PROJECT BRIEF
National Water Commission
Water Supply Improvement Project for the KMA and Other Rural Towns
July 2011

1.0 Introduction

An assessment of the water supply and sanitation systems in Jamaica has indicated that there is an urgent need for improvements and upgrades to be made to the existing infrastructure to meet growing demands and improve service delivery. Poorly maintained and limited equipment, outdated technology, and a shortage of technical staff are some of the challenges being faced by the National Water Commission (NWC) in the execution of its duties.

This document focuses on four specific project components related only to water systems upgrade. These include: (i) Rehabilitation of the potable water supply for Kingston and St. Andrew Area (ii) Rehabilitation of the potable water supply for the Kingston Metropolitan Area (KMA) (iii) Energy Efficiency improvements; and (iv) Institutional strengthening of the NWC. The GOJ is requesting a loan operation of US$133 million to fund the implementation of the various projects under these Components.

The identified project designs and associated works to be completed for each project has indicated that keen attention must be paid to the overall environmental footprint of the proposed projects, both on an individual and collective basis. The improvements to be made are likely to have social, economic and environmental benefits during the construction and operational phase of the project. However there can be negative environmental and social impacts, in the absence of proper and effective mitigation strategies and plans. In order to have a comprehensive understanding of the potential environmental and social impacts the water systems project activities are likely to have, it is necessary for an Environmental and Social Analysis (ESA) to be prepared.

The ESA will provide an overview of proposed works and development activities for each of the four (4) project components to be funded by the IDB and implemented by the NWC. The ESA will examine the proposed scope of works for each project component and assess, using an established set of criteria, the potential environmental and social impacts that are likely to occur within the preconstruction, construction and operational phases of the projects. It is important to note that this ESA will examine the impacts of the projects, based on preliminary engineering designs and works.

2.0 Background of Water Sector in Jamaica

The water sector in Jamaica is supported by several agencies, key amongst which is the Water Resources Authority (WRA). The WRA has responsibility for the regulation, control and management of Jamaica's water resources and is the sole water management agency in Jamaica. The WRA oversees the withdrawal of water from over 640 wells across the island. The NWC and the National Irrigation Commission (NIC) are the other two major players within the sector and are responsible for potable water supply and irrigation utility services respectively.

The NWC is a statutory organisation charged with the responsibility of providing potable water and wastewater services for the people of Jamaica. It produces more than 90% of Jamaica's total potable water supply from a network of more than 160 underground wells, over 116 river sources (via water treatment plants) and 147 springs island wide.

Water provided to the population is taken from two major sources: surface water and groundwater. Surface water comes from reservoirs and rivers while groundwater comes from wells that the NWC drills into aquifers[1]. Some wells are relatively shallow, 15 to 30 meters (50 to 100 feet) deep; others are much deeper. Springs are another source of water which begin underground as groundwater. More than 60% of Jamaica's water supply is from underground sources (NWC, 2011)[2].

The Jamaica Survey of Living Conditions (PIOJ, 2011) estimated that 93% of the Jamaican population had access to safe potable water supplies in 2008; 18 percentage points higher than 2005 figures. Within the urban areas, an estimated 98% of persons had access to potable water supplies, compared to 89% in rural areas. Access to water, was via private household connections for 87% of persons in urban areas compared to 47% in rural areas; where an estimated 30% still access water from untreated sources. In the KMA, between 70-80% of households are said to have formal household connections. In spite of the high levels of water coverage in both urban and rural areas, the quality of the water supply and service has remained more inconsistent and unreliable.

The NWC is the largest provider of domestic and commercial water supply on the island and has noted that poor maintenance and highly depreciating infrastructure has led to an overall poorly operated water distribution system. Water service disruptions have become increasingly frequent in both urban and rural areas as the supporting infrastructure has become old and dilapidated. It has been estimated that more than one-third (⅓) of the current population has services that can be considered inadequate. The water services sector, which has been undergoing revamping within the last decade in response to mounting public criticisms, has been plagued by the following issues:

a. Competition for water sources
b. The need to protect surface water from pollution sources
c. Groundwater contamination
d. Unreliable and insufficient water supplies during the dry season
e. Poor water quality at source
f. High treatment costs
g. Lack of convenient access to potable water by rural households
h. Reliance on untreated water from streams and rivers by significant proportion of the poor
i. Resistance to increasing the price paid for water

In the KMA, water theft and widespread illegal connections has limited the revenue earnings for the NWC from the water sector, and has remained one of the more pressing issues affecting the water service delivery system in the region. With an estimated 40% of the island's population living within the KMA, the reduction in the levels of unaccounted for water (UFW) and non-revenue water (NRW) has become a priority issue. The NWC has indicated that improvement in the water service delivery system will require consumers having to pay more for water, but this has been met with increasing resistance by the public. Frequent lock-offs, leaking mains, and poor water quality are few of the issues raised by consumers as their reasons for not being willing to pay a higher cost for water services.

[1] An aquifer is an underground geologic formation which contains and transmits groundwater
[2] http://www.nwcjamaica.com/FAQs.asp#new3

The current consumption pattern and the non-corresponding revenue earning, has made improvement works necessary to ensure the sustainable growth of the water supply delivery system in Jamaica.

3.0 Project Description

This section provides a brief overview of the activities and associated works of each project. The intention is to give an account of the various features of, and components associated with the projects. These include the location, design, size and general layout (footprint), engineering and design works, phasing of implementation (including scheduling), construction and operational activities, project team composition and implementing agency, population to be served and the associated civil and infrastructural works.

3.1 Project Team

The National Water Commission will be the executing agency on all project components with support from other key government agencies.

3.2 Component 1 Design Elements

1. Component 1 comprises the rehabilitation of the potable water supply for Kingston and St. Andrew Area (KSA). The new IDB loan will finance the completion of the works designed under IDB LO-1559/OC-JA – the Kingston Water and Sanitation Project (KWSP), including the rehabilitation of selected water treatment and production facilities; and reduction of commercial and physical losses which comprise non-revenue water (NRW) in the KSA.

The NWC's operating efficiencies are very low especially in the areas of NRW and energy consumption. This is partly due to the state of the existing assets as well as operating practices. NRW is estimated (due to inadequate metering) to be in excess of 65%, despite a number of interventions. Energy costs are approximately 30% of total operating costs.

A perennial challenge facing the NWC has been an inability to recover the full cost of service from consumers. This is partly due to inadequate tariffs as well as excessive losses and inefficiencies. The existing socio-economic challenges in Jamaica also contribute to the financial difficulties being faced by the utility. In order to address the financial viability issues, NWC will need to grow its revenues, improve collections, reduce costs and practice improved financial management.

Component 1 also includes:

1. an artificial limestone aquifer recharge system at Inswood designed to sustain the water resource capacity in western Spanish Town;
2. construction of a Relift Scheme with a new pumping main from Ferry to the Rock Pond Water Tank in Red Hills to address the deficit in supply in the Forest Hills/ Red Hill areas with water from the new Rio Cobre Water Treatment Plant;

Component 1 is a US$103 million investment with IDB funding through the loan US$84.5 million.

1. Rehabilitation of Potable Water Supply Systems

The overall goal of these extensive rehabilitation works is to ensure that water production facilities are being operated at their maximum (design) capacity and under this component twenty six (26) water production stations will be rehabilitated and two (2) water treatment plants (**Table 1** and **Table 2**). The rehabilitation works to be carried out on the water production facilities will include:

a. Distribution main replacement
b. Installation of bulk flow and electromagnetic flow meters
c. Assessment and where necessary replacement of the pumping equipment, chlorination and motor control centres

Table 1 - Water Production Facilities to be Rehabilitated

1. White Marl Wells 1, 2 & 3
2. Ferry Relift
3. Molynes Road Booster
4. Gordon Town Relift
5. Gordon Town Reservoir
6. Kirkland Heights PS and Reservoir
7. Brentwood Reservoir and Relift
8. Chancery Hall Reservoir and Chancery Hall Heights Relift Station
9. Chancery Hall Estates Reservoir # 1and Relift pumping Station
10. Chancery Hall Estates Reservoir # 2 and Relift pumping Station
11. Chancery Hall well
12. Chancery Hall Heights Reservoir #3
13. Forest Hill Well
14. Sterling Castle Reservoir
15. Rock Pond Reservoir
16. Hydra Drive pumping station
17. Forest Hill reservoir and relift station
18. Havendale No. 2 Well
19. Havenmeade PS
20. Montgomery Corner Well & reservoir
21. Ferry Hill Reservoir
22. Ursa Major Reservoir
23. Hope Pastures Reservoir
24. Hope Pastures Pumping Station
25. Hope High Level Pumping Station
26. Hope High Level Reservoir

The Mona and Hope Water Treatment Plants, a component of the KWSP will be rehabilitated under this new IDB loan. Project works will include minor rehabilitation of the raw water collection, transmission and storage facilities. The aqueduct supplying raw water to the Hope Water Treatment Plant will also undergo minor rehabilitation works.

Table 2 - Water Treatment Plants to be Rehabilitated

Mona Water Treatment Plant capacity: 16.0 imgd (840 lps)	Hope Water Treatment Plant capacity: 6.6 imgd (350 lps)

(Note: imgd = imperial million gallons per day; lps = litres per second)

Appendix 1 provides details on the work to be done on the 28 facilities.

2. Reduction of non-revenue water (NRW)

Activities under the NRW project include the following:

1. Water Distribution Development which includes building a calibrated computer model for water distribution throughout KSA.

2. Mains replacement and leakage reduction and control aimed at reducing NRW in the KSA to 25% of production by hiring a NRW Reduction Specialist Contractor (NRWSC) during an agreed period under a performance based arrangement. The activities to be undertaken will include:
    a. Source metering
    b. Establishing District Metering Areas (DMAs)
    c. Quantifying Baseline Flows (MNF[3])
    d. Constructing QMS[4]/GIS[5] database
    e. Assessing DMA consumption
    f. Identifying illegal connections
    g. Assessing in property wastage
    h. Active leakage control
    i. Mains replacement
    j. Leak repairs
    k. Replacing/Refurbishing pressure reducing valves (PRVs)
    l. Establishing distribution supply zones
    m. Maintaining and improving the calibrated computer model for water distribution

3. Rehabilitation of Water Supply Networks in Forest Hills and Red Hills

A key aspect of Component 1 is the reduction of leakage from the water distribution network in sections of St. Andrew, improving operational efficiency and reducing the costs of maintenance.

The cost of water delivered via the Forest Hills System to the Forest Hills/Red Hills areas is significantly higher than the average cost of water produced in Kingston and St. Andrew. This makes it particularly important to address the level of NRW in this area. NRW is the difference between the volume of water produced and the volume billed.

The plan is to carry out extensive refurbishing of the water distribution system associated with the Forest Hills System. This refurbishing will involve rehabilitating/ replacing/ upgrading existing pressure control facilities and the replacement of the distribution mains. The new distribution mains will range from 100 mm to 800 mm in diameter.

Rehabilitation works in the Red Hills/Forest Hill areas will include:

[3] MNF - Minimum Night Flows
[4] QMS - Query Management System
[5] GIS – Geographic Information System

a. **Leak detection** along 77 km of pipelines within the project area. Works to be conducted will include repair or replacement of pipes. Preliminary data has indicated there are approximately 231 leaks.
b. **Replacement of fittings** including replacement of thirteen (13) pressure reducing valves (PRVs), twenty four (24) gate valves, twenty (20) air valves and ten (10) fire hydrants.
c. **Installation of new automatic flow valves** (AVs) - Twenty (20) automatic flow valves installed to prevent overflow at four (4) reservoirs.
d. **Installation of District Meters (DMs) and Establishment of District Metering Areas (DMAs)**: This activity will result in the installation of district meters (DMs) and implementation of a customer zoning system. DMs will be installed in the designated zones and used to monitor production and usage of water supplies for each zone. This will assist the NWC in becoming more efficient at leak detection and production loss detection.
e. **Replacement of pumping station equipment:** Five (5) pumping stations will be rehabilitated.

Figure 1 - Red Hills and Forest Hills Area

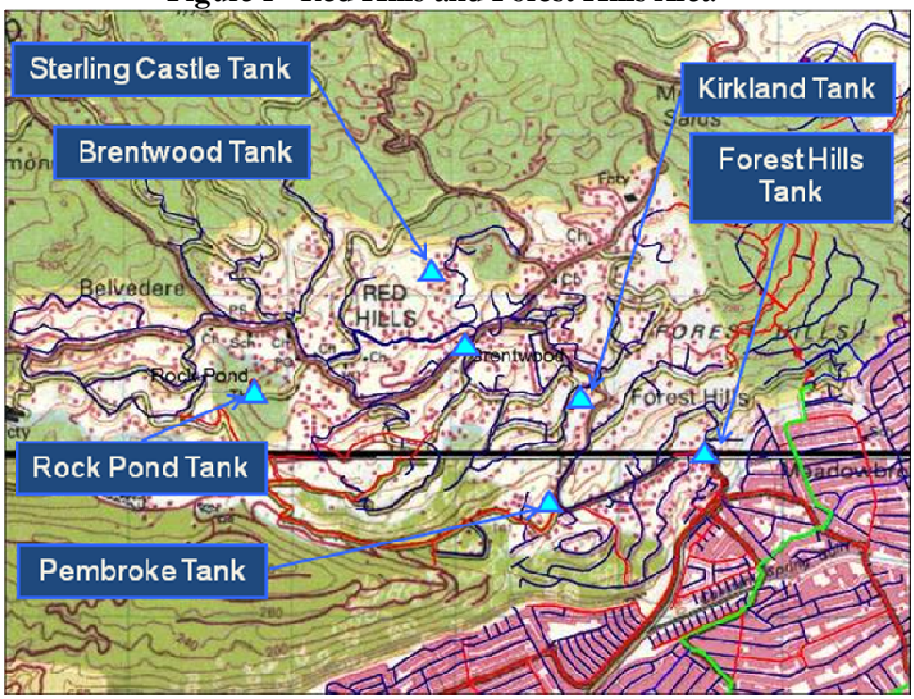
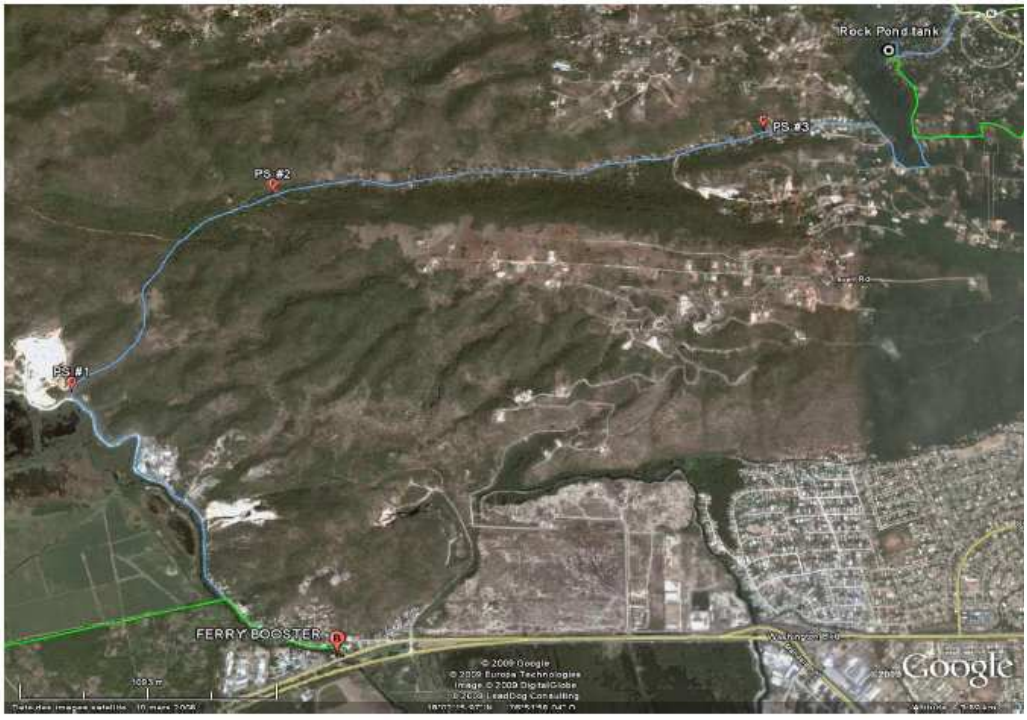


Figure 2 Google map showing pipeline from Ferry to Rock Pond Tank



4. Artificial Limestone Aquifer Recharge at Innswood

The site of the Artificial Recharge for Greater Spanish Town is located at Innswood in Western St. Catherine. The Artificial Recharge work comprises the establishment of facilities to increase the groundwater potential in the limestone aquifer, by treating and discharging surplus surface water into sinkholes and wells, in order to sustain the abstraction of wells located in the area due west of Spanish Town. These works are intended to divert surplus irrigation water from the Old Harbour Branch of the Rio Cobre Irrigation System into a treatment facility, treating the water, and then conveying and discharging the treated water into existing sinkholes and wells.

The activities will include:

1. Construction of Phase 1 of the treatment facility,
2. Construction of 2# settling basins and 4# wetland beds, splitter/ inlet/ collection chambers, inlet/outlet channels and pipes
3. Installation and construction of overflow facilities
4. Construction of boundary fence and gate
5. Construction of a raw-water intake structure,
6. Installation of approximately 1,140 m of new 800 mm diameter raw-water pipeline, with an access road over the pipeline,
7. Installation of approximately 950 m of new 800 mm diameter treated-water pipeline, with an access road over the pipeline,
8. Installation of approximately 50 m of new 60 mm diameter treated-water pipeline, with an access road over the pipeline,
9. Construction of access roads, inlet pipework and observation/inflow-monitoring facilities for 3# sinkholes,

10. Construction of access roads, inlet pipework and observation/inflow-monitoring facilities for 2# existing deepwells

The proposed scheme at Innswood is to divert water from the Old Harbour Canal through a series of detention ponds and constructed wetlands basins to reduce turbidity and suspended solids and improve the canal water prior to recharge.

The water retained within the constructed wetlands basins will then flow by gravity to the 3 No. sinkholes and 1 No. borehole within the Innswood area via pipes or open channels. The use of a borehole placed in a strategic position has been proposed to help distribute recharge waters evenly into the aquifer over the Innswood area, maximise the recharge rate and lessen the effects of groundwater mounding.

The design of the detention basin scheme is based on the following hydraulic parameters:

- Maximum flow rate of 36 Ml/d.;
- The sediment trap efficiency is based on best practice design which suggests approximately 1 day hydraulic retention time at the average wastewater flow rate, as most settleable and suspended solids are removed within this time period. The settling zone should be deep enough to provide adequate accumulation and storage of settled solids, but shallow enough to allow the growth of emergent vegetation.
- Retention time of 24 hours;
- Depth of water in the pond of approximately 2 m;
- 3 No. operational ponds to be used; 1 No. additional pond to provide contingency during maintenance of the operational ponds.
- Length to width ratio of each pond is selected to encourage plug flow.

The design of the constructed wetland basins is based on the following hydraulic parameters:

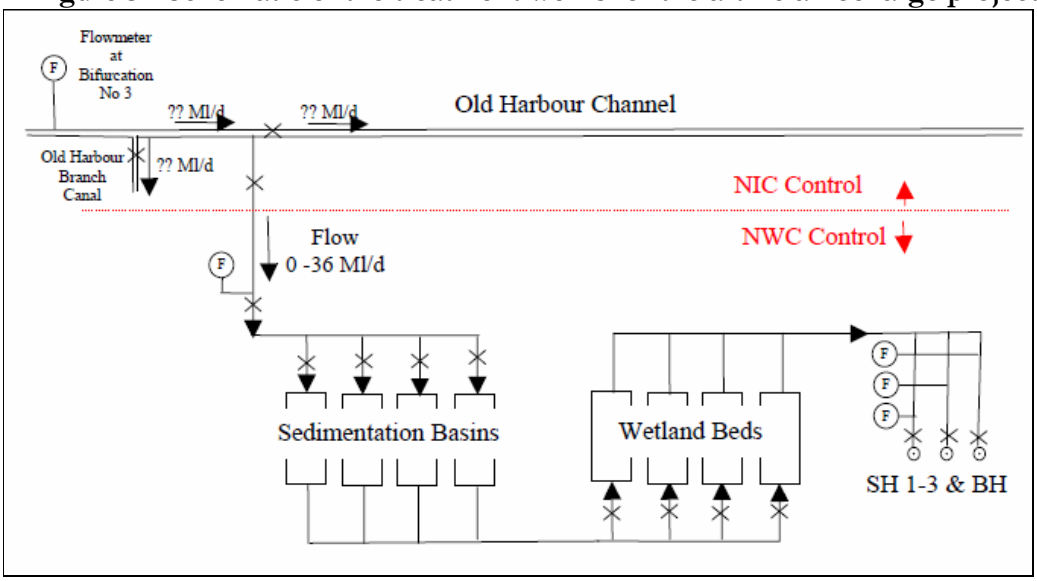
- Maximum flow rate of 36 Ml/d.;
- A hydraulic loading rate of 1.2 $m^3/d/m^2$
- Depth of water in the pond of approximately 0.5 m;
- 3 No. operational ponds to be used; 1 No. additional pond to provide contingency during maintenance of the operational ponds.
- Length to width ratio of each pond is selected to encourage plug flow.

The conceptual design has also considered the layout of the scheme with regard to topography. The area of land slopes to the southwest from a maximum elevation in the north eastern part of the site at 26.5 m aSL to 20.89 m aSL in the southwestern part of the site. The proposed system will feed the sinkholes or boreholes through a gravity feed system of open channels or pipes, therefore the topographical profile of the site is suitable for the proposed scheme.

The detention and constructed wetland basins will have the facility to be fed individually. Each basin will also have an individual outlet to waste, i.e. during storm events or events where high turbidity/suspended solids is experienced the water feed from the canal may be stopped.

Figure 3 shows a schematic of the proposed artificial recharge project and **Appendix 3** shows the location of the proposed works in relation to the NIC Irrigation Canal and Spanish Town.

Figure 3 - Schematic of the treatment works for the artificial recharge project



5. *Ferry Station To Rock Pond Water Tank*

The inadequacy of water supply has been a major constraint to the further development of areas such as Plantation Heights and upper sections of Red Hills (Belvedere, Coopers Hill, Cypress Hall, etc.) in the north-western section of St. Andrew. A number of proposed housing developments have not being permitted in these areas by the planning authorities because of the limited supply of water there.

The existing supply to these areas is largely based on the water obtained from the Forest Hills Water Supply System. This system comprises the Forest Hills well and a series of relift pumping facilities. This system is now the only means to serve the large residential community of Forest Hills, Kirkland Heights, Brentwood and Sterling Castle. The supply to these communities is therefore vulnerable to long disruptions in supply in the event of failure in elements of this supply system.

It is proposed to construct a multiple relift water supply scheme to move some one (1) mgd of the additional water that will be made available at the Ferry Pump Station from the new Rio Cobre Water Treatment Plant into areas such as Plantation Heights, Sterling Castle (upper Forest Hills/Red Hills) and onwards to areas such as Coopers Hill. This new scheme will comprise:

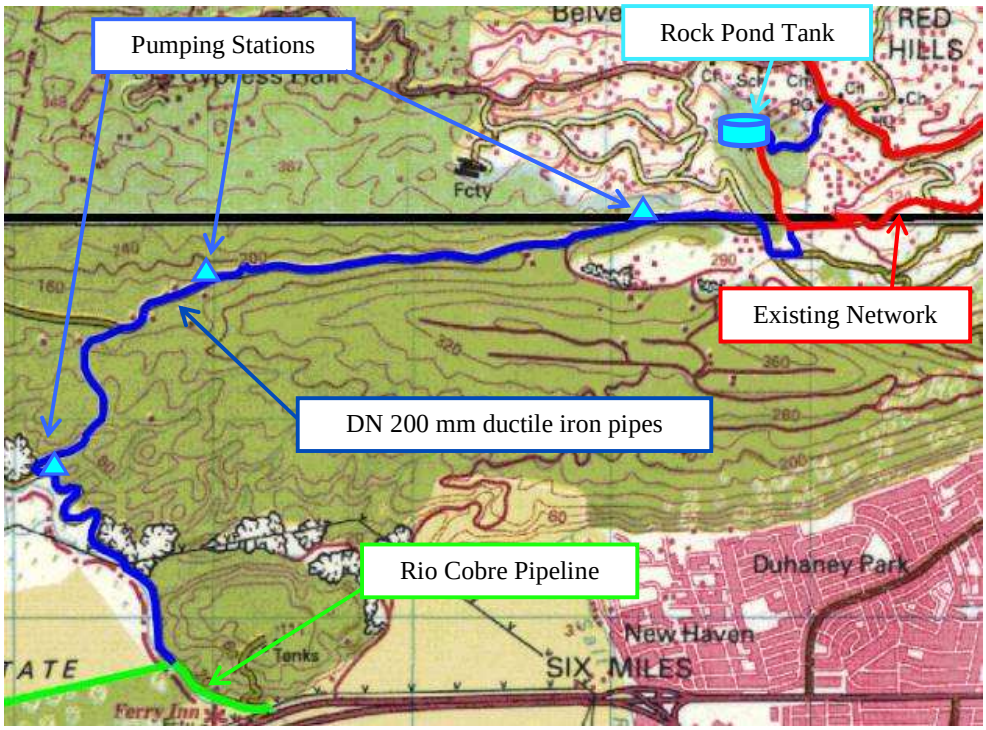
- Six (6) kilometres of 200mm diameter ductile iron pumping mains;
- Three pump stations (3x120 kW pump); and
- Three water storage tanks each 45 m^3 storage capacity
- Construction of one (1)70 kW pump to boost water from Rock Pond reservoir to Red Hills distribution system.

For the pipeline from Ferry to the Rock Pond tank (upper Red Hills), the 200 mm diameter pumping main will be laid under the Ferry parochial road; it will then follow a section that will

be cut through the hill by Caymanas Estate and then follow a parochial road up to Rock Pond in the upper Red Hills area.

This project has already received a permit from the NEPA (Appendix 2).

Figure 4 - New Pipeline Ferry to Rock Pond Tank, Forest Hills



6. *Preliminary Project Implementation Schedule*

This Component is expected to be implemented throughout the entire programme scheduled from 2011 to 2015.

3.3 Component 2 Design Elements

Component 2 comprises water supply improvement works in selected rural areas adjoining the KMA.

Improvement works under Component 2 is a US$25 million investment in the water supply sector with the IDB providing US$20 million under the loan.

1. *Water Supply Improvement works in Rural Towns*

Rehabilitation activities aimed at water supply improvement in rural areas, will be carried out in three towns: Mandeville, Old Harbour and May Pen. Project activities include:

1. Source improvement and/or development
2. Repair, replacement and/or upgrade of distribution mains
3. Reduction in the levels of NRW:
    a. **Leak detection**: leak detection activities will be carried out along existing pipelines within the project areas. Works to be conducted will include repair or replacement of pipes.
    b. **Replacement of fittings**: this will include replacement of pressure reducing valves (PRVs), gate valves, and air valves.
    c. **Installation of new automatic flow valves** (AVs): automatic flow valves will be installed to prevent overflow.
    d. **Replacement of pumping station equipment**

This part of the project is still at the conceptual stage and there are no designs available as yet.

Additional details are provided at **Appendix 4.**

2. Preliminary Project Implementation Schedule

The water supply improvement works in rural towns is expected to commence in 2012 and extend over a period of 24 months, concluding in 2014.

3.4 Component 3 Design Elements

The conceptual framework for the Energy Efficiency Improvement Project (EEIP) was finalised based on the recommendations of the RG-T1605 "Energy Efficiency for Caribbean Water and Sanitation Companies." The main goal of the Energy Efficiency Improvement Project (EEIP) is the reduction in energy consumption and improvement in the quality of service delivered by the NWC to its consumers. This will be achieved by improving the electromechanical efficiency of selected water production facilities (pumping/lift stations, reservoirs, wells, etc.) in urban and rural areas. To achieve this goal, there are three (3) target objectives:

1. Optimizing the efficiency of pumping systems
2. Implementing improvements in the operation and maintenance framework of the NWC
3. Implementing a company-wide staff training programme in the areas of operation, maintenance and energy efficiency at pumping stations.

This Component is divided into four (4) sections:

1. **Structural measures for immediate implementation** - the actions the company will make to formalize the operational structure of the Energy Management Committee (EMC) and initiate its activities.
2. **Investment actions for immediate implementation** - investments that the company will make to strengthen areas of existing operation and maintenance.

3. **Short term investment actions** - investments that the company will implement in the short-term, such as replacing equipment that is working inefficiently and operational improvements in pumping stations with simple payback (less than 1 year).
4. **Medium term investment actions** - investments that the company will implement in the medium-term, such as replacing equipment that is working inefficiently and operational improvements in pumping stations that have a longer payback period (more than 1 year).

The IDB is funding the total value of this Component at US$14 million.

1. Rehabilitation of Pumping Equipment

The rehabilitation of inefficient pumping equipment will be undertaken in the short and medium term. Rehabilitation works will include the replacement of pumping equipment and improvement of electric motors' operation to increase and improve overall operating capacity of the pumps at these water production facilities in urban and rural areas of the island.

Table 3 outlines the stations and the number of pumps to be rehabilitated in the short and medium terms.

Table 3 - Water Production Facilities to be Rehabilitated under the EEIP

Short-term Action Projects	No. of pumps to be rehabilitated	Medium- term Action Projects	No. of pumps to be rehabilitated
Hope F/P	7	Greater Mandeville Peppers wells	3
Mineral Heights	1	Duhaney Park	2
Woodside/May Pen	4	Cavalier Well	1
Iterborale	5	Martha Brae	2
Aqualta Vale	2	Logwood	2
Great Mandeville Porus	5	Negril	1
Greater Mandeville Gutters	2		
Great Mandeville Porus /Comfort	1		
Great Mandeville Porus/Broadleaf	1		

2. Preliminary Project Implementation Schedule

The proposed Energy Efficiency Improvement Project will be implemented in four (4) phases (**Table 4**). The EEIP is slated to commence in 2011 and conclude in 2013.

Phase 1: This phase will include the implementation of all structural measures and will last for a period of 4 months, beginning in month 1 of the project. This phase of the project focuses on the strengthening of the operational functions of the NWC. The activities to be carried out under this phase include:

a. Formalisation of the structure of the Energy Management Committee and the appointment of its members

b. Formalisation of the initial activities of the Energy Management Committee
c. Development of the energy management policies

The maintenance management system and training programme will also be implemented under Phase 1 of the project and will run for 3 years, covering the entire 36 month period identified as the implementation period for the EEIP.

Phase 2: This phase will include the implementation of investment (activities) recommendations. This phase known as the 'Shares of Investment' phase will result in the implementation of the short and medium term activities aimed at the rehabilitation of inefficient pumping equipment. Implementation actions in the short term (Measures 4 to 10 in **Table 4**), start in month 6 of the project and conclude in month 20. The actions for medium-term implementation (Measures 11 and 16 in **Table 4**), will be introduced in month 16 of the project and will be implemented until month 32.

Phase 3: Phase 3 of the exercise will involve the identification and selection of additional water supply and sewerage systems for energy efficiency auditing. The works will include the undertaking of detailed energy efficiency analysis of all the electro-mechanical equipment which are associated with these water supply and sewerage systems. The findings and recommendations of the analysis will form part of the NWC's Energy Improvement Initiative Programme.

Phase 4: This phase of the Energy Efficiency Programme will include the design and continued implementation of the NWC's Energy Improvement Initiative Programme. The Energy conservation and efficiency programme for the Commission's electro-mechanical facilities will include:

1. Replacement of old, inefficient and standard duty motors
2. "Right sizing" of pumping units
3. Automation of the process of procuring, treating and distributing potable water as well as the collection, treatment and disposal of wastewater.
4. Power factor correction
5. Retrofitting of lighting systems

Implementation of the above works is scheduled to be completed within three years.

Table 4 - Implementation Plan for the EEIP

No.	Description	
Immediate Implementation		
1	Energy Management Committee.	
		Project management (3 years)
2	Improve the maintenance program	
		Capacity building (3 years)
		Purchase of portable measuring equipment
3	Improve the operation program	
		Capacity building

No.	Description	
		Measurement equipment purchase
Short-Term Implementation		
4	Improve the electromechanical efficiency of 7 pumps at Hope F/P	
5	Improve the electromechanical efficiency of 1 pump at Mineral Heights	
6	Improve the electromechanical efficiency of 4 pumps at Woodside/May Pen	
7	Improve the electromechanical efficiency of 5 pumps at Iterborale	
8	Improve the electromechanical efficiency of 2 pumps at Aqualta Vale	
9	Improve the electromechanical efficiency of 5 pumps at Great Mandeville Porus	
10	Improve the electromechanical efficiency of 2 pumps at Greater Mandeville Gutters	
11	Improve the electromechanical efficiency of 1 pump at Great Mandeville Porus /Comfort	
12	Improve the electromechanical efficiency of 1 pump at Great Mandeville Porus/Broadleaf	
Medium Term Implementation		
13	Improve the electromechanical efficiency of 3 pumps at Greater Mandeville Peppers wells	
14	Improve the electromechanical efficiency of 2 pumps at Duhaney Park	
15	Improve the electromechanical efficiency of 1 pump at Cavalier Well	
16	Improve the electromechanical efficiency of 2 pumps at Martha Brae	
17	Improve the electromechanical efficiency of 2 pumps at Logwood	
18	Improve the electromechanical efficiency of 1 pump at Negril	

APPENDIX 1 – REHABILITATION PROJECTS IN THE KMA

Water Production Facilities Design Details for 26 facilities in the KMA

1. Kirkland Heights, Forest Hill and Brentwood Reservoirs and Pumping Stations

The rehabilitation works is aimed at increasing the volume of the Kirkland Reservoir to 1,150m^3 and the Brentwood Reservoir to 1,550m^3. Works will include:

a. The installation of:
   - glass fused steel tank (1,150m^3 Kirkland and 1,550m^3 Brentwood), three (3) close coupled vertical turbine, can type pump sets (two duty and one standpipe) with supported fixtures and a new suction piping valve to each pump.
   - new discharge piping for each pump including check valve, gate valve, air valve, pressure switch and pressure gauge
   - Altitude Valve at inlet to reservoir at the Kirkland and Brentwood reservoirs.
   - new transformer and cabling to MCC to be used as new secondary power supply source at Kirkland and new JPS 415 volts, 3 phase, 50hz. Power supply to the site to replace exiting 220 volt supply
   - New MCC to include new indoor electronic soft starter switchgear for 3 no pumps/motors with dust and vermin proof enclosure, transient voltage Surge Suppression System and Power Factor Correction Capacitor Bank
   - Electrical services and lighting for upgraded electrical room and Lightning protection system
   - Inline water metering instrumentation with backup battery and memory storage.
   - New pole-mounted pothead and main cable at Forest Hills
   - Above ground PVCSWA armoured multi-core cable between transformer secondary and switchgear and underground XLPE armoured multi-core cable from switchgear to pump motors at Forest Hills.

b. Demolition of existing redundant buildings. In the case of Forest Hills, one existing building shall be modified to accommodate new MCC.
c. Construction of retaining walls at Brentwood
d. Testing for Water Tightness and Acceptance of the Forest Hills Reservoir

2. Chancery Hall Reservoir and Booster Pumping Station, Chancery Hall Heights Reservoir No. 1 and Pumping Station and Chancery Hall Heights Reservoir No. 2 And Pumping Station

Rehabilitation works at the Chancery Hall Network System will include the installation of:

a. New proposed pumps, one duty and one standby:

   - Chancery Hall Reservoir And Booster Pumping Station: 21.2 lps (336.2 USGPM); at 64.1m TDH; and motors 18.7 kW (25 HP) 415 volts three phase, 50 Hz

- Chancery Hall Heights Reservoir No. 1 and Pumping Station: 18.9 lps (299.7 USGPM); at 144.3 m TDH; and motors 37.3 kW (50 HP) 415 volts three phase, 50 Hz.
- Chancery Hall Heights Reservoir No. 2 and Pumping Station be 11.8 lps (187 USGPM); at 146.5 m TDH; and motors 22.4 kW (30 HP) 415 volts three phase, 50 Hz.

b. New discharge manifold connected to the existing rising main including check valve, gate valve, air valve, pressure switch, pressure gauge and pressure reducing valves (reservoir #2)
c. New MCC to include new indoor electronic soft starter switchgear for 2 No. pumps/motors with dust and vermin proof enclosure, transient voltage Surge Suppression System and Power Factor Correction Capacitor Bank, Each starter to be provided with protective devices against single phasing, phase reversal, under voltage and phase imbalance. There will be new miscellaneous works to support outdoor switchgear at chancery hall heights reservoir No. 1 and Pumping Station.
d. Associated controls to include Motor stop/start in accordance with water level in tank, motor restart after resumption of JPSCo. Ltd power, low water level protection and high discharge pressure protection (rising main Chancery Hall Reservoir "Booster" Relift and Chancery Hall Heights Reservoir #1 and Chancery Hall Heights Reservoir #1and Chancery Hall Heights Reservoir #2).
e. Associated controls to include Motor stop/start in accordance with water level in Reservoir at Brentwood, motor restart after resumption of JPSCo. Ltd power, low water level protection and high discharge pressure protection (rising main Chancery Hall Heights Reservoir #2and Chancery Hall Heights Reservoir #3).
f. Improved external lighting
g. Inline water metering instrumentation with backup battery and memory storage
h. Float Valve at inlet to reservoir at Chancery Hall Reservoir #2 and Chancery Hall Heights Reservoir #3.
i. Power Supply:

- Establishment of a new safer and more efficient incoming Power supply 415 Volts, 3 phase, 50 Hz to the site at Chancery Hall Reservoir And Booster Pumping Station
- Relocation of the pole with metering facility close to the main switchgear for accessibility and upgraded Electricity supply (240V, 3 phase, 50Hz to 415V, 3phase, 50Hz) at Chancery Hall Heights Reservoir No. 1 and Pumping Station
- Miscellaneous works on existing switchgear room and Upgrade of Electricity Supply from 220V, 3 phase, 50Hz to 415V, 3 phase, 50Hz at Chancery Hall Heights Reservoir No. 2 and Pumping Station

j. Miscellaneous concrete works to support pumps and switchgear.
k. Rehabilitation Works of Concrete and Steel Reservoirs

Chancery Hall Reservoir and Booster Pumping Station: rehabilitation works will be conducted on the reinforced concrete reservoir and include:

a. Demolishing of top concrete slab and constructing of new one
b. Cleaning of vertical concrete walls from both sides
c. Minor repair of local damage that might appear after cleaning and concrete patch repair with epoxy mortar and injection of possible cracks,

d. Breaking out of different areas of concrete walls where leakage was observed and clearing of reinforcement bars
e. Protection of exposed reinforcement bars against corrosion. Sika product such as SikaTop Armatec 110 EpoCem or equivalent shall be used
f. Concreting of broken area with high early strength mortar and improved bond strength.
g. Allowances will be included for the repair of visually assessed damage. These include concrete spalling repair if relevant.
h. The SikaRepair 224 product can be used as it is sprayable structural repair mortar, Fill the pores and level the surface with Sikagard 75 EpoCem epoxy mortar where necessary,

Chancery Hall Heights Reservoir No. 1 and Pumping Station: rehabilitation and restoration works will be conducted on the steel reservoir and will include:

a. Cleaning of vegetation around foundation and underneath of bottom steel plate of tank,
b. Preventative treatment of area situated underneath the bottom steel plate of tank with appropriate chemical products aiming to preclude future vegetation from growing up,
c. Restoration works to steel reservoir and foundation: (a) Demolishing and cleaning of top concrete mortar of RC ring wall, (b) Cleaning of outer face of RC ring wall, (c) Drilling and placing of dowels with epoxy mortar on the top of RC ring wall over 20cm height (d) Concreting of new RC annular beam, 20cmx20cm dimensions, on the top of ring wall, (e) Minor repair of local damage and patch repair with epoxy mortar of RC ring wall, (f) Removing of bolts where leakage is taken place and placing of new rubber joints between the two steel shells and fasten with new bolts (g) Sand blasting of steel shells and roof by dry method (h) Cleaning, applying of protective anti-corrosion layer and painting (i) Placing and fastening of missing bolts on roof and (j) Allowances will be included for the repair of visually assessed damage to RC ring wall. These include crack repair and concrete spalling repair if relevant.

Chancery Hall Heights Reservoir No. 2 And Pumping Station: rehabilitation of buildings and steel reservoir and foundation will include:

a. Refurbishment of existing building and inclusion of improved internal and external property lighting.
b. Rehabilitation works for the steel reservoir and foundation: (a) Preventive treatment of area situated underneath the bottom steel plate of tank with appropriate chemical products aiming to preclude future vegetation from growing up (b) Demolishing and cleaning of the top concrete mortar of RC ring wall (c) Cleaning of outer face of RC ring wall (d) Drilling and placing of dowels with epoxy mortar on the top of RC ring wall over 20 cm height (e) Concreting of new RC annular beam, 20cmx20cm dimensions, on the top ring wall (f) Minor repair of local damage and patch repair with epoxy mortar of RC ring wall (g) Sand blasting of steel shells and roof by dry method (h) Cleaning, applying of protective anti-corrosion layer and painting (i) Placing and fastening of missing bolts on roof (j) Allowances will be included for the repair of visually assessed damage to RC ring wall. These include crack repair and concrete spalling repair if relevant (k) Cleaning of vegetation around foundation and underneath of bottom steel plate of tank
c. Replace 1500m of 100mm pipeline with 150mm DI pipeline between CHH PS # 2 to CHH Res # 3:

3. Chancery Hall Deep Well, White Marl Well No 1, White Marl Well No 2, White Marl Well No 3 and Chlorination Building, Havendale No 2 Well, Montgomery Corner Well and Reservoir

The rehabilitation works for the water supply facilities will see the following works being undertaken:

a. Installation of :

- new vertical turbine deep well pump and motor set, including column shaft and bowl assembly, foot valves and screens and discharge head assy. The new pumps shall be installed in existing boreholes
- new discharge piping connected to the existing rising main to contact storage tank. Each pump discharge will be fitted with check valve, gate valve, air valve, inline pressure transducer with incorporated pressure switch and pressure gauge.
- Chlorination facilities, including contact storage tanks, safety equipment, leak detection equipment, system control panel
- New switch gear/Motor Control Centre
- Lighting protection system
- Inline water metering instrumentation with backup battery and memory storage
- New pole-mounted pothead and main cable (except Havendale),

b. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages.
c. Replacement of existing cables
d. Improve internal and external lighting (indoor and outdoor lighting)
e. Rehabilitation of existing buildings to accommodate MCC

4. Chancery Hall Heights Reservoir #3

Rehabilitation works will include:

i. Replace existing float valve
ii. Rehabilitation works for the steel reservoir and foundation:
iii. The reservoir shall undergo the same repair as the previous ones in the Chancery Hall Heights System.

5. Gordon Town Relift Station

Rehabilitation works will include:

a. Installation of:

- New close coupled vertical turbine
- New suction gate valve and piping to each pump an7d new discharge piping to rising main from each pump including check valve, gate valve, air valve, inline pressure transducer and pressure gauge

- New switchboard/ motor control centre
- New suction piping to be tied into existing outlet pipe and repair of existing suction line
- Lighting protection system
- New power factor correction capacitor bank and high efficiency motors, with heaters to prevent condensation

b. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages
c. Replacement of existing cables
d. Upgrading of external and internal lighting
e. Inline water metering instrumentation with backup battery and memory

6. Gordon Town Reservoir and Hope High Level Reservoir

i. Installation of new associated valving to reservoir, including, pilot operated level control float valve, check valve to reservoir as well as new gate valves.
ii. Rehabilitation of reinforced concrete reservoir: (a) cleaning of vertical concrete walls (b) breaking out of concrete walls to fix leaks and clearing of reinforcement bars (c) protection of exposed reinforcement bars against corrosion (d) filling of pores and levelling of surfaces (e) refurbish galvanised steel ladder, including general repairs and painting (f) removal of corroded open mesh covers (g) supply and install galvanised steel open mesh roof cover and (h) undertaking of water tightness test.

For the Hope High Level Reservoir, rehabilitation of reinforced concrete reservoir will include activities listed under (f), (g) and (h).

7. Hope High Level Pumping Station

Rehabilitation works will include:

i. Installation of:
    - New closed vertical turbines, can type pump sets and motors (horizontal pumps for Ferry relift
    - New suction gate valve and piping to each pump and new discharge piping to rising main from each pump including check valve, gate valve, air valve, inline pressure transducer and pressure gauge
    - New switchgear / motor control centre
    - New suction piping to be tied into existing outlet pipe and repair of existing suction line
    - New power factor correction capacitor bank and high efficiency motors, with heaters to prevent condensation
ii. Rehabilitate existing building : cleaning of vertical walls and roof of existing building, including general repairs and painting
iii. Refurbish existing doors and windows: (a) clean and repair any local damage (b) apply anti-corrosion protection and paint surfaces.

iv. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages
v. Replacement of existing cables
vi. Inline water metering instrumentation with backup battery and memory

8. Ferry Relift, Hydra Drive Pumping Station, and Molynes Road Booster

Rehabilitation works will include:

a. Installation of:
    - New closed vertical turbines, can type pump sets and motors (horizontal pumps for Ferry Relift
    - New suction gate valve and piping to each pump and new discharge piping to rising main from each pump including check valve, gate valve, air valve, inline pressure transducer and pressure gauge
    - New switchgear / motor control centre
    - New surge suppression valve and associated isolation valve and piping to replace existing system for suppression of surges (Hydra Drive pumping station)
    - Lighting protection system
    - New pole mounted transformer sub-station, power factor correction capacitor bank and high efficiency motors, with heaters to prevent condensation (Ferry Relift)
    - Glass fused to steel storage tanks (Ferry Relift)

b. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages (except for Hydra drive)
c. Replacement of existing cables (except for Hydra Drive)
d. Upgrading of external and internal lighting (Hydra Drive)
e. Inline water metering instrumentation with backup battery and memory (Hydra Drive)

9. Havenmeade Pumping Station

Rehabilitation works will include the following works:

a. Installation of:
    - New twin compartment rectangular concrete storage tank
    - New close coupled vertical turbine, can type pump sets and motors.
    - New suction gate valve and piping to each pump and new discharge piping to rising main from each pump including check valve, gate valve, air valve, inline pressure transducer and pressure gauge
    - New surge suppression valve and associated isolation valve and piping to replace existing system for suppression of surges.
    - New switchgear/ motor control centre
    - Install lighting protection system

b. Improve indoor and outdoor lighting
c. Replace all existing electrical cables

d. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages
e. Inline water metering instrumentation with backup battery and memory
f. Soundproofing works of existing building to include padding of existing walls and slab with soundproofing membranes.

10. Hope Pastures Reservoir

Rehabilitation works will include:

a. New associated valving to existing reservoir
b. Rehabilitation of reinforced concrete reservoir: (a) cleaning of vertical concrete walls (b) breaking out of concrete walls to fix leaks and clearing of reinforcement bars (c) protection of exposed reinforcement bars against corrosion (d) filling of pores and levelling of surfaces (e) refurbish galvanised steel ladder, including general repairs and painting (f) removal of corroded open mesh covers (g) supply and install galvanised steel open mesh roof cover and (h) undertaking of water tightness test.

11. Mona-Hope Raw water Transfer Pumping Station

Rehabilitation works will include:

a. Removal of existing pipes, valves, pumps, cans, motors and motor control centres
b. Installation of:
    - New close coupled vertical turbine, can type pump sets and motors
    - New suction gate valve and piping to each pump and new discharge piping to rising main from each pump including check valve, gate valve, air valve, inline pressure transducer and pressure gauge
    - Above ground PVCSWA armoured multi-core cable between transformer secondary and switchgear and underground XLPE armoured multi-core cable from switchgear to pump motors.
    - New switchgear and motor control centre
    - New power factor correction capacitor bank complete with circuit breaker
    - New high efficiency motors with heaters to prevent condensation
    - Install lighting protection system
c. Improve indoor and outdoor lighting
d. Replace all existing electrical cables
e. Associated controls to include low well level protection, low discharge pressure protection, pressure switch with timer to Start/Stop Pump motor and electromechanical timers for pump restart after outages

12. Sterling Castle Reservoir

The following works are being undertaken to increase the volume of the Sterling Castle Reservoir to 1,020m^3 :

i. Installation of a new 730m^3 glass fused to steel tank to augment existing storage capacity (increasing it from 450 m^3 to 1120 m^3) at the location.
ii. Rehabilitation of inlet and outlet piping and valves
iii. Cleaning of vertical concrete walls from both sides. Minor repair of local damage that might appear after cleaning.
iv. Repair works including concrete spalling repair if relevant and patch repair with epoxy mortar and injection of cracks.

13. Rock Pond Reservoir

i. Install new Altitude Valve at inlet to reservoir to Rock Pond Reservoir
ii. Removing and placing of new sealing compound at the sliding joint;
iii. Repairs to existing tank including tank cleaning (internal and external), minor repair of local damage that might appear after cleaning, cleaning the spots of humidity, fill the pores and level the surface with Sikagard 75 EpoCem epoxy mortar or equivalent waterproofing on concrete wall.

14. Ursa Major Reservoir

i. Installation of
    - New one way, delay-fill, pilot operated level control altitude valves to reservoir as well as new gate valves and air valves.
    - Inline water metering instrumentation with backup battery and memory storage
ii. Removal of existing valves and pipes (where specified) for storage at NWC stores
iii. Rehabilitation of reinforced concrete reservoir:
    a. cleaning of vertical concrete walls
    b. breaking out of concrete walls to fix leaks and clearing of reinforcement bars
    c. protection of exposed reinforcement bars against corrosion
    d. filling of pores and levelling of surfaces
    e. refurbish galvanised steel ladder, including general repairs and painting
    f. removal of corroded open mesh covers
    g. supply and install galvanised steel open mesh roof cover and
    h. undertaking of water tightness test.

15. Ferry Hill Reservoir

Rehabilitation works will include:
i. Installation of:
    - Two (2) new glass fused to steel storage tanks to replace the existing ferry hill concrete storage reservoirs
    - New level control float valves to each reservoir as well as new gate and air valves
ii. Replacement of all air valves
iii. Rehabilitation of access road to provide ease of transport of storage tanks

APPENDIX 2 – PERMIT FOR FERRY TO ROCK POND TANK

NATIONAL ENVIRONMENT & PLANNING AGENCY
10 & 11 Caledonia Avenue, Kingston 5, Jamaica W.I.; Tel: (876) 754-7540/3 Fax: (876) 754-7595-6 Hotline: 1-888-991-5005
E-mail: ceo@nepa.gov.jm, Web Site: http://www.nepa.gov.jm

THE NATURAL RESOURCES CONSERVATION AUTHORITY ACT
The Natural Resources Conservation (Permits and Licences) Regulations, 1996

Permit to Undertake Enterprise, Construction Or Development in a Prescribed Area [Pursuant to Section 9 (2)]

Permit No. 2009-14017-EP00242

Application Date: 27 October 2009

The Permittee: National Water Commission

Of: 4 Marescaux Road Kingston 5

Is hereby authorized to undertake:

Jamaica Water Supply Improvement Project (Laying of pipelines greater than 15cm from Content District to Ferry and from Ferry to Red Hills)

At: Content Dist. to Ferry and to Red Hills, St. Catherine

In accordance with the terms and conditions specified in the Schedule.

This Permit is granted subject to the Terms and Conditions set forth in the Schedule below

SCHEDULE

The Natural Resources Conservation Authority under its mandate to ensure the proper management, conservation and protection of the physical resources of this island has pursuant to Section 9 of the Natural Resources Conservation Authority Act and the Natural Resources Conservation (Permits and Licences) Regulations 1996 established a system of permits for prescribed activities as mandated by the Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order, 1996). It is an implied condition of every permit that based on the information presented in the Project Information Form, the Application form and where applicable the Environmental Impact Assessment and any addendum or adjustments made thereto, that the Authority is of the view that the activity subject to all the conditions stipulated in this Permit is not likely to be injurious to public health or the environment. Where new regulations are made or existing regulations are amended by the Minister under the Natural Resources Conservation Authority Act 1991 or other statute this permit shall be deemed, upon promulgation of such regulations or statute to automatically be amended to conform with such regulations or statute.

This Permit comprises all five (5) pages of this document, the Permit Application and Project Information Form dated 28 August 2009 received and date stamped October 27, 2009 and Document titled "Jamaica Water Supply Improvement Project" and Project Brief received and date stamped October 27, 2009 and accompanying addenda.

Description of Permitted Activity

This Permit is for the laying of pipe lines greater than 15cm from Content District to Ferry and from Ferry to Red Hills. The design and construction complete of works for the replacement of the Asbestos Cement section of the Rio Cobre Pipeline:

(a) through the Bog Walk Gorge with 600mm ductile iron pipe laid below the main road

(b) of the 600mm and 750mm Asbestos Cement sections of the Rio Cobre Pipeline from the proposed location of the new Rio Cobre Surface Water Treatment Plant (adjacent to the eastern abutment of the existing Rio Cobre Irrigation Headworks Dam) through the existing Caymanas Tank (located on the Caymanas Golf Course) to the existing draw off to Portmore (in the Caymanas cane fields) and thence to Ferry in 800mm Ductile Iron pipe (with the existing mains over this complete routing subsequently disconnected and abandoned). The increase in nominal diameter for the replacement main will allow the full production of the new 15 migd Rio Cobre WTP of Component 4 below to be injected into the transmission pipeline for transfer through to Spanish Town and/or SE. St Catherine and/or KSA, as may be appropriate in the future, in a cost (energy) efficient manner

This component therefore addresses the issue of past frequent failures of the existing Rio Cobre pipeline - to mitigate the major disruptions to traffic movement in the Bog Walk Gorge and the major disruptions to the water supply of KSA, Greater Spanish Town and South-East St. Catherine (Portmore and Hellshire) generally that such past failures have caused and to secure the reliability of water supply from this major scheme to the afore-noted areas, at maximum availability, for the long term future.

Definitions

"Permittee" means the holder of this permit

"Authority" means the Natural Resources Conservation Authority established pursuant to Section 3 of the Natural Resources Conservation Authority Act.

"Representation" means any information implied or express upon which the Authority has relied to grant this Permit and include all the information contained in the application form, the Environmental Impact Assessment where applicable

and addenda and all supplementary documentation including but not limited to correspondence.

The Permittee hereby undertakes to comply with all the following terms and conditions:-

General Conditions

1. All works carried out pursuant to this Permit shall be performed under the professional supervision of trained personnel who are qualified and competent to carry out the functions and duties of the Permitted Activity and who are conversant with the accompanying safety requirements as they relate to workers, the public and the environment.

2. The Permittee shall not assign, or transfer or dispense with this permit or part with any benefit under it, except with the prior written consent of the Authority.

3. Any reference to time in this Permit shall be computed as at the date of this Permit.

4. The Authority reserves the right to alter, amend or introduce new conditions to this Permit at any time.

5. The Authority may in its sole discretion revoke or suspend this permit if it is satisfied that a breach of any term or condition, implied or express, subject to which this permit has been granted has been committed.

6. The Permit is granted subject to any existing legal rights of third parties.

7. This Permit does not dispense with the Permittee's obligations under any other law, nor does it authorize a contravention of any statute, the common law or breach of any agreement.

8. The Authority reserves the right to monitor the implementation of the permitted activity periodically and may initiate administrative and/or judicial action for any violation of any condition by the Permittee, its customers or guests, employees, servants, contractors or assignees.

9. A copy of this Permit shall at all times be placed in a prominent place at the location of operation (or business as the case may be) and shall be in such characters and in such position as to be conveniently read by the person having functions and duties related to the implementation of this Permit.

10. The Permittee shall maintain and keep in good repair all equipment used in carrying on the process (or operation) as the case may be. Maintenance shall be carried out in accordance with the manufacturer's recommendations or in such better manner or at such greater frequency as operational experience may show to be appropriate.

11. The failure of the Authority to enforce at any time or for any period any one or more of the terms or the conditions of this Permit shall not be a waiver of its right at any time subsequently to enforce all the terms and conditions of this Permit.

12. Any member of the Authority or any authorized officer of the said Authority may at any reasonable time, make such periodical inspections and investigations in respect of the activities that are herein permitted for the purpose of ascertaining whether the terms and conditions of this Permit are being observed or not and the Permittee shall allow such authorized officer to do such inspections.

13. If the permitted activity does not commence within five years after the date of this Permit, then this Permit is void and the Permittee shall re-apply for a new Permit.

Specific Conditions

1. The Permittee shall comply with all representations made in the Permit Application and Project Information Form dated 28 August 2009 received and date stamped October 27, 2009 and Document titled "Jamaica Water Supply Improvement Project" and Project Brief received and date stamped October 27, 2009 and accompanying addenda.

2. The Permittee shall apply to the Natural Resources Conservation Authority (NRCA) for a permit for the establishment of the Campsite for the project, to ensure that installations such as fuel storage, sewage treatment and disposal and vehicle access and egress meet the requirements of the Authority.

3. The Permittee shall submit to the Authority an Environmental Management and Monitoring Plan for the installations, within three (3) months of the date of the Permit. The Plan shall include, but not limited to a Mitigation Plan, an Environmental Monitoring Plan, and a Maintenance Plan.

4. The Permittee shall ensure that the installations are maintained by trained personnel in accordance with the approved Environmental Management and Monitoring Plan.

5. The Permittee shall ensure that the installations are operated and maintained in such a manner so as to prevent any significant adverse impact on the environment.

6. The Permittee shall ensure that drains are operated and maintained in such a manner so as to minimize any excessive sedimentation of the marine environment.

7. The Permittee shall implement measures such as wetting to ensure that there is no excessive sedimentation of the marine environment during the construction phase of the project.

8. The Permittee shall implement measures to ensure that there is no fugitive dust emission to create a nuisance during the construction phase of the project.

9. The Permittee shall implement measures for traffic flow and control as approved by the National Works Agency (NWA) and the Local Planning Authority.

10. The Permittee shall obtain approval from the National Solid Waste Management Authority (NSWMA) for the disposal of solid waste at an approved disposal facility, and a copy of the letter of approval shall be submitted to the Authority before any disposal of waste at the facility.

11. The Permittee shall shield mechanical and electrical equipment to ensure that during the construction activities, sustained noise levels do not exceed 70dB at thirty (30) metres from the source of the noise.

12. The Permittee shall confine construction activities between the hours of 7am to 7pm.

13. The Permittee shall submit a report on the status of the project during the construction phase to the Authority on a monthly basis, with copies to the Environmental Health Unit (EHU) and the National Works Agency (NWA). The report shall include, but not limited to:

    (a) activities already completed,
    (b) activities in progress,
    (c) mitigation measures being implemented,
    (d) breaches and resulting impacts,
    (e) measures implemented to mitigate the impact of any breach.

14. The Permittee shall develop an Emergency Response Plan for the project and shall submit the Plan to the Agency for approval within three (3) months of the date of the Permit. The Emergency Response Plan shall cover, but not be limited to,

    (a) Soil, air and water pollution,
    (b) Public and worker health and safety,

    for both the construction and operation phases of the project.

15. The Permittee shall notify the National Environment and Planning Agency (NEPA) in writing of the date when:

    (a) construction activities will commence, and
    (b) the installations will be commissioned

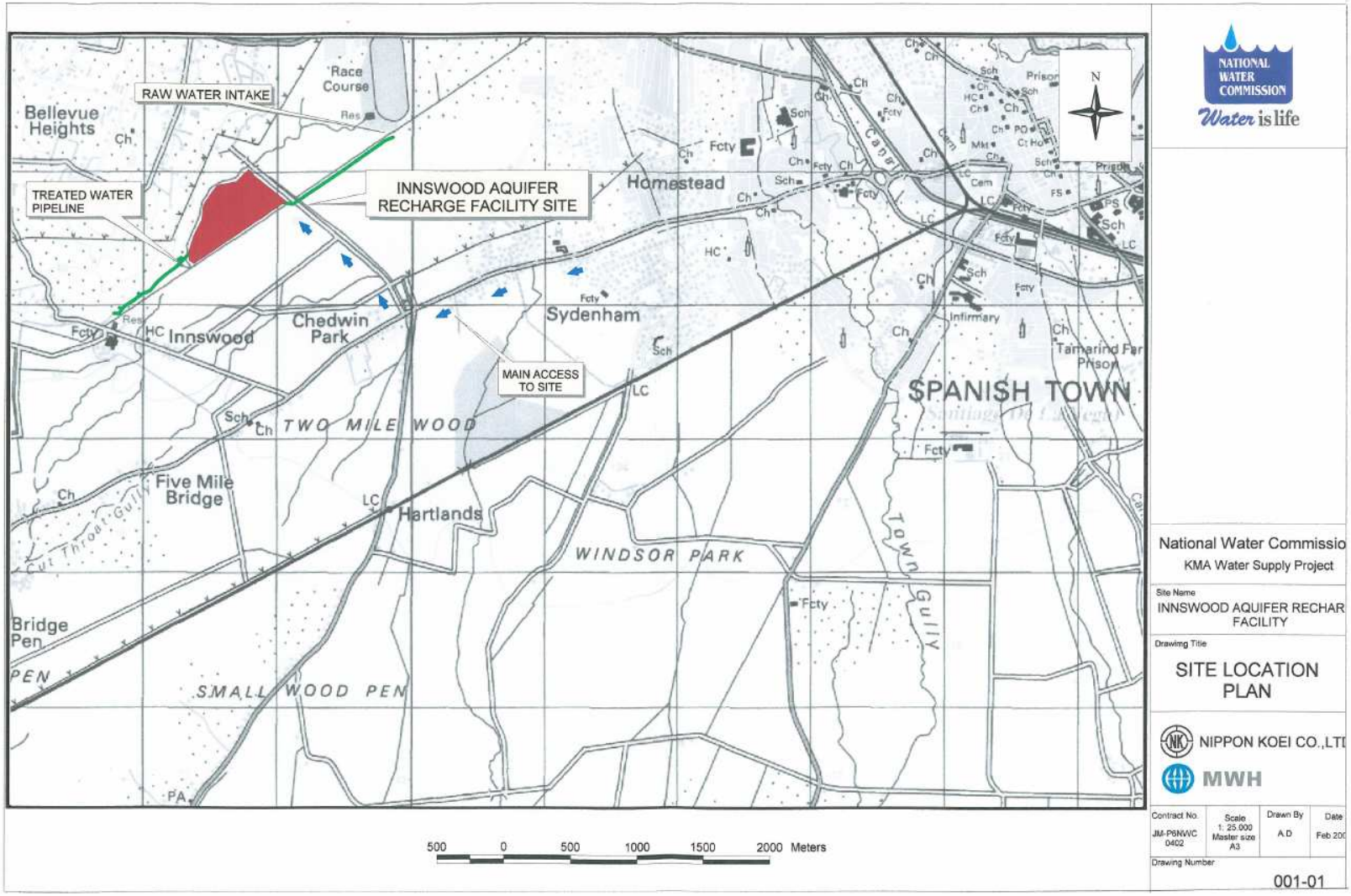
    at least two (2) weeks prior to commencement of construction and the commissioning.

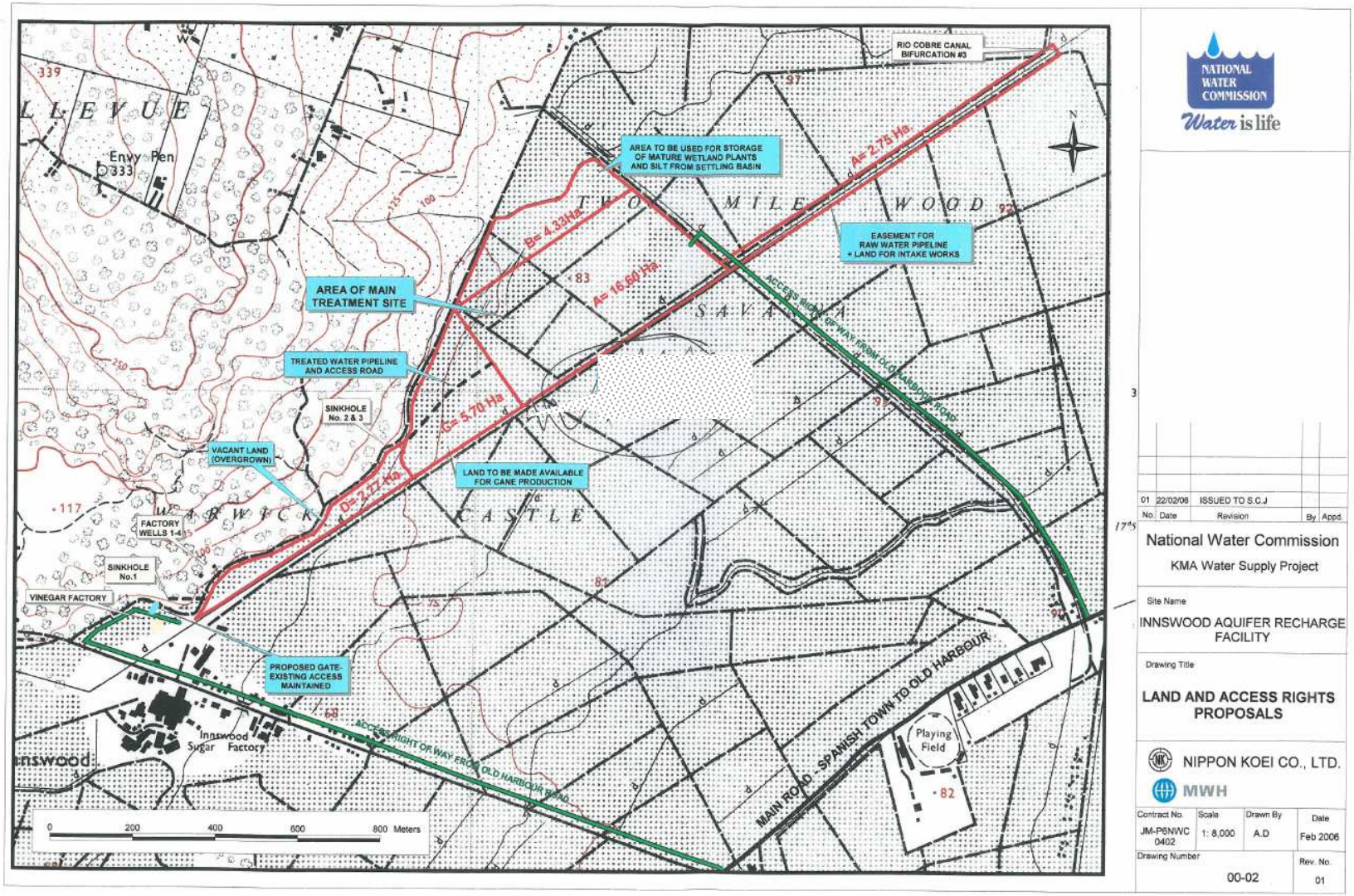
Dated the 18th day of December, 2009

Peter Knight., JP
for Natural Resources Conservation Authority

GILROY ENGLISH
Secretary
Natural Resources Conservation Authority

APPENDIX 3 – LOCATION OF AQUIFER RECHARGE PROJECT





NATIONAL WATER COMMISSION
Water is life

No.	Date	Revision	By	Appd.
01	22/02/06	ISSUED TO S.C.J		

National Water Commission

KMA Water Supply Project

Site Name

INNSWOOD AQUIFER RECHARGE FACILITY

Drawing Title

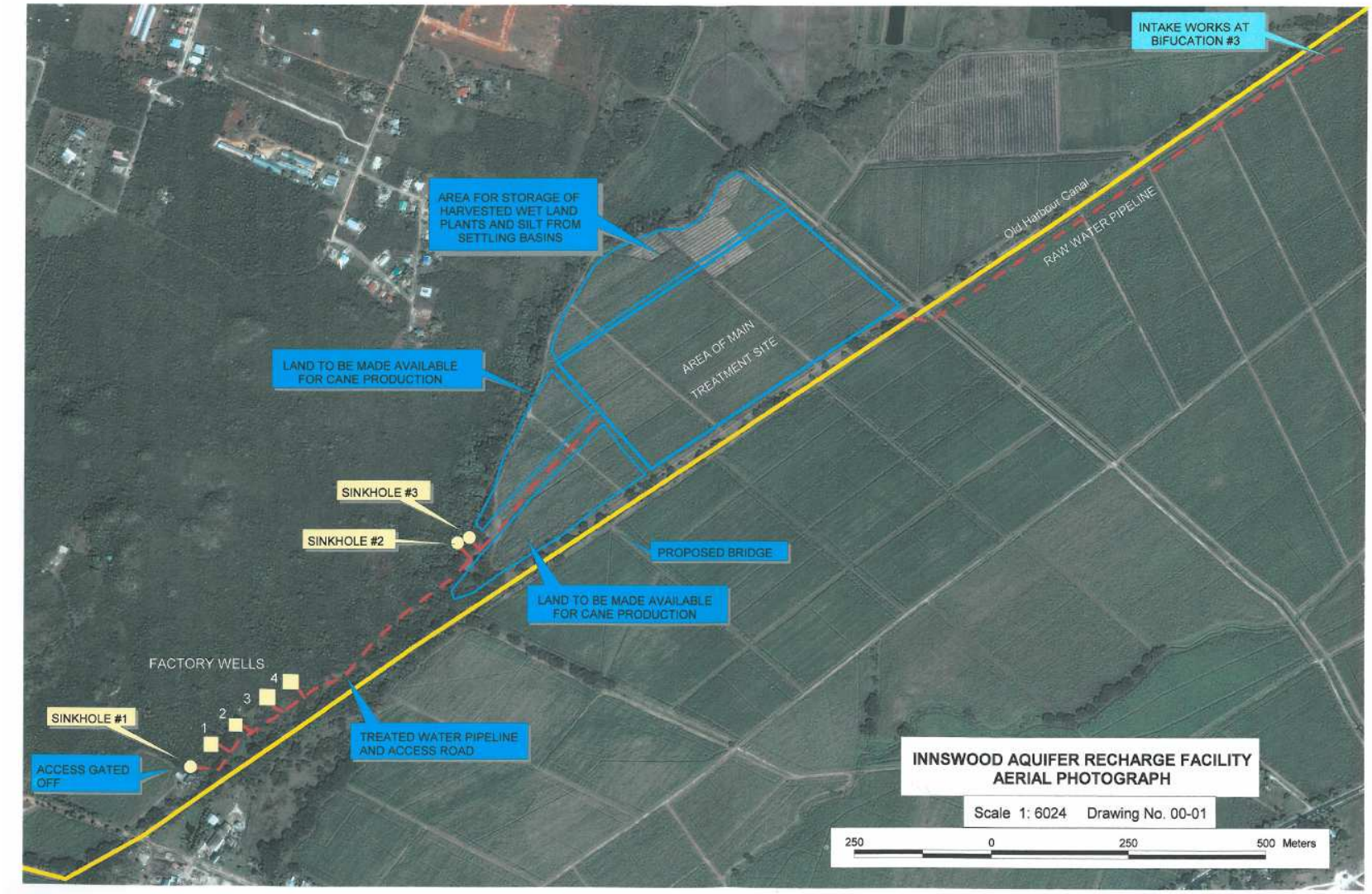
LAND AND ACCESS RIGHTS PROPOSALS

NIPPON KOEI CO., LTD.

MWH

Contract No.	Scale	Drawn By	Date
JM-P6NWC 0402	1: 8,000	A.D	Feb 2006

Drawing Number	Rev. No.
00-02	01


INTAKE WORKS AT BIFUCATION #3
AREA FOR STORAGE OF HARVESTED WET LAND PLANTS AND SILT FROM SETTLING BASINS
Old Harbour Canal
RAW WATER PIPELINE
AREA OF MAIN TREATMENT SITE
LAND TO BE MADE AVAILABLE FOR CANE PRODUCTION
SINKHOLE #3
SINKHOLE #2
PROPOSED BRIDGE
LAND TO BE MADE AVAILABLE FOR CANE PRODUCTION
FACTORY WELLS
1
2
3
4
SINKHOLE #1
ACCESS GATED OFF
TREATED WATER PIPELINE AND ACCESS ROAD
INNSWOOD AQUIFER RECHARGE FACILITY
AERIAL PHOTOGRAPH
Scale 1: 6024 Drawing No. 00-01
250 0 250 500 Meters

APPENDIX 4 – REHABILITATION IN 3 RURAL TOWNS

1. Old Harbour Water Supply Improvement
    - Graham Well
    - Davis Booster Station & Water Supply System
    - Old Harbour Bay water Supply

Graham Well Water Supply

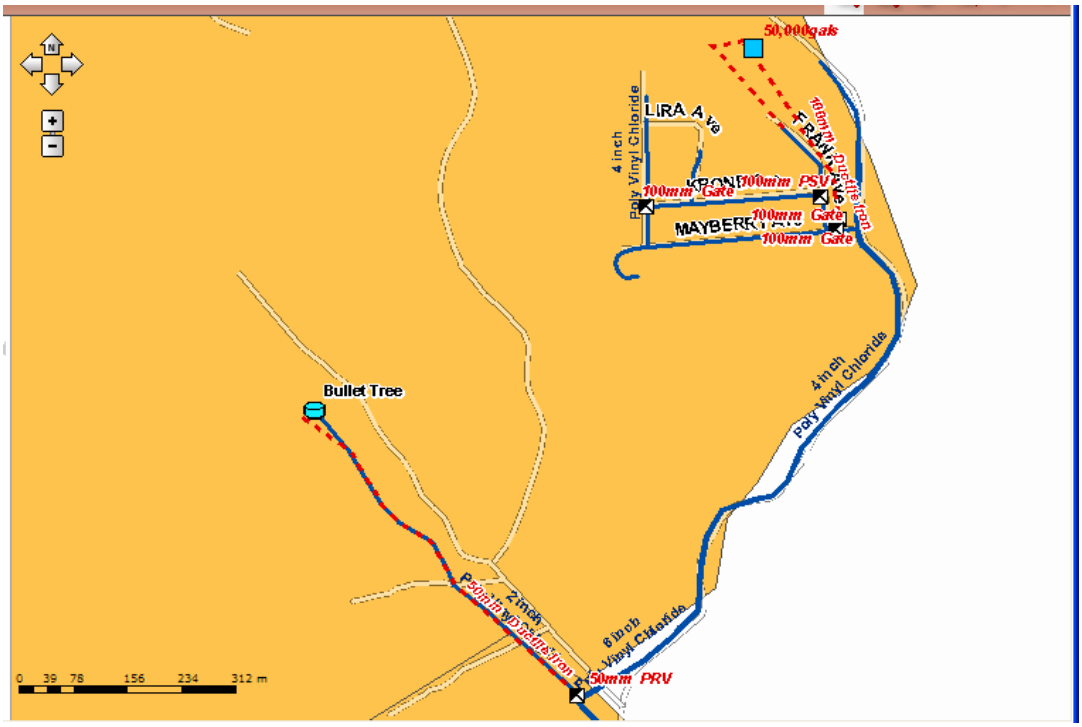
a. Communities served include Bannister, Bullet Tree, Red Ground, Red Ground H/S, New Harbour Dr, Davis District

b. Operational and Physical Problems/Challenges of the Water Supply Scheme: include High NRW, illegal connections, inefficient pump set, unused Storage Tank.

c. Recommendations for Improvement of WSS :
    - Upgrade motor and starter and electrical works.
    - Rehabilitate storage tank above Colbeck Heights Housing Scheme.
    - Disconnect Bullet Tree Community from existing transmission main and distribute from Colbeck Heights Storage tank via new 2" PVC distribution pipeline.

d. Expected Benefits/ Impact of the proposed improvement:
    - NRW reduction and a potential increase in revenue due to a much improve water supply.
    - The storage tank will allow for the energy conservation programme to assist in reducing energy

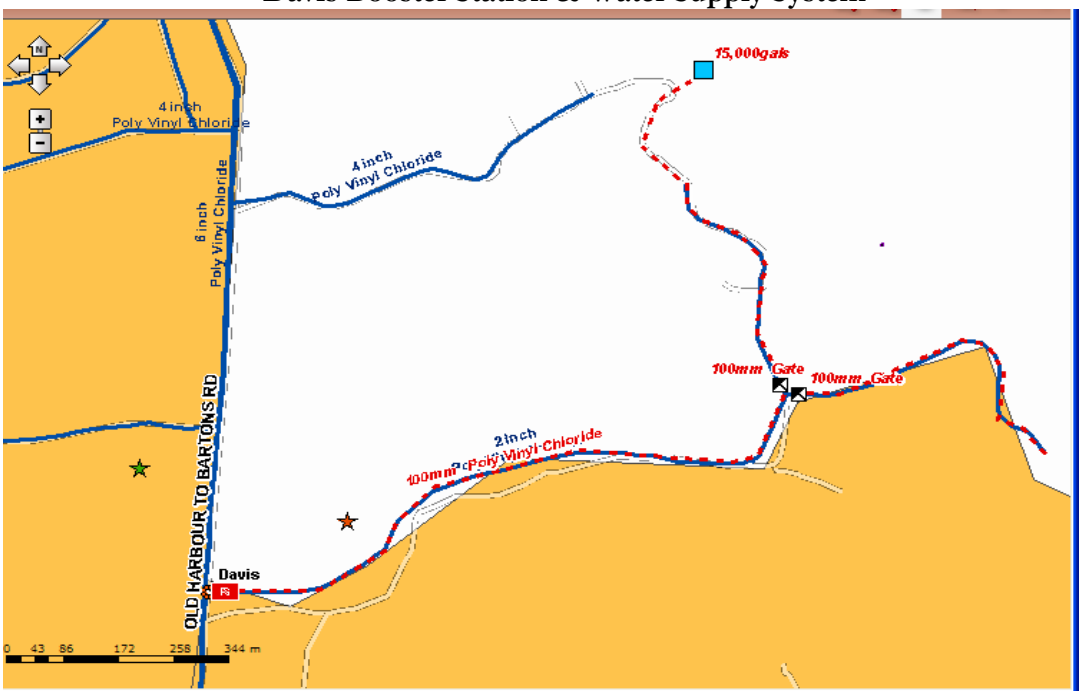
Graham Well



Davis Booster Station & Water Supply System

a. Communities served include Davis District
b. Operational and Physical Problems/Challenges of the Water Supply Scheme: include High NRW, illegal connections, Inefficient pump set, Inadequate Storage Capacity
c. Recommendations for Improvement of WSS :
   - Replace worn motor and pump.
   - Replace existing 1000 gallons storage tank with a 5000 gallons tank. Disconnect all illegal supplies.
   - New 4" PVC transmission and 2" PVC distribution pipeline.
d. Expected Benefits/ Impact of the proposed improvement:
   - Reduce NRW and increase revenue.
   - The storage tank will allow for the energy conservation programme to assist in reducing energy cost.

Davis Booster Station & Water Supply System

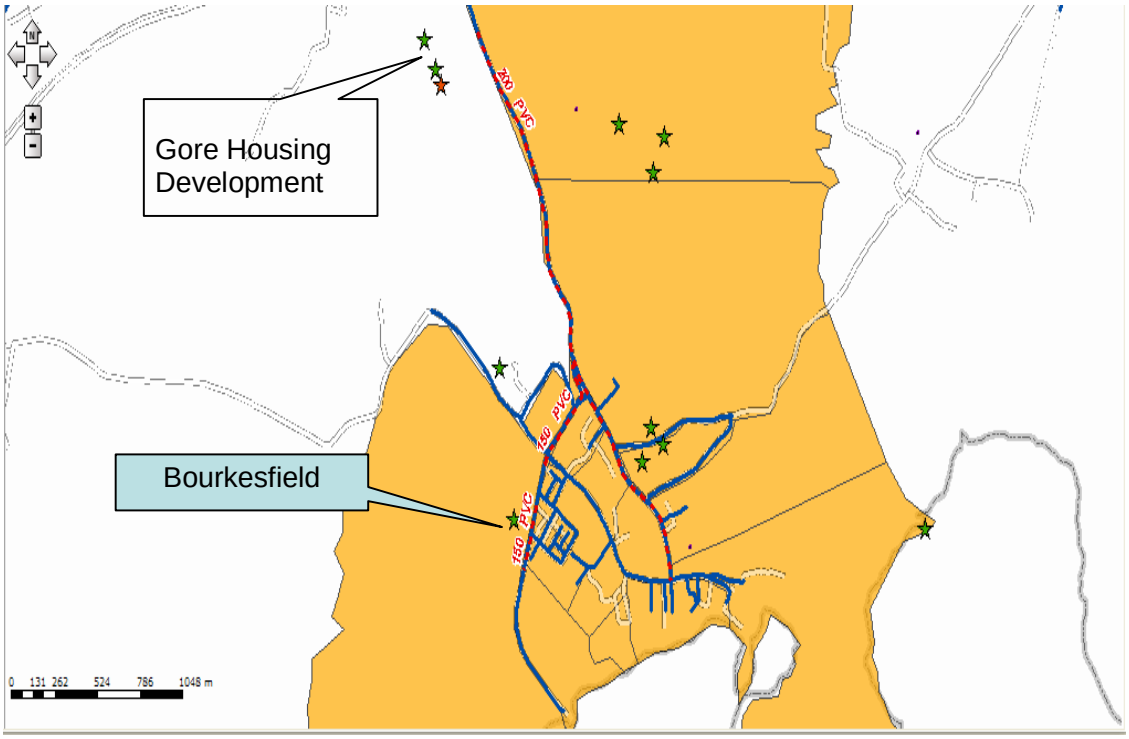


Old Harbour Bay Water Supply Scheme

a. Communities served include Davis District
b. Operational and Physical Problems/Challenges of the Water Supply Scheme include High NRW, illegal connections, inefficient pump set, inadequate Storage Capacity
c. Recommendations for Improvement of WSS:
   - Replace worn motor and pump.
   - Replace existing 1000 gallons storage tank with a 5000 gallons tank. Disconnect all illegal supplies.
   - Replace 4" PVC transmission and 2" PVC distribution pipeline.

d. Expected Benefits/ Impact of the proposed improvement includes improved and sustained water supply to developed and undeveloped communities within Old Harbour Bay area resulting in increase revenue.

Old Harbour Bay



2. May Pen

Existing Production Facilities

- Woodside – 0.68 MGD
- Bushy Park – 0.89 MGD
- Sevens/Chatteau – 0.53 MGD
- Curatoe Hill – 1.25 MGD
- Mineral Heights – 0.87 MGD
- Palmetto Pen – 0.96 MGD
- Twin Palms – 0.62 MGD
- TOTAL PRODUCTION: 5.8 MGD

Total Demand (2010): 7.2 MGD)/Deficit: 1.4 MGD
Total Demand (2030): 9 MGD)/Deficit: 3.2 MGD

Operational and Physical Problems/Challenges of the Water Supply Scheme include:

- Low pressure to no water in sections of Western Park, Thread Light, Evans Heights, Breezy Castle, Glenmuir Rd., Glenmuir Terrace and sections of Bucks Haven, Sections of Hill Crest, Coates Pen, Palmers Cross

- No water in Rosewell, Toby Heights, Salt River.

Recommendations for Improvement of WSS

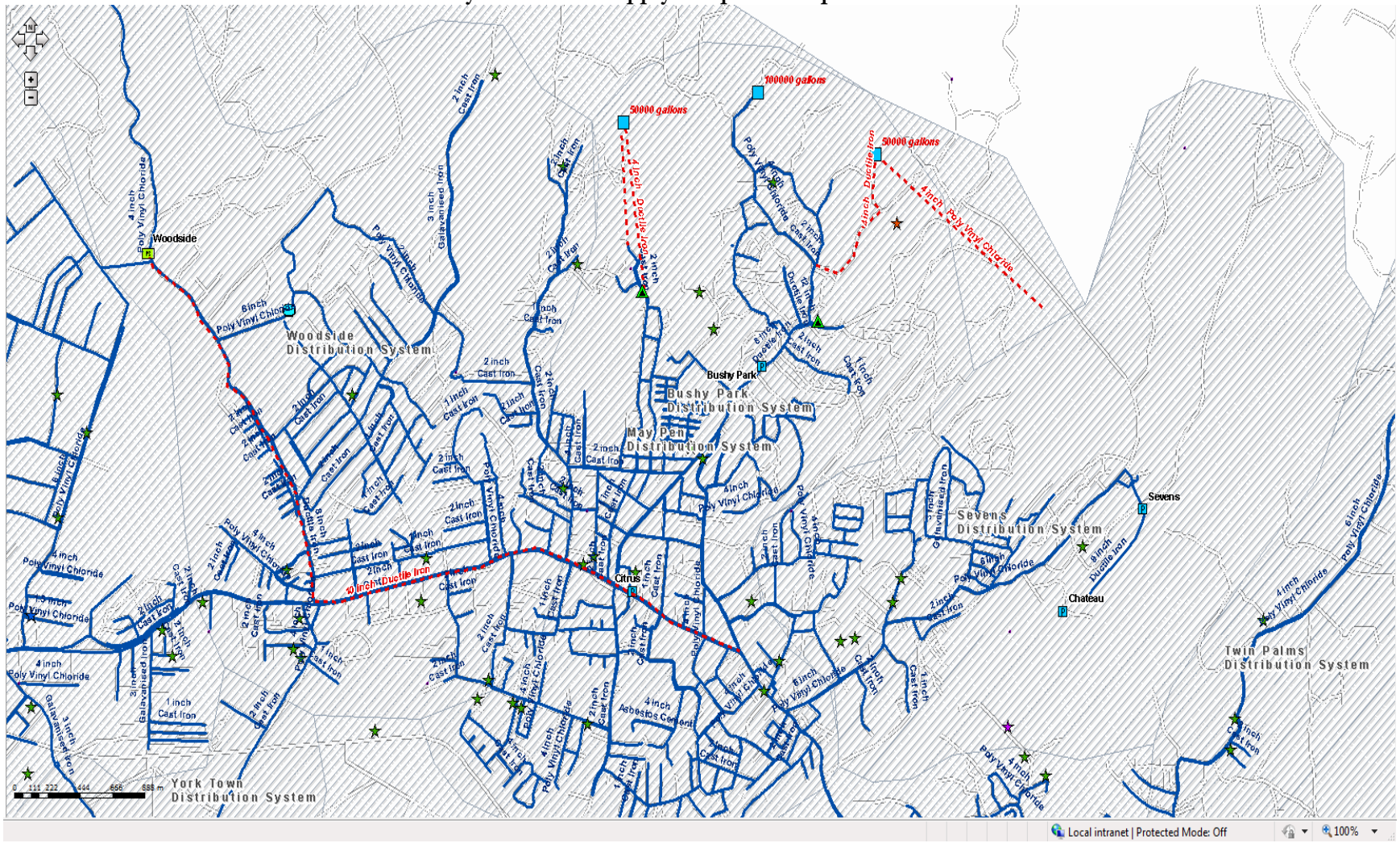
May Pen Town Centre

- Pipe Replacement on selected streets
- Procurement and Installation of Bulk Flow Meters:5
- Replace100mm, 150mm and 200mm DI Pipes

Sevens Heights

- Rehabilitation of Seven/Chatteau Well
- Replace 5 km of 6" pumping main and 2 km of 4" distribution main and storage tanks in Sevens Heights
- Upgrade Sevens Pumping to include sump
- Procure PRV, PSV and Float Valves to reduce NRW
- Procure Bulk Flow Meters
- Implement DMAs within May Pen Water Supply Scheme

May Pen Water Supply – Pipeline Replacement



3. Greater Mandeville Water Supply

a. Existing Water Supply Scheme (WSS) consists of 3 Deep Wells, 3 Booster Stations
b. Operational and Physical Problems/Challenges of the Water Supply Scheme include some areas are experiencing intermittent supply and/ or no water and elevated areas have to be served by trucked water.
c. Recommendations for Improvement of WSS include:
    - Pipeline Replacement and DMA establishment of Greater Mandeville Water Supply System
        - Procurement and Installation of Bulk Flow Meters:16
        - Replace115,000L.m of 100mm DI Pipes
        - Replace 9,000L.m of 150mm DI Pipes
        - Replace 6,000L.m of 200mm DI Pipes
    - Rehabilitation of Gutters P/S:
        - Upgrading of M&E equipment, Procurement of GSM logger, soft starter
        - Rehabilitation of pipe work
    - Rehabilitation of Spur Tree Pumping Station
        - Procurement and installation of GSM logger, soft starter
        - Rehabilitation of pipe work
    - Replacement of old equipment at the Pepper Wells:
        - (3 Premium Efficiency Motors)
        - Portable compressor and GSM Loggers
        - Associated pipe work
    - Implementation of the Pepper #4 Well Project:
        - Development of Well
        - 3km of 12" DI Pipeline
    - Kingsland Rehabilitation
        - Procurement and installation of replacement starter, and rehab of surge vessel
        - Rehabilitation works to tank
d. Expected Benefits/ Impact of the proposed improvement
    - The creation of the DMAs will allow for the targeting of specific areas for NRW reduction exercises.
    - The reduction of leaks, resulting in increased water delivery.
    - Increased revenue generation.
    - Ability to serve areas which have no supply.