Case Study: Performance-based Contract for NRW Reduction and Control - New Providence, Bahamas

Water and Sanitation Division

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Table of Contents

Executive Summary 8

Acknowledgements 11

1 Introduction 12

2 Overview: NRW Management and Performance-based Contracts 15

3 Situational Assessment: Water Supply and NRW 29

4 Situational Assessment: WSC Financial Condition 45

5 Development of the IDB Loan and New Providence PBC 52

6 PBC Implementation Progress through 2016 58

7 Assessment of the PBC – effectiveness and Cost efficiency 69

8 Key Findings, Upcoming Issues, and Lessons Learned 76

Annexes

Annex A References 81

Annex B Brief History of the WSC 85

Annex C WSC Statistical Annex 87

List of Tables

Table 2-1 – Characteristics of Components of NRW 18

Table 2-2 – Benefits of NRW Reduction by Coverage Situation 20

Table 2-3 - Generic Implementation Mechanisms for NRW Projects 24
Table 2-4 - Benefits and Potential Risks of a PBC to a Utility 26
Table 2-5 - Conditions under which PBCs are Effective and Efficient 27
Table 2-6 - NRW PBCs in the LAC Region 28
Table 3-1 - NRW-related Activities Conducted by WSC on New Providence 36
Table 4-1 - Value of Recoverable Water Losses, Earnings and Government Subsidies 51
Table 5-1 - NRW Project Timeline 54
Table 5-2 - Summary of Contract Terms and Conditions (as specified at Contract Signature) 56
Table 6-1 - Real Loss Component Analysis 59
Table 6-2 - Target NRW, Strategy 2012 60
Table 6-3 - Project Results Matrix 68
Table 7-1 - Bahamas NRW PBC Financial Analysis 74
Table 7-2 - Key Results of the Financial Analysis 75

List of Figures

Figure 1-1 - Aerial Image of New Providence Island 16
Figure 2-1 – International Water Association Water Balance for NRW 17
Figure 2-2 – NRW Indicators – AyA Costa Rica 19
Figure 2-3 - The Vicious Cycle of NRW 21
Figure 2-4 - Management Methods for Apparent and Real Losses 23
Figure 2-5 - NRW Reduction: Conventional Projects and PBCs 27
Figure 3-1 - Geographic Map of the Bahamas 30
Figure 3-2 - Long Term Average Temperature and Rainfall 31
Figure 3-3 - Fresh Water Aquifer Location 32
Figure 3-4 - Recent Changes in Rainfall and Temperature – New Providence 33
Figure 3-5 - Fort Fincastle Water Tower 34
Figure 3-6 - Location of Major Water Supply Facilities on New Providence 35
Figure 3-11 - Blue Hills Desalination Plant 38

Figure 3-12 - Water balance calibration 38
Figure 3-1 - Pressure management areas established in 2006, New Providence 39
Figure 3-13 - Priority Leak Detection Zones 40
Figure 3-7 - Water Supply Trends – System Input, Billed Consumption and NRW 41
Figure 3-8 - Water Volume Trends by Connection, New Providence 42
Figure 3-9 - Water Supply Capacity and Actual Water Production 43
Figure 3-10 - Shifting Sources of Water Supply – New Providence 44
Figure 3-11 - Windsor Desalination Plant 44
Figure 4-1 - Operating Costs and Revenues, WSC, New Providence 46
Figure 4-2 - Financial Performance Indicators – WSC New Providence 47
Figure 4-4 - Comparison of Inflation Adjusted Unit Water Cost and Unit Tariff 48
Figure 4-5 - Average annual change in tariff and operating costs – inflation adjusted 49
Figure 4-5 - Financial Earnings and Government Subsidies, WSC, New Providence 50
Figure 6-1 - Water Balances Before the PBC, at Baseline, and After 59
Figure 6-2 - Annual NRW Performance in Comparison to Targets 61
Figure 6-3 - NRW Reduction in Relation to Updated Targets 62
Figure 6-4 - Mains Bursts and Pressure, New Providence 63
Figure 6-5 - Service Connections Leaks and Pressure, New Providence 64
Figure 6-6 - Service connections components 65
Figure 6-7 - Leak Detection Activities 66
Figure 6-8 - Installation of a Pressure Reduction Valve, Bypass and Flowmeter/PRV Controller 67
Figure 7-1 - Reduction Effectiveness of NRW PBC Projects – Real and Apparent Losses 70
Figure 7-2 - Unit Cost of NRW Reduction 71
Figure 7-3 - NRW Project Approaches 72
Figure 7-4 - Financial charts for each project with costs, benefits and net 73

Acronyms

AMR	Automatic Meter Reading
B$	Bahamian Dollars
BABE	Bursts and Background Estimates
BOT	Build-Operate and Transfer
CAPEX	Capital Expenditure
CDB	Caribbean Development Bank
CWBL	Consolidated Water Bahamas, Ltd
DMA	District Metered Area
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EIB	European Investment Bank
EOP	End of Project
FAO	Food and Agriculture Organization
FAVAD	Fixed and Variable Area Discharge path (model)
IDB	Inter-American Development Bank
IG	Imperial Gallon
ILI	Infrastructure Leakage Index
IRR	Internal Rate of Return
ITCZ	Inter-Tropical Convergence Zone
IWA	International Water Association
km	Kilometer
L/C/D	Liters / Connection/Day
Lpcd	Liters per capita per day
m	Meter
MIG	Million Imperial Gallons
MIGD	Million Imperial Gallons per Day
MIS	Management Information System

MSF	Multi-Stage Flash (desalination)
NP	New Providence (Island)
NPV	Net Present Value
NRW	Non-Revenue Water
O&M	Operations and Maintenance
OPEX	Operating Expense
PBC	Performance-based Contract
PRV	Pressure Reducing Valve
psi	Pounds per square inch
PUB	Public Utilities Board
PV	Present Value
QBS	Quality-based Selection
QCBS	Quality-Cost-Based Selection
RFI	Request for Information
RFP	Request for Proposal
RO	Reverse Osmosis (desalination)
ROR	Rate of Rise
SCADA	Supervisory Control and Data Acquisition
TOR	Terms of Reference
UARL	Unavoidable Annual Real Losses
UN	United Nations
US$	United States Dollars
USACE	United States Army Corps of Engineers
URCA	Utility Regulation and Competition Authority
WB	World Bank
WSC	Water and Sewerage Corporation
WSSP	Water and Sanitation Sector Plan
WSSPNP	Water Supply and Sewerage Project for New Providence
WSSRP	New Providence Island Water Supply and Sewerage Rehabilitation Project

Conversions

1 IG = 1.201 US Gallons

1 US Gallon = 0.8 IG

1 IG = 4.546 Liters

1 MIG = 4,546 m^3

1 m^3 = 220 IG

1 Migd = 4546 m3/day

1000 m3/day = 0.220 MIGD

1 psi = 0.680 m of pressure

1 m of pressure = 1.422 psi

1 mile = 1.6093 km

1 km = 0.6214 miles

1 B$ = 1 USD

Executive Summary

The purpose of this case study is to review the context, preparation and implementation progress of the Bahamas Water and Sewerage Corporation's (WSC) Performance-based Contract (PBC) for Non-Revenue Water (NRW) management in New Providence, Bahamas. This innovative contract was implemented as part of the IDB Loan Project: WSC Support Program – New Providence Water Supply and Sanitation Systems Upgrade (BH-L1028). Specialists at IDB, at other international organizations and managers and policymakers at the country / utility levels in the LAC Region will gain an in-depth look into how this project was formulated, and how it was, and is still, being implemented and monitored. They can also gain lessons of experience on NRW and the use of PBCs from the experience of the Bahamas.

The Bahamas is overstressed on water availability, and New Providence is one of the most overstressed areas in the Caribbean. WSC began operations in 1976 under times of water stress and rationing, but in good financial condition. Looking forward, WSC's main development strategy was to continually add small increments of production capacity to be able to meet demand with a narrow margin. As time went on, wells and barged water supplies became far less attractive, due to salinization of many aquifers and logistical difficulties with barging. At this time, desalination is the only viable source of water for New Providence, in spite of its cost.

WSC has historically had problems of poor water quality, low pressure and occasional rationing, resulting in customer departure – which has greatly hurt WSC's financial condition and creates risks for those relying on individual wells. The lackluster service quality partly explains the reluctance of the government to approve tariff increases, which has worsened WSC's financial condition. This situation exacerbated the classic vicious cycle associated with high NRW – sending NRW even higher. Since the 1990s, this cycle of limited budgets, weak operations, high NRW, low tariffs and customer departure has resulted in the need for large subsidies from the government.

NRW has always been a concern for WSC – but, until recently, in a sporadic manner. Early efforts focused on simple leak detection and leak repair, which did not achieve major reductions. Mains replacement programs were introduced in the mid-1990s. WSC has a history of outsourcing NRW work, including early leak detection surveys and an incentive-based NRW project in 2005-2006.

But NRW rose again after that effort, so a larger, more holistic program was needed. In 2008-2009, WSC developed a comprehensive strategy and plan for NRW reduction and control, which included a variety of technical interventions, mostly on leakage reduction. A central premise of the strategy was the use of a performance-based contract (PBC) as the implementation method. PBCs have been shown to be able to reduce NRW faster than conventional projects. As outlined in this case study, the situation with WSC on New Providence meets the conditions under which the use of NRW Reduction PBCs have been shown to be most cost-effective.

Performance-based contracts can, under conditions delineated in this document, be a very effective, and, ultimately, cost-efficient mechanism for implementing NRW projects. The case of the WSC-Miya PBC in New Providence, Bahamas is a very good illustration of the attributes and benefits of a well designed PBC – 1) baseline study and target/plan adjustment period; 2) a "minimum scope" combined with flexibility for the contractor to adjust specific plans to the evolving situation, to both exceed targets and receive additional performance-based remuneration; 3) rapid NRW reduction, with its technical, financial and political benefits and results; 4) reduced project risk for the utility; 5) a lengthy maintenance phase to promote sustainability of the NRW reductions and 6) overall improvement of technical and financial performance at a competitive price.

The 10-year PBC was signed between WSC and Miya, an international company with extensive experience in NRW PBCs, in February of 2012. The project has achieved huge NRW reductions, which could not have been accomplished by WSC alone. Once a careful baseline water audit was completed, a well-founded program strategy was prepared and then implemented precisely. The NRW reduction in the period from mid-2013 to mid-2015 was so large as to be "off the charts." This rapid reduction had huge beneficial impacts, reducing the use of expensive desalinated water and increasing revenues. Operating Cost Recovery rose substantially and the EBITDA loss was cut by more than 50%, as was the Government Operating Subsidy. These are massive improvements in a short period of time, and can be attributed to the strong skills and previous Bahamas experience of the Miya field team, their good collaboration with WSC and the persistent efforts of the WSC General Manager, who has championed NRW reduction for many years.

Concerns have been expressed about the total price and cost efficiency of the WSC-Miya PBC project. A detailed financial analysis, presented here, shows the project will pay for itself within the time frame of the PBC. That same analysis shows that the significant financial and operation benefits of rapid NRW reduction pay for themselves, when compared to a conventional NRW project – even at a lower overall cost. WSC's financial condition is better off with NRW reduced, and service quality improved, but a tariff increase is still long overdue.

The long history traced in this document shows that NRW reduction and control is a very complex matter - technically, financially, institutionally and politically. It reaches across an entire utility, and into the environment it operates in, and its reduction requires high-level expertise, lots of tedious work, political savvy and persistence, persistence, persistence.

An essential element of success, among many, is a detailed and thorough water audit to identify the volume, values and root causes of the various NRW components. Rapid improvements can be made quickly using the latest best practices of the International Water Association (IWA). Top management support for such a deliberate process is also required.

The technical skills required to execute NRW program tasks are not that difficult to learn. However, the expertise to properly assess the situation and plan an efficient and effective program is a very complex matter and requires the lead of an experienced specialist, especially for a large program.

Performance-based contracts can, under conditions delineated in this document, be a very effective, and in the end, cost-efficient mechanism for implementing NRW projects.

For PBC procurement to assure the best selection of a contractor, increased cost competition should be built into the procurement process without sacrificing quality. Other recent NRW PBC projects have used Quality and Cost-based selection (QCBS) methods with a strong (but not total) weighting on technical score.

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I save the best for last...my fullest thanks to Rodrigo Riquelme, who supported this work financially, but also has been an enthusiastic partner in a variety of programs on NRW at IDB. Thanks, Rodrigo!

1. Introduction

1.1 Purpose of the Case Study

The purpose of this case study is to review the context, preparation and implementation progress of the WSC – Miya Performance-based Contract (PBC) for Non-Revenue Water (NRW) management in New Providence, Bahamas. Specialists at IDB, at other international organizations, and at the country / utility levels will gain an in-depth understanding of how this project was formulated, and how it was and is still being implemented and monitored. They can also gain lessons of experience on NRW and the use of PBCs from the Bahamas. Every situation is different, so there is no single path to successful reduction and ongoing control of NRW. The Bahamas experience should not be unilaterally adopted as a model without careful consideration of the characteristics of any given situation. Nonetheless, the experiences with water supply and NRW in New Providence, going back to the 1970s, provide important lessons that are useful to project managers in most situations.

1.2 Organization of the Case Study Document

This document consists of this introductory section, followed by eight sections.

Section 2 provides a brief overview of NRW management, including definitions, terminology and indicators, benefits of NRW reduction, causes of NRW and methods of reducing and controlling both real and apparent losses. This section also provides a description of PBCs as an implementation mechanism for NRW management, including a description of salient features and s

Section 3 provides a technical situational assessment of the context in which the project is set – the Bahamas and New Providence Island, in particular. The section covers the situation regarding water resources, water supply institutions and major projects on supply expansion. This section also reviews historical trends on water production facilities, production, water use, non-revenue water and financial information on WSCs operation on New Providence Island. It highlights the large impact of a lack of tariff increases since 1999.

Section 4 outlines the historical timeline of efforts on NRW and related parameters, spanning activities from the mid-1970s until the start of the WSC-Miya PBC contract. That section enumerates modest efforts in the early years, up through the innovative, incentive-based NRW reduction project with Consolidated Water Bahamas Ltd (CWBL) from 2005-2006.

Section 5 outlines the steps undertaken by IDB, WSC and contractors in the preparation of WSC Strategy for NRW on New Providence and preparation of the IDB loan project – including activities conducted within the IDB loan in parallel with the NRW PBC. These activities include contract oversight, institutional development of WSC, financial assessments, regulatory development and wastewater management activities. In addition to project preparation, this section addresses the PBC procurement and negotiations leading up to PBC signature in February of 2012.

Section 6 provides a detailed look at progress during the PBC from contract signature through the end of 2016, which is most of the anticipated NRW reduction phase. The data shows a remarkable reduction in NRW over the period. The section delineates the baseline, diagnosis and strategy development phase results. It then details specific reduction activities conducted, in relation to the original targets, and their impact on various NRW indicators.Section 7 examines this NRW reduction in comparison to other projects and examines the cost- efficiency of the PBC from several points of view. In broad terms, the PBC has been remarkably effective at NRW reduction, but at a high cost. The Bahamas is certainly a place where materials and labor are relatively expensive and efficient water service is of high value – with a high marginal cost of water -- so typical rules of thumb on project finances do not apply. This section presents a detailed financial analysis comparing the PBC to a less expensive, less effective alternative.

Section 8 provides some perspectives on the coming years regarding NRW and the PBC at New Providence and at WSC.

To close, Section 9 provides lessons of experience that may be useful for program managers tackling similar problems in other locations.

References and other detailed technical information are provided in Annexes.

2. Overview: NRW Management and Performance-based Contracts

2.1 Non-Revenue Water: Key Concepts and Terminology

Any introduction to Non-Revenue Water (NRW) management must begin with a review of the internationally-accepted definitions and terminology associated with NRW and its various components. The International Water Association's (IWA) definition of NRW is:

> ***NRW is defined as water that is placed into a water distribution system that is not billed to customers.***

In brief, NRW includes water that: a) leaks from distribution pipes or joints; b) overflows from water storage tanks; c) is not registered by faulty water meters; d) is not itemized correctly by metering and billing systems and e) is used by unauthorized connections/users. In general practice, NRW does not include losses from long transmission mains from a water source to a water treatment plant, or water use or losses inside the treatment plant or losses from a transmission main carrying water a long distance to a city or town – although these losses are still important to understand, and manage.

Note that, by IWA convention, ***water that is billed, but not paid for is not considered part of NRW***. Therefore, according to IWA classification, improving billing is an NRW reduction activity, but improving revenue collections is not. This categorization does not imply that revenue collections is not important -- it is very important -- but it is distinct from NRW.

Figure 1-1 - Aerial Image of New Providence Island

2.2 The NRW Water Balance and Indicators

NRW consists of multiple components, which are specified in the NRW Water Balance as defined by the IWA, shown in Figure 2-1. The principal components of NRW include:

- unbilled authorized consumption (generally relatively small)
- apparent losses (also known as commercial losses)
- real losses (also known as physical losses or leakage)

These principal components are delineated in Table 2-1, including examples, typical indicators and the basis for the financial valuation of each component. The most important distinction between real and apparent losses is that any reduction in real losses can lead to either 1) additional water becoming available to supply to customers, or 2) a reduction in the quantity of water extracted from water sources and put into the supply network. However, a reduction in apparent losses results in the conversion of the non-revenue water into revenue water with additional billings and revenue achieved by the utility. A reduction in apparent losses does not result in a "savings" in water resources.

Figure 2-1 – International Water Association Water Balance for NRW

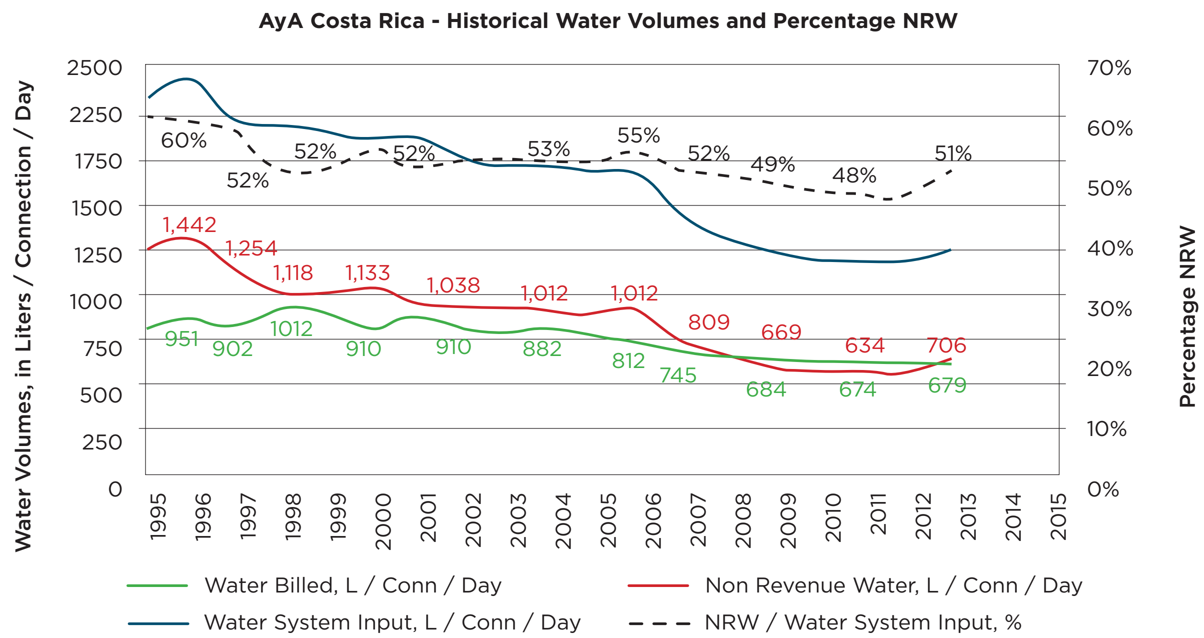
<table>
<tr><td rowspan="8">Volume from Own Sources (corrected for known errors)</td><td rowspan="11">System Input Volume</td><td>Water Exported (corrected for known errors)</td><td colspan="3">Billed Water Exported</td><td>Revenue Water</td></tr>
<tr><td rowspan="10">Water Supplied</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="8">Non-revenue Water</td></tr>
<tr><td>Unbilled unmetered Consumption</td></tr>
<tr><td rowspan="6">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Unauthorized Consumption</td></tr>
<tr><td>Systematic Data Handling Errors</td></tr>
<tr><td rowspan="3">Water Imported (corrected for known errors)</td><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to the point of Customer Metering</td></tr>
</table>

Table 2-1 – Characteristics of Components of NRW

Cmponent	Examples	Recommended Indicators	Value of reduced NRW	
			When short-term demand is met	**When saved water can be sold**
Unbilled Authorized Consumption	Fire-fighting, street washing, pipeline flushing, unbilled public or government use,	• Liters/connection/day • Unbilled authorized consumption/Billed consumption (%)	**Retail Price of Water (and sewer)**	**Retail Price of Water (and sewer)**
Apparent Losses (Commercial Losses)	Meter under-registration, un-authorized water use, metering and billing system errors	• Liters/connection/day • Apparent loss/Billed consumption (%)	**Retail Price of Water (and sewer)**	Retail Price of Water (and sewer)
Real Losses (Physical Losses)	Leakage from distribution mains and service connections, tank overflows, etc.	• Liters/connection/day • Liters/connection/day (wsp) • m3/km/day • m3/km/day (wsp) • Infrastructure Leakage Index • Value of real losses/Operating cost	**Variable operating cost of water production**	**Retail Price of Water (and sewer)**

It is especially important to note that the IWA Water Balance and recommended indicators for each component of NRW do NOT utilize the common indicator – the percentage NRW (the volume of NRW divided by the system input volume). While in very common use, this indicator is highly discouraged by the IWA, because it is a poor indicator for comparing NRW management performance over time in a given location, or for comparing different locations. It is misleading because the denominator—system input volume—is equal to the sum of the NRW and billed water consumption. Therefore, the value of this indicator value can change over time or between locations, due to changes in billed consumption, not due to changes in NRW. For example, if a big new factory opens in a city, greatly increasing consumption, the NRW will be constant, but the percentage NRW will drop.

Figure 2-2 – NRW Indicators – AyA Costa Rica



In many countries, practitioners are frustrated that NRW remains roughly stable at some high percentage, despite efforts to reduce NRW. But this flawed indicator could easily remain stable in value when both NRW and billed consumption are declining, which is common. The example in Figure 2-2 shows such a case: AyA, the national water utility of Costa Rica. Over the period 1995 to 2013, the percentage NRW declined a little from 60% to just over 50%. But the NRW was cut in half – from about 1400 to 700 L / Conn / Day. Over the same time period, billed consumption also dropped considerably. The declining pattern for both NRW and billed consumption led to the misleading stability of the percentage NRW indicator.

The use of the IWA Water Balance to quantify the ***volumes and values*** of the various NRW components, as well as adoption of approved indicators, are critical first steps in understanding the NRW situation and its financial implications, and for planning an NRW reduction program.

2.3 The Benefits of NRW Reduction

The benefits of NRW reduction and control are many, and they are interlinked. Many stakeholders can gain economic, financial, health, social and environmental benefits. These benefits are delineated in Table 2-2, which shows the specific benefits under different situations in terms of water supply coverage in the water utility service territory.

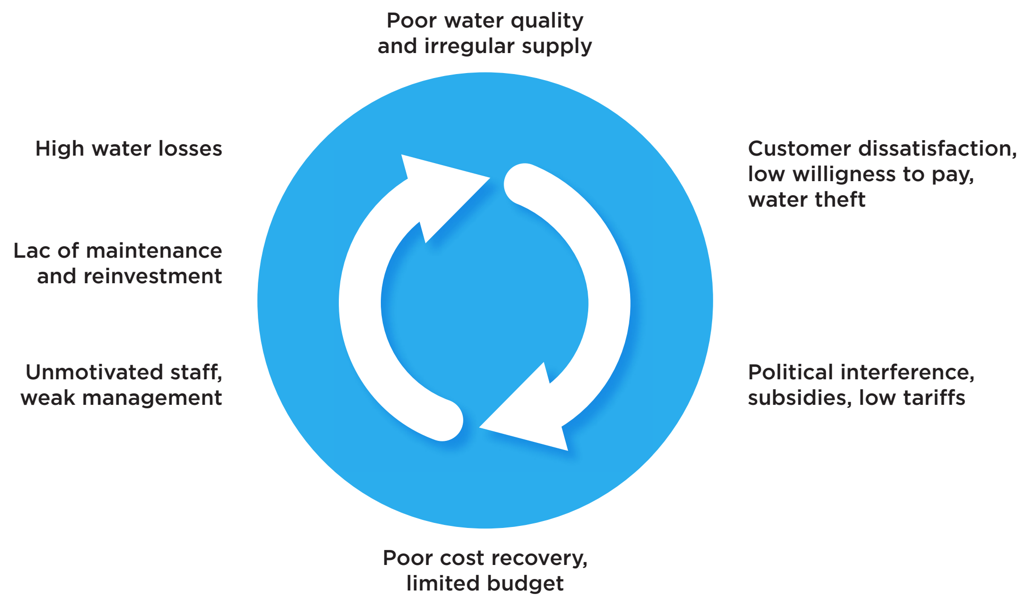
Table 2-2 – Benefits of NRW Reduction by Coverage Situation

Water Coverage Needs Improvement	Water Coverage Close to or at 100%
• **Savings of real losses are now available for previously unserved or underserved customers,** which will provide economic, financial, health and social benefits. • **Water resource conservation** could still occur in some cases, depending on the real loss savings, current level of coverage and water production capacity in place. If so, climate change resilience could be improved. • **Energy savings** could still occur, if real loss savings exceed the expanded water supply demand, but savings would typically be modest, as would savings in other variable operating costs. • **Water supply services are improved** through increased continuity, higher pressure, cleaner water, fewer disruptions and reduced cost to water users. • **Utility revenues increase** by expansion of the customer base and reduction of apparent losses associated with existing customers. • CAPEX costs could be reduced for water production facilities, depending on the situation. • **Financial condition of the utility could improve,** especially through revenue increases. Note that CAPEX and OPEX expense for the NRW reduction and control program will also utilize a portion of the improved operating margin.	• **Conserves water resources** through reduction of real losses and water production requirement. • **Improves resilience to climate change** through increased water reserves and greater allocation options. • **Reduces water production requirement, causing reduced energy usage, reduced GHG emissions** (if carbon based fuels are used) **and reduced energy costs.** • **Reduces other variable operating costs.** • **Improves water supply services,** through increased continuity, higher pressure, cleaner water, fewer disruptions and reduced cost to water users. • **Improves utility revenues,** though the reduction of apparent losses. • **Reduces CAPEX** for water production facilities either through the cancellation or delay of construction of new facilities. • **Improves financial condition** of the utility through cost reductions and revenue increases. Note that the increased CAPEX and OPEX expense for a more robust NRW reduction and control program will utilize a portion of the improved operating margin, but experience has shown that in most cases this additional NRW expense is less than the net revenue gains.

2.4 Origin of NRW and Basic Methods of NRW Reduction

In general, NRW increases with the length of distribution pipes, the number of connections, network pressure, the age of the distribution network infrastructure (including pipes, water meters etc.), the hours per day that the water network is pressurized, soil conditions and many other factors. But the heart of the problem is a vicious cycle where service quality, NRW, customer satisfaction, utility finances and O&M programs interact to make NRW worse over time, if constant efforts are not made to control it. Figure 2-3 illustrates this vicious cycle.

Figure 2-3 - The Vicious Cycle of NRW



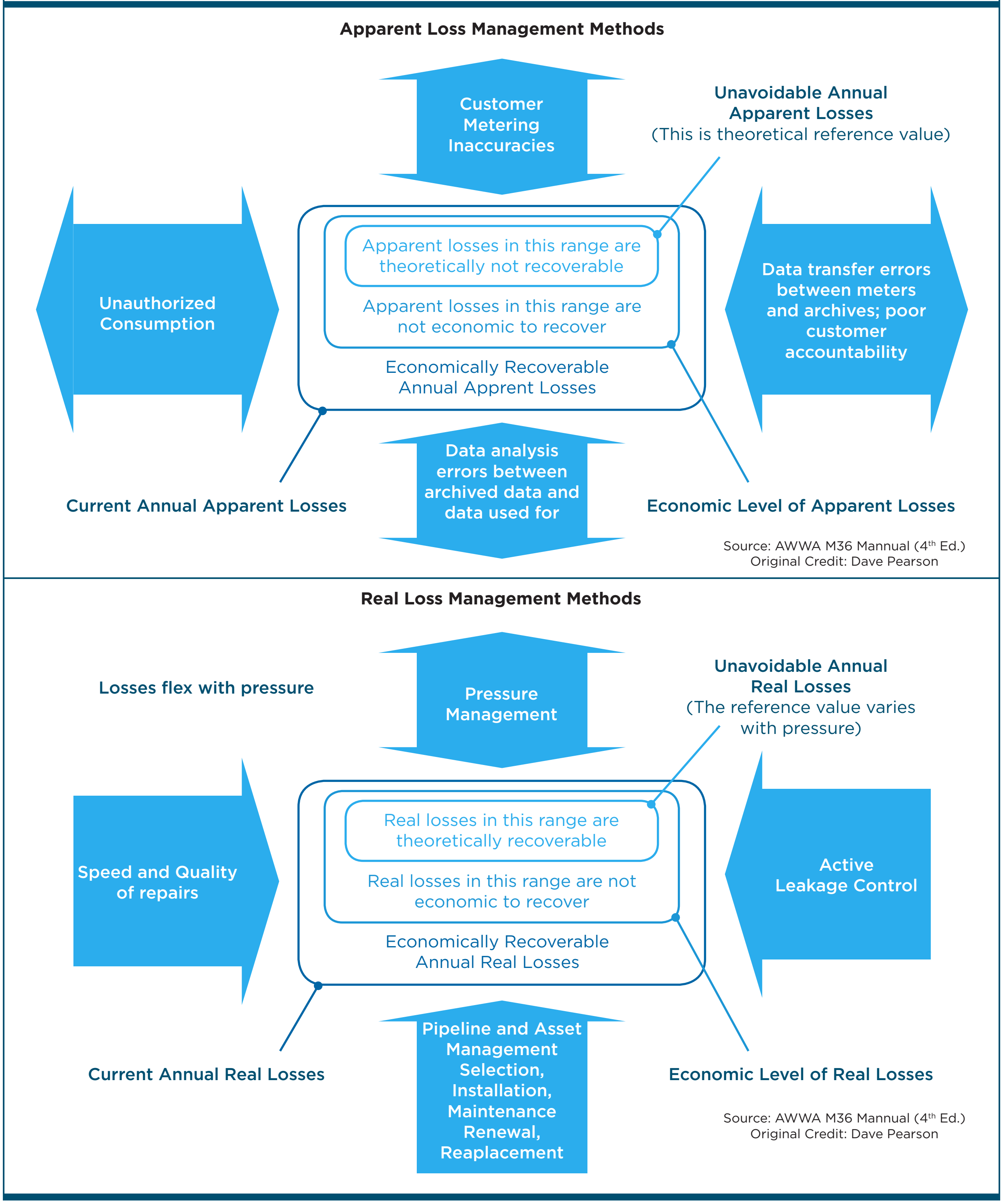
Therefore, the task of reversing the cycle and improving NRW requires a holistic approach to address the various constraints in an integrated manner. Ultimately, the task of reducing and controlling NRW consists of sustaining an organized, ongoing series of activities to:

- systematically and rapidly detect and correct sources of water losses,
- carefully monitor distribution system hardware and operational performance,
- implement both small and large, short-term and long term renewal projects.

These activities serve to maintain the entire distribution system in good condition and to satisfy customer needs efficiently. Additional salient principles of NRW reduction include:

- Any NRW program must be designed on the basis of the institutional context, the existing levels of NRW components, infrastructure condition, supply continuity, local skills and local costs. There is no one approach that fits all, no simple “cook-book” approach.
- Thorough water audits and component analyses will provide the knowledge needed to focus on the largest problems (in terms of volume and/or values), and address the root causes of NRW.
- Programs should operate in the standard operating cycle of planning, implementing, monitoring, assessing results and adjusting plans, year in and year out.
- NRW can be reduced to an optimal level, at which point, further NRW reductions cost more than the benefits they produce. That optimal level depends on local conditions and parameters, such as the cost and price of water, cost of program inputs and other factors.
- Once a target for NRW reduction has been selected, various analytical methods can be used to determine the specific activities that will be most effective and cost-efficient in that location based on system configuration, pressure, the condition of the piping network, valves, meters and the cost of labor and materials. While every situation is different, there are accepted technical best practices for reducing and controlling real losses and apparent losses, shown in Figure 2-4. Planning a good NRW program involves careful situational analysis to decide the amount of each of these practices in the program.
- While the vicious cycle above suggests the importance of a holistic approach, programs can be planned in stages focusing on particular zones, or particular sources of water loss. In so doing, utilities learn as they go along. If, however, the losses are huge and staff has limited skills and resources, outside expertise and support are required.
- NRW programs often can be largely self-financing – rapid revenue gains from apparent loss reduction can generate funding for OPEX and CAPEX needs to reduce real losses.

Figure 2-4 - Management Methods for Apparent and Real Losses



2.5 Basic Options for Implementing NRW Programs

There are several approaches that can be used to implement NRW programs, ranging from full outsourcing with performance incentives – commonly called PBCs – to fully "in-house" operations using internal NRW expertise and labor. Common options are shown in Table 2-3. The best approach in a given situation will depend on the urgency and importance of the NRW issue, technical, planning and management skills in the utility, the perception of the added value of outside expertise and related factors. Even where in-house skills are very good, it may make sense to outsource certain specialized functions, such as bulk meter accuracy testing and calibration or network hydraulic modeling. Moreover, many utilities in the region need significant outside expertise, mostly to plan and manage efficient and effective NRW programs. It can take a long time and considerable resources to build the expertise in-house, so outside help can lead the effort to reduce NRW and train staff at the same time.

Table 2-3 – Generic Implementation Mechanisms for NRW Projects

Mechanism	Characteristics
In-house with internal NRW expertise	Where the skills are available in-house, it would be very logical to use those skills for project design, implementation, monitoring and evaluation. Highly specialized functions might still be outsourced. Requires careful coordination of different parts of the utility (engineering, operations, commercial, finance etc.) and strong project management and supervision skills and experience.
In-house with external NRW expertise	Utility staff conducts the program, with traditional contracting with experienced consulting engineers to conduct audits and assessments, plan interventions, supervise implementation and monitor and assess results. Can be started out slowly and expanded as the organization gains experience and confidence. Fosters development of in-house expertise for the "long haul" of NRW reduction. Requires coordination of different parts of the utility (engineering, operations, commercial, finance etc.)
Conventional NRW contracts	Project design (as described above) could be done in-house or by engineering consultants. Implementation by conventional "works" contracts, or services contracts following standard contracting procedures. Considerable project management experience in the utility required, or a contract for a supervision consultant / contractor. No significant incentives for performance.
Performance-based contracts	A full NRW plan can be outsourced to an experienced PBC contractor, or the NRW program can be conducted in a phased approach with different PBCs for different stages or activities. The latter approach helps the utility to learn step-by-step, but can take a little longer.
Combinations	A large, mature, utility could use a multi-faceted approach where the main planning, monitoring and analysis functions are conducted in-house, while highly specialized technical activities or studies are conducted using traditional contracts, and other specific NRW activities are done via PBCs with reputable local contractors, for maximum efficiency.

2.6 Performance-based Contracts (PBC)

PBCs are becoming increasingly common for NRW reduction contracts. They usually combine a fixed payment and a performance payment, since a full transfer of risk to the contractor through full performance payment is usually unrealistic. The contract should define the expected inputs associated with the fixed payment, and must quantify performance targets, using performance indicators to implement the performance payments. The indicators can be related to inputs such as the number of meters replaced, to ensure critical activities are achieved, but most are focused on NRW volume or value results, such as the value of increased billings, or volume of leakage reduced.

Salient Features of a PBC:

- Part of the contractor payment is based on achieving results rather than the cost of inputs;
- The contractor defines how results will be achieved, including the organization of teams, technology, priorities & sequence within the scope defined by utility
- Usually, the contractor benefits from performance which exceeds the pre-established targets, although some contracts have sent some "extras" back to the utility.

During the preparation of the contract, consideration must be given to the risks borne by each party, and how complex payment formulae will be. For example, should the contract include an allowance for additional leakage that will occur due to the increase in pressure arising from the repair of leaks? Will some of the remuneration be indexed to local inflation, reducing risk for the contractor? Generally, the simpler the terms, the easier the contract will be to implement and monitor. Table 2-4 outlines typical benefits of a PBC and potential risks to be managed.

Table 2-4 – Benefits and Potential Risks of a PBC to a Utility

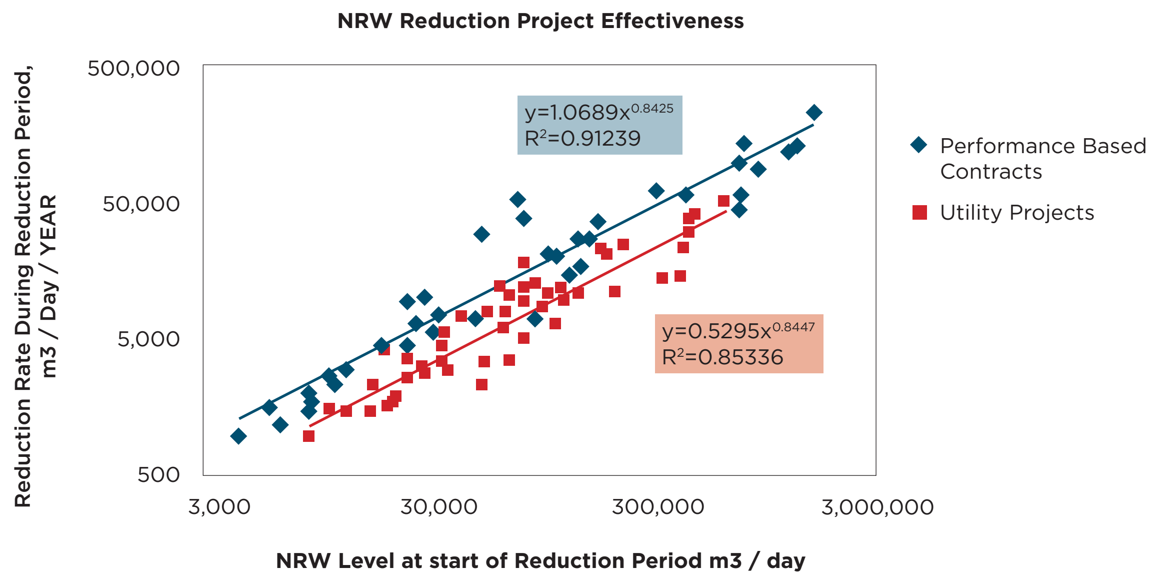
Benefits	Potential Risks
Payments to the contractor are mostly linked to outputs, i.e. the NRW reduction achieved.	Contracts are more complex with the risk of a poor contract. Skilled experts are required to draft the contract.
As payment is performance-based, the process of preparing the baseline audit and regularly agreeing on performance, provides discipline to the NRW reporting, provides transparency in monitoring and fosters skills transfer.	The time taken to perform the baseline and negotiate revisions to targets can cause a delay in the NRW reduction activities.
A PBC gives more flexibility to the contractor to plan the work in order to produce the performance outputs, leading to greater performance efficiency.	With the more complex payment terms of a PBC, there is increased risk of overpayment to the contractor. The risk increases with complexity of the payment formula.
The tendering process inspires both innovation and competition among bidders, promoting high level technical and management approaches and economical pricing.	Fewer contractors are prepared to take the additional risk over conventional contracts, which can reduce the benefits of competition.

Research by the author of this case study has shown that the main difference between PBCs and conventional NRW technical assistance contracts is that PBCs are able to make more rapid reduction in NRW, presumably due to high technical skills, but also the financial incentive to reduce losses. Figure 2-5 shows a comparison of the rate of reduction of NRW for PBCs and conventional utility led programs (usually with external technical assistance but not on a performance incentive basis). That same research shows that the cost per unit reduction is about the same. In the end, places where rapid reduction of NRW is important are locations where PBCs are most sensible. Table 2-5 shows the overall technical financial and institutional conditions where PBCs are the most effective and cost-efficient. Most of these conditions apply in the Bahamas.

Table 2-5 – Conditions under which PBCs are Effective and Efficient

1. 1High level of NRW, especially in combination with low service coverage and/or poor service with intermittent water supply.
2. Major constraints on water resource availability, currently or expected in the future.
3. Large city or number of water connections.
4. High water production cost, such as the use of desalination, or high energy costs.
5. High tariffs providing high financial return on reduction of apparent losses.
6. Utility leadership very interested in making rapid progress in reducing NRW.
7. Political or fiscal pressure for utilities to rapidly reduce water resource withdrawals, and to improve NRW, water service quality and the utility's financial condition.
8. Limited or low utility expertise in NRW planning and reduction.
9. Utility staff and customers and other stakeholders are open to the use of private sector expertise to assist the utility.

Figure 2-5 - NRW Reduction: Conventional Projects and PBCs



2.7 Examples of PBCs in the LAC Region

Table 2-6 provides a listing of known NRW PBCs in the LAC Region to illustrate the number and variety of NRW PBCs in the region. They range from large holistic projects on all facets of NRW across a city, to PBCs with a narrower scope – in the geographic sense or in the scope of activities undertaken.

Table 2-6 – NRW PBCs in the LAC Region

Country	Location	Utility	Purpose	Time Frame
Bahamas	New Providence	WSC	Reduction of leakage, in association with installation of a desalination plant.	2005-2006
Bahamas	New Providence	WSC	Reduction of leakage, in association with installation of a desalination plant.	2012-2021
Brazil	Sao Paulo State	SABESP	Fifteen distinct PBCs, mostly addressing real loss reduction, but also improved metering on large customers and "regularization" of connections in favelas.	A series of 5 year contracts, that extend back to 1999, and are ongoing now
Brazil	Recife	COMPESA	Pilot project to reduce NRW in pilot zone of Olinda, outside Recife.	2016 - 2021
Brazil	Alagoas	CASAL	Reduction of real losses in a touristic area, with technical implementation and project financing by SABESP.	2007-2010
Colombia	Bogotá	EAAB	Apparent loss management and customer service.	1999-2004
Jamaica	North Coast	NWC	Holistic approach to reducing NRW on 3 northern parishes.	2005-2010
Jamaica	Kingston	NWC	Holistic approach to reducing NRW.	2015-2020
Honduras	Tegucigalpa	SANAA	Specialized PBC to improve metering, increase billing and collections, reduce leakage and increase continuity of supply.	2011-2013
Panama	Colón	IDAAN	Specialized PBC to increase billing and collections, reduce leakage and increase continuity of supply.	2013-2017
Uruguay	Salto	OSE	Establishment of DMAs and real loss reduction.	2014-2017

3. Situational Assessment: Water Supply and NRW

3.1 Water Resources and Climate of the Bahamas

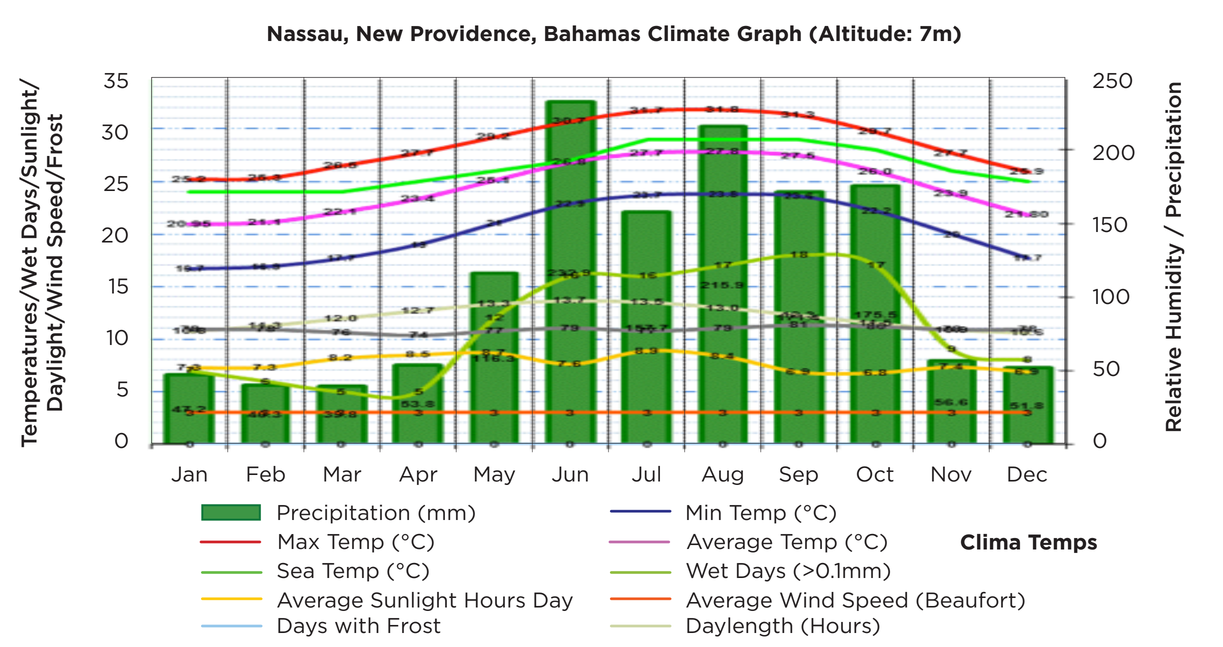
The Bahamas is an island nation located in the northwest corner of the Caribbean Sea. It has a population of about 388,000, spread out over 700 islands and 2,400 uninhabited islets[1]. The majority of the population lives on six islands: Abaco, Andros, Eleuthera, Exuma, Grand Bahama, and New Providence, which includes the capital city of Nassau. The island of New Providence sits in an east–west direction on the edge of the Great Bahama Bank opposite to Andros.

The Bahamas, like the rest of the Caribbean, experiences a warm humid climate governed by the trade winds and the seasonal movement of the Inter-Tropical Convergence Zone (ITCZ). Long-term average monthly temperatures range from a low of 17 deg C to 27 deg C. The long-term average annual rainfall varies somewhat across the islands with a value of 1,455 mm (57.3 inches) on New Providence. Most rainfall occurs from May to October. Rainfall is quite variable from year to year, and punctuated with periodic hurricanes in the late months of the year.

1 World Bank, 2015

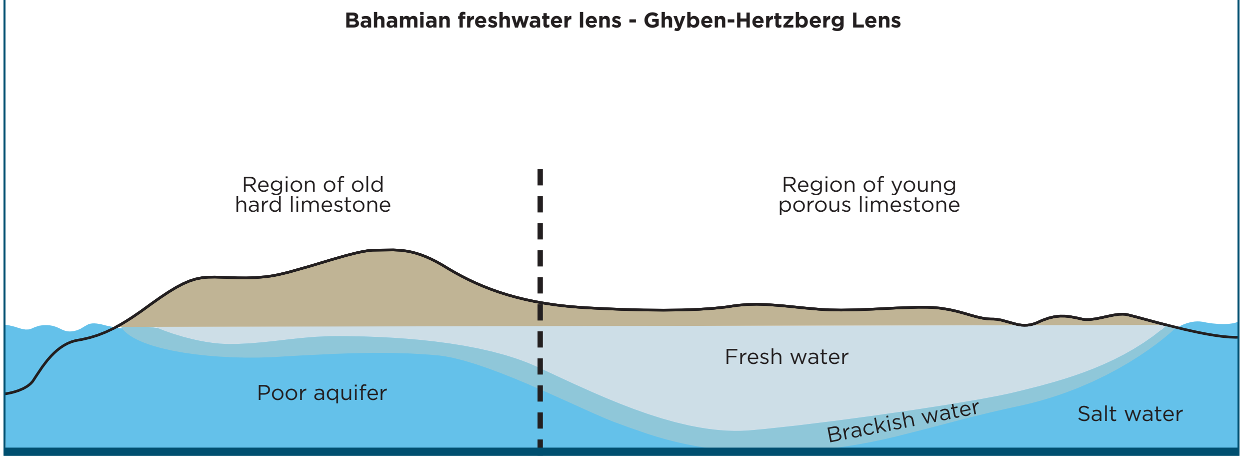
Figure 3-1 - Geographic Map of the Bahamas

Figure 3-2 - Long Term Average Temperature and Rainfall



Like many small tropical islands around the world, natural freshwater supplies in the Bahamas consist of freshwater aquifers, sitting in a lens on top of a lower saltwater layer (Figure 3-3). This resource is dependent on rainwater, and is susceptible to salinization, if over-pumped.

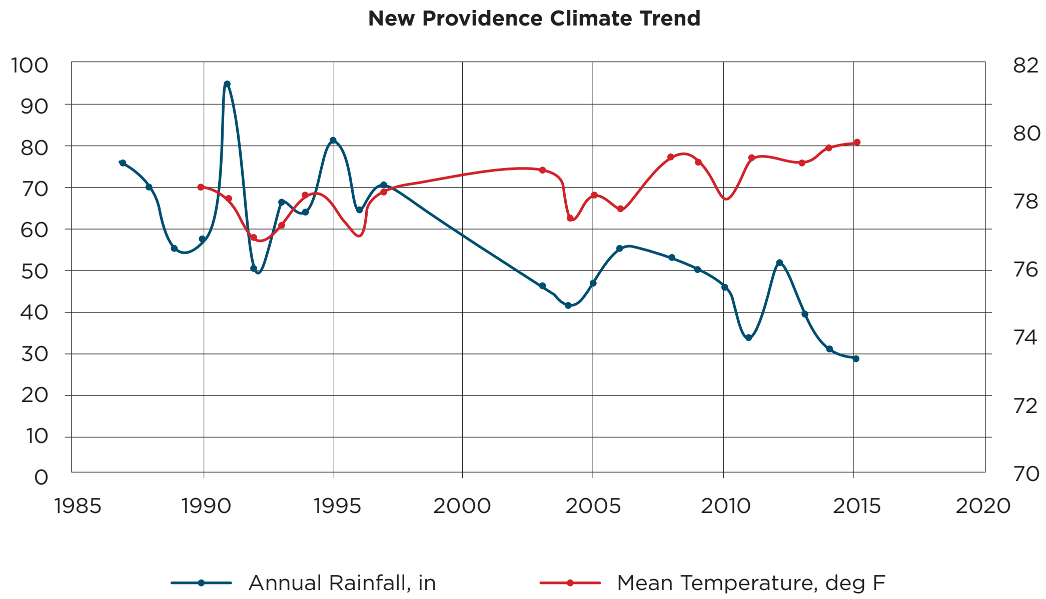
Figure 3-3 - Fresh Water Aquifer Location



The water resource situation is very severe on New Providence Island, which is only about 1% of the land area of the Bahamas, but with about 70% of the population. The total renewable freshwater resources on the island were estimated in 1980 at 16 Mm^3/year (USACE, 2004). This parameter, given recent decreases in freshwater resources tabulated by FAO, translates to a 2014 resource of 0.093 m^3 / capita / day – less than 100 liters per capita per day. More recently, Ekwue (2010) reported a safe yield of groundwater resources of only 3.3 Mm^3/year for the year 2000 or about 0.043 m^3 / capita / day, (under 50 liters / capita / day) ***which is the lowest of anywhere in the Caribbean*** (Ekwue, 2010) and extremely low by any scale.

In addition to these limited resources, climate change is exacerbating the water resource situation, with temperatures steadily rising, sea level rising, and average annual rainfall decreasing and becoming more and more erratic. (See Figure 3-4).

Figure 3-4 - Recent Changes in Rainfall and Temperature – New Providence

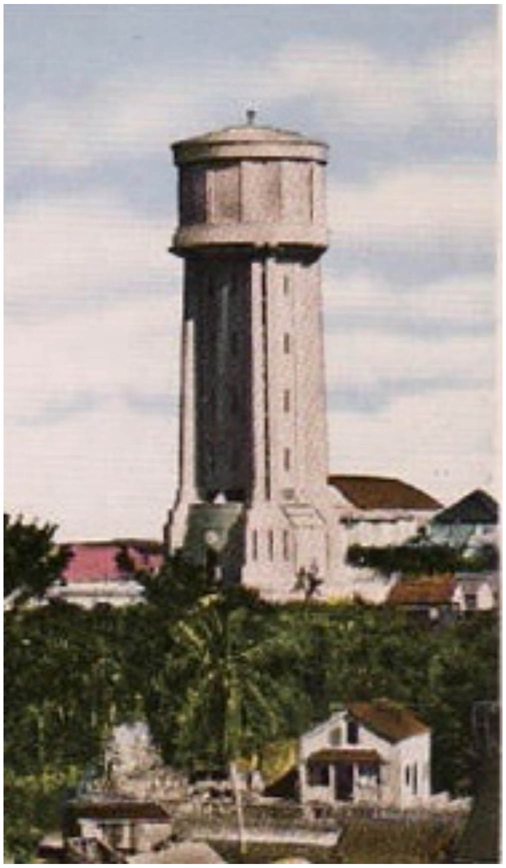


3.2 History of Water Supply and NRW on New Providence

The first piped water distribution system on New Providence was established in 1928, and consisted of a wellfield and pumping station at Blue Hills, and storage tanks at Fort Fincastle in Nassau Town (Figure 3-5). Borehole pumps were run by air pumps powered by windmills. The facility had to be abandoned in 1937 due to declining yield and salinization from over-pumping. Over the next decades, more groundwater supply facilities were built at Prospect, Per Place, Winton, Windsor Field, Southwest Station and others. The first desalination facility was built in 1959 (Clifton Pier), followed by the 2.0 Migd (9,000 m^3/day) MSF desalination plant at Blue Hills in 1972.

Throughout this period, the facilities and distribution were operated by the Water and Sewerage Department of the Ministry of Works. In 1976, the Water Supply and Sewerage Corporation (WSC) was incorporated, and absorbed personnel from the Ministry. Its initial focus was on New Providence, but WSC's mandate expanded to include service provision to North Andros in 1985, and the rest of the Family Islands in 1989.

Figure 3-5 - Fort Fincastle Water Tower



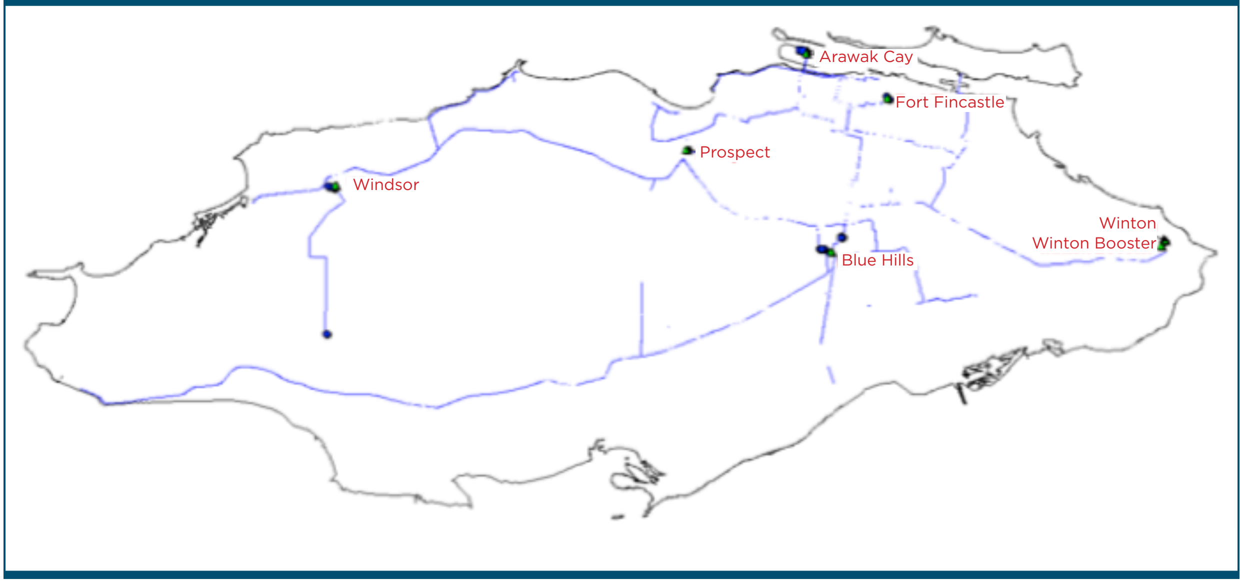
WSC began working on New Providence during a time of rapid increase in demand and strict water rationing. The utility expanded facilities and improved distribution into the 1980s and 1990s. In one its first actions, WSC began barge shipments of water from Andros Island to Arawak Cay on New Providence (1977). Barge shipment facilities were expanded significantly in 1981 and 1989. Other important advances included a 2.0 Migd (9,000 m^3/day) reverse osmosis (RO) desalination plant established at Windsor Field in 1998 and a larger RO desalination plant at Blue Hills in 2005. A listing of milestones in WSC's history is provided in Annex B. Figure 3-6 below shows a map of New Providence with major water supply facilities.

Along its history, WSC received support for improvement of water supply, mostly in the development of sources. A brief synopsis is provided below.

Water Supply and Sewerage Project for New Providence – WSSPNP (1977-1983), had a total budget of $US 36.4 million (World Bank). At this point in time, WSC was rationing water and struggling to meet demand with a total capacity of only 5.0 Migd (22,700 m^3/day). The project objectives were to increase water supply to New Providence and rehabilitate sewerage systems. The principal water supply targets were to a) reduce water losses from 48% to 15%; b) quickly establish barge water shipments from Andros (3.0 Migd or 13,600 m^3/day); and, later, to expand this supply by an additional 3.0 Migd.

As the project was being prepared in 1976, WSC outsourced a leak detection survey of the entire network, which identified the precise locations of leaks representing 0.75 Migd (3,400 m^3/day) – a significant amount of water. WSC commenced repairs, and the WSSP Project planned for ongoing outsourced leak detection, repairs and new meters. However, funding allocation for the water loss program was very small, and the water loss objective was not reached. The project also called for a tariff increase, which did not take place.

Figure 3-6 - Location of Major Water Supply Facilities on New Providence



New Providence Island Water Supply and Sewerage Rehabilitation Project WSSRP (1987-1995), had a budget of US$ 33.5 million (World Bank). The objectives were to a) strengthen WSC financial, commercial and technical operations; b) improve water quality and distribution through wellfield rehabilitation, mains rehabilitation/replacement and water importation improvements; c) reduce NRW through leakage control and meter management; d) rehabilitate the sewerage network and e) fund and conduct studies and technical assistance on tariff reform, water loss management and long term water supply planning. Resources for NRW reduction included bulk and customer meters, pipe replacements and technical assistance and training from international consultants. Project designers estimated that NRW could be reduced from 46% in 1987 to about 32% by 1993.

An independent evaluation found that the project succeeded in achieving most objectives, with some important gaps. Reduction in NRW was limited because the project approach, which relied mostly on WSC resources and small contracts, was systematic, but the gradual treatment of the problem was lengthy and costly and has only resulted in minor improvements. The other issue was a lack of improvement in WSC's financial position, due to delays in tariff increases, high NRW and loss of large customers due to service irregularities and the falling cost of (private) reverse osmosis desalination plants. These observations foreshadow difficulties in the years ahead.

3.3 Specific NRW Activities

Table 3-1 briefly delineates WSC NRW related activities on New Providence. Some elaboration on key findings and major activities related to NRW is provided in the sections below Table 3-1.

Table 3-1 – NRW-related Activities Conducted by WSC on New Providence

- 1976 –Leak detection program was outsourced to a private firm, which pinpointed 0.75 Migd (3,400 m3/day of leakage. The amount of leakage actually recovered is unknown.
- 1980 - UN consultants provide assistance for a WSC leakage control program (WSSPNP).
- 1983 – The WSC Leakage Control Unit was formally established and strengthened with more personnel, vehicles and equipment (WSSPNP).
- 1985 – Leak detection study was conducted by Philadelphia Suburban Water Company. The amount of leakage actually recovered is unknown.
- 1987 - Consultants from the UK helped WSC conduct a comprehensive NRW audit (WSSRP).
- 1988 - Integrated computerized accounting and maintenance work order system established (WSSRP).
- 1990 - Customer Information System and new Meter Management unit were established (WSSRP).
- 1993 to 1994 - Mains replacement/rehabilitation on New Providence undertaken, covering about 3.7% of the network (WSSRP).
- 1995 – Consultancy by an internationally recognized expert. Results include a situational analysis, training on leakage component analysis, the establishment of the first DMA and the night flow measurements, to estimate leakage (WSSRP).
- 1995 - 1999 - Mains replacement/rehabilitation on New Providence continues, covering about 22.7% of the network. It is likely that network “supply zones” or sectors were established on New Providence in this period.
- 2000 - 2001 Thames Water and Lysa conduct studies for WSC, in collaboration with IDB, for the preparation of a WSC Corporate Business Plan for 2002-2012. The Thames Water technical reports identify urgent rehabilitation / upgrade needs for the network, including mains replacement (10%-20% of the network at a cost of $15 million) and rearrangement of the distribution configuration to eliminate direct pumping into the network.

- 2001 –Follow-up on the consultancy by the international expert, with the main objectives of orienting WSC to the new IWA water loss analysis methodologies, including water balances, indicators and the BABE and FAVAD analysis methods. Results include an updated situational analysis, the first IWA water balance for New Providence and recommendations for an NRW reduction strategy based on the emerging IWA best practices. The water balance shows 89% real losses and 11% apparent losses.
- 2003 – WSC establishes Strategy and Action Plan for NRW Reduction, utilizing the findings and recommendations of Thames Water, Lysa and several international NRW consultants.
- 2005-2006 – WSC establishes the innovative, incentive-based contract with Consolidated Water Bahamas LTD (CWBL) to build and operate a large reverse osmosis desalination plant at Blue Hills for supply to WSC over 20 years, AND, conduct a program to reduce NRW by 365 MIG within a year (1 Migd, or 4,550 m3/day). Project achieves and surpasses its targets.
- 2008-2009 - As part of the Inter-American Development Bank (IDB) Water and Sanitation Initiative GN-2446-2 with the Government of the Bahamas, WSC developed a Holistic Plan for NRW Management on New Providence, based on a Water and Sanitation Sector Plan assistance from Castalia Strategic Advisors. This plan, also based results and lessons from previous NRW efforts, led to preparation of the ToR for RFP for the WSC-Miya PBC, that is the subject of this Case Study.

New Providence NRW Strategy and Action Plan 2003 – WSC establishes Strategy and Action Plan for NRW Reduction, utilizing the findings and recommendations of Thames Water, Lysa and the international NRW expert. This first comprehensive plan includes: a) establishing the components of NRW in different sectors on the network; b) pressure management and surge control through rearrangement of the distribution system configuration (no direct pumping into the network); c) commercial/metering audits; d) infrastructure management using DMAs and continual monitoring, active leakage control and pressure management; e) twining/technical assistance with a utility that has successfully reduced NRW (Malta Water Authority) and f) a pilot effort in five DMAs, followed by a PBC covering project management, technical expertise, daily activities and infrastructure hardware. The project was expected to reduce NRW by 675 MIG (3.07 Mm^3) in three to four years (from an ILI of 15.2 to an ILI of 8), at a support budget of about US$ 26 million, in addition to WSC inputs. The payback period was estimated to be two to 12 years, depending on whether recovered leakage was sold to customers at retail prices, or if recovered leakage simply reduced operating costs.

WSC-CWBL Water Supply and NRW Project 2005-2006 – The next major step in the ongoing WSC efforts to reduce NRW on New Providence was an innovative, incentive-based contract between WSC and Consolidated Water Bahamas LTD (CWBL). The project combined two aspects: to build and operate a large reverse osmosis desalination plant at Blue Hills for supply to WSC over 20 years, and to conduct a program to reduce NRW by 365 MIG (1 Migd or 4546 m3/day) within a year, starting in April 2005. CWBL brought in two very experienced NRW specialists. This project was a form of a PBC because, until reduction was achieved, CWBL was required to provide WSC with 1 Migd (4,546 m^3/day) of free water from the Blue Hills plant.

Figure 3-11 - Blue Hills Desalination Plant

The CWBL project did achieve its objectives. Activities included a baseline water audit over the period April 2003 to March 2004, a series of leakage reduction activities, outlined below, and an end-line water audit for the period April 2006 through March 2007. That final audit at first appeared to show that the target had not been realized. But after careful review of bulk meter calibrations (especially Arawak Cay) and adjustments due to pressure changes over the project period, an extensive analysis and independent expert review confirmed that the project had, in fact, surpassed the target. Both the baseline and end-line audits were reviewed by an independent NRW expert, who confirmed their compliance with IWA protocols and their accuracy. See photo of bulk meter accuracy testing for Water Balance calibration in Figure 3-12.

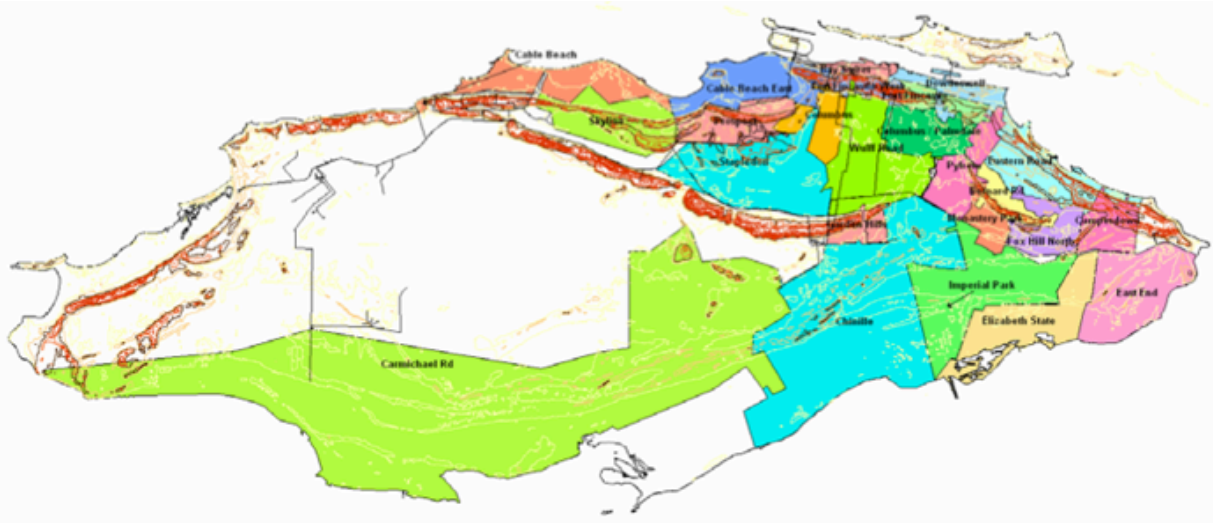
Figure 3-12 Water balance calibration

A summary of the components of the NRW reduction strategy is provided below.

- Pump Control and Surge Protection – Soft start/stop controls and variable speed drives and controllers installed at Windsor, Winton and Arawak pumping stations.
- Large Meter Improvement – Replacement of 113 large meters, including resizing of about half of the large meters, to reduce apparent loss.
- Pressure Management Areas – 25 macro and micro pressure management schemes installed, primarily to reduce night pressure. Each PRV has a flow meter so these zones could be used as large DMAs in flow monitoring. (See map below)
- District Metering Areas (DMAs) – 46 permanently monitored DMAs with flow meters and data loggers on inlets and critical points.
- Leak Detection and Repair – Despite low pressures and plastic pipes, two teams worked continually and found about 2,500 unreported leaks, mainly on services. See Figure 3-13.

The end result was a savings of 432 MIG (2.0 Mm^3), considerably higher than the target of 365 MIG (1.66 Mm3)

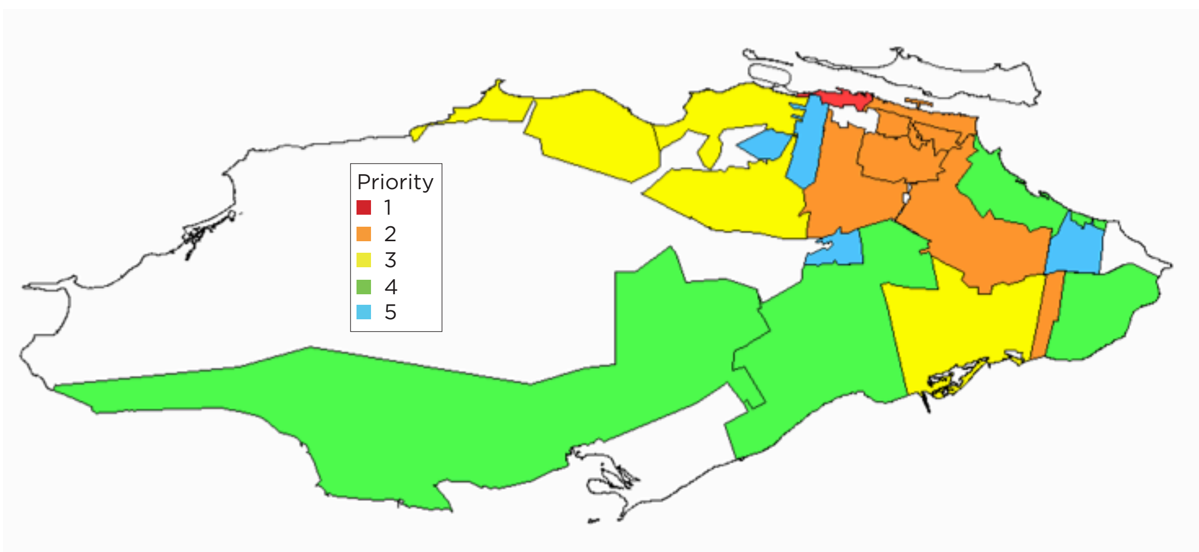
Figure 3-1 - Pressure management areas established in 2006, New Providence



This project provided WSC experience working with PBCs. They learned important lessons, especially related to the importance of regular validated water balances and ongoing leak detection, as well as pressure monitoring to assess PBC accomplishments. Unfortunately, WSC found that NRW rose after the project, as many of the ongoing activities were not sustained by WSC.

But in addition, the PBC, given its one-year duration, was set up for short-run targets, so activities with long-term benefit (which undoubtedly cost more) would not be part of the contractor's strategy to fulfill the contracted targets at minimum cost.

Figure 3-13 - Priority Leak Detection Zones



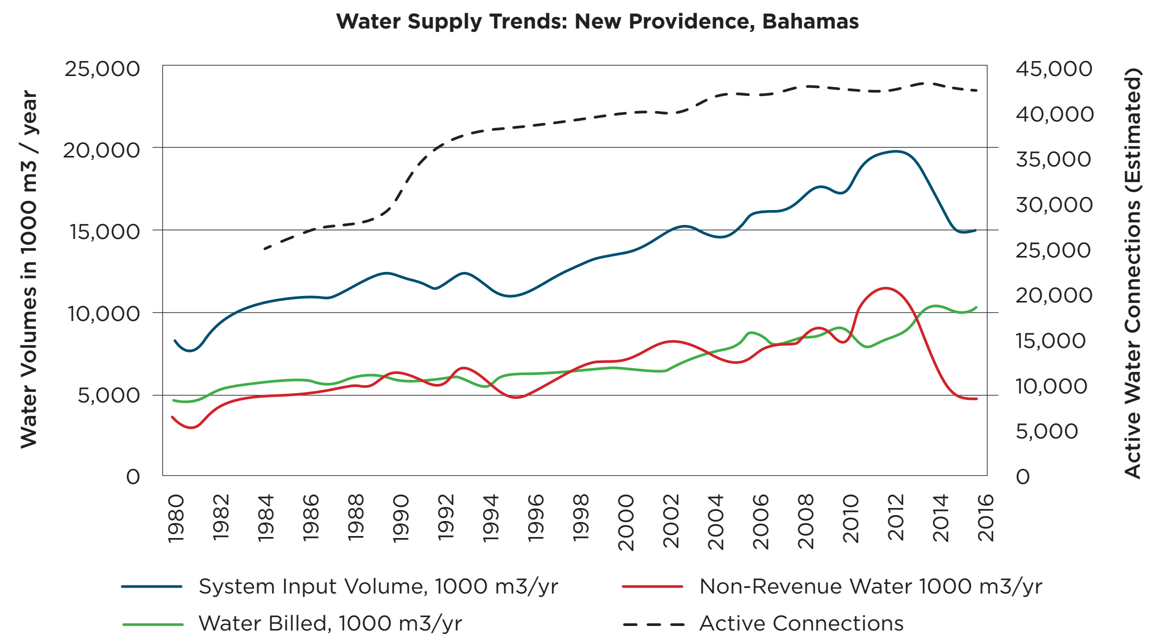
Development of a Bahamas Water and Sanitation Plan (WSSP) (2008-2009) – The IDB funded Castalia Strategic Advisors to work with WSC and the Government of The Bahamas to prepare a Water and Sanitation Sector Plan (WSSP). The objective was to propose solutions to the challenges facing WSC and the sector as a whole, based on an operational, financial and institutional assessment of the sector. Key recommendations were to decrease NRW, reduce staff, conduct a customer win-back strategy, raise tariffs, upgrade the legal and regulatory framework and develop multi-year performance agreements between WSC and the GOB. This plan provided the core strategy inherent in a new IDB loan to WSC, which included the Miya-WSC NRW that is the subject of this case study. The plan and its principal recommendations are reviewed in Section 5 of this case study.

3.3 Water Supply Operational Performance Trends for WSC – New Providence

A review of the long-run history of water supply and NRW at New Providence is very useful to understand the situation, the origins and the results of the PBC. This review includes the results of the ongoing WSC-Miya Performance-based NRW Project, which will be discussed in more detail in succeeding chapters.

Figure 3-7, below, shows trends from 1980 to the present for total system input volume, billed water consumption and resulting NRW, as well as the approximate number of active connections. The overall trend shows that water consumption (shown below as billed water) rose as the number of connections rose.

Figure 3-7 - Water Supply Trends – System Input, Billed Consumption and NRW

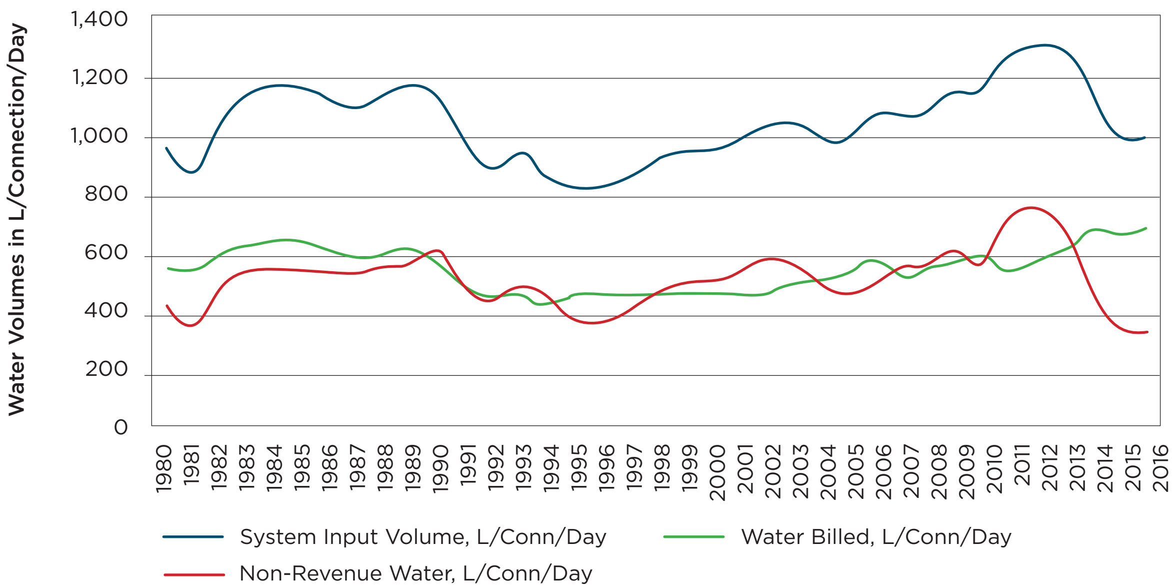


NRW had a general rising trend, but with short-lived decreases in 1980 with UN assistance, in 1994-1995 due to efforts under the WSSRP Project, and again in 2005-2006, due to the NRW reduction program associated with the CWBL contract. However, after the CWBL project, NRW continued to rise, and accelerated rapidly in 2011-2012.

Most recently, NRW and system input volume have decreased sharply with the activities of the WSC-Miya PBC. ***This sharp decrease is a remarkable reversal of what seemed like an immovable, worsening trend.***

It is also useful to examine water production, water use and water losses by connection to get a better idea of the time trends on these parameters. Figure 3-8, below, provides such a graphic. However, it must be noted that in some of the early years, the number of active connections is uncertain because different sources have different values. This uncertainty is linked to some customers stopping use of WSC water without formal disconnection, or new connections added onto the network in advance of actual housing construction. WSC indicates that there may have been as many as 11,000 inactive connections. It is not known how many of those were on pressurized lines and were a source of leakage. Therefore, the values per connection shown in Figure 3-8 must be viewed as approximate.

Figure 3-8 - Water Volume Trends by Connection, New Providence



Nonetheless, we can observe several of the trends mentioned above, including a drop in NRW in 1980 – 1981, then again in 1990-1995, during the WSSRP Project, and then in the mid-2000s during the CWBL NRW Project. After each of these efforts, the NRW per connection rose, presumably as attention was focused on other matters. We can also observe the sharp rise from 2011-2012, followed by the dramatic fall in NRW during the WSC-Miya PBC from 2012 to 2016.

Turning to some technical parameters of the water supply system in New Providence, Figure 3-9 shows water production capacity and actual water production, with periodic jumps in capacity, as new facilities are added or expanded, and also steadily increasing water production. There was little headway, until recent years with the full development of the Blue Hills desalination facility in 2011. Annex B provides a timeline with more details on the development of different water production facilities over the years.

Figure 3-9 - Water Supply Capacity and Actual Water Production

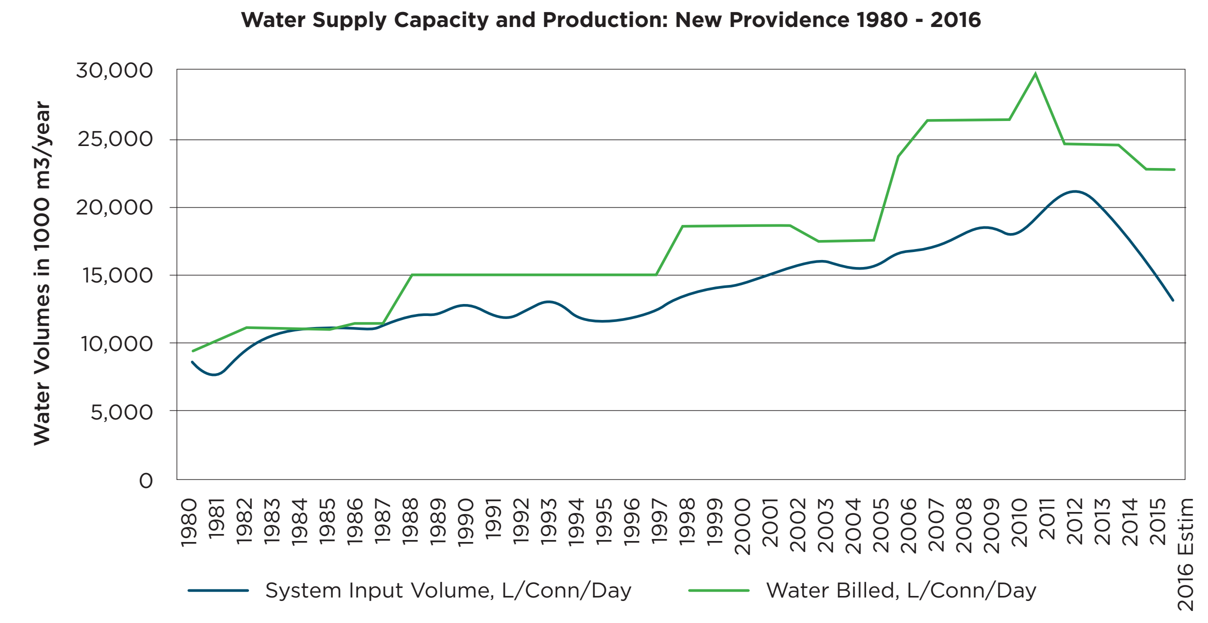


Figure 3-10 shows the shift in water sources, with a decline in the use of both well water and shipments of water from Andros Island, in favor of desalination. Barge transport of water is complex and expensive, and continual reliance on groundwater on New Providence would lead to over-pumping and salinization, especially in times of volatile but decreasing rainfall. Also, the new reverse osmosis plants are falling in cost and increasing in reliability. In addition, they can be provided under BOT/BOO arrangements, where capital outlay by WSC is not an issue.

Figure 3-10 – Shifting Sources of Water Supply – New Providence

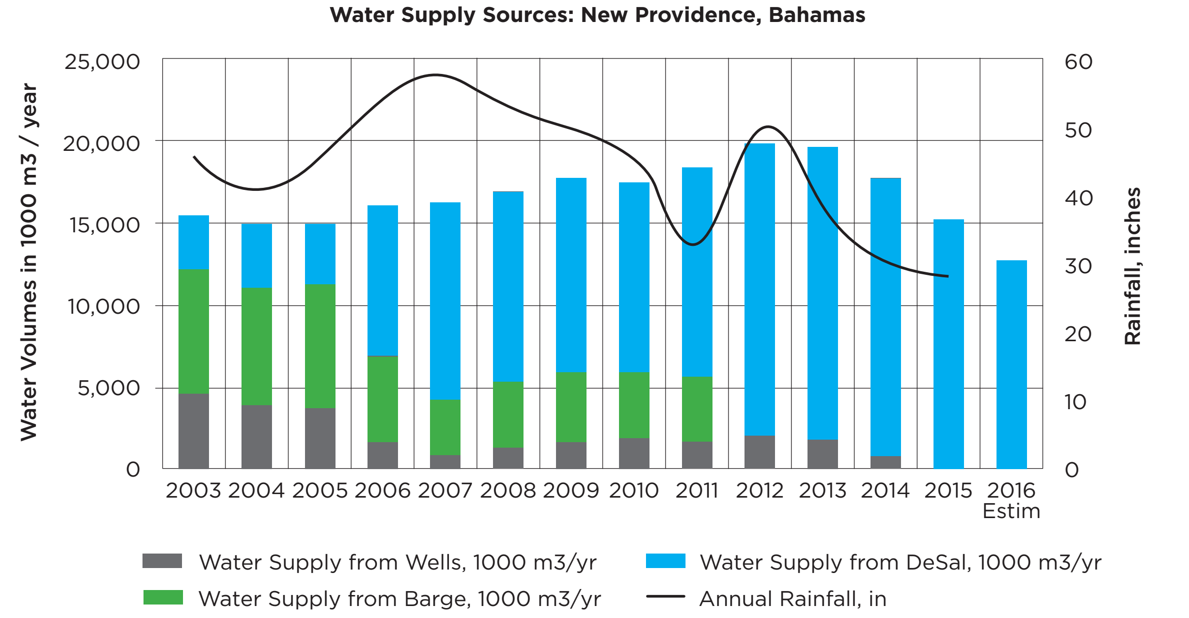


Figure 3-11 - Windsor Desalination Plant

4. Situational Assessment: WSC Financial Condition

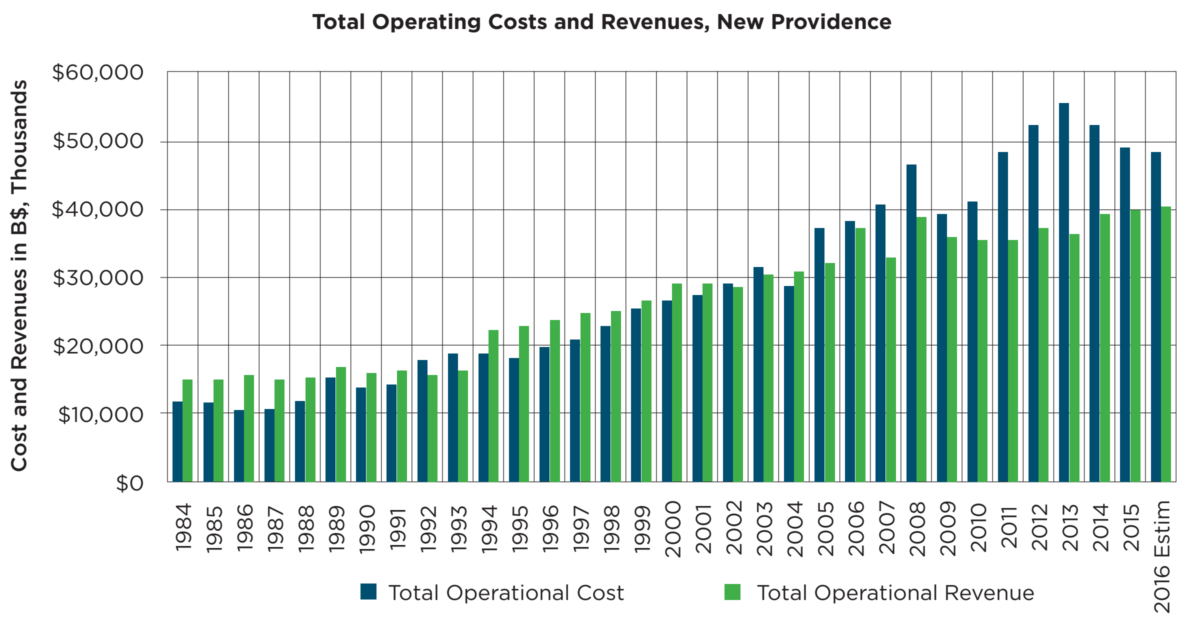
This section reviews the trends on financial condition and performance of WSC, for New Providence alone, not all of WSC.

4.1 Basic Financial Trends

Figure 4-1 shows the principal financial parameters, including total operating costs and total revenues for water and sewerage, since 1984. The years with lighter shading are estimated due to a data gap. In the early years of the history of WSC, revenues generally exceeded costs. Since about 2003, costs have generally exceeded revenues.

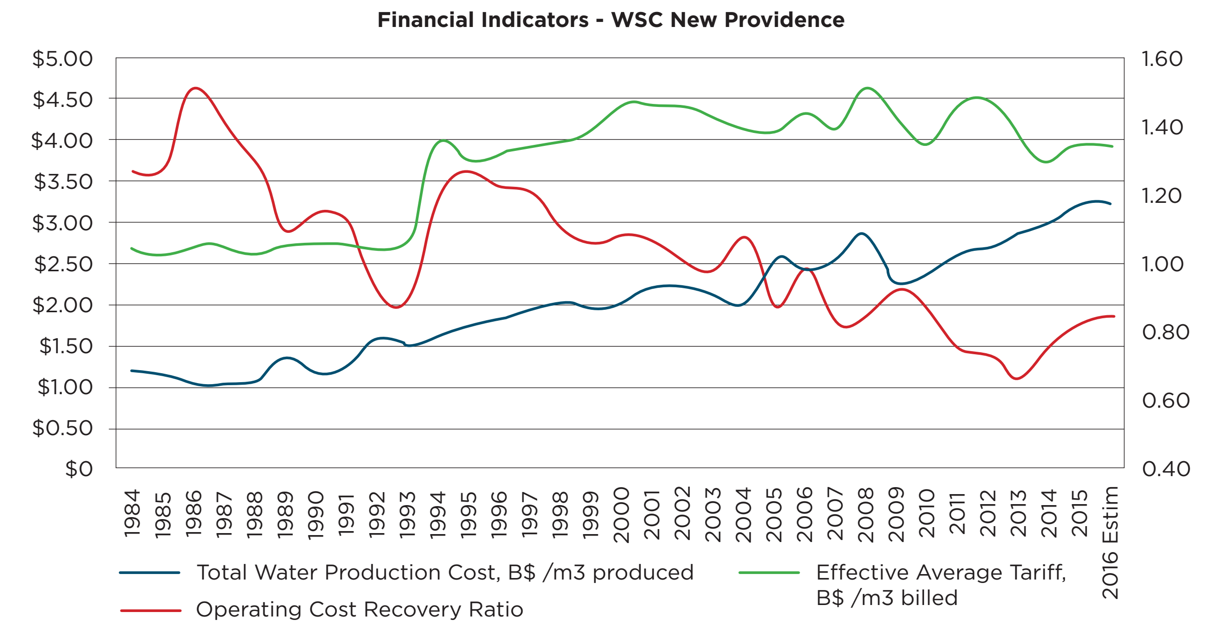
Over the history of WSC, there have been only three tariff adjustments – in 1982 (not shown), in 1993, and in 1999. The tariff increase in 1993 clearly boosted revenue in relation to cost, ensuring a modest surplus for about eight years. The tariff increase in 1999 is not noticeable, however, and since then, costs have climbed considerably.

Figure 4-1 Operating Costs and Revenues, WSC, New Providence



The key unit financial indicators are shown in Figure 4-2 (with no adjustment for inflation). There is an overall trend of decline in operating cost recovery, due to rising unit operating costs (especially as desalination has become the main source of supply), but also infrequent tariff adjustments.

Figure 4-2 - Financial Performance Indicators – WSC New Providence

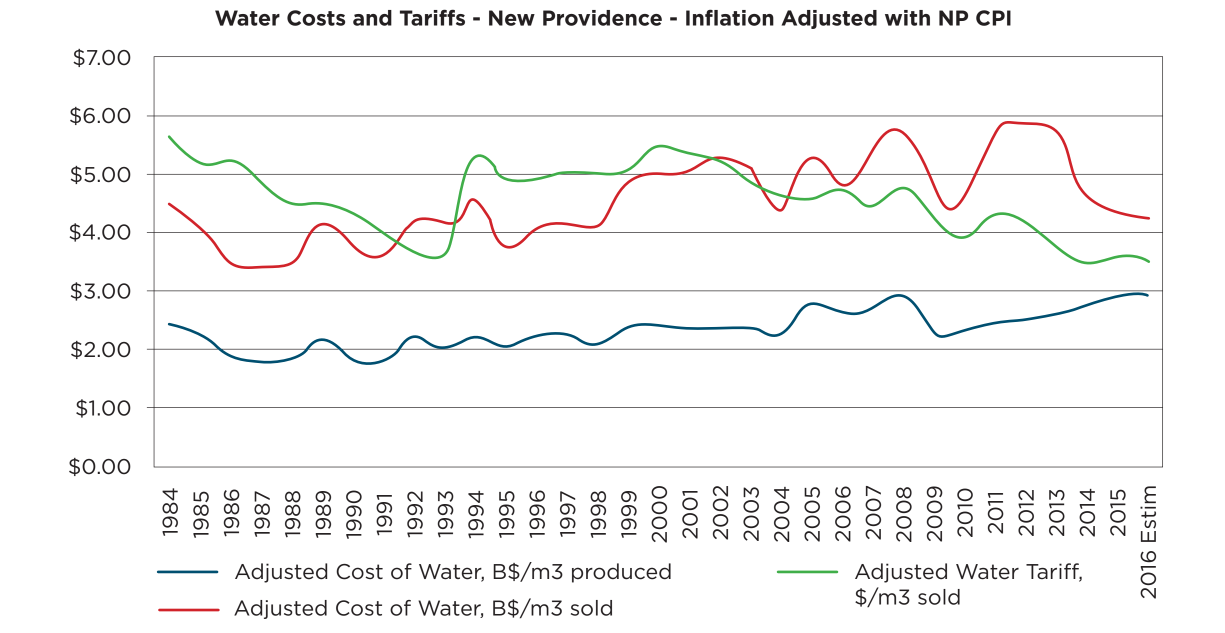


It must be emphasized that since 2013, when WSC-Miya PBC NRW reductions began, the financial condition for New Providence has improved noticeably, and the operating cost recovery may climb back toward 1.0 in another several years. Nonetheless, a tariff increase will be needed to make WSC a financially viable utility.

A core issue relating to the WSC financial condition is the comparative level of the unit tariff to the unit cost. As shown in Figure 4-2, the effective average tariff has been close to stable since the year 2000, while costs for water production (expressed as B$ m^3 produced) have risen considerably. These trends can be attributed to two factors: 1) no tariff increase since 1999 and 2) rising water production costs due to increased use of desalination (see Figure 3-10).

To assess this issue, an analysis was performed to examine unit tariff and unit water cost, adjusted for inflation. Data on inflation (CPI) for New Providence, Bahamas was obtained from the Department of Statistics of the Government of Bahamas for the period 1966 – 2016 – with an index of 1.00 in February 2010. The CPI figures were applied to the data in Figure 4-2, with results shown in Figure 4-4, below. The graph shows the unit operating cost in terms of cost per m3 produced, and also in terms of cost per m^3 sold (which takes into account the level of NRW). This latter indicator can be compared directly to the unit tariff.

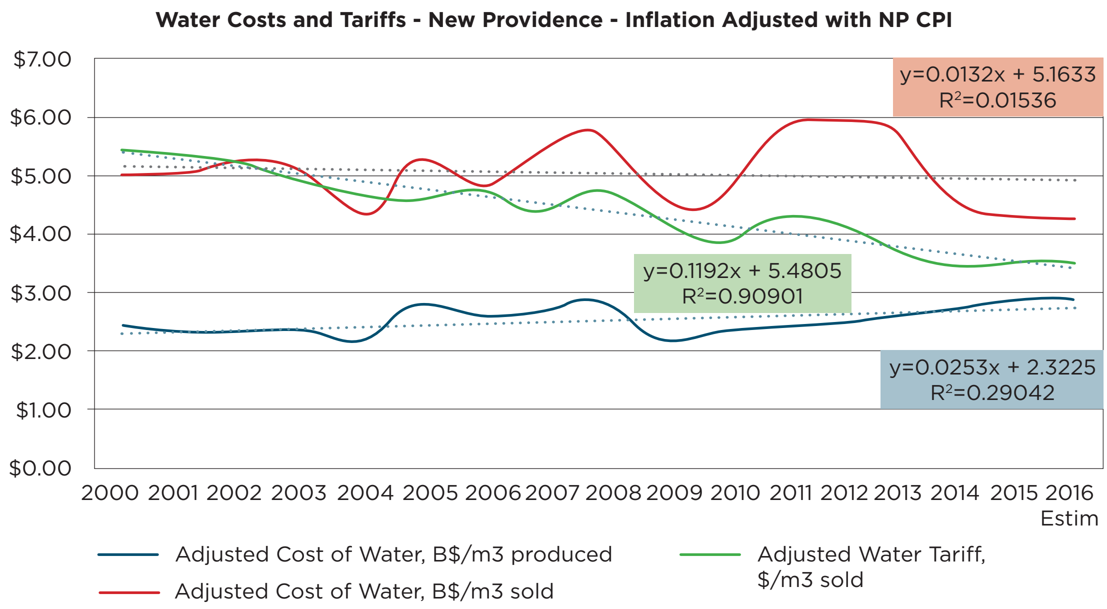
Figure 4-4 - Comparison of Inflation Adjusted Unit Water Cost and Unit Tariff



The unit tariff (in green), declines from 1984 until a big jump with the tariff increase in 1993, and has a slight further increase with the tariff increase in 1999. From 2000 onward, the unit tariff declines steadily, in real terms. The two indicators for water costs show modest increases, in real terms. Figure 4-5, below, shows a closer look at the period 2000 – 2016. The tariff had an average annual decrease, in real terms, of 11.9%. The cost per m^3 produced increased at an average annual rate of 2.5%, in real terms, while the cost per m^3 sold decreased at an average annual rate of 1.3%. The big drop in cost per m^3 sold from 2013-2016 can, of course, be attributed to declining NRW from the NRW PBC.

So, in summary, the tariff has fallen about 12% per year, while the unit cost of water produced, with increased use of desalination, has risen just 2.5%. If the amount of NRW is accounted for by using cost per m3 sold, operating costs have declined about 1.3% per year. Overall, these results underline the importance of the declining tariff to the financial condition of WSC, and its ability to sustain low levels of NRW. While it is always worthwhile to find ways to reduce costs -- through more NRW reduction or other means -- a tariff declining at a rate of about 12% per year is the main cause of WSCs financial difficulties – now and in the future. While modest, a CPI-based tariff indexation/increase would seem a reasonable first step.

Figure 4-5 - Average annual change in tariff and operating costs – inflation adjusted



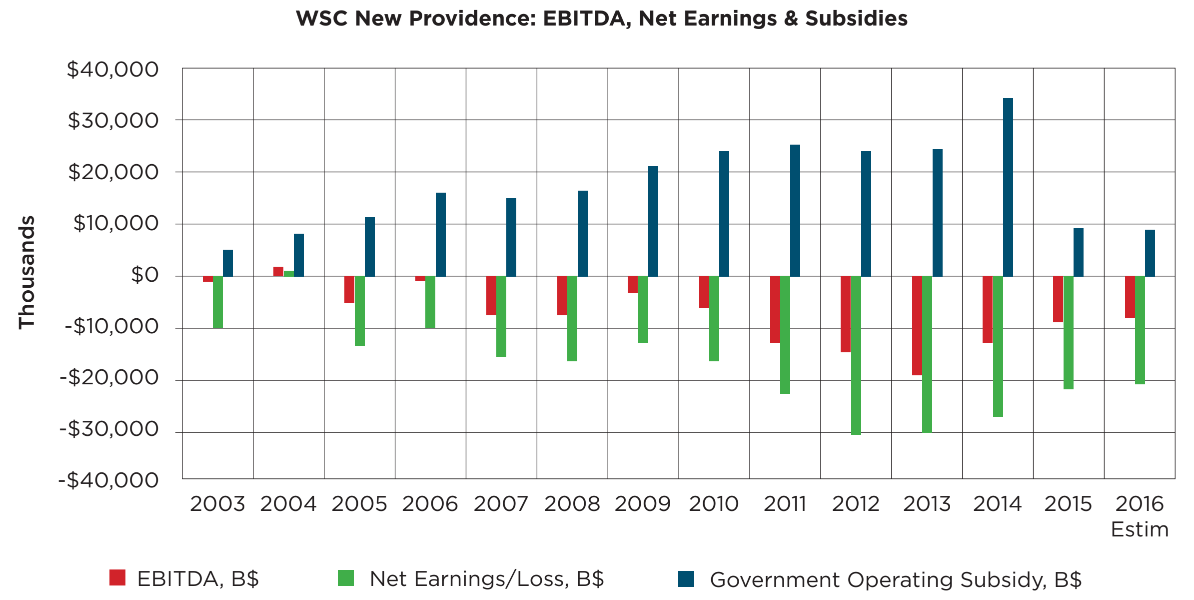
4.2 EBITDA, Earnings and Operating Subsidy

Figure 4-6 shows the net earnings for WSC New Providence, which reflect a large and increasing financial loss since 2003, except as NRW reduction became significant, since 2014. The Government of Bahamas total subsidy is large – B$ 249 Million since 2003. However, subsidies have been reduced significantly in the past two years.

A simple analysis makes the subsidy picture clearer: If a 10-year NRW project could reduce the subsidy from B$ 30 million per year to B$ 10 million per year, the total subsidy reduction would be B$200 Million. If it cost B$80 million or even $100 million to achieve that NRW reduction and control, then the expense on NRW reduction would be very attractive to the government.

Table 4-1 provides a more elaborate, but still hypothetical, calculation of the historical value of the recoverable NRW compared to earnings and subsidies. Calculations are based on an assumed reduction of real losses and apparent losses to 20% of their observed volumes, which would provide increased revenue and reduced costs, resulting in an improved EBITDA and net earnings, and could have allowed operating subsidies to be much lower. The calculation does not estimate a cost to achieve the reductions in losses, but the huge financial value of water losses is compelling.

Figure 4-5 - Financial Earnings and Government Subsidies, WSC, New Providence



From 1985 to 2000, the value of the recoverable water losses was roughly B$ 3.0 to 5.6 million per year. This potential financial benefit would greatly add to the EBITDA, which ranged from B$ 2.0 to 4.7 million per year. Such an increase in the EBITDA could probably have funded the OPEX and CAPEX costs of a concentrated NRW program over those years.

By 2005, the EBITDA had turned to a larger loss, because costs were rising and revenues were stagnant due to no tariff increase since 1999. Nonetheless, a reduced NRW, with a value of about B$ 5.0 to 6.0 million, would have made a significant dent in the EBITDA loss, improved the net earnings, and reduced the operating subsidy. Over the period from 2003 – 2015, the total value of recoverable losses was roughly B$ 93 million, which is just over one-third of the total subsidy over the period.

Table 4-1, and the preceding figures on financial parameters, show the huge impact of a tariff freeze since 1999. First, there is the basic trend of revenues not keeping up with costs, causing the worsening EBITDA and earnings. But looking at the year 2015, which had reduced water losses, WSC still had large negative earnings. Thus, one concludes that reduced losses have helped, but cannot be a cure for the financial situation. There is an undeniable need for a significant tariff increase, if the government wishes to reduce its subsidy to WSC.

In 2014, Castalia Advisors prepared a detailed financial projection for WSC that considered both New Providence and Family Islands (separately and together). In brief, the analysis compared a "business as usual" scenario (with the WSC-Miya PBC continuing, but no tariff increases), to an Action Plan (with the WSC-Miya PBC continuing; three tariff increases in 2016, 2018 and 2020, each at a 20% increase and some cost reduction measures).

The results for New Providence showed the EBITDA turning positive in 2016, the operating subsidy going to zero in 2018, and net earnings rising above zero in 2020. However, under the "business as usual" scenario, EBITDA would still be a large negative number, and operating subsidies would remain large until 2024. In fact, the total operating subsidy from 2014 to 2024 were projected to reach B$ 351 million under the "business as usual" scenario and only B$ 120 million under the Action Plan. While the analysis would benefit from an update, based on WSC-Miya PBC results since mid 2014, it shows the huge financial impact of the stagnant government tariff policy.

Table 4-1 – Value of Recoverable Water Losses, Earnings and Government Subsidies

Country	1985	1990	1995	2000	2005	2010	2015	2003-2015
Volume of NRW, 1000 m3/year	4,916	6,335	4,844	6,918	6,969	8,280	5,049	113,178
Value of Recoverable Losses, B$, 1000s	$3,019	$4,123	$3,707	$5,655	$5,669	$6,185	$5,025	$92,971
WSC New Providence EBITDA, B$ 1000s	$3,110	$1,995	$4,717	$2,230	$5,114	$5,854	$8,796	$97,199
WSC New Providence Net Earnings, B$ 1000s	Not Avail	Not Avail	Not Avail	Not Avail	$13,196	$16,731	$21,876	$226,272
Government Subsidy, B$ 1000s	None	None	Not Avail	Not Avail	$11,720	$24,335	$9,149	$238,609

5. Development of the IDB Loan and New Providence PBC

5.1 Strategic Plan

As mentioned in Section 3.2 above, the IDB funded Castalia Strategic Advisors to work with WSC and the Government of The Bahamas to prepare the Water and Sanitation Sector Plan (WSSP), to propose solutions to the challenges experienced by the WSC and the sector as a whole. The plan identified the following key challenges for WSC:

- a fragmented service area,
- limited water supply and high cost water (both barging and desalination),
- high levels of NRW,
- a poor governance framework,
- and low tariffs, all resulting in poor operational and financial performance.

The plan concluded with the following recommendations designed to 1) reduce costs and increase revenue, thereby fostering financial sustainability, and 2) improve institutional roles and structures, thus facilitating WSC's ability to achieve its goals. The proposed financial/ operational improvements were:

- decrease NRW on New Providence through the use of a performance-based NRW reduction contract and phase out expensive barging supply with reverse osmosis;reduce staff size – from current level of 6.6 employees per 1,000 connections to a target of 4.5 employees per 1,000 connections;
- conduct a customer "win-back" strategy to expand the residential and commercial customer base once NRW has been reduced and
- raise tariffs, once NRW has been reduced, service has improved and the customer base expanded through the win-back strategy.

The proposed institutional/structural improvements included:

- upgrade the legal and regulatory framework for the water sector;develop multi-year performance agreements between WSC and the GOB, to force better planning and promote transparency and accountability;
- incorporate private ownership and management.

5.2 Loan Project Components

Based on the strategy and recommendations outlined in the WSSP, the IDB began preparation of a loan to WSC, which included the following components:Component 1: NRW Reduction (US$50 million): A NRW Reduction Contract for New Providence. The contract's main targets will be to: (a) reduce NRW to 2.5Migd (22,700 m^3/day) within five years; (b) train WSC staff and (c) provide NRW management software.

- Component 2: WSC Institutional Strengthening (US$13 million): (a) MIS integration, including customer information system SCADA; (b) metering improvement; (c) right-sizing of WSC, including training and implementation of the new organizational structure and (d) a tariff study.
- Component 3: Minimum Wastewater Treatment Plant Upgrades and Preparation of a Wastewater Treatment Action Plan (US$15 million): (a) rehabilitation works to improve wastewater treatments plants and (b) preparation of a wastewater treatment master plan.
- Component 4: Upgrade legal and regulatory framework (US$3 million): (a) implementation of an agreement between the GOB and WSC, including an HR strategy, an operational strategy, and benchmark performance standards for preparation of WSC for regulation by the PUB or URCA; and (b) the reorganization of regulatory arrangements for water resources management and environmental protection.

5.3 Formulation of the NRW PBC

Following the Water and Sanitation Sector Plan, WSC prepared a TOR for a new large NRW PBC for New Providence. The initial objective of the project was to reduce NRW from 5.0 Migd (22,700 m^3/day) to 2.5 Migd (11,350 m^3/day) at an average annual system pressure of 25psi (17.6 m) within five years and to maintain that level for a further five years. The TOR also called for training of WSC staff and provision of integrated NRW management software. The TOR stipulated staff positions/ qualifications and phases to be conducted, as outlined below:

- Baseline / Strategy Development – updated IWA water balance and strategy to achieve targets (10 months).
- Negotiation Phase – Final quantities and price-based baseline/ strategy development phase (2 months)
- Execution Phase – Leak detection and repairs, use of DMAs, monitoring systems, AMR metering systems, pipe renewal as necessary, ongoing maintenance and training, reporting. (10 years – with a five-year reduction phase and a five-year maintenance phase)

Table 5-1 – NRW Project Timeline

Date	Activity / Milestone
2008	Draft TOR prepared by WSC
2009	Final TOR prepared by WSC
8/2009	RFP for NRW PBC issued
12/2009	RFP issued to six qualified international firms
2/2010	Proposals submitted by two firms – Miya and Suez
4/2010	Technical scoring completed – Miya higher
6/2010	Miya financial proposal opened – price very high
9/2010	Negotiations completed to reduce scope and cost
9/2011	IDB completes loan preparatory analyses
9/2011	IDB conducts first review of draft PBC
11/2011	IDB conducts second review of draft PBC
11/2011	IDB loan approved
12/2011	Loan signed by IDB and WSC
2/2012	PBC signed by Miya and WSC
4/2012	Miya team Mobilized
10/2012	Baseline/strategy report completed
11/2012	NRW reduction activities formally start

The TOR called for a combination of fixed charges (baseline/strategy work, specialized labor, capital works, monitoring equipment) and a performance-based fee, based on volume of water saved. The TOR provided detailed reports on the CWBL NRW project as a reference.

The final TOR/RFP was quite similar, technically, to the draft TOR, but the reduction target was changed from 2.5 Migd (11,350 m^3/day) to a range of 2.5 Migd (15,900 m^3/day to 3.5 Migd (11,350 m^3/day). The RFP used standard IDB language, and used a QBS evaluation process, based on a desire for the highest quality bidder. The RFP provided a cost estimate of $US 10 – 12 per imperial gallon of reduction. That would correspond to a range of bid prices from $US 25 million to $US 42 million.

As noted in the timeline, six firms were invited to bid, but only two firms submitted proposals. The technical proposals were reviewed by WSC, and independently by an international NRW expert (who was quite familiar with NRW activities and issues in Bahamas) and both reviews led to Miya as the preferred bidder.

When the Miya price proposal was opened, the price was found to be far higher than WSC had estimated. A lengthy negotiation process ensued in which portions of the scope were removed from the contractor's responsibility – such as the AMR metering component -- and other functions were shifted from the contractor's responsibility to WSC's responsibility – including meter change out and leak repairs. The resulting final contract had an estimated total project cost of $83 million, with remuneration split between 70% fixed fees and 30% performance fees (based on a unit payment of $US 2.40 per 1000 imperial gallons of reduction ($0.528 / m^3). The contract included price escalation clauses and procedures for using average pressure changes in calculation of NRW reduction. Table 5-2 provides full details of the contract terms at time of signature in February of 2012.

5.4 IDB Loan Project Preparation

Once negotiations were completed, IDB conducted its typical assessments for a water infrastructure loan, including analyses on technical, financial and environmental variables. The most important result of this work was an independent project cost estimate of $50 million, far less than the $83 million. IDB conducted several follow-up reviews of the proposed contract, and decided to fund the Baseline/Strategy Phase and the Reduction Phase for $50.5 million. The Maintenance Phase would have to be covered by WSC. IDB also included other components to the loan, based on the WSC Water and Sector Plan, as outlined below.

Table 5-2 – Summary of Contract Terms and Conditions
(as specified at Contract Signature)

1. Parties

Client: Water & Sanitation Corporation, Nassau, Bahamas

Consultant: Miya Water Projects Netherlands BV, Rotterdam, Netherlands

2. Term, Phases and Targets:

Effective Date: February 12, 2012 (Contract Signature)

Term: Ten Years from Commencement Date (April 12, 2012)

Milestones & Targets (with dates below in reference to Commencement Date)

- Baseline Survey: Five months
- NRW Reduction Strategy: Seven months
- NRW Reduction Target Achieved: Calendar Year 2017 (2.5 Migd)
- Maintenance Phase: January 1, 2018 to End of Contract (April 2022)
- NRW Ultimate Target Achieved: Calendar Year 2019 (2.0 Migd)

3. Consultant Deliverables and Reporting

- Investment Plan for the Reduction Period to be included with NRW Reduction Strategy
- Monthly Progress Report with activities and NRW levels
- Annual Progress Report, with Activities, Updated Water Audit, Investment Plan Update and Recommendations for Target adjustments, if any

4. Obligations of the Client:

- Perform network burst/leak repairs, customer meter maintenance and replacement, and other normal network maintenance (valves, flushing, etc)

5. Payment to the Consultant:

- Fixed Compensation: Based on Consultant's Proposal, after negotiation. Designed to cover the cost of personnel, travel, materials, equipment, software, etc. Subject to adjustment using a "blended index" for commodity price changes and Bahamas CPI.
- Performance Compensation: $US 2.40 per 1000 imperial gallons of NRW reduction, with adjustment for Bahamas CPI. Volume reduction also subject to adjustment for variation from planned pressure.
- Estimated Payment Schedule (all expressed in $US 1000) below Note: Most of the performance payment is in the later years, incentivizing the consultant to keep NRW down.

Item	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
Fixed Compensation											
- International Currency	9,028	9,325	9,325	8,372	2,147	2,356	1,853	1,360	1,360	1,360	46,986
- Bahamian Dollars	1,972	2,675	2,675	2,628	1,353	144	147	140	140	140	12,014
Total	11,000	12,000	12,000	11,000	3,500	2,500	2,000	1,500	1,500	1,500	59,000
Performance-based Compensation	414	1,062	1,740	2,561	3.118	3,137	3,594	3,613	3,634	902	23,775
Total Compensation	11,414	13,062	13,740	13,561	6,618	5,637	5,594	5,613	5,134	2,402	82,775

6. Other Provisions

- Performance Security: Consultant provides a performance security based on a small percentage of the fixed fee compensation of years 1-5 (ranging from 0.1% to 7%).
- Disputes: "The Parties shall use their best efforts to settle amicably all disputes arising out of or connection with this contract or its interpretation."
- Termination: The client can terminate the contract if the consultant does not remedy a "material failure" within 90 days, due to corruption or insolvency of the consultant or other non-performance. The consultant may terminate the contract, if the client does not remedy a "material failure", becomes insolvent, or fails to pay the consultant within prescribed time frames. Some compensation will be due to the consultant in the case of early termination.

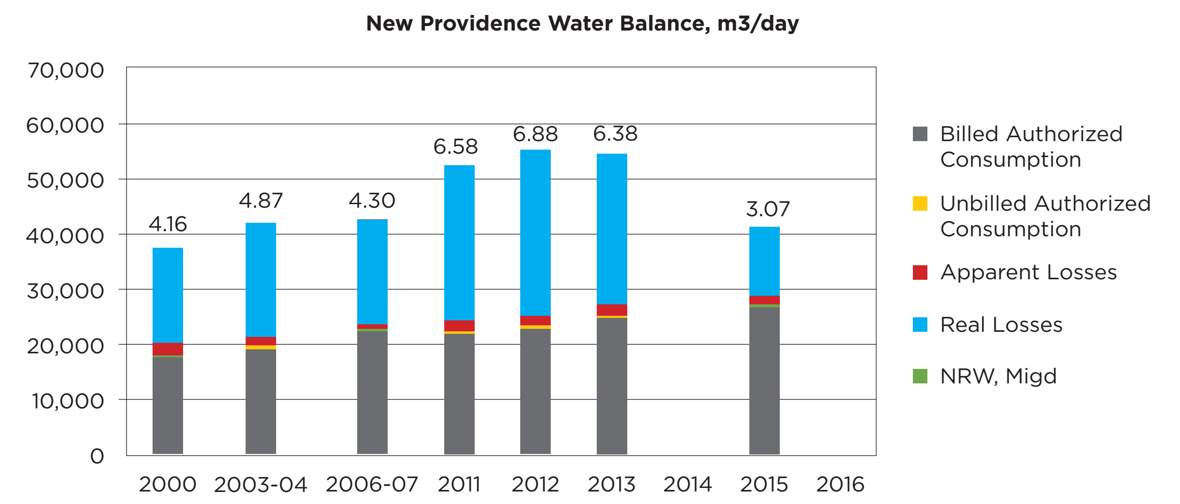
6. PBC Implementation Progress through 2016

6.1 Baseline/Diagnostic/Strategy Phase

As noted above, the first six months of the PBC consisted of the Baseline/Diagnostic/Strategy, which began in April 2012. The Baseline/Diagnostic/Strategy Report was submitted by Miya to WSC in October of 2012, and approved in November of 2012.

The first step in the Strategy (to use a simplified term) was to conduct a validated water audit for 2011, and compare results to the baseline NRW value stipulated in the RFP and contract. As shown in Figure 6-1, the total NRW was found to be about 6.6 Migd (at a pressure of 24.6 psi), as contrasted with an RFP value of 5.0 Migd (at 20 psi). The 2011 validated audit was very thorough, including detailed bulk and customer meter testing, component analysis of real and apparent losses and extensive pressure readings. (The earlier water balance data come from activities described in Section 3 of this case study). The water balances consistently show a predominance of real losses, and quite loss apparent losses.

Figure 6-1 – Water Balances Before the PBC, at Baseline, and After



One of the main results of the diagnostic was that the principal source of real loss was on the service connections / lines. Table 6-1 shows the results of the real loss component analysis, underscoring the need for a focus on service connection replacement and active leak detection. Previous real loss reduction efforts focused on mains replacement and ignored service connections. The service connections were in poor shape due to poor materials, poor installation, the chemistry of water from reverse osmosis plants and corrosive soil conditions in the Bahamas. The Strategy proposed a decrease in resources for mains replacement in favor of more resources for service connection replacements and service disconnection at inactive accounts.

Table 6-1 – Real Loss Component Analysis

PART C: SUMMARY OF BABE CALCULATION	Background leakage	Reported breaks	Unreported breaks	Total
	IMG / year	IMG / year	IMG / year	IMG / year
Mains	68	22	148	239
Fire Hydrants and Valves		0	0	
Service Conns. main to prop. line	185	118	1669	1976
Service Conns. stop taps & meter		3	0	
Totals	253	144	1817	2215
Real Losses Estimate from Annual Water Balance =				2215

- Active leakage control essential!
- Breaks on service lines the main problem

A component analysis of apparent loss showed a small volume from illegal connections, but relatively high under-registration in large-customer meters, and "stuck" small meters.

The diagnostic also found that PRVs and DMA inlet meters had not been maintained properly, requiring an unanticipated cost of rehabilitation and of purchase and installation of new hardware.

The principal components of the Strategy included:

- Advanced pressure reduction and control
- Rehabilitation and monitoring of all DMAs with data-loggers
- Replacement of defective service connections and removal of inactive connections
- Use of improved materials and components – especially on service connections
- Active leak detection and rapid repair
- Large meter replacement
- SCADA and Netbase Information Systems for effective operations and monitoring
- Public/School Education Program on water efficiency (not called for in the RFP).

An Annual Investment Plan was adopted for each component, including target outputs. Results were reported each month. At the conclusion of each year, a water balance was conducted and revisions were made to the Plan, as agreed between Miya and WSC.

Table 6-2 – Target NRW, Strategy 2012

2012	6.87 Migd	31,200 m^3/day
2013	6.42 Migd	29,200 m^3/day
2014	5.92 Migd	26,900 m^3/day
2015	4.87 Migd	22,100 m^3/day
2016	3.77 Migd	17,100 m^3/day
2017	2.50 Migd	11,400 m^3/day
2018	2.25 Migd	10,200 m^3/day
2019-2021	2.00 Migd	9,100 m^3/day

The Strategy also included revised NRW targets, which accounted for the higher baseline NRW, AND were more ambitious than the original planned reduction in the RFP. These targets would be further revised in April 2014 to even lower values, based on experiences in 2013.

6.2 Reduction Phase

The reduction phase started at the beginning of 2013. NRW decreased rapidly in 2013, 2014 and 2015, but slowed somewhat in 2016, as shown in Figure 5-2. It is quite remarkable that the program could, by 2015, surpass the RFP target, when starting from a higher baseline value. Due to rapid progress, the 2012 Strategy NRW targets were revised further downward, with the agreement of WSC and Miya.

Figure 6-2 - Annual NRW Performance in Comparison to Targets

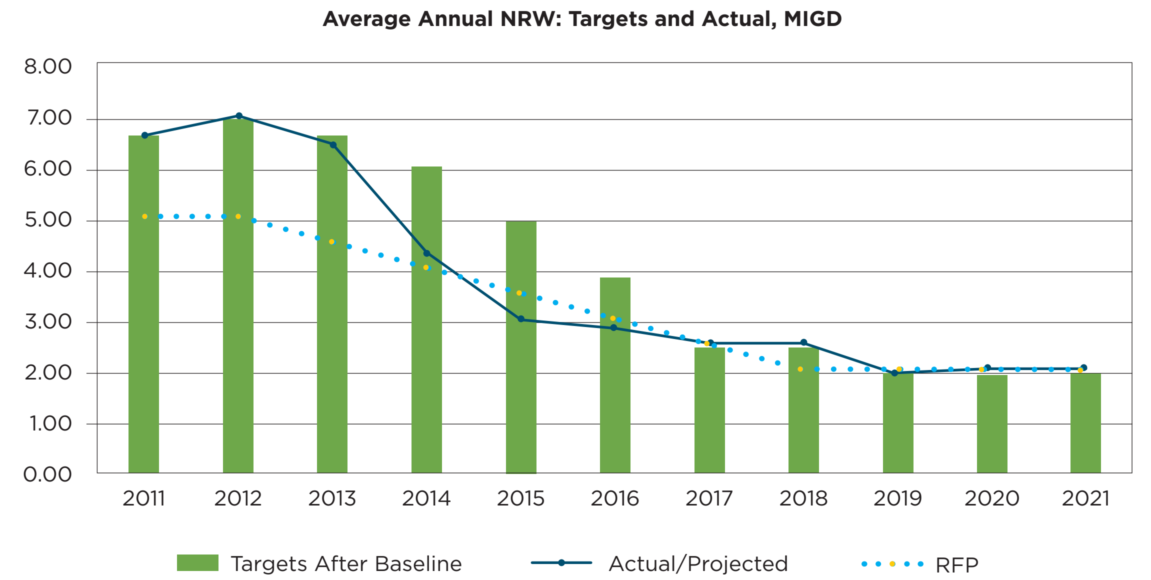
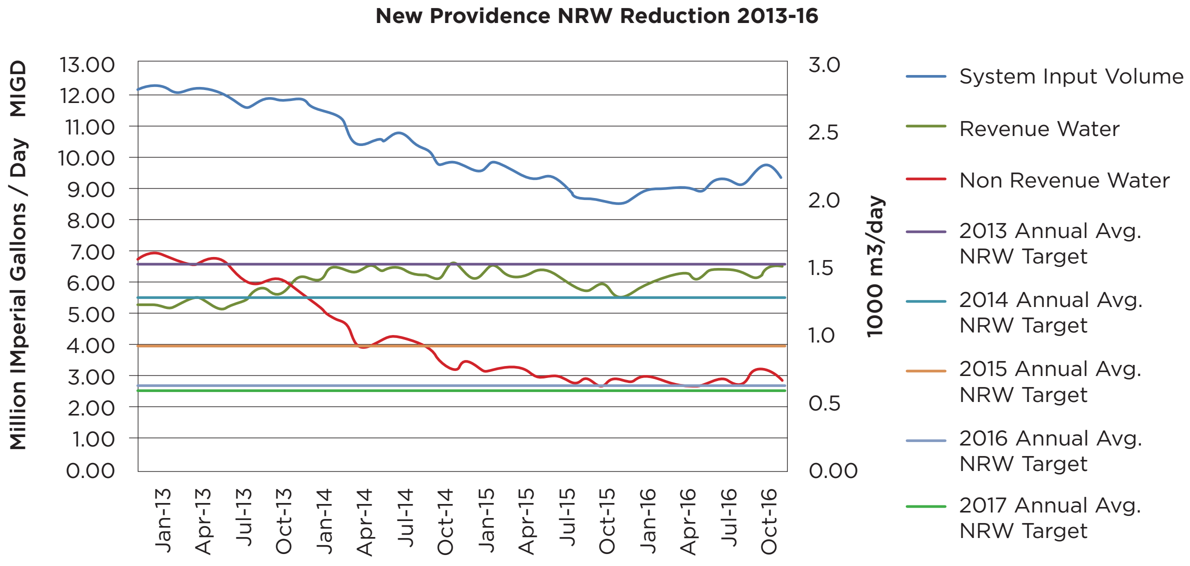


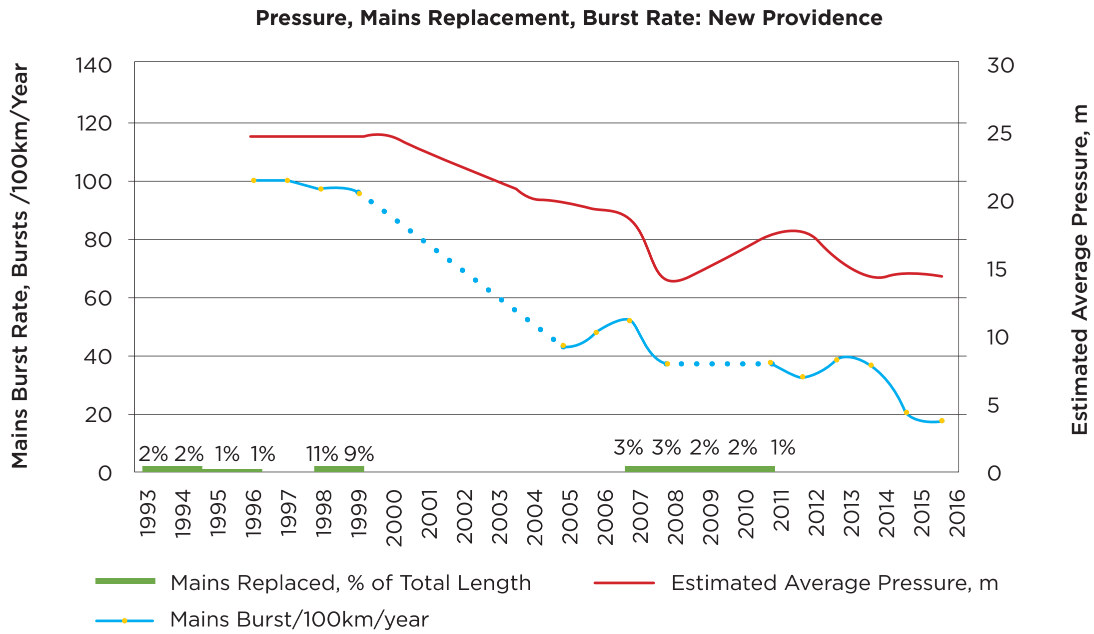
Figure 5-3 shows the monthly trends of system input volumes, billed water consumption and non-revenue water. As noted before, there is a very sharp decline in NRW over the period of mid-2013 to mid-2015 - approximately 1.8 MIGD per year or 8,150 m³/day / year. This translates into a reduction of NRW of about 40% in the first 12 months, and 25% more in the second 12 months. Reduction rates this high are almost unheard of in NRW projects. It is also worth noting that there was a small increase in NRW in October 6, 2016, but reduction directly afterward. This little spike can be attributed to Hurricane Matthew – a Category 4 storm that hit New Providence directly.

Figure 6-3 NRW Reduction in Relation to Updated Targets



Additional technical indicators, plotted over time, demonstrate the results before and after the reduction phase began. Figure 6-4 shows mains burst rates, back as far as the mid-1990s (with some data gaps), including both reported and unreported bursts. In the mid-1990s, the mains burst rate was at about 100 bursts/100 km/year. However, the mains burst rate fell considerably to about 40 bursts/100 km /year once mains replacements reached a significant level, and pressures and pressure transients were reduced. Bursts have declined further under the PBC to about 17 bursts/100 km /year, which represents good performance, given that the "unavoidable" rate is 13 bursts/100 km /year. While mains replacement was a small part of the PBC program, better pressure reduction and control, under the PBC, can explain the much- improved network performance. While some selective mains replacement will be useful as time goes on, it's clear that mains bursts are now not the primary concern.

Figure 6-4 - Mains Bursts and Pressure, New Providence



On the other hand, service connections have been a major focus under the PBC. As shown in Figure 6-5, below, service connection leaks have taken a more dramatic fall, from about 150/ 1,000 connections/year, down to about 14/1,000 connections/year. There is still some room for improvement, given an unavoidable figure of 5/1,000 connections/year. Together with pressure control and aggressive leak detection, the replacement of service connections has been a fundamental part of the PBC strategy, and the main cause of the reduced leakage.

Figure 6-5 - Service Connections Leaks and Pressure, New Providence

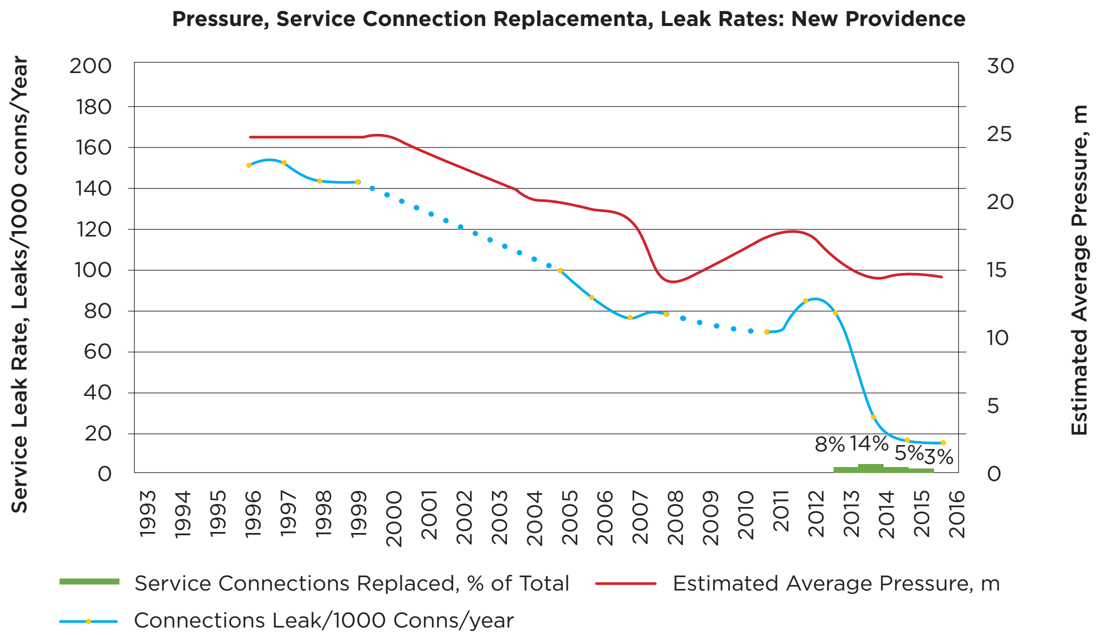


Figure 6-6 shows specialized hardware that was carefully selected for use in service connection replacements in the harsh soil conditions in the Bahamas. A stainless steel bronze connection saddle is used with a high-quality plastic coupling. While these components are expensive, they will last much longer than inexpensive alternatives, saving money and maintaining service quality over time

Figure 6-6 - Service connections components

As noted above, other key elements of the program include active leak detection, use of DMAs and advanced pressure management and control. The active leakage program surveyed approximately 10,400 km of distribution lines with acoustic devices, over the period 2013-2016, which roughly corresponds to surveys of the entire system every six months. The program re-established 89 DMAs, and added new boundary control devices, new pressure tappings and data loggers. The program also replaced 20 defective PRVs/controllers/strainers and installed 12 new PRVs/controllers /strainers. Figures 6-7 and 6-8 simply show pictures and graphics related to these components.

Figure 6-7 - Leak Detection Activities

Figure 6-8 - Installation of a Pressure Reduction Valve, Bypass and Flowmeter/PRV Controller

On financial aspects, there is progress. The financial trend analysis in Section 4 has shown a significant improvement in both revenues and costs, especially in 2015, and presumably in 2016. Over the period 2013 to 2015, the operating cost recovery ratio increased from 0.65 to 0.82, with 2016 estimated at 0.83. The EBITDA fell from a loss of B$19 million to $8.8 million over the same period, and Government Operating Subsidy fell from B$25 million to B$9.2 million.

In addition, WSC has been able to steadily and noticeably reduce overtime expenses, probably due to a lower number of pipe break repairs. Also, WSC reported in 2015 that it had cut the $14 million receivables in half, which is a significant help in its overall financial picture.

The number of new customers or returning customers has been lower than hoped. The “win-back” program has not achieved its targets, at least so far.

Table 6-3 provides a summary of the technical and financial project results through 2016, which on the whole shows significant progress on almost all project performance metrics. The issue of a tariff increase for WSC remains an unanswered impediment to long-term financial sustainability.

Table 6-3 Project Results Matrix		New Providence Water Supply and Sanitation Systems Upgrade										BH-L1028
RESULT	INDICATORS	BASELINE	TARGET	2012	2013	2014	2015	2016	2017	2018	Comments
NRW Reduced	Annual average NRW in Migd	6.58 Migd (2011)	2.25 Migd (2018)	6.88	6.38	4.28	3.04	2.87			Average annual volumes; fast
	NRW baseline / diagnostic / strategy done		1	1							NRW Targets changed from Contract
	Customer services replaced or disconnected (cumulative)		23,000 EOP	137	5,361	14,846	19,702	22,223			Cumulative results, Ahead
	Leaks detected and repaired (cumulative)		6,000 EOP	12	2,119	4,303	5,639	7,667			Cumulative results, Ahead
	Leak detection: miles surveyed (cumulative)		Not specified	1,049	2,168	3,248	4,803	6,467			On average, more than once per year
	DMAs Re-established (cumulative)		89 Possible	0	0	65	89	89			Complete
	PRVs / strainers / controllers replaced or installed	all in poor condition	Not specified	0	25	30	32	32			12 new, 20 replacements; complete
	Bulk meters refurbished / replaced (cumulative)		Not specified	5	32	80	102	102			Some zones & DMAS share bulk meters
	Large customer meters intalled (cumulative)		0	5	29	57	71	71			Not in budget; complete
	Data Loggers installed (cumulative)		Not specified	3	131	301	360	360			Complete
	SCADA & Netbase Systems installed (cumulative)		1 + 1		1 + 1						Complete
	NRW Training Workshops delivered (cumulative)		10			2					Planned for late in Project
WSC Finances Improved	Cost of Water Supplied B$ / m3 supplied (no sewer costs)	B$ 1.82 / m3	Not specified	1.90	1.91	1.93	1.95	1.92 (est)			Only a small rise
	Cost of Water Supplied B$ / m3 billed (no sewer costs)	B$ 5.58 / m3	Not specified	5.84	5.70	4.61	4.25	4.09 (est)			Significant Progress
	Operating Cost Recovery (including depreciation)	0.61 in 2011	0.8 in 2016	0.60	0.56	0.60	0.68	0.68 (est)			Target must have assumed a tariff increase
	Operating Cost Recovery (w/o depreciation)	0.74 in 2011	Not specified	0.72	0.65	0.75	0.82	0.83 (est)			Significant Progress
	EBITDA, B$ 1000	B$ (12.5) M (2011)	Not specified	(14.6)	(19.1)	(13.2)	(8.8)	(8.0) est			Significant Progress
	Government Operating Subsidy, B$, 1000	B$ 25.8 M (2011)	Not specified	24.2	24.9	34.9	9.1	9.0 est)			Significant Progress
	Increase in Active Connections		14,000 by 2018	1,375	2,898	3,398	4,090	5,000 (est)			Slow progress
	Households switching to WSC from private source		5,000 EOP	102	156	223	389	500 (est)			Cumulative.... Slow progress
	Customer "win-back" campaign done		1			Underway					
	Expense on staff overtime	$US 109k	$US 82	$US 113k	$US 112k	$US 99k	$US 80k	NA			Improving well
	Large users billed correctly	84% in 2011	98% EOP	87%	85%	93%	89%	NA			Erratic, but improved
	Revenue collection (All WSC - not just New Prov.)	87% in 2011	Not specified	89%	90%	96%	102%	100% (est)			Significant Progress
	New organizational structure completed, with training		1			Underway					
	New tariff study for economic regulation prepared		1			1					

7. Assessment of the PBC-effectiveness and Cost-efficiency

7.1 NRW Reduction Effectiveness

The rate of NRW reduction, also known as "effectiveness," was calculated for the WSC-Miya PBC and benchmarked against the author's database of dozens of NRW projects addressing both real and apparent losses. Two time periods were chosen: first, the period of mid 2013-to mid 2015 – the core of the reduction phase, and secondly, from the start of 2013 to the end of 2017 (estimated). The results, in Figure 7-1, show a high rate of NRW reduction. This result can be attributed to accurate baseline information, a well-conceived strategy and good program execution.

On the other hand, the cost per unit of NRW reduction is high, as shown in the benchmarking diagram in Figure 7-2. It should be noted that graphs of NRW program costs in different projects in different countries exhibit a large variability due to differences in local costs and differences in the specific the nature of the activities conducted. The variation in unit cost efficiency is much bigger than the variation in NRW reduction rate.

In this case, some of the high cost can be attributed to: 1) the relatively high costs of labor in the Bahamas; 2) the need for high quality, expensive materials for service connections, large meters, monitoring devices and other equipment, due to corrosive conditions and 3) the backlog of repairs and maintenance needed in the distribution network. However, significant additional costs are linked to the performance incentives for rapid reduction. Thus, the assessment issue becomes: ***Was a rapid reduction in NRW from the PBC worth a higher contract price?*** Would a less expensive conventional NRW project, with slower NRW reduction have been a better approach on New Providence, from a financial and operational point of view?

Figure 7-1 - Reduction Effectiveness of NRW PBC Projects – Real and Apparent Losses

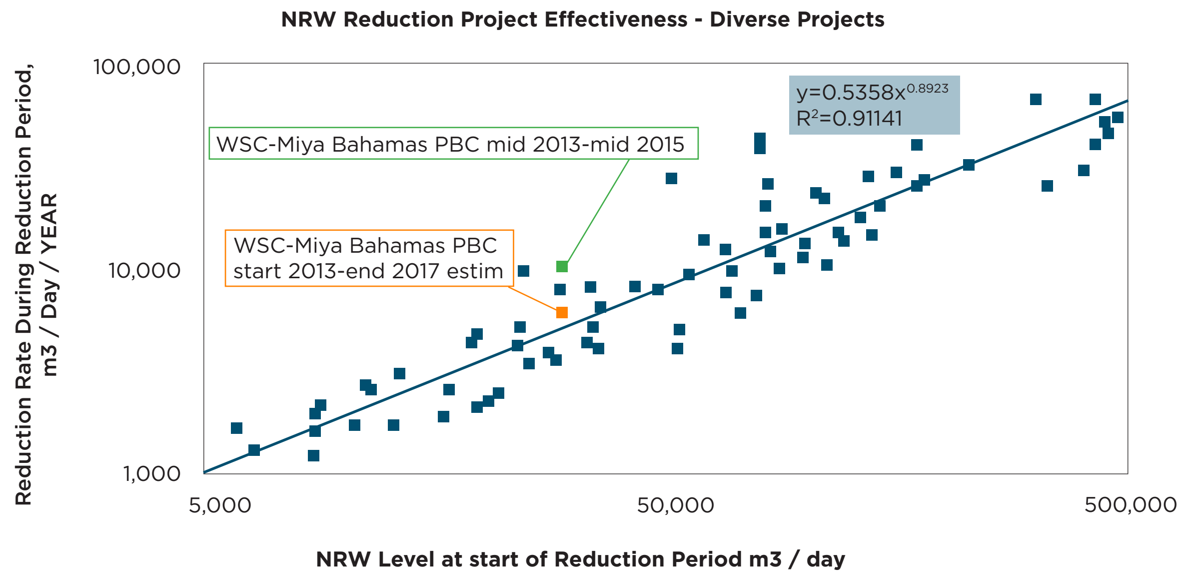
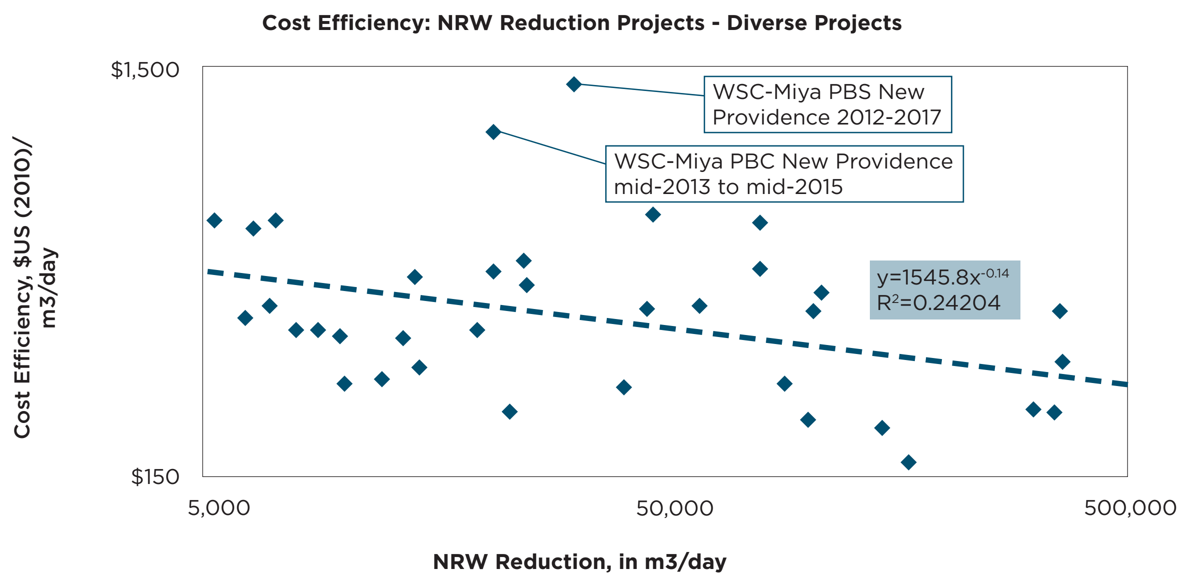


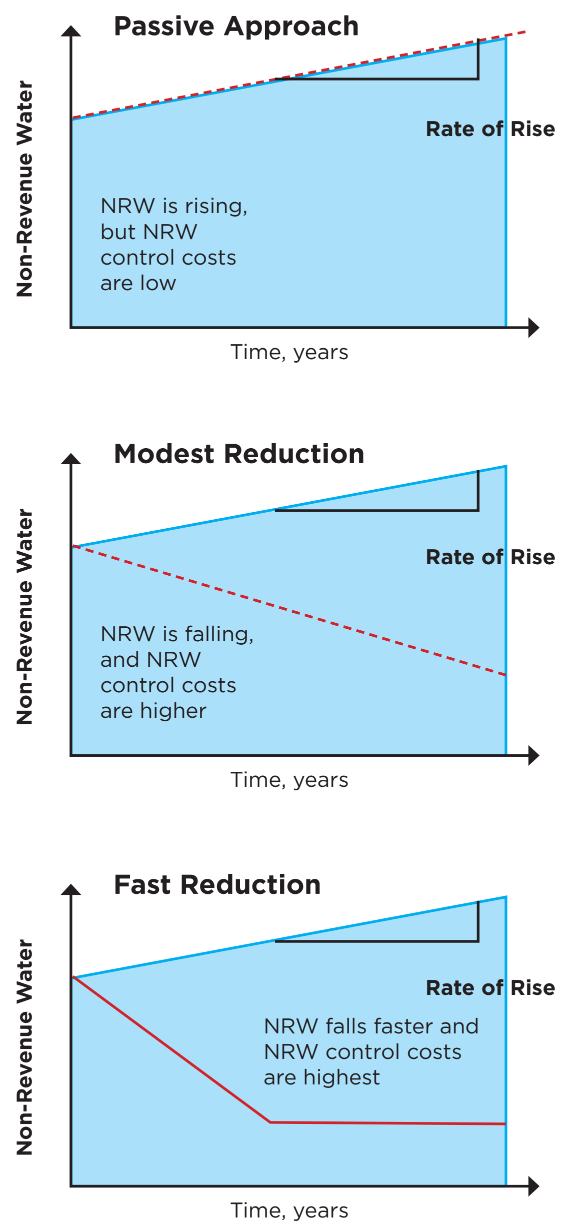
Figure 7-2 - Unit Cost of NRW Reduction



The most accurate way to address that question is to examine financial costs and benefits over the 10-year project and compare those values to a "passive" NRW management approach. The same calculations should be performed for a hypothetical conventional NRW project with slower NRW reduction and lower cost– as speculative as it might be. Such a set of calculations was performed, with the details provided below.

Before considering the results, some important concepts need to be reviewed to demonstrate key elements of the analysis. Figure 7-3 shows the three sample NRW reduction scenarios: a Passive Approach, a Modest NRW Reduction Approach and a Fast Reduction Approach. To evaluate either reduction project, we compare the costs and benefits of each project to the Passive Approach. From there, we can derive a benefit/cost ratio, Net Present Value (NPV) or Internal Rate of Return (IRR).

Figure 7-3 - NRW Project Approaches

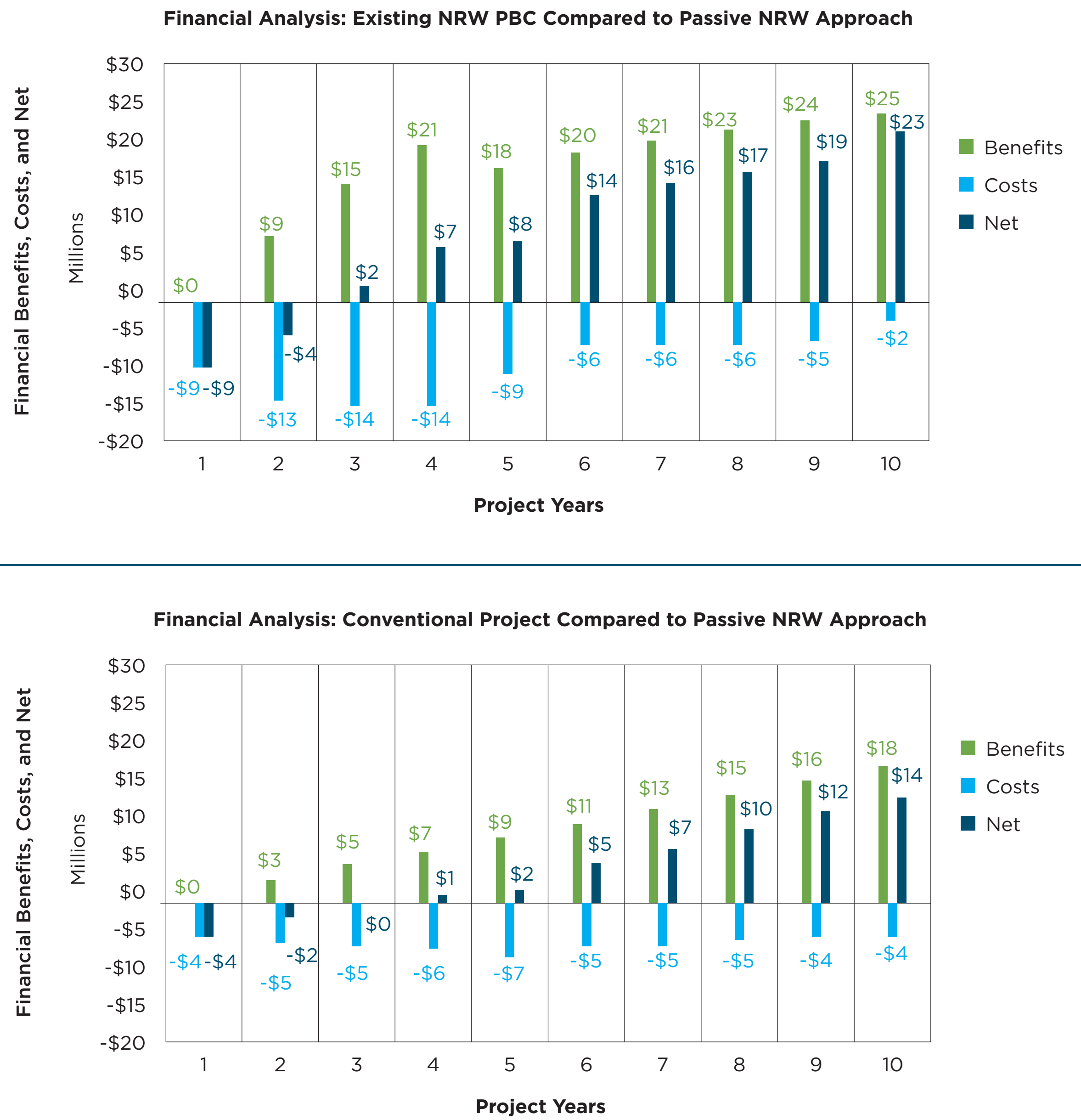


Since the cost of the Passive Program is nominally zero, the cost of either project is simply the PV of the cost of the activities undertaken. The benefit of either project is the difference between the EBITDA of the project and EBITDA of the Passive Approach. In practical terms, the Modest Reduction Project has a modest cost and modest benefit, while the Fast Reduction Project has a higher cost and higher benefits. The key factors influencing the calculations include the rate of rise, the unit value of the NRW, the rates of reduction, the costs of reduction and the real discount rate.

This methodology was used to evaluate the WSC-Miya PBC and a less costly, less effective project, both over a 10-year time frame. Both pairs of analyses used the same number of connections, growth rate of connections, water usage, starting NRW, rate of rise, value of water etc. The Modest Approach had a nominal cost of $50 million, and a modest rate of decline based on the NRW project database, while the Fast Reduction Project had a cost of $83 million and a higher reduction rate based on the reduction achieved on New Providence.

The reader must bear in mind that the Modest Reduction Project is hypothetical, but the Fast Reduction is very closely based on the WSC Miya PBC. Figure 7-4 provides financial charts for each project with costs shown in red, benefits shown in black and net benefits in blue or green. Table 7-1 shows the various financial and technical parameters are shown for each type of project – compared to the Passive Approach.

Figure 7-4 - Financial Charts of Costs, Benefits and Net Benefits



BAHAMAS NRW PBC FINANCIAL ANALYSIS	NO NRW PROJECT - PASSIVE		CURRENT NRW PBC PROJECT		CONVENTIONAL SLOWER PROJECT		NOTES
INPUTS	Start	Growth	Start	Growth	Start	Growth	
Number of Connections	41,998	0.025%	41,998	0.025%	41,998	0.025%	Based on 2012 conditions
Water Use per Connection, m3/month	16.5	0.0%	16.5	0.0%	16.5	0.0%	Based on 2012 conditions
Unbilled Authorized Use / Billed Use	2.00%	3.0%	2.00%	-3.0%	2.00%	-1.5%	
Apparent loss / Billed Use	8.00%	3.0%	8.00%	-4.0%	8.00%	-2.0%	
Real Loss - Annual Change from Start Level	RoR, m3/day =	1300	Reduction follows Actual/Proj		Red. Rate, m3/day =	1400	Based on database of conventional projects
Total Project Cost	$0		$82,775,000		$50,000,000		Hard to Estimate Cost of Conventional Project
Real Discount Rate	5% to 10%		5% to 10%		5% to 10%		
Water Tariff, B$ per m3 sold	$3.60	0.0%	$3.60	0.0%	$3.60	0.0%	Uses 2012 prices for calculation
Variable Operating Cost, $B / m3 produced	$1.80	5.0%	$1.80	0.0%	$1.80	0.0%	Uses 2012 prices for calculation
Fixed O&M Cost per connection	460	0.0%	460	0.0%	460	0.0%	Uses 2012 prices for calculation
OUTPUTS			5% Discount	10% Discount	5% Discount	10% Discount	
Total Financial Benefit			$174,600,000		$97,200,000		
Total Cost			$82,775,000		$50,000,000		
Total Benefit / Total Cost			2.11		1.94		
PV Benefits / PV Costs			1.90	1.72	1.74	1.59	
Net Present Value, $B			$60,500,000	$40,200,000	$29,200,000	$18,600,000	PBC has better financial viability
Internal Rate of Return, %,			46%		39%		PBC has better financial viability
Payback Period, years			9.6		10.4		
Capacity Utilization, % @ year 5	101%		**61%**		**83%**		Rapid NRW reduction from a PBC quickly provides more headroom for future growth
Capacity Utilization, % @ year 10	113%		**54%**		**71%**		
Operating Cost Recovery, % @ year 5	50%		**70%**		**58%**		Rapid NRW reduction from a PBC quickly provides better cost recovery
Operating Cost Recovery, % @ year 10	46%		**75%**		**64%**		

Table 7-2 - Key Results of the Financial Analysis

	Faster PBC Project	Conventional Project
Project Cost	US$ 83 m	US$ 50 m
Total Benefit	US$ 174 m	US$ 97.2 m
Benefit/Cost	2.1	1.9
PV Benefits/PV Costs	1.9	1.7
Internal Rate of Return	46%	39%
Net Present Value @5%	$60.5 m	$29.2 m
Payback Period, Yrs	9.6	10.4
Operating Cost Recovery, Yr 5	70%	58%
Operating Cost Recovery, Yr 10	75%	64%
Capacity Utilization, yr 5	61%	83%
Capacity Utilization, yr 10	54%	71%

Overall, the Faster PBC Project is financially superior, but the difference is not large. In several respects, the results for the two types of projects are similar – the benefit/cost ratios and payback periods are close. his reflects the fact that the extra cost leads to a similar proportion of benefits, but not quite as much.

On the other hand, the existing, Faster PBC has a higher (better) value of NPV.

Several calculations were performed to look at the sensitivity of the results to input assumptions. For example, if the cost of the Modest Reduction Project was as high as $55 million or as low as $45 million, the overall benefit/cost ratio would range from 1.9 to 1.6. The IRR would range from 33% to 46%. The lower, hypothetical project cost results in financial performance similar to the PBC.

However, it is very important to notice that the faster reduction also produces better values for several key technical and financial parameters for WSC. The faster reduction results in a lower water production capacity utilization, which is important for drought years, and the operating cost recovery is better, which is important for all parties. These conditions are inherent in the faster reduction, and are still true if the Modest Reduction project were even less costly.

It is also important to recognize that the results of this comparison are site-specific. No generalizations should be drawn from this hypothetical comparison, without a look at situational parameters. As noted in Chapter 2, Bahamas has financial and technical conditions that favored a PBC. This financial analysis confirms that set of criteria. Overall, a fast reduction of NRW has some strong benefits.

8. Key Findings, Upcoming Issues and Lessons Learned

The paragraphs below succinctly outline the key findings of this case study. This section also raises a few issues for discussion concerning the future of water supply, NRW and financial and regulatory considerations in the Bahamas. Additionally, this section offers some lessons learned thatmay benefit water managers in the Bahamas, as well as funding agencies, planners and practitioners in other countries.

- The Bahamas is overstressed on water availability, and New Providence is one of the most overstressed areas in the Caribbean. Desalination is the only viable source of water.
- WSC began operations in 1976 under water stress and rationing, but was in good financial condition. As years went on, WSC's main development strategy was to continually add small increments of capacity to meet growing demand, even with only a narrow margin. Over time, wells and barged water supplies became more problematic due to potential aquifer decline and operational complexity. In parallel, reverse osmosis desalination was getting more affordable, especially with the possibility of purchasing water thought long-term contracts without large capital outlay.

- WSC has had problems of poor water quality, low pressure and occasional rationing, resulting in customer departure, factors that have greatly hurt their sales and revenues. This partly explains the reluctance of the government to act on tariff increases, and has increasingly left WSC in a poor financial condition. This situation exacerbated the classic vicious cycle associated with high NRW. Since the 1990s WSC, this cycle of limited budgets, weak operations, high NRW, low tariffs and customer departure, has resulted in the need for large subsidies from the government.
- NRW has been a subject of activity on New Providence since the mid 1970s, but in a sporadic way. Early efforts focused on simple leak detection and repair, which did not make major reductions. Later efforts focused primarily on mains replacement.
- WSC has a history of outsourcing NRW work, going back as far as the early years of WSC. That initial effort and the CWBL incentive-based NRW project, set the stage for political acceptance of PBCs. hese projects also gave WSC experience in how to plan PBCs and monitor performance.
- Bahamas WSC meets the conditions under which the use of NRW reduction PBCs have been shown to be preferable to conventional NRW programs (see box).
- The WSC-Miya PBC project has achieved huge NRW reductions, which could not have been achieved by WSC alone (as history shows). Once a careful baseline had been completed, a well-founded logical program strategy was prepared and implemented precisely. The NRW reductions in the period from mid-2013 to mid-2015 were very high. This rapid reduction had huge beneficial impacts on the use of expensive desalinated water and increased revenues. Operating Cost Recovery rose from 0.65 to 0.82, the EBITDA fell from a loss of B$19 million to a loss of B$8.8 million and the Government Subsidy fell from B$25 million to B$9.2 million. These are impressive improvements in a short period of time. Such an achievement can be attributed to the strong skills and previous Bahamas experience of the Miya field team and strong collaboration with WSC.
- The Bahamas case also demonstrates the importance of a “champion” for NRW who works tirelessly over the long haul. In this case, the General Manager, Glen Laville ,is a fine example of such as champion. In addition, the current PBC benefitted greatly from a very experienced project leader (Paul Fanner), who had worked in the Bahamas with Mr. Laville previously, and knew the terrain, technically and otherwise.

Conditions where PBCs are Preferable

1. 1High water stress and scarcity
2. High level of NRW
3. High cost of water production and high water price
4. Urgent need to reduce NRW
5. Strong support from utility management and Government to reduce NRW
6. Limited local expertise in NRW program planning & implementation

- Concerns have been expressed about the total price and cost efficiency of the WSC-Miya PBC project. There are several responses that can be offered. First, the value of the Government Operating Subsidies for WSC were reaching enormous levels and an efficient high-impact project was needed, quickly, even if the price was also high. Second, there is no detailed, Bahamas-specific, cost estimate that suggests the results could have been achieved at any lower overall cost figure. Third, a detailed financial analysis, presented here, shows the project will pay for itself, within the time frame of the PBC. That same analysis shows considerable financial and operational benefits of rapid NRW reduction, as compared to conventional NRW project implementation methods – even at a much lower overall cost.
- WSC's financial condition is better off with NRW reduced, and service quality improved; nonetheless, a tariff increase is long overdue. WSC and the GOB could avoid an ongoing culture of subsidy and political interference, given reasonable tariff adjustments. If the GOB will not allow tariff increases, they run a great danger that the WSC operational budget will be insufficient to conduct the proper operations and maintenance needed to maintain the low NRW levels. NRW will rise again, repeating a dreadful pattern seen all over the world.

The paragraphs below outline several short-term and longer-term issues that should be addressed to ensure maximum benefits from the Bahamas Project. The large investment could be in jeopardy of dilution if proactive plans are not made soon by WSC and IDB.

- Future plans for the maintenance phase of the PBC should be discussed now. It is quite likely that the PBC will reach the target level of 2.0 Migd (9,000 m3/day), and can easily continue to do leak detection/repairs and more service line replacements. But the need to maintain the reduced NRW level might require undertaking some more expensive activities, such as some mains replacement, that would have benefit far beyond the several years that will be left on the contract at that point. Discussion of the plans – at least in concept – would be good to start soonest.
- In addition, conversations should begin now on the training planned for the maintenance phase, and the transfer of NRW operations on New Providence back to WSC. These activities will take more than trained staff – a consistent sufficient budget is needed to keep the losses from rising again – as they have done before.
- Future plans for longer-run water supply sustainability on New Providence also must be discussed soon – well before the maintenance phase is over, with apolitical, realistic discussions of the benefits of regulation and periodic tariff increases. If these issues are not dealt with directly and objectively, WSC will not be able to provide high-quality services for its customers on a sustainable basis.

Some general lessons learned about water utilities include the following:

- The long history traced in this document shows that NRW reduction and control is a very complex matter - technically, financially, institutionally and politically. It reaches across an entire utility, and into the environment in which it operates, and requires high-level expertise, political savvy and persistence, persistence, persistence.
- An essential element of success of an NRW project is that it begins with a broad assessment of the challenges faced by the utility and a multi-faceted plan to address institutional, policy, operational and financial issues.
- Another essential element of success, among many, is a detailed and thorough water audit to identify the volume, values and root causes of the various NRW components. Using the latest IWA best practices, rapid improvements can be made quickly. Top management support for such a deliberate process is also required.
- The technical skills to execute NRW programs tasks are not that difficult to learn. However, the expertise to properly assess the situation and plan an efficient and effective program is a very complex matter and requires expertise of an experienced specialist, especially if a large program is being undertaken.
- Performance-based contracts can, under conditions delineated in this document, be a very effective, and in the end, cost-efficient mechanism for implementing NRW projects. The case of the WSC-Miya PBC in New Providence, Bahamas is a very good illustration of the benefits of a well-designed PBC – including rapid results, flexibility for the contractor to adjust specific plans to the evolving situation, to both exceed targets and receive additional performance-based remuneration, reduced risk for the utility, a lengthy maintenance phase to promote sustainability of the NRW reductions, and overall improvement of technical and financial performance at a competitive price.
- It is also useful to contrast the WSC-Miya PBC and the WSC-Consolidated Water (CWBL) incentive-based NRW reduction project, in terms of duration, incentives and results. The WSC-Miya PBC has a 10-year time frame and remuneration framework based on a mix of fixed and volume-based incentive payments. The CWBL effort was conducted just in the first year of the long-term water supply contract between CWBL and WSC, with a simple payment based on achievement of a single target. The one-year CWBL effort did result in significant reductions, which exceeded the target, but those reductions were not sustained in the following years. CWBL's short-term time horizon only incentivized them to conduct "short-run", "quic- fix" reduction activities. The concept of a five-year reduction phase and a five-year maintenance phase in the WSC-Miya PBC, along with delayed payment in incentive-based remuneration, creates more incentives for the contractor to conduct longer-lasting reduction measures like mains replacement, staff training and other activities that sustain reduced levels of NRW.

- For PBC procurement to assure the best selection of contractor, increased cost competition should be built into the procurement process without sacrificing quality. Other recent NRW PBC projects have used QCBS selection methods with a heavy (but not total) weighting on technical score.
- The NRW PBC on New Providence has been an important learning experience to water utilities in the region. Careful diagnosis, a well-founded plan, high-level expertise and financial incentives associated with a well planned PBC are important elements for success. But the work is never fully done – NRW must always be kept on the program, despite other challenges that wil inevitably arise.
- The experience on New Providence may facilitate others to try innovative and sensible locally-conceived approaches. In the longer run, hopefully these types of programs can be self-financing, and not dependent on external international financing, promoting a more sustainable future for water utilities in the region.

Annex A
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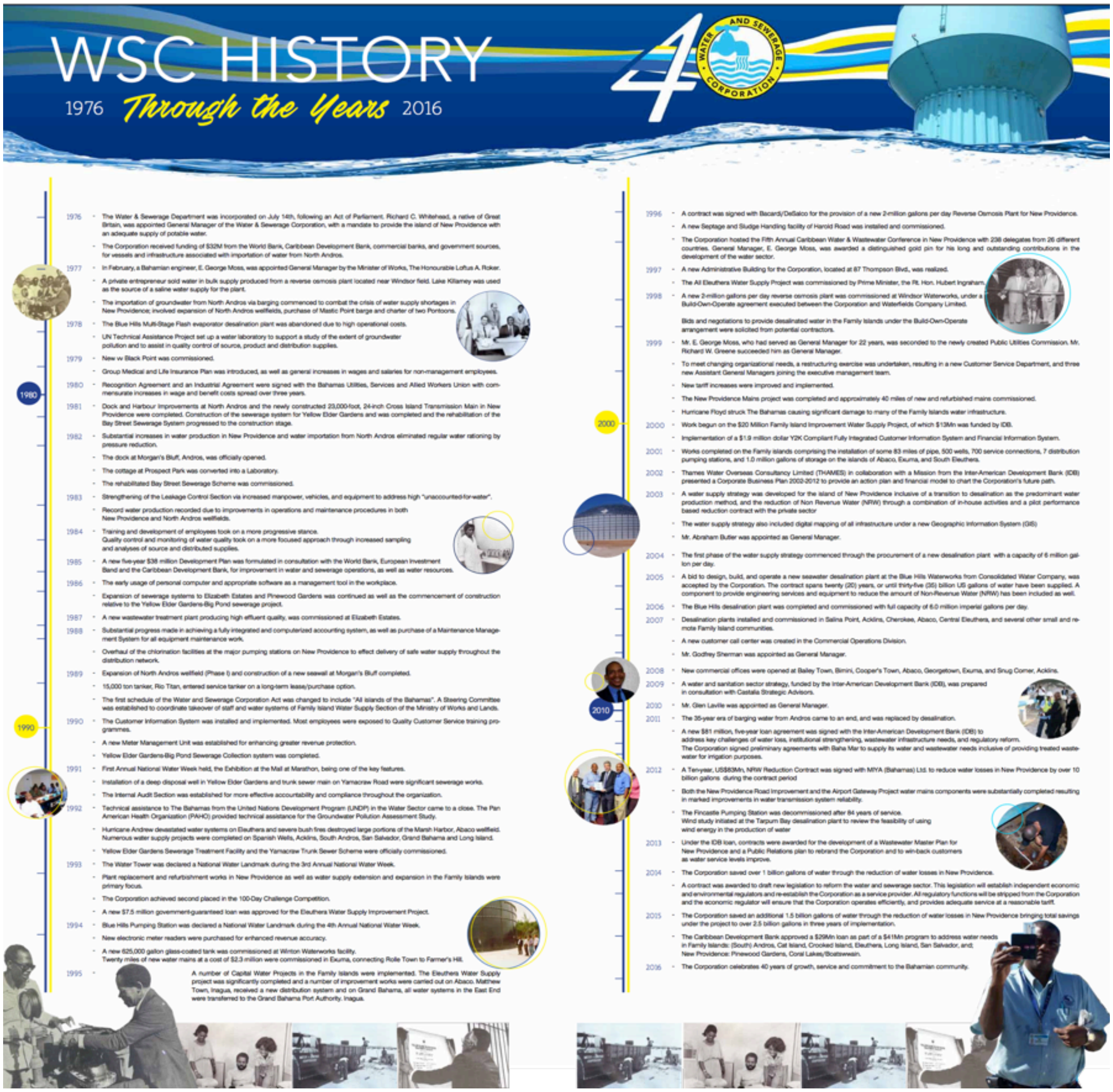
Annex B
Brief History of the WSC


WSC HISTORY
1976 Through the Years 2016
WATER AND SEWERAGE CORPORATION
1976 - The Water & Sewerage Department was incorporated on July 14th, following an Act of Parliament. Richard C. Whitehead, a native of Great Britain, was appointed General Manager of the Water & Sewerage Corporation, with a mandate to provide the island of New Providence with an adequate supply of potable water.
- The Corporation received funding of $32M from the World Bank, Caribbean Development Bank, commercial banks, and government sources, for vessels and infrastructure associated with importation of water from North Andros.
1977 - In February, a Bahamian engineer, E. George Moss, was appointed General Manager by the Minister of Works, The Honourable Loftus A. Roker.
- A private entrepreneur sold water in bulk supply produced from a reverse osmosis plant located near Windsor field. Lake Killarney was used as the source of a saline water supply for the plant.
- The importation of groundwater from North Andros via barging commenced to combat the crisis of water supply shortages in New Providence; involved expansion of North Andros wellfields, purchase of Mastic Point barge and charter of two Pontoons.
1978 - The Blue Hills Multi-Stage Flash evaporator desalination plant was abandoned due to high operational costs.
- UN Technical Assistance Project set up a water laboratory to support a study of the extent of groundwater pollution and to assist in quality control of source, product and distribution supplies.
1979 - New w Black Point was commissioned.
- Group Medical and Life Insurance Plan was introduced, as well as general increases in wages and salaries for non-management employees.
1980 - Recognition Agreement and an Industrial Agreement were signed with the Bahamas Utilities, Services and Allied Workers Union with commensurate increases in wage and benefit costs spread over three years.
1981 - Dock and Harbour Improvements at North Andros and the newly constructed 23,000-foot, 24-inch Cross Island Transmission Main in New Providence were completed. Construction of the sewerage system for Yellow Elder Gardens and was completed and the rehabilitation of the Bay Street Sewerage System progressed to the construction stage.
1982 - Substantial increases in water production in New Providence and water importation from North Andros eliminated regular water rationing by pressure reduction.
- The dock at Morgan's Bluff, Andros, was officially opened.
- The cottage at Prospect Park was converted into a Laboratory.
- The rehabilitated Bay Street Sewerage Scheme was commissioned.
1983 - Strengthening of the Leakage Control Section via increased manpower, vehicles, and equipment to address high "unaccounted-for-water".
- Record water production recorded due to improvements in operations and maintenance procedures in both New Providence and North Andros wellfields.
1984 - Training and development of employees took on a more progressive stance. Quality control and monitoring of water quality took on a more focused approach through increased sampling and analyses of source and distributed supplies.
1985 - A new five-year $38 million Development Plan was formulated in consultation with the World Bank, European Investment Band and the Caribbean Development Bank, for improvement in water and sewerage operations, as well as water resources.
1986 - The early usage of personal computer and appropriate software as a management tool in the workplace.
- Expansion of sewerage systems to Elizabeth Estates and Pinewood Gardens was continued as well as the commencement of construction relative to the Yellow Elder Gardens-Big Pond sewerage project.
1987 - A new wastewater treatment plant producing high effluent quality, was commissioned at Elizabeth Estates.
1988 - Substantial progress made in achieving a fully integrated and computerized accounting system, as well as purchase of a Maintenance Management System for all equipment maintenance work.
- Overhaul of the chlorination facilities at the major pumping stations on New Providence to effect delivery of safe water supply throughout the distribution network.
1989 - Expansion of North Andros wellfield (Phase I) and construction of a new seawall at Morgan's Bluff completed.
- 15,000 ton tanker, Rio Titan, entered service tanker on a long-term lease/purchase option.
- The first schedule of the Water and Sewerage Corporation Act was changed to include "All islands of the Bahamas". A Steering Committee was established to coordinate takeover of staff and water systems of Family Island Water Supply Section of the Ministry of Works and Lands.
1990 - The Customer Information System was installed and implemented. Most employees were exposed to Quality Customer Service training programmes.
- A new Meter Management Unit was established for enhancing greater revenue protection.
- Yellow Elder Gardens-Big Pond Sewerage Collection system was completed.
1991 - First Annual National Water Week held, the Exhibition at the Mall at Marathon, being one of the key features.
- Installation of a deep disposal well in Yellow Elder Gardens and trunk sewer main on Yamacraw Road were significant sewerage works.
- The Internal Audit Section was established for more effective accountability and compliance throughout the organization.
1992 - Technical assistance to The Bahamas from the United Nations Development Program (UNDP) in the Water Sector came to a close. The Pan American Health Organization (PAHO) provided technical assistance for the Groundwater Pollution Assessment Study.
- Hurricane Andrew devastated water systems on Eleuthera and severe bush fires destroyed large portions of the Marsh Harbor, Abaco wellfield. Numerous water supply projects were completed on Spanish Wells, Acklins, South Andros, San Salvador, Grand Bahama and Long Island.
- Yellow Elder Gardens Sewerage Treatment Facility and the Yamacraw Trunk Sewer Scheme were officially commissioned.
1993 - The Water Tower was declared a National Water Landmark during the 3rd Annual National Water Week.
- Plant replacement and refurbishment works in New Providence as well as water supply extension and expansion in the Family Islands were primary focus.
- The Corporation achieved second placed in the 100-Day Challenge Competition.
- A new $7.5 million government-guaranteed loan was approved for the Eleuthera Water Supply Improvement Project.
1994 - Blue Hills Pumping Station was declared a National Water Landmark during the 4th Annual National Water Week.
- New electronic meter readers were purchased for enhanced revenue accuracy.
- A new 625,000 gallon glass-coated tank was commissioned at Winton Waterworks facility. Twenty miles of new water mains at a cost of $2.3 million were commissioned in Exuma, connecting Rolle Town to Farmer's Hill.
1995 - A number of Capital Water Projects in the Family Islands were implemented. The Eleuthera Water Supply project was significantly completed and a number of improvement works were carried out on Abaco. Matthew Town, Inagua, received a new distribution system and on Grand Bahama, all water systems in the East End were transferred to the Grand Bahama Port Authority. Inagua.
1996 - A contract was signed with Bacardi/DeSalco for the provision of a new 2-million gallons per day Reverse Osmosis Plant for New Providence.
- A new Septage and Sludge Handling facility of Harold Road was installed and commissioned.
- The Corporation hosted the Fifth Annual Caribbean Water & Wastewater Conference in New Providence with 238 delegates from 26 different countries. General Manager, E. George Moss, was awarded a distinguished gold pin for his long and outstanding contributions in the development of the water sector.
1997 - A new Administrative Building for the Corporation, located at 87 Thompson Blvd., was realized.
- The All Eleuthera Water Supply Project was commissioned by Prime Minister, the Rt. Hon. Hubert Ingraham.
1998 - A new 2-million gallons per day reverse osmosis plant was commissioned at Windsor Waterworks, under a Build-Own-Operate agreement executed between the Corporation and Waterfields Company Limited.
Bids and negotiations to provide desalinated water in the Family Islands under the Build-Own-Operate arrangement were solicited from potential contractors.
1999 - Mr. E. George Moss, who had served as General Manager for 22 years, was seconded to the newly created Public Utilities Commission. Mr. Richard W. Greene succeeded him as General Manager.
- To meet changing organizational needs, a restructuring exercise was undertaken, resulting in a new Customer Service Department, and three new Assistant General Managers joining the executive management team.
- New tariff increases were improved and implemented.
- The New Providence Mains project was completed and approximately 40 miles of new and refurbished mains commissioned.
- Hurricane Floyd struck The Bahamas causing significant damage to many of the Family Islands water infrastructure.
2000 - Work begun on the $20 Million Family Island Improvement Water Supply Project, of which $13Mn was funded by IDB.
- Implementation of a $1.9 million dollar Y2K Compliant Fully Integrated Customer Information System and Financial Information System.
2001 - Works completed on the Family islands comprising the installation of some 83 miles of pipe, 500 wells, 700 service connections, 7 distribution pumping stations, and 1.0 million gallons of storage on the islands of Abaco, Exuma, and South Eleuthera.
2002 - Thames Water Overseas Consultancy Limited (THAMES) in collaboration with a Mission from the Inter-American Development Bank (IDB) presented a Corporate Business Plan 2002-2012 to provide an action plan and financial model to chart the Corporation's future path.
2003 - A water supply strategy was developed for the island of New Providence inclusive of a transition to desalination as the predominant water production method, and the reduction of Non Revenue Water (NRW) through a combination of in-house activities and a pilot performance based reduction contract with the private sector
- The water supply strategy also included digital mapping of all infrastructure under a new Geographic Information System (GIS)
- Mr. Abraham Butler was appointed as General Manager.
2004 - The first phase of the water supply strategy commenced through the procurement of a new desalination plant with a capacity of 6 million gallon per day.
2005 - A bid to design, build, and operate a new seawater desalination plant at the Blue Hills Waterworks from Consolidated Water Company, was accepted by the Corporation. The contract spans twenty (20) years, or until thirty-five (35) billion US gallons of water have been supplied. A component to provide engineering services and equipment to reduce the amount of Non-Revenue Water (NRW) has been included as well.
2006 - The Blue Hills desalination plant was completed and commissioned with full capacity of 6.0 million imperial gallons per day.
2007 - Desalination plants installed and commissioned in Salina Point, Acklins, Cherokee, Abaco, Central Eleuthera, and several other small and remote Family Island communities.
- A new customer call center was created in the Commercial Operations Division.
- Mr. Godfrey Sherman was appointed as General Manager.
2008 - New commercial offices were opened at Bailey Town, Bimini, Cooper's Town, Abaco, Georgetown, Exuma, and Snug Corner, Acklins.
2009 - A water and sanitation sector strategy, funded by the Inter-American Development Bank (IDB), was prepared in consultation with Castalia Strategic Advisors.
2010 - Mr. Glen Laville was appointed as General Manager.
2011 - The 35-year era of barging water from Andros came to an end, and was replaced by desalination.
- A new $81 million, five-year loan agreement was signed with the Inter-American Development Bank (IDB) to address key challenges of water loss, institutional strengthening, wastewater infrastructure needs, and regulatory reform. The Corporation signed preliminary agreements with Baha Mar to supply its water and wastewater needs inclusive of providing treated wastewater for irrigation purposes.
2012 - A Ten-year, US$83Mn, NRW Reduction Contract was signed with MIYA (Bahamas) Ltd. to reduce water losses in New Providence by over 10 billion gallons during the contract period
- Both the New Providence Road Improvement and the Airport Gateway Project water mains components were substantially completed resulting in marked improvements in water transmission system reliability.
- The Fincastle Pumping Station was decommissioned after 84 years of service. Wind study initiated at the Tarpum Bay desalination plant to review the feasibility of using wind energy in the production of water
2013 - Under the IDB loan, contracts were awarded for the development of a Wastewater Master Plan for New Providence and a Public Relations plan to rebrand the Corporation and to win-back customers as water service levels improve.
2014 - The Corporation saved over 1 billion gallons of water through the reduction of water losses in New Providence.
- A contract was awarded to draft new legislation to reform the water and sewerage sector. This legislation will establish independent economic and environmental regulators and re-establish the Corporation as a service provider. All regulatory functions will be stripped from the Corporation and the economic regulator will ensure that the Corporation operates efficiently, and provides adequate service at a reasonable tariff.
2015 - The Corporation saved an additional 1.5 billion gallons of water through the reduction of water losses in New Providence bringing total savings under the project to over 2.5 billion gallons in three years of implementation.
- The Caribbean Development Bank approved a $29Mn loan as part of a $41Mn program to address water needs in Family Islands: (South) Andros, Cat Island, Crooked Island, Eleuthera, Long Island, San Salvador, and; New Providence: Pinewood Gardens, Coral Lakes/Boatswain.
2016 - The Corporation celebrates 40 years of growth, service and commitment to the Bahamian community.

Annex C
WSC Statistical Annex

Operational Parameters

SYSTEM ATTRIBUTES + OPERATIONS

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Annual Rainfall, inches	42.5	17.2	58.3	69.5	77.6	66.2	44.1	75.2	69.2	54.0	56.7	93.6	49.4	65.7	62.7	81.2
Rainfall as % of 30 yr average (57.27 inches)	74.3%	30.0%	101.8%	121.4%	135.4%	115.5%	77.0%	131.2%	120.8%	94.3%	99.0%	163.5%	86.3%	114.6%	109.5%	141.8%
Annual Average Temp	75.4	74.3	75.9	76.2	75.6	76.3	76.5	76.7	77	77.7	78.3	78	76.8	77.2	78.1	77.8
Temperature as % of 30 yr average (77.02 def F)	97.9%	96.5%	98.5%	98.9%	98.2%	99.1%	99.3%	99.6%	100.0%	100.9%	101.7%	101.3%	99.7%	100.2%	101.4%	101.0%
Water Supply from Wells, MIGD																
Water Supply from Barge, MIGD																
Water Supply from DeSal, MIGD																
Total Water Supplied, MIGD	4.96	4.60	5.66	6.09	6.31	6.45	6.54	6.51	6.89	7.03	7.36	7.04	6.92	7.52	6.95	6.65
Water Supply from Wells, 1000 m3/yr																
Water Supply from Barge, 1000 m3/yr																
Water Supply from DeSal, 1000 m3/yr																
Total Water Supplied, 1000 m3/yr	8,238	7,636	9,384	10,108	10,465	10,697	10,845	10,808	11,433	11,665	12,204	11,679	11,474	12,470	11,538	11,034
Total Water Production Capacity, Migd	5.0	6.0	6.4	6.4	6.4	6.4	6.6	6.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Total Water Production Capacity, 1000 m3/day	22.7	27.3	29.1	29.1	29.1	29.1	30.0	30.0	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1
Capacity Utilization, %	99%	77%	88%	95%	99%	101%	99%	99%	80%	82%	86%	82%	80%	87%	81%	77%
Length of Mains, km EOY														644	644	644
Mains Replaced, % of Total Length														2.2%	1.6%	0.9%
Service Connections Replaced, % of Total																
Assumed NP EOY Water Connections	24,090	24,314	24,540	24,768	25,000	26,320	27,145	27,775	27,890	27,960	31,805	35,950	36,650	37,305	37,680	38067
Assumed Average NP Water Connections	24,090	24,202	24,427	24,654	24,884	25,660	26,733	27,460	27,833	27,925	29,883	33,878	36,300	36,978	37,493	37,873
Water Connection Density (Conn/km)														57.4	58.5	59.1
Average Network Pressure (m)																
Total Water Production, MIGD	4.96	4.60	5.66	6.09	6.31	6.45	6.54	6.51	6.89	7.03	7.36	7.04	6.92	7.52	6.95	6.65
Total Water Production, 1000 m3/yr	8,238	7,636	9,384	10,108	10,465	10,697	10,845	10,808	11,433	11,665	12,204	11,679	11,474	12,470	11,538	11,034
Total Water Billed, MIGD	2.81	2.79	3.13	3.30	3.43	3.48	3.50	3.41	3.60	3.72	3.54	3.57	3.55	3.61	3.37	3.44
Water Billed, 1000 m3/yr	4,669	4,628	5,201	5,469	5,687	5,780	5,805	5,658	5,974	6,178	5,869	5,930	5,895	5,982	5,597	6190
Non-Revenue Water, MIGD	2.15	1.81	2.52	2.80	2.88	2.96	3.04	3.10	3.29	3.31	3.82	3.46	3.36	3.91	3.58	3.21
Non-Revenue Water, 1000 m3/yr	3,569	3,008	4,183	4,640	4,778	4,916	5,040	5,150	5,459	5,487	6,335	5,749	5,579	6,488	5,941	4,844
Non-Revenue Water, %	43.3%	39.4%	44.6%	45.9%	45.7%	46.0%	46.5%	47.6%	47.8%	47.0%	51.9%	49.2%	48.6%	52.0%	51.5%	43.9%
Non-Revenue Water, L/Conn/Day	406	341	469	516	526	525	517	514	537	538	581	465	421	481	434	350
Water Billed: m3 / Conn / Month	16.2	15.9	17.7	18.5	19.0	18.8	18.1	17.2	17.9	18.4	16.4	14.6	13.5	13.5	12.4	13.6
Water Billed, L / Conn / Day	531	524	583	608	626	617	595	565	588	606	538	480	445	443	409	448
Percentage Real Loss	80%				80%	80%	80%	80%	80%	80%	80%	80%	80%	85%	86%	86%
Real Loss, m3/day																
Real Loss, m3/km/day														23.5	21.7	17.7
Real Loss. Liters / Connection / Day														405	371	300
Bursts - Mains																
Leaks - Connections																
Mains Bursts / 100 km / year																
Connections Leaks / 1000 Conns / year																
UARL, 1000 m3/yr																
Estimated Real Loss, 1000 m3/year																
Infrastructure Leakge Index (ILI)																

SYSTEM ATTRIBUTES + OPERATIONS

0.6895

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Annual Rainfall, inches	63.5	69.5	51.8	54.0	62.4	74.5	65.3	45.24	40.57	45.46	54.28
Rainfall as % of 30 yr average (57.27 inches)	110.9%	121.3%	90.5%	94.3%	108.9%	135.4%	118.8%	82.3%	73.8%	82.7%	98.7%
Annual Average Temp	76.9	78.2	78.6	77.5	76.90	77.10	78.50	78.80	77.40	78.10	77.70
Temperature as % of 30 yr average (77.02 def F)	99.8%	101.5%	102.1%	100.6%	99.8%	100.1%	101.9%	102.3%	100.5%	101.4%	100.9%
Water Supply from Wells, MIGD								2.70	2.22	2.11	0.87
Water Supply from Barge, MIGD								4.60	4.35	4.58	3.22
Water Supply from DeSal, MIGD								1.90	2.35	2.24	5.51
Total Water Supplied, MIGD	6.80	7.15	7.71	8.02	8.12	8.48	8.84	9.20	8.92	8.94	9.60
Water Supply from Wells, 1000 m3/yr								4,480	3,686	3,509	1,446
Water Supply from Barge, 1000 m3/yr								7,633	7,216	7,601	5,338
Water Supply from DeSal, 1000 m3/yr								3,153	3,895	3,721	9,141
Total Water Supplied, 1000 m3/yr	11,285	11,866	12,792	13,312	13,480	14,075	14,670	15,265	14,797	14,831	15,926
Total Water Production Capacity, Migd	8.6	8.6	10.6	10.6	10.6	10.6	10.6	10.0	10.0	10.0	13.5
Total Water Production Capacity, 1000 m3/day	39.1	39.1	48.2	48.2	48.2	48.2	48.2	45.5	45.5	45.5	61.4
Capacity Utilization, %	79%	83%	73%	76%	77%	80%	83%	92%	89%	89%	71%
Length of Mains, km EOY	644	644	679	686	692	720	800	900	930	990	990
Mains Replaced, % of Total Length	1.2%	0.0%	11.2%	9.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Service Connections Replaced, % of Total											
Assumed NP EOY Water Connections	38453	38840	39227	39613	40,000	40,000	40,000	41,000	42,000	42,000	41,572
Assumed Average NP Water Connections	38,260	38,647	39,033	39,420	39,807	40,000	40,000	40,500	41,500	42,000	41,786
Water Connection Density (Conn/km)	59.7	60.3	57.8	57.8	57.8	55.6	50.0	45.6	45.2	42.4	42.0
Average Network Pressure (m)	24.6	24.6	24.6	24.6	24.6	23.5	22.4	21.3	20.3	20.0	19.5
Total Water Production, MIGD	6.80	7.15	7.71	8.02	8.12	8.48	8.84	9.20	8.92	8.90	9.60
Total Water Production, 1000 m3/yr	11,285	11,866	12,792	13,312	13,480	14,075	14,670	15,265	14,797	14,768	15,929
Total Water Billed, MIGD	3.22	3.43	3.85	3.90	3.95	3.94	3.94	4.3	4.5	4.7	5.2
Water Billed, 1000 m3/yr	6253	6315	6378	6441	6,562	6,538	6,538	7,135	7,466.8	7,798.7	8,628.3
Non-Revenue Water, MIGD	3.59	3.73	3.86	4.12	4.17	4.54	4.90	4.90	4.42	4.20	4.40
Non-Revenue Water, 1000 m3/yr	5,033	5,550	6,414	6,870	6,918	7,537	8,133	8,131	7,330.0	6,969.0	7,300.9
Non-Revenue Water, %	44.6%	46.8%	50.1%	51.6%	51.3%	53.6%	55.4%	53.3%	49.5%	47.2%	45.8%
Non-Revenue Water, L/Conn/Day	360	393	450	478	476	516	557	550	484	455	479
Water Billed: m3 / Conn / Month	13.6	13.6	13.6	13.6	13.7	13.6	13.6	14.7	15.0	15.5	17.2
Water Billed, L / Conn / Day	448	448	448	448	452	448	448	483	493	509	566
Percentage Real Loss	87%	87%	88%	89%	89%	89%	90%	90%	90%	92%	95%
Real Loss, m3/day											
Real Loss, m3/km/day	18.6	20.6	22.8	24.4	24.3	25.5	25.1	22.2	19.4	17.7	19.1
Real Loss. Liters / Connection / Day	312	341	394	423	420	459	501	488	430	418	455
Bursts - Mains			653							430	469
Leaks - Connections			5520							4,768	3,590
Mains Bursts / 100 km / year	100	100	96.15	95						43	47
Connections Leaks / 1000 Conns / year	150	150	140.7	140						97	86
UARL, 1000 m3/yr					403	279	388	390	380	383	371
Estimated Real Loss, 1000 m3/year					6,135	6,705	7,316	7,303	6,584	6,408	6,899
Infrastructure Leakge Index (ILI)					15.2	24.0	18.8	18.7	17.3	16.7	18.6

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 Estim
Annual Rainfall, inches	57.14	52.36	49.05	44.77	32.73	50.4	38.28	29.84	27.67		
Rainfall as % of 30 yr average (57.27 inches)	103.9%	95.2%	89.2%	81.4%	59.5%	91.7%	69.6%	54.3%	50.3%		
Annual Average Temp	78.90	79.20	79.00	78.0	79.2	79.1	79.0	79.5	79.6		
Temperature as % of 30 yr average (77.02 def F)	102.4%	102.8%	102.6%	101.3%	102.8%	102.7%	102.6%	103.2%	103.3%		
Water Supply from Wells, MIGD	0.44	0.68	0.90	1.02	0.90	1.10	0.99	0.40	0.00	0.00	
Water Supply from Barge, MIGD	2.06	2.46	2.60	2.52	2.77	0.00	0.00	0.00	0.00	0.00	
Water Supply from DeSal, MIGD	7.23	6.97	7.10	6.92	7.70	10.80	10.80	10.16	9.11	9.02	
Total Water Supplied, MIGD	9.73	10.11	10.60	10.46	11.37	11.90	11.79	10.56	9.11	9.02	
Water Supply from Wells, 1000 m3/yr	730	1,128	1,493	1,692	1,493	1,825	1,648	664	0	0	
Water Supply from Barge, 1000 m3/yr	3,419	4,087	4,314	4,181	4,596	0	0	0	0	0	
Water Supply from DeSal, 1000 m3/yr	12,003	11,568	11,781	11,482	12,777	17,920	17,920	16,858	15,116	14,967	
Total Water Supplied, 1000 m3/yr	16,152	16,784	17,588	17,356	18,866	19,746	19,568	17,522	15,116	14,967	
Total Water Production Capacity, Migd	15.0	15.0	15.0	15.0	17.0	14.0	14.0	14.0	13.0	13.0	
Total Water Production Capacity, 1000 m3/day	68.2	68.2	68.2	68.2	77.2	63.6	63.6	63.6	59.1	59.1	
Capacity Utilization, %	65%	66%	71%	70%	67%	85%	84%	75%	70%	69%	
Length of Mains, km EOY	990	1,000	1,000	1,050	1,091	1,100	1,118	1,118	1,118	1,118	
Mains Replaced, % of Total Length	3.2%	2.7%	1.5%	2.1%	1.5%						
Service Connections Replaced, % of Total							8.2%	14.0%	4.7%	2.8%	
Assumed NP EOY Water Connections	42,595	42,600	42,392	42,729	41,476	42,519	42,816	42,694	42,062	42,200	42,800
Assumed Average NP Water Connections	42,084	42,598	42,496	42,561	42,103	41,998	42,668	42,755	42,378	42,131	42,500
Water Connection Density (Conn/km)	43.0	42.6	42.4	40.7	38.0	38.7	38.3	38.2	37.6	37.7	
Average Network Pressure (m)	18.5	14.1	15.0	16.0	17.3	17.7	15.3	14.5	14.8	14.5	
Total Water Production, MIGD	9.70	10.10	10.60	10.40	11.37	11.90	11.80	10.56	9.11	9.02	
Total Water Production, 1000 m3/yr	16,095	16,784	17,588	17,257	18,866	19,746	19,571	17,525	15,111	14,972	
Total Water Billed, MIGD	4.8	5.0	5.1	5.4	4.79	5.02	5.42	6.28	6.064	6.153	
Water Billed, 1000 m3/yr	7,964.6	8,304.7	8,462.4	8,976.8	7,953.0	8,329.6	8,985.1	10,417.0	10,061.9	10,209.6	
Non-Revenue Water, MIGD	4.90	4.87	5.50	4.99	6.5770	6.8800	6.3800	4.2840	3.0430	2.8700	2.5000
Non-Revenue Water, 1000 m3/yr	8,130.5	8,076.0	9,126.1	8,279.9	10,913.2	11,415.9	10,586.3	7,108.4	5,049.2	4,762.2	4,147.7
Non-Revenue Water, %	50.5%	49.3%	51.9%	48.0%	57.8%	57.8%	54.1%	40.6%	33.4%	31.8%	
Non-Revenue Water, L/Conn/Day	529	519	588	533	710	745	680	456	326	310	267
Water Billed: m3 / Conn / Month	15.8	16.2	16.6	17.6	15.7	16.5	17.5	20.3	19.8	20.2	
Water Billed, L / Conn / Day	519	534	546	578	518	543	577	668	651	664	
Percentage Real Loss	95%	95%	93%	93%	92%	93%	92%	91%	90%	90%	
Real Loss, m3/day						10,580	9,724	6,469	4,568	4,309	
Real Loss, m3/km/day	21.3	20.9	23.3	20.1	25.3	26.4	23.8	15.8	11.2	10.6	
Real Loss. Liters / Connection / Day	494	491	549	494	665	682	622	415	298	280	
Bursts - Mains	507	380			400	350	424	413	220	187	
Leaks - Connections	3,695	3,355			2,847	3,562	3,300	1,058	659	580	
Mains Bursts / 100 km / year	51	38			37	32	38	37	20	17	
Connections Leaks / 1000 Conns / year	75	79			69	84	77	26	16	14	
UARL, 1000 m3/yr	358	273	296	322	347	360	316	298	301	296	
Estimated Real Loss, 1000 m3/year	7,682	7,628	8,483	7,696	10,066	10,574	9,719	6,465	4,566	4,306	
Infrastructure Leakge Index (ILI)	21.5	28.0	28.7	23.9	29.0	29.3	30.7	21.7	15.2	14.6	

Financial Parameters

Financial Information	Bahamian Dollars			WSC NEW PROVIDENCE												
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016 Estim	Total from 2003	NOTES
Revenues																
Revenue from water services	$26,297,026	$26,699,514	$28,647,683	$33,471,800	$28,976,988	$34,346,451	$31,022,853	$31,089,400	$30,809,350	$32,700,003	$31,797,100	$33,812,064	$33,939,866	$34,000,000		WSC Ann Reports, WB, IDB
Revenue from sewer services	$3,928,283	$3,941,198	$3,176,939	$3,738,690	$3,772,124	$4,390,482	$4,636,881	$3,924,510	$4,551,880	$4,407,040	$4,113,176	$5,021,444	$5,656,556	$6,000,000		WSC Ann Reports, WB, IDB
Other operational revenue																WSC Ann Reports, WB, IDB
Total Operational Revenue	$30,225,309	$30,640,712	$31,824,622	$37,210,490	$32,749,112	$38,736,933	$35,659,734	$35,013,910	$35,361,230	$37,107,043	$35,910,276	$38,833,508	$39,596,422	$40,000,000	$498,869,301	Calculated
Other non-operational revenues																WSC Ann Reports, WB, IDB
Total Revenues, Thousand B$	$30,225,309	$30,640,712	$31,824,622	$37,210,490	$32,749,112	$38,736,933	$35,659,734	$35,013,910	$35,361,230	$37,107,043	$35,910,276	$38,833,508	$39,596,422	$40,000,000	$498,869,301	Calculated
Operating Costs																
Cost of water services	$19,869,111	$18,603,465	$23,674,352	$28,534,398	$27,524,666	$32,481,953	$27,453,287	$29,063,755	$34,249,643	$37,484,950	$37,402,455	$33,739,917	$29,466,789	$28,700,000		WSC Ann Reports, WB, IDB
Cost of sewer services	$1,750,131	$2,422,511	$3,598,159	-$398,920	$2,263,156	$3,393,659	$1,754,086	$1,978,528	$2,741,390	$2,413,696	$2,780,365	$2,773,916	$3,863,614	$4,300,000		WSC Ann Reports, WB, IDB
Adminstrative Costs	$9,597,950	$7,631,944	$9,665,834	$9,761,919	$10,504,631	$10,304,960	$9,720,588	$9,825,822	$10,903,924	$11,842,031	$14,862,848	$15,501,057	$15,061,767	$15,000,000		WSC Ann Reports, WB, IDB
Other operational costs	$0	$0						$0	$0	$0	$0	$0	$0	$0		
Total Operational Cost	$31,217,192	$28,657,920	$36,938,345	$37,897,397	$40,292,453	$46,180,572	$38,927,961	$40,868,105	$47,894,957	$51,740,677	$55,045,668	$52,014,890	$48,392,170	$48,000,000	$604,068,307	Calculated
Revenue Collection Ratio (ALL WSC)								87%	87%	89%	90%	96%	102%	100%		WSC Annual Reports
Total Water Production Cost, B$ / m3 produced	$2.04	$1.94	$2.50	$2.38	$2.50	$2.82	$2.21	$2.37	$2.54	$2.62	$2.81	$2.97	$3.20	$3.21		Calculated
Just Water Production Cost $B/m3	$1.30	$1.26	$1.60	$1.79	$1.71	$1.98	$1.56	$1.68	$1.82	$1.90	$1.91	$1.93	$1.95	$1.92		Calculated
Operating Cost Recovery Ratio	**0.97**	**1.07**	**0.86**	**0.98**	**0.81**	**0.84**	**0.92**	**0.86**	**0.74**	**0.72**	**0.65**	**0.75**	**0.82**	**0.83**	**0.83**	Calculated
Effective Average Water Tariff $B / 1000 IG	$16.76	$16.26	$16.70	$17.64	$16.54	$18.80	$16.67	$15.74	$17.61	$17.85	$16.09	$14.76	$15.33	$15.14		Calculated
Effective Average Tariff, B$ / m3 billed	$4.24	$4.10	$4.08	$4.31	$4.11	$4.66	$4.21	$3.90	$4.45	$4.45	$4.00	$3.73	$3.94	$3.92		Calculated
EBITDA	-$991,883	$1,982,792	-$5,113,723	-$686,907	-$7,543,341	-$7,443,639	-$3,268,227	-$5,854,195	-$12,533,727	-$14,633,634	-$19,135,392	-$13,181,382	-$8,795,748	-$8,000,000	-$105,199,006	Calculated
Depreciation and Amortization	-$4,946,005	-$5,089,560	-$5,213,401	-$5,747,285	-$5,215,841	-$6,250,652	-$6,776,978	-$9,504,944	-$9,403,332	-$9,107,902	-$9,523,257	-$10,883,550	-$10,990,053	-$11,000,000	-$109,652,760	WSC Ann Reports, WB, IDB
EBIT	-$5,937,888	-$3,106,768	-$10,327,124	-$6,434,192	-$12,759,182	-$13,694,291	-$10,045,205	-$15,359,139	-$21,937,059	-$23,741,536	-$28,658,649	-$24,064,932	-$19,785,801	-$19,000,000	-$214,851,766	Calculated
Debt service / Interest	-$4,288,226	-$914,700	-$4,259,816	-$4,392,392	-$4,622,769	-$5,078,389	-$5,138,854	-$4,953,134	-$4,861,396	-$5,898,640	-$3,866,765	-$3,815,927	-$3,968,541	-$4,000,000	-$60,059,549	WSC Ann Reports, WB, IDB
Taxes, Other, misc	$340,719	$5,181,086	$1,391,361	$1,055,883	$1,841,848	$2,196,515	$2,327,300	$3,581,311	$4,037,653	-$1,035,400	$2,120,167	$722,886	$1,878,108	$2,000,000	$27,639,437	WSC Ann Reports, WB, IDB
Net Earnings /Loss	-$9,885,395	$1,159,618	-$13,195,579	-$9,770,701	-$15,540,103	-$16,576,165	-$12,856,759	-$16,730,962	-$22,760,802	-$30,675,576	-$30,405,247	-$27,157,973	-$21,876,234	-$21,000,000	-$247,271,878	Calculated
Government Subsidy, B$,	$5,320,000	$8,540,000	$11,720,000	$16,325,000	$15,120,625	$16,902,155	$21,373,856	$24,335,000	$25,758,090	$24,251,000	$24,925,000	$34,889,012	$9,149,167	$9,000,000	$247,608,905	WSC Ann Reports
Net Operating Income (Loss)	-$4,565,395	$9,699,618	-$1,475,579	$6,554,299	-$419,478	$325,990	$8,517,097	$7,604,038	$2,997,288	-$6,424,576	-$5,480,247	$7,731,039	-$12,727,067	-$12,000,000	$337,027	Calculated

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