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## **THE BAHAMAS**

### **SOLID WASTE MANAGEMENT PROGRAM**

**(BH-0008)**

### **ENVIRONMENTAL AND SOCIAL IMPACT REPORT**

**1998**

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THE BAHAMAS

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I. EXECUTIVE SUMMARY

PROJECT NAME: Solid Waste Management Program

PROJECT NUMBER: BH-0008

DATE: July 9, 1998

BORROWER & GUARANTOR: Government of the Commonwealth of The Bahamas

EXECUTING AGENCY: Department of Environment Health Services

IDB: US\$22,800 million

LOCAL COUNTERPART: US\$ 9,700 million

TOTAL COST: US\$32,500 million

II. BACKGROUND

A. Introduction

- 2.1 The Commonwealth of The Bahamas is located on the southwestern edge of the North Atlantic Ocean, east of Florida and north of Cuba and Hispaniola. It is an archipelago of approximately 700 islands and over 200 rocks and cays, with a total land surface of approximately 5,370 mi<sup>2</sup>. The population of the Bahamas, approximately 295,000, is centered in Grand Bahamas Island, with 16% of the population, and New Providence, which includes the capital Nassau with 68%. The rest of the population is distributed on the Family Islands, of which Bimini, Abaco, Andros, Eleuthera, Exuma and Long Island are the most populated. Tourism is the major income earner with some three million tourists each year and many winter residents who are drawn to The Bahamas for its beautiful beaches, underwater attractions, boating and fishing. A clean environment, free from litter and garbage, is essential to protect the health of residents and visitors and to maintain the attractiveness of the islands.
- 2.2 Bahamians and visitors together generate more than 264,000 tons of municipal solid waste annually, with New Providence Island contributing about 77% and Grand Bahamas 17% of this total, leaving

only about 6% or 15,800 tons annually generated on the other Family Islands. This waste has been disposed of in dumps, with little protection from scavengers, vermin, cover material and dumping along roadsides and on abandoned land - a generally unsanitary situation in most islands. The focus of the work reported here is on New Providence Island, where the most waste is generated, and on selected Family Islands which have been chosen for remedial work and upgrading because of their currently poor waste management systems.

B. Waste management practices on New Providence Island

- 2.3 Municipal solid waste on New Providence Island is currently disposed of at the Harrold Road disposal facility, a 100-acre site of which approximately 45 acres has been filled since it opened in 1972. Garbage is deposited on the surface, spread by mechanized equipment and partially covered. The area has a high water table (3-10 ft. below the surface), common to all Bahamian islands, so excavation is limited and above ground disposal is common. In the past garbage was mechanically shredded to reduce space requirements at the landfill, but the shredding equipment no longer functions.
- 2.4 The Harrold Road site has a number of issues common to non-sanitary landfills. Lack of adequate cover material and odor control, pests and vermin, noise, illicit dumping on roads leading to the site, widespread scavenging, lack of security and control, and lack of fire prevention. Also, improper operational procedures, control of waste during transport, poor waste acceptance and sorting, and insufficient waste management training and equipment are other issues that are must or are being addressed. Insufficient cover material, in short supply because generally only coralline rock is available, has led to pest, odor and fire problems. Hazardous waste is also indiscriminately dumped with the other waste.
- 2.5 Currently about 180,000 tons/year of municipal solid waste are collected by the Department of Environmental Health Services (DEHS) and private commercial carriers, the service is provided for the entire population (100% coverage). Collection of 50,000 tons/year of domestic (70%) and small business (30%) is currently undertaken by the Waste Management Division of DEHS. Commercial collection is by private collectors, who collect the bulk of the commercial waste - about 130,000 tons/yr, and by DEHS. The DEHS service has been assessed in the Pre-Feasibility Study to be inefficient and more costly than the commercial operators, due to inappropriate containerization, equipment type and maintenance, and excessive staff. Many of government's problems in solid waste management are a result of limited financial resources and the inability to collect accounts receivable and recover costs.
- 2.6 Recycling efforts on New Providence are limited consisting of drink bottles with return deposits at homes and by scavengers at the dump, metal by scavengers at the dump and some cardboard and paper by commercial firms. Lack of overseas markets for plastic and

glass particularly, and to some extent cardboard and paper, reduces the potential for serious recycling efforts. There is a new initiative to recycling of derelict vehicles to markets in the United States.

- 2.7 Hazardous waste is not a general problem throughout most of the Bahamas, with the exception of Grand Bahamas, because of little manufacturing throughout the islands. Spent oil, batteries and pesticides, paints and solvents and their containers are the primary hazardous wastes on most islands. This material is mixed with household waste at the disposal site. There are no existing provisions for segregation, testing and storing these materials.
- 2.8 Environmental education and public awareness campaigns for solid waste management have begun by environmental NGOs such as the Bahamas National Trust, and by the Bahamas National Pride Association on the major islands, but for the most part there is little awareness, understanding or interest in the total waste management problems of the country. Littering and illegal dumping is common, household composting at a low level and potential use of discarded material not appreciated.

C. Current waste management practices on the Family Islands

- 2.9 Because of the long distances between settlements in the Family Islands most settlements have their own dump formal sites, but there is a proliferation of informal dump sites and poor disposal practices and littering. The usual method of disposal is to dump, burn and then push the burned material aside to make space for more waste. Many sites are poorly located, e.g. in wetlands, near airports, or close to the groundwater table and in water-well supply fields. Aesthetic, health and environmental contamination are usual problems at these sites. There are no, or inadequate, operating guidelines or operational plans to assist Local Boards of Works in implementing appropriate solid waste disposal. Collection and disposal facilities are contracted to private firms by the local authorities. Environmental education and awareness programmes focussed on solid waste issues are badly needed, as is enforcement of litter regulations.

1. San Salvador

- 2.10 Three main dump sites are found on San Salvador, with the main site serving Cockburn Town, Club Med and Victoria Hill Settlement located about one-half mile from the airport in a depression along the shore of Little Lake. The site, generally poorly maintained can be seen by arriving passengers at the airport, has a serious fly problem, has solids and leachates overflowing into Little Lake, is in the vicinity of ground water supply wells - all environmentally inappropriate. The other two sites have fly problem, debris is blowing across the landscape and are located along roadsides in full view of visitors. Collection is provide by contractors and is reasonably good. Indiscriminate dumping is

fairly common. Club Med does some recycling and incinerates the remaining waste.

## 2. Great Exuma

- 2.11 Most of Great Exuma's and Georgetown's refuse is located in low-lying marsh land NW of the former airport. This site has fly infestation problems, lacks cover material and equipment, has a smoke problem from burning refuse and contaminates surface water and adjacent marine environment. Refuse from Little Exuma Island is dumped and burned at Williams Town dump site located on the NE shoreline of Boggy Pond, and Steventon dump site one mile east of Steventon. The Williams Town site is unsupervised with indiscriminate dumping taking place over a wide area. The site is fraught with blowing debris and litter, fly infestation, lack of cover material, open burning, contamination of water body and surface water, and aesthetic problems because of its proximity to a highway and residential dwellings. The Steventon site is located in a low lying, seasonal marsh near the shore of a freshwater pond, and has problems similar to Williams Town site.

## 3. Bimini

- 2.12 The North Bimini dump site, located just north of Bayley Town is adjacent to the sea, an open pit for burning refuse and is full. Smoke from burning is objectionable and a potential hazard to downwind residents. The site is subject to flooding from high tides and heavy rains. The South Bimini refuse is disposed along a roadway and parallel to the South Bimini Airport runway. Birds attracted to the dump are an aircraft hazard. A serious fly infestation, blowing debris and litter create an unsightly landscape for visitors, contamination of surface water and indiscriminate refuse disposal at the site are the major problems. Bulky waste and derelict vehicles are deposited at specific sites on North and South Bimini.

## 4. Inagua

- 2.13 The dump site in Great Inagua is located in a mined limestone quarry, is 0.7 miles NE of Mathew Town and 1 mile south of the Great Inagua Airport. The site is unsupervised and uses the typical disposal system with the same problems of the other islands exhibited here, viz. fly infestation, lack of cover material, blowing debris and litter, and indiscriminate dumping.

## 5. Long Island

- 2.14 Eight public and one private dump sites are found on Long Island. Long distances between settlements result in indiscriminate dumping in many undeveloped areas of the island. Most sites are in or adjacent to permanent or seasonal wetlands. The private site is in a limestone quarry and is well controlled. The dump-burn-push

aside method is practiced at most of these sites. Problems described above are applicable to many of the Long Island sites.

#### 6. Andros

- 2.15 Ten existing sites serving the main settlements are found on Andros. The typical mode of solid waste disposal on Andros is the dump, burn and sporadically push aside the burned material to make room for more refuse. Indiscriminate dumping along roadsides is common. Andros is a major water supply area and many of the dump sites are in or adjacent to water-well supply fields and low-lying, marshy areas subject to flooding. Almost all sites are unregulated, have debris spread over wide areas and are contaminating water supply areas.

#### 7. Eleuthera

- 2.16 Eleuthera, a major tourist and winter resident island, is very long and its population is spread out in small, distant settlements. Harbour Island, Spanish Wells and Governor's Harbour are the main settlements, each with dump sites; eight other formal dump sites are located near smaller settlements. The dump-burn-push aside method is employed at these sites. The Harbour Island site is in the middle of town causing unsightly and unhealthy conditions for residents. The site for Governor's Harbour is on a small strip of land between the airport and the sea, with smoke and birds - a problem for aircraft, and contamination to the marine environment. Other sites are near highways, in depression and in marshes affecting water supply and marine habitats.

#### 8. Abaco

- 2.17 Because of long distances between settlements, most settlements on Abaco have their own dump sites. Ten sites for the main settlements are operating. Dumps on Abaco are better maintained than on most islands, but the locations are poor - mainly in low-lying areas and in existing or planned water supply fields, and indiscriminate dumping is still a problem. Steps have been recently taken to improve refuse treatment in many settlements, but some sites should be closed and better management is needed in most sites. Considerable indiscriminate dumping is found throughout undeveloped areas of the island.

#### 9. Grand Bahama

- 2.18 Grand Bahama Island has seven sites, the largest at Freeport. Freeport has many industries, an international airport and numerous tourism facilities, and consequently a large annual solid waste generation - Freeport's solid waste management problems will not be addressed in the IDB program, because the Grand Bahamas Port Authority will provide solutions. Although somewhat advanced in waste management, some sites on Grand Bahamas are in water supply fields, wetlands and close to the sea. Dumping, burning, and

pushing aside to make room for more refuse is the dominant management strategy. Litter and debris along roadsides is common.

10. Cat Island

- 2.19 One existing dump site is in the north near Orange Creek, north of Arthur Town and the other in the south near Old Bight. The site at Old Bight is close to the water's edge. The dump-burn-push aside waste treatment method is used. Litter is not much of a problem because of the low population on Cat Island.

D. Institutional and regulatory framework

- 2.20 The Environmental Health Services Act of 1987 and the Health Rules provide the regulatory framework for solid waste management in the Bahamas and establish overall responsibility in the Ministry of Health. The Department of Environmental Health Services (DEHS), formerly a part of the Ministry of Health and Environment and currently located in the Ministry of Consumer Welfare and Aviation, assists in carrying out the requirements of the Act. DEHS is responsible for collection and disposal of solid waste in New Providence, and the Grand Bahamas Port Authority responsible for the collection and disposal of solid waste in Report and the central area of Grand Bahamas. In the Family Islands, the responsibility lies with the Local Governments, with DEHS an advisor and the Local Board of Works responsible for waste collection and disposal. DEHS's responsibilities also include implementing general health measures, as well as protective measures against pollution, environmental monitoring, training, information dissemination, research, personnel training in environmental health and execution, and management of environmental programs. The Act is currently under review, for amendment, to reflect DEHS's change of Ministry.
- 2.21 The Environmental Health Service Act promotes environmental protection in order to ensure human health. The Act has regulations related to emissions of contaminants to the air, water and soil, and provides for establishment of authorized dumps but makes no provision for their design, siting and operation. Collection and transportation of solid waste is generally covered and provisions prohibiting littering are included. However, there is little evidence that the litter provisions are enforced. The Government has proposed amendments to the Act to more clearly specify environmental protection standards and the development of regulations under the Act. The Draft Environmental Health Regulations (Collection and Disposal) have been sent to the Attorney General and are expected to be sent to Parliament for approval in 1998.
- 2.22 Other legislation relevant to solid waste management include the Local Government Act of 1966 and the Water and Sewer Corporation Act. The latter places water resources use under the control of the government and creates an authority to oversee water management

and protection. The Water Supplies (Out Islands) Act regulates water management in the Family Islands.

E. Current government activities

- 2.23 In the past year the Government has made advances in solid waste management. Along with proposing new regulations and amendments to the existing Act, progress has been made in the management of the Harrold Road land fill by providing better and more regular cover material which has reduced fires and odor, improved the financial management system in DEHS and purchased new collection vehicles. It has also constructed new modified landfills in Bimini and North Eleuthra, is developing recycling agreement with a private firm for the disposal of derelict vehicles, and has developed environmental education curriculum and presented workshops in domestic recycling, composting and litter control.

III. THE PROJECT

A. Purpose

- 3.1 The objective of the project is to support the Government of Bahamas' (GOBH) efforts to improve the solid waste management services for New Providence and the Family Islands. The improved systems will aim to be efficient, financially sustainable, and protect the environment and public health in the Commonwealth of The Bahamas.

B. Project description

- 3.2 The project will consist of the following components: (i) priority investments for disposal facilities at New Providence and for ten of the Family Islands: Abaco, Andros, Bimini, Cat Island, Eleuthera, Great Exuma, Grand Bahama, Inagua, Long Island and San Salvador; (ii) hazardous waste disposal; (iii) Institutional support of DEHS and studies; and (iv) an environmental health education and awareness programme.

1. Investments for disposal facilities

a. Disposal facilities on New Providence

- (i) Harrold Road landfill (US\$7.2 million)

- 3.3 A bio-reactive sanitary landfill consisting of 5 cells, each with an expected life span of approximately four years each will be constructed adjacent north of the existing landfill on approximately 135 acre tract. Approximately 4.5 million tons of refuse will be deposited over the 20-year design period, for a total landfill volume of 7.9 million cubic yards, including cover material. A liner system to prevent leachate contamination of the groundwater will be a 60 mil HDPE geomembrane liner with a double



layer installed under leachate collection trenches. The leachate collection system will drain by gravity to a sump located on the east side of the landfill. The leachate will be recirculated direct to the working face of the landfill. A 100 ft. wide strip between the buffer zone and the landfill cells will accommodate perimeter drainage, access and cover material stockpiling.

- 3.4 The main works will include the access road, an office building, a weigh scale, workshop building, perimeter fencing, groundwater monitoring wells. In addition, construction of the first two cells will include excavation of 950,000 yd<sup>3</sup> of material, base layer underliner, geomembrane liner of 448,000 yd<sup>2</sup>, sand leachate collection layer and leachate collection piping.

(ii) Yard waste shredding facility

- 3.5 A yard waste shredding facility will be constructed and operated by a private firm at the Harrold Road site. The facility will require 2.5 acres and will include a receiving, processing and storage area of approximately 2,000 yd<sup>2</sup>. A Vermeer Shredder and a wheeled loader will be purchased. The capital cost is estimated at US\$446,000. The shredder will provide additional cover material, low cost, high quality feedstock for other composting programmes, and landfill airspace savings of up to 10%.

b. Disposal facilities on the Family Islands  
(US\$12.8 million)

- 3.6 A system of 18, modified sanitary landfills will be constructed on 10 Family Islands, due to the small amount of solid waste generated on these islands and the need to compact and cover only once or twice a week. The majority of the landfills will use the excavated trench mode, with cut material from successive trenches used for cover material. The cell/trenches will be typically 200-800 ft. Long, 25-50 ft. wide and 3-20 ft. Deep depending on the depth to the water table. The trench bottom and walls will be sealed with hot bituminous material (same material that is used for road surfacing). Leachate collecting piping will be installed in the bottom of the trench and leachate conveyed to bituminous-sealed recycling/evaporation ponds. Seven low cost transfer stations will be constructed for Abaco, Eleuthera and Long Island.
- 3.7 The main works at the modified sanitary landfills include site clearing, base excavation, access roads, storm waste collection systems, perimeter fencing, storage buildings, bituminous treatment, leachate collection system and disposal ponds, and installation of chippers at some sites.

c. Complementary project activities

- 3.8 With their own resources the GOBH is implementing a program for the closure of the existing dumps in New Providence and the Family Islands, as well as a derelict vehicle recovery program consisting

of a team to patrol the islands, monitor areas where vehicles are typically abandoned, and ensure processing and subsequent removal and exportation of the hulks. The removal would be contracted to local trucking companies to deliver the vehicles to licensed scrap auto dealers.

2. Hazardous waste disposal (US\$600,000)

- 3.9 The proposed hazardous waste storage facility will allow the hazardous materials to be identified and properly packaged for off shore disposal , as is currently undertaken. The facility will be capable of storing some 365 tons of materials. This storage capacity is sufficient to allow wastes to accumulate for about two years for the more abundant waste clasifications, prior to shipping a container load of any one classification. The design requirements and operating parameters provide for compliance with technical and environmental standards including hurricane proof design.
- 3.10 A hazardous waste storage facility for The Bahamas will be constructed adjacent to the Harrold Road landfill site. The facility will provide eight bays for storage of hazardous waste and one bay for the staging and processing of materials. The dimension of the storage bays will be 36 by 32 feet, 14 feet in height, in order to accommodate a maximum of 30, standard 52-inch barrel on HDPD pallets equipped with spill containment reservoirs. The wall and floor surfaces will be finished with a continuous impact resistant and acid resistant coating. The facility will be equipped with an above ground loading/unloading dock.
- 3.11 The main works will include a concrete slab, building structure, sumps and drains, monitoring system, laboratory equipment, fence and gates.
- 3.12 On the Family Islands, simple holding facilities will be constructed, one at each landfill site, using prefabricated "poly-Safety Pack-Plus" equipment, within small shelters in fenced sites.

3. Institutional support for DEHS and studies (US\$800,000)

a. Institutional support for DEHS

- 3.13 DEHS will receive supervisory and financial management assistance. The activities will include: technical assistance in design and assessment of refuse collection routing, supervision of sanitary landfills, engineering designs and contract documents preparation, inspection, and enforcement of licenses and permits. Also, training in technical and operational aspects of solid waste management will be provided to inspectors, professionals and managers. The technical assistance will be provide by international consultants and will include formal and short courses in solid waste management, as well as participation of individuals

in on-the-job training for periods up to 3 months with reputable solid waste management operators.

b. Studies

- 3.14 An in-depth study will be contracted to optimize the micro-routing structure, schedules and containment procedures in order to improve the collection and containment of refuse on New Providence. The goals will be to maximize the efficiency of refuse collection, to separate the material for yard waste shredding and composting purposes, to provide a weekly minimum collection to every household and to facilitate the separation of recyclables at the source. DEHS will implement the recommendations to optimize the collection routes of the residential areas with its own resources following the findings of the study.
- 3.15 A study will be contracted to follow up the financial mechanisms implemented to recover both capital and operating cost for collection and final disposal of solid waste from residential, commercial and industrial sources.

4. Environmental health education and awareness

- 3.16. This component is aimed to educate, inform and increase the awareness of the general public in waste generation, storage and containerization, collection schedule and procedures, litter, illegal dumping, bulky waste handling, backyard composting, waste materials exchange and derelict vehicles. The activities to be carried out include: (i) public education through media campaigns, printed material and seminars; (ii) technical assistance at the community level for backyard composting; (iii) community clean-up programs; and (iv) school environmental contests and presentations.
- 3.17 Activities within the community will include warning signs, optional depositories such as permanent and temporary litter barrels in public spaces or skips at dump sites, and drop-off depots for recyclables. Increased enforcement of the existing litter law will deter would-be dumpers.

c. Cost and financing

- 3.18 The cost have been based upon final construction designs and operational manuals for the Harrold Road landfill, a conceptual design for the hazardous waste storage facility and prototype designs for the smaller modified sanitary landfills at the Family Islands presented by the international engineering firm contracted with resources of the PPF. The cost of the studies, environmental health education and institutional strengthening were determined through the feasibility studies.
- 3.19 The total cost of the project is estimated at US\$32.5 million equivalent, of which the bank will finance up to US\$27.8 million equivalent, or 70% of the total project cost from the Ordinary

Capital Resources. In addition to the Bank financing, the GOBH would finance the local counterpart of US\$9.7 million equivalent.

D. Project execution

- 3.20 In addition to the establishment and proper function of the Project Executing Unit (PEU) within the structure of DEHS, some institutional adjustments will be implemented to effectively manage the solid waste activities in the Bahamas. DEHS will maintain the overall responsibility for the program, its regulatory and supervisory functions will be strengthened. In order to separate the operational responsibilities, a larger participation of the private sector in the collection and disposal will take place. DEHS will continue providing collection services to residential costumers under an action plan to phase out the provision of these services, which will be gradually transferred to private operators.
- 3.21 In order to avoid eventual problems if a monopolistic system of private operators develops, strict regulations will be establish to promote competition. The disposal facility at New Providence will be contracted with an operator that does not provide collection services. Under this scenario, the DEHS would still be responsible for planning and assessing refuse collection routing, as well as taking a leading role in the administration and monitoring of the refuse collection and refuse disposal contracts to ensure compliance with Government regulations, standards and established levels of service, and compliance with the terms, conditions and specification of the contracts.
- 3.22 The recommended organizational realignment and structure of DEHS will include all operational aspects will be under the responsibility of a Deputy Director, mainly Refuse Collection and Disposal as well as Roads and Parks, as two different Divisions. The regulatory and inspectorate role will be under a different Permanent Secretary with three Divisions Health Inspectorate, Technical Support and Administrative Support. The Health Inspectorate will provide support to the Local Boards at the Family Islands.
- 3.23 If the GOBH intends to play an important role in the provision of the collection and disposal services in New Providence, a completely new institutional structure is recommended, including the establishment of a new Waste Management Corporation (WMC) run by a Board of Directors and a Chairman appointed by the Government. A proposal for the creation of the new WMC has been presented as an alternative institutional structure as part of the Stanley consultants' report.
- 3.24 DEHS will be responsible for the initial development of the Family Islands waste disposal and transfer facilities. This will include the supervision of the contracts for the construction of the facilities. Upon completion of the works, ownership of the facilities will be vested with the respective local government

District Councils. The DEHS Health Inspectors will monitor and enforce environmental health and solid waste management operations in the Family Islands.

- 3.25 Construction of the disposal facilities at Bimini and North Eleuthera were contracted in June 1997, completed in December 1997, and the sites are in operation. The international consulting firm contracted to assess the feasibility of the program supervised the construction of the landfills and transfer station. The construction of the remaining works, i.e. the New Providence landfill and related works, the solid waste facilities in the other Family Islands, and the hazardous waste treatment and storage facilities, will be contracted following Bank procedures.
- 3.26 At the Family Islands the private sector will continue operating the disposal facilities through management contracts. Local contractors will be selected through a competitive process for the operation and maintenance of the new disposal facilities. The project team has reviewed and approved with the tender documents to carry out the local competitive process.
- 3.27 In order to operate the new landfill for New Providence with the highest standards and accessing to private capitals, a qualified operator will be selected through international bidding for the operation and maintenance of the Harrold Road sanitary landfill and related facilities. The private operator will own the mobile assets, while DEHS will control the overall quality of the system, collect revenues and retain ownership of all fixed assets.
- 3.28 The operator will be paid with a fee per ton, to achieve efficiency, a penalty/bonus system will be incorporated into the private operator contract. The incentive will maximizing compact waste density (CWD) and conserving the capacity of the landfills. A penalty amount for falling short of the target CWD (750 kg/m<sup>3</sup> in the sanitary landfill, and a bonus for exceeding the target CWD. DEHS will also monitor the compliance with environmental standards as will be specified in the operational manuals.
- 3.29 Consulting firms will be contracted to execute the environmental health education and public awareness activities, as well as the studies under the institutional strengthening component, under the supervision of DHES. For the study of cost recovery mechanism, the GOBH will submit, for the Bank's consideration, an action plan based on the results of that study.
- 3.30 The execution of the institutional strengthening activities will be phased to ensure that DEHS is adequately prepared to supervise and monitor the disposal operations once they begin. The DEHS will submit, to the Bank, a final revised program for environmental education, waste reduction activities, and a final detailed list of the institutional strengthening activities as a condition prior to loan approval.

- 3.31 In order to improve the collection system and to achieve success in implementing the collection beat design an improved collection plan will be implemented by DEHS. The new plan will include: (i) standardization of existing waste containers; (ii) collection only from the curb; (iii) full loading of collection vehicles before traveling to the landfill; (iv) upgrading of collection equipment and; (v) incentives to attain higher productivity.
- 3.32 Residential collection services will be contracted with private operators to cover neighborhoods, where existing DEHS standard equipment is not ideal for servicing the narrow streets in much of these areas. Contract documents have been prepared and are satisfactory to the Bank.
- 3.33 In order to obtain the quality of service required, improve efficiency levels and to achieve the financial sustainability of the proposed system, the government will assume the following series of commitments to be established in the contract as a conditions prior to the first disbursement:
- a. Evidence of the approval of a combination of tipping fees and an environmental levy to defray the cost of the disposal of imported goods to achieve the cost recovery of the operation, maintenance and depreciation expenses of the new disposal facilities.
  - b. Evidence that DEHS will cease the activities of commercial collection and will privatize the residential collection beginning with an initial private sector cover of at least 25% of the residential collection.

#### IV. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT RESULTS

##### A. Environmental setting

##### 1. Geological and physical characteristics

- 4.1 The surface geology of the Bahamas is formed from Pleistocene and more recent deposits, basically reef limestone and its weathered products. Karstic features, created during Pleistocene sea level fluctuations provide caves and blue holes, remnants of cave systems. The topography of the islands is subdued, with low relief which seldom exceeds 30 ft. above sea level is the norm. Dune ridges of greater than 100 ft. are found on some islands, notably New Providence. Ponds and lakes form between dunal ridges.
- 4.2 The climate of the Bahamas is sub-tropical with high temperatures and moderate rainfall. Mean monthly temperatures range from a high of 82F and a low of 64F. The average annual rainfall varies from 40 to 55 in., with the northerly islands receiving more rain, with 75% of the rain falling between May and October. New Providence Island has a mean annual precipitation from 36 to 73 in. The

prevailing winds from May to September are east to southeast and the rest of the year from north to northeast. The Islands are strongly influenced by winter frontal activity coming off the North American continent. Hurricanes pass intermittently through the Bahamas, the last occurring in 1992.

## 2. Water resources

- 4.3 The highly-porous limestone reef structures, combined with karst features, support a perched freshwater lens system. These lenses, the water of which is interspersed throughout the matrix of the porous limestone, "float" on the underlying salt water in an undisturbed situation and may extend to as deep as 38 ft. below sea level. The lenses are used for groundwater supply, and are exploited through wells and trenches. Salt water intrusion, usually from over-withdrawal, is a problem on some islands. Injection of liquid waste into the salt water zone, 190 to 620 ft. deep, is acceptable practice in The Bahamas. Ponds and lakes are found in depression on many islands, particularly Andros and New Providence, and are fed by rainwater and minor surface runoff. They are usually brackish as a result of evaporation.

## 3. Ecosystems, flora and fauna

- 4.4 The major terrestrial ecosystems of the Bahamas are hardwood forests, Caribbean pine forests found on Andros, New Providence, Grand Bahama and Abaco, scrub or ruinate, fresh water marshes, ponds and lakes, mangroves, caves, dunes, agricultural lands and urban and rural gardens. The marine ecosystems consist of grass beds, coral reefs and the near shore waters and shallow banks. Most of the hardwood forests have been cut for housing and commercial development. Along with the hardwood forests, marshes and mangroves (about 575,000 acres) constitute important habitats for numerous plant and animal species.
- 4.5 There are some 1,371 species of plant found throughout the archipelago, only 9% of which are endemic. Proximity to the North American mainland and Cuba accounts for the low endemism. The Bahamas has 1,001 species of flowering plants and 45 species of ferns and fern-like plants. A 1995 list shows 21 species of rare plant in the Bahamas, two of which are found on New Providence.
- 4.6 Very few species of mammals inhabit the Bahamas and the same species are not found on all islands. Rats and mice are common and are found on nearly every island. Ingraham's hutia - large rodent and endangered, the Bahamian racoon, 12 species of bats - all endangered, feral pigs, goats, donkeys, horses, cows and dogs are found on different islands. Thirty one species of reptiles and amphibians, many of which are rare or endangered, and an abundance of birds - residents and many migrants, inhabit the islands. The endangered Bahamas parrot, once found throughout the country, is now only found in limited numbers on Abaco and Inagua Island.

Seven other bird species are considered rare and/or endangered. Four species of land crabs are found on Andros.

- 4.7 Approximately 10% of the land of the Bahamas has agricultural potential, and of this only 12% is being used for farming. The highest potential for agriculture is found on Abaco, Andros and Grand Bahamas. A strong forest industry occurred in the first part of the 20th century when the pine islands were heavily logged. Pine forests now used mainly as wildlife habitat now.

B. Environmental setting at the Harrold Road landfill site

1. Physical environment

- 4.8 The propose site for the new landfill is located directly north of the existing Harrold Road site. The proposed site, about 100 acres, includes the landfill about 75 acres, and an area south for use as a site for composting yard waste. The site is underlain by soft coralline limestone which is karstic and porous. There is no superficial water or drainage features. The soils are organic and thin, and the site is covered with large Caribbean pine and a small portion of mixed hardwoods with pine.
- 4.9 Test wells in and around the site revealed that the water table was from 0.5 to 6 ft. below the surface, with tidal influence of up to 1.5 ft. even though the site is 2 miles from the sea. Even though the existing landfill has been operating for 25 years, well water sampling indicates that there are no leachate contaminants in the shallow freshwater, but a plume of leachate is present in the deeper saltwater zone beneath the existing landfill has spread slightly to the south and possibly west.
- 4.10 Surveys of plants in the pine and mixed hardwoods with pine forests did not reveal any of the two rare plants listed for New Providence because of habitat unsuitability. Wetlands of interest near the site are Harrold Pond, 0.5 mi east and Wilson Pond, immediately adjacent and west of the site. Harrold Pond has fringing marsh around its periphery and supports a variety of waterfowl and other birds. Both Harrold and Wilson Ponds are recognized by the Society of Caribbean Ornithology as important habitat for migratory and avian species and have a potential for ecotourism. The society suggests that a buffer zone be established around them for protection.

C. General social-cultural setting

- 4.11 Tourism is the major business of the Bahamas, bringing approximately 3 million visitors each year, with about 52% coming from cruise ships. Most of these visitors are accommodated in New Providence and Grand Bahamas. Sixty percent of the GDP is derived from tourism. The market caters primarily to Americans with package tours of 3-7 nights. This business is dependent to some extent on a pleasant and clean environment. Banking services,



government service, agriculture and fishing are the other major economic activities.

- 4.12 New Providence and Nassau has a population of about 172,000 people, nearly two thirds of the population of the country. Grand Bahama Island has a population of about 40,000 and the remainder of the population is distributed to the other 20 or so inhabited Family Islands. The smaller islands have had a net population decrease as young inhabitants migrate to New Providence particularly to find employment.
- 4.13 The cultural aspects of the Bahamas is displayed in the old homes, excellent food focused around the sea, pleasant people with strong family and religious ties, festivals, and pride in country. Protection of the cultural heritage is important and exercised and environmental protection for critical and sensitive ecosystems is exhibited by the declaration of 12 National Parks of approximately 32,000 acres. Some seven other sensitive areas on New Providence are identified by the Bahamas National Trust as in need of protection.
- 4.14 Local attitude toward waste management is subdued. There have been no major campaigns for waste reduction, recycling, etc., and the population is not aware or focused on litter, illicit dumping or waste management in general. Anti-litter or dumping regulation are generally not enforced; dumping along roadsides is common. However, with a greater focus on niche tourism, particularly ecotourism, there is increasing recognition that a clean and unpolluted environment is important. A few environmental education programs are being conducted by environmental NGOs to raise public awareness about these issues.

D. Social-cultural setting in the New Providence landfill site

- 4.15 The existing dump site is zoned Institutional Public, a designation for intended Solid Waste Management (SWM) facilities siting. The proposed site is designate Industrial which will also accommodate a SWM facility. Within one mile of the existing and proposed sites are found a large chicken production facility and the Bahamas Youth Camp on the west, single, duplex and multi-family housing to the southwest and south, single family housing to the southeast, open lands zoned for single family housing septage ponds and Lake Harrold to the east, and pine forest and scrub land to the north. Small businesses, banks, shops, small industry, are interspersed between housing developments. Agriculture activities include the Gladston Farms chicken operation, Diamond Farm, a large, multi-species livestock operation, and a 14- acre private banana farm.
- 4.16 Approximately 4,700, middle-income people live in this area, proximal to the site. The population is expected to increase rapidly through expansion of existing government supported housing developments and private schemes. Complaints of odor and smoke

from the existing facility have mainly come from people to the southeast, downwind from the normally prevailing winds.

E. Environmental and social evaluation

- 4.17 Environmental and social issues and the environmental feasibility of the project have been considered through the original scoping for the site at Harrold Road, in the overall waste management program and as part of the selection process for the modified landfills on the Family Islands. The Phase I pre-feasibility activity produced an Initial Environmental Evaluation, a scoping exercise, in June 1996. An in-depth Environmental Impact Assessment was completed as part of the Phase II feasibility studies in December 1997 and included social-cultural issues was conducted for the Harrold Road site as part of the planning process for the site. Results of the EIA have been used to design the Harrold Road facility and to develop avoidance and mitigatory measures for negative impacts, construction and operation of the landfill. Operational guidelines are being prepared for the land fill, hazardous waste handling and storage, and the modified sanitary landfills on the Family Islands.
- 4.18 Consultations have been carried out with government officials in DEHS, Forestry, Education, Agriculture, Public Works and The Bahamas Environmental, Science and Technology Commission; with NGOs - The Bahamas National Trust and The Bahamas National Pride Association; and with people living in the area of the landfills and dumps. A public hearing on the landfill was conducted by DEHS in Nassau on March 23, 1998.
- 4.19 For the Family Islands consultations were taken with the representatives of the local governments and the selection of each disposal site has been agreed with Local Boards.

F. Beneficial impacts

- 4.20 The environmental aspects of this project are positive because benefits are derived from the totality of the program's components, namely improved final waste disposal for New Providence as a high technology, sanitary landfill, modified landfills in the Family Islands, improved collection, reduction of illicit dumping, initiation of hazardous waste handling and storage program, improved institutional ability to manage, regulate and monitor the solid waste sector, initiation of derelict vehicle recycling, educational programs to assist in raising consciousness of the population in anti-littering, composting and recycling.
1. Improved landfill design and management
- 4.21 The new landfill at Harrold Road on New Providence will be a state-of-the-art landfill incorporating a liner to prevent leachate penetration into the subsoil and water table, a leachate collection system to recycle and treat the effluent; and a venting system for

landfill gas. The management of the landfill will assure that waste is deposited in designated cells with a small active operating face, material compacted and appropriate cover material added daily to prevent fire, odor limited and vermin and pests dissuaded. The dump-like conditions that exist now will be terminated. Scavengers will be controlled through fencing and policing.

- 4.22 The modified land fill sites on the Family Island are appropriate technology for the existing situation there, i.e., the least cost and the best solution for the amount of garbage generated on these islands. Litter and indiscriminate dumping will be reduced as a result of this solution.

## 2. Improved collection

- 4.23 An improved collection system for New Providence with more and newer trucks and containers, improved routing and training of collectors will reduce litter problems and improve waste delivery. Yard waste will be collected separately and delivered to the shredding and composting facility at Harrold Road. Bulky waste, i.e. appliances, furniture, vehicles will be collected on request and deposited at a separate facility. The collection system on the Family Islands will also improve with the new interest and cooperation of Local Boards in solid waste management in their respective districts and communities.

## 3. Transfer facilities

- 4.24 Transfer stations will be installed on three of the Family Islands to improve collection and disposal where long distances from the landfill occur. These facilities will include garbage compactors and large, roll-on containers which are then transported to the landfill, in one case by boat. No transfer stations are needed on New Providence because of the relatively short distances to the centrally located landfill.

## 4. Composting facility

- 4.25 The composting facility, shredder and composting yard, at the Harrold Road landfill will reduce the amount of waste to be land-filled and will provide cover material for the landfill, mulch and finished compost for use as a soil amendment.

## 5. Reduction in illicit dumping

- 4.26 Bulky waste, which is frequently dumped along roadside, will be collected and deposited in a separate area from the landfill so that it will not take up space in the landfill. This will be assisted by stronger enforcement of the regulation of the Environmental Health Services Act.

6. Institutional strengthening

- 4.27 Strengthening of the Department of Environmental Health Services will include training in management and supervision of: collection, disposal, landfill management, measures aimed to improve regulatory, administrative and monitoring capability of the agency. Changes to the Environmental Health Services Act and development of new regulation have been initiated and will be implemented under the program.

7. Environmental education

- 4.28 A program for waste reduction, recycling, composting and litter control has already been initiated during the feasibility studies by the consultants and previously by the DEHS and environmental NGOs. This program will continue with introduction of these aspects into school curricula and through participation of and cooperation with environmental NGOs in New Providence and the Family Islands.

8. Social benefits

- 4.29 The major social benefit will be an increase in general cleanliness of the country which will provide a more pleasant and healthier environment for residents and visitors. The closing of the existing landfill at Harrold Road will reduce odor and smoke to the residents downwind from the site and control vermin and pests problems. Reduction of road-side waste and elimination of dumps in towns and near airports and wetlands will have a broad social benefit for Family Island residents and visitors.

G. Actual and potential negative impacts

1. Landfill at Harrold Road

- 4.30 The actual and potential negative impacts will be minor to moderate and most environmental and social impacts will be avoided and/or diminished if the protection program for construction and operational phases is followed.

a. Terrestrial ecosystems

- 4.31 The Landfill at Harrold Road will take a 75 acre natural Caribbean pine stand with some mixed scrub, secondary vegetation. This is an unavoidable loss from the project, but is not a significant loss because the extensive pine stands on New Providence Island.

b. Aesthetics

- 4.32 The amount of adverse visual impact of the new landfill will be minimal because of the natural pine barrier on three sides and the existing dump on the south. The old site will be covered and planted, and a barrier of trees planted to compliment those that

are already growing naturally on the site, will provide a visual barrier on the south. The setback of the landfill of 1500 ft from the nearest institution/habitation will provide an adequate barrier.

c. Ground water quality

4.33 All landfills produce leachate, the liquid formed when rain percolates through or ground water intrudes into the interior of the landfill, making contact with the waste material and leaching contaminants from the material. Because the ground water so close to the surface at the site, even though tests in and around the present site does not indicate significant quantities of leachate in the surrounding ground water, a synthetic liner will be installed with a leachate collection system to control this effluent.

4.34 The leachate containment system proposed is a compacted base over which a synthetic liner will be laid. A collection system of pipes will be placed on the liner to collect the material to a sump, where in the early years of the landfill the small amount of leachate produced will be pumped on to the active surface of the landfill. In later years when production increases, the leachate will be pumped to adjacent septage lagoons to the east and will be treated along with the septage.

d. Landfill gas

4.35 Gas, primarily methane, is produced through the microbial decomposition of the organic waste in the landfill. Landfill fires can occur if the gas is not vented properly and prevented from building up in pockets under the surface of the compacted waste. A venting system is planned for the landfill.

e. Odor, air quality and noise

4.36 Odor from landfills result from garbage decomposition and the lack of daily cover over the active face of garbage. If sufficient cover material is not applied regularly, then odor will inevitably be a problem, particularly to downwind residents. Because of the number of residences that currently exist and the rate at which new houses are being built in the area. Proper cover and maintenance will prevent odor problems.

4.37 Another potential air quality problem could result from dust generated by machinery operating on the site and from vehicles bringing waste for disposal. Limitation of access to the site will allow for dust control through wetting road surfaces. Noise from bulldozers, trucks and from the yard waste shredding plant will be a problem. The barrier of trees around the site will help dampen the noise level. Ear protection will be worn by operators at the shredding plant.

2. Landfill sites on the Family Islands

a. Terrestrial ecosystems

- 4.38 There will be a loss of mainly secondary growth forest ecosystems from 3 to 7 acres for each of the Family Island modified landfill sites.

b. Aesthetics

- 4.39 The landfills will not present a visual problem because they are located in isolated areas, are primarily below ground and are usually surrounded by trees.

c. Ground water contamination

- 4.40 The landfills are trenches in the limestone that will have a compacted base with two layers of hot bituminous sealer sprayed on the sides and on the bottom. The bottom will have a collecting pipe to gather the leachate. The leachate will be gravity fed or pumped to an evaporation/recycling pond.

d. Transfer stations

- 4.41 The transfer stations are potentially the source of odor, can contaminate water and can be unsightly if not properly operated. The stations will have closed containers and garbage compactors and will be fenced to prevent improper dumping.

e. Odor and air quality

- 4.42 Although isolated from population centers, the landfill sites could have odor problems if cover is not applied weekly. The light use of the facilities is not expected to result in dust problems.

3. Hazardous waste handling and storage

- 4.43 Although there is little seriously toxic or hazardous waste produced in The Bahamas, care must be taken within handling and storing. This waste will be transported to a central storage area at the Harrold Road landfill. Leakage of liquid waste from storage containers or exposure of people collecting the material or working with it at the landfill could be potential health hazardous. Training in hazardous waste handling and storage will be conducted and the storage facilities will have approved containers and pallets and will be fenced.

## V. ALTERNATIVES TO THE PROPOSED ACTION

### A. Program Alternatives

#### 1. No-action

- 5.1 The no-action, or no-build alternative was considered and rejected. Allowing the status quo to continue would result in further degradation of containment and collection, continued environmental problems at the existing New Providence landfill-odor, fires, smoke, leachate escape, etc., and increase in illegal dumping of garbage, bulky and hazardous waste and littering with the associated negative social, environmental and political ramifications.

#### 2. Incineration

- 5.2 Incineration of all or part of the waste stream by government or private entities was considered by the consultants and the GOBH. The option was rejected because of the high cost and realization that incineration is only a solution for final disposal, that a land fill would still be needed and a broader solid waste management program is essential.

### B. Alternative landfill siting

- 5.3 Alternative sites on New Providence were evaluated during the pre-feasibility studies for their environmental and technical suitability. It was judged that the site adjacent to the existing landfill was most suitable because of its central location, relatively minor environmental problems, buffer from surrounding habitations, proximity to cover material, appropriate zoning and availability.
- 5.4 Selection of sites on the Family Islands was aided by a check list of technical, environmental and social factors with ground water contamination considerations judged as a critical factor. The sites selected minimize groundwater contamination, maximize isolation from view and consider transport distances and convenience. The resulting selections are the best possible alternatives given availability of land and environmental considerations.

## VI. ENVIRONMENTAL PROTECTION STRATEGY

### A. Environmental mitigation measures

- 6.1 Preventive and mitigative measures have been developed in response to the potential negative impacts identified in the previous section. Some measures are associated with construction and others with operation of the facilities. Most impacts associated with construction will be moderate to minor, short-term and spatially

well defined. If good engineering and construction practices are employed, impacts will be non-significant, and the solutions will be relatively simple, easy to apply, cost effective and easily integrated into construction and operating schedules.

1. Landfill at Harrold Road

6.2 The landfill will be developed in stages and will require excavation of 950,000 yd<sup>3</sup> of marl and limestone and the cutting of about 75 acres of pine forest, mixed with palms and shrubby trees. This will create noise and dust. Noise cannot easily be controlled, but construction will be limited to regular daytime hours so as not to disturb nearby residents in the evening and night. If dust is a problem, watering of haul roads and stockpiled material will be undertaken. The felled pine trees will be used for lumber, and branches and small woody vegetation will be stockpiled for shredding when the yard waste shredder is installed.

6.3 An Operations Manual is being prepared that will include guidelines for controlling negative impacts and procedures for operating the landfill in an environmentally friendly manner. The manual will address solutions for treating the following issues.

a. Scavengers

6.4 Scavenging will not be permitted at the open phase of the sanitary landfill. Recycling will be contracted with private enterprenours. A perimeter fence will be constructed to enclose the site to control unwanted dogs, people and dumping. The scavenger issue, about 30 mostly illegal aliens, is being addressed in a study by PAHO, which is not yet available. Solutions to the problems will be incorporated in the Operations Manual.

b. Odor, noise, pest and litter control

6.5 Only a minimum amount of garbage will be exposed at any time and the garbage will be covered at the end of the day's operation. This will drastically reduce odor. The landfill will not operate at night, limiting operational noise from trucks and machinery to daytime hours, and the buffer zone of large pines will diminish the sound of landfill operations. Incoming vehicles will be covered with tarps or nets to avoid littering in route and at the landfill. Site maintenance will include retrieval of litter that has blown from the working face. The rat, cattle egret and fly problem will diminish through the compaction of garbage and daily covering of the waste.

c. Aesthetics

6.6 The landfill will be surrounded by natural and planted vegetation. The contouring and closure/capping of the existing landfill and planting the cap will enhance the visual appearance of the site. A 200 ft buffer of existing vegetation will be retained around all



sides of the site, and a 1500 ft setback from the edge of the landfill's active zone to the nearest institution-dwelling will be maintained.

d. Leachate control and groundwater protection

- 6.7 Leachate will be intercepted by a 60 mil thick, high density polyethylene, double liner, collected in pipes above the liner and piped to a concrete sump. The leachate initially will be re-circulated onto the garbage, and as production increases, the excess will be pumped to an existing septage lagoon system at the eastern perimetry of the landfill for treatment. The effluent will meet water quality and effluent discharge standards before being discharged into the surface water system or injected into deep, salt-water wells.

e. Landfill gas

- 6.8 Landfill gas will be vented to the atmosphere to prevent combustion in the landfill. When production reaches sufficient level it will be flared or could be used as a fuel for energy production.

f. Surface water and erosion control

- 6.9 During construction there may be runoff from the site during heavy rains. However, the site is fairly level, so erosion should only be a minor problem. Surface water runoff will be diverted around the perimeter of the site via water diversion channels, and runoff will be deflected away from active disposal areas. Stockpiled excavated and cover material will be protected from rainwater runoff erosion by silt barriers where needed. Sediment screens and sediment ponds would be used if needed.

g. Training

- 6.10 To assure that the landfill will operate in an environmentally sound manner, the staff will be trained and equipped to perform their functions. Training in fire control and prevention, operation of landfill equipment, application of cover material, compaction, leachate sampling and monitoring, landfill gas collection and monitoring, and groundwater sampling will be conducted.

2. Modified landfills on the Family Islands

- 6.11 A Construction and Operations Manual will be prepared for safe construction and operation of the modified landfills on the Family Islands. This will include environmentally safe construction practices, e.g. erosion protection, sediment control, and proper operation of the landfills, e.g. compaction, cover, pest control. Landfill operators will be trained in proper operation and maintenance.

B. Monitoring program

1. Harrold Road landfill

a. Leachate management and groundwater protection

- 6.12 Leachate from the sump will be sampled semi-annually and analyzed for standard leachate contaminants. The analyses will be conducted in the DEHS laboratory. A series of small-bore observation wells will be installed around the perimeter of the landfill for water quality sampling. Sampling and analysis will take place semi-annually, then at longer intervals when warranted, to determine if contaminants are escaping from the landfill. The same procedure will be done for the old landfill using existing wells.

b. Landfill gas

- 6.13 The presence or absence of landfill gas will be monitored quarterly for the first year of operation and thereafter semi-annually.

c. Odor, dust and litter

- 6.14 Levels of odor and dust downwind from the landfill will be assessed at least twice per week by the site staff and remedial measures taken when needed. Litter cleanup will be done daily.

2. Family Island landfills and transfer stations

- 6.15 The Local Boards will assess the operation of the Family Islands landfills quarterly and the DEHS Health Inspectors on the Family Islands will perform quarterly inspections. DEHS will inspect and sample the leachate ponds semi-annually.

3. Hazardous waste facilities

- 6.16 DEHS will inspect the hazardous waste facilities at the Harrold Road site and at the Family Island landfills quarterly to assure that materials are handled and stored properly.
- 6.17 IDB personnel will periodically inspect the Harrold Road and Family Island facilities.
- 6.18 DEHS will prepare a protocol for monitoring the effectiveness of the environmental protection program.

VII. RECOMMENDATIONS

- 7.1 We recommend that the Loan Committee include the following conditions in the loan for implementation by the Executing Agency:

A. Prior to loan approval

- 7.2 The Bank will approve the environmental aspects of the Operations Manuals for the landfills, yard waste shredding facility and the hazardous waste facilities.
- 7.3 The monitoring program for environmental protection and impact mitigation at the Harrold Road and Family Island landfills will be approved by the Bank.

B. Prior to signing contracts with construction firms

- 7.4 Environmental protection clauses will be included in the construction contracts for the Harrold Road and the Family Island facilities and will be reviewed and approved by the Bank.
- 7.5 The Executing Agency will present yearly reports to the Bank on the progress of implementation of the mitigation and monitoring plan for all facilities and operations at Harrold Road, the landfills and hazardous waste facilities on the Family Islands and the overall progress of the solid waste management program.

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