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National Water Commission
Jamaica

The Preparatory Survey
for
Kingston Sewerage Development Project

Main Report

February 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD

KRI INTERNATIONAL CORPORATION

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Location Map

JAMAICA

THE PREPARATORY SURVEY FOR KINGSTON SEWERAGE DEVELOPMENT PROJECT

FINAL REPORT

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CURRENCY RATE
1 USD = 88.9 JMD
1 JMD = 1.00 JPY (Monthly average rate in Oct, 2009)

Lists of Abbreviated Word & Technical Words

KSA	Kingston, Urban St. Andrew
NWC	National Water Commission
NEPA	National Environment & Planning Agency
NMCJ	National Meteorological Center of Jamaica
JRC	Jamaica Railway Corporation
WRA	Water Resource Agency of Jamaica
PMU	Project Management Unit
NCC	National Contract Committee
JMA	Jamaica Manufacturers Association
JICA	Japan International Cooperation Agency
SAPI	Special Assistance for Project Implementation
SENTAR study	Study on Kingston Harbour Environmental Project in 1993
KBR study	Study on Kingston Water and Sanitation Project in 2003
STP	Sewerage Treatment Plant
O&M	Operation and Maintenance
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
NRW	Non Revenue Water
OD	Oxidation Ditch method
CPI	Consumer Price Index
BOT	Built, Operation and Transfer
BTO	Build, Transfer and Operation
PDCA	Plan-Do-Check-Action
LCC	Life Cycle Cost

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CHAPTER 1 BACKGROUND AND OUTLINE OF THE SURVEY

1.1 Background of the Survey

Kingston is the capital city of Jamaica, located at latitude 17º 59' north and longitude 76º 48' west. The city of Kingston and urban St. Andrew form the metropolitan area normally called "KSA". KSA has an area of 155 km2 and contains 22% of the island-wide population of Jamaica. KSA is also the political and financial center of Jamaica. Governmental offices, embassies and international agencies are located in and around the New Kingston area. According to the 2001 Population Census, the total population of Jamaica was 2.6 million persons, and 580,000 inhabitants lived in KSA.

Portmore is the second largest urban area in the parish of St. Catherine, which neighbours KSA to the west. The population of Portmore was 156,000 under the Population Census 2001, 1.57 times the population in 1991. However, most of this population growth was due to the expansion of the Portmore administrative boundary. Nonetheless, Portmore has grown rapidly as a bedroom suburb of KSA. Numerous housing schemes have been implemented in Portmore almost all of which include principle infrastructure development. Target areas of the Preparatory Survey for Kingston Sewerage Development Project (hereinafter the Survey) straddles the said areas, KSA (Kingston, Urban St. Andrew) and Portmore.

Sewerage development started in downtown Kingston more than one hundred years ago. The sewage collection system for Kingston is segregated from an independent storm water drainage system. Currently there are eleven (11) and five (5) sewage treatment plants operated by Jamaica's National Water Commission (NWC) in and around the survey areas of KSA and Portmore, respectively. However, the operation and maintenance for those facilities has been inadequate for a prolonged period due to lack of budget and long term maintenance plan. As a result, almost all sewage treatment plants in KSA and Portmore perform poorly and do not meet the required treated effluent quality. Previous studies have determined that sewage is the most significant pollutant source to the Kingston Harbour. Table 1.1.1 shows the estimated contributing rate of the pollutant loading to Kingston Harbour, which are BOD, Fecal Coliform, Suspended Solid (SS) and nutrients of Nitrogen and Phosphorus.

Table 1.1.1 Pollutant Source of the Kingston Harbour

	Sewage	Industry	River/Channel	Groundwater
Fecal Coliform	100%	0%	0%	0%
SS	55-70%	23-30%	<20%	0%
BOD	29-50%	24-40%	～40%	0%
Nitric Acid Nitrogen	55-65%	0%	<20%	<30%
Phosphoric Acid	75-90%	0%	<20%	0%

Source) "Characterization of Sources of Organic Pollution to Kingston Harbour, the Extent of their Influence and some Rehabilitations"

For the water quality in a closed water body like a harbour, nutrients as represented by Nitrogen and Phosphorus can cause significant eutrophication in the water, leading to red tides or other phenomena degrading water quality, eventually causing serious loss of aquatic resources. Because of the above-mentioned situation, improvement of sewerage facilities and upgrading of sewage treatment quality are urgently required for the improvement of the environmental quality of Kingston Harbour.

The sewer connection rate in KSA is reported as 30% of the area-wide population. The other 70% of households mainly use "soakaways" although some households use septic tanks. A soakaway is a simple pit latrine which receives wastes from the home's internal drain system and allows the wastewaters to soak into the soil media at some depth below ground without treatment. Soakaways are a confirmed source of serious actual groundwater contamination.

Compared to KSA, sewage collection in Portmore is extensive and the sewerage connection rate is more than 95% based on surveys by NWC.

Since 1983, several integrated studies have been executed on the environmental improvement project for the Kingston Harbour including sewerage facilities development. In 1993, the study on Kingston Harbour Environmental Project (hereinafter SENTAR study) provided the master plan of the sewerage improvement plan for KSA and Portmore including development of the Soapberry STP. After the SENTAR study, the study on Kingston Water and Sanitation Project (hereinafter KBR study) was conducted in order to materialize implementation of the Soapberry STP by means of financial support of Inter-American Development Bank (hereinafter IDB) in 2003. The Soapberry STP development project is being developed by means of Build Own Operate and Transfer (BOOT) scheme which contributes to the cleanup and environmental sustainability of the Kinston Harbour and the Kingston and St. Andrew Area. Total project budget at USD 50.6 million was maintained with sharing among public and private sectors as shown in Table 1.1.2:

The Phase 1 project for development of the Soapberry STP was completed in 2007 and practical operation of the Soapberry STP was commenced in 2008. Management of the Soapberry STP is being executed by Wastewater Operation and Management Company by means of a 25-year Operation and Maintenance (O&M) contract with the Central Wastewater Treatment Company (CWTC), a special purpose company (SPC) formed by the project investors.

Table 1.1.2 Financial Source for the Soapberry STP Project

Source	Amount (million USD)	Share (%)
Public Sector		
Urban Development Corporation	4.8	9.5
National Housing Trust	4.8	9.5
National Water Commission	1.0	2.0
Private Sector Bank		
ASHTROM Building System	2.0	4.0
National Commercial Bank	38.0	75.0
Total	50.6	100.0

Source) Jamaica Information Service

The Soapberry STP has an advanced sewage treatment process in order to satisfy the upgraded effluent standard by NEPA. The ultimate total treatment capacity of the Soapberry STP is projected to be 225,000 m^3/day through a three-phase development plan. The Phase 1 Soapberry STP has a capacity of 82,000 m^3/day although the current inflow rate to the plant is only 30% of the design treatment capacity. The principal reason for the low inflow rate is the current lack of inflow from the Darling Pumping Station. A project is currently in the design phase for rehabilitation of the Darling PS.

1.2 Objective of the Survey

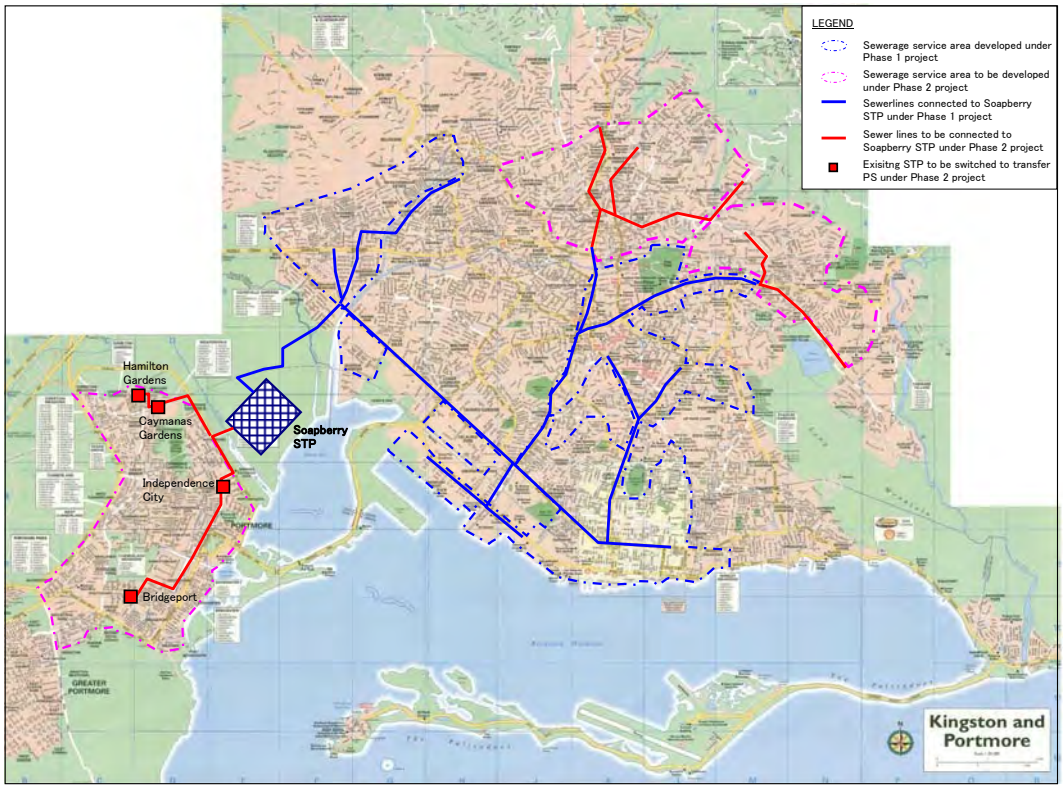
The National Water Commission (hereinafter NWC) approached the Japan International Cooperation Agency (hereinafter JICA) about the sewerage development project for KSA and Portmore by means of Japanese ODA loan scheme. The requested scope of the project is composed of the following schemes:

1) Expansion of the sewered area in northern KSA,
2) Decommission of current four sewage treatment plants in Portmore and conversion of those plants to transfer pumping stations to Soapberry STP,
3) Installation of sewer pipelines between the said transfer pumping stations and Soapberry STP including pipe bridge crossing the Rio Cobre River, and
4) Installation of back up generators to new transfer pumping stations in Portmore.

JICA decided to dispatch the project preparatory survey team to study the feasibility of the requested project for further financial arrangement. The contract for the Preparatory Survey for Kingston Sewerage Development Project was signed between JICA and the consortium of Nippon Koei and KRI International Corporation on July 15, 2009. The objectives of the survey are:

1) Facilitate project preparation through reviewing of sewerage development and management policies for KMA and making specific recommendation including preliminary design and project evaluation for the Soapberry Sewerage Project Phase II,
2) Examine the natural and social environmental consideration for the Soapberry Sewerage Project Phase II, and
3) Establish the project implementation plan, management plan, for sewerage works, Operation and Maintenance (O&M) plan for sewerage facilities and institutional strengthening plan for NWC.

Considering above said requirements, the survey area was originally proposed as shown in Figure 1.2.1. The blue shaded area shows the currently sewered areas defined as Phase 1. Sewage from this area is sent to the Soapberry STP. The area in red is the originally proposed sewered area for this preparatory survey, which was provided on the basis of the result of the JICA preliminary survey.

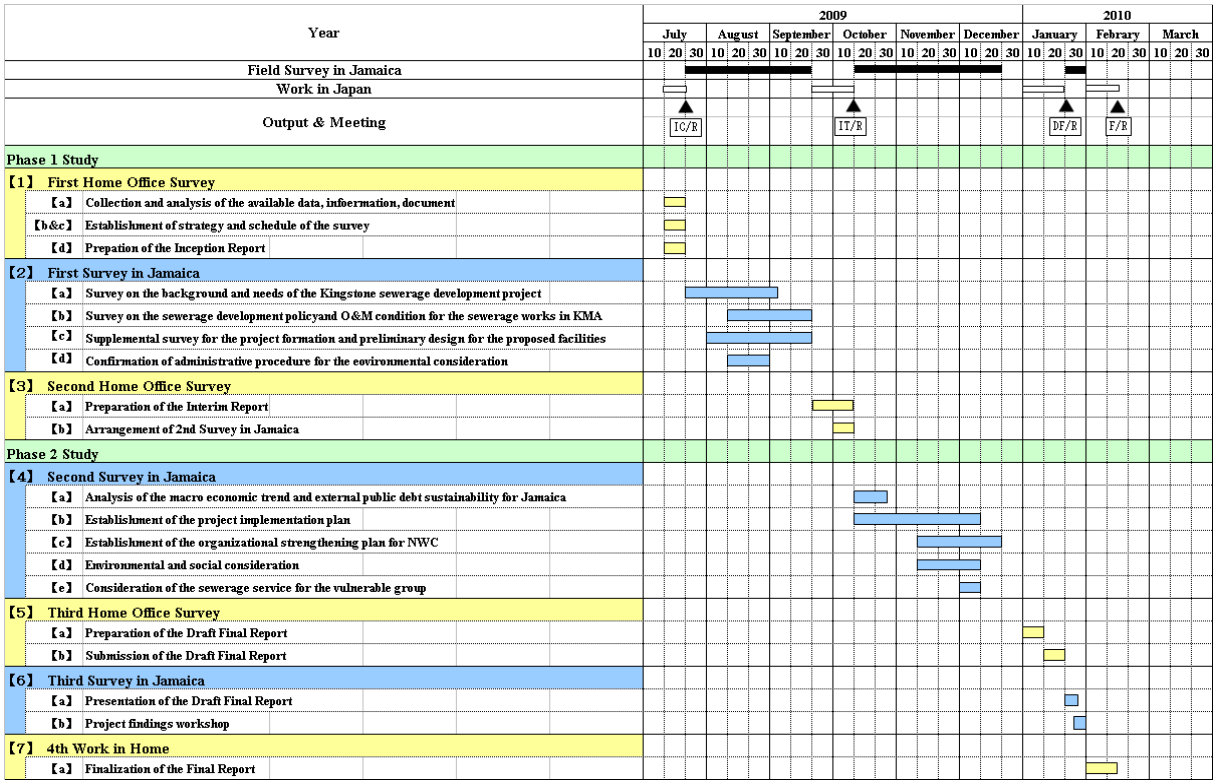


Source) JICA Survey Team

Figure 1.2.1 Original Proposed Survey Area

1.3 Outline of the Survey

Total duration of the survey is approximately eight months from July, 2009 through March, 2010. The survey work is divided into two phases; the first phase from July to October, 2009; the second phase from October 2009 to March 2010. After the first survey in Jamaica, an Interim Report was submitted during October 2009. This Final Report is prepared in February 2010 based on the results and findings obtained during the first and second surveys in Jamaica, and discussions with JICA and NWC regarding the results presented in the Draft Final Report in January 2010. The contents of the Draft Final Report were explained to JICA during a meeting in Tokyo on January 15, 2010, and to the Jamaican side at a workshop held in Kingston on January 26, 2010. The overall schedule and tasks of the Survey are shown in Figure 1.3.1.



Source) JICA Survey Team

Figure 1.3.1 Overall Schedule of the Survey

Throughout the survey period, several supplemental surveys have been conducted, as shown in Table 1.3.1.

Table 1.3.1 Supplemental Surveys

Survey	Period	Scope of Work
1. Inventory Survey	One month during the First Phase	Existing STP, Pump station, sewer line in KSA and Portmore
2. Topographic Survey	One month during the First Phase	Route survey in 1.8 km along trunk sewers in Portmore and Spot Elevation survey at 267 points in KSA
3. Geo-technical Survey	One month during the First Phase	Drilling survey in 105 m at 5 points despite 6 points proposed due to difficult access to the site
4. Social Survey	One month during the Second Phase	Willingness to Pay Survey for 180 households in KSA and Portmore

Source) JICA Survey Team

Local experts and supporting staff were employed as shown in Table 1.3.2.

Table 1.3.2 Local Expert and Supporting Staff

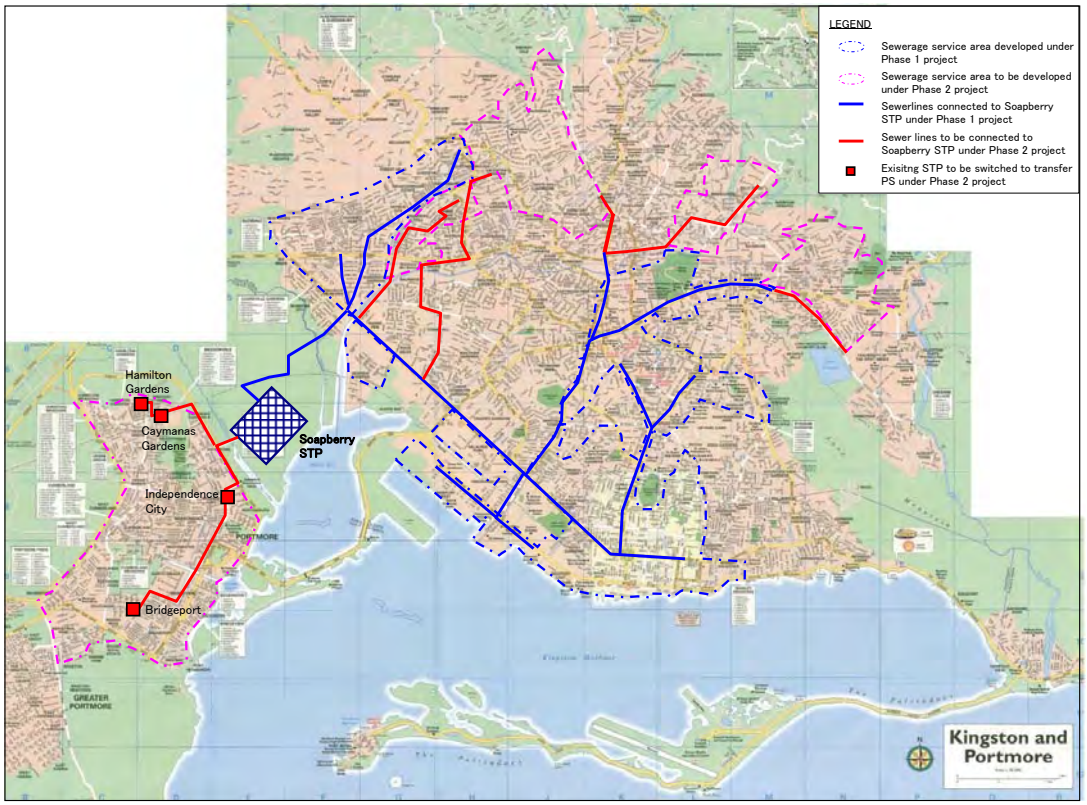
Position	M/M	Major Task
1. Engineer	2.0	Preliminary design, cost estimate
2. Environment Advisor	1.0	Support for environmental consideration
3. Surveyors (Technical)	3.0	Carrying out inventory survey
4. Surveyor (Social)	2.5	Carrying out social survey
5. CAD operator	6.0	Drawing preparation
6. Secretary	5.0	Office administration
7. Operator	5.0	Typist, support for secretary

Source) JICA Survey Team

The first phase of the survey was conducted in Jamaica from July 20, 2009, to September 17, 2009. The following major activities were carried out during the first phase:

1) Collection, review and analysis of the data, information and documents related to the Project as well as discussion with related organization;
2) Inventory survey on existing sewerage facilities including sewage treatment plant, pump station, on-site sanitation facilities, manhole survey and major industry/commercial in the Project areas;
3) Conceptual layout plan of sewerage facilities for the Project area in KSA and Portmore;
4) Confirmation of administrative process for environmental consideration; and
5) Investigation of the organizational strengthening plan for NWC.

After the Inception Meeting on July 22, 2009, NWC requested to adjust priority project areas for KSA from the original proposal of two areas to four areas which are defined as high priority areas in SENTAR report. The new areas are shown in pink in Figure 1.3.2. The Survey team agreed to the adjustment of the target areas for KSA taking into account effective project formulation among the concerned organizations. According to NWC, affordability in those four areas is higher than other areas so that project effectiveness can be enhanced as well as tariff collection.



Source) JICA Survey Team

Figure 1.3.2 Adjusted Survey Area

1.4 Progress of Survey in Jamaica

The progress of first and second survey in Jamaica is summarized in Table 1.4.1 as compared with the terms of reference of the preparatory survey. The results of outstanding issues of the first field survey were added to the progress of the first field survey.

Table 1.4.1 Progress of the First Field Survey in Jamaica

Task and Progress
1. Confirmation of Project Demand and Background
1.1 Review of Existing Sewerage Project and Sewerage Development Policy in Jamaica SENTAR Report (1993) and KBR Report (2003) were collected and reviewed during the first survey in Jamaica. Especially, the SENTAR Report is deemed as the master plan for the Sewerage Development for Kingston metropolitan region. Sewerage development policy for this project shall also be followed to the SENTAR Report although some basic design parameters shall be updated with reference to KBR report, current statistic data and other technical information concerned. The K-Factor is a special provision which was included with the tariff review for the NWC by the OUR. The K-Factor will be used for specific projects, e.g., wastewater treatment plant rehabilitation and sewer network extension in the KSA. Please see page 12, National Water Commission Review of Rates - Determination Notice April 28, 2008. A programme for the implementation of the K-Factor was prepared and submitted to the OUR for its approval/non-objection.
1.2 Survey on Present Condition of Sewerage Facilities in Kingston and St. Catherine
Condition of existing sewerage facilities in/around this project areas were surveyed through visual inspection and hearing to the operators at site. Condition of almost all the facilities is seriously degraded due to inadequate maintenance activities. Some of the treatment plants has stopped operation and been abandoned. In addition, specific data of facilities are not available because of missing such documents. Measurement of inflow rate to the treatment plant is not carried out excluding Soapberry STP. Preventive

maintenance procedure has been introduced, but practical situation is not adequate because of limitation of budget and equipments.
1.3 Confirmation of Project Demand Project demand is very high because of serious degradation of existing facilities. For example, effluent quality discharged from existing treatment facilities in Portmore does not satisfy the NEPA effluent standard in all regulatory items.
1.4 Review of Management for Sewerage Works Information of organization and institution, O&M activities and tariff system including customer service for NWC has been obtained and examined to recognize current issues through the first survey period. During the second survey period, proposed measurements against current issues will be materialized and concluded through the second survey period.
2. Confirmation of Strategy for Sewerage Development and O&M
2.1 Sewerage Demand Forecast Sewerage demand forecast for the project areas in KSA and Portmore employed the latest statistical information with reference to the previous SENTAR Study and KBR Study to the year 2030. The population growth rate for the project areas was estimated through discussions among the appropriate organizations in Jamaica. The NWC is aware of differences in the estimations and was inclined to accept the figures projected by STATIN-the Statistical Institute of Jamaica. Consequently the Survey Team provided two cases of sewerage demand forecast employing latest census results and results of past sewerage development studies in order to grasp sensitivity of the project scope.
2.2 Establishment of Basic Sewerage Development Plan In considering the current situation, the sewerage improvement by means of centralized sewage treatment at Soapberry is deemed essential because of lack of technical and administrative resources against realization of tertiary sewage treatment level in the Kingston area. Specific alternative study shall be carried out during the second survey. The Survey Team provided comparison study on Portmore Scheme, KSA sewerage development map for strategic expansion of the sewered area.
2.3 Sewerage Development Plan for the Unsewered Areas under this Project According to the NWC's opinion, the residential area with tariff collection highly expected shall be prioritized at first rank. It is essential for sustainable operation and maintenance activities. The future expansion of sewered areas has not been discussed with NWC until now. Her requirements shall be considered and reflected to the planning as much as possible. As above-mentioned, the Survey Team provided KSA sewerage development map including areas excluded from the scope of the Project.
2.4 Establishment of Action Plan for Improvement of Sewerage Works Management Action plan will be provided through the second field survey.
3. Establishment of Project Implementation Plan
3.1 Supplemental Survey Topographic survey and geo-technical survey have not been carried out during the first survey period because confirmation of available information took time. The technical performance of a local consultant is enough high, but time management is not so strictly on the basis of past experiences. So considering minimization of work quantities, those survey will be managed and completed until the beginning of December.
4. Confirmation of Environmental Consideration
4.1 Confirmation of Environmental Application Process in Jamaica There is NEPA Guideline for Environmental Permission and License. The application process for environmental consideration has been confirmed already. However the practical arrangement shall be supplemented during the second survey employing a local environmental advisor.

Source) JICA Survey Team

The progress of the second field survey is summarized in the Table 1.4.2.

Table 1.4.2 Progress of the Second Field Survey in Jamaica

Task and Progress
1. Confirmation of Policies of Sewerage Development and O&M
1.1 Analysis of the Macro Economic Trend and the External Public Debt Sustainability for the Government of Jamaica GDP growth has continued the low level of average 1% in the past five years. The public debt to GDP ratio has been as high as over 110% and in FY 2008/09 it recorded 115.8%. Jamaican authorities and IMF had talks on fiscal support and allegedly in December 2009 they reached the key elements of an IMF loan under a Stand-By Arrangement. The amount of SBA under discussion is about US$1.3 billion.
2. Formulation of Project Implementation Plan
2.1 Establishment of Project Scope Project scopes are divided into three contract packages taking account of target areas and project features as shown below. PACKAGE 1 Portmore Sewerage Project: Construction of deep interceptor (gravity low) to convey all the elected sewage at current 4 STPs to Soapberry STP, construction of new regional and transfer pump stations, upgrading of community pump stations PACKAGE 2 North KSA Sewerage Project: Expansion of sewered area in 1,180 ha in the St. Andrew including trunk sewers, street sewers, laterals and house connections. PACKAGE 3 Procurement of O&M equipments for Sewerage Project: Procurements
2.2 Preliminary Design For the Portmore area, two alternatives for the sewerage development method, the gravity option and the pumped option, were studied and assessed from economic and technical points of view. Considering the life cycle cost of those alternatives, the gravity option was selected as the preferred alternative. For the crossing of the Rio Cobre, a pipe-bridge was selected as compared with a tunnel because of costs and other technical reasons. . For the KSA area, a gravity sewer system was applied to the trunk sewer development for the 4 target areas. The trunk sewers are about 37 km long in total. Diameters of the sewers range from 200 mm to 900 mm. Street sewers and laterals are constructed to connect all the households, commercial and industrial buildings in the target areas
2.3 Project Cost Estimate Total cost estimate is 12,803 million JPY (12,803 million JMD) including the eligible portions, (Procurement / Construction and Consulting service), non eligible portion, and interest during project period. Optimization of the cost estimate was studied from various viewpoints. The project itself is composed of typical sewer construction works such that a drastic cost reduction is hard to foresee. The project can be separated into some contract packages and if necessary to satisfy the budget.
2.4 Confirmation of Financial Source The general terms of Japanese ODA Loan are assumed as the primary source of funding covering 85% of the total project cost. Counterpart funding will be supplied by NWC directly or a grant from the Government of Jamaica. Outside financing is not assumed. The Japanese ODA Loan is on-lent to NWC. On-lending is made with the same conditions as the prime Japanese ODA Loan i.e. 1.4% interest rate with a 25-year repayment period including a 7-year grace period for the general terms.
2.5 Establishment of Project Implementation Plan A draft project implementation plan was provided for 5 years between 2010 and 2015. The break down of the time schedule of each contract package was also tentatively provided on the basis of the overall project which would commence with the signing of Loan Agreement between the Governments of Japan and Jamaica.
2.6 Establishment of Procurement Plan The procurement process in Jamaica was confirmed with NWC procurement guidelines. The current approval process in the cabinet would be the key issue for the time compression. According to the previous KMA water supply project, the shortening of approval process can be expected.
2.7 Evaluation of Project Performance

FIRR of the project is calculated as -1.38% due to heavy investment cost and current low tariff level.
3. Organization Development Plan for Project Execution, O&M
3.1 Project Execution Organization It was proposed that the PMU (Project Management Unit) be established with for exclusive control of this project under the direct control of the President. The PMU shall keep all the documents of the project correctly, and build the organization which can grasp progress of the project. Two Staff will be responsible for the daily project supervision activities under the direction of Project Manager who has experience of "KMA Water Supply and Rehabilitation Project".
3.2 O&M Organization It is necessary to reduce operation and maintenance costs of the sewerage facilities by means of proper asset management and stock control. In order to promote the asset management of the sewage business, it is required to establish organizational supporting systems in the NWC. For the O/M of the project, it was confirmed to allot 13 staff from the existing treatment plants, without having to employ additional persons.
3.3 Organization Strengthening Plan It was proposed the strengthening of implementation organization of the NWC at the stage of preparatory, construction, and maintenance and operation of the project. The NWC is required to understand the necessary procedure of the Japanese ODA loan, and to establish the organizational structure to ensure the timely implementation of the project. The present management attitude should be changed toward a more customer-oriented approach.
3.4 Financial Plan FIRR is calculated as 0.71% due to heavy investment cost which does not match the current tariff level. The project is deemed to be financially not feasible. To understand the social background of the target areas, a questionnaire survey of 180 samples including seven meetings of citizens' associations and 79 door-to-door interviews were completed. Based on the questionnaire survey, willingness to pay for sewerage service improvement by the project is estimated as monthly JMD238.50 per capita in KSA (currently unconnected area) and JMD62.05 per capita for currently sewered areas in Portmore.
3.5 Household Connection Promotion The survey disclosed that almost all the household connections are through housing schemes so far and individual connection to the existing households is new to Kingston and Portmore. The ratios of senior citizens and female-headed households are quite high in North Kingston so that they need special attention.
4. Environmental and Social Consideration Environmental Impact Assessment (hereinafter EIA) for this project has not been carried out. The survey team had summarized approval process, environmental laws and regulations, and confirmed that there are few issues regarding to the environmental consideration such as water quality, noise and sound, and involuntary resettlement is not necessary, and heritage sites, local landscapes and ethnic minorities do not exist in the target areas. Since the majority of the beneficiaries have little information on the project and the cost, explanation meetings and public consultation are essential whether an EIA is required or not.
5. Sewerage Service for Vulnerable Groups As described in 3.5, a number of senior citizens and female-headed households are found in the North Kingston through the social survey. For enhancement of house connection to the sewerage system, financial support to vulnerable group should be considered for house connection. In addition, NWC is requested to promote the public relation activities for enlargement of awareness of the sewerage users. The survey disclosed that almost all the household connections are through housing schemes so far and individual connection to the existing households is new to Kingston and Portmore. The ratios of senior citizens and female-headed households are quite high in North Kingston so that they need special attentions.

Source) JICA Survey Team

Progress meetings were held regularly between the JICA Survey Team and NWC to report the progress of the survey, findings and issues arose through the survey in Jamaica. Contents of progress meetings are summarized in the following table.

Table 1.4.3 Progress Meetings held during the Survey

No.	Date	Major Agenda	Summary
1	30 Jul. 2009	Result of site inspection	Findings about current physical and operation condition of the sewerage facilities in KSA and Portmore areas were reported. Urgent measurement necessary to the sewerage facilities was shared among the participants.
2	05 Aug 2009	Progress of data collection	Progress of data collection was reported.
3	12 Aug 2009	Progress of data collection	Progress of data collection was reported
4	20 Aug 2009	Schedule of inventory survey Request of GIS data	Schedule and support from NWC were discussed. Geographical information of the survey area was requested to GIS section of NWC.
5	14 Sep 2009	Findings of 1st survey	Activity and data obtained during the 1st survey in Jamaica were reported. Draft layout plans of the proposed sewerage facilities were presented. Demand of cost saving for the pump stations operation with reducing power consumption was expressed as one of the key issues for NWC by NWC President. Demand forecast for expansion of the Soapberry STP was requested by NWC. Possibility of a loan arrangement for house connection under the project was commented by NWC.
6	09 Nov 2009	Interim Report	Presentation of the ITR was made by the Survey Team. It was reported that slow increase of house connection in the north coast areas (Montegobay and Ocho Rios) has been observed because of no penalty against un-connected household. So NWC requested potential financial support for house connection in the target area of the project. Consideration of participation of the local contractor to the project construction was requested by NWC. NWC requested upgrade of the existing sewers along North Street in the downtown.
7	08 Dec 2009	Sewerage development plan for KSA	Overall sewerage development plan for KSA and updated sewerage layout plan were presented by the Survey Team. Study on the Soapberry STP expansion was requested again. NWC commented that sustainable O&M should be considered for preliminary design of the proposed sewerage facilities.
8	15 Dec 2009	Sewerage development plan and Soapberry STP expansion Project cost estimate	Updated sewerage development plan for KSA and Soapberry STP expansion forecast were presented by the Survey Team. Project cost estimate was reported to NWC. NWC informed that new financial management system would be introduced in

		Operation and Maintenance	another couple of years. Outstanding information was reminded to NWC. NWC asked of availability of the special equipped pick-up which someone saw during JICA training course in Japan in the past.
9	21 Dec 2009	Project Evaluation	Draft estimation of FIRR was reported to NWC. Possibility of application of preferential terms to the ODA loan was asked by NWC. NWC is concerned with slow increase of house connection. So the promotion of house connection should be considered under the Project.

Source) JICA Survey Team

Workshop on the result of the Preparatory Survey for Kingston Sewerage Development Project was conducted at Jamaica Conference Center on 26th January, 2010 during the third survey in Jamaica. Several presentations on the outputs through the Preparatory Survey were provided to representatives of the stakeholders by the Survey Team. The minister of Water and Housing, Japanese Ambassador and representatives of JICA participated to the Workshop. The pogramme of the Workshop and list of participants are shown in Table 1.4.4 and.1.4.5, respectively.

Table 1.4.4 Programme of Workshop

Time	Programme / Presentation	Presenter
9:00	Welcome and Opening remarks	Mr. E. G. hunter / NWC president
	Remarks	Mr. Russell Handeed / NWC Chairman
	Remarks	His Excellency Hiroshi Yamaguchi / Japanese Ambassador to Jamaica
	Remarks	Dr. Horace Chang / Minister of Water and Housing
9:30 – 10:05	Current Situation and Project Overview	Mr. Kevin Tynes / Team Leader, JICA Survey Team
10:05 – 10:20	Coffee Break	
10:20 – 10:30	Re-start and Introduction	Mr. Vernon Barrett / NWC Vice President
10:30 – 11:00	Design of KSA System Improvements	Mr. Hideo Tsuta / Co Team Leader, JICA Survey Tram
11:00 – 11:30	Design of Portmore System Improvements	Mr. Thomas Wilshusen / Sewerage Engineer, JICA Survey Team
11:30 – 12:00	Environmental and Social Consideration, and Organization	Mr. Kevin Tynes / Team Leader, JICA Survey Team
12:00 – 12:30	Cost Estimate and Financial Analysis	Mr. Kevin Tynes / Team Leader, JICA Survey Team
12:30 – 13:00	Final Comments and Questions	
13:00 -	Lunch	

Source) JICA Survey Team

Table 1.4.5 List of Participants

NAME	TITLE	NAME	TITLE
Jamaican Organization		**Japanese Organization**	
Ministry of Water and Housing		Japanese Embassy	
Hon. Dr. Horace Chang	Minister of Water and Housing	His Excellency Hiroshi Yamaguchi	Japanese Ambassador to Jamaica
Mrs. Genefa Hibbert	Permanent Secretary, Ministry of Water and Housing	Mr. Tadahiiko Yamaguchi	Embassy of Japan
Ms. Keisha Tyrell	Technical Director Ministry of Water & Housing	Ms. Karen Coleman	Embassy of Japan
Miss. Sandra Buchanan	Ministry of Water and Housing	JICA Jamaica Office	
Ministry of Health		Mr. Toshimasa Takashima	Resident Representative, JICA/JOCV
Ms. Nenifi Haiduk	EHU, Ministry of Health	Ms. Lorna Wallace	Senior Programme Officer - JICA
Dr. O'Neil Watson	Ministry of Health	JICA	
Mr. Everton Baker	Ministry of Health	Mr. Gen Yoneda	JICA Latin America and the Caribbean Department
Ministry of Finance and Public Service		Ms. Nami Sasaki	JICA Latin America and the Caribbean Department
Dr. Wesley Hughes	Financial Secretary Ministry of Finance & Public Service	JICA Survey Team	
Howard	MOFPS	Mr. Kevin Tynes	Team Leader, JICA Survey Team
Planning Institute of Jamaica		Mr. Hideo Tsuta	Co-team Leader, JICA Survey Team
Ms. Barbara Scott	Director, External Cooperation Management PIOJ	Mr. Tom Wilshusen	Sewerage Engineer, JICA Survey Team
Ms. Pauline Morrison	Manger Bilateral Programme - Planning Institute of Jamaica	Ms. Kaywana Henry	Secretary, JICA Survey Team
Mrs. Saskia Frater- Smith	Economist - PIOJ	Other	
Ms. Marsha Woolcock	Economist - PIOJ	Mr. Masanobu Shimosaka	Nippon Koei LAC
National Water Commission			
Mr. E. G. Hunter	President, NWC		
Mr. Russel Handeed	Chirman, NWC		
Mr. Vernon Barrett	Vice President, NWC		
Mr. Garth E. Jackson	Senior Project Manager		
Ms. Jacqueline Cameron	Corporate Planning Manager		
Mr. Lewis lakeman	AVP, System Development and Planning, NWC		
Ms. Pauline Adams-Russell	Area Manager		
Mr. Patric Dyley			
Mr. Trevor Hewitt			
Ms. Andrea Williamson			
Ms. La'Toya Jacson			
Ms. Karen Clacken	Community relation manager - East Division		
Ms. Jhanelle Barnes			
National Environment & Plannning Agency			
Mr. Peter Knight	CEO, National Environment & Planning Agency		
Mr. Roger Williams	National Environment & Planning Agency		
Mr. Paulette Kolebusch	National Environment & Planning Agency		
Mark Rammelaere	National Environment & Planning Agency		
Office of Utilities regulation			
Mr. Maurice Charvis	Deputy Director General, Office of Utilities Regulation		
Clement Jackson	Director Regulating Service, O.U.R		
Mr. Wayne Macgregor	Senior Legal Counsel O.U.R		
Sashana Miller	Regulatory Analyst O.U.R		
National Works Agency			
Mr. Mark Richards	Planning & Research National Works Agency		
Water Resource Authority			
Mr. Basil Fernandez	Managing Director, Water Resources Authority		
Mrs. Michelle Watts	Sanitation Environmental Office, WRA		
Community, Citizens Association			
Norma Porter	Cagmanas Garden Site D		
Mrs. Carol McLean	President, Independence City Association		
Mrs. Brenda Porter	President Caymanas Gardens Citizens Association		
Mrs. Mary Royes	President, Hamilton Gardens Citizens Association		
Mr. Cunningham	President, Meadowbrook/Havendale Citizens Association		
Mr. Kitson	Pembroke hall Citizens Association		
Mrs. Khann	Hope Pastures Citizens Association		
His Workship Dr. Andrew Wheatley	The Mayor Councillor Spanish Town		
His Workship Keith Hinds	Mayor Portmore		
Other			
Mr. Owen Crooks	General Manager, Jamaica Railway Corporation		
Mr. Patrick Reece	General Manager, Central Wastewater Treatment Company		
Mr. Norman Shand	KSAC		
Mr. Moshe Saldinger	Ashtrom		
Japanese Organization			
Japanese Embassy			
His Excellency Hiroshi Yamaguchi	Japanese Ambassador to Jamaica		
Mr. Tadahiiko Yamaguchi	Embassy of Japan		
Ms. Karen Coleman	Embassy of Japan		
JICA Jamaica Office			
Mr. Toshimasa Takashima	Resident Representative, JICA/JOCV		
Ms. Lorna Wallace	Senior Programme Officer - JICA		
JICA			
Mr. Gen Yoneda	JICA Latin America and the Caribbean Department		
Ms. Nami Sasaki	JICA Latin America and the Caribbean Department		
JICA Survey Team			
Mr. Kevin Tynes	Team Leader, JICA Survey Team		
Mr. Hideo Tsuta	Co-team Leader, JICA Survey Team		
Mr. Tom Wilshusen	Sewerage Engineer, JICA Survey Team		
Ms. Kaywana Henry	Secretary, JICA Survey Team		
Other			
Mr. Masanobu Shimosaka	Nippon Koei LAC		

CHAPTER 2 REVIEW OF THE FRAMEWORK FOR THE SEWERAGE DEVELOPMENT PROJECT

2.1 Natural Environmental and Socio-economical Condition in the Project Area

2.1.1 Natural Environment

(1) Climate

Jamaica is located at the west end of an island chain in the Caribbean Sea and belongs to tropical maritime climatic zone. Jamaica is subject to hurricanes during August through November. The National Meteorological Center of Jamaica (hereinafter NMCJ) provides island-wide climatic data. NMCJ maintains more than 200 rainfall stations across the island.

General climate in the project area is represented by means of climate data between 1998 and 2008 at the Norman Manley International Airport located opposite Kingston on the seaward side of Kingston Harbour as shown in Table 2.1.1.

Table 2.1.1 General Climate Condition of Kingston

Parameters	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annum
Highest Maximum Temperature (°C)	33.5	33.4	33.9	34.4	34.7	35.2	36.4	35.8	35.8	35.4	35.2	34.5	36.4
Lowest Minimum Temperature (°C)	18.5	18.9	18.8	19.1	21.9	21.5	22.3	21.3	21.7	21.6	19.1	19.8	18.5
Mean Daily Temperature (°C)	27.0	26.9	27.3	27.9	28.6	29.3	29.9	29.5	29.2	28.7	28.1	27.4	28.3
Rainfall (millimetre)	15.6	9.7	18.3	21.2	126.1	66.9	83.2	139.6	219.1	183.8	89.1	49.3	1021.8
Number of rainday(s)	4.1	1.9	3.6	3.8	7.7	5.2	4.9	7.0	9.0	10.3	6.2	4.4	68.1
Relative Humidity -7am (%)	75.7	74.4	73.5	70.7	72.2	71.0	71.0	72.4	74.6	76.6	76.3	75.5	73.7
Relative Humudity - 1pm (%)	59.9	59.3	60.5	60.5	63.6	62.4	61.8	64.7	65.8	66.7	63.3	60.7	62.4

Source) National Meteorological Center (1998~2008)

Average daily temperature is 28.3ºC. Maximum and minimum temperatures are approximately 35ºC and 20ºC, respectively, throughout the year. Annual rainfall is approximately 1,000 mm with a bimodal rainfall pattern consisting of two peak periods in May and September-October. Rain days average approximately 70 per year.

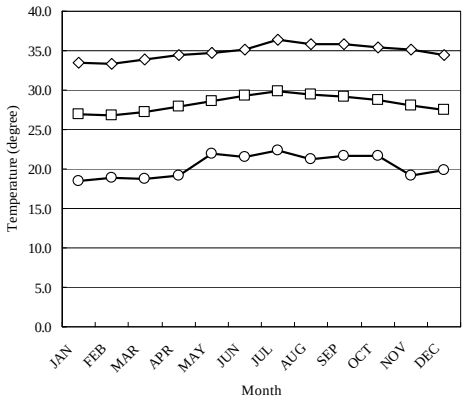


Figure 2.1.1 Temperature

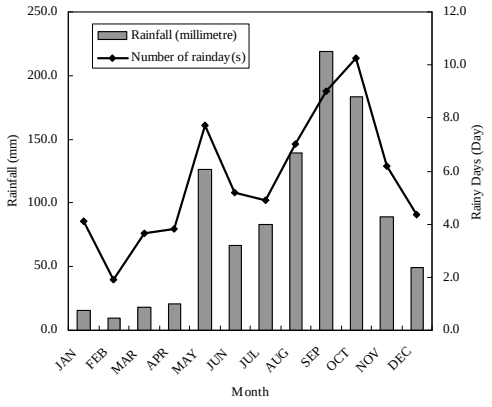


Figure 2.1.2 Rainfall Pattern

(2) Geology

The geology of the Kingston area [1, 2] consists of the Liguanea Formation overlying the White Limestone and Pre-White Limestone Formations. The Liguanea Formation is an alluvial fan deposit consisting of a complex sequence of interbedded gravels, sands, silts and some clays. The deposit is of considerable thickness and has been largely laid down by the Rio Cobre and Hope Rivers to form the Liguanea and St Catherine Plains. Aquifers exist within the Liguanea Formation. Mangrove and salina deposits occur to the west in the Hunts Bay area. White Limestone underlies the Liguanea formation and outcrops at elevations above 150 m to the north of the study area and to also the east as the ridges of Long Mountain and Dallas Mountain. In the higher ground to the northeast of KSA, Granodiorite, Red Andesites and Tuffs and rocks of the Wagwater Group (coarse conglomerates, sandstones and red marls) occur.

According to previous geo-technical survey reports, ground conditions generally consist of loose to compact fine sand and silt, and very soft to very stiff clays in Soapberry area. In this line, the ground condition in Portmore can be assumed almost same condition as that in Soapberry. In considering of the above-mentioned condition, open trench method shall be carefully applied to installation work for sewer pipes in deep position by checking safety margin against heaving.

(3) Topography

Ground elevation in KSA varies from 3 m MSL in the water front along the Kingston Harbour to more than 500 m MSL in the foothills of the Stony Hill. The ground slope in the sewage catchment areas of KSA generally goes down from north or northeast to south or southwest. According to the GIS information of NWC, the ground elevation in the project area of KSA ranges from EL+24m MSL to EL+254m MSL. Maximum relief in ground elevation is more than 100 m in the same catchment area.

There are several gullies that run across the project areas in KSA. The ground level along the gullies is lower than the surrounding area so that the sewer installation along gully is effective for gravity sewer from technical and economical points of view. Some of proposed sewer lines may intersect with gullies. Such intersection shall be minimized in order to ease not only construction but also O&M in the future.

In contrast with KSA, the ground elevation of Portmore is very flat ranging from 3 m MSL to 9 m MSL in general. The groundwater level in Portmore is near the ground surface, essentially at sea level. Natural ground slope contributes to make design depth of the sewer pipes shallow. The layout plan for the sewer pipes shall account for natural ground slope.

[1] C A Matley, 1951, Geology and Physiography of the Kingston District, Jamaica.
[2] Geological Survey Department, Jamaica, 1962, Bulletin No. 4, Synopsis of the Geology of Jamaica.

The Rio Cobre River flows between the Soapberry STP and Portmore. The river width is approximately 320 m as measured between the bounding dikes in this reach. The channel proper measures approximately 40 m at normal flows. The channel bed level is around 0 m MSL on the basis of the railway-bridge drawings provided by Jamaica Railway Corporation (hereinafter JRC) and as verified by a topographical survey. The existing railway-bridge has a total length of approximately 170 m comprising 8 spans of 21 m each.

(4) Rio Cobre River Hydrology

River flow data for some periods was provided by Water Resource Agency of Jamaica (hereinafter WRA). It was not useful in understanding the characteristics of the Rio Cobre River. The SENTAR study provided monthly mean discharge data for the Rio Cobre River for 36 years from 1955 to 1991 although the gauge station is located several kilometers upstream from Portmore. Monthly mean discharge data are summarized in Table 2.1.2

Table 2.1.2 River Flow Rate Data

(Unit: m^3/sec)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annum
Mean	3.1	2.1	1.3	1.9	4.1	9.6	3.7	3.6	8.5	12.7	10.9	5.8	5.6
Max	11.3	10.1	8.5	12.4	20	82.4	22.8	13.2	64.6	59.6	51.4	17.5	82.4
Min	0.1	0	0.1	0.1	0.1	0.1	0.2	0.4	0.4	1.1	0.6	0.1	0

Source) SENTAR Report, Volume 2, Appendix I

The flow rate in the Rio Cobre River is quite low throughout the year although the river's discharge from September to November is greater than other months. For design of a pipe bridge, the bottom elevation of the girder shall be set in the same or higher than the bottom of the girder of railway-bridge, or top elevation of the present river banks. It is assumed that the relatively small river flow would not cause adverse impacts to the river structures. However, in the case that a pipe bridge is selected for the river crossing structure, arrangement of bridge spans and positions of piers should be designed to minimize adverse impact to river flow section and railway-bridge structures.

2.1.2 Socio Economical Condition

(1) Population

The 2001 Population Census, which is the latest island-wide population census of Jamaica, defines the total population of Jamaica at 2,607,632 as of 2001. Considering previous census results from 1960 to 2001 and latest socio-economic survey in 2008, the annual population growth rate is tabulated in Table 2.1.3.

Table 2.1.3 Late Annual Population Growth Rate in Jamaica

Year	Population	Increase	Annual Growth Rate
1960	1,609,800		
		238,700	1.39%
1970	1,848,500		
		341,900	1.42%
1982	2,190,400		
		190,200	0.93%
1991	2,380,600		
		227,000	0.91%
2001	2,607,600		
		84,800	0.45%
2008	2,692,400*		

Source) KBR Report Volume 1 (JICA Survey Team updated.)
Note) Population in 2008 is referred to Economic& Social Survey Jamaica 2008

Annual population growth rate goes down gradually and averages approximately 0.9% in the late two census decades from 1982 to 2001. The report on Economic and Social Survey Jamaica 2008 pointed out significant negative impact on the population growth caused by external migration to the USA, Canada and the UK.

On the other hand, the population growth rates in KSA and Portmore were estimated on the basis of results of the population census in 1991 and 2001 as shown in the Table 2.1.4.

Table 2.1.4 Annual Population Growth Rate in KSA and Portmore

Item		Kingston	St. Andrew (Urban)	Portmore
Population	1991	99,700	472,100	99,900
	2001	96,000	483,000	156,400
Annual Growth Rate (%)		-0.4	0.3	4.6

Source) Population Census 2001

Annual population growth rate in Kingston, Urban St. Andrew and Portmore is estimated at minus 0.4%, 0.3% and 4.6%, respectively, in the last census decade. The result shows tendency of population movement from Kingston to the adjacent areas. The population growth in Portmore increased significantly during the last census decade. It is deemed that the expansion of the administrative boundary of Portmore might cause such drastic change of population. The project target area for Portmore is almost same area as former administrative area of 1991. Considering the particular project area in Portmore, the population growth rate was re-estimated at 0.3% as shown in Table 2.1.5.

Table 2.1.5 Population Growth Rate for Portmore Project Area

Item		Portmore	Remarks
Population	1991	97,000	
	2001	99,600	Population in 1999's administration boundary
Annual Growth Rate (%)		0.3	

Source) Population Census 2001

It is found that population in the project area has been increased quite gently during the last census decade, and assumed that such trend would be continued for the future Population growth rate should be periodically reviewed at census year.

(2) Macro Economic Development and Financial Status

Jamaica's nominal GDP is JMD1,048 billion which makes the country one of the largest economies in the Caribbean region. Jamaica's economy is characterized by high dependence on bauxite, aluminum and tourism and low real growth. Jamaica's real annual GDP growth has not been greater than 2.7% during the past 10 years, a period during which GDP growth averaged 1.3% per year. Jamaica's economic situation has been further pressured by the sharp increase in commodity prices from 2006 through 2008, flood disasters caused by hurricanes in 2004, 2007 and 2008, and the recent global financial crisis which intensely impacted the country's economy in 2008 and 2009. Growth stopped in 2007 and dropped to -0.6% in 2008. According to World Economic Outlook by IMF (2009), the decrease in GDP is projected at -3.6% in 2009.

In its fiscal status, the deficit is expected to continue for FY 2009/10 according to the economic outlook by Bank of Jamaica (2008). Public debt was 115.8% of GDP in 2008. High level of debt service expenditure cannot allow the government to take measures for economic recession. The debt sustainability analysis by IMF Article IV consultation (2008) shows that, without policy changes, the debt stock will probably increase in the coming years.

The country's high indebtedness has become one of the main obstacles for economic growth. High level of debt affects the resource allocation in the public sector especially in capital investment, which, in turn, is required for faster growth and efficient basic structure to improve standard of living of the population.

After several months of discussions, the government agreed with IMF to a 27-month Stand-by Program amounting to US$1.25 billion aiming at (i) fiscal consolidation strategy to streamline expenditure and reform the public sector; (ii) comprehensive debt management strategy to reduce the governments interest bill; and (iii) reform to strengthen the financial system. With the program streamlining public expenditure and reducing interest payments, the government will have more resources available for investments in infrastructure.

Table 2.1.6 Selected Economic Indicators

	Unit	2004	2005	2006	2007	2008
GDP at Current Prices	JMD bn	620.2	694.5	788.2	890.0	1048.0
GDP Growth at Constant Prices	%	1.4	1.0	2.7	1.4	-0.6
Fiscal Revenue	JMD bn	172.8	186.7	211.4	256.6	282.3
Fiscal Expenditure	JMD bn	199.5	207.7	248.0	294.3	350.2
Recurrent Expenditure	JMD bn	188.4	192.3	224.5	252.9	310.1
Capital Expenditure	JMD bn	11.1	15.5	23.5	41.4	40.1
Debt Servicing	JMD bn	222.5	228.3	219.9	207.8	272.3
Deficit	JMD bn	-26.7	-21.0	-35.1	-37.6	-67.9
National Debt (% of GDP)	%	119.42	118.72	113.23	108.45	115.80
External Debt (% of GDP)	%	48.80	51.09	50.19	47.53	52.93
Domestic Debt (% of GDP)	%	70.62	67.63	63.04	60.92	62.87

Source) ESSJ 2008 and Ministry of Finance and Public Service

2.1.3 Legal Framework for Sewerage Works

Law (Act) and national policy related to the sewerage works are summarized in Table 2.1.7, which shows regulations separately at the national level, governmental agency level as well as parish level. Especially water and sewerage tariff structure and their levels are normally reviewed and judged by the Office of Utilities Regulation (OUR) which is the regulatory body in the public service sector in Jamaica.

Table 2.1.7 Legal Framework of Sewerage Sector

Title	Issuer
1. National Level	
1) Vision 2030 Jamaica: National Development Plan	Planning Institute of Jamaica
2) Water Sector Policy	Ministry of Water and Housing
3) National Environmental Policy (2005 ~ 2015)	National Environment Planning Agency
4) Sewerage Effluent Standard	National Environment and Planning Agency
2. Agency Level	
1) National Water Commission Act	Ministry of Justice
2) Office of Utilities Regulation Act	Ministry of Justice
3) Natural Resource Conservation Authority Act	Ministry of Justice
3. Local Government Level	
1) Kingston Improvements Act	Ministry of Justice
2) Town and Community Planning Act	Ministry of Justice

Source) JICA Survey Team

2.2 Current Water Supply and Sewerage Condition in the Project Area

2.2.1 Water Supply

According to the JBIC sector study on water supply and sanitation of Jamaica in 2005, potable water for KSA and Portmore is supplied to approximately 98% of households with piped water system, as compared to approximately 86% in other towns. The National Water Commission (hereinafter NWC) is the largest service provider for the urban water supply

and sewerage services throughout the island. The share of the water supply service by provider as of 1998 is shown in the Table 2.2.1. The share of NWC is more than 70%.

Table 2.2.1 Water Supply Services by Provider

Supplier	Supply Type	Customers/ Unit	Unit	No of People	Share (%)
NWC	Private Tap	260,000	Connections	1,300,000	50.4
	Access Standpipe	(2,500)	Connections	250,000	9.7
	Red Zone	47,000	Connections	300,000	11.6
	Institutions	19,000	Connections	Not applicable.	
UDC/private	Private Tap			30,000	1.2
Parish Councils	Entombed Springs	229	Scheme	230,000	8.9
	Rainwater Catchments	285	Scheme	60,000	2.3
	Wayside Tanks	450	Scheme	10,000	0.4
Own	Tank/River/Other	80,000	Households	400,000	15.5
Total				2,580,000	100.0

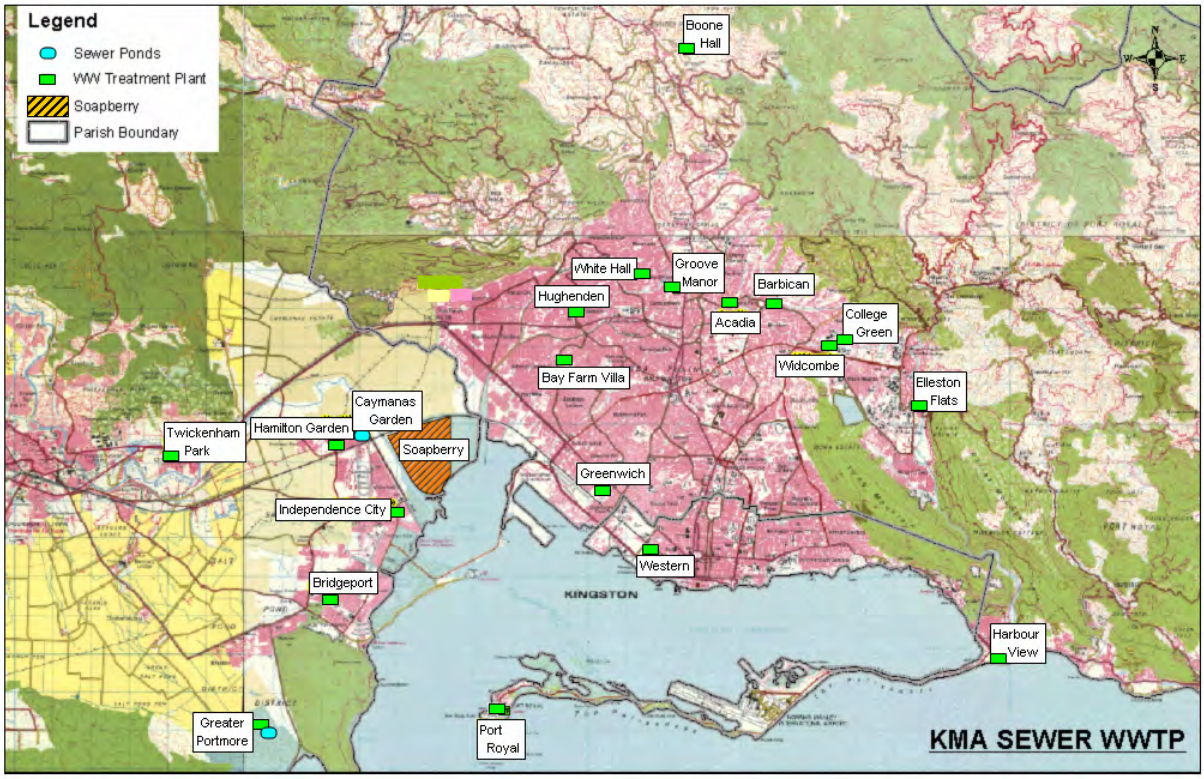
Source) Sector Study on Water Supply and Sanitation in Jamaica, JBIC, 2005

Currently, non-revenue water (NRW) is the most serious issues in the water supply sector of Jamaica. NRW accounts for approximately 60% of water production in 2008 in KSA. On the other hand, there is not specific figure of NRW for Portmore, but the aforementioned sector study estimates NRW in other parishes at approximately 73%.

2.2.2 Sewerage

(1) Sewage Treatment Plants

There are more than 130 sewage treatment plants in existence throughout island. Ownership of these facilities is shared among the NWC, which operates 69 treatment plants throughout island, other government agencies and private institutions including housing subdivisions and hotels. The existing main sewerage system in KSA currently serves approximately 30% of the population and most of the larger industrial dischargers. As part of the Soapberry STP Project, some of major treatment plants, e.g., Greenwich and Western STPs, were decommissioned. Currently the former Greenwich STP is functioning as grit removal and flow measurement station prior to transfer of sewage from downtown area to the Soapberry STP via siphon system. There are also a number of small independent systems in KSA. Those are mainly serving housing development schemes that drain to package treatment plants prior to discharge to gullies. Current sewage treatment plants in/around the project



Source) NWC

Figure 2.2.1 Sewage Treatment Plants in/around the Project Area

Some of the treatment plants located in or adjacent to the project area were investigated by means of visual inspection and hearing survey during the first survey period. The general conditions of those treatment plants are summarized in Table 2.2.2.

Table 2.2.2 General Condition of Sewage Treatment Plants

Treatment Plant	Parish	Type of Facility	Capacity (m3/day)	Map	Site Survey	Service		Remarks
						Commencement	Decommission	
Acadia	KSA	Extended Aeration	220	x	-	NA	NA	Insufficient treatment performance
Barbican Mews	KSA	Extended Aeration	260	x	x	NA	NA	Out of service
Bay Farm Villa	KSA	Contact Stabilization	220	x	-	NA	NA	Insufficient treatment performance
Boone Hall	KSA	Extended Aeration	400	x	-	NA	NA	Plant designed with latest standard
College Green	KSA	Oxidation Ditch	260	x	x	NA	NA	Plant decommissioning shortly
Elletson Flats	KSA	Contact Stabilization	1,100	x	-	NA	NA	Insufficient treatment performance
Greenwich	KSA	Primary Treatment	23,000	x	x	NA	NA	Grid removal in service
Grove Manor	KSA	Extended Aeration	260	x	x	NA	NA	Insufficient treatment performance
Harbour View	KSA	Contact Stabilization	4,500	x	-	NA	NA	Out of service
Hughenden	KSA	Contact Stabilization	1,300	x	x	NA	NA	Insufficient treatment performance
Oakwood	KSA	Extended Aeration	220	-	-	NA	NA	NA
Port Royal	KSA	Sand Filter	50	x	-	NA	NA	Insufficient treatment performance
Western	KSA	Primary Treatment	22,000	x	-	NA	NA	Sewage connecting to Greenwich
White Hall	KSA	Extended Aeration	350	x	x	NA	NA	Insufficient treatment performance
Widcombe	KSA	Contact Stabilization	440	x	x	NA	NA	Plant decommissioning shortly
Blackwood Gardens	St. Catherine	Waste Stabilization Ponds	570	-	-	NA	NA	Insufficient treatment performance
Bridgeport	St. Catherine	Contact Stabilization	7,600	x	x	NA	NA	Insufficient treatment performance
Caymanas Gardens	St. Catherine	Waste Stabilization Ponds	100	x	x	NA	NA	Out of service
Charlemont	St. Catherine	Oxidation Ditch	600	-	-	NA	NA	Insufficient treatment performance
De la Vega City Housing	St. Catherine	Waste Stabilization Ponds	520	-	-	NA	NA	Insufficient treatment performance
Ensom City Housing	St. Catherine	Contact Stabilization	380	-	-	NA	NA	Insufficient treatment performance
Hamilton Gardens	St. Catherine	Oxidation Ditch	760	x	x	NA	NA	Insufficient treatment performance
Horizon Park	St. Catherine	Oxidation Ditch	1,900	-	-	NA	NA	Insufficient treatment performance
Independence City	St. Catherine	Contact Stabilization	11,300	x	x	NA	NA	Insufficient treatment performance
Knollis Housing	St. Catherine	Slow Sand Filter	110	-	-	NA	NA	Insufficient treatment performance
Lime Tree Grove	St. Catherine	Aerated Lagoon	380	-	-	NA	NA	Insufficient treatment performance
New Works	St. Catherine	Slow Sand Filter	70	-	-	NA	NA	Insufficient treatment performance
Nightingale Grove	St. Catherine	Oxidation Ditch	380	-	-	NA	NA	Potential plant for upgrading
Red Ground Housing	St. Catherine	Oxidation Ditch	170	-	-	NA	NA	Insufficient treatment performance
Tawes Pen Housing	St. Catherine	Contact Stabilization	240	-	-	NA	NA	Insufficient treatment performance
Twickenham Park	St. Catherine	Extended Aeration	150	x	-	NA	NA	Insufficient treatment performance

Source) NWC STP Auditing Presentation and JICA Survey Team Site Inspection

Four sewage treatment plants form the basis for the project in Portmore. These include the Bridgeport STP, the Independence City STP, Hamilton Gardens STP, and the Caymanas Gardens STP. These facilities are in an advanced state of disrepair, and none are operating satisfactorily, much less optimally. For these and several other reasons, the NWC wishes to decommission these facilities and deliver their influent sewage to the Soapberry STP.

The Independence City and Bridgeport facilities are mechanical, secondary treatment facilities featuring above-ground steel tankage and conveyance structures. They employ a contact stabilization process to biodegrade wastes. These two plants are severely dilapidated. Parts of the steel tanks have rusted through. Broken and leaking process piping release raw and partially treated wastewater to the ground. A high fraction of the installed mechanical equipment is out of service, scavenged, missing, or abandoned in place. Plant housekeeping is minimal, with vegetation overgrowing through much of the sites. It does not appear that sufficient aeration is provided to the tanks, likely the result of inoperative and missing blowers. The quality of the effluent is quite poor, and the few analytical data provided show effluent BOD is very high and sometimes little more than 10% BOD removal occurs.

The Hamilton Gardens plant features an oxidation ditch to treat wastes. The ditch tank is a partially buried concrete structure in satisfactory condition. The original screw pumps are out of service and a self-priming pump now elevates wastewater from the influent sump to the treatment tank. The aerator brush mechanism is operation and in satisfactory condition.

The secondary clarifier, sludge treatment tank and drying beds, and the chlorine contact tank are all in-ground concrete structures in good condition. They are not well operated. For example, no chlorination was occurring. The plant effluent appears significantly clearer than the influent. This and analytical data supplied for the plant suggest the plant is operating relatively successfully.

Caymanas Gardens is a pond system. It is found in a remote location without an access road and can be visited only on foot. The lagoons are empty and mostly dry. The lagoons are overgrown with vegetation. A break in the influent line allows all influent to escape to an adjacent gully along the lagoons, and no wastewater arrives at the small plant influent structure. The system hasn't been in operation for several years.

Table 2.2.3 shows the results of water quality checks for the treatment plants in Portmore. Actual effluent quality exceeds considerably the allowable limit for the major regulated characteristics. These data are from minimal sampling episodes and are not thorough or statistically valid.

Table 2.2.3 Water Quality at Sewage Treatment Plants in Portmore

Item	Unit	Bridgeport		Ind/ City		Hamilton Gardens		Caymanas Garden		NEPA*
		Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Effluent
BOD	mg/L	464.3	306.4	482.4	339.6	493.1	73.8	NA	NA	20
TSS	mg/L	250	93	234	194.3	241.3	18	NA	NA	30
Phosphate	mg/L	18.5	16.7	20.1	18.4	26.8	11.7	NA	NA	10
Nitrogen	mg/L	40.1	33.5	45.4	36.4	62.1	19.1	NA	NA	30
PH	-	7.3	7.4	7.4	7.2	7.6	7.4	NA	NA	6-9
COD	mg/L	555.6	509.8	488.8	380.7	703	181.7	NA	NA	100
Fecal Coliform	MPN/100mL	≥1600	≥1600	≥1600	≥1600	≥1600	≥1600	NA	NA	1000
Res. Chlorine	mg/L	0.09	<0.02	0.06	0.09	0.06	0.02	NA	NA	1.5

Source) NWC
Note) NEPA standard to be applied to existing treatment plants.

Current sewerage development strategy for KSA and Portmore is to convey all sewage generated in those areas to the Soapberry STP to be treated in its tertiary treatment process to satisfy the requirement of NEPA effluent standard. Existing treatment plants in those areas will be decommissioned in the future excluding some treatment plants in remote areas, e.g., Harbour View STP. Specifications for the Soapberry STP are shown in Table 2.2.4.

Table 2.2.4 Soapberry Sewage Treatment Plant

Item	Specification
Target Year	2025 (completion of Phase 1 development in 2008)
Design Served Population	743,600 as of 2025
Treatment Capacity	Planned total treatment capacity: 225,000 m^3/day Present treatment capacity: 82,000 m^3/day (18 MGD)
Treatment Process	Waste Stabilization Pond (Advanced Integrated Pond System) +Sand filtration for tertiary treatment
Outlet	Rio Cobre River
Facilities	Inlet Chamber, Anaerobic Pond, Facultative Pond Pumping Station, Dissolved Air Flotation, Sand Filtration Control house including laboratory

Source) JICA Survey Team

Table 2.2.5 shows current daily inflow rate to the Soapberry STP on the basis of actual flow measurement data from March, 2008 to March, 2009, excluding some outliers.

Table 2.2.5 Inflow Rate to Soapberry Sewage Treatment Plant

Measurement Point	Average Daily Flow Rate	Remarks
Soapberry STP	26,777 m^3/day	32.7% of Capacity
Greenwich STP	16,122 m^3/day	Flow to Soapberry
Nanse Pen PS	9,353 m^3/day	Flow to Soapberry

Source) NWC data

Sewage to the Soapberry STP is transferred through the Greenwich STP and the Nanse Pen pump station where the flow rates are measured. The result shows that current inflow rate is only approximately 30% of the design capacity of the current phase of the plant although the measurement equipment is functioning properly. The low rate of inflow to the Soapberry STP seems to be due to operational difficulties at the Darling Street PS. At present, essentially none of the sewerage from the Darling Street PS is being pumped to Soapberry. An ongoing project is expected to remedy this problem.

Characteristics of the influent and effluent to the Soapberry STP are shown in Tables 2.2.6 and 2.2.7, respectively.

Table 2.2.6 Influent Quality of Soapberry STP

	pH	**BOD (mg/L)**	**COD (mg/L)**	**TSS (mg/L)**	**Phosphate (mg/L)**	**T-N (mg/L)**
Design Limit	**6-9**	**250**		**240**		**50**
Average	7.3	273.2	511.1	294.9	11.4	41.1
Maximum	8.07	1124.0	1700.0	1090.0	37.0	159.0
Minimum	6.21	65.0	137.0	76.8	4.7	11.0

Source) NWC

Table 2.2.7 Effluent Quality of Soapberry STP

	pH	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Phosphate (mg/L)	T-N (mg/L)	Faecal Coliform (MPN/100ml)
NEPA Standard	**6 - 9**	**20**	**100**	**20**	**4**	**10**	**200**
Average	8.0	15.2	43.5	5.5	5.8	14.0	288
Maximum	9.0	55.0	67.0	10.0	12.6	35.5	2,400
Minimum	6.6	1.0	14.0	2.0	0.8	0.8	3

Source) NWC

As a result of the water quality survey, some treatment performance indicators, e.g., Phosphorus, Total Nitrogen and Fecal Coliform, exceed the allowable limit value of the NEPA standard although the O&M condition is deemed adequate through the visual inspection.

(2) Pump Stations

There are a number of sewage transfer pump stations in the Project Area, especially Portmore. The major pump stations are Darling Street and Nanse Pen pumping stations in KSA, pumping sewage collected from currently sewered areas to the Soapberry STP. Those pumping stations were upgraded under the first phase project of the Soapberry STP.

In Portmore, there are eighteen (18) existing sewage pump stations. However, the specifications of those pump stations have not been obtained due to missing of design documents in the past. From a review of some design drawings and interviews with NWC operations and engineering personnel, most pump stations were designed for submersible pumps or for some type of pump installed in a wet well/dry well configuration.

Many of the pump stations in Portmore included influent screens or communinators for managing solids. Some also had mixers in the wet wells to prevent solids depositions. All appeared to have been designed to include stand-by generators as well. However, within the past twenty years, all pump stations were redesigned to accommodate above-ground self-priming pumps through a principal of attrition of the previous pumps or problems with flooding. Also contributing to the redesign of the pump stations was the owner's general dissatisfaction with the original pumps, which apparently had problems with solids or grit.

Now, all pump stations feature two (2) or three (3) above-ground self-priming pumps, all of the same Gorman-Rupp model of various sizes ranging between three (3) and eight (8) inches suction diameter. All pumps are powered by belts connected to a motor mounted at an elevation at or above the top of the pump casing. Most pumps are mounted on indoor or outdoor slabs at or above ground level. A few were encountered below grade on steel platforms mounted above the wet well. In all pump stations, the suction piping extended down to the swage sump or wet well with steel pipe. Generally, the suction pipes were not taking suction from an optimal location within the wet well, but rather the pumps were mounted in any location available, with the suction piping terminating at any point communicating hydraulically with the flow. In some cases, suction was taken from influent

channels. Aside from a few apparently shop-made screens, all influent works were either removed or in place but out of service. The present sewerage layout plan in Portmore is shown in Figure 2.2.2.

In all cases save for the Garveymead site, all stations were operating with only one pump in service. The other pumps were without motors or in other sorts of disrepair-typically very significant disrepair. NWC staff suggested the other pumps, motors, and parts were scavenged to serve other stations. However, the staff also suggested that the stations operate satisfactorily with one pump in operation. This suggests that the pump stations were designed for one single pump to handle even peak flows, with no occasional duty assistance from the spare pump.

None of the pumping stations have any flow meters, nor do they have any wet well level indication devices. The stations have no sort of remote operation or signaling system. There appeared to be no alarms for high- or low-level conditions in the wet well.

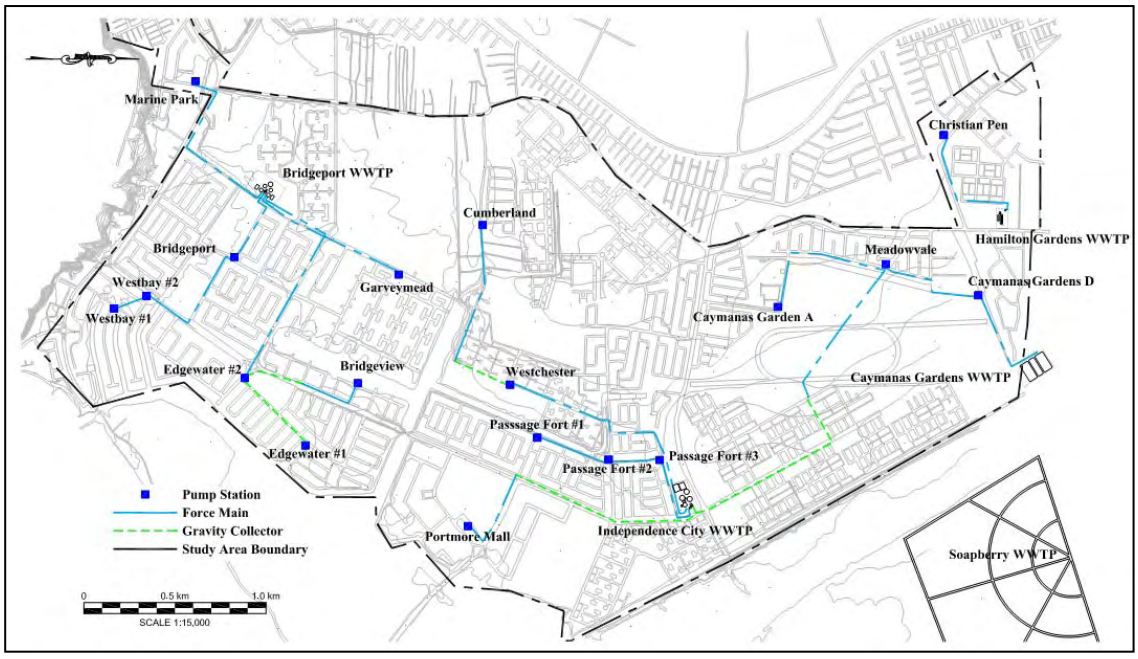
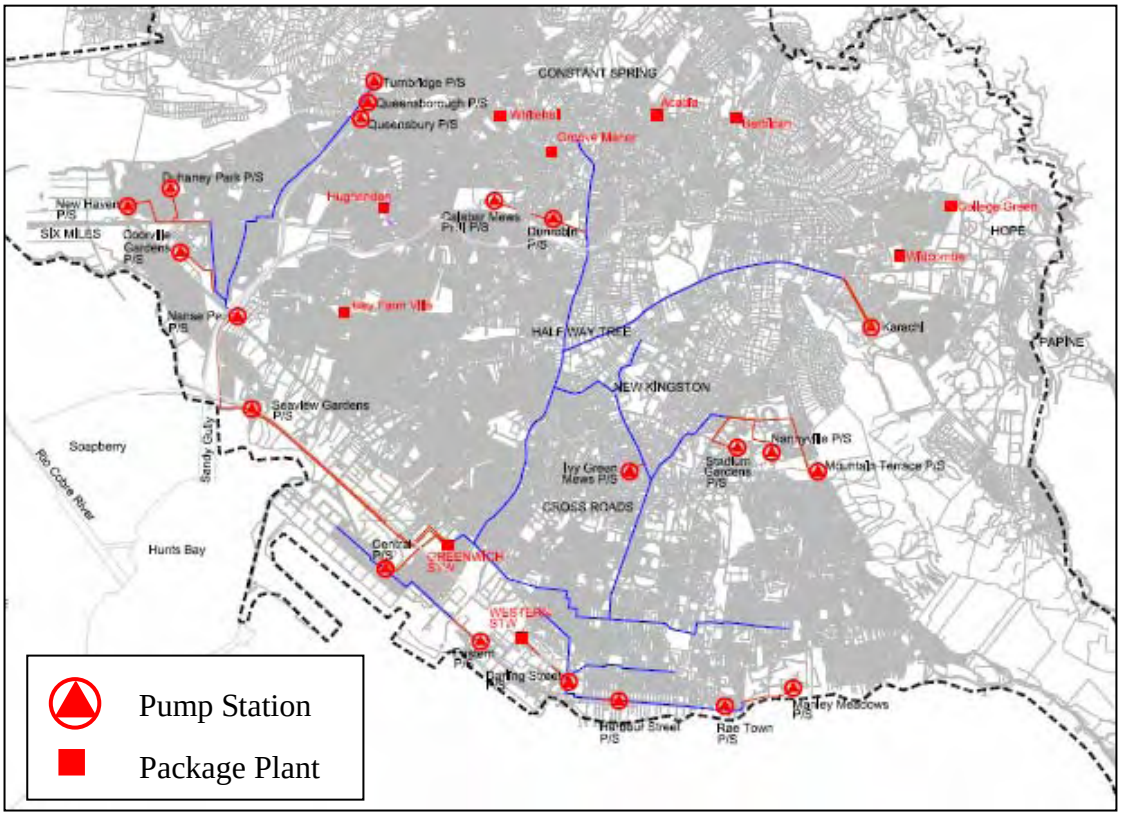


Figure 2.2.2 Existing Sewerage Facilities in Portmore

Overall, the pump stations were in poor condition with regard to the supporting infrastructure. The accompanying building structures seemed to be satisfactory, but motor control centers were often partially disassembled or scavenged for parts. About half of the stations included standby generators that were many years out of service, with many parts ostensibly scavenged for other facilities. Few buildings had functioning lighting, and the security fences and building doors generally lacked locks. Slight evidence of some corrosion in the concrete resulting from sewer gases was observed, but generally only where wet wells were enclosed in concrete structures. Considering the age, this was normal or less than expected.

Operationally, the wet wells were generally unkempt, with accumulated trash and debris observed. A few pump stations, for example at Portmore Mall, had very thick and hard grease layers on the wet well water surface. None of the pump/motor combinations had protection for rotating equipment; the belt-and-pulley style of the self-priming pumps presents a significant hazard to operators and mechanics. Evidence of some surcharging in a few pump stations was observed. Odors were typically minimal at the facilities, indicating short detention times in the collection system and well ventilated sewers. In general, housekeeping was quite poor at the facilities, with overgrown grass and shrubbery, litter, and interior facilities with much accumulated dirt and dust.

On the other hand, several pump stations are located in KSA area although those are out side of the project target areas excluding Nanse Pen pump station. The Nanse Pen pump station works to pump sewage flown from Duhaney Park residential area in the western part of KSA up to the junction point of the primary trunk sewer from Greenwich STW. Sewers from western two catchment areas of the project target area of KSA would be also connected to the Nanse Pen pump station. According to the KBR study, the pumping capacity of the Nanse Pen pump station is 720 l/sec consisting of 3 duty pump units and one stand-by pump unit. The location of the pump stations in KSA is shown in Figure 2.2.3.



Source) KBR study

Figure 2.2.3 Existing Sewerage Pump Station in KSA

General information of pump station is summarized in Table 2.2.8.

Table 2.2.8 Summary of Pump Station

Station Name	Location	Capacity (L/s)	No. of Pump Unit	Pump Type	Service Commencement	Remarks
Calabar Mews PH II	KSA	NA	NA	NA	NA	
Cooreville Gardens	KSA	58	2	NA	NA	
Darling Street	KSA	168	3	NA	NA	under IDB rehabilitation project
Duhaney Park	KSA	52	3	NA	NA	
Dunrobin Acres	KSA	26	2	NA	NA	
Harbour Street	KSA	210	4	NA	NA	
Ivy Green Mews	KSA	5	2	NA	NA	
Karachi	KSA	NA	NA	NA	NA	
Manley Meadows	KSA	79	2	NA	NA	
Mountain Terrace	KSA	26	2	NA	NA	
Nannyville Gardens	KSA	52	2	NA	NA	
Nanse Pen	KSA	720	4	Submersible	NA	Pump unit updated
New Haven	KSA	58	2	NA	NA	
Newport East (Eastern Industrial)	KSA	63	3	NA	NA	
Newport West (Central Industrial)	KSA	95	4	NA	NA	
Queensbury	KSA	26	2	NA	NA	
Queensborough	KSA	26	2	NA	NA	
Rae Town	KSA	58	2	NA	NA	
Seaview Gardens	KSA	58	4	NA	NA	
Stadium Gardens	KSA	26	2	NA	NA	
Tunbridge	KSA	26	2	NA	NA	
Bridgeport	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Bridgeview	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Caymanas Garden A	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Caymanas Garden D	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Christian Pen	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Cumberland	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Edgewater #1	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Edgewater #2	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Gravymead	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Marine Park	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Meadowvale	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Passage Fort #1	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Passage Fort #2	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Passage Fort #3	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Portmore Mall	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Westbay #1	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Westbay #2	Portmore	NA	2	Self-priming	NA	Only one pump unit in service
Westchester	Portmore	NA	2	Self-priming	NA	Only one pump unit in service

Source) KBR study and JICA Survey Team Site Inspection

The Darling Street pump station which is the main pump station transferring sewage from existing downtown catchment area to the Greenwich Sewage Treatment Works (STW) has been degraded and need to be upgraded for enhancement of sewage flow to the Soapberry STP. Fortunately the Darling Street pump station will be rehabilitated under the Kingston Water and Sanitation project funded by IDB

(3) Sewer Pipelines

The current sewer network is developed in the downtown area, Harbour View community, and Duhaney Park community of KSA, and almost all of the Portmore area. Current total length of sewer pipelines in KSA is about 240 km with diameters ranging from 100 mm to 1,050 mm. Table 2.2.9 shows the breakdown of the length of current sewer pipe lines by

diameter, and Figure 2.2.4 shows the areas of KSA currently serve by sewer collection systems.

Table 2.2.9 Current Sewer Pipe Lines in KSA

Diameter (inch/mm)	Length (m)	Diameter (inch/mm)	Length (m)
4/100	5,390	20/500	1,470
6/150	58,550	21/525	1,480
8/200	83,910	22/550	420
10/250	23,620	24/600	2,120
12/300	9,250	30/750	29,890
13/330	1,650	36/900	1,120
15/380	6,310	42/1050	2,880
16/400	930	N/A	7,050
18/450	1,740		
Total			237,780

Source) NWC

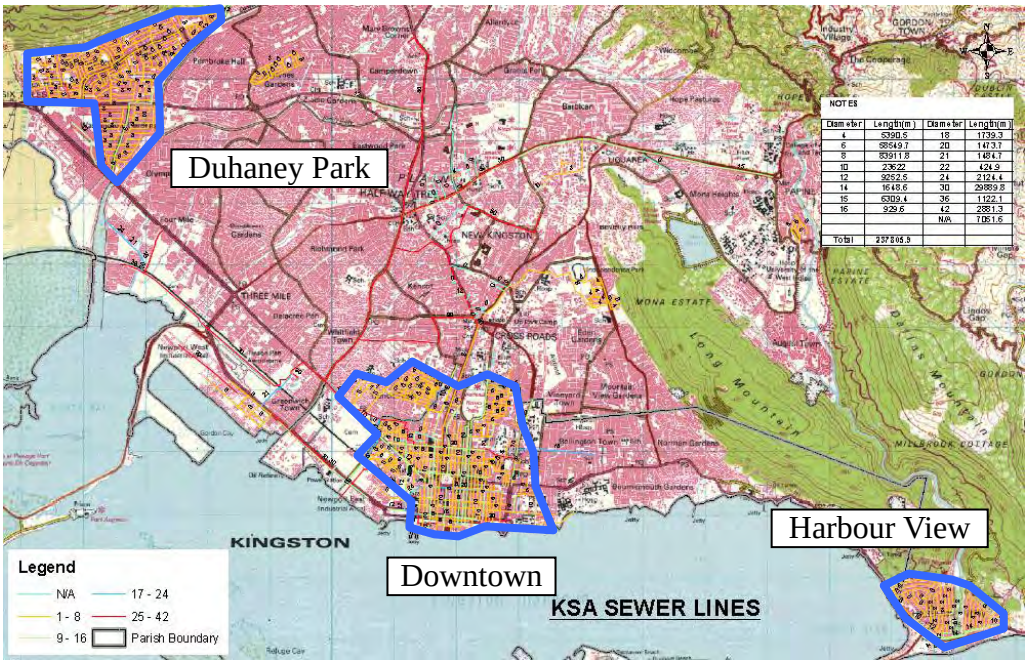


Figure 2.2.4 Current Sewer Pipe Lines in KSA

Flow capacities of existing trunk sewers were estimated under the KBR Study. The results of this estimation are applied to this survey for the demand forecast of the existing sewers' upgrade scheme under the future sewerage development.

Drawings depicting the existing sewer network in Portmore were not well catalogued in NWC archives. The general character of the system in Portmore was determined from a review of original design drawings at a local contractor responsible for the construction of a large number of housing schemes in the area, some of which were constructed 40 years ago. In general, gravity sewers are constructed near the ground surface in the middle of the street.

The sewers drain small areas to numerous lift stations, and the discharge force mains convey sewage to one of the several treatment plants in the area. The sewers are typically of small diameter and there is no existing long interceptor system which could be utilized in this project.

Because of the lack of data available from the NWC, many aspects of the existing sewage system in Portmore. Despite site visits, review of available plans, and interviews with NWC operations personnel in the area, there remain many doubts regarding alignment of force mains, the limits of sewer catchments contributing to specific lift stations, and the overall areas contributing to the Caymanas Gardens Ponds and Hamilton Gardens treatment plants.

These doubts could not be resolved during the activities included in this Preparatory Survey. Any future engineering phases of this project should include a relatively substantial data collection task to delineate some questionable sewer catchments and solidify the boundaries that will contribute to the improved system.

(4) Other Donor Activities for Sewerage Sector

The Inter-American Development Bank (hereinafter IDB) is financing the renovation of the Darling Street Pump Station. According to NWC, the conceptual design has been completed in October 2009. The study was carried out by the consortium of N.O.WHYTE & Associates and Egis Bceom International. The total construction cost is estimated at approximately 5.2 million USD (original estimation made in EURO because of French consultant's estimation) as most feasible option selected out of three alternatives. The project would be mainly composed of replacement of pump facilities, installation of mechanical screen, construction of new generator & control room and surge tank. Five units of submergible pumps including four duties and one stand-by would be installed. Total capacity of the pump station would increase to 0.6 m^3/sec as contrasted with the current capacity of 0.2 m^3/sec. The design horizon of the pumping units was set at 2030.

(5) Groundwater Contamination

According to NWC, some of wells in Kingston Area, which were utilized for water sources, were closed down due to contamination of the groundwater. But any health hazard caused by contaminated groundwater has not been confirmed. The following table shows results of water quality test in wells closed down.

Table 2.2.10 Water Quality of Water Source Wells closed down

Name of Well	Date	Chloride (mg/l)		NO_3 (mg/l)		Reason for Closure
		Result	Standard	Result	Standard	
Cockburn Pen	27 Aug 1974	106	250	96.0	45	High Nitrates
Devon House	20 Jun 1982	25.0	250	38.0	45	Insufficient capacity of pump
Oakland Road	04 Sep 1973	117	250	116	45	High Nitrates
Trench Town	10 Sep 1991	72.0	250	98.5	45	High Nitrates and corruption of well

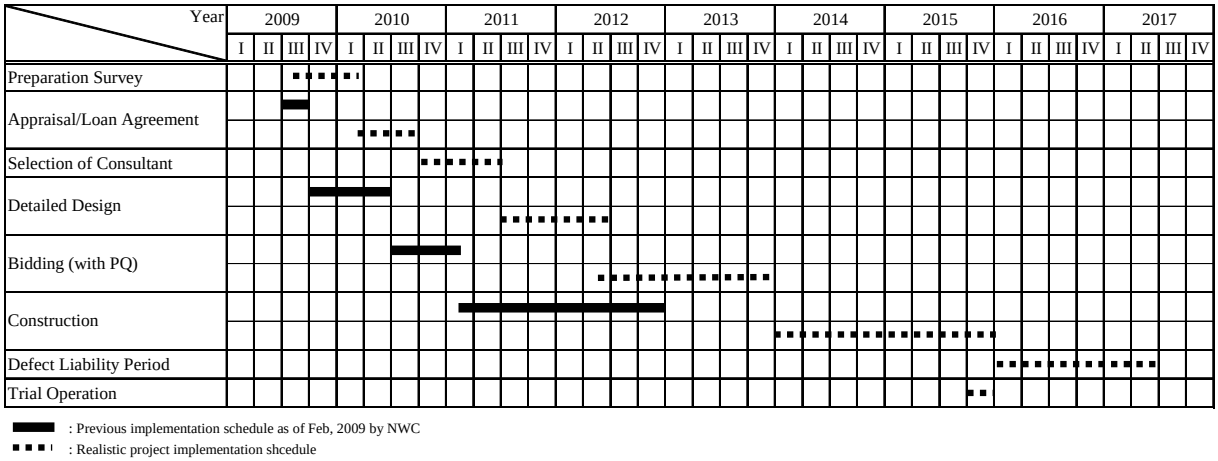
Source) NWC

Nitrates in the water/groundwater are normally derived from inorganic fertilizer, domestic sewage, industry sewage, etc. Taking into consideration that almost all unsewered households use soakaways, untreated domestic sewage infiltrated into the ground probably affects groundwater quality so that the expansion of sewerage network and certain house connection in the sewered areas are to be essential.

2.3 Review of Framework for the Sewerage Project

2.3.1 Target Year

As described above, the demand for these sewerage development projects for KSA and Portmore is high. It is urgent for the NWC to realize sustainable management of proposed sewerage works through an increase in revenue. Considering the project implementation plan and an effective project performance, the target year for this project shall be 2020, which is around 5 years after completion of the project, based on the tentative project implementation plan in Figure 2.3.1.



Source) JICA Survey Team

Figure 2.3.1 Project Implementation Plan

The dashed lines show a more realistic schedule compared to the continuous lines, representing the schedule once suggested by NWC. Completion of this project would be expected in 2015. Accounting for reasonable rate of sewer connections in the KSA area, 2020 is a more reasonable projection.

On the other hand, a long term sewerage development plan is normally set over 20 to 30 years. The current project horizon is until 2025 so that the year of 2030 is suitable for the long term sewerage development plan. Current long term development plan horizon until 2025 shall be reviewed and upgraded if necessary.

2.3.2 Population Forecast

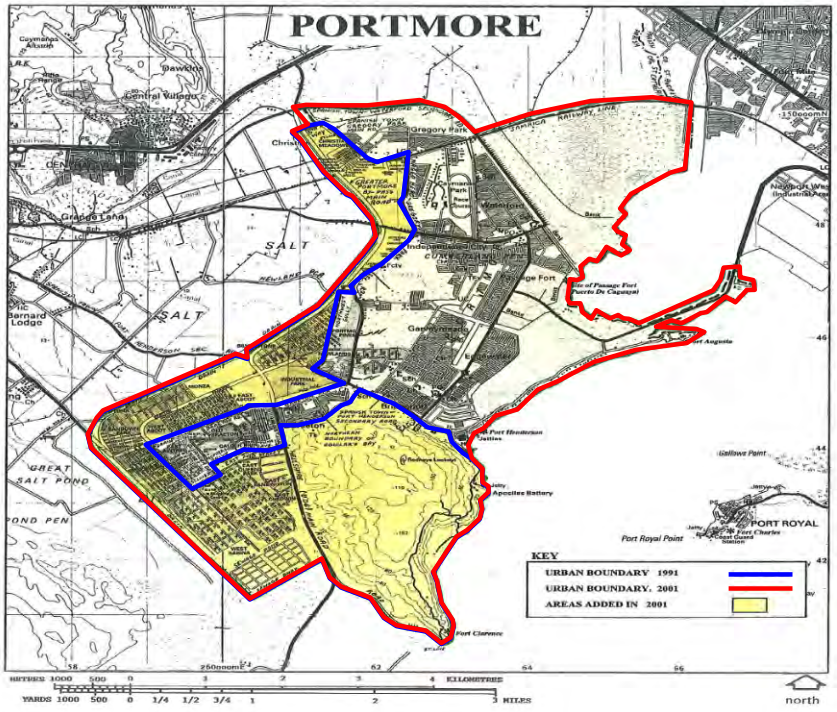
(1) Population Growth Rate

In contrast to the actual population growth rate in the project area as described in Section 2.1.2, the KBR study concluded that the population of Kingston would cease to decrease and remain static because the National Housing Trust has a redevelopment plan for the downtown of Kingston in order to introduce commercial activities and improve the surrounding area for residential use, and the population of Urban St. Andrew would continue to increase at 0.9% per annum.

The population forecast for Portmore has not been reported since 1999 when the Special Assistance for Project Implementation (SAPI) study conducted for the KMA Water Supply and Rehabilitation Project. The SAPI report concluded the population growth rate for Portmore at 2.0% per annum. The SAPI report concludes:

"The towns of Spanish Town and Portmore have average population growth rates during 1982-1991 of 2.55% and 2.12% per annum, respectively, according to the census population."

Comparing the above-mentioned rate at 2.12% with latest result at 0.3% in 2001, the population migration to the project area for Portmore seems quite low currently. It can be assumed that housing development schemes in the project area have been completed, and expanded to the adjacent areas. The expansion of administration boundary of Portmore is shown in Figure 2.3.2.



Source) Population Census 2001

Figure 2.3.2 Change of Boundary of Portmore

For sensitivity of project scope with different population growth rate, the population forecast was provided in both cases with actual growth rate and design growth rate in the previous studies as shown in the following table. The population growth rate for the Kingston is negative in the latest census decade, but the project sites of KSA is basically located in St. Andrew so that the population growth rate of the Kingston does not directly affect the project scope. Population growth rate for Kingston was preserved as stable because of on-going redevelopment scheme in the downtown area of the Kingston for improvement of living condition.

Table 2.3.1 Design Population Growth Rate

(Unit: %)

	KSA		Portmore
	Kingston	St. Andrew	
Previous Study Basis	0	0.9	2.0
Census 2001 Basis	0	0.3	0.3

Source) JICA Survey Team

(2) Population Forecast

For KSA area, the future population was estimated not only for the project target area but also for the other area of KSA because of consideration for the future sewerage expansion.

For the Portmore area, the future population was estimated for the project target area only, because of the sewered area to be connected to the Soapberry STP has been specified as

existing catchment areas for the Bridgeport STP, the Independence City STP, Hamilton Garden STP and Caymanas Garden STP. According to the above-mentioned condition, the future population was estimated as shown in Table 2.3.2.

Table 2.3.2 Forecasted Population in the KSA and Portmore Area

(Unit: persons)

Catchment	Year	2010		2015		2020		2025		2030	
KSA	Grwth Rate	0.3%/annum	0.9%/annum	0.3%/annum	0.9%/annum	0.3%/annum	0.9%/annum	0.3%/annum	0.9%/annum	0.3%/annum	0.9%/annum
	Project Area	52,800	55,700	53,600	58,200	54,400	60,900	55,200	63,700	56,000	66,600
	Other	514,600	538,300	521,000	559,000	527,600	580,600	534,300	603,300	541,100	626,900
	Sub-total	**567,400**	**594,000**	**574,600**	**617,200**	**582,000**	**641,500**	**589,500**	**667,000**	**597,100**	**693,500**
Portmore	Grwth Rate	0.3%/annum	2%/annum	0.3%/annum	2%/annum	0.3%/annum	2%/annum	0.3%/annum	2%/annum	0.3%/annum	2%/annum
	Independence	51,900	60,500	52,700	66,800	53,500	73,700	54,300	81,400	55,100	89,900
	Bridgeport	25,900	30,300	26,300	33,500	26,700	37,000	27,100	40,800	27,500	45,100
	Hamilton G	1,500	2,000	1,500	2,200	1,500	2,400	1,500	2,600	1,600	2,900
	Caymanas G	5,600	6,500	5,600	7,100	5,700	7,900	5,800	8,700	5,900	9,600
	Sub-total	**84,900**	**99,300**	**86,100**	**109,600**	**87,400**	**121,000**	**88,700**	**133,500**	**90,100**	**147,500**
Total		**652,300**	**693,300**	**660,700**	**726,800**	**669,400**	**762,500**	**678,200**	**800,500**	**687,200**	**841,000**

Source) JICA Survey Team

The result of estimation shows that the future population of 2030 in the KSA and Portmore areas would reach to 600,000~694,000 and 90,000~148,000, respectively.

2.3.3 Water Demand Forecast

The Study Team was provided with approximately three (3) years of water meter billing data for the Kinston, St. Andrew and Portmore in the survey areas. Previously, the NWC GIS staff executed a pilot project to geo-locate a significant number of accounts to their actual coordinates; these GIS files were provided to the Survey Team and were used to select the water meter records within the Portmore study area.

The result was a database of a year of water billing data for some accounts in the Portmore area for eleven (11) months between July 2009 and August 2008 (excepting September, 2008). Overall, approximately 9,600 records were identified for the Portmore area. Given that over 17,000 homes are identified in Table 2.3.2, it is assumed that these records do not include exactly every water meter record in the study area, but in this case they are a very accurate representation given the number of accounts. When viewed graphically in the GIS, they are well distributed across the survey area and do not appear to show any obvious geographic bias.

The data included water meter readings and data about each account, such as fields for "rate code" and a "property class". The data included a significant number of records that showed zero consumption for all 11 months; these data were discarded, resulting in a useful database of approximately 7,100 users. Only 3,500 of these showed non-zero numbers for all 11 months.

The summary of these 3,500 records are provided in Table 2.3.4, segregated by rate code and property class to illustrate the difference between types of users. Only the records with all 11 months were used because it was unknown why months were missing and whether the water

use for missing months was accurately included in the subsequent month's water meter readings.

The most useful information from this data is the average monthly water use for rate code 01, which must be for typical residential users. That value is 15.9 m^3 per month. Given the number of accounts and account names for the other rate codes, they are assumed to represent high-volume commercial, industrial, institutional, and high-occupancy users.

The average residential water use of 15.9 m^3 per month per connection correlates to about 520 lpd per connection, which in turn is equivalent to 115 igpd per connection. Assuming 3 to 4 residents per connection results in a daily per capita water use of 130 ~ 170 lpd, which are normal values.

Table 2.3.3 Summary of Water Use Records in Portmore for the Year Ending July 2009

Rate Code	Property Class	Average Monthly Water Use (m^3)	Number of Records
Domestic Rate: 01		15.88	3,416
	House: HO	15.08	270
	High school: HS	12.40	34
	Open lot: OL	14.18	2
	Shop: SH	16.41	2
	blank	15.99	3,108
Commercial Rate: 02		25.98	26
	House: HO	21.27	2
	Open lot: OL	19.67	3
	Shop: SH	5.55	4
	Supermarket : SM	39.73	1
	blank	32.00	16
Primary School: 03		11.09	1
	blank	11.09	1
Staff Rate: 30		23.85	36
	House: HO	37.23	2
	blank	23.06	34
Blank			
	blank		
Grand Total		16.03	3,479

Source) NWC

To glean additional conclusions from the data, the sum of water meter readings for all months was performed. This diminishes some of the errors from using only averages. The total water demand for the 7,100 users for the 11 months in the data set is illustrated in Figure 2.3.3.

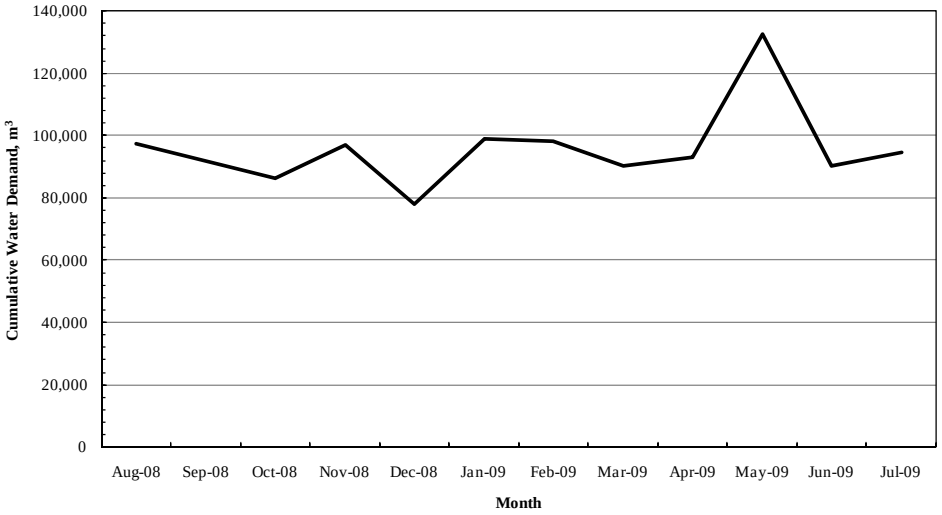


Figure 2.3.3 Monthly Cumulative Water Demand for 11 Months of Recent Data

Given these metering data, the average daily water use in the entire area, including all metered uses from all residential, commercial, and industrial users in the area is approximately 1.15 million m^3 per year, for the approximately 7,100 users for which the data are provided. So the water consumption per user (connection) can be estimated at 162 m^3 per year, which is equivalent to 444 l/day per user. If 3 to 4 residents per connection are assumed, the daily consumption per capita is estimated ranging 111 ~ 148 lpd per capita.

According to the KBR study, the water consumption as of 2001 was estimated at 173 lpd per capita including domestic, commercial and industrial uses. Future water demand in 2025 was estimated at 182 lpd per capita. In accordance with all these data, water demand projection per capita for the future is presented in Table 2.3.4.

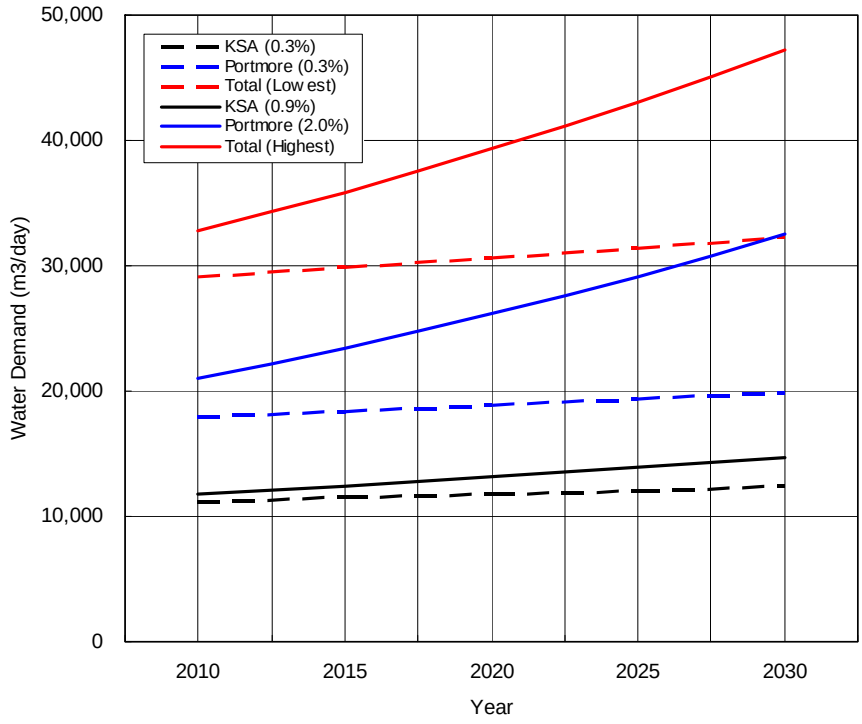
Table 2.3.4 Forecasted Water Demand per Capita

(Unit: lpd per capita)

Year	2001	2005	2010	2015	2020	2025	2030
Demand	173.0	174.5	176.3	178.2	180.1	182.0	183.9

Source) JICA Survey Team

In this line, the water consumption in 2009 is estimated at approximately 176 lpd per capita. Comparing current consumption at 110 ~ 170 lpd per capita with the forecasted value at 176 lpd per capita, the forecasted value can be deemed suitable to apply to the project. Water demand forecast for the Project areas of KSA and Portmore is illustrated in Figure 2.3.4.



Source) JICA Survey Team

Figure 2.3.4 Water Demand Forecast for the Project Areas

Conditions of estimation for water demand forecast are as follows:

1) Served population rate was set at 100% of the population in the target area,
2) Allowance at 20% of total demand for commercial and industrial consumption on the basis of the NWC's Customer Accounting System (CAS) data for 2002

2.3.4 Sewage Production Forecast

(1) Sewage Production Rate

As above described, the water consumption per capita which was reviewed and updated during KBR study in 2003 is basically accepted for this survey. The proportion of domestic sewage production is also referred to the KBR study. In accordance with the KBR study, the proportion of the water consumption returned as sewage was defined as return factor at 85% of water consumption. This value is appropriate as compared with other cases of the sewerage development studies, for example 90% for Hanoi City in Vietnam or 80% for Ciudad del Este in Paraguay. The KBR report said that the domestic sewage production would increase from 147 lpd per capita in 2001 to 155 lpd per capita in 2025. In line with this, the domestic sewage production per capita for the future was estimated as shown in Table 2.3.5.

Table 2.3.5 Forecasted Sewage Production per Capita

(Unit: lpcd)

Year	2001	2005	2010	2015	2020	2025	2030
Demand	147.0	148.3	150.0	151.6	153.3	155.0	156.7

Source) JICA Survey Team

The KBR study provided detailed sewage production rate for KSA on the basis of the classification of community-wise household income level as shown in Table 2.3.6.

Table 2.3.6 Unit Sewage Production Rate for KSA

(Unit: lpcd)

Year / Classification	2001	2010	2015	2020	2025	2030
L	85	93	97	101	106	111
L/M	149	149	149	149	149	149
M	187	187	187	187	187	187
M/H	213	213	213	213	213	213
H	255	255	255	255	255	255

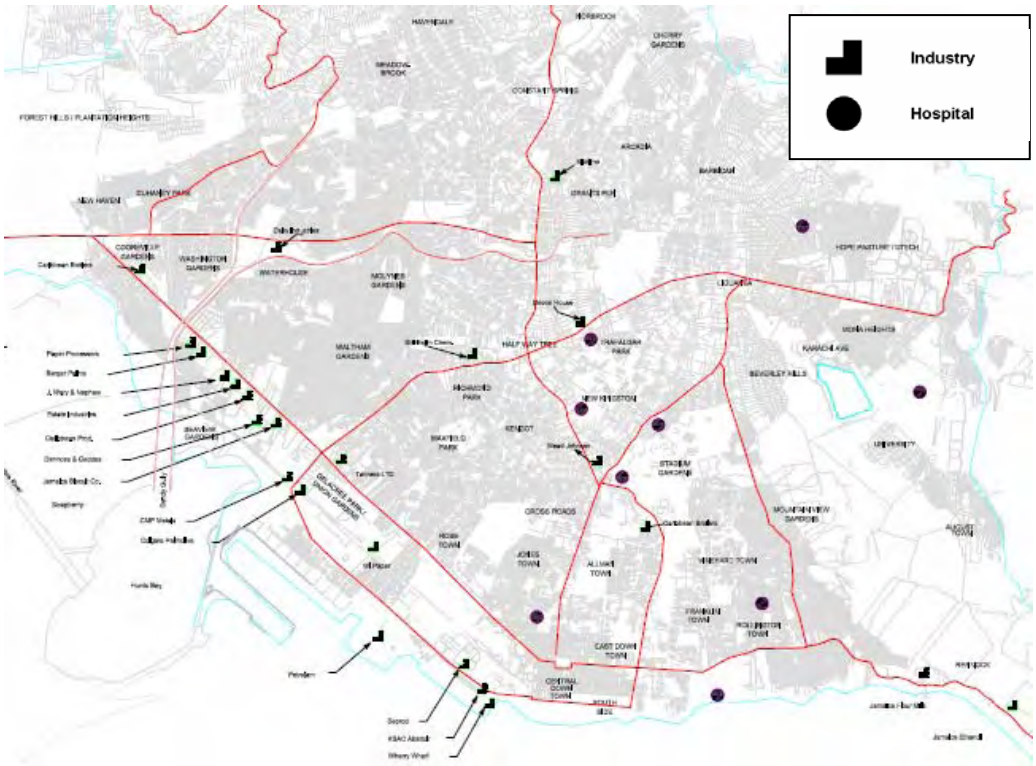
Source) JICA Survey Team (Estimation based on the KBR study)

It was assumed that the classification in Table 2.3.6 might be provided on the basis of quintile group of the household expenditure level which was analyzed through the past statistical surveys such as the household expenditure survey by Jamaica Statistical Institute (STATIN) and/or Jamaica Survey of Living Condition by Planning Institute of Jamaica (PIOJ).

For the preliminary design calculation of the sewerage facilities, those classified unit sewage production rates were applied. However those values were prepared for KSA area so that the figures as shown in Table 2.3.5 should be applied to Portmore area because the survey team did not encounter such community classification data for that area.

(2) Industrial and Commercial Sewage

As a quick survey of the industry manufacturers in/around the project target areas, there are not large scale industries but several service industries of shopping centers, restaurants, small retailers and other similar enterprises. Those service industries do not cause significant impact to the water use in general. Locations of industries and hospitals/institutions to be considered as point sewage inflow to the sewerage system in the KSA area are illustrated in Figure 2.3.5. Almost of all those points exist outside of the project sites for KSA area. The specific rates of point sewage inflow were referred to the KBR study and included overall sewage flow estimation for the KSA area.



Source) KBR Study

Figure 2.3.5 Location of Industries and Hospitals for Point Inflow

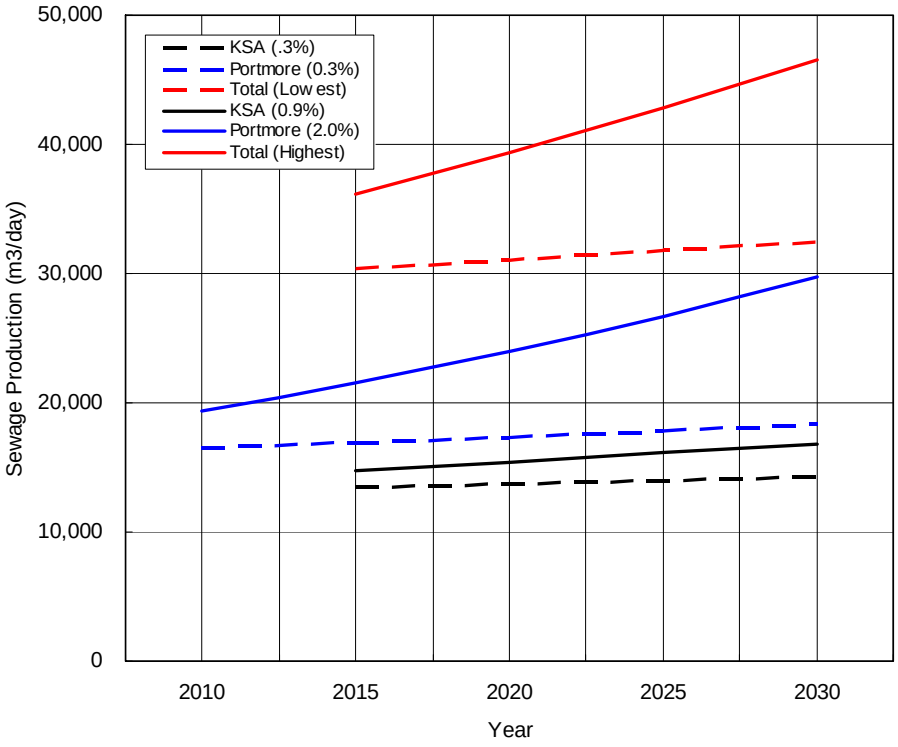
As described in Figure 2.3.5, major industries do not exist inn the project areas in KSA. This was confirmed through the field investigation during the first survey in Jamaica. One hospital, National Chest Hospital and University of Technology (UTECH), is located in the project area so that sewage inflows from those institutions were considered as point sewage inflow into the design sewage flow rate calculation. Sewage inflow from other minor industries and commercial buildings were estimated multiplying specific ratio as same value of the KBR study by domestic sewage inflow.

(3) Infiltration

With regard to infiltration into a sewerage system, the KBR study provided infiltration rate at 40% of average sewage flow regardless of new sewers. This figure is very high for a new sewerage system when considering pipe materials, pipe joint type, and modern construction methods. According to a Japanese design guideline for sewerage works, infiltration rate for a sewerage system is recommended at 10~20% of the sum of domestic and commercial sewage flows. So infiltration rate at 20% would be recommended considering the use of PVC and GRP pipes, common materials in Jamaica, which provide higher water tightness.

(4) Sewage Production Forecast

In considering the above-mentioned situation, the sewage production for the project areas of KSA and Portmore was estimated and illustrated as shown in Figure 2.3.6.



Source) JICA Survey Team

Figure 2.3.6 Forecasted Sewage Production for the Project Area

Conditions of estimation for sewage production forecast are as follows:

1) Sewered rate was set at 100% in the KSA sites and 98% in the Portmore sites;
2) Allowance at 20% of domestic sewage production for industrial and commercial sewage for the Portmore sites. 13.1%~39.4% of domestic sewage rate was adopted for the KSA sites with reference to the community classification based on the KBR study; and
3) Allowance at 20% of total amount of domestic and commercial/industrial sewage for infiltration to the sewers.

Breakdown of the sewage production estimation is described in Appendix B of this report. Table 2.3.7 shows summary of estimation.

Table 2.3.7 Summary of Sewage Production Estimation

Case/Area	Item	2010	2015	2020	2025	2030
	Unit Sewage Production (lpcd)	150.0	151.6	153.3	155.0	156.7
Minimum Population Growth (KSA: 0.3% per annum, Portmore:0.3% per annum)						
KSA	1. Sewered Population (per.)	0	53,555	54,360	55,182	56,014
	2. Sewage Flow Rate (m3/day)	0	13,509	13,718	13,927	14,167
	1) Domestic	0	9,340	9,481	9,624	9,770
	2) Industrial & Commercial	0	1,917	1,951	1,982	2,035
	3) Infiltration (groundwater)	0	2,252	2,286	2,321	2,362
Portmore	1. Sewered Population (per.)	83,155	84,410	85,684	86,977	88,289
	2. Sewage Flow Rate (m3/day)	16,449	16,875	17,311	17,758	18,217
	1) Domestic	12,461	12,784	13,114	13,453	13,801
	2) Industrial & Commercial	1,246	1,278	1,311	1,345	1,380
	3) Infiltration (groundwater)	2,741	2,813	2,885	2,960	3,036
Maximum Population Growth (KSA: 0.9% per annum, Portmore: 2% per annum)						
KSA	1. Sewered Population (per.)	0	58,217	60,886	63,674	66,592
	2. Sewage Flow Rate (m3/day)	0	14,674	15,343	16,041	16,805
	1) Domestic	0	10,154	10,619	11,103	11,613
	2) Industrial & Commercial	0	2,073	2,168	2,265	2,391
	3) Infiltration (groundwater)	0	2,447	2,556	2,673	2,801
Portmore	1. Sewered Population (per.)	97,236	107,356	118,530	130,866	144,487
	2. Sewage Flow Rate (m3/day)	19,234	21,462	23,947	26,719	29,813
	1) Domestic	14,571	16,259	18,142	20,242	22,585
	2) Industrial & Commercial	1,457	1,626	1,814	2,024	2,259
	3) Infiltration (groundwater)	3,206	3,577	3,991	4,453	4,969

Source) JICA Survey Team

2.4 Current Issues for the Water and Sanitation Sector

Through the survey obtaining related information, visiting present project site and inspecting existing sewerage facilities, the current issues for the water and sanitation sector are recognized hereunder:

1) Modernization and integration of the existing sewerage system

Almost all the sewerage facilities have been operated in insufficient performance due to degradation of the equipments and facilities. Many existing plants under the NWC management disperse human resources against efficient operation and maintenance (O&M) activities. For streamlining of the O&M, modernization and integration of the sewerage system should be demanded.

2) Capital Cost and O&M Cost Saving

Jamaica faces serious financial crisis especially of excessive public external debt triggered by global economic recession since 2008. The high inflation rate continues in the recent years so that the material cost, equipment cost as well as labor cost have been increasing. Electricity cost has shared approximate 30% of the annual expenditure of NWC and has affected sustainable operation of sewerage facilities. Cost saving program not only for capital cost but for O&M cost should be taken into account in the sewerage development project.

3) Strengthening of O&M Activity

Currently NWC has initiated the integrated information management for her water supply and sewerage works employing GIS technology. All the information of NWC's properties would be integrated to the GIS data base system and effectively applied to the practical O&M plan. In parallel, the preventive O&M plan should be introduced and strengthened to the property management policy of NWC in order to reduce life cycle cost (LCC) of her facilities for sustainable water and sewerage works.

4) Mitigation of Environmental Impact

Almost all the sewerage treatment facilities are operated under poor performance condition and discharge insufficient effluent to a river/stream and a harbour. The Kingston Harbur is the seventh largest natural harbour in the world and the asset of Jamaica from viewpoints of tourism resources and aquatic resources. Current negative impact caused by the untreated sewage discharged should be improved urgently to conserve natural environmental condition of the harbour.

CHAPTER 3 FORMULATION OF THE SEWERAGE DEVELOPMENT PLAN AND PRELIMINARY DESIGN

3.1 Proposed Sewerage Development Schemes for Portmore

3.1.1 Development Policy

NWC requested that four (4) existing sewage treatment plants (STPs) in Portmore, namely the Bridgeport, Independence City, Hamilton Garden and Caymanas Garden STPs, should be decommissioned and pumping stations be constructed to transmit sewage previously treated at these four STPS to the Soapberry STP, a facility originally developed as the centralized STP for the KSA area.

The condition of the four existing Portmore STPs was surveyed through the site investigations by the Survey Team. Caymanas Garden is a lagoon system, but it has been abandoned for several years. The other three STPs are mechanical plants in a state of serious disrepair and do not satisfy the current effluent regulation.

Because of the original design of the plants and the serious deterioration found today, to create a treatment system necessary to satisfy effluent regulations, the existing plants would have to be completely demolished, redesigned, and reconstructed. New treatment plants would require advanced treatment processes for removal of nitrogen and phosphorus.

Through a qualitative evaluation the Survey Team confirmed that the conversion of current STPs into pump stations for the Soapberry STP would be feasible as compared to demolition, redesign, and reconstruction of the four existing STPs. Table 3.1.1 shows a general comparative survey for reconstruction of the four STPs and conversion into pump stations:

Table 3.1.1 General Comparative Survey on Project Validity

Item	STP Reconstruction		Conversion into Pump Station	
Daily Average Flow	Bridgeport (BP)			6,000 m3/day
	Independence City (IC)			11,000 m3/day
	Hamilton Garden (HG)			900 m3/day
	Caymanas Garden (CG)			3,500 m3/day
	Total			21,400 m3/day
Construction Cost	Oxidation Ditch (100,000JPY/m3)		Pump Solution	
	BP (15,000m3/day)*	1,500MJPY	Pump Facilities:	1,383MJPY
	IC (22,000m3/day)*	2,200MJPY	Force Main:	453MJPY
	HG (3,500m3/day)*	350MJPY	Total	1,836MJPY
	CG (9,000m3/day)*	900MJPY		
*: Design Capacity	Total	4,950MJPY		
O&M Cost	BP:	88MJPY/yr	Pump Facilities:	28MJPY/yr
	IC:	161MJPY/yr	Increment at Soapberry Cost	
	HG:	13MJPY/yr	35.59JMD/m3*21,400m3/day	
	CG:	51MJPY/yr	*365days	278MJPY/yr
	Total	313MJPY/yr	Total	306MJPY/yr
Effluent Quality	Satisfaction to NEPA standard		Satisfaction to NEPA standard	

Source) JICA Survey Team

The estimation conditions are shown below:

1) Sewage inflow is based on the projected flows for the year 2020;
2) Oxidation Ditch (OD) method is utilized for the modified treatment process for all four STPs;
3) Construction cost of OD is estimated at 100,000 JPY/m^3 capacity;
4) Construction costs of pump station and conveyance sewers are based on the cost estimate for this project;
5) O&M cost of pump station is based on Japanese guidelines; and
6) O&M costs for OD plants are estimated multiplying unit cost at 40 JPY/m^3 by the daily average flow rate. The treatment unit cost of OD plant was knowingly set higher than the common value because the treatment unit cost of Soapberry STP compared is quite high despite principal treatment process in lagoon type.

3.1.2 Alternatives for Proposed Scheme

The main objective for the improvements proposed here is to eliminate the wastewater treatment plants and deliver flows currently received at the treatment plants to the Soapberry STP. In general, there are two methods to achieve this. The flows can be pumped through force mains buried near the ground surface or allowed to drain via gravity through pipelines that are progressively deeper in the direction of flow. The geography of the area is relatively flat and unfortunately approximately the same elevation of the target Soapberry STP; this is an impediment to either of the alternatives.

Another geographical impediment is the Rio Cobre, which separates the Portmore area and the Soapberry STP and would present a problem to either type of solution. Given that Soapberry already has an expansion plan, it does not appear that there is available land for any receiving/pumping facility at that plant. Any pumping or lifting of flows should occur on the Portmore bank of the Rio Cobre.

3.1.3 Alternative A – Pumped Option

In this alternative, flows are delivered to the Soapberry STP through a series of pumping stations and force mains, in a configuration similar to that proposed in the SENTAR Report in 1993. In general, flows from the Bridgeport STP are pumped via a force main to the Independence City STP site. There, the flows from Bridgeport are combined with the flows currently arriving at the Independence City treatment plant, and another new pumping station at the site sends the flows north, across the river, to the Soapberry STP headworks distribution chamber.

On the northern part of the study area, a new package lift station is installed at the Hamilton Gardens STP and those flows are sent to the Caymanas Gardens Ponds site. A new pumping station at the Caymanas Gardens site receives the flows from Hamilton Gardens and other

areas currently discharging to the Caymanas Gardens ponds. As well, the NWC has requested that the flows arriving at the Portmore Villas ponds, located just north of the Caymanas Gardens Ponds be directed to the new sewage transmission scheme. This new pump station at Caymanas Gardens pond site discharges to a short force main which conveys the flows to the proposed large-diameter force main crossing the Rio Cobre to the Soapberry plant.

(1) New Bridgeport Pump Station and Force Main

The proposed New Bridgeport Pump Station will receive flows from four distinct sources: the Marine Park Pumping Station, the Bridgeport Pump Station, the West Bay Pump Station, and the flows contributing to the Garveymeade Pump Station. The average influent flow from these sources is 70 lps. Given the population served, a peaking factor of 2.5 is selected, leading to a peak flow of 180 lps.

For the peak flow predicted and velocity desired, the selected force main diameter is 250 mm. The force main will discharge to the Independence City PS, a distance of 2,630 m. These parameters lead to a friction head loss of 20 m. There is virtually no difference in the elevation of the two sites, so a static head of zero is selected. Two duty pumps and one standby are selected for the pump station design. The pumps are then specified at 90 lps / 20 m TDH. At 70% efficiency, the pumps require a power of 25 kW.

The pump station is located adjacent to the existing Garveymeade Pump Station. This location advantageously uses a location closer to the subsequent pump station, saving costs for the force main. It is assumed that the land would have to be acquired by the government for this use from a private landowner. It remains possible that the proposed pumping station be constructed on the exact site of the Garveymeade station, though construction activities would be constrained in the smaller area.

The flows from the four existing force mains are delivered to the new pump station by utilizing a combination of a new 300 mm gravity sewer and reversing the flow in the existing force mains. The existing Garveymeade force main extends from the proposed pump station site to the Bridgeport STP. It is assumed that this pipeline can be utilized by reversing the flow direction to accept the Marine Park and Bridgeport force main flows. Where the Edgewater force main reaches the main road, the three flows then discharge into the new gravity sewer. The hydraulic feasibility of this scheme would have to be confirmed in the next phase of the project.

All existing facilities and infrastructure at the existing Bridgeport STP can be demolished and the site restored to a completely clean and native condition. The site may be utilized by the NWC or Jamaican Government for other purposes or sold to a private interest.

(2) Independence City Pump Station and Force Main

This facility will receive sewage from several sources. The primary source will be the gravity sewer presently conveying flows from the sewers in the surrounding housing

schemes. The proposed Bridgeport Force Main also discharges to this station, as do the existing Passage Fort and Westchester pump stations. Significant civil works are required at the site to connect all the sources into a single influent pipeline leading to the pump station. The pump station will be constructed in the Southeast quadrant of the existing Independence City STP. The remainder of the site will be cleaned and available for reutilization as in the Bridgeport STP.

The pump station is similar to the Bridgeport pump station and includes three (3) submersible pumps installed in a dry pit configuration. The force main is 3,210 m long and 600 mm in diameter, conveying flows to the influent splitter box at the Soapberry STP. The design drawings for the Soapberry STP reveal a future connection from Portmore in the splitter box, at an elevation of +3.2 m.

The estimated influent flow to the pump station is 190 lps with a peaking factor of 2.1 for a peak flow at the pump station of 400 lps. The pumps are specified for 200 lps / 77 m TDH, for an overall power requirement of 48 kW.

The force main to the Soapberry STP has two reaches. The first reach is 2,240 m long and extends between the Independence City pump station and the Caymanas Gardens force main connection and features the flows mentioned above. From the Caymanas Gardens force main to the Soapberry plant, a distance of 970 m, the peak flow is 480 lps.

(3) Caymanas Gardens Pump Station

The Caymans Gardens Pump Station in this alternative receives flow from three sources. The first is the areas formerly served by the Caymanas Gardens lagoons. The pipe which formerly conveyed this sewage is broken and discharges to the watercourse along the western boundary of the lagoons. This pipe is repaired and the flows directed to the new pump station site via a gravity sewer. The second is the Hamilton Gardens force main. The third is a new gravity main to be constructed in this project to convey the flows from the existing Portmore Villas lagoons north of the Caymanas Gardens lagoons south to the new Caymans Gardens pump station.

The design flow for this facility is 130 lps peak. The short 70 m force main is 300 mm in diameter. The force main discharges to the Independence City force main near Dyke Road. Because of the principle of this force main discharging into another force main which may have varying pressures, an additional pressure sustaining valve or slow-opening control valve tied to the pump operation at the Caymanas Gardens pumps may be included.

(4) Hamilton Gardens Pump Station

The Hamilton Gardens STP is replaced by a pump station in this alternative. The flows arriving to this station are estimated at 10 lps on average. Given the small population served, the peak design flow is 40 lps. A simple, pre-fabricated duplex pump station is projected for this site, with two pumps sized for 20 lps and 18 m TDH. This station would include only a

sump, and a small above-grade control panel mounted outdoors, with no building or other facilities at the site.

The force main is 1,280 m long, extending to the Caymanas Gardens lagoon site. T his force main is 200 mm in diameter and is placed along the railroad right-of-way for much of its length.

As with the other treatment plants in this option, the tanks and infrastructure at this site can be demolished and the site restored to pristine condition for reutilization or sale to private interests. This component is included in both Options.

(5) Rio Cobre Crossing

In either of the transmission system alternatives, a large diameter force main must cross the Rio Cobre. Two methods for crossing the river were briefly evaluated in this project. Due to the preference of the NWC, the option to attach a pipe to the existing railroad bridge was discarded.

The first alternative is an above-grade bridge supporting the force main pipe. The west bank of the river is gently sloping from Dyke Road to the river channel proper. The east bank is relatively steep and includes an earthen dyke and beyond, the Soapberry lagoons. The total distance of the channel and banks is 171 m.

The conceptual design used in this study includes a multiple-span structure with bridge piers matching the hydraulic shadow of the supports for the railroad bridge, which are spaced at approximately 21 m. The crossing is constructed approximately 30 m downstream of the railroad bridge. With no structural engineering included in this phase of the project, the details of the support are uncertain. The horizontal support structure could be a steel truss or concrete beams. A more economic option may be a single-span suspension structure crossing the entire reach between banks.

An alternative method is a trenchless technology solution burrowed below the bed of the river. This alternative would include relatively small jacking pits on each side of the river, and a single drive below the river. Such a drive would be 400 to 500 m in length to cross the width of the stream bed, the floodway, and the dikes. A horizontal directional drilling excavation method with flexible HDPE pipe might be the most appropriate method

The general features of the pumped option are summarized in Table 3.1.2. The general layout plan of the pumped option is shown in Figure 3.1.1.

Table 3.1.2 Project Features of Pumped Option for Portmore Scheme

Item	Specification	Remarks
Trunk Sewer	D200 mm (6") x L = 1,280 m	Hamilton Garden ~ Caymanas
	D250 mm (8") x L = 2,630 m	Bridgeport ~ Independence City
	D300 mm (10") x L = 70 m	Caymanas ~ Independence City force main (Y-joint)
	D600 mm (20") x L = 3,210 m (Rio Cobre Section: 170 m)	Independence City ~ Soapberry STP
Pump Station	(2+1) units x 20lps x 18m TDH	Hamilton Garden PS
	(2+1) units x 65lps x 12m TDH	Caymanas Garden PS
	(2+1) units x 90lps x 20m TDH	Bridgeport PS
	(2+1) units x 200lps x 77m TDH	Independence City PS

Source) JICA Survey Team

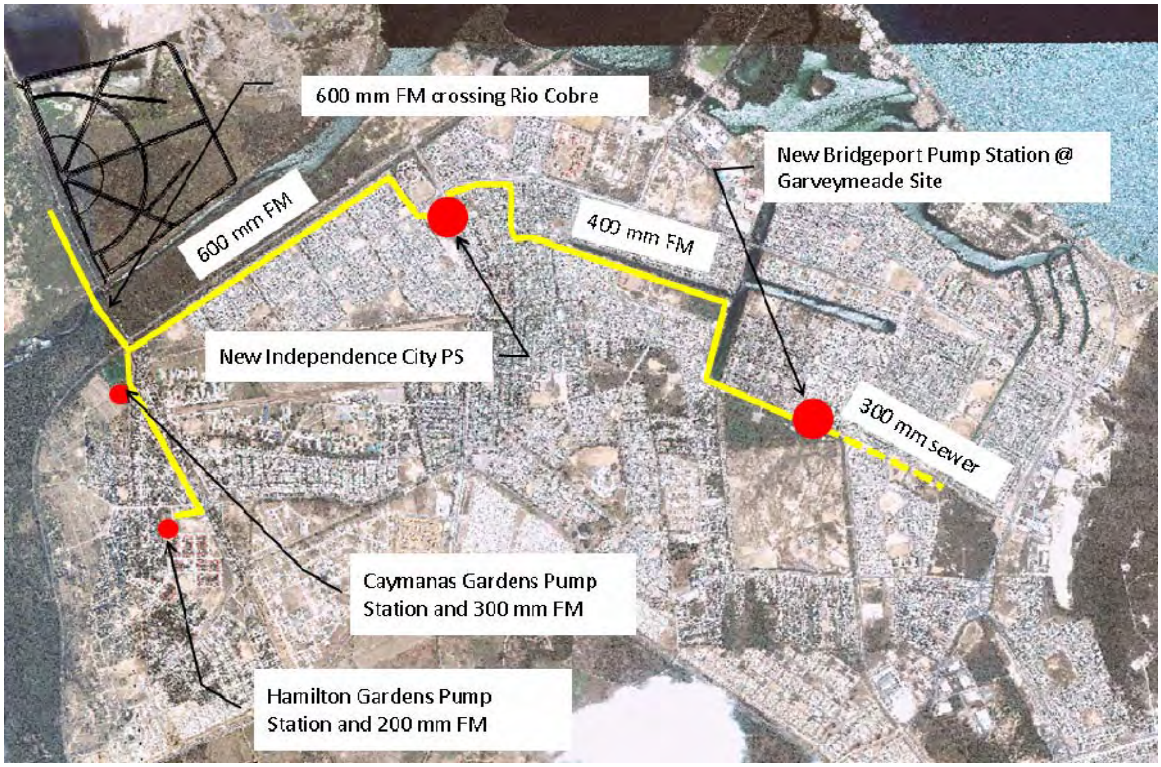


Figure 3.1.1 General Layout Plan for Proposed Pumped Option

3.1.4 Alternative B – Gravity Option

The gravity option includes a large-diameter deep interceptor constructed using trenchless technology. A single regional lift station lifts sewage from the deep interceptor and transmits it across the Rio Cobre and to the Soapberry STP distribution chamber.

The gravity alternative requires one single large pump station, and also eliminates five (5) existing pump stations. These include the Passage Fort #1 - 3, Westchester, and Garveymead pump stations. The existing lift station at the Independence City treatment plant will be removed from service as well (this is true in both alternatives). This will result in significant improvements in ease of operation and reliability of the system and reduces operational costs.

In this case, flows arrive to the Rio Cobre via gravity. From there it is pumped to the Soapberry STP

(1) Deep Interceptor

In this alternative, a deep interceptor is constructed using trenchless technology. The route of the interceptor is serpentine and traverses the length of Portmore, mostly beneath existing roads and streets. Because of the number of right-angle bends, it is assumed that a bore-and-jack style trenchless technology would be utilized. In this method, a boring pit is excavated at each severe change in direction and tunneling drives are mostly straight. One straight drive of the pipeline is completed at a boring pit, then the tunneling equipment is moved to the next pit. Drive lengths are variable, and some curvature and steering of the tunneling equipment is possible.

There are three reaches to this alternative, with different flows in each reach. The most upstream reach is between the Bridgeport STP and Passage Fort #3 Pump Station. Between there and the Independence City STP is another reach. The last reach is between that point and the Caymanas Gardens lagoon site, where the tunnel discharges to a new pumping station.

The assumed slope for the interceptor is 0.5 m per km. The pipe diameters for each reach were based on a criterion of no more than 70% full at peak flow. The flows and resulting diameters for the reaches are shown below.

Table 3.1.3 Design Calculation for Gravity Sewer

Location	Pop Served	Total Pop	Qavg, lps	Peak Factor	Qpeak, lps	Pipe dia. (mm)
Bridgeport STP	31,000					
		31,000	70	2.5	180	700
Passage Fort #3	26,500					
		57,500	130	2.2	290	800
Independence City STP	26,500					
		84,000	190	2.1	400	900
Caymanas Gardens						

Source) JICA Survey Team

If a trenchless method is selected, it is likely the contractor could minimize costs by utilizing a single pipe size for the entire project. Also, the diameters listed above may be on the lower range of efficient and feasible bore-and-jack methods. Hence, a nominal diameter of 1000 mm was assumed for all reaches this alternative. This provides additional capacity, or assurance against the limitations of the flow estimation procedures in this study.

The preliminary geo-technical investigation performed for this study reveal varying layers of sands and clays in the Portmore area beyond the depths anticipated for the deep interceptor. The tunnel would be constructed entirely in soil. Because of this and the groundwater levels, a slurry excavation method for the tunnel should be the most appropriate method of trenchless construction.

The profile elevation of the proposed pipeline ranges from -8 m to -2 m, leaving it 5 to 12 m below ground service, well below existing utilities, and hydraulically viable for gravity discharge from the existing sewers.

(2) Caymanas Gardens Regional Pump Station

The Caymanas Gardens Regional Pump Station will receive all flows from study area. It is similar to the pump stations described in the pumped alternative, but it is significantly deeper to receive the influent from the tunnel.

This pump station design includes two (2) duty pumps and a standby specified at 240 lps / 18 m TDH. It includes additional space for a third duty pump, should the Greater Portmore area be added. This station also receives the influent currently discharging to the Caymanas Gardens Ponds, the Portmore Villa flows, and the Hamilton Gardens flows. The total flow for this facility is an average of 240 lps. For the population served, the peaking factor is 2.0, leading to a peak flow of 480 lps.

The force main is 600 mm in diameter, extending 1,030 m from the site to the Soapberry STP distribution chamber. In this case, the static head to lift the sewage from the deep interceptor to the Soapberry headworks is significant.

The general features of the gravity option are summarized in Table 3.1.4. The general layout plan of the gravity option is shown in Figure 3.1.2.

Table 3.1.4 Project Features of Gravity Option for Portmore Scheme

Item	Specification	Remarks
Trunk Sewer Pipe	Dia 1,000mm (40") x L = 5,600 m	Gravity: Portmore area
	Dia. 600 mm (24") x L = 1,030 m	Force main: Caymanas PS ~ Soapberry STP
Pump Station	(2+1) units x 240lps x 18m TDH	Caymanas PS

Source) JICA Survey Team

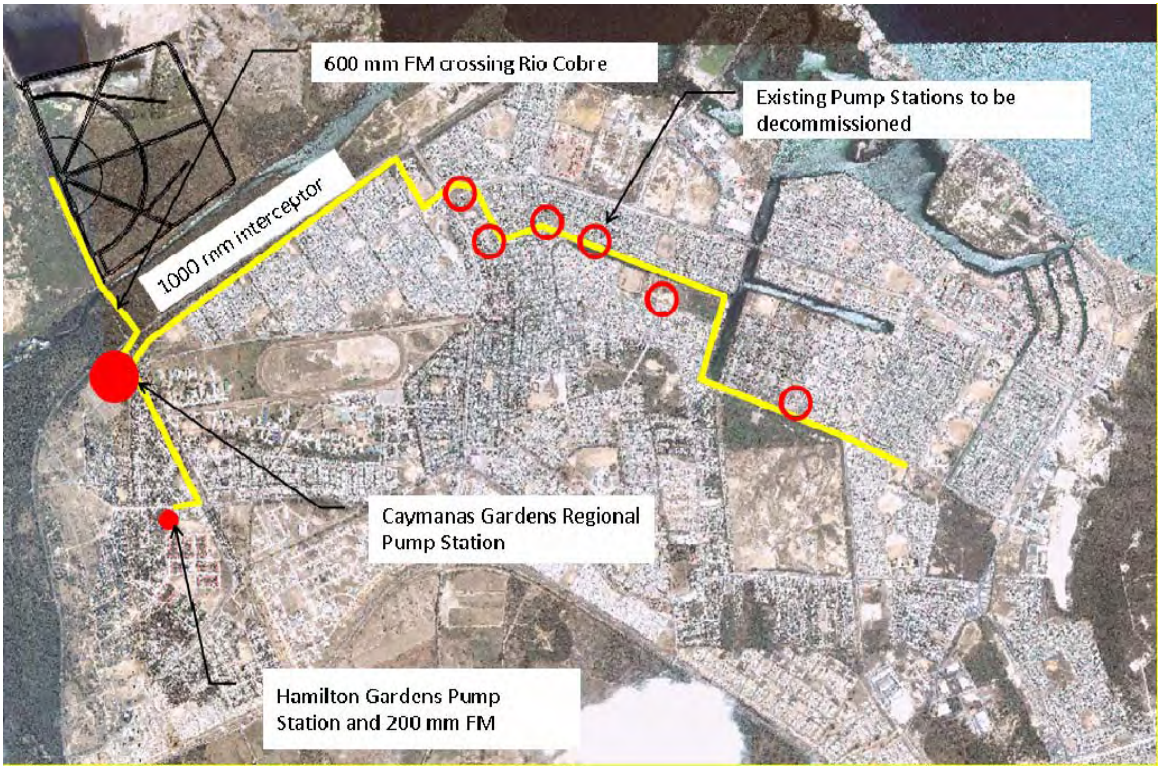


Figure 3.1.2 General Layout Plan for Proposed Gravity Option

(3) Expansion to Include Greater Portmore

The NWC has expressed an interest in expanding the system to include the entire Portmore area, i.e., the areas currently served by the Greater Portmore Ponds, a treatment system located on the southern end of the Portmore administrative area. The gravity option proposed here provides this flexibility. A very rudimentary evaluation was performed without any information related to the existing sewer system in the Greater Portmore area.

An arbitrary location was selected inside of the Greater Portmore area that was deemed to be a collection point for the sewage in the area. This point was selected with no knowledge of its applicability hydraulically. This point is approximately 3 km southwest of the terminus of the gravity interceptor, i.e., the current Bridgeport STP. Assuming a continuation of the same slope (0.5 m per km) proposed for the gravity interceptor, the profile would have to be lowered by approximately 2 m (more precisely, 1.5 m) to reach the Greater Portmore collection point at the same maximum elevation of about 5 m below ground surface. This implies that the Caymanas Gardens Regional Pump Station would have to be lowered by an equal amount.

As described above, the base diameter for the interceptor is selected based on constructability issues and presents additional capacity. To include the Greater Portmore area, the diameter would have to be increased to 1,200 mm. However, the reach between Bridgeport STP and the extended terminus in Greater Portmore, could be smaller. Even though the required diameter in this reach is 700 mm, again for constructability reasons, this

reach would most likely be constructed of the same pipeline diameter as the remainder of the pipeline, or 1200 mm.

Incremental costs would arise from the deepening of the pump station, and increase in the diameter over the original length of the interceptor, and an extension of 3 km to the length of the original interceptor. The costs for this variation are presented in Chapter 7.

3.1.5 Upgrade of Existing Pump Stations

In either alternative, it is contemplated to allocate funds in the potential loan agreement to the repair and rehabilitation of each of the existing pump stations in Portmore. These actions would include:

- Restoration of all pumps and motors to full operating capacity;
- Replacement standby generator;
- Restoration of electrical power and control systems;
- Purchase of numerous complete sets of spare parts to serve all sizes of pumps, pipes, and valves; and
- Miscellaneous painting, security improvements, landscaping.

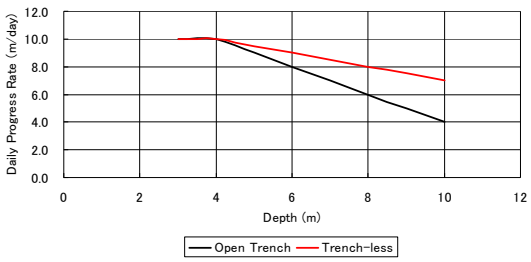
The NWC may also consider linking the pump stations into a central data and control system.

In Alternative A, the number of pump stations to be rehabilitated is eighteen (18). In the case of Alternative B, five (5) pump stations are removed from service, requiring only thirteen rehabilitations.

3.1.6 Application of Trenchless Technology

Possibility of trenchless technology for this project was preliminarily studied. As mentioned above, the geography in the Portmore area is relatively flat so that the sewer pipe in the gravity flow condition increases in depth toward the downstream end. Traffic density has become very high in the entire KSA and Portmore areas, and heavy traffic jams are usual during morning and evening commutes.

Short-term traffic restrictions affect living and economic activities negatively. Sewer pipes are constructed in public road rights-of-way by means of open-trench method, as proposed for Alternative A, includes the steps of excavation of a trench to the designated depth and width, laying of sewer pipes to the proper grade, backfilling and compaction of the trench with suitable materials, and restoration of the pavement. For deeper excavations, temporary retaining structures are required, likely using penetrating steel sheet piles to secure the trench and provide a safe construction zone. The cost and time to construct increase significantly with greater trench depth. Figure 3.1.3 shows daily progress rate per depth for the sewer installation. In contrast, the graph of trenchless method is much less dependent on depth of construction as compared with the open trench method. The upward slope arises from the depth of the jacking pits at the beginning and end points of each jacking reach.



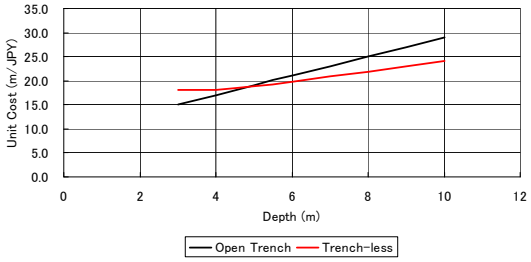


Figure 3.1.3 Daily Progress Rate per Depth **Figure 3.1.4 Unit Cost per Depth**

Figure 3.1.4 shows the unit construction cost per meter. For shallow depths, the open trench method is cheaper than the trench-less method. However the trenchless method becomes cheaper when the depth is greater than five meters because of costly retaining works. On a purely financial basis, the trenchless method could be applicable enough to sewer construction method of this project if the average depth of sewer pipes is more than 5 m. When accounting for other related costs such as the negative impact on traffic, trenchless construction becomes more favorable.

However, there is no local contractor experienced in practical use of trenchless technology under any civil engineering project until now. So it is recommended that the local company should employ or subcontract to the experienced foreign company in case that the local contractor intends to install sewer pipes by using trenchless technology despite the subproject under the LCB contract package.

3.1.7 Results of Geo-technical Survey

To obtain basic design information, a geo-technical survey was carried out by a locally subcontracted consultant. The geo-technical survey was composed of borings, field tests, and laboratory tests of sample soils. Borehole locations are shown in Figure 3.1.5. Six sites were selected originally but the boring at one site was canceled due to difficulty in accessing the site.

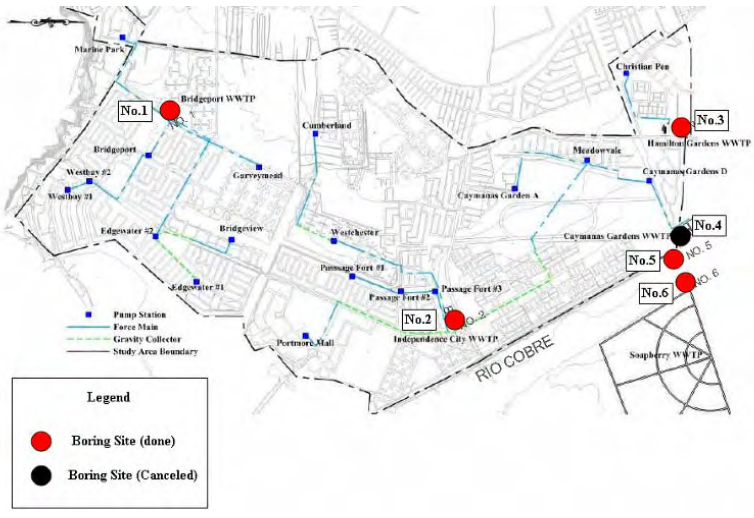


Figure 3.1.5 Geo-technical Survey Sites

The soil layers encountered in the survey are categorized into two major soil groups, compact sand with some silt/clay and firm to stiff clay/silt with some sand. Groundwater was observed about 1.2 m below the ground surface. Figure 3.1.6 generalizes the geology at each point.

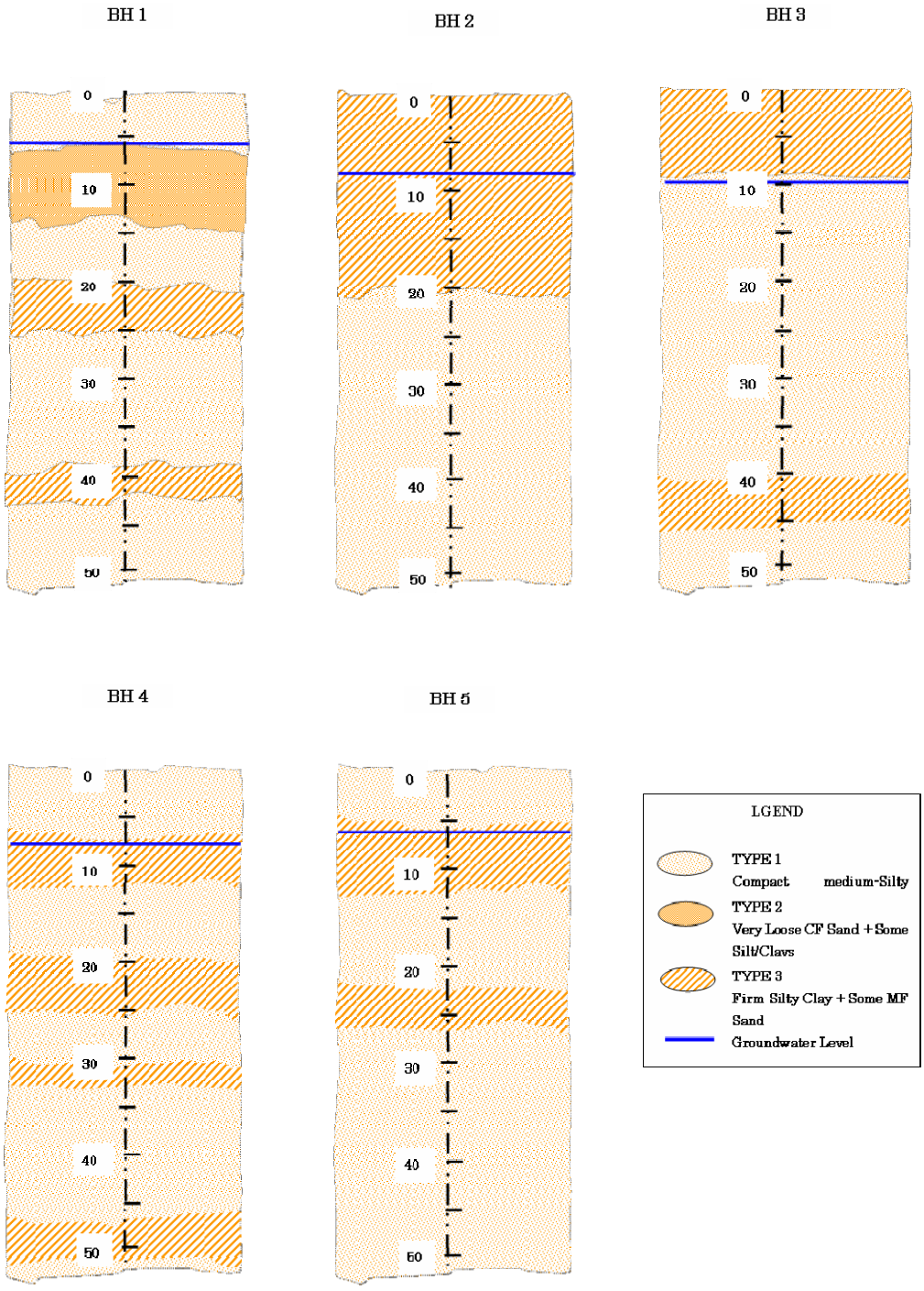


Figure 3.1.6 Geology Encountered in the Portmore Area

3.1.8 Improvement of Unsewered Households in Portmore

Current sewered ratio of Portmore is estimated at 95~98% because almost all houses in Portmore were developed under housing development schemes including house connection to both of water supply and sewerage systems which were the mandatory infrastructures to the housing development schemes as well as road and power supply.

On the other hand, less than 5% of households in Portmore has remained as unsewered households. During social survey in Portmore, several households were found in the isolated area from existing housing areas. Those households could be assumed as unsewered households.

For NWC, improvement of current inadequate sewage treatment condition in Portmore is to be the first priority by means of decommission of the current four STPs and establishment of new sewage conveyance system to the Soapberry STP. Hence the expansion of sewered area in Portmore should be taken care after completion of the first issue. NWC also considers enhancement of tariff collection from sewerage users so that expansion of sewered area should be embarked from affordable area because of sustainable sewerage management.

If the house connections scheme to the unsewered households in Portmore is initiated, location of the unsewered area should be surveyed to arrange the additional sewer layout plan.

3.2 Preliminary Design for Portmore Scheme

3.2.1 Design Considerations

(1) Pumping Station Design

All pump stations are designed utilizing wet well specifications from the Hydraulic Institute Standard 9.2. This wet well design has numerous advantages. The greatest advantage is better confidence in high efficiency pump operation, free of cavitations, entraining air, and eddies. This sump design also minimizes odors because the volume is minimized, sewage in the sump remains mostly quiescent, and solids are not allowed to accumulate and biodegrade and release malicious gases.

This configuration includes a "self-cleaning" principle where accumulated solids in the bottom of the sump as well as floating materials can be withdrawn from the sump, macerated by the pump impellers, and delivered eventually to the wastewater treatment plant. This reduces the need for operator attention and the probability for odor generation that could affect neighbors.

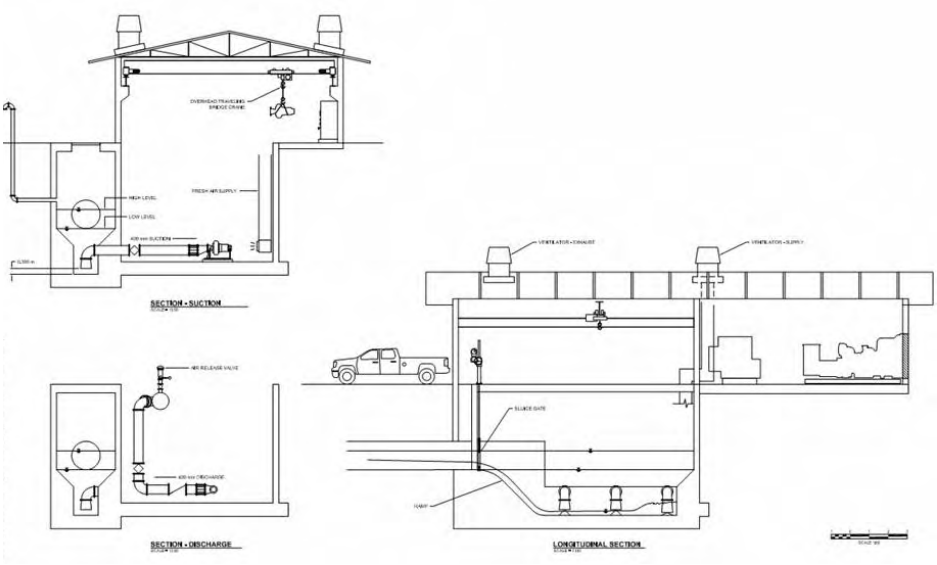


Figure 3.2.1 Conceptual Design of Wet Well

The pump station design reflected in this project utilizes a wet-well/dry pit configuration, featuring submersible pumps installed horizontally in the dry pit. This is a different configuration than the NWC prefers and it is acknowledged that it is similar to a configuration that was previously disfavored by the NWC due to problems. However, the design proposed here will not experience these problems and presents the best value for the utility. It will save energy costs over its life and be easy to maintain. With the procurement of quality pumps, it should have little problem with debris in the wastewater. It should be noted that the Nanse Pen pump station is configured similarly to the designs proposed here.

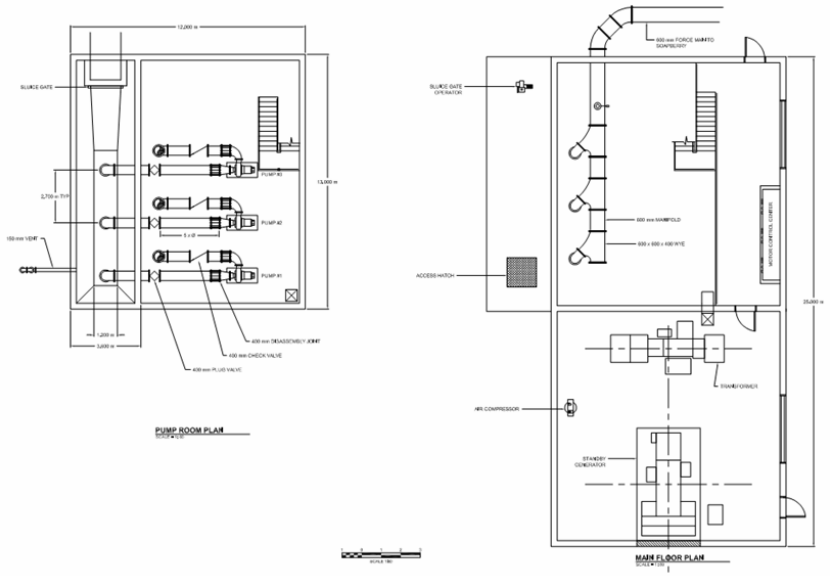


Figure 3.2.2 Conceptual Layout Plan of Pump Station

The pump stations do not include pretreatment (e.g., screens). A clear example of the suitability of screens or other pretreatment facilities is present at all the existing lift stations

in Portmore: each one is disfunctional and abandoned. Modern solids-handling pumps are quite qualified to manage the debris encountered in wastewater streams and accommodate them effortlessly through improved impeller designs.

The pump stations were designed to be easily maintained and serviced. The piping is aligned both for hydraulic efficiency, but also to allow workers to access the components.

(2) Standby Generator

A standby generator set will supply power to the stations in the event of power outages. The exhaust has a muffler to prevent excessive noise to neighbors.

(3) Ventilation

The pump stations will be enclosed, albeit with screened openings in the walls to permit entrance of ambient air. The enclosures will also be continuously ventilated with powered supply and exhaust fans sized to provide ten (10) air changes per hour in the pump rooms. Fresh air will be delivered in ducts to the pump room floor. An exhaust fan in the ceiling will extract air and any accumulated heat from mechanical and electrical equipment. While this is beneficial for life safety, the space is still classified as Division 2 and will require some explosion-proof equipment.

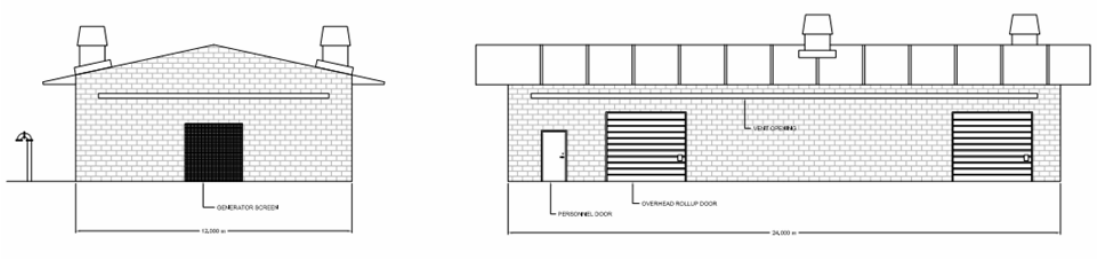


Figure 3.2.3 Elevational View of Pump House

The wet well is not ventilated actively, but has a simple vent. Entry is not expected and if done should require appropriate personnel protective practices to ensure life safety. Without ventilation, it is classified as Class I, Group D, Division 1 location per NFPA and requires explosion-proof equipment. In this case, the only equipment installed in the wet well is the level measurement instrument.

(4) Self Cleaning Operation

The procedure is intended to create in short, occasional, planned events, a turbulent condition in the sump to draw all deposited solids into the force main and eventually to the treatment plant. This operation also should draw in floating materials such as oils & greases and small floating debris.

This procedure is started by closing the influent sluice gate. This impounds sewage in the upstream influent sewer. The pumps are started to draw down the level in the wet well. The sluice gate is opened, and the rush of influent sewage agitates any deposited solids in the

sump. The upstream two pumps are turned off, and the final pump is left on. As the wet well level is lowered, a hydraulic jump forms at the bottom of the ramp, agitating and directing all solids to the final pump intake. This includes mixing and incorporating the floating solids into the sewage via the disturbance to the surface caused by the hydraulic jump.

(5) Effect on Community

The buildings would have an industrial aesthetic. Architectural accoutrements could be added to appease any community objections. The pump stations should be essentially silent at the site boundary except during power outages when the generator is active. Odors should be minimal with proper operation and occasional cleaning of the wet well.

(6) Force Mains

Force mains were designed to result in a velocity of 1.8 m/s at peak flow, sufficient to scour deposited solids.

(7) Motor Control Center

Each pump station has a motor control center installed within the building at the ground level. This permits operator attention without having to descend to the pump room floor and provides flood protection in the unlikely event the pump room is flooded.

(8) Sump and Utilities

The pump room floor will have a supply of potable water to assist in cleanup and maintenance. The pump room also includes a small sump and sump pump to remove any accumulated water or minor leaks before they can be repaired. The sump pump discharges to the adjacent wet well. An air compressor and compressed air piping are used for tools and miscellaneous use. These components are not illustrated on the drawings, except for the air compressor.

(9) Lighting and Low-Voltage Electrical

The pumping stations include interior lighting for workspace and exterior security lighting. Also included are low-voltage outlets for miscellaneous use.

(10) Instrumentation and Controls

The pumps will be controlled automatically and locally from the level meter in the wet well sump and simple controls in the MCC. The NWC may select to install a SCADA system for central monitoring and control of the new or existing pumping stations.

Preliminary design drawings are presented in the Appendices of this report.

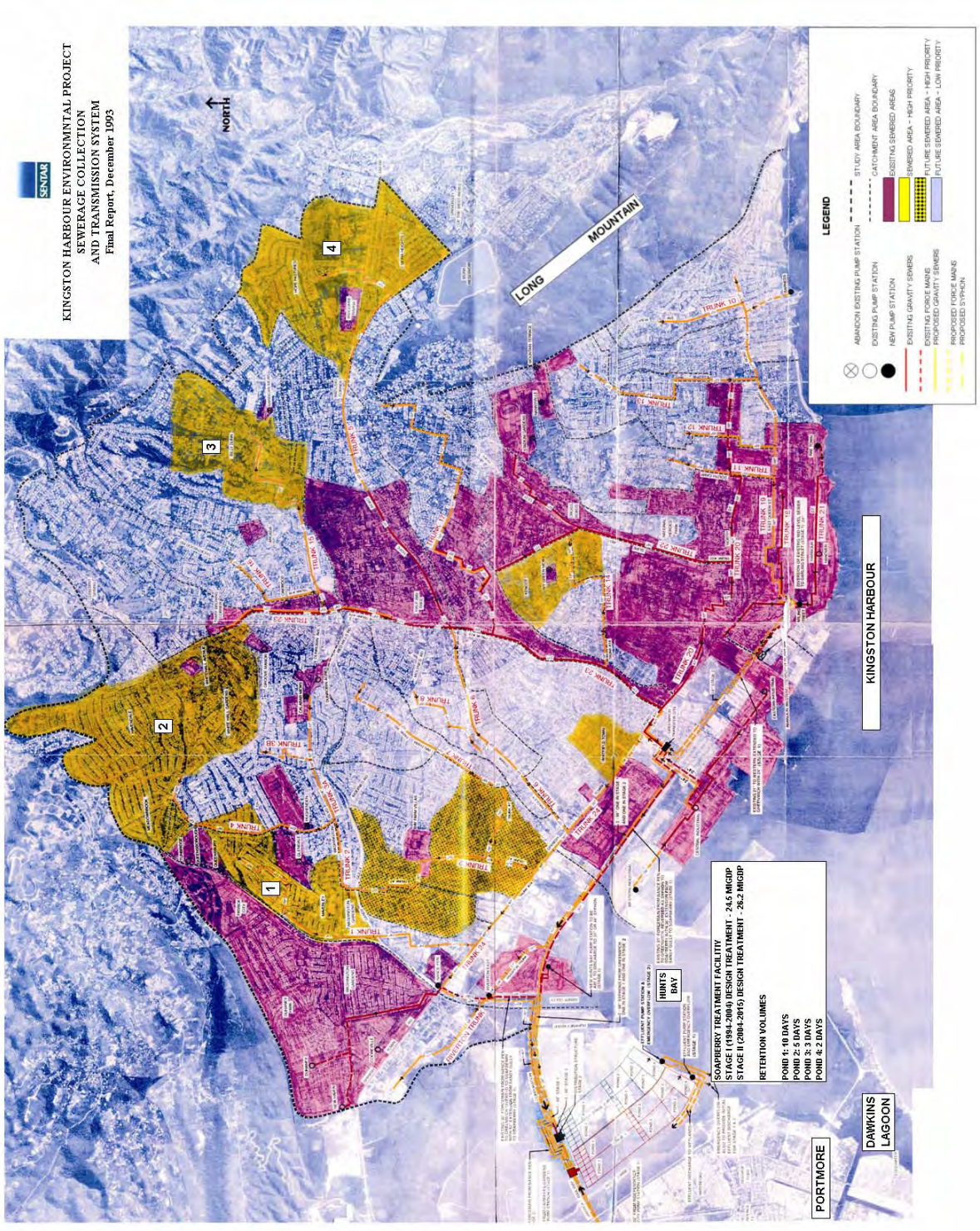
3.3 Proposed Sewerage Development Schemes for KSA

3.3.1 Overall Sewerage Development Plan of KSA for 2030

The overall sewerage development plan of KSA was provided through the KBR study. According to the current plan, the sewerage system for KSA area would be expanded via three (3) stage-wise development schemes to the whole KSA area. The Survey Team has reprioritized the stage-wise development schemes taking the following into account:

1) Target year set at 2030;
2) Three stage-wise sewerage development plan to be retained;
3) Future sewerage expansion to the surrounding of project area;
4) Demand assessment for existing sewer improvement; and
5) Sewerage development reserved areas in remote area.

Four project target areas were originally selected through the SENTAR Study in 1993 as shown in Figure 3.3.1. The yellow hatched area is the prioritized project areas. The numbered areas 1 ~ 4 in the figure are the same areas as NWC requested.



Source) JICA Survey Team

Figure 3.3.1 Priority Project Area of SENTAR Study

According to the NWC, demand to the sewerage service and affordability of the residents would be higher than other residential areas in KSA because of middle- to high-class income level. Visual impression of those areas seemed middle class-or more affluent as many larger home lots could be found in those areas. As the result of the social survey conducted by the

Survey Team, more than half of households in the areas have incomes greater than 40,000 JMD per month. In contrast to this, most of the income level in the Portmore area is less than 40,000 JMD per month. In addition, the water bills in the target areas of KSA are almost twice of that in the Portmore area despite no sewerage use. Consequently sustainable tariff collection could be expected in the selected four areas in KSA.

Surroundings of those four areas are also higher demand areas for sewerage service. Future connection from such surroundings of the project area was considered to the preliminary design of sewerage facilities. Staging for the sewerage expansion for the entire the KSA area was based on the conclusion of the KBR Study. The eastern half of the KSA area would be sewered earlier than western half.

The capacity of the existing trunk sewers was assessed and compared with the projected sewage flows through the project horizon. The future sewage flows are projected in the following table based on the percentage of inhabitants connected to the proposed sewer system.

Table 3.3.1 Sewer Connection Rate in KSA Area

(Unit: %)

Area	2010	2015	2020	2025	2030	Remarks
Present sewered area	100	100	100	100	100	
Target priority area	0	100	100	100	100	4 project areas
Second stage area	0	0	70	80	90	Eastern area of KSA
Third stage area	0	0	0	70	80	Western area of KSA

Note: Definition of 2nd and 3rd staged areas is referred to the project phasing of the KBR study. Sewered rate was determined by the JICA Survey Team as conceivable ultimate condition by 2030.

The eastern area of KSA is the catchment area of the Greenwich Sewerage Treatment Works (STW). The western area of KSA is the catchment area of the Nanse Pen Pump Station. The overall sewerage development plan for KSA is shown in Figure 3.3.2. More detailed development plan is shown in Appendix of this report.

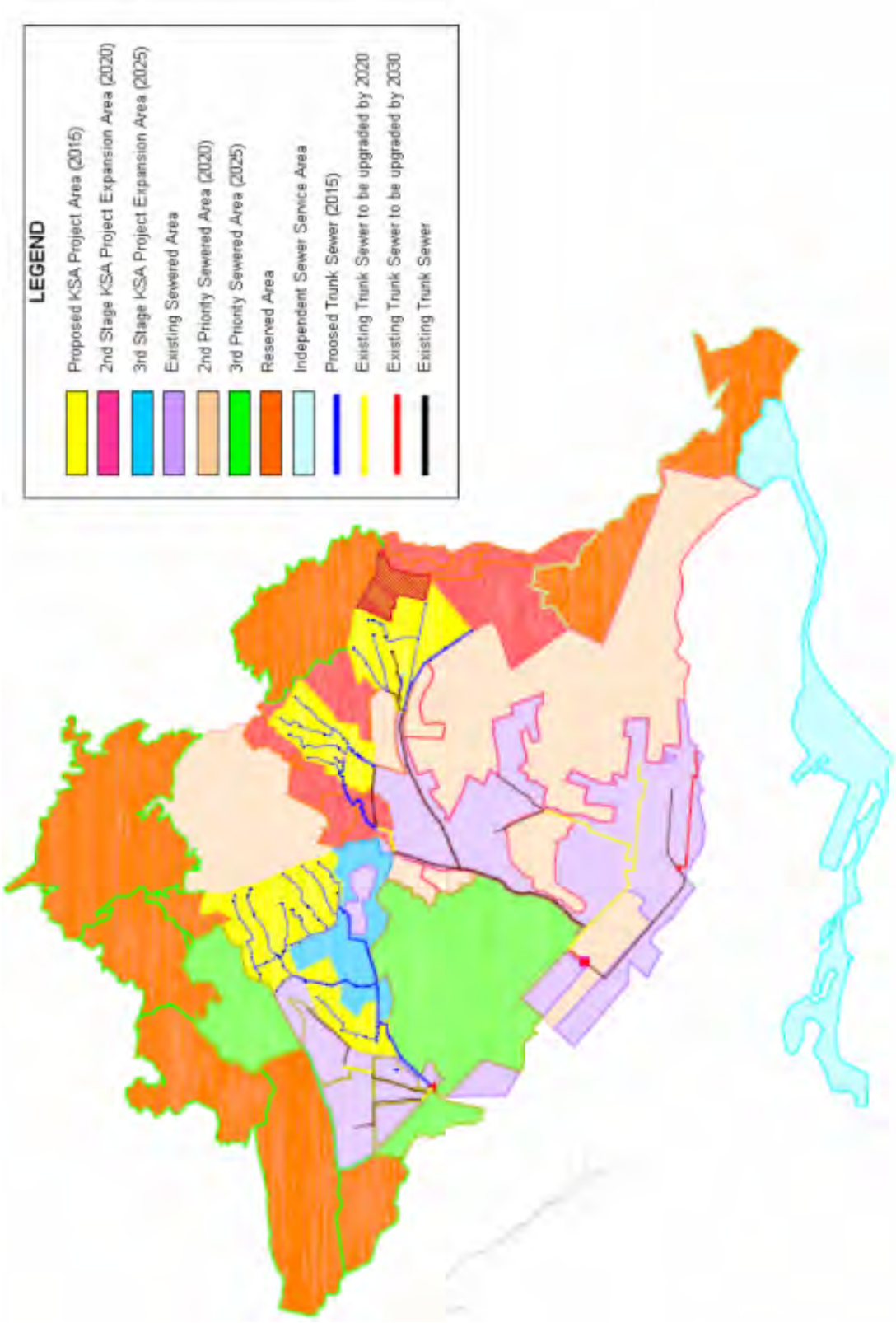


Figure 3.3.2 General Sewerage Development Plan for KSA

The sewage production rate in the Greenwich and Nanse Pen catchments are shown in as shown in Table 3.3.2.

Table 3.3.2 Sewage Production Rate in KSA Area

(Unit: m^3/day)

Area	2010		2015		2020		2025		2030	
	0.3%	0.9%	0.3%	0.9%	0.3%	0.9%	0.3%	0.9%	0.3%	0.9%
Greenwich	31,800	32,600	36,200	37,900	60,400	65,000	65,900	72,200	69,700	78,100
Nanse Pen	16,600	17,400	26,300	28,500	26,800	29,800	55,800	63,000	59,800	69,200
Total	48,400	50,000	62,500	66,400	87,200	94,800	121,700	135,200	129,500	147,300

Source: JICA Survey Team

The comparison between the projected wastewater flows and the capacity of the trunk sewers over several reaches is provided in Table 3.3.3. The flow projections for the three target years are based on the two different population growth rates described in Chapter 2.

Nanse Pen pump station has pumping capacity at 720 l/sec (equivalent to 62,200 m^3/day) employing three duty pump units. As compared with sewage inflow rate estimation in Table 3.3.2, the capacity would be sufficient up to 2030 in the case of the lower population growth. Despite the case of the higher population growth, the pump capacity would be sufficient by 2025. Hence the pump capacity uprating is not urgent issue. Other existing pump stations in KSA area would remain under this project.

Table 3.3.3 Assessment of the Flow Capacity for the Existing Trunk Sewers

(Unit: m3/sec)

Catchmant	Node		Street	Capacity	2020		2025		2030	
	from	to		(m3/sec)	0.3	0.9	0.3	0.9	0.3	0.9
Greenwich	**M25**	**M45**	**Up Watre Loo~Bedford Av**	**0.119**	**0.119**	**0.129**	**0.150**	**0.165**	**0.163**	**0.184**
	M150	**M160**	**Mona Rd**	**0.375**	**0.147**	**0.165**	**0.361**	**0.373**	**0.400**	**0.418**
	DH190	DH230	Spanish Town Rd	0.650	0.402	0.434	1.060	1.103	1.162	1.217
	DH230	**DH240**	**Spanish Town Rd**	**0.806**	**1.320**	**1.400**	**1.634**	**1.747**	**1.795**	**1.862**
	H80	DH120	Orange Street~Slipe Rd	0.194	0.103	0.113	0.213	0.223	0.236	0.251
	DH120	DH190	North Street	0.714	0.323	0.345	1.029	1.022	1.100	1.140
	DSPS		Darling Street PS	0.520	0.259	0.265	0.981	0.989	1.086	1.057
	Dh240	**GSTW**	**Access to GSTW**	**1.707**	**0.851**	**0.932**	**1.635**	**1.747**	**1.796**	**1.863**
Nanse Pen	N230	N160		0.181	0.449	0.459	0.460	0.477	0.497	0.520
	SGPS		Seaview Garden PS	0.057	2.063	2.008	2.048	1.996	2.245	2.187
	N160	N250CP	Access to Nanse Pen PS	1.711	2.103	2.065	2.125	2.181	2.369	2.346

Source: JICA Survey Team

Reaches where future projected flows in the different planning horizons exceed the capacity of the sewer will require improvements to accommodate the additional flows. Those reaches are indicated in bold type. The locations where additional capacity is required are shown in Figure 3.3.3.

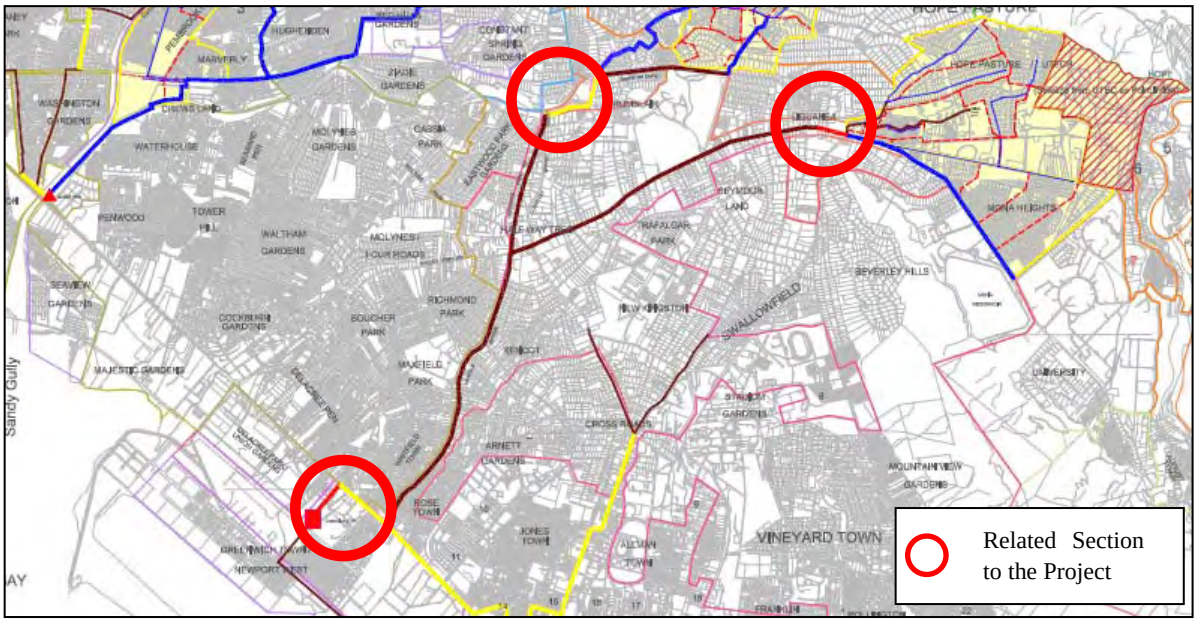


Figure 3.3.3 Location of Existing Sewers Requiring Improvements to Accommodate Future Flows

3.3.2 Assessment of Expansion for the Soapberry STP

Current sewage inflow to the Soapberry STP averages approximately 27,000 m^3/day based on NWC measurement data. This is about 33% of the current treatment capacity of the plant. The Survey Team confirmed that the sewage received at the Darling Street Pump Station, located near the Kingston railway station, is discharged to the adjacent gully because the existing sewage transmission main between the Darling Pump Station and Greenwich STW has collapsed at the Shumaker Gully. After the restoration of the transmission main, it is estimated that the sewage inflow would increase by 8,000 ~ 9,000 m^3/day.

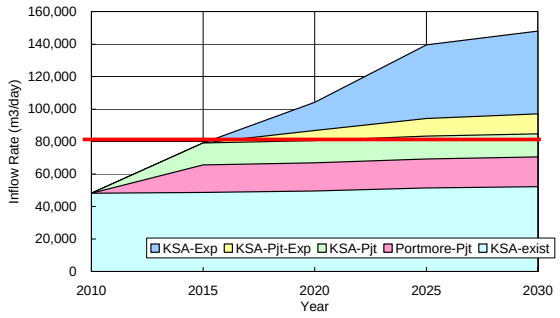
The conditions for the assessment of the need for expansion of the Soapberry STP are summarized in Table 3.3.4.

Table 3.3.4 Condition of Assessment for Expansion of Soapberry STP

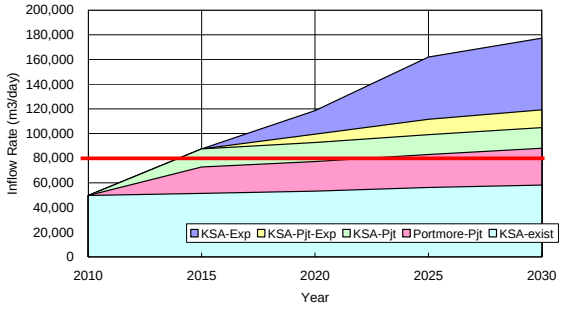
Case	Condition
Case-1	Full development of sewer system in KSA and Portmore
Case-2	Sewerage development including current sewered area, project area and project expansion area with current inflow condition for existing sewered area in KSA
Min	Annual population growth rate at 0.3% for both of KSA and Portmore
Max	Annual population growth rate at 0.9% for KSA and 2% for Portmore

Source: JICA Survey Team

The projected flow rates over time are shown for both cases in Figures 3.3.4 and 3.3.5. Minimum and maximum cases are assessed for sensitivity analysis with different population growth rate. The red line indicates the present capacity of the Soapberry STP.

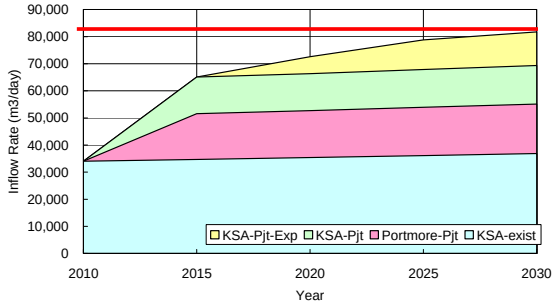


(Min)



(Max)

Figure 3.3.4 Result of Case-1 (Full Development)



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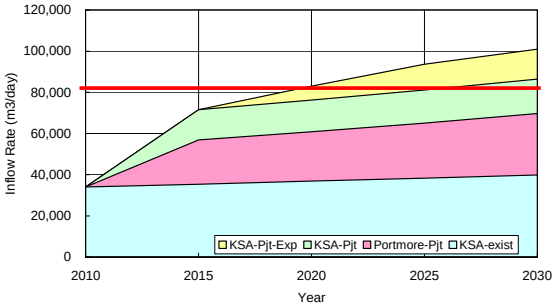


(Max)

Figure 3.3.5 Result of Case-2 (Current Inflow plus Project)

The flow rate is the average daily flow. According to the results, the present capacity of Soapberry STP would accommodate the sewage inflow from the areas to be served in this project until 2020~2030. If any other areas are connected to the system discharging related to the Soapberry STP, the NWC may consider expansion as soon as 2015.

3.3.3 Mitigation of Pollutant Load to Kingston Harbour

The project will provide effective mitigation of the pollutant load to the Kingston Harbour. Table 3.3.5 shows the sewered population ratio to the estimated total population in KSA and Portmore areas.

Table 3.3.5 Sewered Population Increase Ratio by the Project

(Unit: %)

Case	Year	2015	2020	2025	2030
Lowest Growth	Target Priority Area only	20.9	20.9	21.0	21.0
	Target area + Surroundings	20.9	24.9	27.7	28.6
Highest Growth	Target Priority Area only	22.0	23.5	24.3	25.1
	Target area + Surroundings	22.0	27.4	30.9	32.5

Source) JICA Survey Team

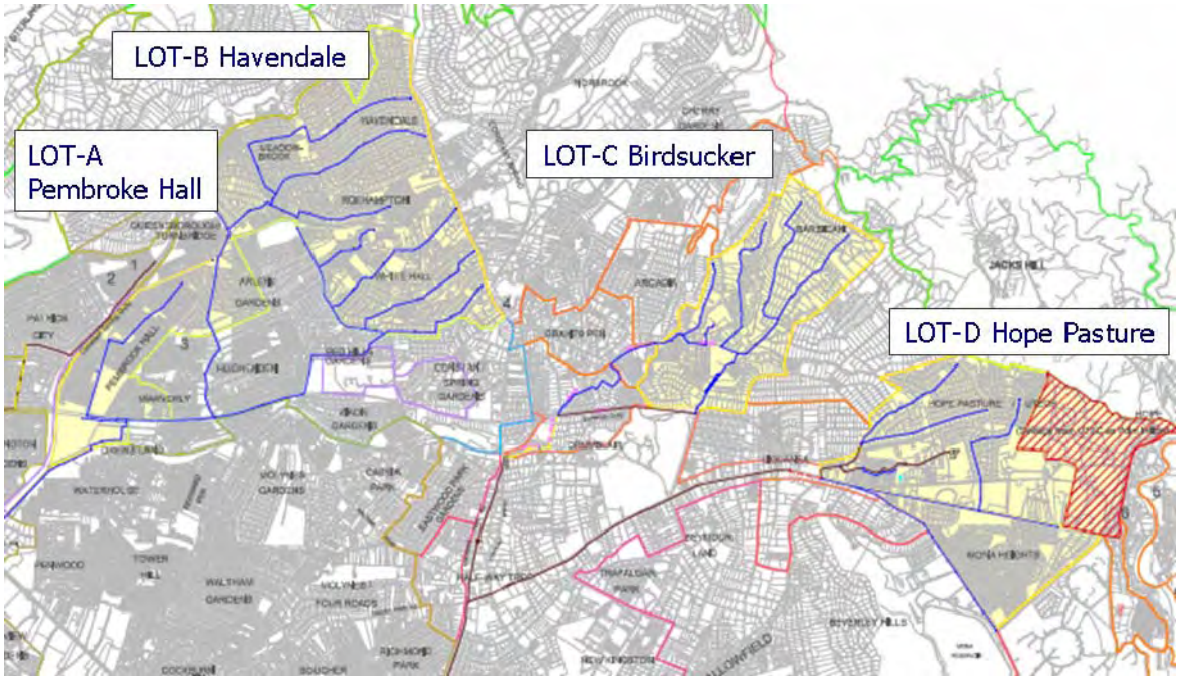
After the completion of the project in 2015, approximately 20% of the total population in the KSA and Portmore areas would be connected to the sewer system by this project. The

collected sewage from the sewered area is conveyed to the Soapberry STP and discharged to the public water body after appropriate treatment. In other words, the project would ensure a 20% reduction of the pollutant load to the Kingston Harbour. As shown in Table 3.3.5, contribution to pollutant load mitigation would be extended to about 30% by means of stepwise project expansion schemes.

3.3.4 Proposed Sewerage Development Scheme

(1) Sewage Catchment Area

As described in the former chapters, four sewage catchment areas were requested for the expansion of the sewered areas for KSA by NWC. The ground naturally slopes favorably for gravity flow in each sewage catchment area so that gravity sewage collection system shall be considered as much as possible. The general view of the four catchment areas is shown in Figure 3.3.6.



Source) JICA Survey Team

Figure 3.3.6 General View of KSA Scheme

(2) Design Sewage Flow Calculation

For the sewage flow calculation from sewage catchment area to the trunk sewer, the formula used in the KBR study was adopted for the design sewage flow calculation to maintain continuity among the related projects.

Qo = (Domestic Flow * Diurnal Peak Factor) + (Industrial 9 hour flow * peak factor) + Commercial/Institutional + Infiltration

Where, Qo: Minimum full bore sewer capacity

Diurnal peal factor was estimated by means of Gifft Formula as described below.

Peak Factor = A/P^B

Where, P: Contribution population/1,000

A, B: Constants (typically A = 5, B = 0.167)

Industrial sewage is included as point flow with the same value of KBR Study. Peak flow of the industrial sewage was estimated with twice of daily average flow. Commercial sewage flow was taken multiplying domestic sewage flow by some classified factors which KBR study adopted on the basis of household income level.

Although the infiltration rate was fixed at 40% in KBR study, values of 20% and 40% have been adopted for this project. For new sewer construction, assuming improved joints at pipes and manholes, a lower infiltration of 20% was adopted. It is assumed that existing sewers are less water-tight and a higher infiltration rate of 40% was adopted. Detail design flow estimation sheets are attached as Appendices of this report.

(3) Design Calculation of Trunk Sewer

The design capacity of trunk sewer was estimated employing Manning's Formula for flow velocity calculation with full bore as shown below:

Qd = A*v

Where, Qd: Design capacity (m^3/sec)

A: Wetted area (m^2)

v: Flow velocity (m/sec)

$v = 1/n*R^{2/3}*i^{1/2}$ (Manning's Formula)

n: Manning's roughness coefficient (n = 0.010 for PVC/GRP)

R: Hydraulic meaning depth (m)

i: Hydraulic Gradient (m/100m)

The KBR report employs a roughness coefficient (n) of 0.015 but such a value is normally adopted for reinforced concrete pipe and is excessively rough. The use of PVC and GRP pipes is anticipated for this project, allowing the use of lower, i.e., more slick, n values. Hydraulic gradient is equal to the bottom slope of the sewer line under gravity flow conditions. For the preliminary design of trunk sewers, the design minimum slope as shown in Table 3.3.6 was considered.

Table 3.3.6 Minimum Design Slope for Sewer

DN (inch/mm)	Slope (m/100m)	DN (inch/mm)	Slope (m/100m)
8/200	0.40	18/450	0.12
10/250	0.28	21/525	0.10
12/300	0.22	24/600	0.08

13/330	0.17	27/685	0.067
15/380	0.15	30/750	0.058
16/400	0.14	36/900	0.046

Source) NWC Developers Manual, January 2006

Design calculation sheets for proposed trunk sewers are presented in the Appendices of this report.

(4) Design Consideration for Each Project Site

1) Lot-A (Pembroke Hall)

The main sewage catchment area of the Pembroke Hall lies along the left bank of the Constant Spring Gully in the north of the Washington Boulevard Road and has an expanse of approximately 155 hectares. The ground surface in the catchment area generally slopes southward in the same direction as the flows in Constant Spring Gully. The ground elevation in the catchment area varies from EL+24m MSL to EL+56m MSL.

The social condition in this target area is such that a young generation of25~34 years old might be assumed to be more than 30% of the residents, almost all people pay a water bill of less than 4,000 JMD per month, and 40% of the households get income from pension (30,000~40,000 JMD per month). General geographical features are summarized in Figure 3.3.7.

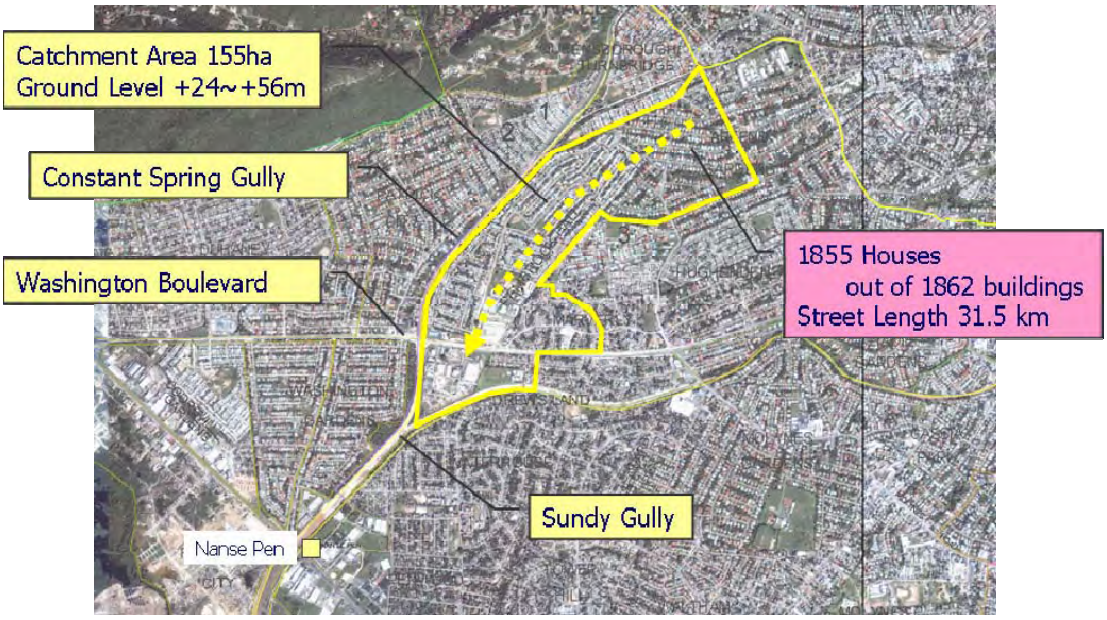


Figure 3.3.7 General Geographical Features of Lot-A

The original layout plan of the trunk sewers for this target area (Lot-A) and the adjacent target area (Lot-B) presented here differs from the route proposed in the SENTAR Study. Figure 3.3.7 shows the route proposed here along with the original route by SENTAR.

The original route goes across the future sewered area in the south of the target priority area of Lot-A and -B. However, that area would be sewered in the further future after completion

of this project, so the proposed route shortened length of trunk sewers for this area. In addition, the proposed route makes gully crossings in only one location and construction is simplified by rearrangement of the route across the community to the side of the gully. Other design

Sewage from the catchment area is conveyed to the Nanse Pen pump station located near the intersection between the Constant Spring Gully and Spanish Town Road. The original plan of the trunk sewer proposed by the SENTAR study crosses the Balmagie Community, but the proposed trunk sewer runs along the left bank of the Sandy Gully. The proposal herein will allow more convenient construction work outside of residential areas and allows cost reduction from the shorter sewer length.

In the reach between Washington Boulevard Road and the Nanse Pen Pump Station, the trunk sewer is connected to sewers conveying sewage from the Lot-B. Hence, the sewer development cost could be compressed as compared with the original independent sewer development plan for each lot.

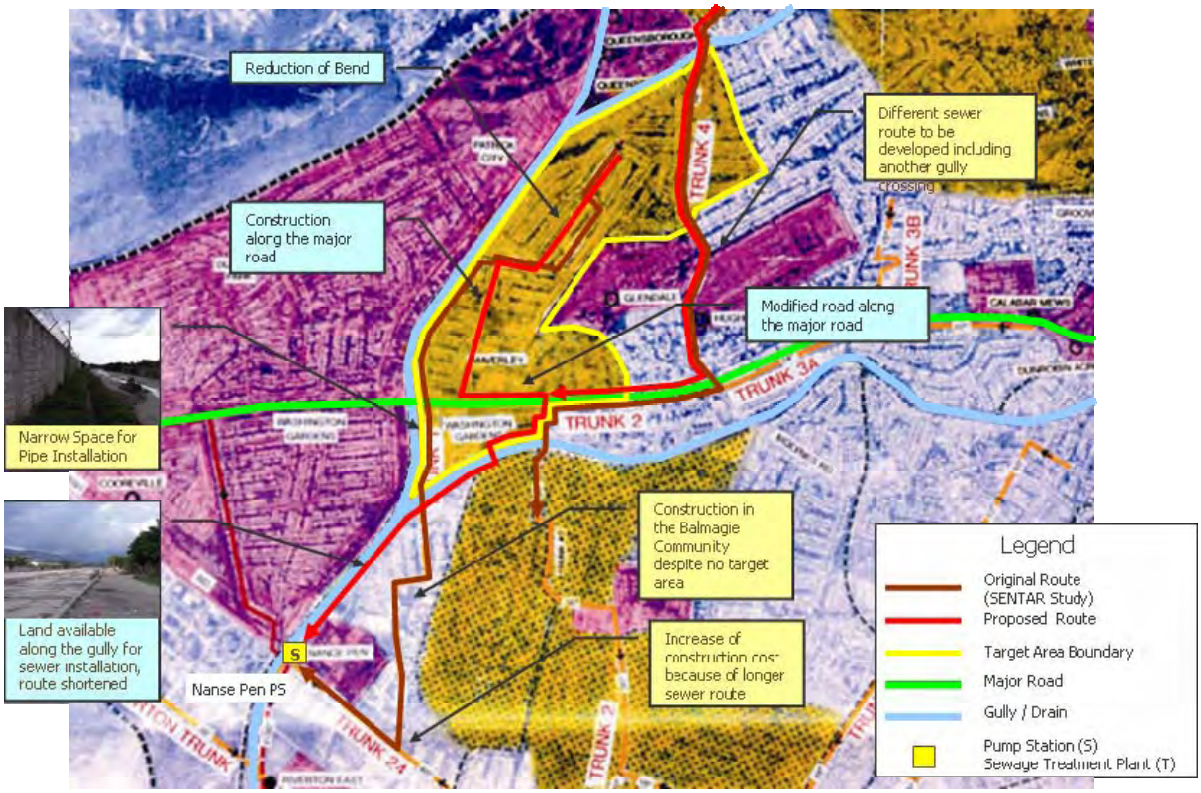


Figure 3.3.8 Design Consideration for Lot-A

The length of the trunk sewer before and after the modification is summarized in Table 3.3.7.

Table 3.3.7 Length of Trunk Sewer

Original Plan	Modified Plan	Difference
15,300m	9,100m	6,200m

Source) JICA Survey Team

The modification of the original route contributes capital cost saving by means of reduction of the sewer length. The general layout plan of Lot-A is shown in Figure 3.3.9, and plan and profile of proposed trunk sewers are shown in the Drawings of Appendices of this report.

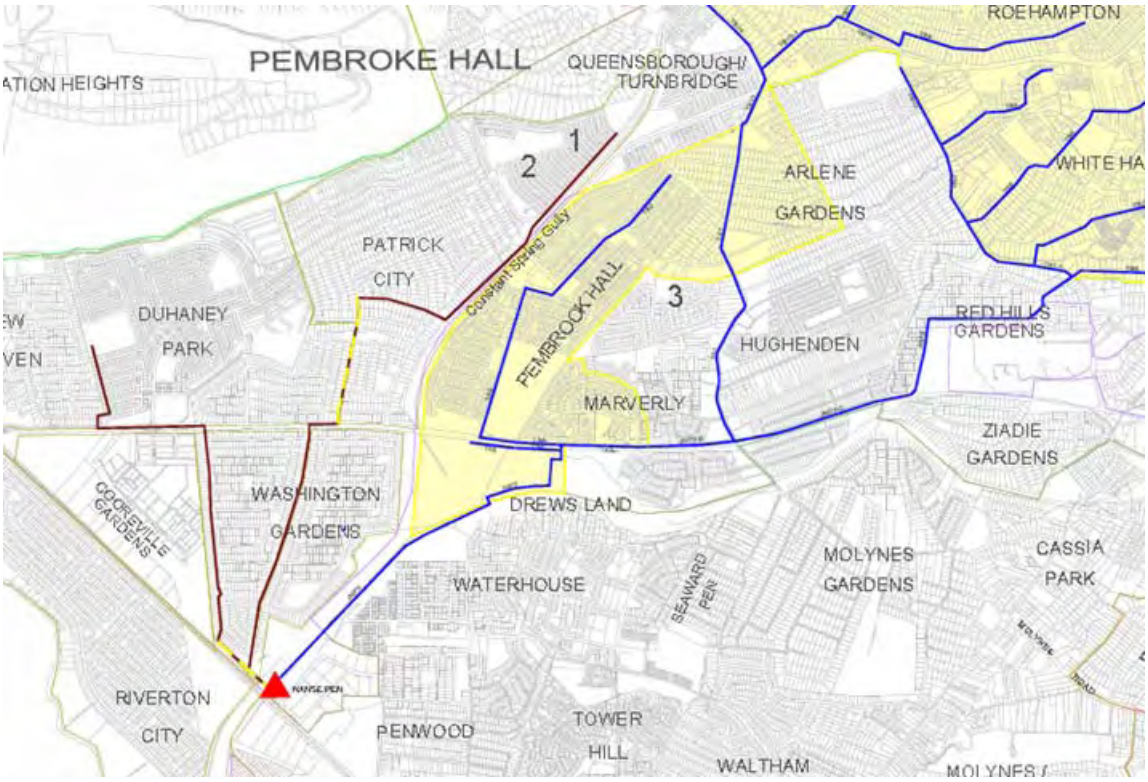


Figure 3.3.9 General Layout Plan of Trunk Sewers for Lot-A

2) Lot-B (Havendale)

The main sewage catchment area of Havendale lies between Molynes Road and Red Hill Road on the north side of Washington Boulevard Road, and has an overall area of approximately 430 hectares. The ground surface in the catchment area generally slopes in a southwestwardly direction. The ground elevation in the catchment area varies from EL+56m MSL to EL+125m MSL. The catchment area is separated into three parts by gullies which flow across the catchment area from east to west. The sewers were designed taking the sewer route in the downstream side to the Nanse Pen Pump Station.

The social condition in this target area is that middle generation in 35~54 years old might account about 50% of the residents, half of household heads are female, 90% of the households pay water bill less than 5,000 JMD per month and 40% of the households get income from pension. General geographical features are summarized in Figure 3.3.10.

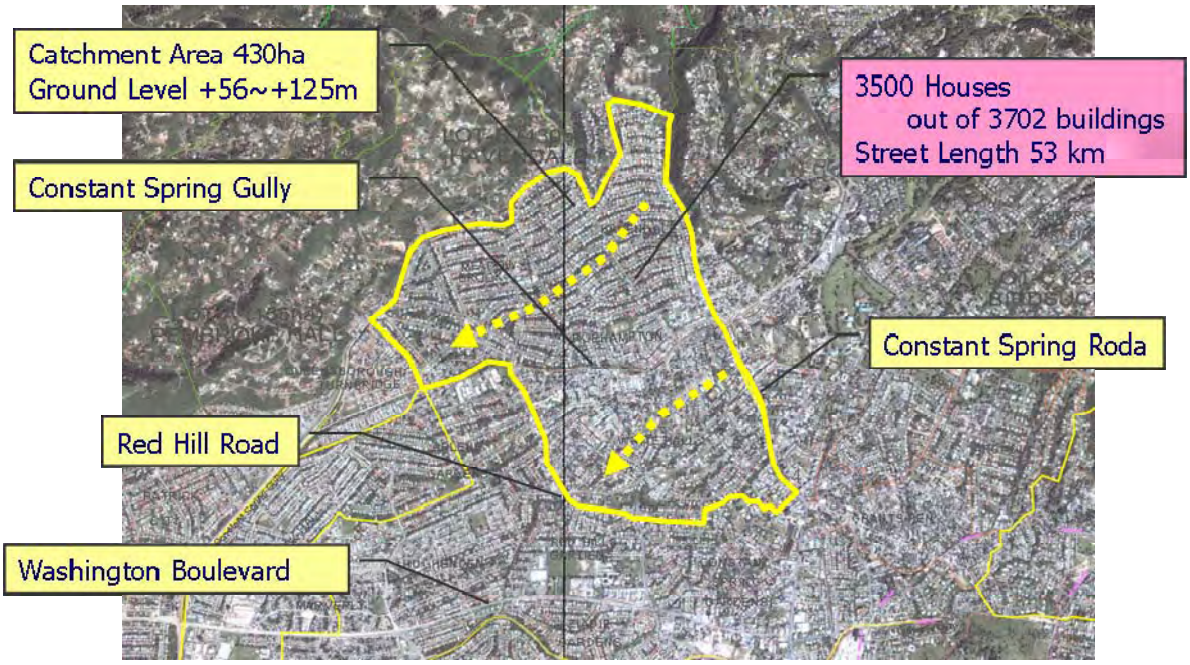


Figure 3.3.10 General Geographical Features of Lot-B

The sewage from northern area is connected to the trunk sewer of Lot-A so that the sewage finally flows to the Nanse Pen Pump Station.

The sewage from mid and southern areas are collected by the trunk sewer running along the Red Hill Road and flow southward to Washington Boulevard Road through the local roads from the intersection of the Red Hill Terrace Road. The sewer comes westward along the Washington Boulevard Road and finally joins the JNP3-B at the intersection of Molynes Road. The sewage of Lot B is finally combined with that of Lot-A and conveyed to the Nanse Pen Pump Station.

The original sewage conveyance route of Lot-B was designed into two routes, one is connected to Spanish Town Road going across the Tower Hill Community and the other connected to Constant Springs Road. However, those routes are longer and will cause an increase in the overall construction cost and reduce the project performance. Design consideration and general layout plan are shown in Figure 3.3.11 and 3.3.12, respectively. Plan and profile of proposed trunk sewers are shown in Drawings of Appendices of this report.

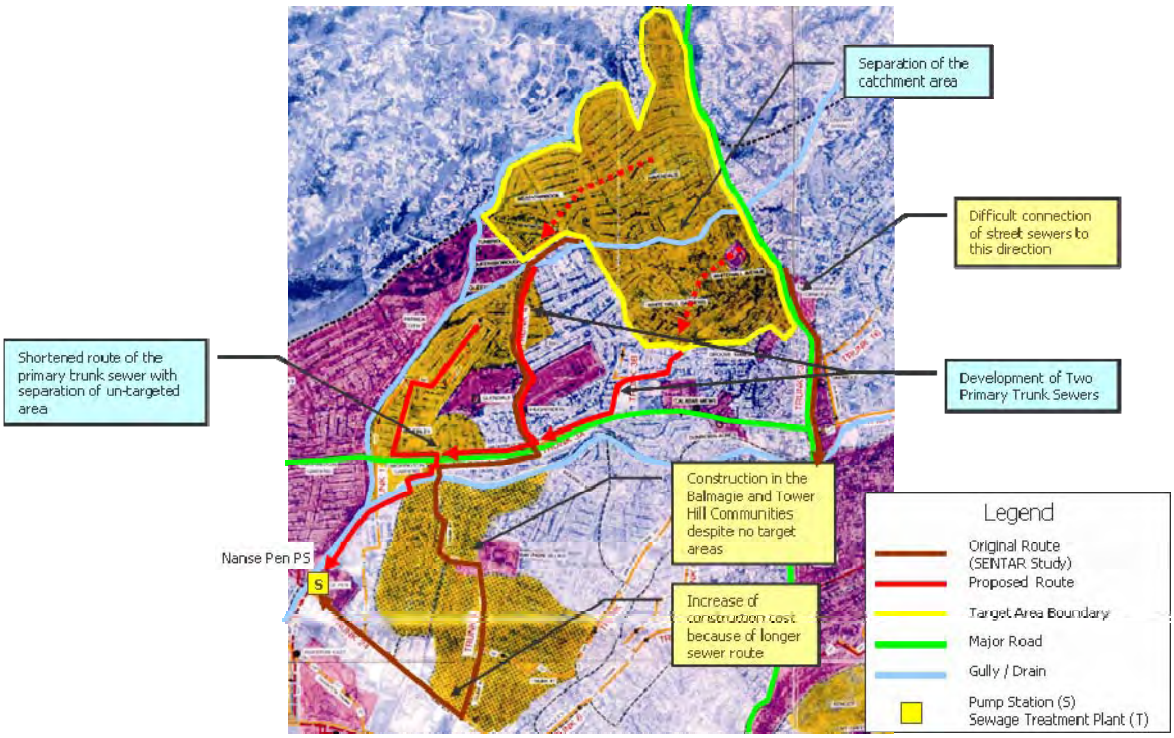


Figure 3.3.11 Design Consideration for Lot-B

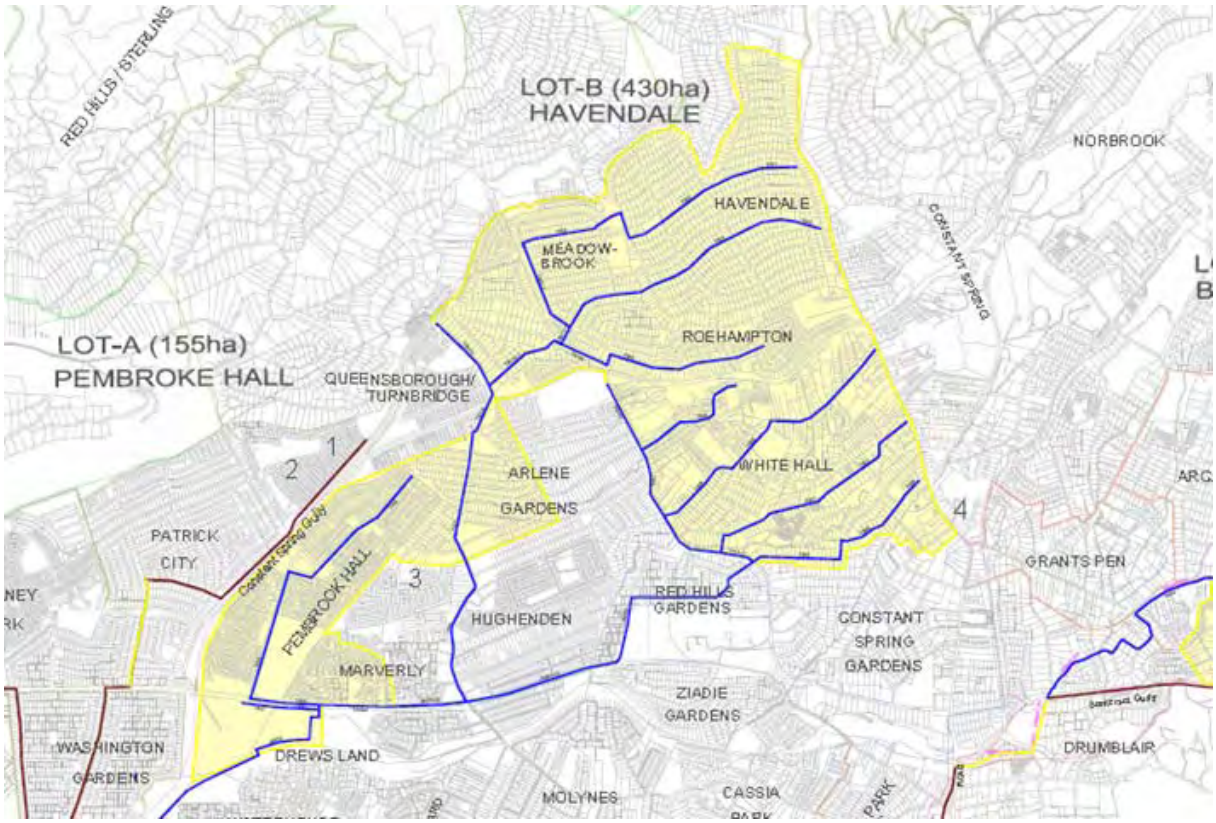


Figure 3.3.12 General Layout Plan of Trunk Sewers for Lot-B

3) Lot-C (Birdsucker)

The main sewage catchment area of the Birdsucker is located on the hillside of northeast KSA. The catchment area has an area of 240 hectares, and the ground surface elevation varies from EL+90m MSL to EL+253m MSL. The ground slopes steeply in a southward direction. The catchment area is separated by the general topography into an eastern part and a western part. Sewage flows from both areas are finally connected to the existing trunk sewers. The sewage from the eastern part of Lot-C is connected to the existing trunk sewer running along the Barbican Gully at the Liguanea Prep School at the northeast corner of the Kings House. Sewage from western part is connected to the existing trunk sewer running along the Upper Waterloo Road at the bridge crossing Barbican Gully, located 1.4 km from the project catchment area since available land for the new sewer line is limited, as is the flow capacity of the existing trunk sewer along the Barbican Gully. All the collected sewage would flow along Upper Waterloo Road and connect to the main sewer line along Maxfield Avenue via which it is conveyed to the Greenwich STW.

The social condition in this target area is that elder generation in 55~64 years old might account about 30% of the residents, nearly 60% of household heads are female, 80% of the households pay water bill less than 4,000 JMD per month and nearly 40% of the households get income from pension. General geographical features are summarized in Figure 3.3.13.

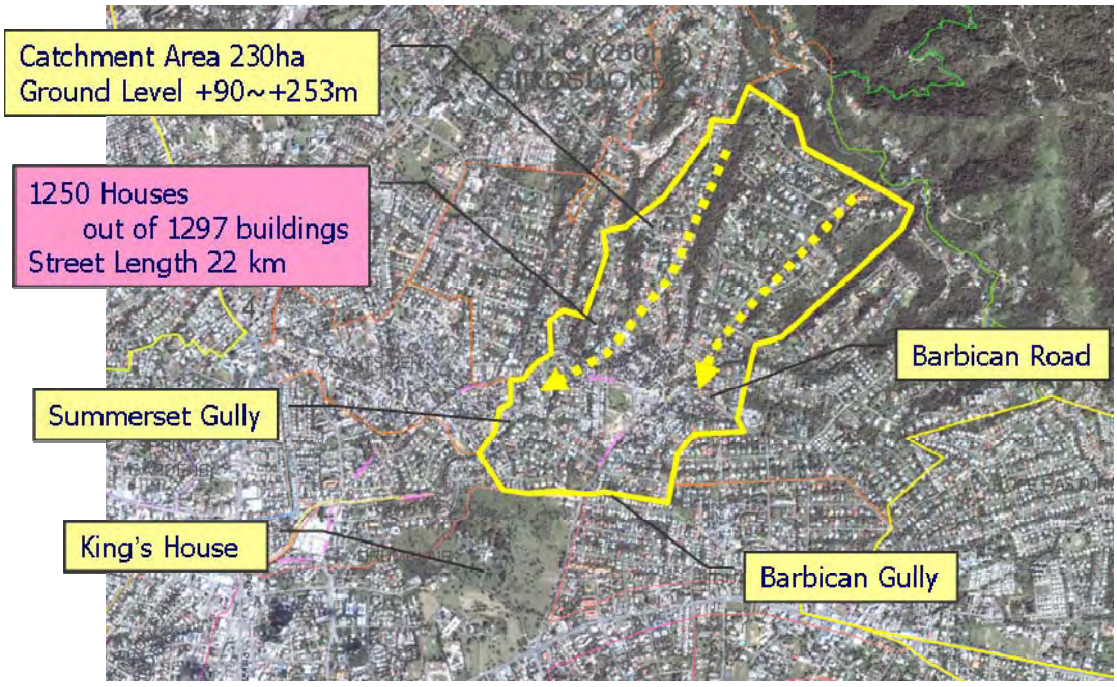


Figure 3.3.13 General Geographical Features of Lot-C

Taking account that the natural ground slope in the Lot-C inclines to two directions of southwest and southeast, the catchment area was also divided to two part of western part and eastern part. The design considerations are summarized in Figure 3.3.14 and general layout plan of Lot-C is shown in Figure 3.3.15.

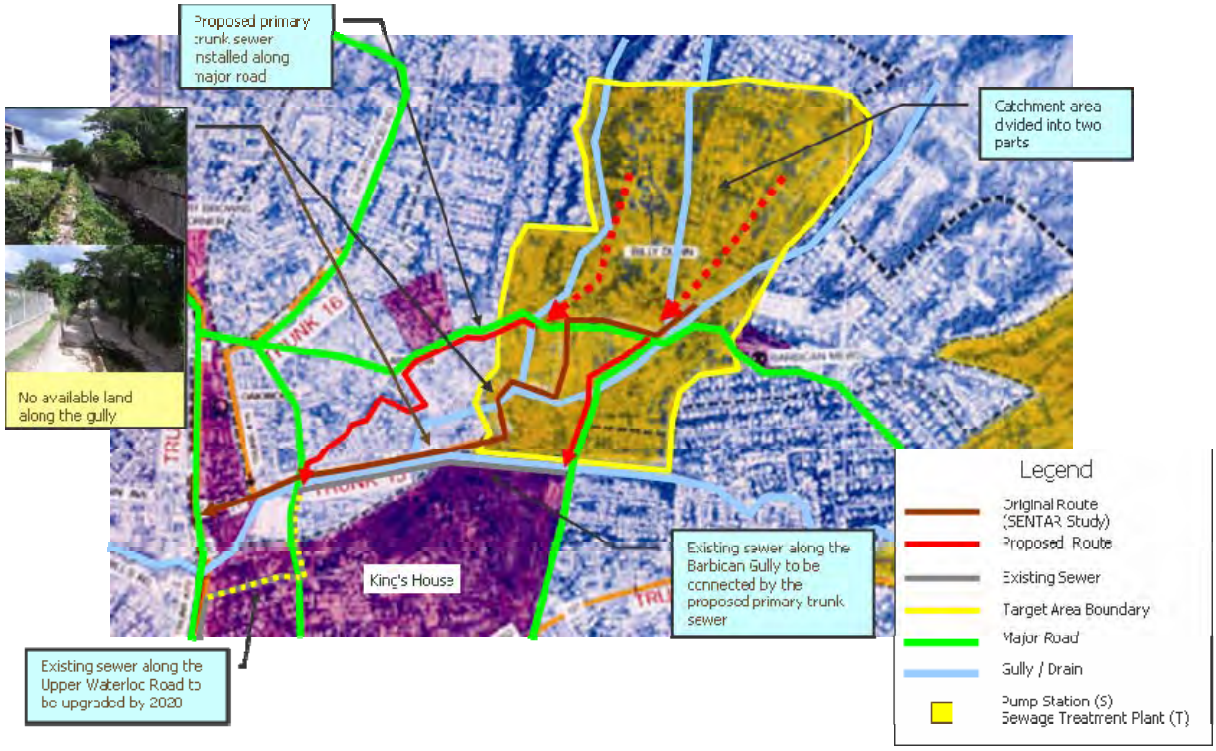


Figure 3.3.14 Design Consideration for Lot-C

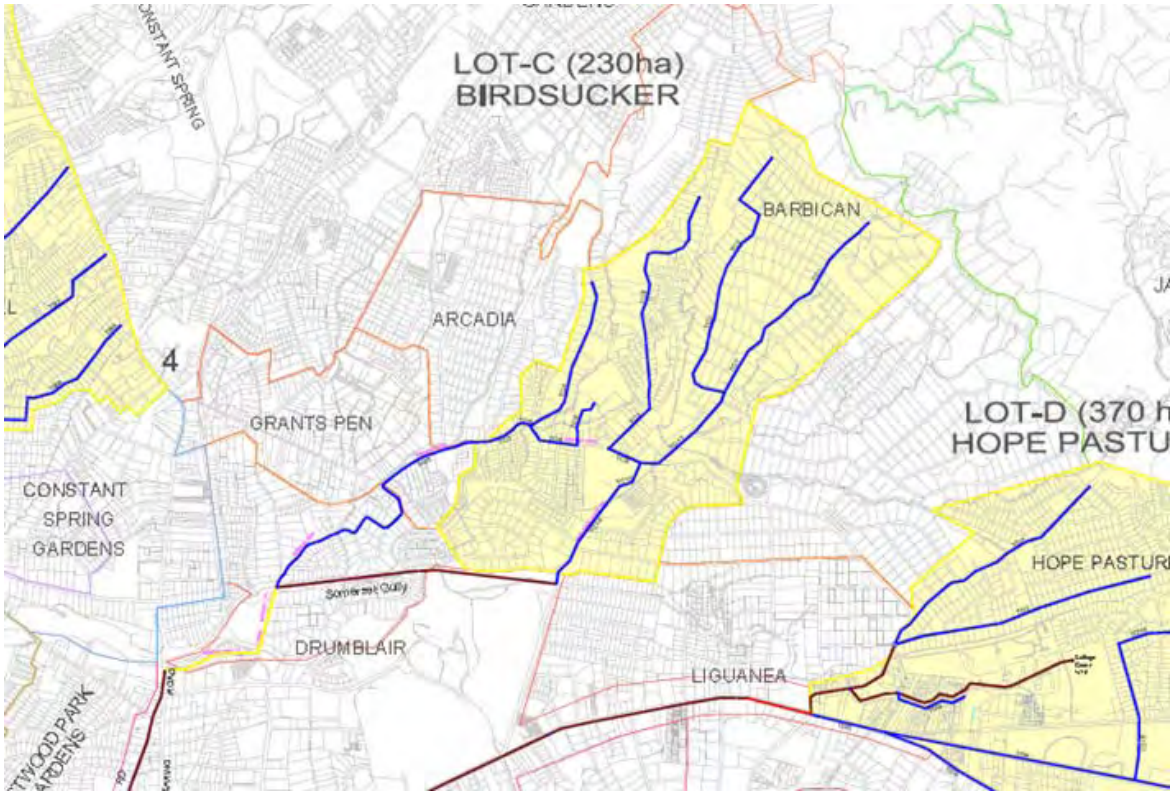


Figure 3.3.15 General Layout Plan of Trunk Sewers for Lot-C

3) Lot-D (Hope Pasture)

This sewage catchment area extends to the base of Jack Hill where the Old Hope Road and Mona Road run across the catchment area. The main land use in the area is residential although the University of Technology (UTECH) exists in the eastern part of the catchment area. The Lot-D catchment has an area of approximately 370 hectares and the ground surface elevation varies from EL+147m MSL to EL+226m MSL. The ground slopes to the southwest, and is steeper in the northern part of the catchment area.

The social condition in this target area is that elder generation in 55~64 years old might account about 30% of the residents, almost household heads are male, 80% of the households pay water bill less than 4,000 JMD per month and more than 30% of the households get income from pension. General geographical features are summarized in Figure 3.3.16.

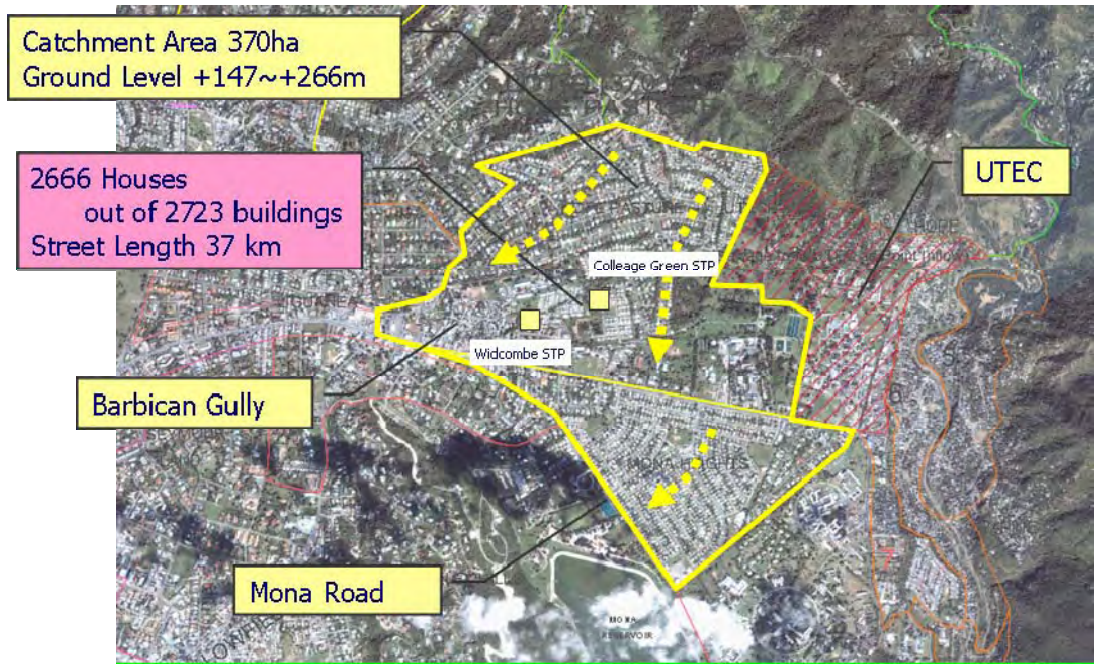


Figure 3.3.16 General Geographical Features of Lot-D

There are two package plants for sewage treatment, namely College Green and Widcombe, which were developed under the previous housing schemes. Widcombe STP has been abandoned and College Green STP has essentially ceased operation. A local sewer installation project is in progress in the catchment of those STPs so that sewage collected to those STPs will be connected to the existing Mona Road sewers and those STPs will be decommissioned shortly thereafter. The catchment areas of the College Green and Widcombe STPs are approximately 35 hectares and can be deducted from street sewer and lateral installation. Design consideration and general layout plan for Lot-D are shown in Figure 3.3.17 and 3.3.18, respectively.

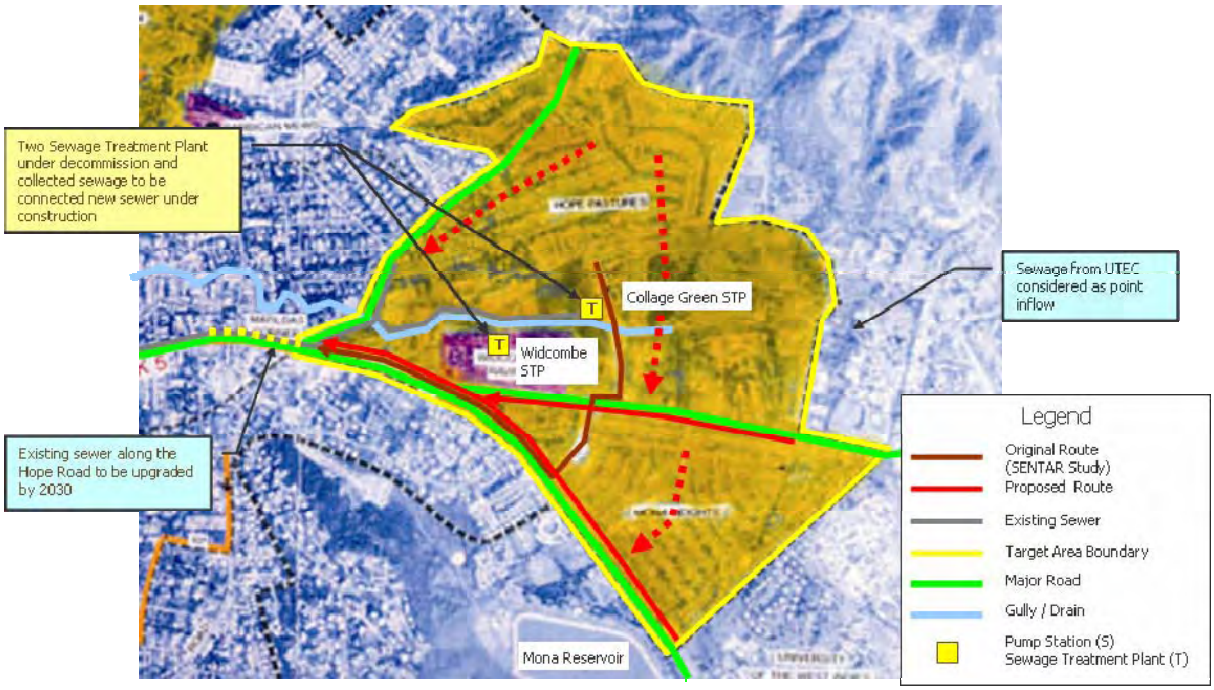


Figure 3.3.17 Design Consideration for Lot-D

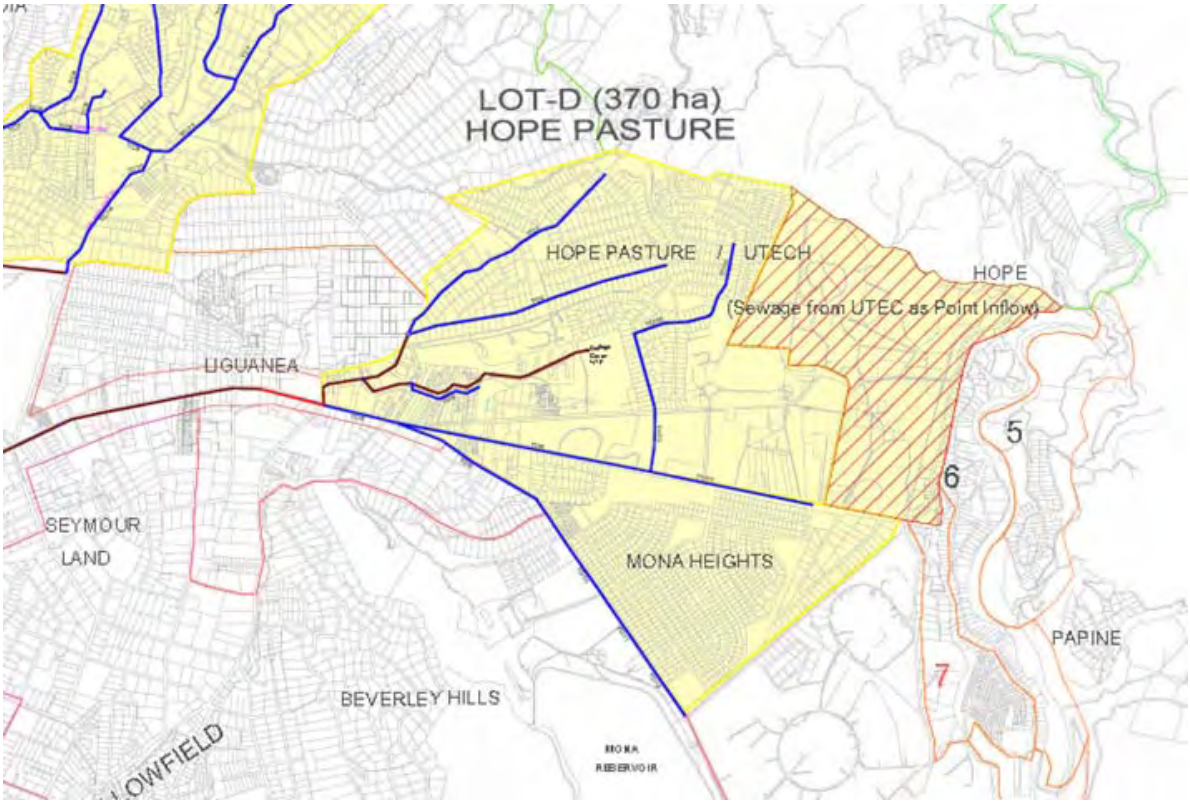


Figure 3.3.18 General Layout Plan of Trunk Sewers for Lot-D

(5) Formulation of the Sewerage Development Component

Design calculations were made for the following cases and compared to each other for a determination of the project component from the viewpoint of construction cost.

1) Target year of 2020 and 2030; and

2) Annual population growth rate at 0.3% and 0.9%.

The results are summarized in Table 3.3.8.

Table 3.3.8 Construction Cost Comparison

Year	Lot	A (Pembroke Hall)		B (Havendale)		C (Birdsucker)		D (Hope Pasture)		Total	
2020	Case	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%
Sewered Area	Project Area	155 ha		430 ha		230 ha		370 ha		1,185 ha	
Beneficiaries	Project Area	13,437	15,051	25,862	28,966	5,409	6,058	9,652	10,811	54,360	60,886
Sewer Design	Dia (mm)	Length (m)									
	200	430	430	8,955	8,955	4,775	4,775	6,009	6,009	20,169	20,169
	250	800	800	880	880	685	685	0	0	2,365	2,365
	300	0	0	720	1,970	0	0	0	0	720	1,970
	350	1,260	1,260	2,500	1,250	2,115	2,115	0	0	5,875	4,625
	380	0	0	0	0	0	0	0	0	0	0
	400	0	0	595	595	0	0	645	0	1,240	595
	450	0	0	1,780	1,780	0	0	1,605	1,910	3,385	3,690
	530	0	0	0	0	0	0	0	340	0	340
	600	410	410	1,270	1,270	0	0	0	0	1,680	1,680
	685	1,920	1,920	0	0	0	0	0	0	1,920	1,920
	750	0	0	0	0	0	0	0	0	0	0
	900	0	0	0	0	0	0	0	0	0	0
	Total	4,820	4,820	16,700	16,700	7,575	7,575	8,259	8,259	37,354	37,354
Construction Cost	Trunk Sewer	295	295	654	644	253	253	296	306	1,498	1,498
(Million JPY)	Branch/Lateral	372	372	1,032	1,032	552	552	804	804	2,760	2,760
	Total	667	667	1,686	1,676	805	805	1,100	1,110	4,258	4,258
Year	Lot	A (Pembroke Hall)		B (Havendale)		C (Birdsucker)		D (Hope Pasture)		Total	
2030	Case	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%	0.30%	0.90%
Sewered Area	Project Area	155 ha		430 ha		230 ha		370 ha		1,185	
Beneficiaries	Project Area	13,846	16,460	26,649	31,682	5,573	6,626	9,946	11,824	56,014	66,592
Sewer Design	Dia (mm)	Length (m)									
	200	430	430	8,955	7,835	4,775	4,775	4,834	4,834	18,994	17,874
	250	800	800	2,660	2,000	685	685	1,175	1,175	5,320	4,660
	300	0	0	190	1,970	0	0	0	0	190	1,970
	350	1,260	1,260	1,250	1,250	700	700	0	0	3,210	3,210
	380	0	0	0	0	0	0	0	0	0	0
	400	0	0	595	0	0	0	0	0	595	0
	450	0	0	1,780	595	1,415	1,415	0	0	3,195	2,010
	530	0	0	0	1,780	0	0	0	0	0	1,780
	600	0	0	0	0	0	0	0	0	0	0
	685	0	0	0	0	0	0	0	0	0	0
	750	2,330	410	1,270	1,270	0	0	2,250	1,910	5,850	3,590
	900	0	1,920	0	0	0	0	0	340	0	2,260
	Total	4,820	4,820	16,700	16,700	7,575	7,575	8,259	8,259	37,354	37,354
Construction Cost	Trunk Sewer	318	356	663	694	274	274	390	397	1,646	1,722
(Million JPY)	Branch/Lateral	372	372	1,032	1,032	552	552	804	804	2,760	2,760
	Total	690	728	1,695	1,726	826	826	1,194	1,201	4,406	4,482

Source) JICA Survey Team

The construction cost comprises the trunk sewer construction and street sewers and laterals construction. Because the street sewers and laterals are largely a function of the project area served, there is not a large gap of construction cost between the target years of 2020 and 2030, or between the two different population growth rates. In our method of estimation, the lengths of street sewers and the number of laterals to be made was based on geographical parameters, i.e., a survey of aerial photography to quantify lengths of streets and the number of connections to be served. This method results in quantities and costs which are irrespective of population growth rates and number of years of growth. Only minor changes in the pipe diameters result from the different growth rates and periods. It was concluded

that the sewerage development component for KSA area should be formulated in consideration of target year of 2030 with higher population growth rate at 0.9% per annum.

3.4 Preliminary Design for KSA Scheme

3.4.1 Design Considerations

(1) Applicable Design Standard

NWC design standards are basically applied to the preliminary design of the sewerage facilities for this project. Other international standards were used in a supplemental manner in the cases in which the NWC design standards do not cover a particular issue. Some adjustments of NWC design standards were proposed and discussed during the survey in Jamaica. The major points of the adjustment of the design standards are summarized in the following table.

Table 3.4.1 NWC Design Standard and Adjustments

Item	Original Standard	Adjusted Standard	Viewpoint of Adjustment
Minimum Pipe Diameter	200 mm (8 in)	←	No adjustment.
Minimum Velocity	Min: 0.6 m/sec Max: 3.0m/sec	←	In practice, 0.8 m/sec shall be recommended as minimum velocity.
Minimum Slope	NWC Standard	←	See Table 3.3.6
Manhole Interval	Not more than 90m (300 ft)	DN≤600mm: L≤ 60m DN≤1,000mm: L≤ 90m	Interval depended on DN of Pipe
Minimum Cover	Not less than 600mm (2 ft)	1.5 m	Connection of collector sewer considered

Source) JICA Survey Team

1) Minimum Sewer Pipe Diameter

The minimum diameter of the sewer pipe was referred to in the NWC Developer's Manual with the diameter at 200 mm (8 in). The Japanese guideline for sewerage works also defines the minimum diameter at 200 mm to accommodate maintenance . The NWC's requirement is reasonable and acceptable.

2) Minimum Flow Velocity

Minimum velocity is related to the slope of the pipe and flow condition. NWC requests a minimum flow velocity at least 0.8 m/sec for proper flushing of deposits. For the preliminary design, the minimum slope for the flow velocity at 0.8 m/sec with full-flow condition will be adopted against design sewage flow rate.

3) Minimum Slope

The minimum slope should be considered for this preliminary design as shown in Table 3.3.6.

4) Manhole Interval

The NWC Developer's Manual requires that the interval between manholes should not be more than 91 m (300 ft). On the basis of the Japanese design guideline, the shorter interval at 60 m should be adopted to the pipes of which the diameter equal to or less than 600 mm because of maintenance requirements. Pipes a diameter equal to or larger than 600 mm should be designed with the typical manhole interval of NWC.

A manhole should also be placed at the change of flow direction, change of sewer pipe diameter, change of sewer depth and intersection of the sewer pipes.

5) Minimum Cover

The minimum soil cover for the sewer pipes should be retained at least 1.5 m from ground surface for the preliminary design. The minimum required cover of NWC at 0.6 m (2 ft) in case of a sewer line under the sidewalk taking easement of street sewer connection into account. The maximum cover was also set at about 4 m to accommodate ease of construction. That may be exceeded in rare cases when the slope of the pipe is contrary to the ground slope..

(2) Common Sewer Structures

1) Sewer Installation

Sewer pipes should be properly laid in the trench with proper bedding works 10 cm thick under the pipe as well as backfill with approved granular material and 30 cm above the pipe. Bedding and backfill should be compacted properly by using tapping machines. Selected excavated material is also utilized for backfill work above the granular layer. Finally the road pavement structure should be restored in accordance with road classification.

The width of the trench should be retained at 15 cm on each side of the outer surface of the pipe.

2) Manholes

Typical circular shaped precast concrete is the basic design for manholes. Typical manhole design is shown in Drawings. When the gap of invert level of the pipes between upstream and downstream at the manhole is larger than 0.8 m, backdrop pipe should be placed on the upstream side.

Step-irons should be equipped along the inside wall of the manhole for safety of workers. The step-irons should be treated with rustproofing agent to combat the acidic environment arising from to Hydrogen Sulfide (H_2S). The cover of the manhole should be made of cast iron in accordance with NWC standard design.

3) Street Sewer and Lateral

Street sewer and lateral should be provided on the basis of the NWC typical design. For the preliminary design, the diameter of the street sewer is temporarily set at 203 mm (8 in) with the length of 85 m per hectare in average for the project areas. The length of street sewer was determined through the sampling survey of the street length in the several selected areas in the project sites of KSA. The number of laterals was also assumed through counting of the number of buildings in the project sites of KSA.

4) Household Connections

One of the serious issues for the sewerage works operation of NWC is the low percentage of household connections where sewers are present. This is due to the high cost of connecting the household drain to the public sewer system.

For consideration of household connections, the average length of the house drain between the current soak pit or the septic tank and the lateral is assumed at 30 m on average. This is based on the field survey. This is considered adequate although it is based on a sampling of only 22 homes in KSA. Most houses have soak pits or septic tanks in the rear of houses away from the main street.

In accordance with the Japanese design guideline, the household sewer can be designed simply with pipe diameter of 100 mm for connections serving up to 150 users, with a fixed slope of 1% and minimum soil cover at 20 cm.

3.4.2 Preliminary Design of KSA Scheme

The preliminary design as well as detailed calculations of sewerage facilities for KSA area is provided in the Appendices of this report. A summary of the preliminary design is given in Table 3.4.2.

Table 3.4.2 Summary of Preliminary Design for KSA Scheme

Item	Unit	Lot A	Lot B	Lot C	Lot D	Total
Sewered Area	(ha)	155	430	230	370	1,185
Beneficiaries	(persons)	16,460	31,682	6,626	11,824	66,592
Households	(nos)	1,870	3,710	1,250	2,730	9,560
Street Length	(m)	18,500	39,500	14,500	29,000	101,500
Trunk Sewers	Dia (mm)	Length (m)				
	200	430	7,835	4,775	4,834	17,874
	250	800	2,000	685	1,175	4,660
	300	0	1,970	0	0	1,970
	350	1,260	1,250	700	0	3,210
	450	0	595	1,415	0	2,010
	530	0	1,780	0	0	1,780
	750	410	1,270	0	1,910	3,590
	900	1,920	0	0	340	2,260
	Total	4,820	16,700	7,575	8,259	37,354
Street Sewer	Dia (mm)	Length (m)				
	200	18,500	39,500	14,500	29,000	101,500
Lateral	(nos)	1,870	3,710	1,250	2,730	9,560
Household Connection	(nos)	1,870	3,710	1,250	2,730	9,560

Source) JICA Survey Team

3.5 Area-wise Sewered Ratio

The area-wise sewered ratio was estimated by means of the ratio of sewered population to the entire population of target area. The sewered rate in Portmore is constant because of no consideration of expansion of the current sewered area. The summary of the estimation is shown in Table 3.5.1.

Table 3.5.1 Summary of Sewered Ratio Estimation

(Unit: %)

Area	Year / Case	2010	2015	2020	205	2030
KSA	1. Existing + Project Areas	30	38	38	38	38
	2. 1. + 2nd and 3rd Project Expansion	30	38	43	46	46
	3. Entire Sewered Expansion	30	38	55	77	82
Portmore		98	98	98	98	98

Source) JICA Survey Team

CHAPTER 4 CONSTRUCTION PLAN AND COST ESTIMATE

4.1 Summary

The objective of this chapter is to describe and discuss the construction plan and cost estimate for the works proposed in this project. International Competitive Bidding (ICB) and Local Competitive Bidding (LCB) packages were assumed.

The cost estimate was developed from the following bases:

1) Base date of the estimate of July 2009.

2) Kingston Water and Sanitation Project by KBR in 2003. These costs were increased by 84.6% to include escalation of consumer price index (CPI) since 2003.

3) Actual bid tabulations for projects executed in Jamaica, for example the Kingston Metropolitan Area Water Supply Project, Lots 1 and 2A. These projects were executed by foreign contractors in Jamaica, and include foreign and local costs.

Table 4.1.1 presents a general summary of the estimated costs for the project.

Table 4.1.1 Summary Cost Estimate

Contents	Cost (Unit: JPY)
A. Eligible portion* (Ⅰ+Ⅱ)	12,083,000,000
Ⅰ) Procurement / Construction (1+2+3)	10,200,000,000
1. Portmore Sewerage Project (alternative B -gravity option)	2,974,000,000
2. Sewerage Project of North Kingston Area	7,107,000,000
3. Procurement for Sewerage Project	119,000,000
Ⅱ) Consulting service	1,273,000,000
B. Non eligible portion	416,000,000
C. Interest during Construction	231,000,000
D. Commitment charge	59,000,000
Grand Total (A+B+C+D)	12,178,000,000

Source) JICA Survey Team

* included in the price escalation and physical contingency

4.2 Workflow of Cost Estimate

Cost estimate for this project is carried out the following sequence.

(1) Basic Condition (Section 4.3)

Price escalation and physical contingency were specified by JICA. Other conditions were derived from regulations and guidelines in Jamaica.

(2) Field Survey and Review (Section 4.4)

The consultant team surveyed the current conditions in KSA and Portmore to understand the available methods of construction and the impacts on costs.

(3) Preparation of Construction Plan (Section 4.5)

The Survey Team prepared basic engineering drawings (see Appendix) to further define the magnitude of and impacts from the construction of the works proposed herein.

(4) Preparation of Unit Price & Quantity (Section 4.6)

Quantity estimates were prepared using the basic drawings as described above. Unit prices were prepared for the multitude of various, but similar components of the project. The unit prices were derived from bid tabulations on previous projects in Jamaica, the KBR Report from 2003, and the Survey Team's prior experience in international wastewater infrastructure projects.

(5) Cost Estimate (Section 4.7)

The cost estimate is composed of an eligible portion and a non-eligible portion. The eligible portion reflects the main construction contract costs and is calculated based on the unit price and quantities of materials, including price escalation and contingency. The non-eligible portion reflects a cost to be assumed by the Owner and comprises land acquisition cost, administration cost, and taxes, duties, and fees.

(6) Disbursement schedule (Section 4.8)

The disbursement schedule was developed with the following bases:

1) The method of the contract is assumed to be a standard engineering / procurement / construction style. In this form, the Owner performs or contracts the engineering and design required to create a Contract Document upon which interested construction firms submit bids. A selected bidder constructs the works specified in the Contract Document, and upon conclusion of the Contract the Owner takes possession and operates the newly constructed works.

2) Project duration is set for 5 years from 2011 to 2015 between start of engineering and completion of construction.

3) The project involves three packages one for the construction in KSA, one for the construction in Portmore, and one for the consulting services to engineer and design the works, then to manage and inspect the construction.

4.3 Basic Conditions

(1) Base Cost Date

July 2009

(2) Exchange Rate

1 USD = 89.6 JPY (Monthly average rate in Dec, 2009)

1 USD = 88.9 JMD (Monthly average rate in Oct, 2009)

1 JMD = 1.00 JPY

(3) Price Escalation

Foreign currency: 3.1 %

Local currency: 5.8%

(4) Physical Contingency

5.0%

(5) Taxes

GCT: 16.5%, but exempted for this project.

Import Tax: The charge for CUF (Custom User Fee) is 2% of C.I.F. invoice value on all imports and not a flat rate previously. It is exempted in this project.

(6) Spare Parts, Maintenance

Pumping station: Spare parts for two years to maintain are included in the cost of Mechanical and Electrical works.

Gravity pipe: High pressure Vactor truck to clean sewerage pipes is estimated based on recent procurement by the Owner.

4.4 Field Survey and Review

(1) Portmore Area

1) Sewage treatment plants: Four sewage treatment plants are located in Portmore area. These facilities are in disrepair and will be demolished in this project.

2) Pump station: There are eighteen existing sewage pump stations. The pump stations are in generally poor condition. Each will be rehabilitated and restored to an acceptable condition.

3) Sewer pipelines: Current sewer network is fully developed and requires no specific improvement, aside from the main interceptor pipeline to collect all flows from the service area.

Previous studies include useful cost data related to the improvements to the Portmore system. A pumped system design for the conveyance of Portmore sewage was prepared previously in the KBR report. The cost estimate presented there is shown in Table 4.4.1. It includes a 20% contingency on capital costs.

Table 4.4.1 Summary of Cost Estimate (Portmore Lift Station Costs)

(Unit: JMD)

Lift Station	Capital Cost		Annual O&M cost	
	Stage1	Stage2	Stage1	Stage2
1. Hamilton Gardens	75,000	---	1,000	1,000
2. Caymanas Gardens	98,000	---	2,900	2,900
3. Bridgeport	1,265,000	---	20,800	20,800
4. Independence City	2,703,000	---	26,100	26,100
5. Marine Park	14,000	---	---	---
6. Breaton	35,000	---	---	---
Total Cost Estimate	4,190,000	---	50,800	50,800

Source: SENTAR report, Fluid Systems

Other costs were reviewed for the construction of pipelines. Force main costs shown in Table 4.4.2 are for gravity sewers constructed with sheet pile protection and 6.7 – 9.8 ft depth of bury and include installation and restoration. A cost factor of 2.0 on installation was applied due to high groundwater table.

Table 4.4.2 Summary of Cost Estimate (Pumping Main Costs)

(Unit: USD)

Lift Station	Height	Cost
1. Hamilton Gardens to Caymanas Gardens	2,300 ft. 06”	107,641
2. Caymanas Gardens to Soapberry	4,100 ft. 08”	192,216
3. Bridge Port to Independence City	13,600 ft. 18”	1,450,048
4. Independence City to Soapberry	9,980 ft. 30”	1,847,353
Contingency and Engineering (35%)	---	1,259,040
Total Cost Estimate	---	4,856,298

Source: SENTAR report, Fisher Pryce and Associates

(2) North Kingston Area

1) Sewage treatment plant: The existing sewerage system in KSA currently serves approximately 30% of the population and most of the larger industrial discharges. There are, small independent systems serving other parts of the city.

2) Sewer pipelines: Current sewer network is mainly developed in Downtown, Harbour View, and Duhaney Park.

The KBR report from 2003 provided unit costs per meter for open trench construction. These are repeated in Table 4.4.3. That report also included costs for street sewers and laterals on an area basis (see Table 4.4.4). The costs in both tables include contingency and engineering.

Table 4.4.3 Unit Price for Sewer Pipes with Open Trench Construction

(Unit: USD/m)

a (mm)/Depth	200	225	300	375	450	525	600	675	750	900	1050	1200	1500	1800
n/e 2 m	130	149	166	200	242	298	339	415	467	556	639	697	-	-
2 - 3 m	136	155	172	207	248	304	346	426	474	568	652	712	860	1,100
3 - 4 m	167	186	204	238	279	335	356	458	505	608	701	771	936	1,176
4 - 5 m	189	208	225	260	301	357	402	482	533	636	736	812	1,043	1,258
5 - 6 m	254	273	291	325	369	429	476	560	610	723	826	914	1,227	1,353
6 - 7 m	336	356	381	408	458	510	577	655	734	846	924	1,024	1,321	1,460

Source: KBR report

Table 4.4.4 Unit Price for Street Sewers and Laterals

(Unit: USD/ha)

housing classification	Sewer	Lateral	Total Cost/ha
low	50,070	4,700	54,770
low/medium	25,580	5,110	30,690
medium	20,830	2,480	23,310
medium/high	18,150	5,600	23,750
high	14,430	730	15,160

Source: KBR report

4.5 Preparation of Construction Plan

The construction plan is divided into two parts: Portmore sewerage improvements and the KSA Sewerage works. Dividing the construction into two parts is logical from a geographical perspective, and the magnitude and construction methodology of the two projects also allows for two contracts.

(1) Portmore Sewerage Project

Construction period: 24 months, including preparation and project liquidation.

Construction method

1) Installation works will be applied for the pipe jacking (Alternative B – gravity option), total length approximate 6,200 meters.

2) Special Civil works such as new pipe bridge to support pipeline crossing Rio Cobre to headworks of Soapberry STP. Total length is approximately 1,100 m.

3) Pumping Stations (Bridgeport, Independence City, Caymanas and Hamilton STP) and demolition of existing facilities.

(2) Sewerage Project of North Kingston Area

1) Construction period: 24 months, including preparation and project liquidation.

2) Construction method

Open trench construction for gravity pipe, total length approximate 37 km.

Installation of street sewers and laterals, total area approximately 1,185 ha.

3) House connection, total quantity is approximate 9,560.

4.6 Preparation of Unit Price and Quantities

4.6.1 Preparation of Bills of Quantities

Quantity calculation was prepared by designers of the Survey Team using the basic engineering drawings presented in the Appendix.

4.6.2 Preparation of Unit Price

Some of the unit prices employed in the cost estimate are listed in Table 4.6.1 along with the source from which they were taken.

Table 4.6.1 Source of Selected Unit Prices

Specification	Source
Open trench construction (Gravity pipe) Force pipe	- Actual result in Japan from Construction price index, September in 2009 - KBR report in 2003 - Actual project in Jamaica from site and NWC
Civil works of Pumping station	- Actual project in Jamaica recently
Pumping station	Cost function refer to actual result in Japan
Convey to headworks of Soapberry STP	- Actual project in Jamaica recently (bridge pipe) - Actual result in Japan (pipe jacking)
Street sewers and Laterals	KBR report in 2003
House connection	Proposal by JICA survey team
Procurement	Hearing from the client

Source: JICA Survey Team

(1) Open Trench Pipeline Construction

Three sources were compared to identify the most appropriate costs for the unit price of open trench pipeline construction. As there are more than 40 km of pipelines to be constructed in the two contracts, the overall project cost will be very sensitive to the selected cost.

The first source is the KBR report from 2003. Those costs are tabulated according to pipeline diameter and anticipated range of trench depth. Those data are summarized in Table 4.6.2. All costs were included as foreign currency.

Table 4.6.2 Unit Price for Sewer Construction with Open Trench Method

(Unit: USD/m)

Dia (mm)/Depth	200	225	300	375	450	525	600	675	750	900
n/e 2 m	239	275	307	370	447	550	626	765	863	1,027
2 - 3 m	251	286	318	382	458	561	638	787	874	1,048
3 - 4 m	308	344	376	439	515	619	656	845	932	1,123
4 - 5 m	348	384	416	479	556	659	741	891	983	1,174
5 - 6 m	469	504	537	600	682	791	879	1,034	1,127	1,335
6 - 7 m	620	658	704	752	845	942	1,066	1,209	1,355	1,561

The second source was the actual bid tabulations received for the Kingston Metropolitan Area Water Supply Project. These bids included multiple international contractors for similar construction works, namely pipeline construction. Although mostly for pressurized pipeline construction, they nonetheless give important information on trenching and construction in urbanized streets. Costs were divided between local and foreign currency.

The last source is the Engineering Implementation guidance document from the NWC. These data are for the 2009-2010 period, and all costs are identified as local currency.

The comparison of these three methods is presented in Table 4.6.3. The highlighted column, representing actual bid prices, is deemed the most appropriate.

Table 4.6.3 Compared Unit Price for Open Trench Construction

Item	Unit	Quantity	Unit Price					
			KBR report from 2003		Actual bid		NWC actual result	
			Foreign	Local	Foreign	Local		Local
			1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD
1. Force pipe (Plastic)								
ϕ 200	m		22.5	0.0	17.6	8.9		
ϕ 300	m		34.2	0.0	19.7	16.1		
ϕ 400	m		41.0	0.0	24.6	22.3		
ϕ 600	m		44.8	0.0	35.0	24.8		
2. Gravity pipe (Plastic)								
ϕ 200	m		22.5	0.0	17.6	8.9	0.0	19.0
ϕ 250	m		25.6	0.0	19.7	16.1	0.0	20.6
ϕ 300	m		28.5	0.0	19.7	16.1	0.0	29.0
ϕ 350	m		34.2	0.0	21.7	22.2	0.0	33.0
ϕ 375	m		34.2	0.0	24.6	22.3	0.0	37.0
ϕ 400	m		41.0	0.0	24.6	22.3	0.0	41.0
ϕ 450	m		41.0	0.0	31.9	23.9	0.0	45.5
ϕ 750	m		78.3	0.0	51.3	39.3		
ϕ 900	m		93.9	0.0	61.5	47.2		

Source) JICA Survey Team

To verify and supplement these data, the JICA Survey Team solicited quotations from local contractors in Jamaica. The following are two main results of these discussions.

1) The designs were not sufficiently advanced to fix the unit price in the eyes of the contractors. A major variable is the selection of pipe type. The type of pipe will be selected in the final design phase.

2) Trenchless construction (in this case, pipe jacking) is significantly more expensive than simple open trench construction. While the cost of conventional open-cut construction increases greatly with increasing depth, as shoring and dewatering become more important, it is difficult identify the intersection of the cost curves of the two technologies, especially when considering narrow roads and deep excavations.

(2) Civil works of pumping station

General unit prices were taken from the actual bids data. For example,

- Site clearing: 3,400 JMD / m^2;
- Temporary work (sheet piles): 28,000 JMD / m^2;
- Excavation work: 3,100 JMD / m^3; and
- Concrete work: 16,000 JMD / m^3.

These selected costs include a labor cost of 40% and an overhead and profit of 20% of the total cost.

(3) Pumping Stations

Pumping station construction costs are based on a cost function derived from real bid data in Japan.

Cost = 85.5 $Q^{0.6}$ x (103.3 / 78.0) million JPY (Q: Pumping station capacity, m^3/min)

This cost represents the mechanical and electrical works and is allocated to foreign cost in the tables.

(4) Rio Cobre Crossing

Three methods of crossing the Rio Cobre were investigated. While utilizing the existing railway bridge would be the most economical the Jamaica Railway Company was disinclined to accept the solution. A pipe bridge solution was used in the final cost estimate tables.

Table 4.6.4 Cost Comparison to Convey to Headworks of Soapberry STP

Method	Diversion use of Railway bridge	Water pipe bridge	Pipe jacking
Cost (USD/m)	1,200	1,200	2,000
Construction method	Not appropriate (Confirmation of JRC)	Appropriate	Appropriate
Evaluation	Not appropriate	Appropriate	Appropriate, but expensive cost

Source: JICA Survey Team

(5) Revised unit prices for street sewers & laterals

Unit prices for street sewers and laterals are shown in Table 4.6.5. In this survey, length of the street sewers & laterals per ha was applied for 27,985 USD/ha on basis of the KBR report as below. But the length of street sewers was changed from 110 to 95 m/ha, and quantity of household per ha is not same compared with the different area on the background of site survey. Therefore, this unit price was revised street sewers-22,798 USD/ha + Laterals-80USD per house.

Table 4.6.5 Street Sewers & Laterals

(Unit: USD/ha)

housing classification	Sewer	Lateral	Total Cost/ha
low	92,429	8,676	101,105
low/medium	47,221	9,433	56,654
medium	38,452	4,578	43,030
medium/high	33,505	10,338	43,843
high	26,638	1,348	27,985

Source: KBR report, Street sewer is 110m/ha

(6) House Connection

The cost of the house connection included in this estimate is not a construction cost, but instead is a subsidy to the homeowner to cover costs they require within the property line to

connect their current house sewer to the new system at their property line. Other items such as decommissioning soak pits, additional manholes on the property, etc, would have to be covered by the individual owners, if needed. Therefore, the current figure of USD 1,500 per house is to encourage people to connect by lowering the effective cost to them. This item is included on a provisional basis.

(7) Procurement for Sewerage Project

NWC requires additional resources to implement this project, especially for equipment to be used during the operation and maintenance after construction. As such a modest allowance is included for the purchase of heavy equipment and tools.

4.6.3 Material Procurement

Material procurement is the same for local or foreign contractors. The JICA survey team confirmed that local contractors could purchase imported materials such as sewerage pipe from foreign companies.

1) Local Material

There are cement factories in Jamaica, but no steelworks. Any Contractor can purchase from trading companies that import standard building materials from countries around Jamaica. Therefore, almost all materials of civil works and buildings will be supplied in Jamaica. These include cement, stone, brick, sand, reinforcement, scaffolding, concrete block, fences, gates, asphalt, etc.

2) Imported Materials

Jamaica has no manufacturing facilities for pipes anticipated for this project (e.g., ductile iron, glass-fiber reinforced, PVC), and no fabrication facilities for pumps and other installed electro-mechanical equipment. Almost all materials of pipelines and pumping stations will be imported materials from the developed counties. Imported materials and equipment includes PVC, ductile and plastic sewer pipe, pumps, motors, starters, transformers, switches, and motor control center equipment.

4.7 Cost Estimate

4.7.1 Construction Cost

The cost estimate for the Pumped Option for the Portmore sewerage improvements (Pumped Option) is shown in Table 4.7.1, and the Gravity Option in Table 4.7.2. The KSA sewer implementation portion is revealed in Table 4.7.3, while the cost of new equipment for the NWC is shown in Table 4.7.4.

Table 4.7.1 Cost Estimate for Portmore Sewerage Area (Alternative A – Pumped Option)

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD	1,000 JPY
Total Cost Estimate					1,402,904	406,962	1,809,866
1. Proposed force pipe (PVC or GRP)							
ϕ 200 (Hamilton Gardens to Caymanas)	m	1,290	17.6	8.9	22,704	11,481	34,185
ϕ 300 (To Caymanas, gravity)	m	570	19.7	16.1	11,229	9,177	20,406
ϕ 300 (Caymanas to Soapberrry WWTP)	m	80	19.7	16.1	1,576	1,288	2,864
ϕ 400 (Bridgeport to Independence City)	m	2,630	25.9	22.3	68,117	58,649	126,766
ϕ 600 (Independence City to Soapberrry	m	2,240	35.0	24.8	78,400	55,533	133,933
2. Convey to headworks of Soapberry WWTP (GRP)							
ϕ 600 (Caymanas to Soapberrry WWTP)*1	m	1,030	37.4	79.5	38,500	81,840	120,340
3. Replacement of Pumping Station							
1) Bridgeport (3.88m3/min)	LS	1	198,349	57,080	198,349	57,080	255,429
2) Hamilton Gardens (0.08m3/min)	LS	1	19,798	5,080	19,798	5,080	24,879
3) Independence City (23.3m3/min)	LS	1	668,887	80,525	668,887	80,525	749,412
4) Caymanas Gardens (1.81m3/min)	LS	1	115,343	46,308	115,343	46,308	161,651
5) Modified existing PS	nos	18	10,000		180,000	0	180,000
4. Miscelanious cost of 1-3 Work items	LS	1	0%	0%	0	0	0

Source) JICA Survey Team

Table 4.7.2 Cost Estimate for Portmore Sewerage Area (Alternative B – gravity option)

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD	1,000 JPY
Total Cost Estimate					1,771,970	500,593	2,272,563
1. Proposed Gravity pipe (GRP)							
ϕ 200 (Hamilton Gardens to Caymanas,	m	1,290	17.6	8.9	22,704	11,481	34,185
ϕ 300 (To Caymanas)	m	570	19.7	16.1	11,229	9,177	20,406
ϕ 900 (Bridgeport to Caymanas via Independence City)*1	m	5,600	126.9	49.3	710,775	276,120	986,895
2. Convey to headworks of Soapberry WWTP (GRP)							
ϕ 600 (Caymanas to Soapberrry WWTP)*2	m	1,030	37.4	79.5	38,500	81,840	120,340
3. Replacement or Demolish of Pumping Station							
1) Bridgeport (0m3/min)	LS	1	0	2,688	0	2,688	2,688
2) Hamilton Gardens (0.08m3/min)	LS	1	19,798	5,080	19,798	5,080	24,879
3) Independence City (0m3/min)	LS	1	0	2,688	0	2,688	2,688
4) Caymanas Gardens (34.7m3/min)	LS	1	838,964	111,519	838,964	111,519	950,483
5) Modified existing PS	nos	13	10,000		130,000	0	130,000
4. Miscelanious cost of 1-3 Work items	LS	1	0%	0%	0	0	0

Source) JICA Survey Team

Table 4.7.3 Cost Estimate for Sewerage Project of North Kingston Area

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD	1,000 JPY
Total Cost Estimate					3,233,021	2,199,641	5,432,662
1. Pembroke Hall (154ha)							
1) Open trench construction							
ϕ 200	m	430	17.6	8.9	7,568	3,827	11,395
ϕ 250	m	800	19.7	16.1	15,760	12,880	28,640
ϕ 350	m	1,260	21.7	22.2	27,342	27,972	55,314
ϕ 750	m	410	51.3	39.3	21,033	16,113	37,146
ϕ 900	m	1,920	61.5	47.2	118,080	90,624	208,704
2) Street sewers & Laterals	ha	154	1,277.2	851.5	196,696	131,131	327,826
3) House connections	Unit	1,870	80.6	53.8	150,797	100,531	251,328
2. Havendale(430ha)							
1) Open trench construction							
ϕ 200	m	8,130	17.6	8.9	143,088	72,357	215,445
ϕ 250	m	2,000	19.7	16.1	39,400	32,200	71,600
ϕ 300	m	190	19.7	16.1	3,743	3,059	6,802
ϕ 350	m	3,030	21.7	22.2	65,751	67,266	133,017
ϕ 450	m	600	31.9	23.9	19,140	14,340	33,480
ϕ 550	m	1,780	35.1	26.3	62,460	46,796	109,256
ϕ 750	m	1,270	51.3	39.3	65,151	49,911	115,062
2) Street sewers & Laterals	ha	430	1,264.3	842.9	543,668	362,445	906,113
3) House connections	Unit	3,710	80.6	53.8	299,174	199,450	498,624
3. Birdsucker (231ha)							
1) Open trench construction							
ϕ 200	m	4,780	17.6	8.9	84,128	42,542	126,670
ϕ 250	m	690	19.7	16.1	13,593	11,109	24,702
ϕ 350	m	700	21.7	22.2	15,190	15,540	30,730
ϕ 450	m	1,420	31.9	23.9	45,298	33,938	79,236
2) Street sewers & Laterals	ha	231	1,247.1	831.4	288,089	192,060	480,149
3) House connections	Unit	1,250	80.6	53.8	100,800	67,200	168,000
4. Hope Pasture (366ha)							
1) Open trench construction							
ϕ 200	m	4,840	17.6	8.9	85,184	43,076	128,260
ϕ 250	m	1,180	19.7	16.1	23,246	18,998	42,244
ϕ 750	m	1,910	51.3	39.3	97,983	75,063	173,046
ϕ 900	m	340	61.5	47.2	20,910	16,048	36,958
2) Street sewers & Laterals	ha	366	1,255.7	837.2	459,601	306,401	766,002
3) House connections	Unit	2,730	80.6	53.8	220,147	146,765	366,912

Source) JICA Survey Team

Table 4.7.4 Procurement for Sewerage Project

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			1,000 JPY	1,000 JMD	1,000 JPY	1,000 JMD	1,000 JPY
Total Cost Estimate					91,428	0	91,428
1. Vehicles							
1) Twin Cab Pick up Truck (2,500cc)	nos	2	3,584	0	7,168	0	7,168
2) Vactor Jet (2100series)	nos	1	27,776	0	27,776	0	27,776
3) Backhoe (1.3m^3)	nos	2	5,376	0	10,752	0	10,752
4) Mini Excavator (0.6m^3)	nos	2	3,584	0	7,168	0	7,168
5) Lift Truck (5 ton)	nos	1	8,064	0	8,064	0	8,064
6) Dump truck with Clam Shell Bucket (1.3m^3)	nos	1	26,880	0	26,880	0	26,880
2. Maintenance							
1) Power Quality Analyser	nos	2	179	0	358	0	358
2) Vibration Meter	nos	2	90	0	179	0	179
3) Tacho Meter	nos	2	18	0	36	0	36
4) Laser Shaft Alignment Kit	nos	2	538	0	1,075	0	1,075
5) Cable Route Chaser	nos	2	538	0	1,075	0	1,075
6) Flow meter	nos	4	224	0	896	0	896

Source) JICA Survey Team

4.7.2 Consulting Services (by Japanese ODA Loan) Cost

The base cost of consulting service is assumed as 10% of the direct construction cost, as found in typical similar projects. The consulting contract is anticipated to include the detailed design of the works, compilation of the bidding plans and specifications, and assistance with tendering the bids. Upon award of the construction contract, the consultant is retained to provide construction management and supervision on behalf of the Owner.

Average remuneration of international consultant, local consultant and local supporting staff are JPY2.69 million per man-month, JMD600,000 per man-month and JMD200,000 per man-month, respectively.

4.7.3 Operation and Maintenance Cost

Operation and maintenance cost items for this project are:

- Spare parts cost for pumping stations;
- Maintenance of pumping stations;
- Energy cost for pump station; and
- Maintenance cost for gravity pipe.

It is difficult to estimate the costs of these details without information on the current operation costs incurred by the Owner. Therefore, the JICA survey team conducted interviews with existing maintenance management from NWC, and made the following observations and calculations:

- Total budget in NWC per year is 831.0 million JMD (included in the labor, electrical, maintenance, operation and administrative cost);

- Total NWC wastewater staff are 150 people;
- Average cost per assigned staff is 5.54 million JMD / person; and
- The necessary staff for this project is 15 people.

Accordingly the operation and maintenance cost for the project is estimated at 83.1 million JMD / year. This cost will be added to the budget after construction period, but the cost estimate does not include any present-worth value to accommodate future recurring costs.

4.7.4 Non eligible Cost

1) Land acquisition: Because the construction projected here is entirely within public lands or rights-of-way, no land acquisition is anticipated.

2) Administrative cost per year will be applied for the operation and maintenance cost shown above. Therefore, an annual cost of 83.1 million JMD / year is assumed for the years between detail design and completion of construction, approximately five years. This cost is listed in the disbursement schedule.

3) Tax and Import tax: The JICA survey team confirmed that taxes and duties will be exonerated.

4.7.5 Summary of Cost Estimate (Direct cost)

Table 4.7.5 Summary of Cost Estimate (Direct Cost)

Contents	Cost (Unit: JPY)
A. Eligible portion (Ⅰ) + Ⅱ))	11,473,000,000
Ⅰ) Construction cost (Gravity Option)	10,200,000,000
1. Portmore Sewerage Project (alternative B -gravity option)	2,273,000,000
2. Sewerage Project of North Kingston Area	5,433,000,000
3. Procurement for Sewerage Project	91,000,000
Base cost (1+2+3)	7,797,000,000
Price escalation & Physical Contingency	1,917,000,000
Ⅱ) Consulting service cost	1,273,000,000
Base cost	1,020,000,000
Price escalation & Physical Contingency	254,000,000
B. Non eligible portion (a+b+c+d)	416,000,000
a. Land Acquisition	0
b. Administrative cost	416,000,000
c. VAT	0
d. Import tax	0
C. Interest during Construction	231,000,000
D. Commitment charge	59,000,000
Total (A+B+C+D)	12,178,000,000

Source) JICA Survey Team

The total cost developed here (¥ 12.2 billion, or US$135 million) is substantially greater than the estimated cost provided in the initial request for assistance from the Government of Jamaica (US$ 55 million). This escalation is cause by the following factors.

1) Unit prices have risen 4% per year in the nearly 3 years since the date of the request.

2) Quantities: it is assumed that the quantities proposed here are significantly greater than those contemplated for the Request for Assistance. Regrettably, the Survey Team was unable to locate the data from which the Request for Assistance was generated.

3) This cost estimate considers house connections; these were not contemplated in the 2007 request.

4.8 Disbursement Schedule

The project was divided into two portions; one is costs to be covered by the Japanese ODA loan, and another portion reflecting the costs to be absorbed by the government of Jamaica. The outline of project funds is shown in Table 4.8.1.

Table 4.8.1 Outline of Project Funds

Covered by Japanese ODA	The government of Jamaica
Ⅰ). Constructions 1) Portmore sewerage area Force(Gravity) pipe Convey to Soapberry STP Replacement of Pumping Station 2) North Kingston Area sewerage area Open trench construction Street sewers and Laterals 3) Procurement for Sewerage Project Ⅱ). Consulting services Ⅲ) Physical Contingency and Price escalation on the above Ⅰ) & Ⅱ)	a. Land acquisitions b. Administrative cost c. VAT d. Import tax

Source) JICA Survey Team

(1) Recommended Construction Packages

The JICA Survey Team considered available methods of contracting this project. The contract types were considered:

- Standard design/bid/build contract where contractors prepare bids on design documents prepared by or for the Owner and construct the project exactly as specified;
- Design build, where a contractor is required to design works within functional requirements and construct the works after the Owner approves the design; and
- BOT (Built, Operation and Transfer), BTO (Build, Transfer and Operation) A BOT contract requires a contractor to construct a system as designed by or for the Owner, but also requires him to own and operate the facility according to a framework, then

transfer the ownership and operation of the facility to the Owner at a later date.

As an example, the recent Soapberry STP project was via a BOT scheme, with a private company currently operating the plant at an estimated cost of 100 million JPY per month.

The operation and maintenance requirements for the KSA/Portmore project are not great, and the works are geographically distributed and would not lend itself to an outsourcing concept. Therefore, the standard design/bid/build contract for this project is deemed most appropriate.

For reasons related to construction method and geography, three separate contracts are proposed for this project. These are identified in Table 4.8.2. Beforehand, JICA survey team discussed with the executing agency, NWC, and confirmed some comments as follows.

- It's appropriate to divide the package on basis of project area
- This project is requested to join the local contract company as possible.

Table 4.8.2 Recommended Contract Packages

Package	Component	Procurement	Fund
PACKAGE 1 Portmore Sewerage Project	Deep Interceptor via trenchless construction Convey to Soapberry STP Replacement of Pumping Station	ICB	ODA loan
PACKAGE 2 Sewerage Project of North Kingston Area	Open trench construction Street sewers and Laterals	LCB	ODA loan
PACKAGE 3 Procurement for Sewerage Project	Procurement	ICB	ODA loan

Source) JICA Survey Team

(2) Preparatory Works by Jamaican Side

The followings are the general requirements of JICA that must be executed by Jamaican side during project implementation period:

1) Completion of approval process of EIA, and,

2) Land acquisition and resettlement if required.

According to the preliminary design, it is assumed that land acquisition and resettlement would not be required under this project.

(3) Definition of Completion for the Project

Defined the completion of the project is as the Taking-over Certificate issued by the Engineer in accordance with FIDIC.

1) Defects Liability Period

"Defects Liability Period" is normally one year for the civil engineering project.

2) Defects Liability Certificate.

"Defects Liability Certificate" (DLC) is to be issued by the Engineer at due time of Defect Liability Period. In some cases, DLC is issues by the Employer instead of the Engineer because of absence of the Engineer after his project assignment has been finished.

To prepare an accurate disbursement schedule, a detailed project implementation schedule is required. The schedule for project implementation is illustrated in Figure 4.8.1. Based on this sequence of construction activities, the disbursement schedule was prepared as shown in Table 4.8.3. The majority of the disbursements occur in the last two years, when the construction is implemented under two main contracts.

Figure 4.8.1 Project Implementation Plan

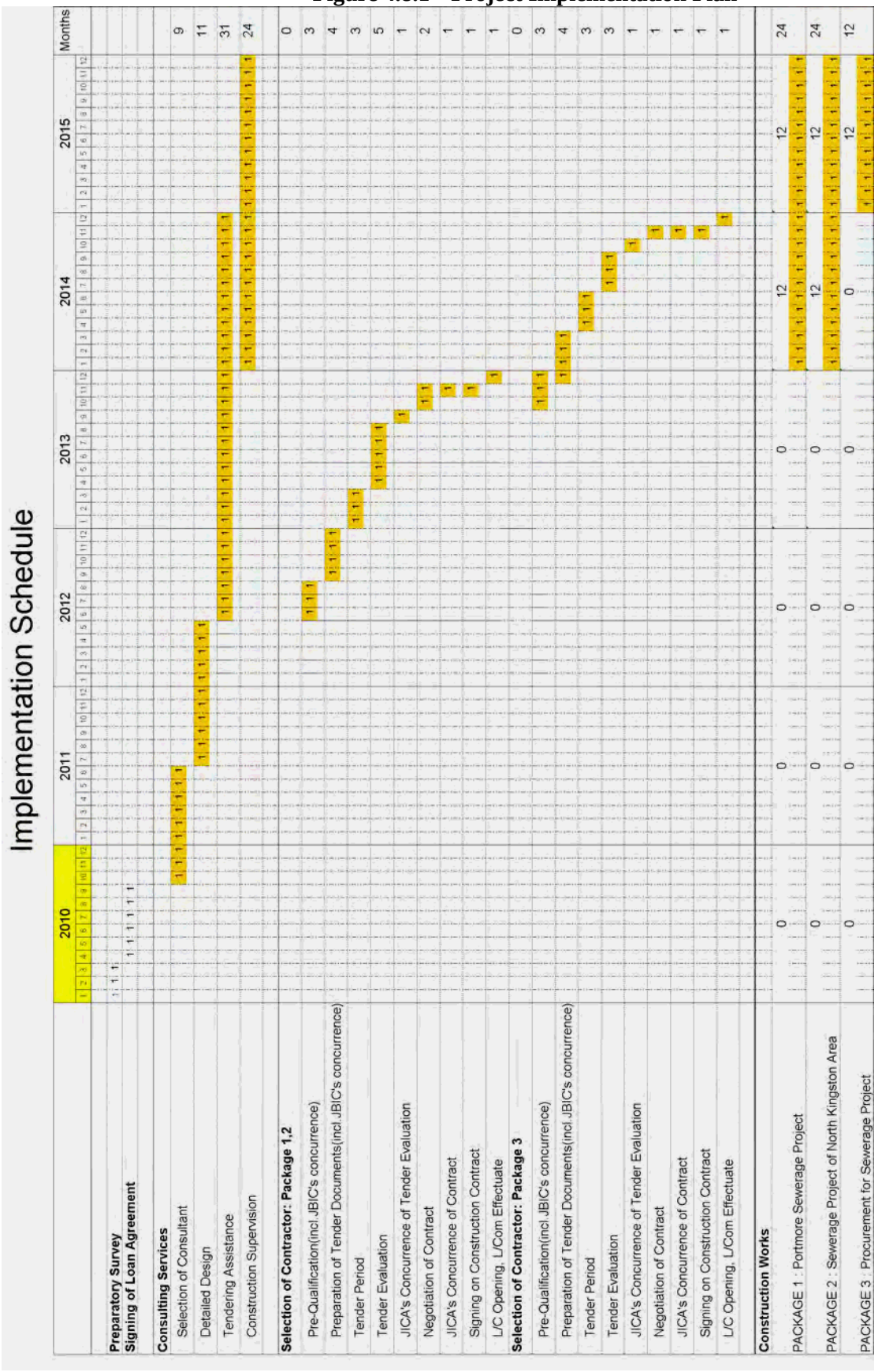


Table 4.8.3 Disbursement schedule

Disbursement Schedule

Base Year For Cost Estimation:	July 2009		FC & Total:	million JPY
Exchange Rates	JMD 1 = JPY	1.000	LC :	million JMD
PriceEscaration:	FC: 3.1%	LC: 5.8%		
Physical Contingency	5%			
Physical Contingency for Consultant	5%			

Item	Total			2010			2011			2012			2013			2014			2015		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																					
I) Procurement / Construction	6,332	3,868	10,200	0	0	0	0	0	0	0	0	0	0	0	0	3,061	1,879	4,940	3,271	1,988	5,259
PACKAGE 1 : Portmore Sewerage Project	1,772	501	2,273	0	0	0	0	0	0	0	0	0	0	0	0	886	250	1,136	886	250	1,136
PACKAGE 2 : Sewerage Project of North Kingston Area	3,233	2,200	5,433	0	0	0	0	0	0	0	0	0	0	0	0	1,617	1,100	2,716	1,617	1,100	2,716
PACKAGE 3 : Procurement for Sewerage Project	91	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	0	91
Base Cost	5,096	2,700	7,797	0	0	0	0	0	0	0	0	0	0	0	0	2,502	1,350	3,853	2,594	1,350	3,944
Price Escalation	934	983	1,917	0	0	0	0	0	0	0	0	0	0	0	0	413	440	852	521	543	1,065
Physical Contingency	302	184	486	0	0	0	0	0	0	0	0	0	0	0	0	146	89	235	156	95	250
II) Consulting services	755	518	1,273	0	0	0	62	41	103	221	119	339	165	110	275	112	106	218	196	142	338
Base Cost (10% of construction cost)	633	387	1,020	0	0	0	55	35	90	192	95	287	139	84	223	92	76	168	155	96	252
Price Escalation	86	107	193	0	0	0	3	4	8	18	18	36	18	21	39	15	25	40	31	39	70
Physical contingency	36	25	61	0	0	0	3	2	5	11	6	16	8	5	13	5	5	10	9	7	16
Total (I +II)	7,088	4,385	11,473	0	0	0	62	41	103	221	119	339	165	110	275	3,173	1,985	5,158	3,467	2,130	5,597
B. NON ELIGIBLE PORTION																					
a Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	416	416	0	0	0	0	4	4	0	12	12	0	10	10	0	187	187	0	203	203
c VAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
d Import Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (a+b+c+d)	0	416	416	0	0	0	0	4	4	0	12	12	0	10	10	0	187	187	0	203	203
TOTAL (A+B)	7,088	4,801	11,889	0	0	0	62	45	107	221	131	352	165	120	285	3,173	2,172	5,345	3,467	2,333	5,800
C. Interest during Construction	231	0	231	0	0	0	1	0	1	5	0	5	9	0	9	73	0	73	143	0	143
TOTAL (A+B+C)	7,319	4,801	12,120	0	0	0	63	45	108	226	131	357	174	120	294	3,246	2,172	5,418	3,610	2,333	5,943
D. Commitiment Charge	59	0	59	0	0	0	12	0	12	12	0	12	12	0	12	12	0	12	12	0	12
GRAND TOTAL (A+B+C+D)	7,377	4,801	12,178	0	0	0	75	45	120	238	131	369	186	120	306	3,258	2,172	5,429	3,621	2,333	5,954

Administration Cost =	3.6%	of the Eligible portion
VAT=	0.0%	Exemption (Normal: 16.5% of the expenditure in local currency of the eligible portion)
Import Tax=	0%	Exemption (Normal: 2.0% of the expenditure in foreign currency of the eligible portion)
Commitment Charge=	0.1%	: (A.Eligible Portion Total+ C.Interest during Construction) x Commitment Charge(%)
Construction Period=	5	years
Loan Period=	25	years

Price Escalation

	2010 FC	2010 LC	2011 FC	2011 LC	2012 FC	2012 LC	2013 FC	2013 LC	2014 FC	2014 LC	2015 FC	2015 LC
Price Escale	1.031	1.058	1.062961	1.119364	1.09591279	1.18428711	1.12988609	1.25297576	1.16491256	1.32564836	1.201024845	1.402535964
d Price Escal	0.031	0.058	0.062961	0.119364	0.09591279	0.18428711	0.12988609	0.25297576	0.16491256	0.32564836	0.201024845	0.402535964

Loan interest during const.

Financing rate	85.0%	
Interest rate for JPY loan	1.40%	

	Total	2010 FC	2010 Total	2011 FC	2011 Total	2012 FC	2012 Total	2013 FC	2013 Total	2014 FC	2014 Total	2015 FC	2015 Total
Temporaly alocation	11,889	0	0	91	107	299	352	243	285	4,543	5,345	4,930	5,800
Debt at the end of term		0		91		391		639		5,191		10,194	
Interest during const		0		1		5		9		73		143	

CHAPTER 5 ORGANIZATIONAL STRENGTHENING PLAN

5.1 The Water Sector Policy and NWC Mission

5.1.1 NWC Mission and Organization

(1) Mission

The NWC (National Water Commission) is a statutory organization charged with the responsibility of providing potable water and wastewater services for the people of Jamaica. Although there are other water service providers such as Parish Councils and private water companies, NWC is by far the largest provider of water and sanitation services in Jamaica.

The Mission of the NWC is to provide the highest quality potable water and wastewater services, maintain good working conditions and good corporate citizenship while protecting the natural environment and contributing positively to national development.

(2) Background

In 1977, the Cabinet had given its approval in principle that as a first step towards its objectives of rationalizing the water use and management and the integration of all its elements, there should be an amalgamation of the Water Commission and the National Water Authority. By the National Water Commission Act of 1980, the National Water Commission was established.

It was envisaged that the National Water Commission would eventually control all inland water regardless of local boundaries or specific application for which water is used. The merger of the two major water supply bodies was to be followed up with the embracing of the Water Resources Division of the Ministry of Local Government, the Irrigation agencies, the Water Supply Branches of the Kingston and St. Andrew Corporation, the Parish Councils and the Underground Water Authority. In the mid 1980's the Water Supply Branches of the Kingston and St. Andrew Corporation and the Parish Councils were taken over by the NWC.

The NWC's focus was on providing water supply and sewerage services to communities across the island and the other agencies did not become a part of this organization. By the early 1990's some of the minor water supply facilities were returned to the Parish Councils for operation and maintenance.

(3) Customer Operation

With regard to the provision of potable water service NWC states that as of March 2007 its customer base was 457,852 users of which 368,456 represent active accounts. The customer base increased on average by 2.4% per year between 2004 and 2007. Only 23% of the customer base is provided with sewage service. Table 5.1.1 shows the movement in the customer base.

Table 5.1.1 Movement in NWC Customer Base over Four Year Period

CATEGORIES	Number of Accounts			
	March 2004	March 2005	March 2006	March 2007
Domestic	394,783	406, 585	416,161	423,277
Commercial	28,187	29,222	30,470	31,423
Primary School	1,162	1,168	1,182	1,123
Condominium	255	255	263	259
Others	1,815	1,789	1,770	1,816
TOTAL	426,202	439,019	449,892	457,852

Source) NWC, Tariff Requirement for the Period 2007-2010, September 2007

(4) Organizational Structure

The NWC is headed by a nine-member Board of Commissioners appointed by the portfolio Minister (the Ministry of Water and Housing) and the members range from a Businessman, Public Health Inspector, Attorney-at-Law, Managing Director of Water Resource Authority, Permanent Secretary of the Ministry of Water and Housing, etc. Together, they establish policy and give general direction to the organization. Under the new structure, the NWC is operated under the direction of a President assisted by seven Vice Presidents (refer to Fig. 5.1.1). Operationally, two Vice Presidents head the Eastern and Western operational divisions that are responsible for the day-to-day provision of service to customers islandwide. These two semi-autonomous divisions consist of eight Areas, each headed by Area Managers.

"Eastern Division" composed of Kingston, St. Andrew and St. Thomas, St.Mary & Portland, St. Catherine and Clarendon

"Western Division" composed of St. Ann, St. James & Trelawny, Westmoreland & Hanover, and Manchester & St. Elizabeth

During the year 2005 these new structures were cemented into place and charged with the mandate of providing improved services to the customers in a more efficient manner.

Included in the programme was the development and adoption of new work procedures to improve operational effectiveness and efficiencies. Special emphasis has been placed on the development of a culture within the utility that is performance driven. In this respect, a performance management system was developed and begun implementation throughout the organization from the highest to the lowest levels. During 2009, elements of an educational programme were also implemented with the aim that each employee would understand the overall mission and objectives of the company, the role they play in achieving these objectives and the benefits to them if the objectives are achieved.

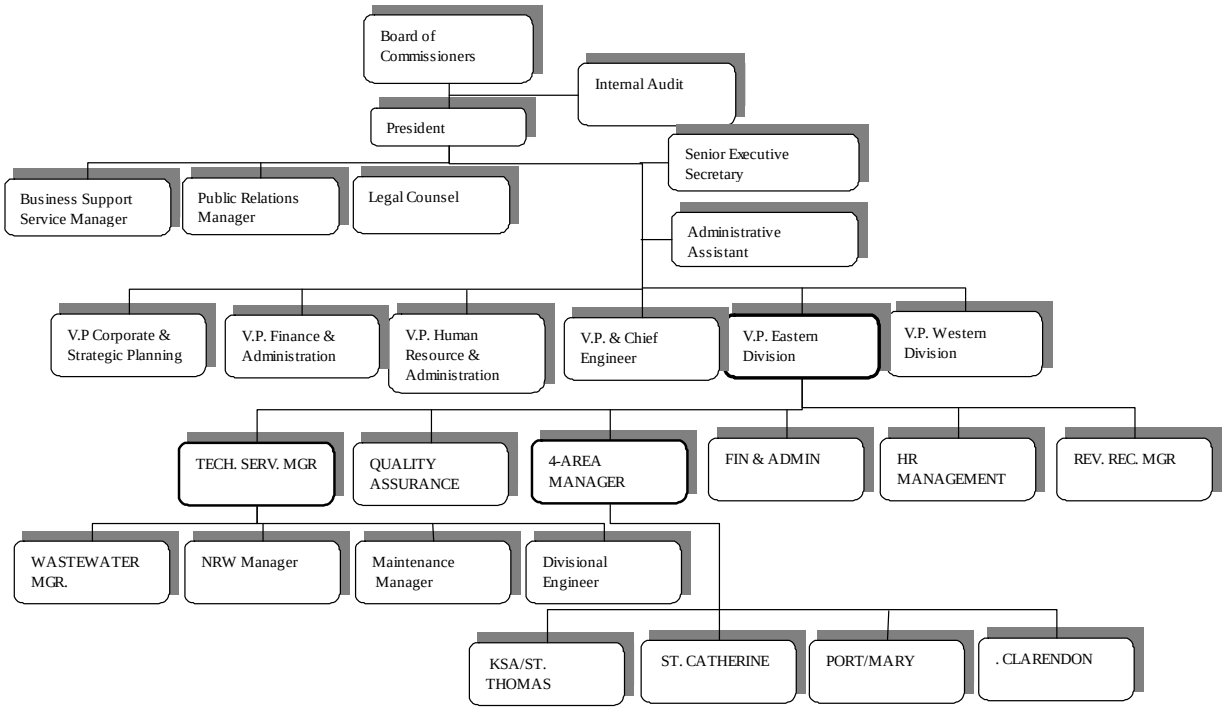


Figure 5.1.1 NWC Organizational Structure

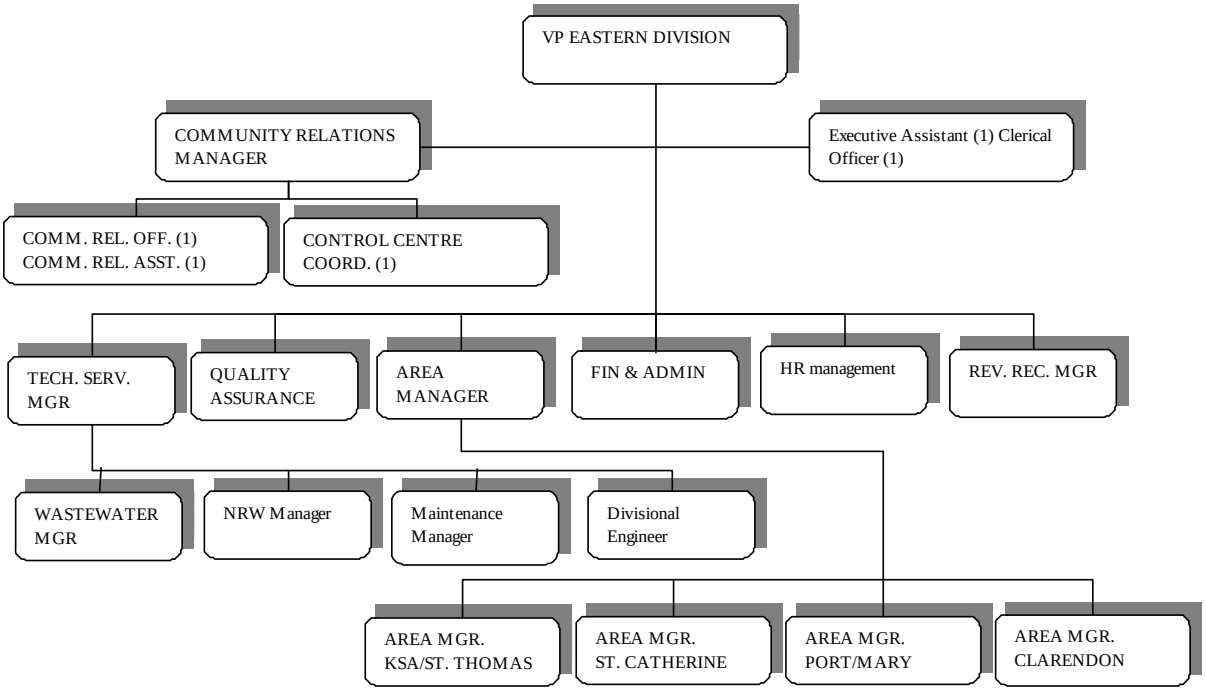


Figure 5.1.2 Organizational Structure of Eastern Division

The role of each division and department is as follows.

1) Legal Counsel

Legal advice and services are provided for cases involving litigation, commercial contracts, criminal litigation and disciplinary matters. The General Manger Legal Affairs also interfaces with regulatory bodies. Cases are outsourced to external lawyers as required. The property function is incorporated into this department with Property Administrator reporting to the department head.

2) Corporate and Strategic Planning Department

Data collection and analysis: The planning process is driven by the availability of board-based, relevant, up-to-date information. Information must be gathered from both internal and external sources and include data on national plans and policies, economic indicators and statistic, inputs on activities and projections from divisional/ department managers. Concomitant with the data collection is the maintenance of a database comprised of statistical, financial, economic and other relevant information in other to facilitate management decision making.

Monitoring and analyzing actual versus expected performance: The monitoring and analysis function addresses both overall company performance as well as individual department/divisions/units performance. It also involves monitoring the company's external/internal environment for occurrences that might impact the company's corporate strategies and plans recommending actions as necessary.

Project planning and implementation: This involves assisting in the planning and implementation of various projects and the performance of feasibility studies.

3) Finance and Administration Department

The responsibilities in this area are further broken down as follows:

Risk, Property and Administration: Properties management; insurance administration; general administration.

Materials Management: Inventory: Inventory management; purchasing and procurement; receipt, custody and issue of goods; handling of chlorine.

Budget and Cash Management: Budgeting preparation and reporting; collection analysis; regional accounting.

Revenue management: Resources management; financial reporting; cost control and monitoring; and revenue maximization.

4) Human Resource and Administration

The responsibilities in these areas include:

Regional Human Resource Operation: Human resource policy implementation, personal administration, staffing orientation, contract administration.

Compensation and Benefits Administration: Life and health insurance administration, uniform tender and contracting, pension administration, salary administration, job evaluation, assistance with salary negotiations.

Industrial Relations: Strategy formation, grievance and dispute resolution, liaison with union representatives, management advisory service.

Safety and Occupational Health: Administration of wellness programme, conduct of wellness seminars, conduct of mini-physical, coordination of annual medical by employee type and level of exposure to safety hazards, interface with employees.

Training: Coordinate training schedule, organize courses, deliver course material, conduct needs analysis, and facilitate identification of training options.

Corporate Human Resources: Oversee manpower and corporate planning process, coordinated and supervise human resources service, manage training and development process, oversee compensation/benefits and employee relations, administer the HR Information System programme.

General Office Administration

5) Engineering Department

The Engineering Department is primarily responsible for planning, design and construct of the works associated with water supply and sewerage projects being implemented by the NWC. On completion, the constructed works are commissioned and then handed over to the appropriate operations departments of the NWC.

The engineering inputs for these projects are provided using the services of permanent staff, contract professional or Consulting Engineers engaged by the NWC for specific projects.

The Chief Engineer is also responsible for providing technical advice to the NWC as required and the incumbent works in close collaboration with the Vice President Corporation and Strategic Planning on the development of the capital works programme for the Commission.

6) Management Information System Department - MIS

The Business Support Service Department provides development and system services to all offices island wide. A description of the key functional areas within the department is as follows:

Network Communication: Voice, data systems networks planning, implementation and maintenance; provision of user access to database.

Technical Support: hardware solutions design; computer systems implementation; computer hardware and software procurement; maintenance of the functionality of all hardware, software and networks including system administration, installation, backup, security and integration.

Development: new computer system development; identification of new ways to apply existing system to manual operations; updating and maintaining existing software applications.

User Service: data integrity; quality control; CAS procedures administration; Help Desk administration; computer related consumables distribution e.g. cashier printer ribbons and tapes, diskettes.

Billing Operation: Bills preparation and dispatch to the over 300, 000 active NWC customers.

The department is incorporated within the Corporate and Strategic Planning.

(5) Staffing

By the beginning of the 2005/2006 financial year, the NWC had completed its comprehensive organizational restructuring and was beginning to see the benefits of the exercise. It is of significance that the restructuring programme, that was conducted over an 18-month period and reduced staffing levels by 587 positions and provided annual savings in excess of JMD300 million, occurred without a strike or other major labor unrest at the organization.

According to the data provided by the NWC, total staff at the end of March 2009 was 2,095 including 164 temporary staff. The JICA Survey Team confirmed total number of staff is 2,050, by division and department (refer to Table. 5.1.2).

The organizational structure of Eastern Division is also shown in Fig. 5.1.2. The wastewater section belongs to the Technical Service Department in the Eastern Division.

The number of staff in Eastern Division is 1,213 which accounts for some 60% of total staff of the NWC. The number of staff in the wastewater section is 150 as of March 31, 2009. These staff will undertake operation and maintenance of the wastewater facility for the Project.

NWC organization and staffing are also closely linked with outsourcing activities.

Table 5.1.2 Number of Staff by Division and Department

Total	2050	Corporate	219	Western Division	618	Eastern Division	1213
President Office	13			VP'S Offiece - Western	15	VP'S Office - Eastern	18
President	1			Vice President/Western		Vice President/Western	
Assist Vice President/Internal Audit	1			Admini Assistant	1	Executive Assistant	1
Exe. Assistant	1			Community Relations	5	Community Relations	8
Leagal Counsel	1			Revenue Recovery	1	Revenue Recovery	1
Manager Public Relations	1			Human Resources	1	Human Resources	1
Admini Assistant	1			Finance & Administration	1	Finance & Administration	1
Vice President/Coporate &Strategic P	1			Area Manager-St.Ann	1	Area Manager-Clarendon	1
Vice President/Finance	1			Area Manager-St.James/Trelawny	1	Area Manager-Port/Mary	1
Vice President/Human Resource & Ad	1			Area Manager-Manchesters/St.Elizabeth	1	Area Manager-St.Catherine	1
Vice President/Chif Engineer	1			Area Manager-WestMoreland/Hanover	1	Area Manager-KSA/St. Thomas	1
Vice President/Eastern	1			Quality Assurance	1	Quality Assurance	1
Vice President/Western	1			Technical Servises	1	Technical Servises	1
Business Support Services Manager	1						
Public Relations	4			Revenue Recovery	10	Revenue Recovery	23
Manager				Manager		Manager	
Assistant	1			Admini Assistant	1	Admini Assistant	1
Graphic Artist	1			Analyst	1	Revenue Analyst	2
Senior PR Officer	2			Field Officers	8	Clerk	3
Leagal Affaires	7					Customer Care Officer	1
Leagal Counsel						Field Officers	12
Leagal Secretary	1					Plumber	4
Leagal Officer	1						
Paralegal Officer	2						
Senior Property Officer	2						
Property Officer	1						
Human Resource & Administration	58			Human Resources	6	Human Resources	6
Vice President/Human Resource & Admini.				Manager		Manager	
Admini Assistant	7			Admini Assistant	1	Admini Assistant	1
Admini Coordinator	22			Human Resource	2	Human Resource Officer/Clerk	4
Training Coordinator	4			Sefty & Security	1	Sefty & Security	1
Safty & Occupatina Health	5			Industrial Nuse	2		
Compensaion & Benefit	4						
Payroll	11						
Industrial Relations	2						
HR Systems	3						
Business Support Service	7			Quality Assurance	13	Quality Assurance	16
Manager				Manager		Manager	
Admini Assistant	1			Admini Assistant	1	Admini Assistant	1
Revenue Reconcilation Clerk	2			Data Entry Clerk	1	Data Entry Clerk	1
Credit Control Supervisor	1			Technical Officer (Microb)	3	Technical Officer	3
Business Analyst	1			Technical Officer (Chemical)	8	Laboratory Analyst	10
Business Administrator	2					Field Assistant	1
Corporate & Stragegic Planning	63						
Vice President/Coporate &Strategic Planning							
Admini Assistant	1						
Management Information Systems	8						
Computer Operations	15						
User Services	9						
Programme Analysis	7						
Technical Support Analysis	9						
Systems Development & Planning	7						
Corporate Planning	7						
Finance	87			Finance & Administration	15	Finance & Administration	31
Vice President/Finance				Manager		Manager	
Admini Assistant	8			Admini Assistant	3	Admini Assistant	3
Budget & Cash Management	9			Material Coordinator	5	Material Coordinator	5
Materials Management	52			Transport Coordinator	2	Transport Administrator	15
Financial Reporting & Compliance	4			Divisional Accountant	5	Divisional Accountant	8
Management Risk & Insurance	1						
Financial Accounting	12						
Financial Systems Database	1						
Engineering Department	50			Technical Servises	60	Technical Servises	256
Chief Engineer				Manager		Manager	
Admini Assistant	6			Admini Assistant	4	Admini Assistant	1
Engineering Design	17			NRW Manager	10	NRW Manager	10
Capital Projects Implementation	17			Divisional Engineer	4	Divisional Engineer	13
Project Manager (Special Projects)	10			MaintenanceSector-1	21	Maintenance	82
				Sector-2	21	Westwater	150
				Area-St. Ann	100	Area -Clarendon	83
				Manager		Manager	
				Assistance	3	Assistance	3
				Finance & Administration	5	Finance & Administration	5
				Customes Relations	46	Customes Relations	50
				Waste Water	16		
				Water Production	30	Water Production	25
				Area-St. James/Trelawny	124	Area -Port/Mary	118
				Manager		Manager	
				Assistance	2	Assistance	3
				Finance & Administration	5	Finance & Administration	9
				Customes Relations	48	Customes Relations	55
				Waste Water	16		
				Water Production	53	Water Production	51
				Area-Manchester/St. Elizabeth	149	Area -St.Catherine	156
				Manager		Manager	
				Assistance	3	Assistance	3
				Finance & Administration	5	Finance & Administration	8
				Customes Relations	80	Customes Relations	34
				Waste Water	14		
				Water Production	47	Water Production	111
				Area-WestMoreland/Hanover	126	Area -KSA/St. Thomas	506
				Manager		Manager	
				Assistance	3	Assistance	3
				Finance & Administration	5	Finance & Administration	8
				Customes Relations	60	Customes Relations	102
				Waste Water	13		
				Water Production	45	Water Production	267
						Field Operator	122
						Grounds Manintenance Supervis	4

(6) Human Resource Development

Recruiting

NWC has planned hiring of new 41 staff as of March 2009. Eastern Division, responsible to KSA and St. Thomas, plans to hire 20 employees, accounting over 50%. Corporate Division and Western Division plan to recruit 9 and 12 staff respectively. NWC hired 9 new employees in 2008.

Training

388 employees took trainings in 2008, consisting of 113 managers, 137 supervisors and 138 pre-supervisors. 20% of total NWC employees participated any of its training courses. NWC has an in-house training center that holds courses conducted in home. Other training opportunities provided are the courses conducted externally by universities, etc. and courses conducted overseas by donor agencies such as JICA.

Most of the trainees participate in-house courses conducted by NWC. Course duration ranges 3-5 days to 30 days, but 2-3 week courses are the most standard length. Diverse types of courses are offered such as engineering, supervisory management seminars, commercial operations, customer relationship, GPS training, etc.

(7) Private Sector Participation in Facility Development and Management

NWC has policy to apply private sector participation in its operation to ensure efficient management. Operation of its customer call center has been outsourced to a private company. Meter reading is also outsourced partly in Kingston area on a trial basis.

In sewerage treatment, Soapberry STP project has been implemented under a BOOT contract with a joint venture of Urban Development Corporation, National Housing Trust and Ashtrom Development. It was also planned to develop Harbour View STP by BOOT but the project has not yet been implemented. NWC has a laboratory to potable water quality test whereas wastewater quality test has been consigned to external laboratory for about three years. However, due to increasing test fees and insufficient test quality, NWC is considering to in-house testing of wastewater effluent.

5.1.2 Improvement Strategies

The following improvement strategies are stated clearly in “Jamaica Water Sector Policy, Strategies and Action Plans, Ministry of Water and Housing”.

(1) Wastewater Systems Development Strategies

In order to mitigate health risks and environmental degradation, it will be necessary to ensure that all major towns have proper sewerage services.

Twenty (20) towns have been identified as requiring major additional sewerage infrastructure.

These have been prioritized and a schedule for sewer has been developed. In addition to the construction of new facilities in major towns, the GOJ will support efforts to rehabilitate existing non-compliant facilities to bring them into compliance with environmental standards, as promulgated by the NEPA. The GOJ and NWC will take the lead role in mobilizing

financing for construction and rehabilitation of large central systems in urban centers. In addition to the major systems, the GOJ will also be seeking to improve the operations of smaller sewerage systems associated with housing developments.

The NWC or other licensed providers will be encouraged to assume the operation and maintenance of these systems. Where the systems are uneconomical to rehabilitate and operate, the GOJ will provide financial incentives to the service providers.

In respect of new developments, developers will be obliged to ensure that the necessary arrangements are put in place to facilitate the sustainable operation of associated sewerage facilities.

This may be achieved by:

1) Contracting service providers being contracted to design, build and operate the system at the developer's cost;
2) Contracting service providers being contracted to operate and maintain the system on behalf of the developer, prior to takeover during the statutory operational period;
3) The developer's designing, building and operating the facility for the statutory operational period and handing it over to a service provider expeditiously; and
4) The developer's designing, building and seeking a license to operate the facility.

The regulation governing development and operation of sewerage systems will be set out in the industry-specific legislation for the sector.

(2) Operation and Maintenance of Facilities

Improvement strategies will include the following:

1) A review of operation and maintenance practices to clarify requirements;
2) The preparation of operation and maintenance manuals for the respective facilities;
3) The acquisition of the necessary tools and equipment;
4) Training of technical staff;
5) Strengthening the supervision/monitoring of operation and maintenance;
6) The implementation of a computerized maintenance management system; and
7) Improvements in safety control.

(3) Energy Efficiency

Key strategies for directly improving energy efficiency and reducing the costs associated with this input will include the following:

1) Improving plant, motor and pump efficiency;
2) Ensuring that equipment is operated and maintained in accordance with specifications, and monitoring process variables to optimize operations;
3) Optimizing the operation of water pumping equipment including, where possible, taking advantage of off-peak energy rates through installation of additional storage capacity;

4) Maximizing the use of gravity-driven systems by placing facilities at higher elevations, where feasible;
5) Improving the monitoring and control of water transmission and distribution operations;
6) Utilizing energy efficient lighting and air conditioning systems;
7) Where feasible, utilizing alternative energy sources such as wind, solar and hydroelectric power; and
8) Ensuring that the most efficient electricity tariff is applied to each facility.

(4) Business Operations and Customer Service

The NWC will redefine its concept of customer service to emphasize service delivery at the customers' premises. Elements of this will include:

1) Replacing the current billing system;
2) Improving meter reading accuracy and frequency;
3) Training of staff;
4) Improving co-ordination among frontline customer service staff and maintenance crews for prompt response to customer complaints;
5) Improving the response to customer enquiries, to include the establishment of a call centre;
6) Improving emergency response capabilities;
7) Increasing the bill collection points; and
8) Simplifying payment procedures.

(5) Human Resource Development

Strategies to improve capacity strengthening in this area will include:

1) The ongoing review of the organizational structure and processes to ensure continuous improvements in operational efficiency;
2) Designing and implementing a comprehensive training programme to improve the effectiveness of employees at all levels;
3) Designing and implementing a performance based compensation system;
4) Evaluating and analyzing the existing culture to determine the barriers to satisfactory performance, and implementing strategies designed to foster a culture of excellence and high performance.

(6) Information Systems Development

A fully computerized Information Management System (IMS) will be established to integrate the major related systems, including the billing, tariff collection and general ledger systems. The IMS will also include systems to improve the management of inventory,

procurement, preventative maintenance and human resources. Under this programme a Geographic Information System (GIS) will also be developed.

(7) Social Water

Social water refers to the provision of the minimum levels of potable water and sewerage services to persons who cannot afford the full cost of such services.

The definition is also expanded to include water supplied to the public at large in circumstances where collection of payment from the user is impractical.

The relevant stakeholders, including the OUR and the Ministry of Finance and Planning, shall agree on revenue sources for social water including:

1) Tariffs and user fees;
2) Cross subsidies; and
3) Direct subsidies.

(8) Watershed Management

The NWC owns watershed lands covering more than 5,000 hectares scattered throughout the Watershed Management Units. It is the company's direct responsibility to ensure that these lands are adequately protected from excessive degradation.

For the NWC-owned lands, an aggressive programme will be pursued involving an environmental audit and reforestation of critical areas. These activities will form part of a comprehensive programme that will be harmonized with the efforts led by the NEPA, WRA and the Forestry Department. Once watersheds have been restored, plans will also be but in place to prevent future degradation.

5.1.3 NWC Proposed Performance Objectives

The NWC has outlined several financial, customer service and operational objectives it expects to achieve during 2008-2011(refer to Table 5.1.3). The major performance issues are as follows.

(1) UFW

The NWC reports indicate that instead of reduction in UFW, level increased and at December 2007 was 62%. Additionally, functioning meters decreased to 67% over the three years. The OUR is of the view that the performance of the NWC in this regard has been a significant contributor to the poor financial status of the company. Furthermore, the lack of functioning meters may also have prevented the NWC from determining the actual amount of water losses it experiences.

(2) Water Sales

Although NWC revenues grew, it was mostly attributed to the movements in the PAM, and not additional water sales. This is despite the average of 2.4% annual growth in its customer base.

(3) Specified Targets Achievement

It will be recalled that the OUR determined that it will assume that the NWC will have achieved the specified the targets at the next review of the rates. The NWC has not provided any convincing arguments as to reasons why it was unable to achieve the specified targets. Consequently, in making this determination on the new rates the OUR will be constrained to assume that NWC is operating in a more efficient manner by taking into account the expected impact of the achievement of the benchmarks set at the previous review.

(4) Consideration of Public Consultation

The OUR will also give due consideration to the issues raised at the public hearings.

(5) Test Year Financial Statements

The OUR must also determine the appropriate test year (April, 2006-March, 2007) that should be used as base on which the tariffs will change over the next three years. The OUR has adopted the approach to use the most recent audited financial statements as the test year. In this case, the most recent audited data available is for the year ending March 31, 2007. The OUR has determined that this will be the test year. However, the test year financial statements have been adjusted to reflect information that is known and measurable and which will occur within twelve months of this analysis. The OUR has also applied the deemed efficiency adjustments based on previous targets to these statements.

(6) Achievement of Performance Objectives

The OUR regarded the achievements of these targets as critical to the financial sustainability of the NWC and also factored the achievement of these targets in the development of an efficiency factor. The following highlight the main targets that were set and which the OUR expected the NWC to achieve over the 3-year period.

Table 5.1.3 NWC 3-Year Performance Objectives

PERSPECTIVE	OBJECTIVES	CRITICAL MEASURES	DEFINITION	TARGETS		
				2008 / 09	2009 / 10	2010 / 11
FINANCIAL	Become a viable, bankable utility	Current Ratio (Min.)	Current Assets / Current Liabilities	1.3	1.4	1.5
		Quick Ratio (Min.)	Current Assets – Inventories / Current Liabilities	1.0	1.1	1.2
		Net Fixed Asset Turnover(Min.)	Revenue(P&L) / Net Fixed Assets	29%	33%	37%
		Net Profit Margin (Min.)	Operating (loss) Profit / Revenues (P&L)	5%	7%	9%
		Debt to Capital Ratio (Max.)	Current liabilities + Current due of long term liabilities / Net fixed Assets	30%	33%	36%
	Dramatically grow revenue and collections	Real growth in revenues (including tariff adjustment)	Amended Revenue Total less PAM YTD / Amended Revenue Total less PAM YTD previous Year	**18%**	**4%**	**4%**
		Increase collection efficiency	Collections YTD / Revenue YTD linked to collections	92%	93%	94%
	Increase productivity and contain operating costs	Staff costs as % of revenue	Employee Expenses /Revenue (Income &Expense)	35%	32%	30%
		Operating Costs / Revenue	Operating Costs /Revenue (Income &Expense)	**75%**	**73%**	**70%**
CUSTOMER	Ranked as the number one utility in Jamaica in terms of customer service	Ranking based on OUR quarterly reports		1	1	1
		Ranking based on OUR annual survey		1	1	1
	Improve general service delivery and public image	Average performance based on NWC survey		60%	70%	90%
	Maintain high quality of water supply and sewerage services	Supply average availability in urban and rural areas(hours /day)		24 /18	24 /18	24 /18
	Efficiently comply with regulatory standards	Compliance with agreed NEPA Standards		20%	30%	40%
		Compliance with MOH Standards		**95%**	**97%**	**99%**
		Compliance with OUR Standards		**95%**	**97%**	**99%**

INTERNAL PROCESSES	Improve billing and collection procedures	Percentage of active customers billed each month	Number of active customers billed with service charge / Total number of active customers	95%	98%	100 %
		Average receivable days	Gross Receivables YTD/(Collections YTD/ No of days in collection period)	180	120	90
	Expeditiously treat with customer queries and complaints	Average time to resolve complaints (Days)		86%	88%	90%
		Average time to repair reported leak (Days)		**5**	**7**	**9**
	Ensure effective management of fixed assets	Average condition of fixed assets (1-10)		5	7	9
		Average project overrun on budget and schedule		15%	10%	5%
		Accuracy and completeness of asset inventory based on sample survey		85%	90%	95%
	Reduce NRW and increase operating efficiencies	NRW as % of production		**60%**	**55%**	**50%**
LEARNING AND GROWTH	All staff understand and deliver on mission and strategy	Staff awareness of mission and strategy based on internal survey		75%	85%	95%
	Develop requisite skills and orientation	Average training hours per staff/year	Total Training hrs YTD/ No of employees all converted to a yearly basis	15	25	35
	Provide appropriate technology and resources	Resource availability based on internal survey		50%	75%	95%
	Implement performance management system with incentives	Number of employees explicitly on performance management system		100 %	100 %	100 %

Source) Source: National Water Commission Review of Rates, Determination Notice, the OUR

(7) State of Customer Service Actions

NWC's customer base accounts for 457,852 as of March 2007; of which 368,456 are active accounts. 23% of them are sewerage users. Coverage of the active accounts stays around 80% because troubles such as refusal of payments by customers who are invoiced extreme water charge due to the wrong metering cased by many deteriorated water meters. It is estimated that 84,985 water meters require replacements. Defective water meters also cause meter reading operation to be quite inefficient. Customers with bad meters or without meters are temporarily charged water tariff estimated based on past records or number of household members.

Table 5.1.4 shows the state of customer service actions taken by the NWC during the month of July, 2008. Of some 35,400 actions, responses to complaints concerning the bill accounted for nearly half. There were just over 4,500 cases of non-reading of the meter for more than two months, accounting for 13% of all customer service actions. There were also some 4,800 cases of breach of standards (termination of the service contract). The number of reconnections in this month stood at 3,753in July 2008.

The penalty imposed by the NWC for non-payers or those in arrears is disconnection and the NWC implements some 6,500 disconnections a month which can be translated to a monthly disconnection rate of 1 - 2 households per 100 households receiving water supply from the NWC. Meanwhile, some 4,000 households, i.e. equivalent to 60% of disconnections, are reconnected (see Table 5.1.5). Currently it takes 61 days on average to impose the penalty. OUR requests NWC to shorten the period to 45 days based on the recommendation by World Bank and good practices in other countries with average of 30 days. In July, 2008, there were 281 reports of sewage leakage (flooding from sewers). Although the NWC has a policy of dealing with such incidents within 24 hours, only some 10% of these incidents were successfully dealt with within 24 hours of the initial report.

Table 5.1.4 Guaranteed Standard Statistics, July 2008

Requested	Number	%
New services connected	780	2%
Delivery of bills to new services	780	2%
Appointment	354	1%
Billing Complaints	14,353	41%
Non-billing Complaints	3,178	9%
Requested disconnections	103	0%
Request for meters	281	1%
Verified faulty meters	642	2%
Meters not read within 2 months	4,531	13%
Reliability of supply (lock-offs)	136	0%
Sewerage (flooding from sewers)	281	1%
Water meters changed	1,380	4%
Reconnection	3,753	11%
Breaches of standards	4,866	14%
Total	35,418	100%

Source) Guaranteed Standards Statistics, 2008, NWC

Table 5.1.5 Number of Disconnections and Reconnections

	2008			
	Jan-Mar	Oct-Dec	Average /month	b/a (%)
a) Disconnections	19,400	20,040	6,573	
b) Reconnections	10,779	13,275	4,009	61%

Source) Guaranteed Standards Statistics, 2008, NWC

1) Number of Complaints

As shown in Table 5.1.6, the NWC receives some 17,500 customer complaints a month. This number can be translated to approximately 4.5% of the total number of households receiving water supply from the NWC. In other words, 4 - 5 households per 100 households have some kind of complaint about the services provided by the NWC. Complaints can be largely classified into two categories. One is related to the actual water supply service and the relevant complaints include water leakage, irregular water supply, no water supply, low/high water pressure and a long waiting time/period for reconnection of the service. The other is related to the bill (see Table 5.1.6 for the number of bill-related complaints), including high consumption, high estimates, non-reading of the meter, defective meter, inability to understand the bill, payment (figure) not on the bill and bill not received this month. Complaints in the first category, i.e. those related to the water supply service, account for some 20% and the remainder is all related to the bill. Many customers complain about the billed amount for payment. The number of complaints is particularly high for each of high consumption, inability to understand the bill, payment (figure) not on the bill and bill not received this month. All of these four types of complaints account for some 70% of all bill-related complaints.

The NWC is keen to deal with these complaints properly through its call centre and other desks to improve the overall level of its customer service. Most complaints are dealt with within one month although some complaints take longer to settle.

The NWC has introduced a CIS (Customer Information System) and this system became operational in September, 2009. Monitoring of the system is necessary to determine its actual effectiveness. Because of the manual input of data to the CIS, the NWC must recognize the continual need for the capacity development of its staff.

Table 5.1.6 Total Number of Complaints Received, July 2008

Complaints	Number	Share	%
High consumption	1,594		11%
Unable to understand Bill	2,907		20%
Payment not on Bill	2,567		18%
Bill not received this month	3,091		22%
Others	4,194		29%
Total Bill-Related	14,353	82%	100%
Leaks (Broken Main etc.)	2,184		69%
Others	994		31%
Non Bill-Related Total	3,178	18%	100%
Grand Total	17,531	100%	

Source) Guaranteed Standards Statistics, 2008, NWC

2) Activity to Facilitate House Connections

Interviews with residents to determine the level of the WTP (Willingness to Pay) as part of the social survey found that the level of the WTP was substantially lower than the actual house connection cost and this social survey (see Chapter 6) failed to discover a viable measure to facilitate house connections. It was also found that many residents in areas without the sewerage service were actually paying the sewerage fee. Based on this discovery, consultations with staff members of the NWC were held and it was found that the inclusion of USD 1,500 per household in the construction budget as a subsidy would be a realistic measure to facilitate house connections as described in Section 4.6.2.

5.2 NWC Financial Performance

5.2.1 Financial Performance Review

During the period January 2004 to March 2006, NWC's finances improved in some respects primarily due to:

- Improvements in operating efficiencies resulting from the organizational restructuring and process re-engineering programs that were undertaken;
- The tariff increase which came into effect in January 2004;
- General tightening in the management of the Commission's resources.

However, Operating Profit showed a turnaround, moving from JMD187 million in 2005/06 to negative JMD 1,718 million in 2007/08 as shown in Table 5.2.1.This was driven by revenues increasing at an annual average rate of 2.4% while costs increased at an annual average rate of 17.6% in 2007/08. When depreciation and interest expenses are taken into account, it becomes clear that revenues were still far from adequate.

NWC's organization consists of water supply, sewerage and corporate sections; however, it has only single accounting and financial management system on which revenue and cost streams of these wings are consolidated and not separately managed. OUR has urged NWC to separate accounting system into the water supply and sewerage operations, it has not yet come off.

Table 5.2.1 NWC Profit and Loss Accounts for 3-year (April 2005 – March 2008)

(Unit: J$ million)

Category	2005/06				2006/07				2007/08			
A.Operating Revenue	Water	Sewage	Total	Share	Water	Sewage	Total	Share	Water	Sewage	Total	Share
Water	5,628.3		5628.3	65.9%	6,292.2		6292.2	65.7%	6,274.5		6274.5	64.0%
Sewage		1,625.1	1625.1	19.0%		1,880.4	1880.4	19.6%		1,869.7	1869.7	19.1%
Service charge	1,002.1		1002.1	11.7%	854.7	253.8	1108.5	11.6%	876.9	260.0	1136.9	11.6%
Price adjustement	100.0		100	1.2%	78.3	23.9	102.2	1.1%	243.4	74.6	318	3.2%
Bulk water	12.7		12.7	0.1%	25.2		25.2	0.3%	13.9		13.9	0.1%
Bulk water shipping	4.4		4.4	0.1%	5.1		5.1	0.1%	5.6		5.6	0.1%
New installations	53.2		53.2	0.6%	59.3		59.3	0.6%	67.6		67.6	0.7%
Reconnections	102.7		102.7	1.2%	97.5		97.5	1.0%	111.4		111.4	1.1%
Cesspool & other sewerage		14.4	14.4	0.2%		8.9	8.9	0.1%		8.5	8.5	0.1%
a) Sub-Total	6,903.4	1,639.5	8,542.9	100%	7,412.3	2,167.0	9,579.3	100%	7,593.3	2,212.8	9,806.1	100%
Share of Total	80.8%	19.2%	100.0%		77.4%	22.6%	100.0%		77.4%	22.6%	100.0%	
Change of previous year			112.8%				112.1%				102.4%	
B. Operating Expenses	Water	Sewage	Total	Share	Water	Sewage	Total	Share	Water	Sewage	Total	Share
Salaries & wages	3,317.5	144.4	3461.9	41.4%	3,149.3	941.3	4090.6	41.8%	3,998.2	1,013.3	5011.5	43.5%
Repairs and Manintenace	1,087.8	46.5	1134.3	13.6%	1,111.0	212.8	1323.8	13.5%	1,212.6	239.6	1452.2	12.6%
Administration	1,274.5	15.6	1290.1	15.4%	1,124.6	356.2	1480.8	15.1%	1,241.9	385.0	1626.9	14.1%
Electricity	2,059.7	158.0	2217.7	26.5%	2,442.9	194.9	2637.8	26.9%	2,901.0	233.1	3134.1	27.2%
Telephone	78.5		78.5	0.9%	56.4	17.8	74.2	0.8%	55.5	17.5	73	0.6%
Fuel and lubrications	105.9		105.9	1.3%	96.0	25.6	121.6	1.2%	122.8	29.5	152.3	1.3%
Purchases-water	67.3		67.3	0.8%	60.6	6.3	66.9	0.7%	67.2	6.8	74	0.6%
b) Sub-Total	7,991.2	364.5	8,355.7	100%	8,040.8	1,754.9	9,795.7	100%	9,599.2	1,924.8	11,524.0	100%
Share of Total	95.6%	4.4%	100.0%		82.1%	17.9%	100.0%		83.3%	16.7%	100.0%	
Change of previous year			115.2%				117.2%				117.6%	
C. Operating loss (A-B)	-1,087.8	1,275.0	187.2		-628.5	412.1	-216.4		-2,005.9	288.0	-1,717.9	
Loss % of Revenue (c/a)			2.2%				-2.3%				-17.5%	
D. Other Expenses			Total				Total				Total	
Loan interest			134.8				192.8				312.2	
Depreciation			1,769.0				1,834.4				1,843.7	
Other			184.5				195.9				411.2	
d) Sub-Total (B+D)			10,444.0				12,018.8				14,091.1	
e) Balance (a-d)			-1,901.1				-2,439.5				-4,285.0	

Notes; Financial Statements , year ended March 31, 2006 and 2008

(1) Operating Revenue

The NWC reports that during the tariff period, January 2004 to December 2007, it experienced improvements in its operating profit but continued to operate at a net loss. The NWC attributes this performance to the December 2003 tariff increase, improvements in operating efficiencies resulting from the organizational restructuring and process re-engineering programs and general tightening in the management of the Commission's resources.

Although the NWC's revenues grew, the growth was mostly attributed to the movements in the Price Adjustment Mechanism (PAM), and not additional water sales. This is so despite the average of 2.4% annual growth in its customer base.

(2) Operating Expenses

1) Salaries, Wages and Related Costs

Employee related costs constitute a significant proportion of NWC's operating costs.

NWC stated that as a part of its efforts to be more efficient in its operations, it implemented a restructuring and rationalization programme in October 2003. This exercise was completed in January 2005 and achieved the following:

Establishment and implementation of the new organizational arrangements, including the reduction in the number of regions from 5 to 2; and

Reduction in staff levels from some 2,600 persons to 2,100, resulting in an 8% decrease in employee expenses. This translates to 4.5 employees per 1,000 accounts.

However, even with the downsizing of NWC's staff complement as a result of internal restructuring exercise, the contribution of employee costs as a percentage of total operating costs has been increasing from April 2006 to March 2008. It constituted 41.4% of total cost but increased to 43.5% by the end of the tariff period (March 2008). As part of the last tariff determination, the OUR set a target for employee costs to be at most 35% of the Commission's gross revenues by March 2006. The data shows that NWC has not yet met this target. The main factors that could explain this is as well as the imposition of two (2) memorandum of understanding (MOU) between the government and the unions. Based on the agreement with unions, salaries and wages were increased by 34% retroactive to January 2006. Allowances, pensions and other employee related expenses are expected to generally move at the same rate as salaries and wages. These add up to approximately 32% of salaries, wages and benefits.

2) Repairs and Maintenance

Repairs and maintenance expenses are expected to increase as the new projects come on stream. Total value is expected to amount to approximately 3.9% of gross property, plant and equipment which is less than the normally expected 4% - 5% range. Traditionally, NWC has under-spent on repairs on maintenance due to budgetary constraints. This is one of the factors that have lead to the current poor state of its facilities.

3) Administration

The major components of administration expenses include bad debts, rents, insurance, postage, printing, computer services, security, consultancy fees, etc.

The projected figures were calculated at 8% of billed revenues, as per the OUR target.

4) Electricity

Electricity costs are projected based on current JPS (the Jamaica Public service) tariffs with increases being driven by expected expansions in potable water and sewerage systems. It is assumed that the price adjustment mechanism (PAM) will provide compensation for movements in electricity prices.

Electricity cost, as percentage of total expenses is expected to increase to average about 20% over the next few years.

5) Telephone

Telephone expenses are expected to increase to just over JMD70 million per year which is a relatively low percentage of overall expenses.

6) Fuel and Lubricants

These expenses are also relatively low and are projected to increase to JMD152 million by year ending 2008.

7) Purchases – Water

Water purchases will depend on weather conditions. Expenditure is, however, expected to remain below JMD100 million per year.

(3) Other Expenses

Other expenses comprise the financial charges and interest as well as depreciation. Depreciation, at 78% of this category, is by far the largest component, with loan interest at 21% being the other significant item.

1) Loan Interest

Loan interest is based on the different loan terms and the extent of drawdown based on the capital projects being implemented.

2) Depreciation

Depreciation is being driven by the asset base.

3) Other

Pursuant to an amendment of the Income Tax Act, NWC's previous exemption from income tax was revoked as of January 1 2004. Income tax has therefore been included as an expense since that date.

It should be noted that during the 1999 review the OUR had included as part of the regulatory requirement that the NWC should separate its business into water and sewerage and apportion costs accordingly. At the time of rate submission the NWC had failed to separate its accounts.

Given the lack of accounting separation and apportionment of cost, the OUR is unable to precisely determine the cost of sewerage services.

5.2.2 NWC Performance and Tariff Methodology

(1) General

In December 2003, the OUR approved a 26.36% increase over the then existing rate for the NWC. This increase became effective January 1st 2004 and was to be effective for a period of three years (to December 2006). It included a price cap regime which provided for adjustments in NWC's rates during this 3-year tariff period where the rates are adjusted on an annual basis by a Price Adjustment Mechanism (PAM) less an efficiency factor of 3.5%.

The Regulatory Framework that was specified by the OUR in their document dated July 8 2004 did not indicate the guiding principles and methodology to be applied in the determination of NWC's tariffs. However, based on the approach used by the OUR for other utility companies and for NWC (with some modification) during the last tariff review and recent discussions with the OUR, it appears that the OUR is committed to the Price Cap methodology. The Rate of Return methodology is the other common approach used by utility regulators.

(2) New Water Rates Approved by the OUR

The OUR has determined that the effective increase of NWC rates shall be 23% in April 2008 even though in NWC's application for a 44% increase in rates was based on a number

of compelling issues including the fact that the existing rates do not cover the cost of providing service.

In making this determination the OUR has given due consideration to several issues:

- Efficient cost recovery,
- Adequate service delivery,
- Sustained financial viability,
- Rate structure that is simple but reflects the cost of usage whilst not unfairly burdening consumers at the lower end of the consumption spectrum, and.
- Targets set at the last rate review

At the 2003 rate review, the OUR included in its determination, several performance benchmarks that the NWC should achieve under the 3-year tariff period (January 1st 2004 – December 31st 2006). These targets addressed the operational, financial and customer service aspects of the NWC's operations (refer to Table 5.2.2). The following highlights the main targets that were set and which the OUR expected the NWC to achieve over the three-year period.

Table 5.2.2 Performance Targets for NWC

Performance Measure	Target – per 2004 Tariff Review	NWC Performance Dec 2007
Net receivables	Not more than 25% of revenues	17%
Bad Debts	Not more than 8% of revenue billed	5%
Employee cost	Not more than 35% of revenues	32%
Asset valuation	Assets re-valued and brought to books and indexation mechanism developed	Done
Billing and collection	Collection 92% of billed revenues	95%
Unaccounted for water (UFW)	53% by March 2006	62%
Inactive accounts	Revisit disconnected account within 90 days to ensure no illegal connection	
Functioning meters	85% of accounts	67%
Water quality	99% compliance	
Waste water quality	MOU with NEPA to achieve compliance	99%
Billing related complaints	Not more than 5% of bills printed	3%
Meter reading	Every other month and 97% in billing cycle	95%

Source) National Water Commission Review of Rates, Determination Notice, the OUR

With regards to reporting, the OUR is dissatisfied with the level of reporting during the 3-year period (2004 – 2006). The NWC did not meet the 45 days deadline in most instances and even with the delay in submission, there were questions raised at times as to the accuracy of the reports submitted. The NWC has argued that the reporting requirements are onerous, but the OUR maintains the view that the level of detail required represents the normal level of reporting required by a company that provides water and sewerage services to inform business and management decisions.

(3) Consideration of Public Consultation Results

In consideration of the OUR Act which states that the OUR may consult with stakeholders on the rates or fares to be charged by a licensee, the OUR held fourteen (14) public consultation meetings across the island to hear the views of utility consumers on the NWC's application for a 44% rate increase. The meetings also served to provide feedback to the OUR on NWC's service to consumers since the company's last approved tariff in 2004.

1) A summary of the NWC's rate application was placed in the print media along with the dates, time and location of the meetings for each parish. The NWC's application was also placed on the OUR's website and in public libraries across the country.

2) During each meeting, the NWC cited several reasons for their submission, including;

- Existing tariff does not fully cover operating costs
- Major costs associated with hurricanes and flooding
- Aging infrastructure was in need of replacement
- The need to invest to address existing levels of Non Revenue Water (NRW), and
- Significant service deterioration would likely occur in the absence of a new tariff

3) It was evident throughout the consultations that the majority of NWC customers were not opposed to the company receiving an increase in rates. In fact, the view was expressed that on an international level, the NWC has been providing 'good water' but this however did not justify the need for a 44% increase. It was the opinion of many that NWC's presentation in support of such an exorbitant increase merely reflected the Commission's operational inefficiencies. It was strongly felt that if the NWC was efficient in its operations, only a small increase would be needed.

4) Despite majority acceptance that a small increase is necessary to sustain the business, some customers who were totally against any increase to the company at this time.

Table 5.2.3 New Rates

Charges by Consumption and Customers			Rates (JMD) Effective from 1st May 2008	Rates (JMD) Effective from 1st April 2009
Service Charge	(Min.)	5/8 inch /15mm-	364.59	359.95
	(Max.)	6 inch /150mm	11,666.72	12,670.06
Consumption Charge (1000 Gal)	Commercial		779.45	846.49
	Condominiums		386.65	419.91
	Domestic (Min.)	00 to 3Gal	207.86	225.74
	Domestic (Max.)	20 Gal & above	809.61	879.23
Consumption Charge (1000litres)	Commercial		171.39	186.13
	Condominiums		85.01	92.38
	Domestic (Min.)	00 to 14 litters	45.70	49.63
	Domestic (Max.)	81 litters & above	178.04	193.35
Sewerage charge		100% of water charges		

Source) National Water Commission Review of Rates, Determination Notice, the OUR

(4) Sewerage Charge

At most of the consultation meetings, the issue of the sewerage charge being 100% of water charges was of great concern to consumers. Residents of Portmore in particular were of the view that as the sewage that is collected at the treatment plant in Waterford is not processed, this charge should be reduced to 50%.

1) The manufacturing sector had similar concerns regarding sewerage charges. In a meeting held between the OUR and representatives of the Jamaica Manufacturers Association (JMA), members of the association were of the view that special consideration should be given to the sector as water was an important input in production. As majority of the water used did not enter the sewerage system, they also felt that there should be a revision of the application of sewerage charges to the sector. In a subsequent letter to the OUR, the JMA proposed the following:

- Calculated based on water usage minus a percentage estimate of water retained in the final product or utilized outside; and
- Rebated if a company does not discharge water to the main sewers.

2) The JMA was also of the view that sewerage charges should not be applicable in cases where manufacturing companies although located within the specified distance of the NWC's sewerage main, do not utilize the Commission's treatment plant or sewerage

line having already invested in their own treatment plant.

3) There was also the argument by others that sewerage charges levied were being used to subsidize the overall inefficient operation of the Company at the expense of adequate maintenance and upgrading of sewer facilities. Further, it was felt that there should be accounting separation for water and sewerage systems as only then could the efficiency performance of each service be properly assessed.

(5) Proposed Management Improvement Targets

The financial balance of the NWC for FY 2008/09 is expected to show a fall of the ratio of the deficit to the revenue from a massive deficit ratio of 48% in FY 2007/08 to 18% (see Table 5.2.4). The principal reason for this is an expected 26% increase of the operating revenue (collection) following the revision of the water fee in April, 2008. This level of revenue, however, can only cover the operating expenses and will fall short of covering other expenses which include loan interest and the depreciation cost, among others. There are several factors which can significantly improve the financial balance: 1) reduction of the NRW (non-revenue water), 2) improvement of the collection efficiency and 3) reduction of the operating cost. In connection with the revision of the water fee, the OUR and NWC have agreed on the management improvement targets (NRW: 50%, collection efficiency: 94% and operating cost: 70%) for FY 2010/11. The financial balance for FY 2010/11 is estimated on the basis of this case as well as the following two cases.

Case 1: The level of the operating cost remains at the present level and the NRW is reduced to 45% as targeted by the NWC.

Case 2: The level of the NRW is reduced to be 45% as targeted by the NWC and the level of the operating cost is reduced to 65% from the current 75%.

The estimation results are shown in Table 5.2.4. While the improvement targets set by the OUR can cover the operating cost, the overall balance incorporating other expenses will start to show a small deficit ratio of 3%. The reduction of the NRW rate from 65% to 45% in Case 1 will similarly produce a small deficit ratio of 2%. In Case 2 where the operating cost is also reduced, the balance in FY 2010/11 will almost achieve equilibrium. To achieve this result, it will be necessary for the NWC to reduce the NRW rate from 65% in FY 2007/08 to 45% and the collection efficiency from 89% in FY 2007/08 (although the target was 92%) to 90%. Because improvement of the operating revenue (collection) alone is insufficient, the NWC must adopt an operating cost reduction target of 65%. This target means that the operating cost must be reduced by a further 15% from the present level. Meanwhile, the NRW ratio must improve by 33% from the present level. These management improvement targets pose a great challenge for the NWC, necessitating strong efforts, possibly including a salary cut for not only senior management but also ordinary staff members, to improve the financial performance of business management.

As clearly shown by the findings of the latest social survey on the level of the WTP (willing to pay), inhabitants are very unwilling to pay a higher fee. In the light of this finding, the NWC must recognize that a positive understanding of the need for a higher water fee among inhabitants can only be achieved when its own efforts to reduce the cost through improvement of the business management convince inhabitants of the NWC's commitment to rational management.

It is proposed that the NWC should commence management improvement efforts in Kingston/St. Andrew Parish and St. Catherine Parish as these two areas provide more than 50% of the NWC's operating revenue (collection; 39% by Kingston/St. Andrew Parish and 14% by St. Catherine Parish).

Table 5.2.4 Case Study of Management Improvement

		2007/08	2008/09	Changed from 2007/08	Target by OUR	Estimated by JICA	
					2010/11	Case-1	Case-2
	Improvement Target						
	NRW	65%	60%		50%	45%	45%
	Collection efficiency (b/a)		89%		94%	90%	90%
	Operating Cost Reduction		75%		70%	75%	65%
	Loss/Profit Assumption						
a)	Revenue Billed (JMD mil)		13,881.9		16,658.3	18,509.2	18,509.2
b)	Collections (JMD mil)	9,806.1	12,375.7	126%	15,658.8	16,658.3	16,658.3
c)	Operating Expenses (JMD mil)	11,524.0	13,529.2		12,627.2	13,529.2	11,725.3
d)	Operating Loss (JMD mil)	-1,717.9	851.7		3,031.6	3,129.1	4,031.0
e)	Other Expenses (JMD mil)	3,037.2	3,492.8		3,492.8	3,492.8	3,492.8
f)	Total Expenses (c + e)	14,561.2	17,022.0		16,120.0	17,022.0	16,120.0
g)	Balance (b-f)	-4,755.1	-2,185.5		-461.2	-363.7	538.3
	% of Loss/profit (g/b)	-48%	-18%		-3%	-2%	3%

Notes; 1) Values in 2007/08, revenue billed and collections amount in 2008/09 are actual figures

2) Other values are estimated at the fixed price of year 2009 by JICA Survey Team.

5.3 Strengthening of the Organizational Structure

5.3.1 Project Implementation Stage

This section proposes the strengthening of the NWC organization structure at the preparatory and construction stage of this project.

(1) Necessity of Actions Undertaken by NWC

NWC is required to understand the flow of Japanese ODA loan, and to establish the organizational structure to ensure the timely implementation of the project timely based on the E/N conclusion between both countries.

The following actions shall be taken by the NWC in the project implementation stage. Therefore it is proposed that a PMU (Project Management Unit) be established with exclusive control of this project in the NWC. The PMU shall keep all the documents of the project correctly, and build the organization which can grasp progress of the project.

1) Preinvestment stage, including:

- Determination of the relative priority to be accorded the project;
- Formation and comparison of alternatives, and approvals of recommendations as to which is the best;
- Determination of general engineering layout and preliminary design of major structures;
- Review of estimates of costs, benefits and construction period;
- Evaluation of economic and technical soundness, financial and commercial viability, suitability of organizational and managerial arrangements and social and environmental impact;
- Implementation related to environmental and social matters, including implementation/review of environmental impact assessments; and
- Other actions concerning implementation of the project.

2) Preparation stage, including:

- Selection and employment of Consultants;
- Detailed investigations and review of preinvestment studies
- Preparation of detailed designs, specifications and contract documents;
- Pre-qualification of contractors, suppliers or manufacturers;
- Evaluation and approvals of bids and recommendations regarding award of contract; and
- Implementation related to environmental and social matters, including implementation/review of environmental impact assessments

3) Implementation stage, including:

- Supervision of construction work;
- Technical and administrative services for the implementation and management of the project; and
- Recommendations and/or implementation related to environmental and social matters, including environmental management, monitoring and audit.

4) Other actions necessary for the project, including:

- Confirmation and approvals in the start-up of facilities and their operation for an initial period;
- Necessary actions, in connection, for example, with development and sector planning and institution building;
- Necessary actions in implementation of recommendations, post-evaluation and impact studies of the project, and
- Other support actions

(2) Project Management Unit (PMU)

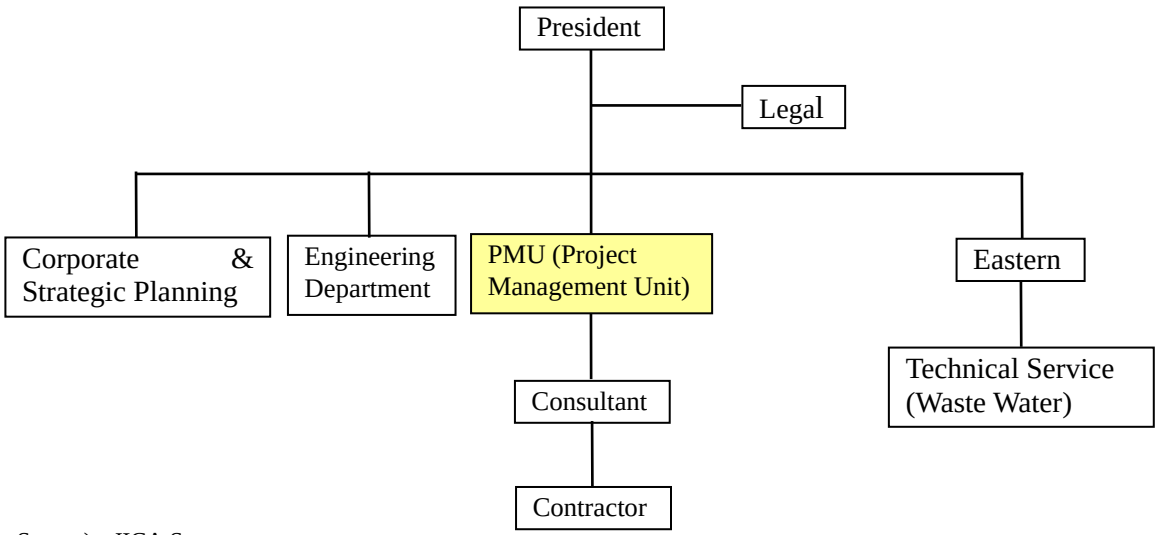
It is proposed that a PMU (Project Management Unit) be established with exclusive control of this project under the direct control of the President as shown in Figure-5.3.1. The Project

Manager of "KMA Water Supply and Rehabilitation Project" is recommended as the leader of this unit based on the experience obtained regarding Japanese ODA loan to this project.

The Water Supply Project under Japanese ODA loan is also in progress. To avoid duplication of resources, a Staff of an Assistant Vice President level with exclusive contract should be assigned with reporting responsibility to the project executive. This Staff will be responsible for the daily project supervision activities under the direction of Project Manager. The storage of all the documents which is related from a project being a long period of time over many years is important business. One secretary under exclusive contract is allotted for this business. Therefore, the PMU is comprised of three-persons of which two persons are under exclusive contract.

The staff under exclusive contract takes charge of daily operations or adjustment business with JICA, coordination of internal related departments and sections (Corporate & Strategic Planning, Finance & Administration, Engineering, Wastewater, etc.) in the NWC. Exclusive staff shall act on the directions of the Project Manager, when needed.

It is important the Project Communication Plan be developed by the NWC as at time of the project commencement. This plan will outline the charge of daily routine works such as preparation, collection, transmitting and accumulation among various information concerning the project to be done by "Who", "What", "When", "to Whom", "How". Simultaneously with E/N conclusion, it is desirable to hold the kickoff meeting at the start of the project. The Project Manager is responsible for the preparing a document which calls and explains the outline of a project which appeals for the cooperation of the representative of NWC related department.



Source) JICA Survey team

Figure 5.3.1 NWC Project Implementation Structure

(2) Procurement Procedures by NWC

The procurement activities of NWC should be executed in accordance with the "Handbook of Public Sector Procurement Procedures, the Government of Jamaica." Purchasing Section of Material Management Department is outlined in it. The scope of approval is differed by

range of procurement amount. When the procurement amount is more than JMD10 million, approval will be needed from external authorities such as NCC (National Contract Committee) and Cabinet.

In NWC, if procurement decision is made, in accordance with the Guideline, a public announcement is made in the printed media and the bidding activity begins. In case of the small scale project can be decided by only the NWC from a bid announcement to supplier or contractor selection (contract) within about three months. Potential bidders should be given at least 4 weeks in which to respond to invite to tender. When the bids are received evaluation exercise can take up to four weeks. The large scale project (more than JMD10 million) is required to get approvals from the NCC and Cabinet within about six months. Projects of JMD10 to 30 million can take two to three weeks to be endorsed by the NCC. The project exceeding of JMD30 million can take up to five weeks including Cabinet approval.

In case of Japanese ODA loan project, employment of consultant and procurement of goods shall be in accordance with the Guideline stated above. It is necessary to make it simplify and to shorten approval procedure in NWC based on the experience of "KMA Water Supply and Rehabilitation Project".

Table 5.3.1 NWC Project Implementation Structure

	NWC			External Authorities		
Contract Size	Invitation	Evaluation	Approval	NCC	Portfolio Minster	Cabinet
Above JMD10 million	X	X	X	X	X	X
Small Size	X	X	X			

Source) Handbook of Public Sector Procurement Procedures, JAMAICA

Notes: “x” means applicable. NCC: National Contract Committee

(3) Claim for Payment (Invoice)

The procedure to clear a claim for payment (invoice) within the NWC is explained here. Although this procedure is not complicated, it often requires up to two months to complete the internal approval. In some cases, however, only one week or less is required.

1) The construction company submits the invoice to the consultant.
2) After review of the invoice by the consultant, the invoice is approved by the NWC project manager.
3) Following approval of the invoice by the Manager of Finance and the President, the project manager forwards it to the relevant section of the Ministry of Finance and Planning.

This procedure is often delayed by the slow progress of the review of the invoice by the project manager, Manager of Finance and the President who have many other job assignments. They may be unable to give swift approval because of their other business

engagements away from the office and other reasons. For the present project, the assignment of a full-time staff member to assist the project manager should reduce the required time for invoice approval. Shortening of the approval time can also be achieved by clearly determining and invoking the process of transferring the authority for the approval of invoices to a proxy when the competent person is absent from the office.

5.3.2 Operation and Maintenance System Improvement

Assets of water supply and sewerage systems in NWC are managed in an integrated manner in its accounting and financial system. All the assets are categorized in (i) land and land rights; (ii) buildings and warehouses; (iii) reservoirs, pumps and sewerage plants; and (iv) motor vehicles and equipment, regardless of operational purposes.

In 2004, Engineering Service Department (Wastewater), Eastern Division surveyed and evaluated the asset management status in 65 sewerage treatment facilities; however, the information such as repairing and maintenance records has not been updated. Especially, asset management information of pipeline and conduit facilities is not yet collected.

This section proposes the strengthening of the NWC organization structure at the present and future maintenance and operation stage after construction of the project.

(1)Necessity of Introduction of New Concept for Operation and Maintenance System

The sewerage facilities of the KMA and Portmore area are old facilities constructed during the past 20-40 years. The current condition of the sewage plants do not meet the effluent standard as stipulated by NEPA, and as a result needs to be addressed urgently. Additionally, the maintenance and operation expenses will be increased by the expansion of sewerage facilities (stock); because the present sewerage coverage ratio is less than 15% of the KMA and Portmore areas. Therefore, the NWC is required to develop an efficient operation and maintenance system of the sewerage facilities which collects the vast quantity of sewer stocks.

On the other hand, the NWC requires that residents perform the connection duties from their individual facilities to the sewer main pipe, and the NWC plans to supplement its financial resources by a usage fee that is collected from the residents who use the system. The NWC has strongly called for accountability of the users.

Furthermore, some sewerage facilities in which construction management are carried out by the BOOT (Build Own Operate and Transfer) principles such as the Soapberry Wastewater Treatment Plant. The NWC needs to explain to the residents the necessity of providing good service in terms of effective sewage business management. The NWC's performance efficiency should be monitored and rated by the users similar to the private companies.

It is necessary to reduce operation and maintenance costs of the sewerage facilities by means of proper management; this means maintaining a long-life span of facilities. Thus, the annual operation and maintenance costs of sewerage facilities are required to be distributed properly by the systematic measure.

In order to maximize the user's benefits, the NWC is responsible for minimizing the cost of the design, construction, maintenance operations, repair, and updating of the sewerage

facilities through the introduction of a policy for attaining optimization through a series of processes.

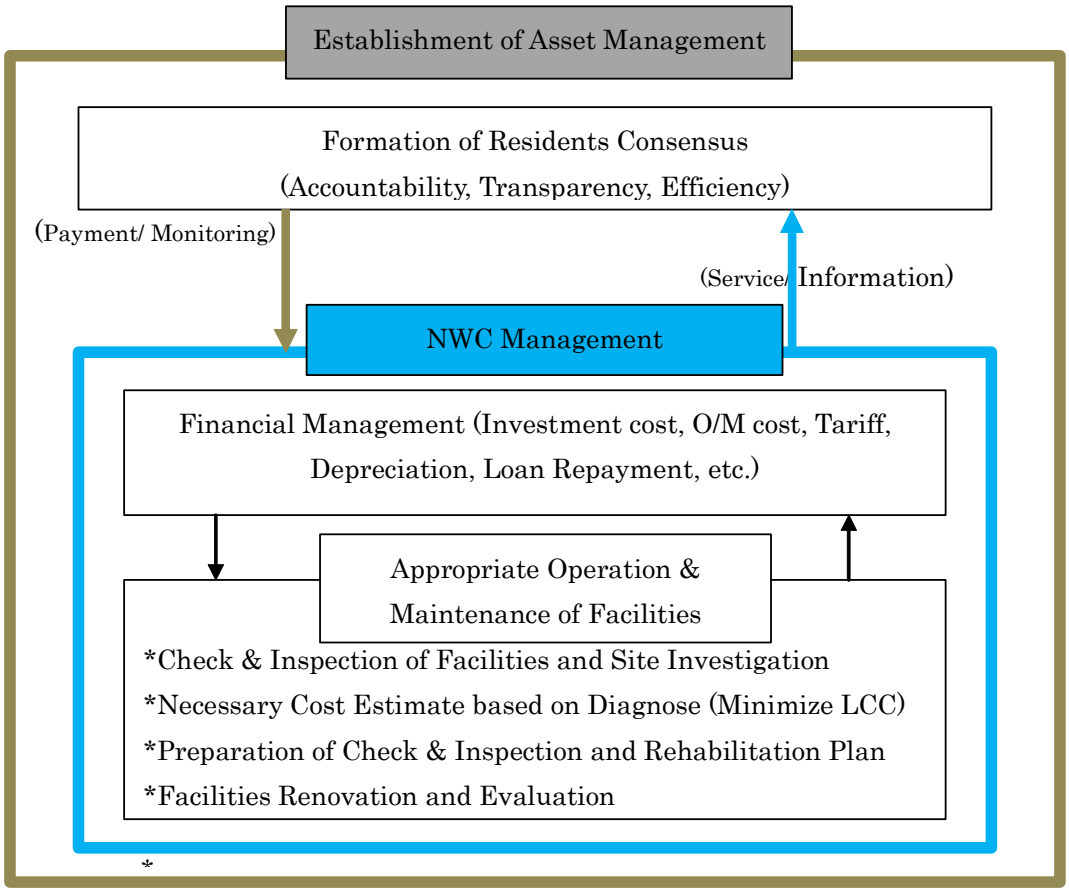
(2) Goals of Asset Management

There are three intended targets for the asset management of the sewerage facilities:

1) Securing safety,
2) Securing service quality level, and
3) Minimizing life cycle cost.

The objectives of asset management are to synthesize and optimize these three targets. In addition, setting up of the targets for asset management is aimed at communicating with the residents.

From the above points, the information about the sewerage facilities situation or functional maintenance should be disclosed to the public and general consensus of the residents/users should be formulated. For sustainable management of sewerage facilities, the NWC is required to ensure optimization of the new investment, through the operation, maintenance and repairing of sewerage facilities.



Source) JICA Survey team

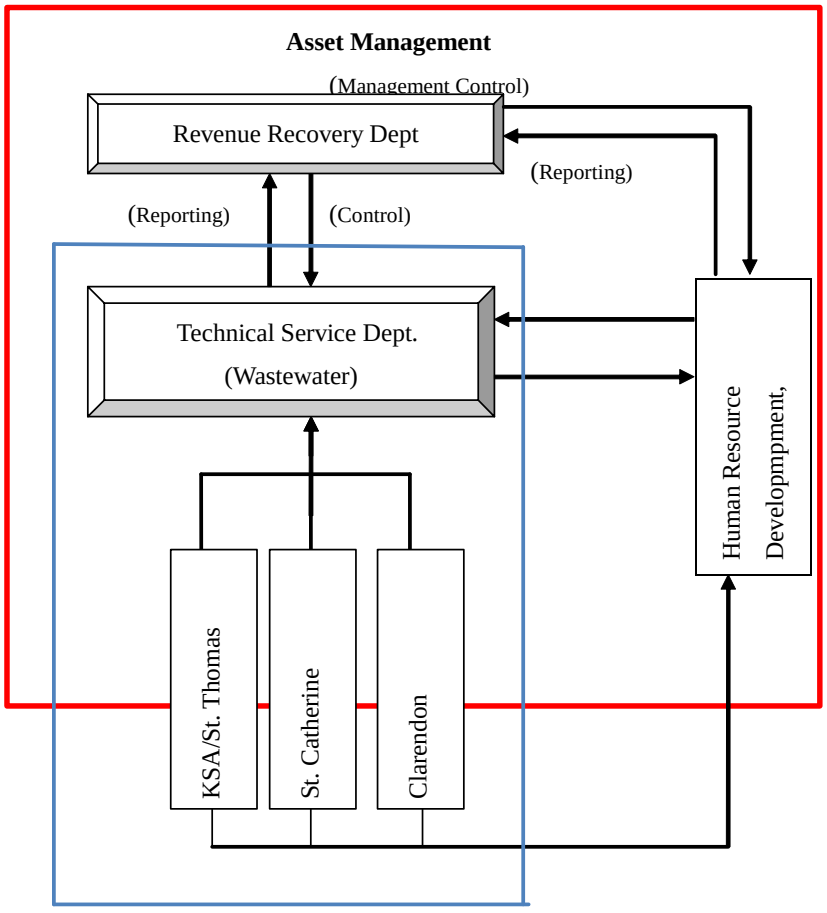
Figure 5.3.2 Asset Management Concept

(3) Organizational Supporting System

At present the NWC has not introduced the concept of the asset management in the sewage business. In order to promote the asset management of the sewage business, whilst sharing the necessity and the concept of asset management widely, it is required to establish organizational supporting systems in the NWC. This role should be assigned in "Corporate and Strategic Planning Department".

The Human Resource and Administration Department is in charge of development of the talented persons who can fully understand the asset management technique of a sewer enterprise, not only Wastewater Department but other departments (Finance & Administration, Revenue Recovery) as well in order to fully promote asset management.

In order to perform asset management, it is important to make practical use of diagnostic information on the maintenance repair to evaluate the degree prediction of life span of the facilities. It takes a long time and an investment budget for nation-wide data accumulation. Firstly it is essential to introduce asset management into the KMA and St. Thomas of the Eastern Division; examples of methods of introduction i.e., employment of a foreign experienced consultant or participation in the overseas training program.

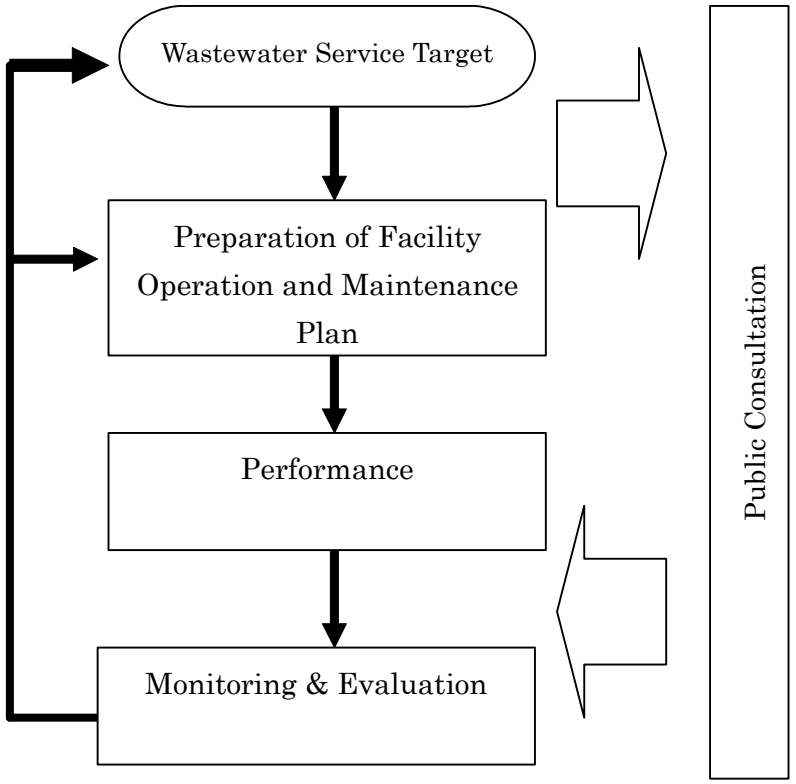


Source) JICA Survey team

Figure 5.3.3 Asset Management in NWC

(4) Practical Implementation of Asset Management

Firstly Asset management sets up a clear and concise goal; thus, in order to accomplish the goal, activities such as Plan, Do, Check, and Action (PDCA: a plan, execution, evaluation, reexamination) should be carried out continuously. The NWC shall establish procedures to efficiently and effectively execute goals of asset management. The NWC will communicate this to the residents who demand an acceptable expense burden and suitable facilities for use.



Source) JICA Survey team

Figure 5.3.4 Practical Implementation Concept of Asset Management

(5) Preparation of Sewerage Facilities O/M Plan

In asset management, the intended goal will first be disclosed to the public, after which public consultations (opinion exchanges by resident participation) will be conducted. It is named the "Facility O/M Plan". PDCA is practiced continuously; residents can also understand about the importance of asset management through public consultation.

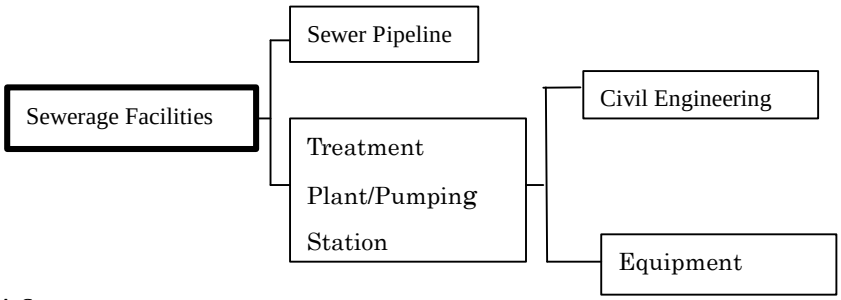
It can be clarified the priority of an individual facility is to attain the standard of the whole sewerage facilities. The long-term target period of asset management and the facility O/M plan is a maximum of 20-30 years, whilst taking into consideration the difficulty of prediction and development at a technical level. The short-term detailed development plan is also prepared for five years. This is done at the beginning of the planning stage. The short-term plan is reviewed yearly in principle; the long-term plan is to be improved in compliance with changes to the short-term plan.

It is a premise that the sewerage facilities asset management of the NWC is in accordance with the environmental guidelines of the NEPA. The total sewerage facilities development goal will be discussed with the Office of Utility Regulations (OUR), in order to realize business goals through the clarification of the responsibilities for the sewer enterprise.

(6) Preparation of Facility O/M Plan and Performance

The NWC Wastewater Department is performing O/M activities according to the roles and duties of assignments as outlined in the "Wastewater Management Operation Procedures"

However, the functions and characteristics of the facilities are different. In the future, it will become necessary to draft separate procedures for each of the roles i.e. "Sewer pipe facility O/M plan", "Civil engineering works O/M plan of treatment plant" and "Equipment O/M plans of Treatment plant.



Source) JICA Survey team

Figure 5.3.5 Sewerage Facilities Components

Facility O/M plans comprise of "check and inspection plan" and "Rehabilitation plan." It is necessary to refer to these two plans simultaneously. In order to carry out the facility O/M efficiently and effectively, it is necessary to build an information communication systems (database etc.) which records the past activities of each facility condition. It should include:

1) A diagnostic result,
2) Maintenance and reconstruction,
3) An accident and failure, and
4) Complaints.

This database should be updated continuously.

(7) Check and Inspection Activity

It should be identified to prioritized facilities and inspection items based on the past maintenance record. Periodical evaluation of record is carried out and a check item is added if necessary; the inspection plan is improved based on periodical evaluation. (Fig. 5.3.6)

The check and inspection for facilities will be quantitatively performed for prediction of the facility operation period or if required the facility to be failed in terms of sustainability.

When judging the degree of facility sustainability, it is important to clarify the definition among inspectors so as avoid any discrepancies; it is recommended that the check and

inspection activity be done as soon as possible so as to create good management conditions of the sewerage facilities.

1) Check and Inspection for Sewer Pipe

Periodic checks and inspection of sewer pipe is performed in highly prioritized areas in view of social influence and the physical characteristic of pipelines. In Japan, the check and inspection method is by visual investigation, the result of investigation is categorized according to the level of urgency.

2) Check and Inspection for Civil Engineering Works

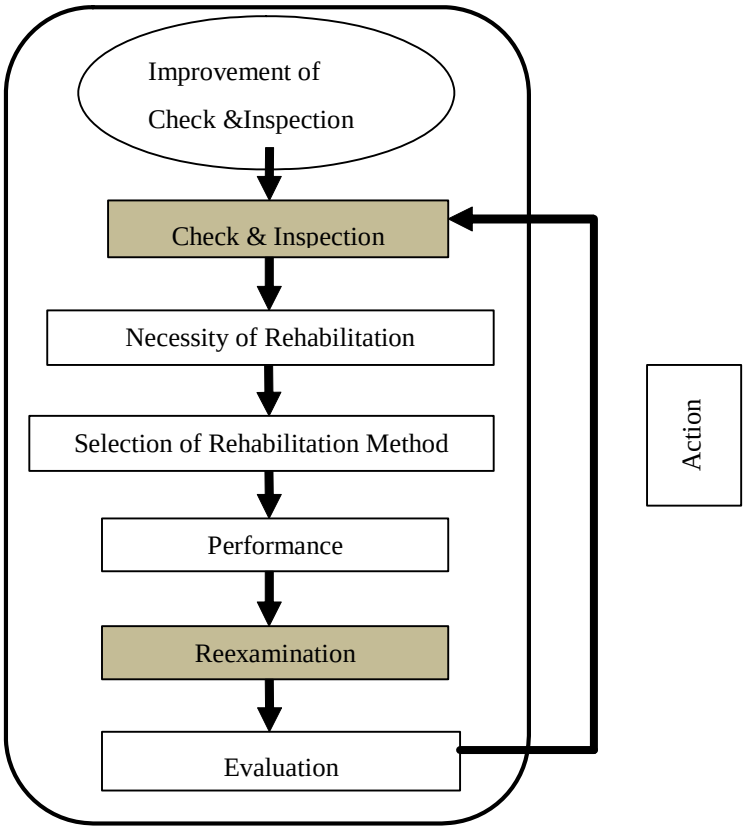
The degradation of the civil engineering-works and concrete structure of treatment plants and pumping stations is mostly due to corrosion of the concrete due to the presence excess hydrogen sulfide. For this reason, inspection of the civil engineering-works and concrete structure is performed at the place where concrete corrosion is generated. The inspection is conducted taking into consideration the renewal period of the facility.

Inspection of the civil engineering works is usually conducted and recorded at the time of equipment repair of sewerage facilities. If there is no accumulation of sufficient data at that time, the degree prediction of the concrete structure is diagnosed using the index of hydrogen sulfide gas concentration.

3) Check and Inspection of Equipment

Presently, inspection of each pumping station is recorded in the Wastewater department. It is necessary to record the equipment condition, separate and apart from daily operation. Since the apparatus and equipment are huge and varying, it is more effective to classify based on the characteristic of each piece of equipment, and establish the frequency and the contents of check and inspection.

In Japan, the diagnostics of the equipment is executed based on the equipment list or operation and maintenance record. On-site visual investigation of the equipment is conducted; based on the result of the on-site investigation, diagnosis of physical or functional conditions is carried out, and classified into the necessity for reconstruction, repair of the scale and urgency.



Source) JICA Survey team

Figure 5.3.6 Improvement of Check and Inspection

(8) Preparation of Rehabilitation Plan and Performance

The rehabilitation plan consists of three sub-plans:

1) Sewer pipe facility rehabilitation plan;
2) Civil engineering works rehabilitation plan; and
3) Equipment rehabilitation plan at the treatment plants.

The cost of the annual rehabilitation project is based on the cost estimation of each facility according to the life span of operation. Next, the necessary costs per annum of three facilities are added together, and all estimated costs are compared with the next year budget. If the estimated cost is beyond the annual budget, then the rehabilitation of some facilities by year is moved forward or post-sending for adjustment of the budget. The following points are considered for proper budgeting of rehabilitation projects:

1) It is necessary to take into consideration the importance, the risk, the life cycle of each facility.
2) The priority of the rehabilitation plan is to set up the function and superannuation of the sewerage facilities.
3) The rehabilitation plan for wastewater treatment plants and pumping station is required to adjust the reconstruction plan of equipment and civil engineering works efficiently.

4) It is necessary to hold coordination meetings with supervisors of maintenance sections and area managers.

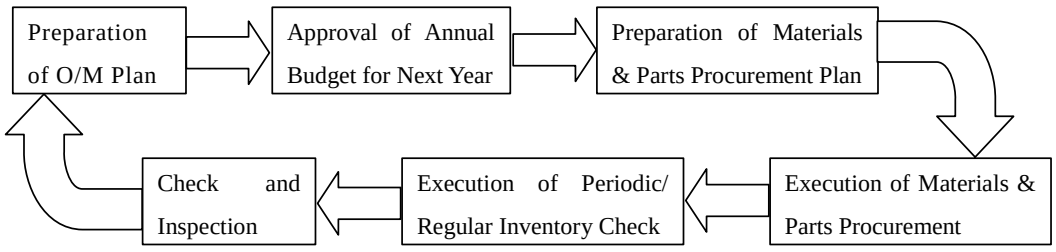
(9) Establishment of Stock Control System

Almost all equipment and materials for the water-and-sewage facilities are imported from foreign countries. This may have happened because of suffering to a supply for several months caused by supplier's conditions. On the other hand, it is necessary for stock to hold materials beforehand to cope quickly when they are needed. Various construction materials are piled in heaps at the Eastern Division; however, it becomes a huge burden financially to hold many stocks. It will have a negative impact on the management principles of the NWC. For this reason, the NWC is required to rationally manage a series of procurement of materials or parts and deliver them to the site when necessary.

Consumable goods are required to import periodically through the allocation of proper budget per annum. On the other hand, it should be noted the following demerits for stock possession so that it is necessary to manage stock adequately.

1) Increase of inventory control expense;
2) Stay of stock fund;
3) Obsolescence of stock articles, and deterioration of quality;
4) A lack of stock articles; and
5) Increase of stock space;

It is suggested that the NWC should perform stock control according to the following procedures outlined in Figure 5.3.7.



Source) JICA Survey team

Figure 5.3.7 Inventory Control Flow

1) Preparation of Rehabilitation Plan and Performance

NWC prepares annual budget of the next fiscal year by the end of the fiscal year (1st April to 31st March). In parallel with this activity, the Technical Service Department (WW: Wastewater) is required to prepare materials and parts list for maintenance in the next year. The O/M plan should specify repairing time, and materials and parts in order to reflect materials and parts procurement plan whenever it is needed. The plan should be considered to reflect the number of repairing, kinds of materials, etc. to be requested by the Supervisors.

Technical Service Department (WW) also considers the urgent repairing materials list which is to will be needed in the next year and prepares the O/M plan.

2) Preparation of Materials and Parts Procurement Plan

If the budget is approved in the next fiscal year, indispensable amount is to be calculated based on the O/M plan and the materials and parts procurement plan. the contents of the materials and parts procurement plan includes purchasing item, indispensable amount, the appointed date of delivery from suppliers, a prices, terms and conditions, etc. The plan should consider the following points:

i) Cost reduction

It is necessary to calculate quantity of indispensable materials based on a stock directory to reduce stock cost of materials and parts at the initial stage. Quantity of the ordering amount will be finalized taking consideration of economic lot of a delivery by supplier and a price fluctuation possibility.

ii) Operation funds reduction

Supply period of materials and parts should be examined the in order to reduce saving stock quantities of operation funds as much as possible. To aim at reduction of operation funds, immobilized stock is to be reduced as much as possible.

iii) Prevention of lack of stock articles

Quick delivery of materials or parts to the repair spot from a warehouse is required upon the request of their exchange. It is always necessary to keep materials and parts for system repair judging from the existing data and experience.

3) Materials and Parts Procurement

It is necessary to manage materials and parts procurement for supplier to be implemented according to the contract. It is necessary to stop business with the supplier that is unfavorable in quality and price of the product and to find out appropriate supplier. The latest information of the materials for future uses can be regularly collected by internet, etc. In addition, participation in an exhibition and a trade fair performed in a neighborhood country is one of the effective ways to get detailed information of the products at a time.

4) Inventory Control

It is necessary to conduct stock inventory control continuously every day in order to avoid various problems to be occurred unless stock of an inventory control account book accords with the stock articles precisely. Through adequate management of daily adequate, method called "a circulation inventory control" which provides all items should be checked regularly at a fixed period. Even NWC has to perform an inventory check every month at least. It is recommendable to perform easy management for sock articles by importance and use frequency of an item.

(10) Establishment of Information Communication

As for the present condition of sewerage facilities of the NWC, the database of sewerage facilities is not yet established. Most data about maintenance repair of sewer pipeline has

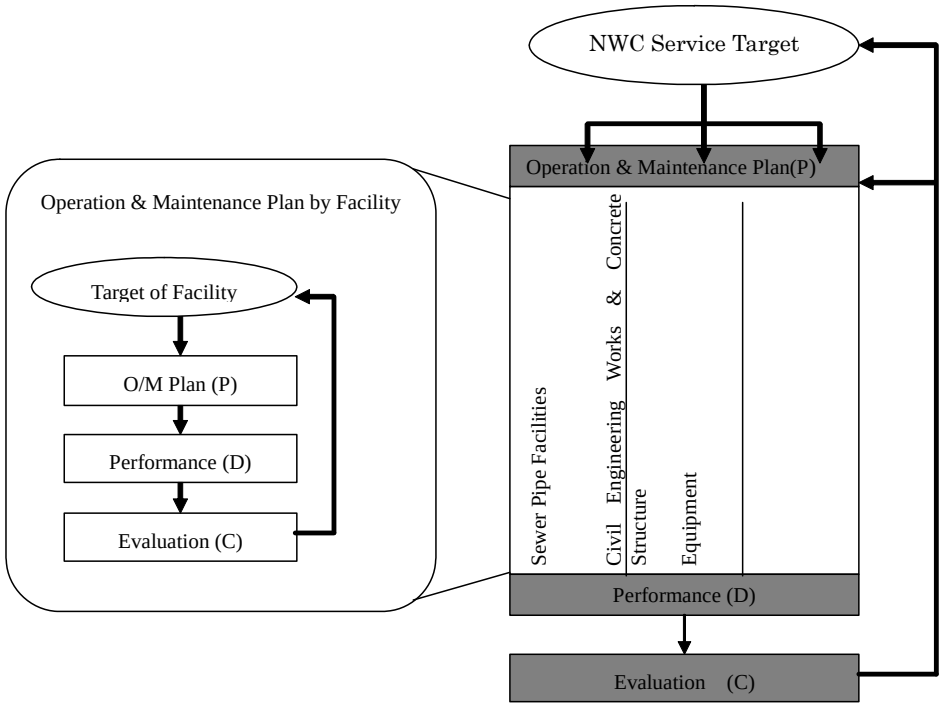
not yet been stored. In order to establish a suitable asset management, it is important to share related information widely to the relevant persons in the NWC; the existing communication information system is applied for this purpose more effectively.

In order to carry out suitable facility O/M continuously, it is important to accumulate and systematically manage records; such as construction information, facility condition, a diagnostic result, maintenance repair and reconstruction, an accident and failure, and a complaint. In order to utilize this information efficiently, information shall be suitably updated. It is desirable to support the optimal facility O/M plan based on the stored data which calculates evaluation of a stock, degradation prediction, etc.

(11) Review and Evaluation of Facility O/M Plan

The PDCA cycle of the facility O/M plan is shown Figure. 5.3.8. The order for the evaluation of facilities O/M plan, firstly evaluation of targets in the "Sewer Pipe O/M Plan", the "Civil Engineering Works O/M Plan", and the "Equipment O/M Plan" are made separately and PDCA is practiced accordingly. Next, the whole Sewerage Facilities O/M target is determined based on the evaluation of an individual target and PDCA is practiced.

When deviations of the predictions or falling short of the target of the plan, the causative analysis is made with the expectation for a steady improvement in future. The request to upgrade the sewer services is confirmed periodically; and re-examination of the whole target and the individual target of O/M plan is reviewed.



Source) JICA Survey team

Figure 5.3.8 PDCA Cycle of the Facility O/M Plan

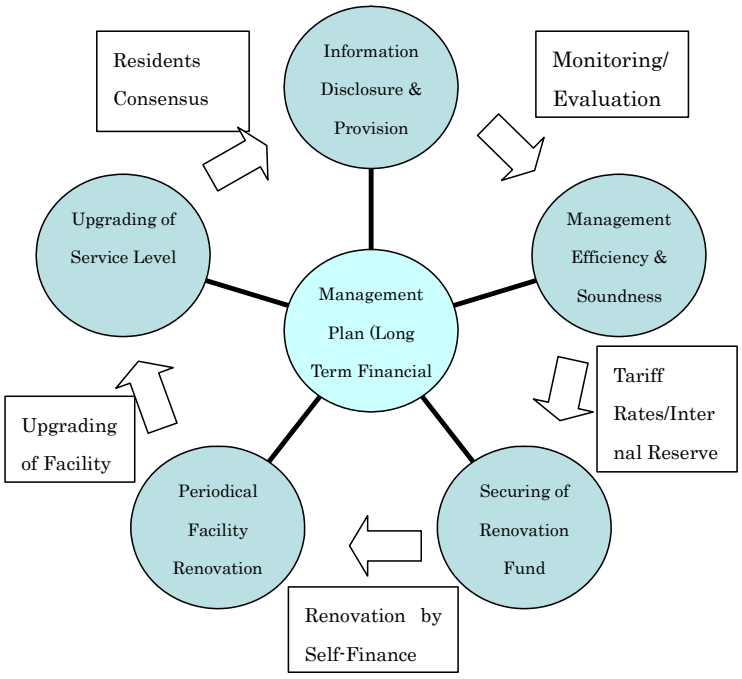
(12) Establishment of Communication System with Residents

The sewage management business is fully dependent on the sewer usage fee; the NWC should strive for information disclosure and an opinion interview to the residents/users.

However, with the present management attitude of the NWC it is very difficult to take this action, for instance, “Performance Objectives and Business Plan, 2009-2010”,”Annual Report 2007-2008” and ”Annual Report 2008-2009”are not yet published as of December 2009. This management attitude should be changed toward a more customer-oriented approach.

The information that should be released to the residents is not only the outline or maintenance situation of the sewerage facilities, but also there is a need to disclose understandably and concretely the role of the NWC in terms of the financial conditions, the situation of operation and maintenance and future expansion plans. It is also important in that case to use an intelligible index (PI: Performance Indicator) to obtain an understanding of residents.

In the decision and re-examination process of a Facility O/M plan, it is necessary to strive for information disclosure and an opinion interview at a time that is suitable in the process. A report about a road cave-in, a bad smell, etc. is precious information. Residents will be able to evaluate the enterprise performance record and efficiency of the NWC by this information disclosure. This result will be reflected in the management policy of the NWC, and will lead to sustainable enterprise management. This process is shown in the following Figures 5.3.9.



Source) JICA Survey team

Figure 5.3.9 Sustainable Management Process

(13) Plan of Operation

Asset management is an efficient as well as rational method of management improvement emphasizing customer service as described above rather than conventional management centering on maintenance. At the NWC, a GIS (Graphical Information System) and CIS (Customer Information System), both of which are effective tools for asset management, have already been introduced although the examination of truly effective ways of using these tools will be essential in the coming years.

The introduction of asset management should follow the process described below. Fig. 5.3.9 shows the framework and responsible department for the implementation of such process.

1) Preparation of Implementation Framework

i) Gathering and Analysis of Literature and Guidelines Featuring Asset Management

Efforts to establish the practice of asset management constitute a major project aimed at improving the management at the NWC. It is necessary to obtain and analyze the relevant information from the EU, USA, Japan, Australia and other countries where asset management is in place. Various asset management-related guidelines have been prepared in Japan and can be easily obtained. Corporate & Strategic Planning will be responsible for the gathering of information.

(Examples of Asset Management in Japan)

In Japan, the work related to the sewerage service is primarily the construction of new facilities in those cities with a low service coverage rate. However, efforts to establish a preventive maintenance system have commenced in cities with a high service coverage rate. These efforts include the preparation of an efficient maintenance plan and reduction of the maintenance cost. In relation to the asset management of pipelines, the Ministry of Land, Infrastructure and Transport in Japan has almost established a practical way of calculating the LCC (Life Cycle Cost) using the statutory useful life. Meanwhile, the Japan Sewage Works Agency has published asset management-related manuals, including the Manual for Reconstruction/Rehabilitation of Sewage Facilities, Manual for Cost-Benefit Analysis of Sewerage Service and Guidelines for Maintenance of Sewage Works.

According to information provided by the above Agency, 115 local public bodies (municipalities) have introduced or plan to introduce asset management in their sewerage service operation as of the beginning of 2009. Typical examples are shown in the table below. Some examples in other industrialized countries are included in Appendix F for reference. Table 5.3.2 shows examples of asset management introduced to Japanese sewerage sector.

Table 5.3.2 Examples of Introduction of Asset Management to Sewerage Service Operation in Japan

Service Provider (Municipality)	Objective	Description of Asset Management
Tokyo	Establishment of the timing for the systematic renewal of pipelines and electrical/mechanical equipment	Estimation of the economic lifetime based on life cost analysis
Osaka	Establishment of suitable indices to evaluate investment and impacts	Evaluation of sludge treatment based on the quantification of investment and impacts
Kyoto	Alleviation and leveling of the excessive concentration of operational expenditure	Determination of the economic lifetime based on the LCC calculation for each facility/system
Fukuoka	Establishment of an efficient system for the reconstruction of pipelines	Automatic diagnosis of the urgency of investigation data and preparation of a repair ledger
Hiroshima	Computerization of the pipeline ledger system	Diagnosis of the reconstruction/repair needs and computation of the timing for such work

Source: National Institute for Land and Infrastructure Management, "Project Research Report"

It will be necessary for the study committee of the NWC to gather information relating to the examples listed in the table above and other similar examples and to examine the possible effects of the introduction of asset management.

ii) Establishment of Study Committee

In Japan where asset management guidelines are prepared by local public bodies, it is common practice to establish a study committee of which the members include external experts along with some staff members of the actual implementing body. It is, therefore, proposed that the NWC establish such a committee.

Another committee consisting of senior management personnel should also be established for the purpose of examining a concrete implementation framework within the NWC when the analysis of the gathered information on asset management confirms the validity and positive effects of the said information. This committee will be led by the VP of Corporate & Strategic Planning and the members will include, for example, representatives of Business Support Services and Public Relations of the Headquarters as well as those of Technical Services (Waste Water), Revenue Recovery and Human Resources of the Eastern Division.

iii) Clarification of Assignments and Roles of Staff and Department

The study committee will check the likely effects of the introduction of asset management towards the improvement of management, clarify the role of each department of the NWC and prepare a basic policy to achieve the said improvement.

In the short-term (2010 - 2014), the study committee will propose the preparation of an asset list for each facility and an asset directory (database). This directory will be essential for an accurate understanding of the state of each facility and relevant information and can be used to identify the asset value and degree of deterioration of each facility and to estimate the

future costs. Apart from the preparation of the principal directory, the information contained in the directory should eventually be made into a computerized database. What is important is to start with what ever is possible. While this short-term plan can be prepared by the project team described below, the preparation of a long-term management strategy and vision by the study committee is desirable.

iv) Identification of Staff Training Method

As asset management should be put into practice by NWC staff, it will be necessary for the said staff to acquire the relevant skills. Asset management consists of a wide range of key elements featuring not only technical issues but also financial and customer service issues as listed below. The Department of Human Resources must examine suitable training methods for staff members working in specific fields. Estimation of the likely costs and potential to secure the necessary budget is also important.

- Level of service definition
- Selection of performance goals
- Information system
- Asset identification and valuation
- Failure impact evaluation and risk management
- Condition assessment
- Rehabilitation and replacement planning
- Capacity assessment and assurance
- Maintenance analysis and planning
- Financial management
- Continuous improvement

v) Approval of Asset Management Implementation Framework

The study committee will prepare an asset management implementation framework document stating the expected effects, targets, implementation system, required budget and other relevant matters and submit this document to the Board for its approval. The Board will examine whether or not the proposed framework is compatible with the existing development policies of the NEPA and Ministry of Water and Housing regarding water supply and sewerage services and will modify the contents of the proposed implementation framework if necessary.

2) Human Resources Development

The Department of Human Resources will examine tangible human resources development through consultations with the Department of Technical Services on the required skill levels of staff members for each type of work involved. Asset management skills can also be learned in various ways, including i) attendance at seminars organized by the NWC to which foreign consultants have been invited as lecturers by the NWC and ii) dispatch of staff members to overseas training courses.

i) Dissemination of Gathered Information and Materials

The Department of Human Resources will regularly (at least every six months) provide information designed to facilitate capacity development among staff members (supervisors upwards) in the form of the dissemination of asset management-related information and materials gathered by the study committee and/or the disclosure of the said information and materials to the existing ICT network.

ii) Seminars

Compared to the dispatch of staff overseas, seminars held at the NWC's training facility to which foreign consultants are invited as lecturers have the advantage of allowing many more staff members to learn about asset management techniques. Given the possibility of securing lecturers under technical cooperation and other ODA schemes, the Department of Human Resources should discuss and examine the concrete details (contents, frequency, duration and other aspects of a training programme) with organizations likely to provide assistance for these seminars.

iii) Dispatch of Staff to Overseas Training Programmes

Staff members may be dispatched to training programmes held by educational institutions and aid organizations in the EU, Japan and other countries where asset management is practiced. As such dispatch is expensive, an alternative method of training whereby staff members are dispatched to training programmes under the technical cooperation scheme should be explored. Another issue is examination of the staff eligibility for such training. For example, the candidates may be restricted to those holding the position of manager or higher.

3) Preparation of Action Plan

Concrete actions in the field will be conducted based on the implementation framework prepared by the study committee. In order to proceed with concrete actions, the preparation of an action plan will be necessary. It must be stressed here that asset management is not a conventional narrowly defined management method as a (technical) maintenance method for facilities. It is a broad management method designed to improve the business management of the NWC with the additional involvement of users and residents. The establishment of a project team to effectively handle this considerable task is essential. The principal responsibility of the project team will be the preparation of a concrete plan based on the examination results of the study committee and will then move to the stage of their implementation.

i) Establishment of Project Team

A project team consisting of representatives of the department concerned should be established and an action plan should be formulated. The appointment of the VP (Vice-President) of the Eastern Division as leader of this project team is desirable. The team members are likely to include representatives of such departments as Revenue Recovery, Technical Services (Waste Water), Human Resources and Finance & Administration among others. This project team will report the progress of its work to the President's Office of the

NWC every three months and will try to build a common understanding of the pending tasks for effective asset management with the President's Office.

ii) Preparation of Asset Lists

Asset lists should be prepared to include all of the facilities currently owned by the Department of Engineering and the Department of Sewerage Service. Separate lists should be prepared to cover civil engineering and concrete structures and mechanical/electrical equipment for sewerage pipes and treatment plants (and pumping stations). The project team must identify the priority of listing in relation to individual areas and facilities. The Department of Sewerage Service will upload the prepared lists to the existing information network for the Internet access by all those concerned. These asset lists will form the basis for an asset directory described below. Concrete actions will start in the area under the Eastern Division where ever possible.

iii) Preparation of Check and Inspection Plan

Once assets lists have been prepared, a check and inspection plan should be prepared for each of the civil engineering and concrete structures and equipment as described earlier in (7) - Preparation of Check and Inspection Plan.

In Japan, the inner surface of a pipeline is checked by the naked eye and/or TV camera. The table below shows the checking interval, checking method and evaluation grades in Japan for pipelines and manholes. The checking interval is classified in terms of the period passed since initial installation while the evaluation determines the level of urgency of the required response in three grades.

Table5.3.3 Example of Checking of Pipelines and Manholes

Years Passed	Visual Check	TV Camera Check (inner diameter of less than 800 mm)	Evaluation Grades
Less than 30 years	Every 5 years	Every 10 years	Urgency Grade I (High) Immediate response is required Urgency Grade II (Medium) Required response can be delayed up to 5 years provided that a simpler response is immediately implemented Urgency Grade III (Low) Required response can be delayed by more than 5 years provided that a simpler response is immediately implemented
30 years or more	Every 3 years	Every 7 years	

Source: Japan Sewage Works Association, "Guidelines for Maintenance of Sewage Works"

4) Preparation of Facility O/M Plan

i) Site Investigation

Checking and inspection will take place along with other types of routine work at the priority facilities and areas identified by the project team. Such checking and inspection work should

be incorporated in the daily maintenance plan which is in preparation by the Department of Sewerage Service and the planned weekly work schedule should be modified.

ii) Preparation of Asset Directory

A database incorporating the diagnosis results for the timing of the repair or renewal of pipelines and mechanical/electrical equipment should be prepared based on the results of on-site checks and inspections conducted using the asset lists. If repair or rebuilding work has been conducted, the relevant information must be renewed so that the latest information is available to staff members of the NWC. This work should be conducted by the Department of Technical Services (Waste Water).

iii) Preparation of Check and Inspection Plan

Based on the above-mentioned database, the contents of the check and inspection plan should be further consolidated (with reference to facilities and target areas). Given the fact that the current maintenance system adopted by the Department of Waste Water is not a preventive maintenance system, vital information should be clearly given in this plan in connection with important issues, including inspectors, timing of inspection and required tools/equipment.

iv) Preparation of Rehabilitation Plan

As already mentioned in (8) - Preparation of Facility O/M Plan, the preparation of three different O/M plans (a) sewerage pipe O/M plan, b) civil engineering and concrete structure O/M plan and c) equipment O/M plan) for each type of facility is necessary. The simultaneous preparation of these O/M plans will be quite difficult in view of the necessity to continue with other essential daily work. A realistic approach is the preparation of those plans for priority areas and facilities identified by the project team.

5) Implementation of Operation and Maintenance

Facility rehabilitation work is currently being conducted although not in a systematic manner. Here, it is assumed that such work will be conducted in accordance with the facility O/M plans described in 4)-iii) above.

i) Procurement of Materials and Parts

Jamaica is an island country and the timely import of the materials and parts required for facility rehabilitation is essential. The efficient procurement of materials and parts should be conducted in accordance with the procedure described earlier in (9) - Establishment of Stock Control System.

ii) Facility Rehabilitation

The present staff members of the Department of Technical Services (Waste Water) have the technical capability to rehabilitate the facilities. However, there is a problem in terms of the unsystematic implementation of the rehabilitation work. It is essential for such work to be conducted in accordance with the facility rehabilitation plan to be prepared by the asset management project team. In addition to the repair tools/equipment currently owned by the NWC, a range of equipment (see Chapter 4) to be procured under the project will be fully

utilized for the rehabilitation of the facilities. This rehabilitation work should be followed by the establishment of an authentic maintenance system, including the renewal of data in the asset directory.

6) Monitoring and Review of Various Plans

i) Public Consultation Meetings

The NWC already has a call centre as part of the system to receive customer complaints and requests. However, the disclosure of information on the business management of the NWC is inadequate. As described earlier in (12) - Establishment of Communication System with Residents, public consultation meetings should be held to explain the vision, facility rehabilitation plan and other matters to facilitate the understanding of the NWC services among residents. Through these meetings and other means, what residents actually want will be identified to compile basic data for the review of plans.

ii) Review of Check and Inspection Plan

When improvements are required as a result of the facility checking and inspection work, the plan (composition of the team, schedule, tools/equipment to be used and other components) explained in 4)-iii) will be revised.

iii) Review of Rehabilitation Plan

Any requests for improvement of the sewerage service will be regularly checked with a view to revising the overall as well as individual targets. In this context, the implementation of the PDCA cycle shown in Fig. 5.3.8 – PDCA Cycle of the Facility O/M Plan is important. This management technique must be continually applied as long as the NWC exists.

Figure 5.3.10 Plan of Operation for Asset Management

	Activity	Performance Measure	2010	2011	2012	2013	2014	2015 2020	Responsible
1	Preparation of Implementation Framework	Collection and analysis of asset management information							CSPD
		Establishment of study committee							CSPD
		Clarification of assignment and role of persons and departments							PRD, HRAD, BSSD, CSPD, FD, ED, RRD,
		Identification of staff training method							HRAD,HRD
		Framework plan approved by the Board							CSPD
2	Human Resources Development	Dissemination of collected information							HRAD,HRD
		Holding seminars by consultants							HRAD,HRD
		Dispatching staff for overseas training programme							HRAD,HRD
3	Preparation of Action Plan	Establishment of project team							ED, RRD, HRD, FAD, TSD-WW
		Preparation of asset list							FD, TSD-WW
		Preparation of check and inspection schedule							TSD-WW
4	Preparation of Facility O/M Plan	Site investigation							TSD-WW
		Preparation of asset directory							TSD-WW
		Preparation of check and inspection plan							TSD-WW, FAD, FD
		Preparation of rehabilitation plan							TSD-WW, FAD, FD
5	Implementation	Procurement of materials and parts							TSD-WW, FAD, FD
		Facility rehabilitation							TSD-WW
6	Monitoring and Review of Plan	Public consultation meeting							PRD, RRD
		Review of check and inspection plan							TSD-WW
		Review of rehabilitation plan							TSD-WW

Notes: ・PRD: Public Relations Department
・HRAD: Human Resources & Administration Department
・BSSD: Business Support Service Department
・CSPD: Corporate & Strategic Planning Department
・FD: Finance Department
・ED: Engineering Department
・RRD: Revenue Recovery Department, Eastern Division
・HRD: Human Resources Department, Eastern Division
・FAD: Finance & Administration Department, Eastern Division
・TSD(WW): Technical Services Department, Wastewater, Eastern Division

5.3.4 Operation and Maintenance Staff for the Project

(1) Operation and Maintenance Staff

The operation and maintenance system of Wastewater in Eastern Division is divided and managed in three areas of (i) KSA/St.Thomas, (ii) St.Catherine and (iii) Clarendon.

This project is under operation and includes the maintenance staff of KSA/St.Thomas. The intended plan is to allot 15 staff from the existing treatment plants (Western, College Green, and Hughenden) which will no longer be in use upon the implementation of this project, without having to employ additional persons.

Western Treatment Plant has already stopped operating and seven personnel have been relocated to the operation and maintenance services for other sewerage facilities. Since it is not a new employer, it is expected that operation and maintenance techniques for sewer main pipeline can be acquired by on-the-job-training at the site.

(2) Operation and Maintenance of sewerage pipe

Based on the inspection of the sewer facilities by the JICA Survey Team, it was determined that proper operation and maintenance (O&M) of the facilities is insufficient, especially in Portmore. As mentioned in Chapter 2, the Portmore Area is particularly plagued by the following conditions:

- Garbage, grease, and debris are encountered in pipelines and wet wells
- Electromechanical equipment is in disrepair, with missing parts and rampant scavenging of parts to serve other facilities
- Treatment facilities are antiquated, in deteriorated physical condition, and mechanical equipment in poor condition or inoperative

These conditions result from the following:

- Insufficient number of qualified operators on staff
- Insufficient training of staff
- Insufficient inventory of spare parts
- Insufficient equipment to maintain and repair the facilities

This report describes an ambitious program to construct large wastewater collection facilities for KSA and Portmore, representing a large investment for the Government and citizens of Jamaica. The existing O&M processes in the NWC must be expanded in both magnitude and quality to properly accommodate the extensive new pipelines and pumps proposed herein. This O&M effort will protect the investment and, provide the best service for the customers being served. If this does not occur, then the system will fail, and the ultimate goal of this project, the improvement in the environment of Kingston Harbour, will not be achieved.

1) Objective

The objectives of a robust O&M system for the improved wastewater system in KSA & Portmore are as follows:

- Ensure the flow capacity of the system
- Extend the operating life of the infrastructure
- Ensure safety of the staff against accident and injury

2) General Activities

The activities of the NWC field operations and maintenance staff are generalized into the following categories:

- Inspection: the facilities must be constantly inspected to identify problems, hopefully before such problems might affect customers or the environment.
- Cleaning: a program of regular cleaning of pipelines and pump station wet wells must be executed to remove debris and accumulated greases and sediments. This activity prevents problems before they occur. This activity is performed using the Vactor truck with a pipe cleaning trolley.
- Repair: Repair of sewer pipes requires heavy construction equipment to excavate soil to reach the buried pipe, then place new pipe, fill and compact the excavation, and repair the pavement or ground surface. Other light equipment is required for repair of pump systems. Both pumps and pipes require a sufficient inventory of spare parts and materials to minimize down time.
- Protection: Lining of new or existing pipelines will extend the life of installed infrastructure against the attack of sewer gas corrosion.

3) O&M Data

A proper O&M system must incorporate data collection and results monitoring. Most O&M systems nowadays are linked to a utility-wide GIS system. In a typical GIS problems are noted and activities recorded in a database that is linked to system maps and available to all personnel in the utility. In this manner, chronic problems can be identified, catalogued, and addressed rapidly. This also allows easy monitoring of preventative maintenance progress.

The NWC is engaged in producing a digital GIS model of their wastewater infrastructure and future O&M operations should be linked to this system.

4) Proposed Equipment to be Procured

The O&M activities described above require specialized equipment. These include:

- Vactor Truck and Cleaning Trolley Additional Vactor trucks are proposed for the existing NWC fleet to serve the new pipelines proposed. A Vactor truck is a proprietary brand name used to describe a truck with a tank and pump system that is dedicated to removing sewage from clogged pipelines or to perform cleaning activities.

Chapter 4 provides a more detailed list of the proposed list of equipment to be procured under a separate contract in addition to the main construction contracts. Other costs and required personnel for the additional O&M required for the extensive works proposed in this project are included in other chapters of this report.

5) Capacity Development

While a detailed investigation of the training programmes for new or existing operations staff was not performed by the JICA Survey Team, it can be assumed from the condition of the infrastructure that such training could be improved. Irrespective of the current state of training in the NWC, most water and wastewater utilities recognize the benefits of investing in training for their employees to ensure they hold the best knowledge available so that they can perform their duties efficiently, and to continuously review the training program.

Given the limited experience and geographical isolation of Jamaica, it is appropriate to consider training programs from international sources.

(3) Draft Training Program for Pump Operation and Sewer Pipe Maintenance

NWC's current operation and maintenance is not at sufficient level due to shortage of funding. It has been a vicious cycle that facilities without appropriate O&M causes troubles that impose much heavier financial burden than normal maintenance costs to NWC that leads to further funding shortage.

In order to implement appropriate O&M of pumping facilities and sewer pipes constructed under the project, it is imperative to perform reasonable asset management as described above. It is proposed that NWC acquire and implement the following O&M methodology:

i) Long-term and comprehensive O&M planning method required for the asset management

ii) Technical capability to perform appropriate testing, diagnosis, maintenance and repairing of equipment and facilities introduced by the project

iii) Basic knowledge on advanced O&M technology e.g. video scope survey, asset management system, etc. including preparation for its introduction

A representative training regimen is presented below. This information is presented for illustrative purposes only. Future steps in this project should clarify any training and shape training for the exact infrastructure proposed.

It is important to improve technical capability and develop human resources and knowledge among staff through these trainings.

Table 5.3.4 Pump Operation and Maintenance Course

Training Type	Manager Level	Operator Level
Main Subjects	general characteristics of pumps pump control systems preventive maintenance to study document control pump operation	pump mechanism pump control system maintenance data recording practice pump operation in normal and emergency condition practice pump maintenance and repair
Trainee	Site manager of Portmore M&E Supervisor of Portmore	Operators and mechanics responsible for pump stations
Evaluation	Examination during training course Dispatch of follow-up team, periodically	Examination during training course Dispatch follow-up team to visit Jamaica

Source) JICA Survey Team

Table 5.3.5 Sewer Pipe Maintenance Course

Training Type	Manager Level	Operator Level
Main Subjects	inspection and cleaning procedure sewerage data base (sewerage ledger) system maintenance data processing preventive maintenance maintenance recording document control to practice sewer pipe cleaning using CCTV and water jetting	inspection and cleaning system maintenance data recording to practice inspection using CCTV to practice data processing to practice sewer pipe cleaning using jetting Repair of pipelines lining and coating of pipelines
Trainee	Manager of wastewater Department Sewerage Supervisor	Operators and repair personnel in KSA and Portmore
Evaluation	Examination during training course Dispatch of follow-up team to Jamaica	Examination during training course Dispatch of follow-up team, periodically

Source) JICA Survey Team

CHAPTER 6 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

6.1 Summary

The objective of the review of Environmental and Social Considerations is to ensure appropriate implementation of the project in accordance with the JBIC Guidelines for Confirmation of Environmental and Social Consideration 2002 (hereinafter, JBIC Guidelines).

Main points of Environmental and Social Considerations which are reviewed are shown in Table 6.1.1.

Table 6.1.1 Summary of Environmental & Social Considerations

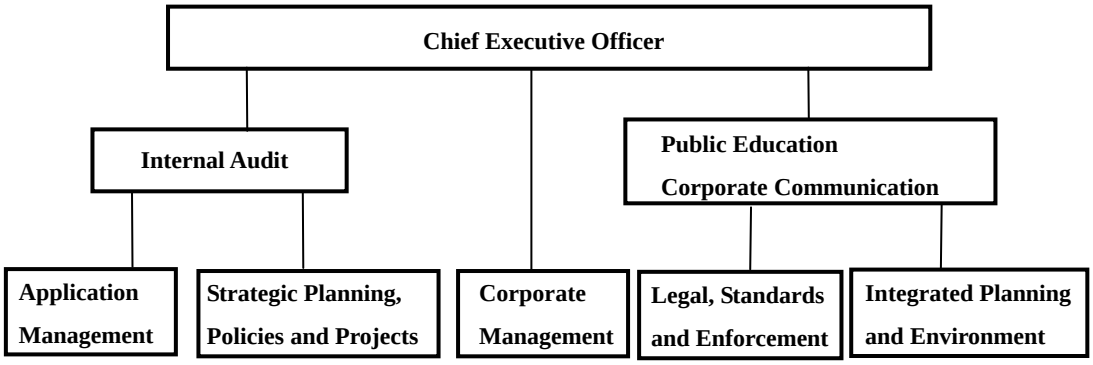
Contents	Remarks
1. EIA	EIA for this project has not been carried out, and "not full EIA" would probably be required for the project, but that it would be possible to make a definitive determination in basic design stage.
2. Existing condition	JICA Survey Team had some discussions with the executing agency, and summarized approval process, environmental laws and regulations.
3. Environmental checklist	Environmental checklist was prepared, in order to grasp the current condition for the project area and the necessary actions such as mitigation and monitoring by executing agency.

Source) JICA Survey Team

6.2 Environmental Laws and Regulations in Jamaica

(1) Organization Chart

The Organization of the National Environment and Planning Agency (hereinafter NEPA), the agency responsible for the Environmental Impact Assessment (hereinafter EIA) approval process, is shown in Figure 6.2.1



Source) JICA Survey Team

Figure 6.2.1 NEPA Organization Chart

(2) Regulations

Various environmental regulations exist related to EIA preparatory and approval process in Jamaica. Basic regulations relevant to the execution of this project are shown as Table 6.2.1. The Natural Resources Conservation Authority (NRCA) Act, Section 9 provides the declaration of Prescribed Areas in which specified activities require a permit for which applicants may be obliged to provide an Environmental Impact Assessment if required by NEPA. In addition to the NRCA Act, the principal laws for controlling environmental and associated issues are shown in Table 6.2.1. A summary of each regulation is provided in Attachment 6.1.

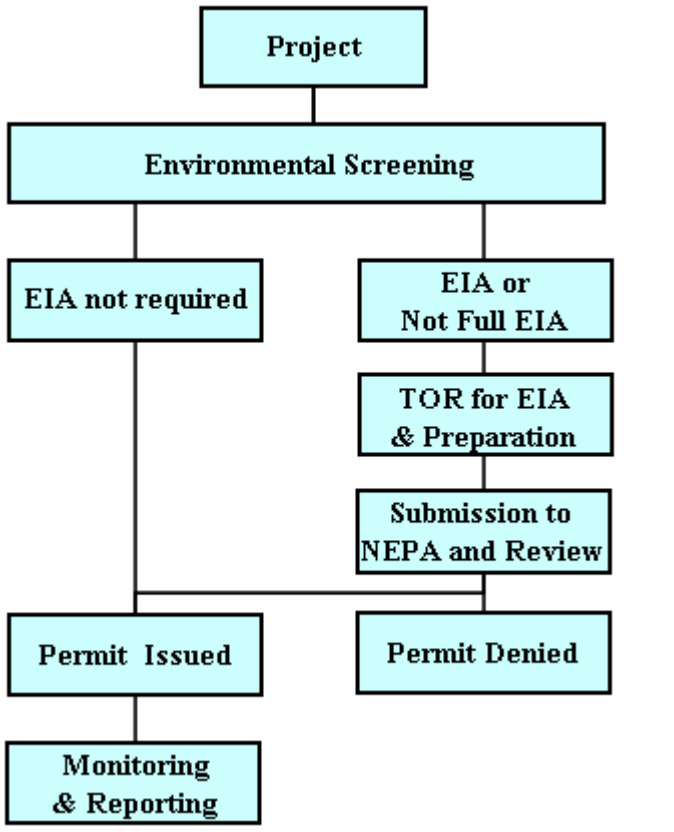
Table 6.2.1 Regulation List

Title	Year
1. Natural Resources Conservation Authority Act (NRCA Act) -> It is basic regulation of the EIA approval	1991
2. The Town and Country Planning Act	1958
3. The Land Development and Utilization Act	1996
4. The Watershed Protection Act	1963
5. The Beach Control Act	1956
6. The Endangered Species (Conservation and Regulation of Trade) Act	2000
7. The Wildlife Protection Act	1975
8. Fishing Industry Act	1976
9. The Forest Act	1995
10. Jamaica National Heritage Trust Act	1985
11. Land Acquisition Act -> 2-11 It is regulation to be associated to the EIA preparation.	1947

Source) JICA Survey Team

(3) Approval Process

The process for EIA screening and approval is shown in Figure 6.2.2.



Source) JICA Survey Team

Figure 6.2.2 NEPA EIA Screening and Approval Process

Main points and summaries for each process are described below.

1) Environmental Screening

Based on Section 10 of the 1991 NRCA Act, an EIA is required before the permission of the project, subject to the category of the project. These categories are defined under Section 38 (1) (b) (see Attachment 6.2). This project is subject to the prescribed categories as “pipelines and conveyors over 10 cm diameter” and “sewage and industrial wastewater facility”.

It is estimated that this screening will take approximately two weeks, and it will be judged if EIA is required or not.

2) TOR for EIA & Preparation

It is not possible to make a definitive determination with regards to the requirement of performance of an EIA. NWC will need to submit the project outline at basic design stage. This part is described to the contents of “EIA” and “Not full EIA” shown as Table 6.2.2.

Table 6.2.2 Comparison of "EIA" and "Not full EIA"

Contents	EIA	Not full EIA
TOR	Needs to be prepared by the consultant and approved by NEPA	Needs to be prepared by the consultant and approved by NEPA
Volume	TOR for EIA Attachment 6.3.	Report Attachment 6.3.
Preparation period (from consultant contract to completion of EIA report)	Three or four months	A few weeks
Submission to NEPA and review period	Approximately two months	Approximately two months
Necessary Application	Checklist, PIF, PIA Attachment 6.4, 6.5, 6.6	Checklist, PIF, PIA Attachment 6.4, 6.5, 6.6
Regulation	NRCA Act	NRCA Act

Source) JICA Survey Team

- EIA

The Terms of Reference (TOR) will define the aspects of an EIA which will provide comprehensive evaluation of the site, in terms of predicted environmental impacts, needed mitigation strategies, potentially viable alternatives to the development proposed and all related legislation. Basically, the TOR for the EIA needs to be prepared by the consultant and approved by NEPA. A draft TOR for the EIA for this project is summarized as Attachment 6.3.

If an EIA is required, it is estimated that three to four months will be required from the consultant contract to the completion of the EIA Report.

- Not full EIA

On the other hand, the TOR for the EIA may be reduced in one of two ways if NEPA decides that a "Not full EIA" is required after the screening process.

- Reduce the scope of the TOR by focusing on only some issues. For example, traffic, dust, noise and public consultation may be focused on, whereas other issues that they consider less important or less relevant may be excluded (biodiversity, ecology, analysis of alternatives, etc.).
- The other way of reducing the scope of the TOR for EIA would be to reduce the depth of analysis of the study. In other words to rely on information already available, a desk study, rather than gather primary information.

Of course a mixture of both ways could also be used. The requirements will depend on the results of the screening exercise and inevitably on the final opinion of NEPA.

It is estimated that the preparation of the "Not full EIA" will only require a few weeks.

3) Submission to NEPA and review

This EIA report will be submitted not only to NEPA but also to other government agencies shown in Table 6.2.3, for review and construction permitting. The outline of EIA report is reviewed by NEPA, and some parts are reviewed in terms of each government agencies, considered to the characteristic of the project, if necessary.

Table 6.2.3 List of Government Agencies

1. Forests Department
2. Fisheries Division
3. Ministry of Health – Public Health
4. Ministry of Health – Environmental Health Unit
5. Water Resource Authority
6. National Works Agency
7. Parish Council

Source) JICA Survey Team

If an EIA (including "Not full EIA") is required, it will require approximately two months to review and obtain approval by NEPA and related organizations.

4) Necessary Application

The application process for both types of EIA managed by NEPA is governed by the permit and license system, which came into effect on 1997. The Permit & License System (P&L) is a mechanism to ensure that all Jamaican facilities, within the prescribed categories, meet required standards in order to minimize negative environmental effects.

i) Checklist (Application for Environmental Permit), see Attachment 6.4

ii) Project Information Form (PIF), see Attachment 6.5

iii) Permit Application (PIA), see Attachment 6.6

(4) Environmental Policy of Jamaica

The environmental policy of Jamaica is embodied in a statement of objectives enunciated in the JANEAP of 1992. These objectives include:

Creating attitudes and behavior which are responsible and oriented to action in environmental protection and the sustainable use of natural resources;

Encouraging the use of non-renewable resources including bauxite, limestone and other minerals for the greatest social and economic benefit of the Jamaican people while minimizing harmful environmental impacts;

Ensuring that renewable resources including forests and wildlife are used in a sustainable manner;

Ensuring good air quality in Jamaica;

Ensuring surface and underground water are in sufficient quantities and quality appropriate for present and future human needs and ecosystem integrity;

Ensuring that urban and rural land is used in the most beneficial and sustainable way;

Providing for the protection and conservation of plants and animal species, particularly endemic species;

Minimizing the impact of natural hazards and environmental hazards on the population, the economy and on natural systems;

Allowing for global environmental co-operation and security with special attention to the needs of developing countries and the circumstances of vulnerable island states;

Enhancing the natural beauty of the island in natural areas, built-up areas, roadways, and open spaces on both public and private land; and

Protecting and preserving the marine environment and territorial waters within the exclusive economic zone.

To the above are now added the following objectives:

Promoting research and development of appropriate technology which are environmentally friendly;

Promoting socio-economic and technical research as it relates to the development and use of the natural resources of the environment;

Promoting the reduction of inefficiency and waste as a method of yielding additional financial resources for environmental management; and

Developing renewable energy sources while seeking to reduce the use of fossil fuels.

It was proposed during 1995 that a National Environmental Policy document will be produced, through a consultative process, to expand upon the above concepts.

Since the UNCED Conference in Brazil and the elaboration of Agenda 21, official policy on the environment now explicitly articulates the linking of environment with the development process to ensure that national development takes place in a sustainable manner. In addition, the present national review of the Constitution of Jamaica has accepted in principle that the constitution should address environmental conservation and preservation of ecosystem integrity. Consequently, it is expected that a statement will be framed within the new Jamaican constitution to reflect this.

6.3 Review of EIA through JBIC Guidelines

The JICA Survey Team confirmed Environmental and Social Considerations stated in the JBIC Guidelines in the following ways:

1) Confirmation of environmental laws and standards, of the host national and local governments concerned, whether it confirms to their environmental policies and plans, refer to “Section 6.2 Environmental Laws and Regulations in Jamaica”; and

2) Confirmation of good governance with regard to projects for appropriate Environmental and Social Considerations.

Main points of this review for EIA through JBIC Guidelines are as follows. These contents are included in the actual EIA report in Jamaica, referred to ”(2) Review of Existing Condition and Actual Results (Page 6-7)”, and confirm to be descried to the TOR for EIA, referred to “Section 6.2 Environmental Laws and Regulations in Jamaica (2) Approval Process (Page 6-2)”.

Executive summary;

Policy, legal and administrative framework;

Project description;

Baseline data: Existing of Environmental and Social Considerations for project area;

Environmental impact assessment (EIA);

Analysis of alternatives;

Environmental management plan (EMP): Measurement of mitigation and monitoring; and

Consultation.

However, the EIA for this project has not been carried out. The JICA Survey Team had some discussions with NEPA and executing agency (NWC) to confirm the existing condition, and its understanding is as follows

1) NEPA stated that “Not full EIA” would probably be required for the project, but that it would not be possible to make a definitive determination in the beginning of basic design stage for this project.
2) Once the project scope is finalized, NWC should submit the project details to NEPA, in accordance with the Permit Application Form and Project Information Form checklist.
3) NEPA will conduct the screening of the documents on the above, and make a determination if an EIA is required. It is estimated that this screening will take approximately two weeks.
4) If EIA is required, NEPA and NWC estimate that EIA preparation will require three to four months, and that the EIA review and approval by NEPA and related organizations will require approximately two months.

On the other hand, an environmental checklist for this project was prepared in line with the JBIC Guidelines, in order to study the current condition for the project area and the necessary actions such as mitigation and monitoring by NWC. The preparation process for the environmental checklist is as follows:

1) Outline of the Project
2) Review of Existing Condition and Actual Results
3) Preparation of the Environmental Checklist

(1) Outline of the Project

In accordance with the information presented in Chapter 3 of this report, the JICA Survey Team basically recognizes the terms of the Environmental and Social Considerations of this project as follows:

1) No possibility of resettlement and land acquisition affected by the project;
2) Expectation of environmental improvement in Portmore area by approximate collection of sewer; and
3) Expectation of water quality improvement in Kingston Harbour by sewage treatment in Soapberry STP.

(2) Review of Existing Condition and Actual Results

During process on the above, the Survey team classified each project in terms of its potential environmental impact, taking into account such issues as:

1) Existing condition of the project site and surrounding areas

The existing conditions for each project area are described in Section 2.2, summarized as follows.

Sewage treatment plants: The existing sewerage system in KSA currently serves approximately 30% of the population and most of the larger industrial discharges, and there are small independent systems. Four sewage treatment plants are located in Portmore area. These facilities are in disrepair, and none are operating satisfactorily, much less optimally.

Pump stations in Portmore: There are 18 existing sewage pump stations. However, the pump stations were in poor condition with regard to the supporting infrastructure. Operationally, the wet wells were generally unkempt, with accumulated trash and debris observed.

Sewer pipelines: Current sewer network is mainly developed in Downtown, Harbour View, Duhaney Park and almost all Portmore area.

Water quality: Influent and effluent qualities of the Soapberry STP are presented in Table 2.2.6 and Table 2.2.7, respectively.

2) Actual results of EIA

Actual results of EIA in this project area are as follows. For more details please refer to Attachments 6.7 and 6.8

Soapberry Wastewater Treatment Plant (Ashtrom Building Systems, December 2004)

The National Water Commission (NWC) proposed to construct a 225,000m^3/day wastewater treatment plant in Soapberry located north of Hunt Bay on the southeastern St. Catherine coast. Old dilapidated small plants have long been unable to meet treatment requirements, and discharge of poorly treated effluent to Kingston Harbour has been a major contributor to the ecological deterioration of this major environmental asset.

> The proposed facility will receive the sewerage produced from sewered areas of Kingston and will have the highly beneficial effect of stopping the pollution of Kingston Harbour with untreated sewage. The nature of the proposed system will prevent the production of odours and sludge thus making the facility of little nuisance to the surrounding communities.

Kingston Harbour Environmental Project Final Phase II Report (National Water Commission Jamaica, West Indies, December 1993)

This EIA report included following aspects.

Summary of the proposed sewerage project and the alternatives considered;

Description of the existing Kingston Harbour environment, including relevant physical, biological and legal-administrative factors;

Discussion of significant project benefits and impacts, including analysis of various effluent disposal alternatives;

Proposed impact mitigation measures; and

Recommended environmental monitoring programs.

3) Resettlement

There will be no resettlement and no land acquisition. The only new ground structure necessary is for the pipe bridge of about 400 meters between Caymanas Gardens and Soapberry Waste Water Treatment Plant on open land that is presently owned by the Government of Jamaica. No squatters live there either.

Figure 6.3.1 Site Condition for Pipe Bridge between Caymanas and Soapberry STP

4) Living and livelihood

Almost all the households in the Portmore area are in housing schemes, connected to the sewage system already and paying water bills including sewage bills. Almost all the households of the North Kingston target area, on the other hand, are not connected to the sewage system yet, using soak-away and not paying sewage bills. Most households in North Kingston side need to connect from the main pipes to houses and start paying the sewage

bills. The construction cost for individual connection could be more than JMD 100,000. Also JICA Survey Team found that close to 40% of the respondents to the questionnaire survey in Lot-A (Pembroke Hall), Lot-B (Havendale) and Lot-C (Birdsucker) are pensioners, more than 20% of the heads of the households in Lot-A and Lot-B are over 75 years old and more than 50% are female headed in Lot-C. NWC may elect to exempt senior-headed, female-headed and poor households from immediate connection and to defer until the registration of transfers, also to include subsidies and the installment plan for the individual connection cost. Compulsory sewerage bills for the socially vulnerable, who cannot bear the connection cost, could become a burden too. Exemption of sewerage bills need to be considered for them.

During the citizens' associations meetings and by the responses in the questionnaire survey, many people say this is a good project. At the same time, however, they worry about the cost and lack of information. There are few residents who say the project is not necessary because they don't have any problems with their soakaways. They do not recognize the seriousness of contamination of the ground water and then the Kingston Harbour. Therefore, whether EIA is required or not, full explanation of the project outline, rationale, benefits and the cost is indispensable especially on North Kingston side. JICA Survey Team recommends having one explanation meeting for Portmore and two explanation meetings for North Kingston at the early stage. The team also recommends having two public consultation meetings in Portmore and four public consultation meetings in North Kingston if EIA is required. Squatters who are not paying water bills are not targeted by this project, however, public lavatories might need to be considered if there is a public hygiene problem.

Another slight concern is for laying a main pipe along the gully of Waterhouse, a socially sensitive area. To avoid any conflicts with the living and livelihood of the residents, it needs to be carefully addressed.

(3) Preparation of Environmental Checklist

An environmental checklist prepared in accordance with JBIC Guidelines is shown in Table 6.3.1, referred to information from Jamaica's EIA report, (1) Existing condition of the project site and surrounding areas and (2) Actual results on the above.

Table 6.3.1 Environmental Checklist: Sewage and Wastewater Treatment 1/5

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	1. Have EIA reports been officially completed? 2. Have EIA reports been approved by authorities of the host country's government? 3. Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? 4. In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	1. No, the Executing Agency (NWC) has not officially started the EIA process. It is their opinion, confirmed in meetings with the National Environmental Planning Agency (NEPA), that a not full EIA would be required. NWC has been requested to prepare the EIA report, if necessary. 2. No, EIA reports have not been approved. Approval authority (NEPA) has reserved judgement on whether or not an EIA would be required until screening process is done. 3. No, it will be judged from the screening process and reviewed by NEPA if the EIA reports are unconditionally approved or not. The executive agency (NWC) has not started the EIA process officially, and it will take approximately 6 months for the EIA approval process. 4. No other permits are required because only rehabilitation works at pumping stations and piping under the road are envisaged. No building or construction permits are required.
	(2) Explanation to the Public	1. Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? 2. Are proper responses made to comments from the public and regulatory authorities?	Public meetings have been held with the communities to be included in the project as part of the JICA study. These meetings have focused on making an initial introduction of the project to local community leaders and the public at large. The reception has been generally positive. If an EIA is required then two public meetings would be required (Portmore & Kingston). NWC would be required to conduct additional meetings to explain to the public the costs and benefits of the project, independent of whether an EIA is required, since an informed public would have a better understanding of the goals and eventual positive impacts of the project.
2 Mitigation Measures	(1) Water Quality	Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards?	The existing small, local sewerage treatment plants which are projected to be taken out of service as part of the Kingston Sewerage Development Project (KSDP) do NOT comply with the national standards. The Soapberry Sewerage Treatment Plant, at which the KDSP wastewater will be treated, does comply with national standards. The existing sewerage treatment plants at best only partially treat sewage, resulting in pollution of nearby water bodies (Rio Cobre, Hunts Bay and Kingston Harbour). This project will be improved collection and treatment of sewage within the project areas. It will also result in the decommissioning of non-functional plants and transmission of sewage for proper treatment at the Soapberry plant. The result will be that the treated sewage effluent conforms to national standards and does not result in pollution of water bodies.

Table 6.3.1 Environmental Checklist: Sewage and Wastewater Treatment 2/5

2 Mitigation Measures	(2) Wastes	Are wastes, such as sludges generated by the facility operations properly treated and disposed of in accordance with the country's standards?	No wastes are generated in the operation stage, but construction spoils are expected to be produced. Pollution may result from the improper disposal of solid wastes produced from construction activities. NWC would be required their Contractors to properly dispose solid wastes generated by construction activities in the nearest landfill (Riverton City Landfill). The result would be that solid waste generated by the project is disposed with regards to national standards.
	(3) Soil Contamination	If wastes, such as sludges are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	No heavy metals or industrial wastes are expected. Only domestic sewage will be discharged to the system.
	(4) Noise and Vibration	Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	Noise and vibrations are generated by outdated mechanical treatment plants that are very noisy when they operate and do not comply with national standards. This results in nuisance noises for neighbours and potential hearing loss by NWC Staff. Communities now complain about the noise from these plants. This project is to decomission the noisy sewage treatment plants and transform them into pumping stations. The new pumping stations should be designed and constructed to conform to national noise standards which indicates for construction activities, which would be most pertinent to the project the noise should not exceed 75dB(A): NRCA Act.
	(5) Odor	Are adequate control measures taken for odor sources, such as sludge treatment facilities?	At present no adequate odour control measures are taken. Outdated mechanical treatment plants that break down frequently produce very foul odours resulting in nuisance and health hazard to surrounding communities. Community members complain about foul odours at present. This project is included in decommission existing sewage treatment plants and implement an efficient collection system transferring sewage to Soapberry for proper treatment and disposal. This would result in no foul odours being emitted from the sewage treatment facilities.
3 Natural Environment	(1) Protected Areas	Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	It is not located in any protected areas.

Table 6.3.1 Environmental Checklist: Sewage and Wastewater Treatment 3/5

3 Natural Environment	(2) Ecosystem	1. Does the project site and discharge area encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? 2. Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? 3. If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? 4. Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	1. The project site and discharge area do NOT encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g. coral reefs, mangroves, or tidal flats). 2. The project site does NOT encompass the protected habitats of endangered species designated by country's laws or international treaties and conventions. 3. An overall net positive impact is expected. Significant negative impacts identified during project feasibility and design stage is in the impact and mitigation document. 4. Clean up of Hunts Bay and Kingston Harbour is the net effect of proper sewering and proper sewage treatment. Discharge to Rio Cobre river dilutes pollution that now exists in the estuary.
4 Social Environment	(1) Resettlement	1. Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? 2. Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? 3. Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? 4. Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? 5. Are agreements with the affected persons obtained prior to resettlement? 6. Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? 7. Is a plan developed to monitor the impacts of resettlement?	No involuntary resettlement will be caused by project. Land Acquisition is not necessary. Project sites are presently owned by either NWC or the Government of Jamaica. Therefore, no resettlement plans are required. Also there is no need to establish an administrative structure or budget to implement resettlement.
	(2) Living and Livelihood	1. Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? 2. Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	Land use and water use will NOT be altered. No, there is no sewerage rates paid at present. However, the improved sewerage system will increase costs to householders (monthly sewage charges and connection charges). NWC would be requested to prepare a financial incentive programme for customers including marginalised groupings (female headed households, pensioners, households below the poverty line). This would result in a reduced impact on living conditions for customers including marginal groups.

Table 6.3.1 Environmental Checklist: Sewage and Wastewater Treatment 4/5

4 Social Environment	(3) Heritage	Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	There are NO archaeological, historical, cultural, or religious heritage sites declared under the Jamaica National Heritage Trust Act within the project sites. However, there is a possibility that artifacts may be unearthed during construction. If artifacts are found, they should be turned over to JNHT and construction stopped until the JNHT has conducted further investigations and advised the NWC as how to proceed. This would result in the protection of archaeological, historical and cultural artifacts.
	(4) Landscape	Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	The project is located at urban already altered sites. There should be NO permanent change in landscape features
	(5) Ethnic Minorities and Indigenous Peoples	1. Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? 2. Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	There are no ethnic minorities or indigenous peoples to be affected in the project areas. Only one set of indigenous peoples exists in Jamaica (the Maroons), but their settlements are in the mountainous interior of the island. There is no expected impact on ethnic minorities and indigenous peoples.
5 Others	(1) Impacts during Construction	1. Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? 2. If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? 3. If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? 4. If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	1. Adequate measures are not yet prepared. Negative environmental impacts identified on water quality, Wastes, Soil Contamination, Noise and Vibration and Odour due to construction activities. Such items should be prepared by the NWC as part of the EIA report, if necessary. Even if it is determined that an EIA is not required, adequate mitigation measures should be included in the Terms of Reference for the contractors to be employed for the construction of the planned works. 2. Adequate measures identified in the EIA report and environmental Permit implemented by the NWC to mitigate negative environmental impacts on water quality, wastes, soil contamination, noise and vibration, and odour would result in construction activities that will not affect the natural environment (ecosystem) 3. Adequate measures have not been considered as yet. Traffic congestion is the main negative social impact. NWC would be requested to prepare an EIA report, which includes social impact, if necessary and that would include mitigation efforts. Traffic management plan is required. Consideration of micro- 4. Not as yet. Stringent Health & Safety legislation does not exist.

Table 6.3.1 Environmental Checklist: Sewage and Wastewater Treatment 5/5

5 Others	(2) Monitoring	1. Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? 2. Are the items, methods and frequencies included in the monitoring program judged to be appropriate? 3. Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? 4. Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	1. No, monitoring program isn't prepared as yet. If there is no monitoring programme for negative environmental impacts and mitigation measures not done it may result in environmental damage. NWC would be requested to prepare and implement the monitoring programme. 2. No, the items, methods and frequencies aren't judged as yet. This may allow ineffective monitoring. NWC woould be requested to prepare monitoring programme which would include details of methods to be used and frequency of monitoring. 3. Yes, an adequate monitoring framework exists at the NWC (laboratory tests and quality monitoring of potable water and sewage treatment plants across the island). It is unclear if these resources would be given to the project but assumed to be so. The monitoring framework needs to be established otherwise monitoring is ineffective and may result in environmental damage. NWC would be requested to prepare monitoring programme which would include the framework necessary to carry out an effective monitoring programme. 4. No. Existing Laws do not require monitoring except that determined through
6 Note	Note on Using Environmental Checklist	① If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	There are no trans-boundary or global issues to be caused by the project.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience)
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of t country and locality in which it is located.

6.4 Measurement of Mitigation for Expected Environmental and Social Impacts

Proposed environmental and social impacts, measurement of mitigation during the construction and operation and maintenance phases of the project are shown in Table 6.4.1 and 6.4.2 based on the Field survey and environmental checklist.

Table 6.4.1 Environmental and Social Impacts

Contents	Detail
1) CONSTRUCTION IMPACTS	
1. Soil and Water Pollution	It is relatively minor.
2. Noise and Dust	Certain levels are unavoidable in the vicinity of construction sites.
3. Disposal of Surplus Materials	Surplus soil material will need to be sent to the municipal landfill.
4. Traffic congestion	It will generally be confined to increased journey time and the costs associated with delays, which in the majority of cases will only be of minor inconvenience.
2) OPERATIONAL IMPACTS	
1. Water and Sewage Overflows	Sewage pipelines lay at a suitable depth should be largely trouble free.
2. Soil and Water Pollution	With all facilities will quickly contaminate the surrounding soils, nearby water courses and ultimately near-shore environments.
3. Noise and Vibration	Noise and vibration from the sewage pumping stations will be minimal.
4. Odour	An effective and efficient treatment stream will emit little or no odour.

Table 6.4.2 Environmental and Social Measurement of Mitigation

Contents	Detail
1) CONSTRUCTION IMPACTS MITIGATION: Contractor	
1. Soil and Water Pollution	The contractor shall comply with all applicable regulations concerning the control and abatement of water pollution.
2. Noise and Dust	The contractor shall ensure all his equipment is fitted with appropriate noise muffling devices.
3. Disposal of Surplus Materials	The disposal of all surplus materials shall be carried out in accordance with the regulations by the contractor.
4. Traffic congestion	The Contractor shall incorporate in his proposed arrangements for traffic diversions in the form of a Traffic Management Plan. It shall also contain details of the timing of the proposed closure, dates of closing and re-opening the route, and of any necessary remedial works.
2) OPERATIONAL IMPACTS MITIGATION: NWC	
1. Water and Sewage Overflows	The expeditious repair of pipe breakages and the maintenance of pumping stations by NWC will mitigate actual and potential sewage overflows.
2. Soil and Water Pollution	In readiness for incidents NWC should develop an Emergency Response Procedure.
3. Noise and Vibration	It will be mitigated through adherence to a program of preventive maintenance and the expeditious response to emergencies by NWC.
4. Odour	The most effective means is to maintain pipelines, pumping stations and the treatment plant in good order and ensure efficient operation by NWC.

Source) JICA Survey Team

Measurement of mitigation needs to be carried out by the contractor in accordance with the construction impact, and NWC regarding to the potential permanent impacts and operational impacts.

6.5 Monitoring Plan

This section presents the proposed environmental monitoring plan. After defining the standards against which environmental performance will be assessed the details of the monitoring to be undertaken and how it will be reported is defined. This summary is shown in Table 6.5.1, and environmental monitoring checklist is shown in Attachment 6.9.

Monitoring plan needs to be carried out by the contractor during construction stage under the management of NWC.

Table 6.5.1 Environmental Monitoring Plan

Contents	Detail
1) CONSTRUCTION MONITORING: Contractor	
1. Soil and Water Pollution	The Construction will monitor the monthly consumption of materials including aggregates, hazardous materials, fuel, water and electricity, the disposal of surplus earth materials and other solid and liquid wastes, referred to the environmental monitoring checklist. The monitoring of Health and Safety shall include but not be limited to Health & Safety signage, the availability and use of protective headgear, footwear and other clothing, the occurrence of accidents and the potential for accidents in relation to general site condition.
2. Noise and Dust	
3. Disposal of Surplus Materials	
4. Traffic congestion	
2) OPERATIONAL MONITORING: NWC	
1. Water and Sewage Overflows	Operational monitoring to check the continued sustainability of project performance will be the responsibility of NWC and include the following: - The performance of the sewage pumping stations; - Recording of the amounts of sewage being pumped to Soapberry treatment plant; - The visual inspection of sewers at manholes. Routine sewage flow measurements will be undertaken to monitor leakage and to compare sewage generation with design expectations.
2. Soil and Water Pollution	
3. Noise and Vibration	
4. Odour	

Source) JICA Survey Team

6.6 Conclusion

This project is considered to be appropriate in terms of Environmental and Social Considerations by Survey Team. While some slight negative impacts are anticipated during project implementation, positive impacts are also foreseen which would contribute to improvement of public health and sanitation, water quality in Kingston Harbor. The long-term positive impacts prevail significantly over the potential short-term negative impacts.

CHAPTER 7 FINANCIAL AND ECONOMIC ANYLYSIS

7.1 Financial Analysis

7.1.1 Methodology

This financial analysis aims at evaluating the project's profitability from viewpoint of the executing agency (NWC). The cost-benefit analysis on a with- and without-project basis will be performed by applying the discounted cash flow method at the financial values. The project's profitability is evaluated by calculating the financial internal rate of return (FIRR), which is a discount rate at which the present value of two cash flows, i.e. benefit and cost, becomes equal, as defined in the following equation:

$$\sum_{t=0}^{n} C_t /(1+r)^t - \sum_{t=0}^{n} B_t /(1+r)^t = 0$$

Where;

Ct : Cost

Bt : Benefit

t : Year

n : Project Life (Year)

r : Discount Rate (= EIRR)

The project's debt service capacity will also be evaluated by calculating the debt service coverage ratio (DSCR) over the project life.

7.1.2 Basic Assumptions

The following basic assumptions are adopted in the analysis with reference to technical discretion by the study team, the project implementation plan and the results of discussions with NWC.

(1) Project Life

The project life for the analysis is 35 years; i.e. 30 years of operational life of constructed facilities with a five-year construction period.

(2) Cost Estimate

Estimation of costs is based on the price level of 2009. The cost of existing facilities constructed before the project is considered as sunk cost and excluded from the analysis. It is assumed that the project is exempt from GCT, Import Tax and VAT.

(3) Price Escalation

Price escalation is not considered in the analysis; economic values are expressed in constant price.

(4) Interest during Construction

Interest during construction is excluded from the calculation since the analysis aims at calculation of the project IRR of total capital used.

7.1.3 Financial Benefits

(1) Tariff Revenue

Financial benefit of the project is identified as the sewerage tariff revenue increased by the expansion of the service area. However, since the Portmore project component does not include an expansion of the sewerage service area, the analysis merely on a with- and without-project basis cannot include the revenue stream in the area as compared to significant investment therein. Therefore, the tariff revenue in Portmore is recognized as financial benefit in this analysis while the cost of the wastewater treatment at the Soapberry STP is included in the financial costs.

(2) Applicable Sewerage Tariff

According to the NWC tariff table approved by OUR in April 2008, sewerage tariff is set as 100% of water supply tariff. Base water supply tariff is revised yearly and monthly adjustment for fluctuations in exchange rate, electricity cost and consumer prices is made through Price Adjustment Mechanism (PAM). X-Factor and K-Factor are factors determined yearly. Based on the factors determined for PAM and base water rates revised for FY2009/10, the water rates applicable to the project are calculated as shown Table 7.1.1. Financial benefit of the project will be calculated based on these tariffs and the water consumption projection of connected consumers.

Table 7.1.1 Water Supply Tariff Calculation

Price Adjustment Mechanism (PAM) factor

Components	Base (Apr 2009)	Weight	Jul 2009			
			Indices	Change from Base	x Weight	Total PAM
Foreign Exchange Rate (JMD/US	88.06	*0.280*	89.05	*0.0112*	*0.31%*	***10.34%***
Electricity Rate (JMD/kWh)	15.97	*0.252*	20.98	*0.3137*	*7.91%*	
Consumer Price Index (CPI)	137.1	*0.468*	143.3	*0.0452*	*2.12%*	

July 2009 Water Tariffs

Domestic Water Rates (JMD/m3	Base Rate (Apr 2009)	PAM (Jul 2009)	Water Rate (Jul 2009)	K-Factor (FY2009/10)	X-Factor (FY2009/10)	Total Tariff (Jul 2009)
(1) Up to First 14m^3	49.63	*10.34%*	54.76	*5%*	*14%*	**59.31**
(2) Up to Next 13m^3	87.51	*10.34%*	96.56	*5%*	*14%*	**104.57**
(3) Up to Next 14m^3	94.50	*10.34%*	104.27	*5%*	*14%*	**112.92**

Source: JICA Survey Team based on NWC information

7.1.4 Financial Costs

(1) Initial Investment Cost (Construction Cost)

Table 7.1.2 shows the initial investment (construction cost) by major component distributed across the construction horizon. The costs are based on the cost estimation presented in Chapter 5. Total construction cost is calculated as JMD9,593 million.

Table 7.1.2 Initial Investment Cost

(JMD million)

Description	1st Year		2nd Year		3rd Year		4th Year		5th Year		Total		
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	Total
I. Construction Cost													
Package 1: Portmore Sewerage	0	0	0	0	0	0	886	250	886	250	1,772	501	2,273
Package 2: Sewerage Project in North Kingston Area	0	0	0	0	0	0	1,617	1,100	1,617	1,100	3,233	2,200	5,433
Package 3: Procurement for Sewerage Project	0	0	0	0	0	0	0	0	91	0	91	0	91
Total Base Cost	0	0	0	0	0	0	2,502	1,350	2,594	1,350	5,096	2,700	7,797
Physical Contingency (5%)	0	0	0	0	0	0	125	68	130	68	255	135	390
Total Construction Cost	**0**	**0**	**0**	**0**	**0**	**0**	**2,628**	**1,418**	**2,724**	**1,418**	**5,351**	**2,835**	**8,186**
II. Consulting Services													
Base Cost	55	35	192	95	139	84	92	76	155	96	633	387	1,020
Physical Contingency (5%)	3	2	10	5	7	4	5	4	8	5	32	19	51
Total Construction Cost	**58**	**37**	**201**	**100**	**146**	**88**	**96**	**80**	**163**	**101**	**665**	**406**	**1,071**
III. Administration Cost													
Administration Cost	**0**	**3**	**0**	**11**	**0**	**8**	**0**	**153**	**0**	**160**	**0**	**335**	**335**
TOTAL (I to III)	**58**	**40**	**201**	**111**	**146**	**97**	**2,724**	**1,650**	**2,887**	**1,678**	**6,016**	**3,577**	**9,593**
TOTAL (FC + LC)	**98**		**312**		**243**		**4,374**		**4,565**		**9,593**		

Source: JICA Survey Team

(2) Reinvestment for Replacement

Within the initial investment cost, several items are categorized in electro-mechanical equipment whose economic life is assumed as twenty years. Reinvestment for the replacement of this equipment is assumed at twenty years after commissioning. Reinvestment requirement is estimated as per Table 7.1.3.

Table 7.1.3 Reinvestment Requirement

(JMD million)

Description	Electro-Mechanical Equipment			Remarks
	FC	LC	Total	
Package 1: Portmore Sewerage	989	0	989	
1. Gravity Pipes	0	0	0	Civil works
2. Convey to Soapberry STP	0	0	0	Civil works
3. Replacement / Demolishion of Pumping Stations	989	0	989	
(1) Bridgeport *	0	0	0	Only demolishing works for existing facilities
(2) Hamilton Gardens	20	0	20	
(3) Independence City *	0	0	0	Only demolishing works for existing facilities
(4) Caymanas Gardens	839	0	839	
(5) Modified Existing Pump Stations	130	0	130	
Package 2: Sewerage Project in North Kingston Area	0	0	0	Civil works
Package 3: Procurement for Sewerage Project	91	0	91	
Total Base Cost	**1,080**	**0**	**1,080**	
Physical Contingency (5%)	54	0	54	
Total Construction Cost = Reinvestment Requirem	**1,134**	**0**	**1,134**	

Source: JICA Survey Team

(3) Operation and Maintenance Cost

Operation and maintenance cost (O&M cost) for the facilities constructed in the project is estimated based on the NWC budget and number of employees designated to wastewater operations (See Table 7.1.4). Assuming 15 employees will engage the operation and maintenance of the project facilities, the annual O&M cost is estimated as JMD83.1 million per year.

Table 7.1.4 Annual Operation and Maintenance Cost

(JMD million)

	2009/10 Wastewater Budget	Unit Cost per Employee (150 Employees)	O&M Cost for the Project (15 Employees)
Employment Cost	231.40	1.54	23.14
Electricity	257.60	1.72	25.76
Maintenance	37.10	0.25	3.71
Operation	28.30	0.19	2.83
Administration	276.57	1.84	27.66
Total	830.97	5.54	83.10

Source: JICA Survey Team

While additional O&M resources are required for the new facilities, the project improvements for the Portmore area are calculated to decrease the energy consumption due to a decrease in the number and size of pumping stations, as well as a reduction in the energy cost for the existing STP's which will be removed from service. The total energy savings is estimated to be JMD0.2 million per year. Considering this savings from the Portmore operations, the adjusted annual cost for O&M is JMD76.4 million per year.

(4) Operational Cost of Soapberry STP

Since the wastewater treatment tariff at the Soapberry STP is yet to be decided by the OUR, the operational cost is estimated based on the existing information provided by NWC. As of April 2008 the annual cost of Soapberry STP was estimated at JMD840 million. Converted with exchange rates as of April 2008 (JMD70.23/USD) and July 2009 (JMD89.05/USD), as well as with the treatment capacity (82,000 m^3/day), the current unit cost per wastewater inflow is estimated as JMD35.59/m^3.

7.1.5 Population, Sewerage Connections and Wastewater Inflow Projection

In accordance with the engineering planning of the project, population, sewerage connection and wastewater growth projections shown in Table 7.1.5 are used for the analysis. Population growth rates applied in the analysis are 0.9% p.a. for North Kingston Area and 2.0% p.a. for Portmore.

Table 7.1.5 Population, Sewerage Connection and Wastewater Inflow Projection

	Area	2015	2020	2025	2030 -	Remarks
Population	**KSA**	58,200	60,900	63,600	66,600	Sewerage Connection Households
(No. of Population)	**Portmore**	107,300	118,400	130,900	144,500	
Sewerage Connections	**KSA**	9,560	9,560	9,560	9,560	For water rate revenue estimation
(No. of Sewered Households)	**Portmore**	26,825	29,600	32,725	36,125	
Wastewater Inflow	**KSA**	14,700	15,400	16,100	16,800	For Soapberry TP cost estimation
(m^3/day)	**Portmore**	21,500	24,000	26,700	29,800	
Daily Water Use per Capita (ldp)	-	178.2	180.1	182	183.9	

Source: JICA Survey Team

7.1.6 Financing Plan

It is assumed that Japanese ODA Loan finances 85% of the project cost. According to discussion with NWC, the counterpart funding will be supplied by NWC directly or via a

grant from Government of Jamaica. Outside financing is not assumed. The ODA Loan is on-lent to NWC, with the same conditions as the prime ODA Loan.

As for the ODA Loan, the General Terms (1.40% p.a. interest rate) applicable for Jamaica are primarily assumed for the project. The case applying Preferential Terms (0.65% p.a.) is also considered in the analysis. The conditions of the terms are presented in Table 7.1.6.

Table 7.1.6 ODA Loan Conditions for Jamaica (as of April 2009, Standard Options)

Terms	Interest Rate	Repayment Period	Incl. Grace Period	Procurement
General Terms	1.40% p.a.	25 years	7 years	Untied
Preferential Terms	0.65% p.a.	40 years	10 years	Untied

Source: JICA Website

7.1.7 Calculation of FIRR

Table 7.1.7 shows the summary of the FIRR calculation based on the assumptions presented above. FIRR is calculated as 0.71%, showing the project's low profitability due to the heavy investment cost. The project is deemed financially not feasible.

Table 7.1.7 FIRR Calculation

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Cost																			
Initial Investment Cost (JMD million)	98.4	312.4	242.7	4,374.2	4,565.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reinvestment for Replacement (JMD million)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operation and Maintenance (JMD million)	0.0	0.0	0.0	0.0	0.0	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4
Soapberry STP Cost (JMD million)	0.0	0.0	0.0	0.0	0.0	478.5	486.8	495.1	503.5	511.8	520.1	528.4	536.7	545.0	555.9	561.6	570.0	578.3	586.6
Total Cost (JMD million)	98.4	312.4	242.7	4,374.2	4,565.0	554.9	563.3	571.6	579.9	588.2	596.5	604.8	613.1	621.4	632.4	638.1	646.4	654.7	663.0
Benefit																			
Water demand per capita (lpd)	176.7	177.1	177.4	177.8	178.2	178.6	179.0	179.3	179.7	180.1	180.5	180.9	181.2	181.6	182.0	182.4	182.8	183.1	183.5
North Kingston Area																			
Water use per household (m3/month) (6.09 persons/HH)	0.0	0.0	0.0	0.0	0.0	32.6	32.7	32.8	32.8	32.9	33.0	33.0	33.1	33.2	33.2	33.3	33.4	33.4	33.5
Monthly water tariff rate for up to 14m3 (JMD/HH) (JMD59.31/m3)	0.0	0.0	0.0	0.0	0.0	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3
Monthly water tariff rate for next 13m3 (JMD/HH) (JMD104.57/m3)	0.0	0.0	0.0	0.0	0.0	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4
Monthly water tariff rate for next 14m3 (JMD/HH) (JMD112.92/m3)	0.0	0.0	0.0	0.0	0.0	634.1	641.9	649.7	657.6	665.4	673.3	681.1	688.9	696.8	704.6	712.4	720.3	728.1	736.0
Monthly water tariff per household (JMD/month)	0.0	0.0	0.0	0.0	0.0	2,823.8	2,831.6	2,839.4	2,847.3	2,855.1	2,862.9	2,870.8	2,878.6	2,886.5	2,894.3	2,902.1	2,910.0	2,917.8	2,925.6
Number of connected households	0	0	0	0	9,560	9,651	9,743	9,834	9,926	10,017	10,103	10,190	10,276	10,363	10,449	10,551	10,653	10,755	10,857
Yearly total water tariff revenue (JMD million)	0.0	0.0	0.0	0.0	0.0	327.0	331.1	335.1	339.1	343.2	347.1	351.0	355.0	358.9	362.9	367.4	372.0	376.6	381.2
Portmore Area																			
Water use per household (m3/month) (4.0 persons/HH)	0.0	0.0	0.0	0.0	0.0	21.4	21.5	21.5	21.6	21.6	21.7	21.7	21.7	21.8	21.8	21.9	21.9	22.0	22.0
Monthly water tariff rate for up to 14m3 (JMD/HH) (JMD59.31/m3)	0.0	0.0	0.0	0.0	0.0	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3
Monthly water tariff rate for next 13m3 (JMD/HH) (JMD104.57/m3)	0.0	0.0	0.0	0.0	0.0	776.9	781.7	786.4	791.2	796.0	800.8	805.5	810.3	815.1	819.8	824.6	829.4	834.1	838.9
Monthly water tariff per household (JMD/month)	0.0	0.0	0.0	0.0	0.0	1,607.2	1,612.0	1,616.7	1,621.5	1,626.3	1,631.0	1,635.8	1,640.6	1,645.3	1,650.1	1,654.9	1,659.6	1,664.4	1,669.2
Number of connected households	0	0	0	0	26,825	27,380	27,935	28,490	29,045	29,600	30,225	30,850	31,475	32,100	32,725	33,405	34,085	34,765	35,445
Yearly total water tariff revenue (JMD million)	0.0	0.0	0.0	0.0	0.0	528.1	540.4	552.7	565.2	577.6	591.6	605.6	619.6	633.8	648.0	663.4	678.8	694.4	710.0
Total Benefit (JMD million)	0.0	0.0	0.0	0.0	0.0	855.1	871.4	887.8	904.3	920.8	938.7	956.6	974.6	992.7	1,010.9	1,030.8	1,050.8	1,070.9	1,091.1
Net Benefit (JMD million)	-98.4	-312.4	-242.7	-4,374.2	-4,565.0	300.1	308.2	316.2	324.4	332.6	342.2	351.8	361.5	371.3	378.5	392.7	404.4	416.2	428.1

Year	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Total
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	
Cost																	
Initial Investment Cost (JMD million)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9,592.7
Reinvestment for Replacement (JMD million)	0.0	0.0	0.0	0.0	0.0	1,134.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,134.2
Operation and Maintenance (JMD million)	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	2,292.9
Soapberry STP Cost (JMD million)	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	605.3	17,142.9
Total Cost (JMD million)	681.7	681.7	681.7	681.7	681.7	1,815.9	681.7	681.7	681.7	681.7	681.7	681.7	681.7	681.7	681.7	681.7	30,162.7
Benefit																	
Water demand per capita (lpd)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
North Kingston Area																	
Water use per household (m3/month) (6.09 persons/HH)	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	
Monthly water tariff rate for up to 14m3 (JMD/HH) (JMD59.31/m3)	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	
Monthly water tariff rate for next 13m3 (JMD/HH) (JMD104.57/m3)	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	1,359.4	
Monthly water tariff rate for next 14m3 (JMD/HH) (JMD112.92/m3)	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	743.8	
Monthly water tariff per household (JMD/month)	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	2,933.5	
Number of connected households	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	10,959	
Yearly total water tariff revenue (JMD million)	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	385.8	11,120.0
Portmore Area																	
Water use per household (m3/month) (4.0 persons/HH)	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	
Monthly water tariff rate for up to 14m3 (JMD/HH) (JMD59.31/m3)	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	
Monthly water tariff rate for next 13m3 (JMD/HH) (JMD104.57/m3)	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	843.7	
Monthly water tariff per household (JMD/month)	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	1,673.9	
Number of connected households	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	36,125	
Yearly total water tariff revenue (JMD million)	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	725.7	20,219.5
Total Benefit (JMD million)	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	1,111.4	31,339.5
Net Benefit (JMD million)	429.7	429.7	429.7	429.7	429.7	-704.5	429.7	429.7	429.7	429.7	429.7	429.7	429.7	429.7	429.7	429.7	1,176.8

FIRR	0.71%

Source: JICA Survey Team

7.1.8 Sensitivity Analysis and Debt Service Coverage

(1) Comparison with Cost of Capital

The sensitivity of the FIRR is analyzed in the following cases with different conditions:

Decrease in the construction cost by (a) 5%; and (b) 10%; and

Increase in water tariff level by (a) 10% and (b) 20%.

Results are presented in Table 7.1.8. Even in the most favorable case (10% decrease in construction cost and 20% increase in water tariff), FIRR is calculated as low as 4.67%.

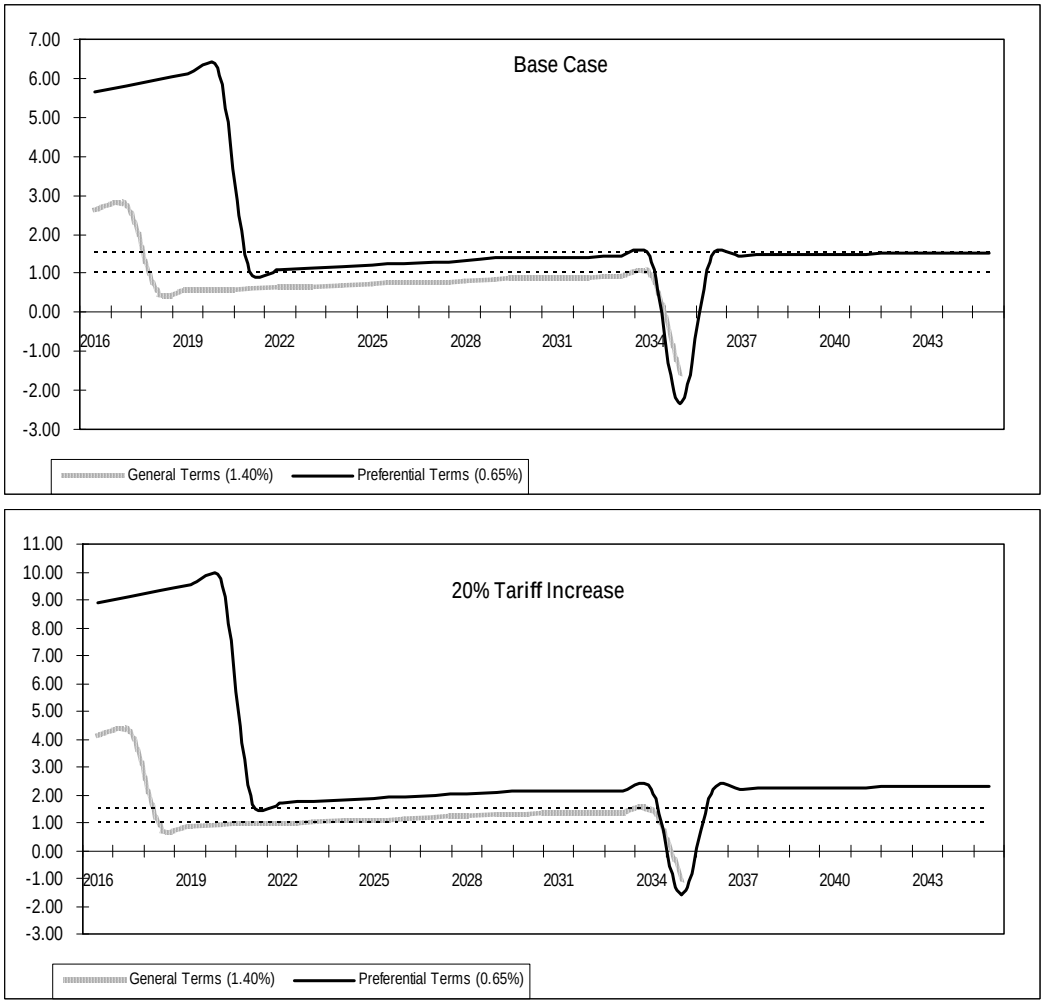
Table 7.1.8 Sensitivity Analysis Results

		(i) Construction Cost		
		Base	5% Decrease	10% Decrease
(ii) Water Tariff Increase	Base	0.71%	1.07%	1.45%
	10% Increase	2.38%	2.76%	3.17%
	20% Increase	3.83%	4.23%	4.67%

Source: JICA Survey Team

(2) Debt Service Coverage

Debt Service Coverage Ratio (DSCR) of net benefits of each year is calculated to evaluate the debt sustainability of the project. Figure 7.1.1 shows the results of the base case and the case with 20% increase in water tariff.



Source: JICA Survey Team

Figure 7.1.1 Debt Service Coverage Ratio Projection

The figure demonstrates that DSCRs with both General and Preferential Terms in the base case cannot reach 1.5 which is generally considered acceptable DSCR. Except the year in which reinvestment takes place, with general terms the DSCRs are consistently below 1.0, which means the net cash flow of the project cannot fully cover the debt service in the whole repayment period. In the case with 20% increase in water tariff, DSCRs with General Terms for the loan are mostly between 1.0 and 1.5 indicating its marginal sustainability during the repayment period, whereas with the Preferential Term loan DSCRs are above 1.5 for almost all of the repayment period.

7.2 Social Survey on Willingness to Pay

Prior to the economic analysis of the project, social survey was conducted to collect information of residents in the project area (North Kingston and Portmore) on their water use, tariff payment and willingness to pay for sewerage service.

7.2.1 Sample Size and Information Gathering Methodology

Minimum sample size originally determined by the terms of reference of Preparatory Survey was 100 samples, broken down to 50 samples from the existing sewered area (Portmore) and 50 samples from not-sewered area (North Kingston). To obtain more confident results from the survey, JICA Survey Team increased the target sample size to 200 in total, or 100 each from Portmore and North Kingston, taking into consideration the resource availability and survey period. Since there are four catchment areas / lots in Portmore and North Kingston respectively, 20 was the minimum target size for each catchment area / lot.

Due to constraints of information availability on resident listing and the limited timeframe for the social survey, simple method was taken to identify the sample respondents by setting up community meetings in collaboration with Citizens Associations of the respective areas / lots as well as door-to-door visits by surveyors in field survey. Information was obtained from respondents through face-to-face interviews based on questionnaire.

7.2.2 Implementation of Survey

The survey team was formed from two local surveyors and one international social consideration expert. During approximately four weeks of the survey period from late October to late November 2009, the team spent first 10 days to visit related institutions for pre-interviews and preparation of the questionnaire survey. The team was provided lists of Citizens Associations from Municipal Councils, visited them and discussed the proposed project and the questionnaire survey. Many Associations, including the ones in North Kingston, agreed to invite the survey team for their meetings and to do the survey.

Since almost all households in Portmore are connected to the sewerage system whereas almost all in North Kingston are soak-away users and not connected, two different versions of questionnaires are prepared particularly in questions regarding sewerage service and willingness to pay. Questions were adjusted to the reality learned through observations in pre-interview sessions. The team spent next two weeks to attend the meetings of Citizens Associations and to conduct the door-to-door survey.

There were no Citizens Associations in Lot-C (Buirdsucker) in North Kingston, and the Associations did not have general meetings during the survey period in Independence City in Portmore and in Lot-D (Hope Pasture) in North Kingston. The team conducted more door-to-door survey in these communities than others; however, the responses were 18, 19 and 12 respectively and the minimum target was not fulfilled. The numbers of attendants were not large in two meetings of Bridgeport Citizens Associations so that the responses were only 16. In results, final responses obtained were 180 in total, or 97 from Portmore and 93 from North Kingston (See Table 7.2.1).

Table 7.2.1 Questionnaire Survey Responses

Catchment	Date & Time of Citizens Accociation Meetings	Responses at the Meetings	Additional Responses	Door-to-door Visits	Total
Portmore		40	22	35	97
Independence City	Cancelled	0	0	19	19
Bridgeport	5PM 4 Nov. 2009 Wednesday	8	2	0	16
	7PM 8 Nov. 2009 Sunday	6			
Hamilton Gardens	7PM 15 Nov. 2009 Sunday	8	0	16	24
Caymanas Gardens	1PM 8 Nov. 2009 Sunday	18	20	0	38
North Kingston		39	0	44	83
Lot-A (Pembroke Hall)	7PM 14 Nov. 2009 Saturday	16	0	4	20
Lot-B (Havendale)	4PM 15 Nov. 2009 Sunday	18	0	15	33
Lot-C (Birdsucker)	No Citizens Association	0	0	18	18
Lot-D (Hope Pasture)	7PM 9 Nov. 2009 Monday	5	0	7	12
	Total	79	22	79	180

Source: JICA Survey Team

7.2.3 Outline of Target Area

The target area includes four catchment areas in Portmore, namely Independence City Catchment, Bridgeport Catchment, Hamilton Gardens Catchment and Caymanas Gardens Catchment, and four lots in North Kingston, namely Lot-A (Pembroke Hall), Lot-B (Havendale), Lot-C (Birdsucker) and Lot-D (Hope Pastures). Estimated population of the target area in 2010 is 154,534 or 99,160 in Portmore side and 55,374 in North Kingston side as shown in Table 7.2.2.

Table 7.2.2 Outline of the Target Areas

Catchment	Community	2010 Estimated Population	Responses of Questionnaire Survey
Portmore	*Subtotal*	*99,160*	*97*
Independence City	Meadowvale, Portmouth, Passagefort, Independence City, Waterford, Portmore Gardens, Cumberland, Westchester, South East, South Central and Town Center	60,409	19
Bridgeport	Westport, Bridgeview, Garveymeade, Westmeade, Bridgeport, Southboro, West Bay, Edgewater, Marine Park, Breaton, Maggo Head, Bayside and Forum	30,318	16
Hamilton Gardens	Hamilton Gardens, Cedar Grove, Christian Gardens, Christian Meadows and Christian Pen	1,960	24
Caymanas Gardens	Caymanas Gardens including Caymanas Estate	6,473	38
North Kingston	*Subtotal*	*55,374*	*83*
Lot-A (Pembroke Hall)	Pembroke Hall	12,998	20
Lot-B (Havendale)	Havendale, Meadowbrook and White Hall	25,678	33
Lot-C (Birdsucker)	Birdsucker, Billy Dunn and a small part of Barbican	5,869	18
Lot-D (Hope Pasture)	Hope Pasture, Mona Heights and University of Technology	10,829	12
	Total	*154,534*	*180*

Source: JICA Survey Team

Almost all the houses in the Portmore area are in the newly developed housing schemes and are connected to the sewage system, while most of the houses in North Kingston side are in old high-class residential areas, detached and not connected to the sewage system.

Development of Portmore started in 1969 with the construction of 1,100 two- or three-bedroom houses in Independence City as shown in Table 7.2.3. Bridgeport housing scheme followed in three phases from 1972 to 1977 with 700 two-bedroom and 660 three-bedroom houses. Waterford housing scheme near Independence City Water Treatment Plant was constructed with the largest number of 3,725 two-bedroom twins from 1975 to 1977. Cedar Grove Estate with 840 service lots and Christian Gardens with 632 studios in Hamilton Gardens Catchment are the newest schemes developed in 1998-2000. Houses are still being constructed in Cedar Grove Estate.

On North Kingston side, Mona Heights, which is a part of Lot-D (Hope Pasture), was developed under a large-scale housing scheme and 880 three-bedroom houses were constructed as early as in 1959-1960. College Green Estate in Hope Pasture is a newly developed large-scale housing scheme with 158 houses and was completed by 1998.

Table 7.2.3 Development of Housing Schemes in Portmore

Year from	Year to	Name of community	Developer	1BRM	2BRM	3BRM	2BRM TWN	Studios	Service lots	Total
1969	1970	Independence City	WHICON		1,100					1,100
1971	1972	Edgewater Villas	WHICON			700				700
1972	1972	Bridgeport Phase I	WHICON			280				280
1973	1974	Bridgeport Phase II	WHICON		700					700
1974	1976	Passagefort	WHICON		1,200					1,200
1975	1977	Waterford	WHICON				3,725			3,725
1976	1977	Bridgeport Phase III	WHICON			380				380
	1978	Braeton	MEH		435					435
	1978	Marine Park	Essn House Ltd.		100	110				210
	1978	Westmeade	Ashtrom		368					368
1978	1979	Portmouth	WHICON		1,000					1,000
1979	1980	Southborough	WHICON		900					900
1979	1980	Caymanas Gardens	Gore Tuca	192	134	152				478
1983	1983	Westchester	WHICON		1,140					1,140
1983	1984	Cumberland	WHICON		1,134					1,134
1983	1984	Hamilton Gardens	MEH		300					300
1987	1987	Westbay Phase I	WHICON			20				20
	1988	Cumberland (Pureto Rican)	UDC		396	160				556
1988	1988	Westbay Phase II	WHICON			80				80
1990	1990	Westbay Phase III	WHICON			54				54
	1991	Christian Pen	MHT/Mutual Life		45					45
	1993	Bridgeview	UDC		408					408
1993	1994	Cumberland (Trunco)	Trunco		4					4
1993	1994	Cumberland Meadows	NHT		78			101		179
1996	1997	Bridgeport	WHICON			380				380
1998	1999	Cedar Grove Estate	Cedar Grove Invest. Ltd.						840	840
1999	2000	Christian Gardens	WHICON					632		632
			Total							17,248

* MEH: former Ministry of Environment and Housing
* Source: Portmore Municipal Council (NHT, WHICON and other developers.)

Source: JICA Survey Team

(1) Portmore Target Area

Independence City catchment area consists of Meadowvale, Portmouth, Passagefort, Independence City, Waterford, Portmore Gardens, Cumberland, Westchester, South East, South Central and Town Center and its 2010 estimated population is 60,409. There are eight housing schemes with 9,937 houses, of which 3,725 are two-bedroom twins and the rest are two-bedroom houses and some three-bedroom houses.


Independence City (Waterford)

Bridgeport catchment area consists of Westport, Bridgeview, Garveymeade, Westmeade, Bridgeport, Southboro, West Bay, Edgewater, Marine Park, Breaton, Maggo Head, Bayside and Forum and its 2010 estimated population is 30,318. There are 13 housing schemes and phases with 5,016 houses, of which 2,911 or about 60% are two-bedroom houses, 2,004 or about 40% are three-bedroom houses and 101 are studios.


Bridgeport


Hamilton Gardens

Hamilton Gardens catchment area consists of Hamilton Gardens, Cedar Grove, Christian Gardens, Christian Meadows and Christian Pen and its 2010 estimated population is 1,960. There are four housing schemes with 345 two-bedroom houses, 632 studios and 840 service lots. Not all the service lots are occupied by houses yet, but they are connected to the sewage system. This is newly developed area and is still under construction, so that the 2010 population might be underestimated.


Caymanas Gardens

Caymanas Gardens catchment area consists of Caymanas Gardens including Caymanas Estate and its 2010 estimated population is 6,473. Caymanas Gardens Scheme has 192 one-bedroom, 134 two-bedroom and 152 three-bedroom houses. This is the only scheme in Portmore with one-bedroom houses.

(2) North Kingston Target Area

Lot-A consists of Pembroke Hall and its 2010 estimated population is 12,998. 1,311 houses were constructed under a housing scheme which was developed in the early 1970's.

Lot-B consists of Havendale, Meadowbrook and White Hall. Estimated population in 2010 is 25,678. There are 2,438 houses in Havendale and 569 houses in Meadowbrook which are developed in late 1970's. White Hall is one of the 'depressed' areas with 3,628 houses.


Lot-A (Pembroke Hall)


Lot-B (Havendale)

Lot-C consists of Birdsucker, Billy Dunn and a small part of Barbican and its 2010 estimated population is 5,869. Statistical figures are available only for Barblican including Birdsucker and they are 9,744 with 3,453 houses. The average household size is 2.9 and is smaller than other lots of North Kingston where the average is 3 to 4. Barblican Road and Birdsucker Lane at the lower part of Lot-C represent the middle-low to low income level groups, where the upper part represents home-owners with tertiary level education.

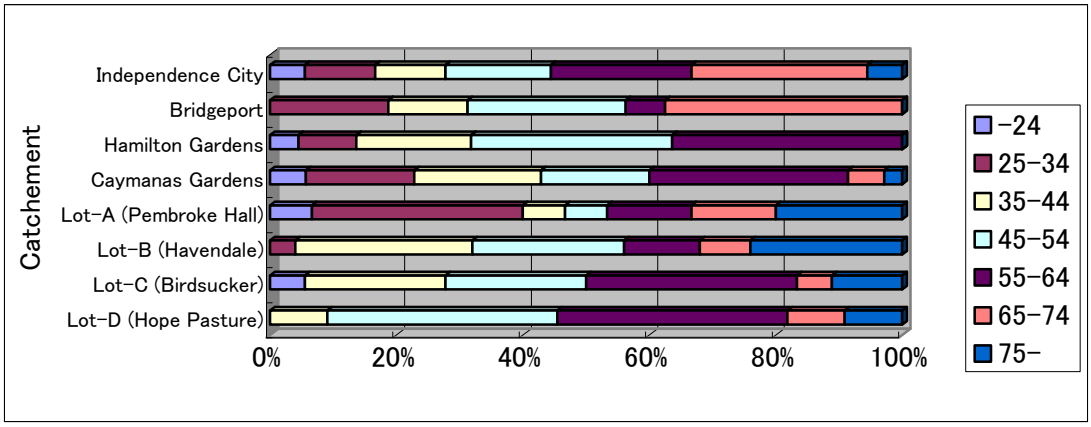
Lot-D consists of Hope Pasture, Mona Heights and University of Technology and its 2010 estimated population is 10,829. Mona Heights was originally developed in 1959-1960 with 880 three-bedroom houses and there are 1,547 houses with 5,003 residents in Hope Pasture. College Green Estate, which has 158 houses, was newly developed by 1998, and is connected to the sewage system. The residents represent the upper to middle-upper class.

7.2.4 Survey Results: Social Characteristics

(1) Age Structure

Age structures of the respondents of the questionnaire survey in Portmore and North Kingston are totally different. There are few respondents 75 years and over in Portmore, but close to 20% in North Kingston are over 75 years as shown in Figure 7.2.1. The ratios are especially high in Lot-A (Pembroke Hall) and Lot-B (Havendale). About 30% of the respondents in Lot-A (Pembroke Hall) are 25-34 years so that old generations, who live more in the upper part, and young generations, who live more in the lower part, coexist.

30-40% of the respondents of Independence City and Bridgeport are 65-74 years so that it is expected to see many people over 75 years in ten years. 30-40% of the respondents of Hamilton Gardens and Caymanas Gardens are 55-64 years and those age structures reflect the history of housing development.

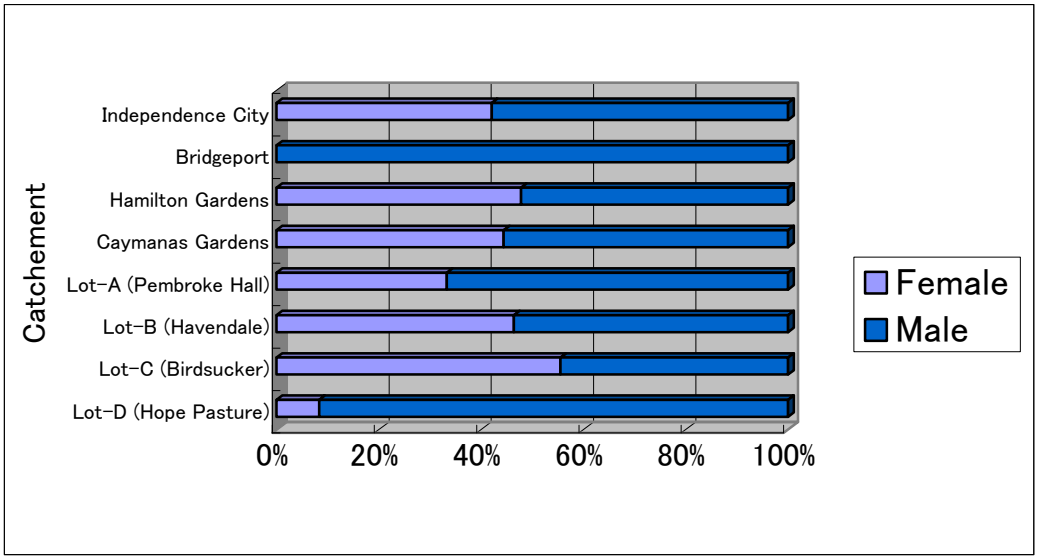


Source: JICA Survey Team

Figure 7.2.1 Age Composition of the Target Area (160 valid samples)

(2) Gender of the Heads of Household

Female headed households are many especially in Lot-C (Birdsucker) and then in Hamilton Gardens and Lot-B (Heavendale) as shown in Figure 7.2.2**.**

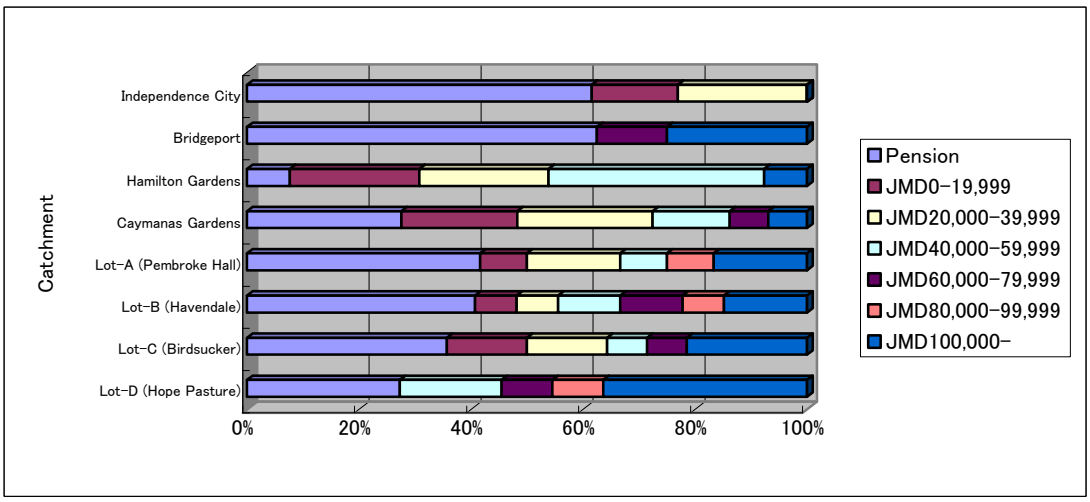


Source: JICA Survey Team

Figure 7.2.2 Sex of the Heads of the household (166 valid samples)

(3) Income Level

Income level is highest in Lot-D (Hope Pasture) and relatively high in all the lots in North Kingston where majority of the employed households get more than JMD40,000 per month. No respondents in Lot-D (Hope Pasture) earn less than JMD40,000. Pensioners are more than 30% except in Hamilton Gardens, Lot-D (Hope Pasture) and Caymanas Gardens. Some pensioners earn more than JMD100,000 per month, but the pension income is more likely to be JMD30,000 to 40,000.



Source: JICA Survey Team

Figure 7.2.3 Income Level (127 valid samples)

7.2.5 Water Supply and Sewerage Services

(1) Present Status of Water Supply and Sewerage Services

Present status of water supply service is shown in Table 7.2.4. All households have water supply connection except for one household in Hamilton Gardens. 44% of households use bottled water for drinking purpose.

Table 7.2.4 Present Status of Water Supply

	Water Supply		Use of Other Water Sources			
	Connected	Metered*	Bottled Water	Communal Tap	Rainwater	Well
Portmore	99.0%	92.7%	45.4%	10.3%	6.2%	0.0%
Independence City	100.0%	94.7%	47.4%	10.5%	10.5%	0.0%
Bridgeport	100.0%	93.8%	50.0%	0.0%	6.3%	0.0%
Hamilton Gardens	95.8%	95.7%	41.7%	16.7%	4.2%	0.0%
Caymanas Gardens	100.0%	89.5%	44.7%	10.5%	5.3%	0.0%
North Kingston	100.0%	100.0%	43.4%	8.4%	19.3%	1.2%
Lot-A (Pembroke Hall)	100.0%	100.0%	45.0%	20.0%	0.0%	0.0%
Lot-B (Havendale)	100.0%	100.0%	39.4%	3.0%	30.3%	3.0%
Lot-C (Birdsucker)	100.0%	100.0%	72.2%	5.6%	22.2%	0.0%
Lot-D (Hope Pasture)	100.0%	100.0%	8.3%	8.3%	16.7%	0.0%
Total	99.4%	96.1%	44.4%	9.4%	12.2%	0.6%
Valid Responses	180	179	180	180	180	180

* Households who have water supply connection were asked whether their connection is metered.

Source: JICA Survey Team

Table 7.2.5 shows the status of sewerage service. 99% of Portmore households are connected to sewerage system. Only one household has no sewer connection in Portmore who has soakaway as alternative wastewater treatment. In North Kingston, almost all but one household in Lot-D have no sewerage connection. 80% of them use soakaway as alternative and others have septic tanks.

Table 7.2.5 Present Status of Sewerage Service

	Sewerage Connection	Alternative Wastewater Treatment /1		Indoor Toilet
		Septic Tank	Soakaway	
Portmore	99.0%	0.0%	100.0%	100.0%
Independence City	100.0%	-	-	100.0%
Bridgeport	100.0%	-	-	100.0%
Hamilton Gardens	95.8%	0.0%	100.0%	100.0%
Caymanas Gardens	100.0%	-	/2	100.0%
North Kingston	1.2%	21.3%	80.0%	100.0%
Lot-A (Pembroke Hall)	0.0%	47.1%	52.9%	100.0%
Lot-B (Havendale)	0.0%	12.9%	87.1%	100.0%
Lot-C (Birdsucker)	0.0%	11.8%	88.2%	100.0%
Lot-D (Hope Pasture)	8.3%	20.0%	90.0%	100.0%
Total	53.9%	21.1%	80.3%	100.0%
Valid Responses	178	76	76	180

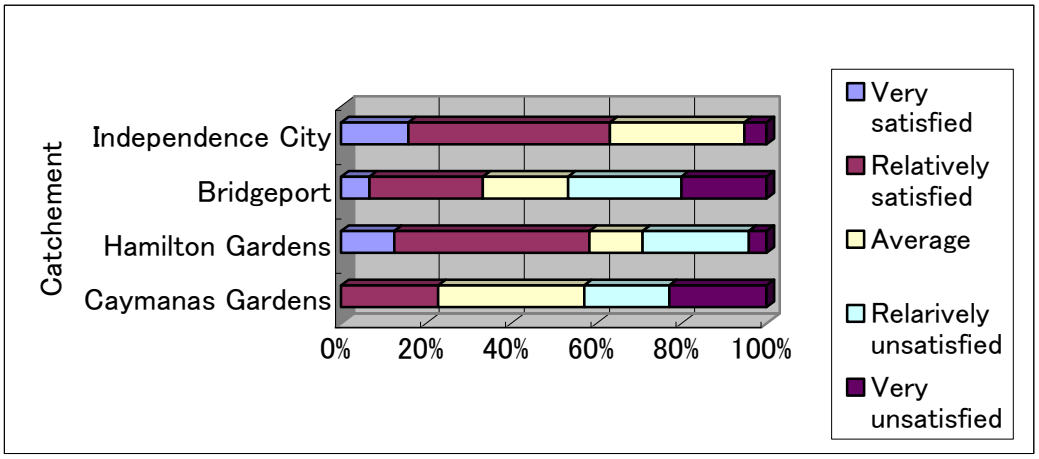
/1 Households who have no sewer connection were asked what is alternative wastewater treatment at their houses.

/2 There are four households not shown in table who have both sewer connection and septic tank.

Source: JICA Survey Team

(2) Satisfaction Rating of the Sewage System

Satisfaction was rated according to the five-rank system of (i) very satisfied, (ii) relatively satisfied, (iii) average, (iv) relatively unsatisfied and (v) very unsatisfied by the respondents in the four catchments in Portmore, where houses are presently connected to the sewage system. Satisfaction rate is high in Independence City, but more than 20% of the respondents were very unsatisfied in Bridgeport and Caymanas Gardens as shown in Figure 7.2.4.



Source: JICA Survey Team

Figure 7.2.4 Satisfaction Rating of the Sewage System (93 valid samples)

Respondents rated unsatisfied to sewerage service were asked reasons for their dissatisfaction (See Table 7.2.6). Foul odor (73%) is the most frequent answer followed by high sewerage payment (49%). From the open-ended questions of the questionnaire survey and the opinions at the citizens association's meetings, the major issue in Bridgeport turned out to be mosquitoes and the one in Caymanas Gardens is drainage. Odor is also mentioned by the nearby residents of Independence City and other Wastewater Treatment Plants.

Table 7.2.6 Reason for Dissatisfaction

	Reason for Dissatisfaction (67 Valid Responses)				
	Low discharge capability	Sewage overflow	Foul odor	High sewage charge	Others
Portmore	10.4%	37.3%	73.1%	49.3%	3.0%
Independence City	0.0%	0.0%	81.8%	36.4%	0.0%
Bridgeport	7.7%	23.1%	84.6%	61.5%	0.0%
Hamilton Gardens	8.3%	33.3%	50.0%	41.7%	0.0%
Caymanas Gardens	16.1%	58.1%	74.2%	51.6%	6.5%

Source: JICA Survey Team

(3) Water Bill Payment

Summary of current water bill payments by sample households is presented in Table 7.2.7. In Portmore, sample households pay JMD2,893 on average or median of JMD2,800 for both water supply and sewerage services. Assuming 100% of water supply charge is payment for sewerage service, the Portmore households pay average JMD1,446 or median of JMD1,400

per month for sewerage. North Kingston households pay JMD3,190 for water supply on average.

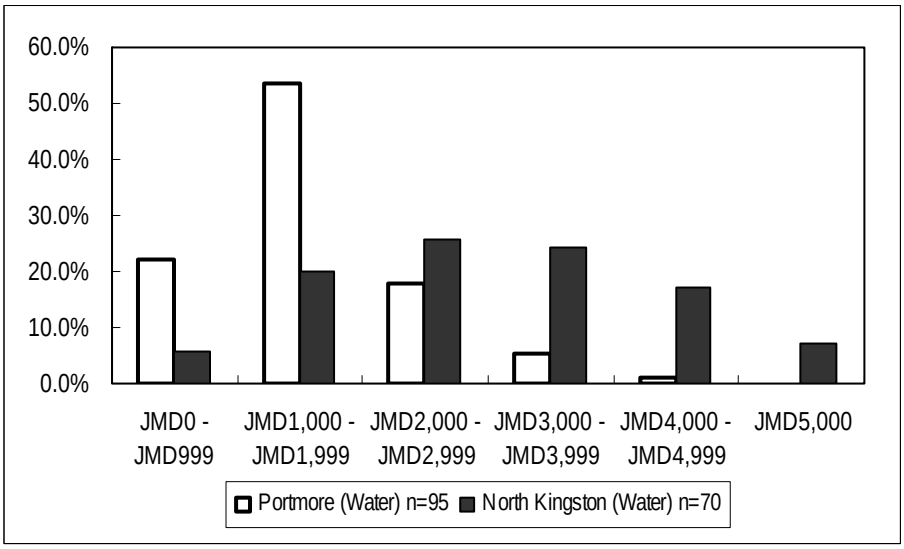
Table 7.2.7 Monthly Water Bill Payments

	Portmore (Water & Sewerage)	Portmore (Water / Sewerage)*	North Kingston (Water)	North Kingston (Wastewater & Drainage Payment)
Mean (JMD)	2,892.6	1,446.3	3,189.6	1,015.9
Median (JMD)	2,800.0	1,400.0	2,800.0	0.0
Minimum (JMD)	500.0	4,000.0	600.0	0.0
Maximum (JMD)	8,000.0	1,446.3	25,000.0	8,000.0
Std. Deviation (JMD)	1,533.6	766.8	3,225.3	2,192.5
Valid Responses	95	95	70	22

* Each total bill amount responded is devided by 1:1 ratio assuming 100% of water rate is charged for sewerage service.

Source: JICA Survey Team

Distribution histogram is presented in Figure 7.2.5. The majority of the respondents of Portmore are paying less than JMD2,000, but the majority of the respondents in North Kingston are paying more than JMD3,000. The sewage bills are equivalent to the water bills and all the respondents in Portmore except one and three respondents in North Kingston are actually paying that amount.



Source: JICA Survey Team

Figure 7.2.5 Water Supply Payment (Distribution Histogram)

Comparison of water bill amount with income level is shown in Table 7.2.8. Taking median figures, 7.1% of income is paid for both water supply and sewerage charges by the Portmore households. In North Kingston, households pay 3.0% of their income for only water supply charge. 7.1% expenditure on water supply and sewerage of household income for Portmore is higher than a generally accepted benchmark of five percent of household income[1]; thus it implies that the current tariff setting exceeds the ability to pay among the households. In North Kingston, it is also suspected that the water supply and sewerage expenditure will

[1] Handbook for the Economic Analysis of Water Supply Projects, Asian Development Bank (1999)

exceed the ability to pay if 3.0% of income is doubled by applying the current sewerage service tariff as 100% of water supply. Compared with the average current wastewater and drainage expenditure of JMD1,016 in North Kingston (See Table 7.2.7), sewerage payment of JMD1,446 in Portmore is larger though their income level is lower than North Kingston. Likewise, 100% of water supply charge in North Kingston (JMD3,190) is much larger than their current expenditure on sanitation.

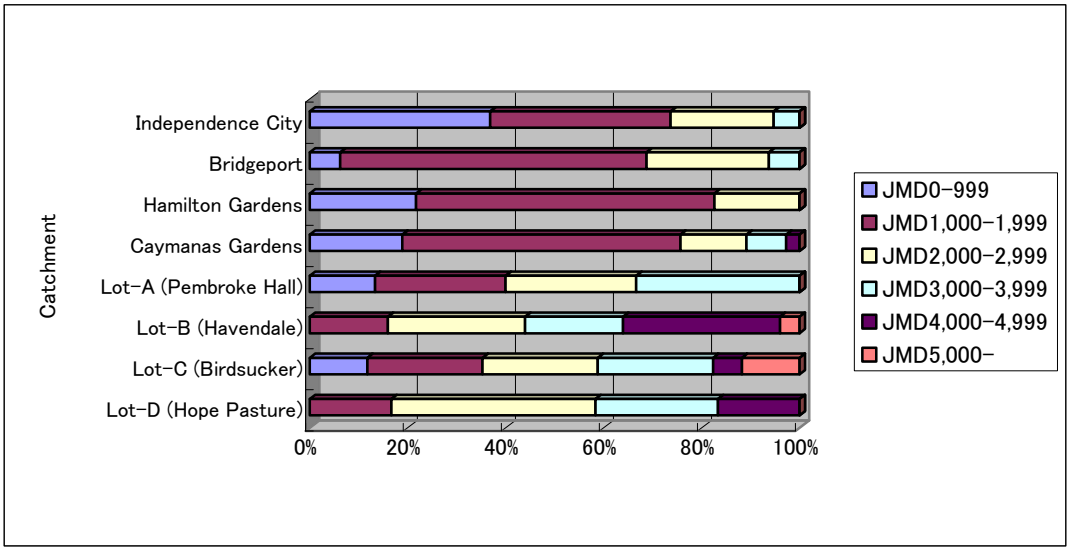
Table 7.2.8 Comparison of Income and Water Bill Payments

	Portmore			North Kingston		
	Monthly Income (JMD)	Water & Sewerage Monthly Payment		Monthly Income (JMD)	Water & Sewerage Monthly Payment	
		Amount (JMD)	% to Income*		Amount (JMD)	% to Income*
Mean	42,688.6	2,892.6	11.4%	85,370.0	3,189.6	6.4%
Median	28,000.0	2,800.0	7.1%	58,500.0	2,800.0	3.0%
Minimum	0.0	500.0	0.7%	0.0	600.0	0.5%
Maximum	300,000.0	8,000.0	46.7%	500,000.0	25,000.0	60.0%
Std. Deviation	59,061.1	1,533.6	11.5%	96,307.7	3,225.3	9.9%
Valid Responses	51	95	42	50	70	40

* Percentage of monthly payment to income amount is calculated for each respondent household. Extreme results over 100% are excluded.

Source: JICA Survey Team

For comparison among catchment areas / lots, water bills excluding sewage bills are shown in Figure 7.2.6.



Source: JICA Survey Team

Figure 7.2.6 Water Bills (164 valid samples)

(4) Expenditure on Other Utilities

Expenditure on other utilities is summarized in Table 7.2.9. Households are paying three to four times more for electricity than water charge excluding sewerage, or one and half to double for electricity than water including sewerage.

Table 7.2.9 Monthly Expenditure on Other Utilities

Unit: JMD

	Portmore				North Kingston			
	Electricity	Cooking Gas	Phone	Others (Cable, etc.)	Electricity	Cooking Gas	Phone	Others (Cable, etc.)
Mean	6,214.0	1,436.4	3,230.2	2,955.2	8,529.2	1,169.1	5,985.2	4,833.3
Median	6,000.0	1,326.7	2,982.0	2,500.0	8,000.0	966.7	4,000.0	4,350.0
Minimum	0.0	0.0	500.0	500.0	1,500.0	185.7	1,000.0	2,000.0
Maximum	15,000.0	4,000.0	7,000.0	12,000.0	40,000.0	2,750.0	20,000.0	13,000.0
Std. Deviation	3,096.3	661.3	1,561.2	2,185.1	5,969.7	599.2	4,796.5	2,963.5
Valid Responses	88	84	22.0	41	72	63	27	12

Source: JICA Survey Team

7.2.6 Willingness to Pay for Sewerage Service Improvement

(1) Questions on Willingness to Pay

Sample households were asked the amount that they are willing to pay for sewerage service improved by the proposed project. Two different versions of question on willingness to pay (WTP) were prepared for Portmore and North Kingston because of the difference in sewer connection status. The questions include information on the proposed sewerage development and its benefits as well as payment conditions. Question on WTP for sewerage charges are separated in (i) monthly sewerage charge and (ii) initial payment for connection (only New Kingston samples). For the monthly charge, different sets of multiple choices are provided for sewered households (Portmore) and not-sewered households (North Kingston). See Table 7.2.10 for details.

Table 7.2.10 WTP Questions

	Explanatory Information / Instruction	Monthly WTP Answer Choices
Portmore	Currently, your household is connected to a sewerage system and you pay sewage charges to NWC. Assuming that the service you receive is not to your satisfaction, but could become so, by the upgrading of the already existing system, how much would you agree to pay in addition to the current sewage charges? (Choose one or specify an amount in between) Please note that these payments would be in addition to your current monthly household expenditures.	JMD100, JMD200, JMD300, JMD400, JMD500, JMD600
New Kingston	A street sewer network is developed in your area by NWC and your household becomes able to be connected to a centralized sewage system. With such a system, sewage is collected in a sanitary fashion from each household and transported to a safe place where the system has sufficient capacity to deal with increases in water due to rainfall etc. and does not overflow. Collected sewage is treated in a sanitary fashion until it reaches a level that is not problematic for the environment and then discharges into the natural environment properly. Currently, your household is not connected to the system so you do not pay such charges to NWC. If you were to receive the satisfactory sewage service as explained above, you would have to make (i) new monthly sewage bill payment. Prior to that, you would have to make (ii) an initial payment for the individual connection work from the street sewer to your house. How much would you agree to pay for these expenses? (Choose one or specify amount in between) Please note that these payments would be in addition to your current monthly household expenditures but your current expenses for sanitation services other than by NWC would be replaced by them.	JMD600, JMD800, JMD1,000, JMD1,200, JMD1,400, JMD1,600

Source: JICA Survey Team

(2) Estimation of WTP

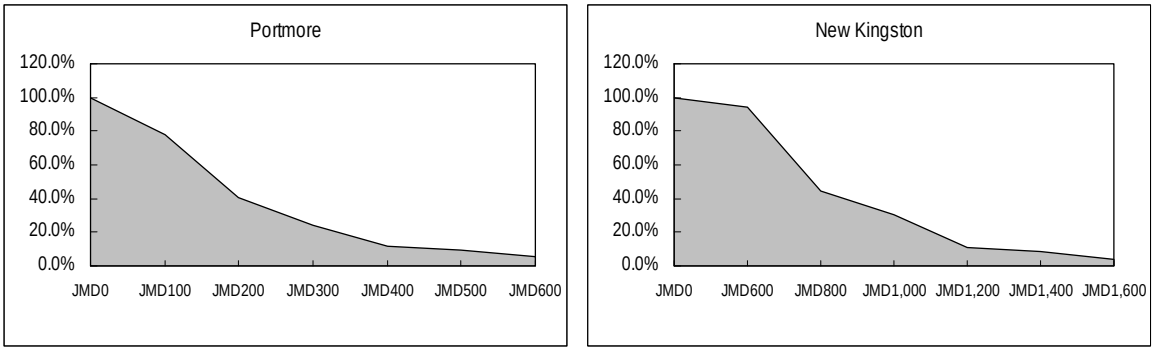
Results of WTP questions on monthly sewerage charge are summarized in Table 7.2.11 and Figure 7.2.7.

Table 7.2.11 Results of WTP Questions (Monthly Sewerage Charge)

Portmore				North Kingston			
WTP	Respondents	Cummulative	%	WTP	Respondents	Cummulative	%
JMD0	19	86	100.0%	JMD0	3	56	100.0%
JMD100	32	67	77.9%	JMD600	28	53	94.6%
JMD200	14	35	40.7%	JMD800	8	25	44.6%
JMD300	11	21	24.4%	JMD1,000	11	17	30.4%
JMD400	2	10	11.6%	JMD1,200	1	6	10.7%
JMD500	3	8	9.3%	JMD1,400	3	5	8.9%
JMD600	5	5	5.8%	JMD1,600	2	2	3.6%
Valid Responses	86	-	-	Valid Responses	56	-	-

Source: JICA Survey Team

The graphs show willingness to pay curves in which frequency of responses is gradually descending from 100% with no payment (JMD0) to lower percentages with higher WTP amounts. Average WTP is estimated by calculating area under each curve.



Source: JICA Survey Team

Figure 7.2.7 Willingness to Pay (Monthly Sewerage Charge)

Estimation of average WTP is shown in Table 7.2.12. WTP for monthly sewerage charge per household is estimated at JMD216.86 for Portmore and JMD871.43 for North Kingston. The Portmore WTP is much lower because the households are already connected to sewerage and the benefit of the project perceived by residents is considered minimal. For North Kingston where residents will benefit from connections to be newly developed by the project, WTP of JMD871.43 is estimated at similar level to that of Inner City Basic Services for the Poor Project supported by World Bank in Jamaica (JMD819.35)[2]. However, the estimated WTP is much lower than the current water bill payment of North Kingston households (around JMD3,000) and the actual payment for sewerage by Portmore households (around JMD1,400). It is implied that (i) current sewerage tariff is set at very level; and (ii) current soak-away use is relatively satisfactory to most of the North Kingston residents.

[2] Project Appraisal Document for Inner City Basic Services for the Poor Project, World Bank (2006)

Table 7.2.12 Estimation of WTP (Monthly Sewerage Charge)

Portmore		New Kingston	
WTP range	Average	WTP range	Average
JMD0 - JMD100	88.95	JMD0 - JMD600	583.93
JMD100 - JMD200	59.30	JMD600 - JMD800	139.29
JMD200 - JMD300	32.56	JMD800 - JMD1,000	75.00
JMD300 - JMD400	18.02	JMD1,000 - JMD1,200	41.07
JMD400 - JMD500	10.47	JMD1,200 - JMD1,400	19.64
JMD500 - JMD600	7.56	JMD1,400 - JMD1,600	12.50
Total WTP per household	216.86	Total WTP per household	871.43
Average Household Size	3.49	Average Household Size	3.65
WTP per capita	62.05	WTP per capita	238.50

Source: JICA Survey Team

WTP of North Kingston households for initial connection is estimated JMD22,285.23 on average. This is only 25% of actual connection cost (USD1,000 per connection) estimated by JICA Survey Team. Considering ordinary household income of JMD60,000 to JMD70,000 per month in the area, certain mitigation measures such as subsidy for connection works are required to promote household sewerage connections. As a result, the household connection works are included in the project scope by the present study.

7.2.7 Other Observations

(1) Portmore

In the Portmore area, one of the major concerns raised was the quality of sewerage service that does not match the cost charged by NWC such as foul odor from toilets and overflows of drains. The residents think that upgrade of the sewerage system is very necessary and is long overdue; however, they are concerned that they will be asked to pay more without any improvement of the service.

(2) North Kingston

In North Kingston area, there were many questions raised with regard to cost of connection and actual laying and pipes and laterals. There was no opposition to the project, but one of the main concerns was the inconvenience of the road construction when the pipe laying was being done. There are some residents who are not at all in support of paying more for water bills whether it is going to benefit the environment or not.

7.3 Economic Analysis

7.3.1 Methodology

Cost-benefit analysis based on economic values is made through discounted cash flow projection on a with- and without-project basis by calculation of economic internal rate of return (EIRR).

7.3.2 Basic Assumptions

The following basic assumptions are adapted to economic analysis. The same basic assumptions as financial analysis are applied to project life, price escalation and interest during construction.

(1) Cost Estimate

Estimation of costs is based on the price level of 2009. The cost of the existing facilities constructed before the project is considered as sunk cost and excluded from the analysis. A Standard conversion factor of 1.0 is applied to convert the financial costs into economic costs, i.e. economic values are equal to financial values. This is because 2006-2008 external trade statistics shows that the trade duties are minimal as compared to the exports and imports values resulting in the estimated conversion factor of 0.99998. Taxes and duties such as VAT are considered as transfer items and excluded from the analysis although it is assumed that the project is already exempt from GCT, Import Tax and VAT in terms of financial cost.

(2) Opportunity Cost of Capital (Social Discount Rate)

The opportunity cost of capital refers to an interest rate at which the appropriateness of an investment can be justified by comparison with the EIRR of a particular project. A rate of 12% is used based on the rates used for other projects in Jamaica, such as "Inner City Basic Services for the Poor Project" (World Bank, 2006).

7.3.3 Economic Benefits

Economic benefits of a sewerage development project are generally considered the improvement of public health, positive impacts on environment, increase in land values, tourism industry promotion, etc. However, it is very difficult to obtain the relevant data sufficient to estimate the monetized economic benefits for the analysis including past similar studies such as KBR Study.

In this survey, willingness to pay (WTP) values estimated based on the social survey conducted for 180 sample households is applied as the economic benefit of the project in accordance with the survey TOR. Unit WTPs of JMD238.50/month for KSA (unconnected area) and JMD62.05/month for Portmore (connected area)[3] are used along with population forecast presented in Table 7.1.5.

7.3.4 Economic Costs

Based on the project cost estimation and the basic assumptions, economic costs of the project is estimated as the same as financial costs; total construction cost is JMD9,593 million (Table 7.1.2). The operation and maintenance cost of JMD76.4 million per year is applied. Likewise, the same condition is applied for reinvestment cost for replacement of electro-mechanical equipment.

[3] WTP is valued as monthly payment for availability of connected sewerage service in each household regardless of discharge amount.

7.3.5 Estimation of EIRR

The table below shows the summary of the EIRR calculation based on the assumptions presented above. EIRR and NPV (with 12% discount rate) are calculated as -3.52% and negative JMD5,083.2 respectively, ostensibly due to the heavy investment cost and low WTP values. The EIRR based on WTP value indicates the project is not economically feasible. However, EIRRs estimated to be as low as in this project are observed in similar sewerage development projects in Jamaica applying WTP as benefit such as "Inner City Basic Services for the Poor Project" (World Bank, 2006) and KBR report.

Table 7.3.1 EIRR Calculation

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Cost																			
Initial Investment Cost (JMD million)	98.4	312.4	242.7	4,374.2	4,565.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reinvestment for Replacement (JMD million)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operation and Maintenance (JMD million)	0.0	0.0	0.0	0.0	0.0	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4
Total Cost (JMD million)	98.4	312.4	242.7	4,374.2	4,565.0	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4
Benefit																			
North Kingston Area																			
Sewered Population					58,200	58,740	59,280	59,820	60,360	60,900	61,440	61,980	62,520	63,060	63,600	64,200	64,800	65,400	66,000
Annual Willingness to Pay (JMD238.50/month per capita) (JMD million)	0.0	0.0	0.0	0.0	0.0	168.1	169.7	171.2	172.8	174.3	175.8	177.4	178.9	180.5	182.0	183.7	185.5	187.2	188.9
Portmore Area																			
Sewered Population					107,300	109,520	111,740	113,960	116,180	118,400	120,900	123,400	125,900	128,400	130,900	133,620	136,340	139,060	141,780
Annual Willingness to Pay (JMD62.05/month per capita) (JMD million)	0.0	0.0	0.0	0.0	0.0	81.5	83.2	84.9	86.5	88.2	90.0	91.9	93.7	95.6	97.5	99.5	101.5	103.5	105.6
Total Benefit (JMD million)	0.0	0.0	0.0	0.0	0.0	249.7	252.9	256.1	259.3	262.5	265.9	269.3	272.7	276.1	279.5	283.2	287.0	290.7	294.5
Net Benefit (JMD million)	-98.4	-312.4	-242.7	-4,374.2	-4,565.0	173.2	176.4	179.6	182.8	186.0	189.4	192.8	196.2	199.7	203.1	206.8	210.5	214.3	218.0

Year	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Total
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	
Cost																	
Initial Investment Cost (JMD million)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9,592.7
Reinvestment for Replacement (JMD million)	0.0	0.0	0.0	0.0	0.0	1,134.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,134.2
Operation and Maintenance (JMD million)	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	2,292.9
Total Cost (JMD million)	76.4	76.4	76.4	76.4	76.4	1,210.6	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	13,019.8
Benefit																	
North Kingston Area																	
Suwered Population	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	66,600	
Annual Willingness to Pay (JMD238.50/month per capita) (JMD million)	190.6	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	830.3	15,140.7
Portmore Area																	
Sewered Population	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	144,500	
Annual Willingness to Pay (JMD62.05/month per capita) (JMD million)	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	107.6	3,024.6
Total Benefit (JMD million)	298.2	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	937.9	18,165.3
Net Benefit (JMD million)	221.8	861.4	861.4	861.4	861.4	-272.8	861.4	861.4	861.4	861.4	861.4	861.4	861.4	861.4	861.4	861.4	5,145.5

EIRR	-3.52%
NPV	-5,083.2

Source: JICA Survey Team

7.3.6 Sensitivity Analysis

The sensitivity of the EIRR is analyzed in the following cases with different conditions:

- Decrease in the construction cost by (a) 5%; and (b) 10%; and
- Lower population growth of 0.3% p.a. in both North Kingston and Portmore.

Results are presented in Table 7.3.2. EIRRs do not become positive in any cases with decrease in the construction cost. Population growth rate has a significant effect on EIRR due to benefits estimated based on WTP values.

Table 7.3.2 Results of Sensitivity Analysis

		(i) Construction Cost		
		Base	5% Decrease	10% Decrease
(ii) Population Growth	Base 0.9% Growth in North Kingston 2.0% Growth in Portmore	-3.52%	-3.19%	-2.85%
	Lower Growth 0.3% Growth in North Kingston 0.3% Growth in Portmore	-5.89%	-5.56%	-5.21%

Source: JICA Survey Team

7.4 Conclusion

Financial analysis shows very marginal profitability of the project mainly due to the heavy project cost that does not match the current tariff level. This could be interpreted as need to reduce or divide the project scope and need for tariff increase. However, as for the tariff level, results from the social survey indicate that the residents' actual expenses for sewerage service are already more than their willingness to pay and supposedly than their affordability; thus it will hardly be possible to increase the tariff level drastically in near future. Thus the project is deemed to be financially not feasible. The low WTP values have also resulted in difficulty to measure appropriate economic benefits of the project. EIRR of negative 3.52% indicates the project is not economically feasible based on benefits estimated as WTP. Besides cutting down on the project cost by reducing project scope, it is imperative to identify additional economic benefits such as improvement of public health, positive impacts on environment, increase in land values, tourism industry promotion, etc. in order to appropriately measure the economic viability of the project.

CHAPTER 8 CONCLUSIONS AND RECCOMMENDATIONS

Based on the information presented in the previous Chapters and the experiences in Jamaica during the execution of this Preparatory Survey for Kingston Sewerage Development project study, the JICA Survey Team makes the following conclusions and recommendations for the project implementation stage

1. Sewerage works in Jamaica have been seriously affected by budget shortfalls and the lack of a long-term O&M plan. The result is that almost all existing facilities, especially sewage treatment plants (STP), are in a state of serious deterioration and do not meet existing requirements for treated effluent quality. The Soapberry STP, constructed in 2007 in operation since 2008, is the centralized sewage treatment plant for entire KSA but currently receives inflow at only 30% of its current treatment capacity. Integration of the existing sewerage system to the Soapberry STP by means of decommissioning of existing small package plants and further expansion of sewered areas in KSA and Portmore should be the principal focus of the renovation of the sewerage system in KSA and Portmore.

2. Previous sewerage system development plans for KSA elaborated as the SENTAR and KBR studies were reviewed and updated during this survey by means of extension of target year to 2030 and integration of this Kingston Sewerage Development project. As a result almost the entire KSA area is covered in a three stage sewerage development plan. At the completion of this three-phased program, the sewered ratio in KSA should reach more than 80% by the year 2030.

3. The necessity for expansion of the Soapberry STP was assessed using basic assumptions for population growth and expansion of sewerage coverage to currently unserved areas. For the inflows from existing sewered areas and the selected first-phase project sites of KSA and Portmore, it is estimated the expansion of the Soapberry STP will probably not be required until at least 2020, possibly even 2025. However, in the case that further integration of Greater Portmore area into the Soapberry systems occurs in the near future, the expansion of Soapberry STP would be demanded earlier.

4. Soapberry STP is a lagoon based treatment plant with tertiary polishing. In principle this treatment process should have sufficient capacity to accommodate fluctuations of influent quality caused by septage discharged into the primary trunk sewer to Soapberry STP at Greenwich STW. However, current septage discharges contain substantial concentrations of grease, chemicals and other components which are harmful to the principal biological treatment process employed at Soapberry STP. Pretreatment should be regulated for commercial and industrial sources, including septage, prior to their discharge to the public sewerage system.

5. The four selected project sites for the first phase development in KSA are deemed as priority project sites because of their higher potential of affordability to pay sewerage tariff. On the

other hand, Portmore is the second largest urban area in the parish of St. Catherine and the level of households currently connected to the sewerage system is estimated at more than 95%. Nonetheless, local residents, especially those living near the existing STPs, suffer from offensive odors, poor treated effluent quality and sewage inundations from manhole overflows. Given that these customers have paid the sewerage tariff for a long time despite insufficient service level of sewerage works, improvement of the Portmore sewerage system is a very urgent issue for enhancement of the customer service.

6. A gravity sewage conveyance system, as opposed to the pumped alternative proposed in the original plan, is the selected sewerage development scheme for the Portmore area. Capital costs for the gravity option are slightly greater than those for the pumped option. However power consumption would be reduced by 300 MW-hr per year equivalent to the electricity cost by at least ¥8.3 million JPY per year as compared with the pumped option. Currently the electricity cost consumed in the sewerage facilities has reached approximately 30% of the annual expense of NWC, straining NWC's fiscal management capabilities. O&M cost savings is a principal focus of NWC. The proposed scheme contributes not only for sustainable sewerage works but also for mitigation of greenhouse gas emissions since electricity is predominately generated in Jamaica by non renewable sources.

7. For the project target areas of KSA, a gravity sewage collection system is proposed, also allowing for substantial O&M cost savings. The original routes of some trunk sewers were modified and shortened to eliminate the original circuitous route which passed through future sewered areas that are excluded from this project. As the result of these modifications, capital costs have been decreased by an estimated ¥864 million.

8. Gravity sewers must have a slope that is adequate to ensure the proper sewage flow. This can cause some sections in which the sewer pipes are relatively deep below the ground surface. The depth in some sections of the proposed sewers reaches around as much as ten (10) meters below the ground level. The potential use of trenchless technologies has been assessed for installation of deep sewer pipes under this project. The results of this assessment show that trenchless technology would be probably feasible for sewers more than five (5) meters deep. Trenchless technology could also improve the safety of the construction works, decrease construction periods, and mitigate potential nuisances such as vibration, noise and dust, and traffic congestion. It is recommended therefore that the bid process include international contractors which possess previous trenchless experience for construction of similar sewer systems.

9. Total project cost is estimated at approximately ¥12.2 billion including eligible and non-eligible portions. The project is composed of three contract packages: (1) Portmore ICB Project; (2) KSA LCB project; and (3) O&M ICB Equipment Procurement. The KSA project includes not only trunk sewers and street sewers but also house connections. Promotion of house connection is one of the challenges for NWC because of reticence of individual house owners to connect to the new systems on similar past projects. The inclusion of a capital cost

allowance for house connections should enhance both sewerage use and tariff collection.

10. The financial condition of NWC is being improved by means of organizational restructuring, tariff increases and improved management in recent years. However, NWC's operating profit has been negative since FY2006. Considered further reduction of operation cost is essential for the continued sustainable business of NWC.

11. For the project implementation stage, the establishment of a Project Management Unit (PMU) is essential for exclusive control of this project. The PMU would be under the direct control of the President of NWC in order to enhance the project management. PMU should have clearly demarcated responsibilities and obligations, enhancing the efficient expedition of bidding and disbursement processes required for proper project execution.

12. Introduction of a new concept for the NWC O&M system should be required in order to improve the current property management condition. This will allow NWC to optimize its O&M activities as well as improve its O&M budget allocation. Asset management has been broadly utilized in the public sector. The objectives of asset management are to: (1) secure safe use of property; (2) maintain service quality; and (3) optimize life cycle costs (LCC). These objectives fit well NWC's current sewerage management principle. NWC has developed GIS database system interfacing with customer information system (CIS). Those tools are very useful and integrated into the asset management. Prior to the asset management introduction, an implementation plan and responsible organization should be clarified. A practical action plan should be also prepared.

13. An Environmental Impact Assessment (EIA) has not been prepared for this project. NWC must prepare the EIA in accordance with local regulations. Jamaican regulations allow for both a full EIA and a "not full EIA" depending on project characteristics. A "not full EIA" is the simplified version of EIA reducing scope of survey in terms of qualitative and quantitative analysis. This type of EIA is usually applied to sewerage projects which do not include STP construction. NEPA, the Jamaican regulatory authority for environmental and social considerations, expressed the opinion that the "not full EIA" would be probably applied to this project although the final decision would be made at the basic design stage.

14. It is necessary to mitigate the minor negative impacts predicted to occur during the construction periods. Major negative environmental impacts are not forecast for this project. The expected minor impacts are not considered to be serious so that conventional countermeasures should be adequate for their control. There are no individual households or other private properties affected by the proposed sewerage facilities so that no population resettlement would be required under this project.

15. There are a number of pensioner households as well as female household heads in the project target areas, especially KSA. An individual house connection to the sewer network could be a financial burden for these people. The house connection allocation included as a part of the project budget should help to mitigate their financial concerns and promote individual house

connection.

16. FIRR was calculated in order to assess the financial sustainability of NWC for project implementation. FIRR is projected at 0.71% under current sewerage tariff, original estimated project cost and project life at 35 years. In parallel, sensitivity of FIRR was also analyzed in terms of increase of sewerage tariff and decrease of project cost. The result says the project cost decreased by 10% would result FIRR at 1.45%. The low FIRRs show the very marginal profitability of the project due to high project cost. Unless significant cost reduction such as reducing project scope is planned, the project is deemed financially not feasible. On the other hand, EIRR was calculated based on economic benefit estimated through WTP of sewerage customers in the subject area. Because of the high current tariff and alternative treatment methods used, WTP values are estimated quite low resulting in negative 3.52% indicating that the project is not economically feasible. Besides cutting down on the project cost, it is necessary to identify additional economic benefits such as positive impacts on environment in order to appropriately measure the economic viability of the project.

17. Performance index (PI) of the project is proposed as shown in Table 8.1.1

Table 8.1.1 Project Performance Indices

Performance Index	Reference Value (Actual Rate in 2009)	Target Value (2017) (2 yrs. after project completion)
Sewered population connected to Soapberry STP (person)	160,000 (estimated)	315,000
Inflow rate at Soapberry STP (m3/day)	30,000	64,000
Rate of facility utilization of Soapberry STP (%)	30	78
Street sewer covered ratio in KSA target areas (%)	0	100
House connection ratio in KSA (%)	0	100

Source) JICA Survey Team

18. The potential for sewage sludge fuelization should be investigated through another study. In general dried sludge contains around 60% of coal calorie so that the sewage sludge can be utilized as a fuel for a coal boiler or a biomass boiler. If sewage sludge fuelization is to be considered, dehydrate and/or drying facilities and biomass boiler would be required. Unfortunately, the design report of Soapberry STP was not available during the survey period so it was not possible to collect data on this possibility. For further study, specific information and actual characteristics of sludge should be surveyed and clarified.