Negligible
<b>Human Resources</b>			
Hazardous materials related effects on the public	<ul style="list-style-type: none"> <li>Inappropriate handling of hazardous materials.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that all contractors are trained in the appropriate handling of material.</li> <li>Ensure that all contractors are provided with the appropriate PPE if needed (i.e., gloves, protective glasses, steel toe shoes, etc.)</li> <li>Employ best available work practices on-site to minimize occupational exposure.</li> </ul>	Negligible
Fire hazard risk	<ul style="list-style-type: none"> <li>Accident release of refrigerants or used oils.</li> </ul>	<ul style="list-style-type: none"> <li>Provide emergency response procedures in case of accidental releases</li> </ul>	Negligible
Socioeconomic	<ul style="list-style-type: none"> <li>Project induced economic activity will result from contracting of materials and services during the construction</li> <li>Decrease in fossil fuel dependency.</li> <li>Increase use of renewable energy in Barbados.</li> <li>Reduction of the emission of greenhouse gases.</li> </ul>	No additional mitigation measures are proposed.	Positive

As previously discussed in Section 2.3.4 above, the proposed Project will have negligible impacts on the environment or the community. However, the handling of hazardous wastes involves potential risks, which merits that the Project be classified as Category “B”. In accordance with OP-703, Category B projects “are likely to cause mostly local and short-term negative” impacts, for which “effective mitigation measures are readily available”. Appendix A presents the ESMP of the Project.

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**APPENDIX A   ENVIRONMENTAL AND SOCIAL  
MANAGEMENT PLAN**