



WSC Support Program – New Providence Water Supply and Sanitation Systems Upgrade (BH-L1028; Loan 2624/OC-BH)

Project Completion Report (PCR)

Original Project Team (until July 2017) : Evan Cayetano (WSA/CTT), Project Team Leader; Rodrigo Riquelme, Maria Alejandra Perroni, Jorge Ducci, Cynthia Nuques (INE/WSA); Yvon Mellinger (INE/WSA); Maria Teresa Soto-Aguilar (VPC/PDP); David A. Ochoa (PDP/CGY); Syreta Roberts (CCB/CBH); and Guillermo Eschoyez (LEG/SGO).

Project Team (since August 2017) and PCR Team: David Wilk (INE/WSA), Project Team Leader; Evan Cayetano (WSA/CTT), Kleber Machado (INE/WSA), Jorge Ducci (INE/WSA); Sebastian Martinez (SPD/SDV); Syreta Roberts (CCB/CBH); Liliana López (INE/WSA); and Camilo Garzon (Consultant).

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Electronic Links

1. [Development Effectiveness Matrix \(DEM\)](#)
2. [Final version of the Progress Monitoring Report \(PMR\)](#)
3. [PCR Checklist](#)
4. [Changes in the results matrix](#)

Optional Electronic Links

1. Annex A -- [Counterfactual Analysis](#)
2. Annex B – [Socio-Economic Analysis Ex-post](#)
3. Annex C - [Relevant Data Tables](#)
4. Annex D – [Final Evaluation](#)
5. [Minutes of the Final Evaluation Workshop](#)

Acronyms and Abbreviations

ALC	Active Leak Control
AMR	Automatic Meter Reading
BABE	Breaks and Background Estimate
DMA	District Metered Areas
EEP	Employee Effectiveness Program
ESMP	Environmental and Social Management Plan
GIS	Geographic Information System
GOTB	Government of The Bahamas
IDB	Inter-American Development Bank
IGPM	Imperial Gallons per Minute
ILI	Infrastructure Leakage index
IWA	International Water Association
M&E	Monitoring and Evaluation
MIGD	Million Imperial Gallons per Day
N1	Pressure Leakage Relationship Exponent
NRW	Non-Revenue Water
MIS	Management Information System
MTE	Mid-Term Evaluation
MOE	Ministry of the Environment
PEU	Program Executing Unit
PMR	Program Monitoring Report
PMZ	Pressure Management Zones
PRV	Pressure Reducing Valves
PS	Pumping Station
PSI	Pounds per Square Inch
RO	Reverse Osmosis
SIV	System Input Volume
SLA	Service Level Agreement
SCADA	Supervisory Control and Data Acquisition
UARL	Unavoidable Annual Real Losses
URCA	Utilities Regulatory and Competition Authority
WSC	Water and Sewerage Corporation
WWTP	Wastewater Treatment Plant

BASIC INFORMATION (US\$ AMOUNT)

PROJECT (S): BH-L1028

TITLE: WSC SUPPORT PROGRAM – NEW PROVIDENCE WATER SUPPLY AND SANITATION SYSTEMS UPGRADE

LENDING INSTRUMENT: INVESTMENT LOAN

COUNTRY: THE BAHAMAS

BORROWER: WATER AND SEWERAGE CORPORATION (WSC)

LOAN (S): 2624/OC-BH

SECTOR/SUBSECTOR: WATER AND SANITATION

DATE OF BOARD APPROVAL: NOVEMBER 16, 2011

DATE OF LOAN CONTRACT EFFECTIVENESS: DECEMBER 16, 2011

DATE OF ELIGIBILITY FOR FIRST DISBURSEMENT: FEBRUARY 16, 2012

LOAN AMOUNT

ORIGINAL AMOUNT: US\$81,000,000

CURRENT AMOUNT: US\$81,000,000

LOCAL COUNTERPART:

TOTAL PROGRAM COST: US\$81,000,000

MONTHS IN EXECUTION

FROM APPROVAL: 89

FROM CONTRACT EFFECTIVENESS: 88

DISBURSEMENTS PERIODS

ORIGINAL DATE OF FINAL DISBURSEMENT: DECEMBER 16, 2016

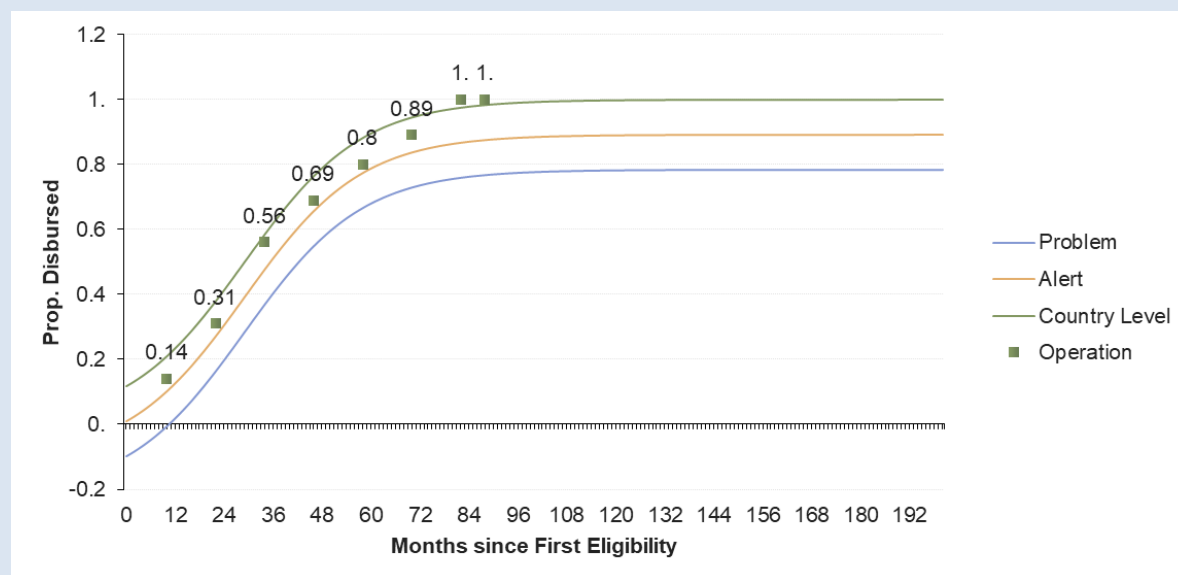
CURRENT DATE OF FINAL DISBURSEMENT: APRIL 30, 2019.

CUMULATIVE EXTENSION (MONTHS): 24

SPECIAL EXTENSIONS (MONTHS):

DISBURSEMENTS

TOTAL AMOUNT OF DISBURSEMENTS TO DATE: US\$81,000,000



REDIRECTIONING. HAS THIS PROJECT?

RECEIVED FUNDS FROM ANOTHER PROJECT [No] WHICH? [PROJECT NUMBER]

SENT FUNDS TO ANOTHER PROJECT [No] WHICH? [PROJECT NUMBER]

Ratings of project Performance in PMRs:

No.	PMR Date	PMR Stage	Classification	Actual IADB Disbursements (USD millions)
1	Jul 24, 2014	Jan – Dec 2013	Satisfactory	21,890,000
2	May 14, 2015	Jan – Dec 2014	Satisfactory	39,847,012
3	Apr 04, 2016	Jan – Dec 2015	Satisfactory	57,992,000
4	Apr 18, 2017	Jan – Dec 2016	Satisfactory	73,080,000
5	Apr 19, 2018	Jan – Dec 2017	Satisfactory	73,080,000
6	May 07, 2019	Jan – Dec 2018	Satisfactory	73,080,000

EX POST ECONOMIC ANALYSIS METHODOLOGY: C-B ANALYSIS

EX POST EVALUATION METHODOLOGY: TIME SERIES COUNTERFACTUAL ANALYSIS

DEVELOPMENT EFFECTIVENESS CLASSIFICATION: **SUCCESSFUL**

BANK STAFF

POSITIONS	AT PCR	AT APPROVAL
VICE PRESIDENT VPS	ANA RODRIGUEZ-ORTIZ	SANTIAGO LEVY
VICE PRESIDENT VPC	ALEXANDRE ROSA	ROBERTO VELLUTINI
COUNTRY MANAGER	THERESE TURNER	GERARD JOHNSON
SECTOR MANAGER	JOSE AGUSTIN AGUERRE	ALEXANDRE ROSA
DIVISION CHIEF	SERGIO CAMPOS	FEDERICO BASAÑES
COUNTRY REP	DANIELA CARRERA MARQUIS	ASTRID WYNTER
PROJECT TEAM LEADER	DAVID WILK	EVAN CAYETANO
PCR TEAM LEADER	DAVID WILK	-

Staff Time and Cost

Stage Project Cycle	# of staff weeks	USD (including travel and consultant costs)
Preparation	40	\$65,000.00
Supervision	90	\$81,000.00
Total		\$146,000.00

STATEMENT OF THE DEVELOPMENT OBJECTIVES OF THE PROGRAM: The general objective of the operation is to improve the efficiency and quality of service provision of potable water, address immediate problems of sanitation in the island of New Providence, prepare implementation of economic and environmental regulation, and create and support the corresponding regulatory entities. The specific objectives are to: (i) reduce water losses; (ii) strengthen the Water and Sewerage Corporation (WSC); (iii) upgrade and rehabilitate selected sewerage infrastructure; and (iv) improve the legal and regulatory framework of the sector.

I. INTRODUCTION

The island of New Providence, on which this program is centered, accounts for approximately 70% of the population of The Bahamas (351,000 inhabitants). The availability of renewable freshwater per capita in the country, and on this island, is one of the lowest in Latin America and the Caribbean. For this reason, the island population relies on groundwater and desalination as its only two drinking water sources. Groundwater, however, is very limited and over-abstraction is a serious concern. The well fields in New Providence have a maximum estimated capacity of 1.5 MIGD, while customers' demand fluctuates around 10 MIGD. For this reason, over 90% of the drinking water supplied to the island comes from reverse osmosis plants, which yield a comparatively expensive product. In this context, the water losses in the distribution network, estimated to be close to 50% of the water produced, were considered economically and financially unacceptable. These losses originated from leaks in the network, unauthorized consumption and metering inaccuracies. They are collectively known as non-revenue water (NRW) in this report.

Several utility companies, such as the Water and Sewerage Corporation (WSC), Grand Bahama Utility Company, and Paradise Island Utilities, in addition to other smaller independent companies and private developers, provide water and sanitation services in the Bahamas. The largest provider of water and sewerage services in the Bahamas is WSC, a state-owned utility established in 1976, which has a mandate to provide adequate amounts of water for domestic and industrial uses, as well as facilitate the safe disposal of domestic sewage and industrial effluents. WSC currently registers more than 60,000 water connections (42,800 in the island of New Providence) and 13,000 sewerage connections (12,300 of which are in New Providence). WSC also has responsibilities for the management of the water resources of the Bahamas. This last responsibility is shared with the Ministry of the Environment (MOE), which has functions related to the protection of water resources, but without the proper organization and the financial resources to address the growing challenges to address water security in New Providence and main islands.

On the financial side, the Cabinet is the highest decision-making authority in the country and, therefore, the body that determines the level of support provided by the Government to the water and sanitation sector. Until an independent economic regulator, such as the Utilities Regulation & Competition Authority (URCA), is properly empowered, the Cabinet is by default the entity responsible for setting the tariffs that WSC charges to its customers. The last adjustment on the tariff regime occurred in 1999. Evidently, the institutional and legal framework, in which WSC operates, lacks legal provisions for adequate levels of administrative autonomy and accountability, and does not offer incentives for management effectiveness, economic efficiency and financial self-sufficiency.

Recognizing the seriousness of the situation, on November 16th, 2011, the IDB approved a loan, requested by the Water and Sewerage Corporation (WSC) of The Bahamas, to finance a much-needed investment program to address water losses and other critical institutional issues. The general objectives of the five-year operation were to improve the efficiency and quality of the potable water service, address immediate sanitation problems in the island of New Providence, prepare the WSC for implementation of economic and environmental regulation, and create and support economic and environmental regulatory entities. The specific objectives were to: (i) reduce water losses; (ii) strengthen the institution of the WSC; (iii) upgrade and rehabilitate selected sewerage infrastructure; and (iv) improve the legal and regulatory framework of the sector

The program was comprised of four components established to address the aforementioned objectives: (i) NRW reduction; (ii) institutional strengthening; (iii) rehabilitation of critical sewerage infrastructure; (iv) the legal and regulatory framework upgrades. The total cost of the program was estimated at US\$81 million, financed solely by an IDB loan, as no local counterpart was required (See Annex C, Table 1 - Program Costs).

The borrower and executing agency was WSC, with the Government of The Bahamas acting and the guarantor. WSC established a Program Executing Unit (PEU) composed a Program Manager and two senior engineers in charge of the water loss reduction and the wastewater rehabilitation components. Additional support was provided to the PEU by other WSC Departments. To oversee the activities planned under the fourth component, the Loan Contract stipulated that an inter-institutional committee would be created with representatives from the Ministry of the Environment, the Ministry of Finance, WSC, URCA, and the Attorney General's Office.

II. CORE CRITERIA & PROJECT PERFORMANCE

A. Relevance

2.1 Alignment with Country Development Needs and Strategic Alignment

In the context described above, of limited drinking water supply and high production costs, the economic losses from non-revenue water (NRW) were deemed unreasonably high. For example, in 2012, based on a detailed evaluation at the beginning of the program, NRW was estimated at 6.87 MIGD, or about 58% of the water produced.¹ Thus, a comprehensive plan to reduce NRW, as sought jointly by the Government, WSC and IDB, was clearly justified.

The NRW reduction plan took into account that the quality of service received by many customers suffered from low pressure and occasionally 'rusty' water, which drove some to terminate their relationship with WSC, opting for alternative arrangements, such as private wells. It was also taken into consideration that the lack of a properly functioning public wastewater collection, treatment, and disposal system, and the widespread use of private septic systems, posed a significant risk of contaminating the groundwater resources, especially the shallow aquifers used by large segments of the population. These considerations and the lack of a clear wastewater management plan constituted a related challenge that the program needed to address, in spite of the limited loan resources available.

It was also decided that the improvements envisioned in the water supply and wastewater infrastructure had to be coupled with parallel activities aimed at enhancing WSC's internal operational efficiency, financial condition, and long-term sustainability. Lastly, a decision was also made to promote the creation of an enhanced legal and regulatory framework to protect water resources from overuse and contamination and to enable appropriate regulation of economic aspects and service quality. Thus, the project defined as a general objective "to improve the efficiency and quality of service provision of potable water, address immediate problems of sanitation in the island of New Providence, prepare implementation of economic and environmental regulation, and create and support the corresponding regulatory entities", and detailed four components directly associated with these development needs: 1. NRW Reduction, 2. WSC Institutional Strengthening; 3. Rehabilitation and upgrade of sewerage infrastructure and preparation of a Wastewater Treatment Master Plan; and 4. Upgrade legal and regulatory framework.

¹ WSC Support Program, New Providence Water Supply and Sanitation Systems Upgrade, Technical Analysis, August 2011.

In relation to the relevance of the programme to the country's sectoral plans, the general objective is related to The Bahamas' Water and Sanitation Strategic Sector Plan (WSSP) completed in 2009. The WSSP identified operational areas where WSC should reduce costs or improve revenues and made recommendations for WSC to move toward financial sustainability as well as the Legal and Regulatory Framework Update completed in 2010.

Finally, the program was in line with the Bank's Strategy with The Bahamas 2010-2014 (GN-2558-2) as stated in the program's Loan Proposal. The Country Strategy (CS) asserted that the aim of the program was to improve the efficiency of service provision and coverage of water supply and sanitation systems, within the pillar of enhancing economic growth through the provision of critical infrastructure. Specific targets were: (i) improvement of the operational and financial performance of WSC; (ii) expansion of services; (iii) reduction of physical losses; and (iv) strengthening the legal and regulatory framework of the sector. The program was also aligned with the following GCI-9 priority areas: lending to small and vulnerable countries and support for climate change initiatives and environmental sustainability.

The Bank's Strategy with the Bahamas for the 2013 - 2017 period (GN- 2731) addresses water and sanitation as a priority sector under the Coastal Risk Management and Climate Change Adaptation strategic line. The Program is aligned with these strategic lines in that the financing provided to improve efficiency of service provision and coverage of water supply and sanitation systems does contribute to building resilience to the onset of climate change and the increased occurrences of hurricanes. The much-needed improvements in the service provision and coverage of water supply and sanitation under increasing systems contribute to water security in the Bahamas.

The program, at its completion phase, is also in line with two of the three priority areas of the IDB Group Country Strategy with The Commonwealth of The Bahamas 2018-2022 (GN-2920): (i) enhancing public sector effectiveness and (ii) supporting resilient infrastructure for growth.

2.2 Strategic Alignment

The Project aligns with several of the institutional challenges and cross-cutting themes defined in the Updated Institutional Strategy (UIS) 2010-2020 (AB-3008). In relation to the challenges², the Project is specifically aligned with the development challenges of Social Inclusion and Equality, by increasing the access and reliability of the population to water supply and sanitation services. Additionally, the operation is aligned with Productivity and Innovation by reducing NRW and increasing WSC's efficiency. In relation to the cross-cutting themes³, the Project is aligned with Climate Change and Environmental Sustainability through reduction in NRW which reduces the level of water production; and Institutional Capacity and Rule of Law by adoption of modern regulatory regimes with respect to economic and environmental regulations.

In 2019 the Bank carried out a second update of its Corporate Strategy (AB-3190-2), which endorsed the 3 strategic priorities (associated with the 3 challenges) and the 3 cross-cutting themes, as well as emphasizing the importance of resource mobilization, and the development of innovation and technology to accelerate progress on the Bank's priorities.

² The challenges are: (i) Social inclusion and equality; (ii) Productivity and innovation; (iii) Economic integration.

³ The cross-cutting themes are: (i) Gender Equality and Diversity; (ii) Climate Change and Environmental Sustainability; and (iii) Institutional Capacity and Rule of Law.

2.3 Relevance of Program Design

As stated before, the program was comprised of four components, two of which were designed to improve the existing water distribution network and the wastewater infrastructure, respectively. The other two addressed pressing institutional issues related to both the internal WSC's needs for improvement and the external reform of the regulatory environment. These four components were to be carried out in parallel, not being completely independent from each other. Figure 1 illustrates how the four components worked simultaneously, seeking to improve WSC's operational efficiency and enhance the quality of the services provided. This four-prong approach seems adequate, as does the sequence cause-effect observed for each of the four components. It is important to add that the improvements of the regulatory framework under component 4 of the project were contingent to the achievement of intermediary outputs, namely the construction and adoption of mechanisms and instruments without which no final planning and regulatory process was completed. Those key outcomes were part of the vertical logic of the project, aiming at higher legislative impacts (See Table 1 for a description of these outcomes that are accounted for in this PCR). Table 1 presents the changes in the Outcomes/results matrix, reflecting important adjustments in the overall results. More importantly, outcomes for Component 3 (wastewater treatment) and Component 4 (institutional/legal) were adjusted or added, to better represent the impact of the activities. Since the project was eligible before 1 September 2013 and the 60-day update rule after eligibility was not yet in force, it is not possible to submit information for that period.

Seven years after approval, the program's specific objectives continue to be relevant and worth pursuing: (i) additional reductions in water losses, beyond the accomplished goals, can and should be pursued; (ii) WSC's operational efficiency and sustainability improvements, largely unattained, are still valid and justified; (iii) further sewerage infrastructure rehabilitation is needed; and (iv) the adoption of legal and regulatory upgrades, especially the establishment of the Economic and Environmental Regulators, for which the respective by-laws have already been drafted, reviewed and approved under this program. The Program spearheaded a very important strategic planning process for the Family Islands, with a Strategic Plan that would be ready for implementation through a funding initiative.

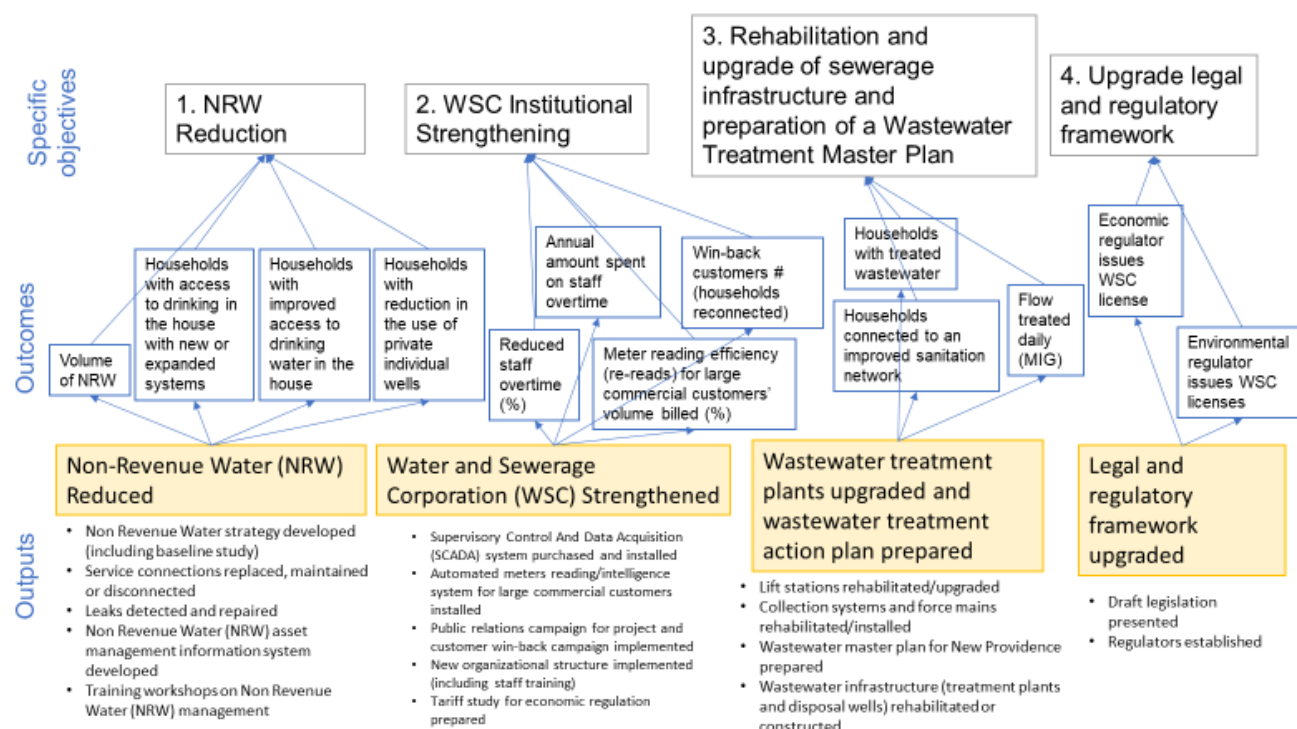
Table 1. Results matrix (approval, eligibility + 60 days, exit)

Indicator	Approval			Eligibility + 60 days ⁴			Exit			Comments
	Unit	Baseline	Target (P)	Unit	Baseline	Target (P)	Unit	Baseline	P(a)	
Impact										
Operating cost recovery of WSC %	%	61	80				%	61	71	
NRW in New Providence (average daily volume)	MIG	5.5	2.5				Deleted			
Increase in number of active connections	Number	66,000	75,000				Number	66,000	60.451	
Regulatory functions are separated from the provision of services	Regulatory functions	0	1				Regulatory functions	0	0	
Specific objective 1. NRW Reduction										
Volume of NRW (avg daily volume)	MGL	5.5	2.5				MGL	5.5	2.00	
Households with improved access to drinking water in the house (better pressures, quality, and volume)	Household	0	38,000				Household	0	34,920	
Households with access to drinking in the house with new or expanded systems (home)	Household	0	2,000				Household	0	1.987	
Households with reduction in the use of private individual wells	Household	0	5,000				Household	0	1.500	
Specific objective 2. WSC Institutional Strengthening										

⁴ Since the project was eligible before 1 September 2013 and the 60-day update rule after eligibility was not yet in force, it is not possible to submit data for that period.

Indicator	Approval			Elegibility + 60 days ⁴			Exit			Comments
	Unit	Baseline	Target (P)	Unit	Baseline	Target (P)	Unit	Baseline	P(a)	
Reduced staff overtime (%)	%	100	75				Deleted			
Annual amount spent on staff overtime	-						US\$	81,750	75,000	
Meter reading efficiency (re-reads) for large commercial customers' volume billed (%)	%	84	98				%	84	98	
Win-back customers # (households reconnected)	Household	0	2,000				Household	0	1,000	
Specific objective 3. Rehabilitation and upgrade of sewerage infrastructure and preparation of a Wastewater Treatment Master Plan										
Households connected to an improved sanitation network	Household	0	8,662				Household	0	7,266	
Flow treated daily (MIG)	MIG	2,1	6.5				MIG	2,1	4,5	
Households with treated wastewater	-						Household	12,000	11,300	
Specific objective 4. Upgrade legal and regulatory framework										
Economic regulator issues WSC license	License	0	1				License	0	ND	
Environmental regulator issues WSC licenses	License	0	1				License	0	ND	
Regulatory Reform Committee	-						Committee	0	1	
By-laws for Economic and Environmental Regulators	-						By-laws	0	2	
Water Development Strategy with Legal/ Institutional proposals, Family Islands	-						Strategy	0	1	

Figure 1. Program's Vertical Logic



2.4 Effectiveness

The assessment of effectiveness was based on an evaluation of the extent to which the program achieved its stated objectives and outcomes, given the outputs that were financed under each component. This section presents a descriptive analysis of each of the sets of outputs delivered under the program. Annex A presents an analysis of the effectiveness of the interventions implemented under BH-L1028 in New Providence, centered on the most important program component and its outputs, that is, non-revenue water reduction (NRW). The analysis uses administrative micro-data on Non-Revenue Water (NRW) and pressure. A descriptive analysis of the time-series provides an overview of the post-intervention trends in outcomes. These descriptive analyses provide evidence of correlation, rather than causation.⁵ However, given the nature of the outcomes and their direct proximity to the intervention of interest, the descriptive analysis combined with the program's theory of change and supporting qualitative evidence from the executing agency and program counterparts provide strong evidence of contribution of the program towards its primary objective of reducing NRW. A second set of complementary analysis implements fixed and random effects time-series models to estimate the impact of repairs of water lines on non-revenue water. The evidence supports the conclusion that maintenance efforts conducted by the program contributed to reductions in NRW, particularly the repair of water mains, essentially offsetting the increase in NRW produced by the leak. Together, the effectiveness analysis presented in this section and Annex A (Counterfactual Analysis) and Annex C (Final Evaluation) suggest that the interventions conducted under BH-L1028 contributed

⁵ In the absence of baseline data for a period before the initiation of the program, a rigorous counterfactual (attribution) analysis of the effects of the intervention was not possible. However, for each of the outcomes analyzed in this PCR, a simpler counterfactual analysis is performed to assess that conditions.

to substantially decrease non-revenue water and improved water pressure for users of the water system of New Providence.

a. Statement of Program Development Objectives

The general objective of the operation was to improve the efficiency and quality of service provision of potable water, address immediate problems of sanitation in the island of New Providence, prepare implementation of economic and environmental regulation, and create and support the corresponding regulatory entities. The specific objectives were to: (i) reduce water losses; (ii) strengthen the Water and Sewerage Corporation (WSC); (iii) upgrade and rehabilitate selected sewerage infrastructure; and (iv) improve the legal and regulatory framework of the sector.

b. Results Achieved under the program

Next table shows the results achieved at the end of the project. An analysis of each result achieved is presented after the table.

Table 2. Results Achieved

Impact/Indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Means of verification
Impact #1: A Financially viable Water and Sewerage Corporation (WSC).							
Indicator #1: WSC operating cost recovery (Revenues Collected/Operating Cost)	%	61	2011	P	80	50	WSC accounting reports
				P(a)	80		
				A	71		
Indicator #2 Increase in number of active (water) connections	Connections	60,099	2011	P	75,000	2	WSC commercial registry
				P(a)	70,000		
				A	60,451		
Impact #2: Establishment of an economic and environmental regulator to regulate the activities of the Water and Sewerage Corporation (WSC)							
Indicator #1: Regulatory functions are separated from the provision of services	Law approved	0	2011	P	1	0	Law issued
				P(a)	1		
				A	0		

Outcome/Indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Means of verification
Specific Objective 1. Non-Revenue Water (NRW) reduction							
Indicator #1.1: Volume of Non-Revenue Water NRW (average daily volume)	MIG	6.87	2012	P	2.5	100	WSC approved water balance
				P(a)	2.5		
				A	2.00		
Indicator #1.2: Households with improved access to drinking water in house (better pressure, quality and volume) *	Households	0	2012	P	38,000	92	WSC commercial & technical reports
				P(a)	36,000		
				A	34,920		
Indicator #1.3: Households with new access to drinking water in house	Households	0	2011	P	2,000	99	WSC commercial reports
				P(a)	3,000		
				A	1,987		

Outcome/Indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Means of verification
Indicator #1.4: Households changing from using private individual wells to becoming clients of the Water and Sewerage Corporation (WSC)	Households	0	2011	P P(a) A	5,000 5,000 1,500	30	Socio-economic surveys
Specific Objective 2. Water and Sewerage Corporation (WSC) strengthening							
Indicator #2.1: Annual amount spent on staff overtime	US\$	109,000	2011	P P(a) A	81,750 75,000 75,000	100	WSC HR report
Indicator #2.2: Win-back customers (households reconnected)	Households	0	2011	P P(a) A	2,000 2,000 1,000	50	WSC commercial reports
Indicator #2.3: Large commercial customers billed in accordance to metered consumption	%	84	2011	P P(a) A	98 98 98	100	WSC commercial reports
Specific Objective 3. Rehabilitation and upgrade of sewerage infrastructure and preparation of a wastewater treatment Master plan							
Indicator #3.1: Households connected to an improved sanitation network	Households	0	2011	P P(a) A	8,662 8,662 7,266	84	WSC technical reports
Indicator #3.2: Wastewater flow (million imperial gallons treated daily)	MIG	2,1	2011	P P(a) A	6,5 6,5 4,5	55	WSC technical reports
Indicator #3.3: Households with treated wastewater **	Households	8,700	2011	P P(a) A	12,000 11,700 11,300	79	WSC & Consultant's reports
<p>Outcome 1.2 (Households with improved access to drinking water in house (better pressure, quality and volume) has been revised. The achievements in leak detection and repair, pressure management and system operations during the entire execution period have been measured in all the 89 DMAs that were constituted, closed and managed under this component. Only a small number of households (3%) fall under DMAs that could not be proven totally closed (because of missing data or irregularities that prevented full DMA measurement). Therefore, 92% of the target was achieved.</p> <p>**As revised in Table 1, the outcome 3.3 (Households with treated wastewater), had incorporated incorrect figures for baseline target (62,491) and original target (67,000). The correct baseline target should have included only households with wastewater connections under the WSC's service, as improvements in WW treatment apply to these households and not to households with other individual systems, such as septic tanks and other individual systems. The correct figures are already reflected in this table. The actual Households with WWT in 2018 are reported at 11,300. These are households that benefitted from WWT investments in Component 3, as clearly stated in Annex B (Socio-economic Analysis Ex-post). This represents a 79% achievement of the baseline target established for the project.</p>							
Specific objective 4. Legal and regulatory framework							
Indicator #4.1: Water and Sewerage Corporation (WSC) license from economic regulator	License	0	2011	P P(a) A	1 1 0	0	License issued
Indicator #4.2: Water and Sewerage Corporation (WSC) license from environmental regulator	License	0	2011	P P(a) A	1 1 0	0	License issued

Outcome/Indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Means of verification
Added Indicator # 4.3 Regulatory Reform Committee	Committee	0	2011	P P(a) A	1 1 1	1	Legal Instrument
Added Indicator # 4.4 By-laws for Economic and Environmental Regulators	By-laws	0	2011	P P(a) A	2 2 2	1	Legal instrument
Added Indicator # 4.5 Water Development Strategy with Legal/ Institutional proposals, Family Islands	Strategy	0	2011	P P(a) A	1 1 1	1	Planning document

Output indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Comments
Component 1. Non Revenue Water (NRW) Reduced							
Non Revenue Water strategy developed (including baseline study)	Strategy	0	2011	P	1	100	
				P(a)	1		
				A	1		
Service connections replaced, maintained or disconnected	Connections	0	2011	P	23.000	98	
				P(a)	22.558		
				A	22.106		
Leaks detected and repaired	Leaks	0	2011	P	6.000	96	
				P(a)	6.189		
				A	5.915		
Non Revenue Water (NRW) asset management information system developed	System	0	2011	P	1	100	
				P(a)	1		
				A	1		
Training workshops on Non Revenue Water (NRW) management	Workshops	0	2011	P	10	17	
				P(a)	12		
				A	2		
Component 2. Water and Sewerage Corporation (WSC) strengthened							
Supervisory Control And Data Acquisition (SCADA) system purchased and installed	System	0	2011	P	1	100	
				P(a)	0		
				A	1		
Automated meters reading/intelligence system for large commercial customers installed	System	0	2011	P	3.000	0	
				P(a)	3.000		
				A	0		
Public relations campaign for project and customer win-back campaign implemented	Campaign	0	2011	P	2	50	
				P(a)	2		
				A	1		
New organizational structure implemented (including staff training)	Structure	0	2011	P	1	0	
				P(a)	1		
				A	0		
Tariff study for economic regulation prepared	Study	0	2011	P	1	100	
				P(a)	1		
				A	1		
Component 3. Wastewater treatment plants upgraded, and wastewater treatment action plan prepared							
Lift stations rehabilitated/upgraded	Lift Stations	0	2011	P	60	91	
				P(a)	11		

Output indicator	Unit of Measure	Baseline value	Baseline year	Targets and Actual achievement		% Achieved	Comments
				A	10		
Collection systems and force mains rehabilitated/installed	Miles	0	2011	P	4	100	
				P(a)	2		
				A	2		
Wastewater master plan for New Providence prepared	Plan	0	2011	P	1	100	
				P(a)	1		
				A	1		
Wastewater infrastructure (treatment plants and disposal wells) rehabilitated or constructed	Infrastructure	0	2011	P	9	100	
				P(a)	5		
				A	5		
Component 4. Legal and regulatory framework upgraded							
Draft legislation presented	Legislation	0	2011	P	2	100	
				P(a)	2		
				A	2		
Regulators established	Regulators	0	2011	P	2	0	
				P(a)	2		
				A	0		

2.4.1 Specific objective 1. NRW Reduction

The NRW reduction component was the largest of the four components, absorbing more than 60% of the program resources. Its timely and effective completion was expected to have a significant impact on WSC's operational and financial performance. The following activities were carried out:

NRW Reduction Contract. A ten-year US\$83 million performance-based contract between WSC and Miya Water Project Netherlands B.V. and Veritec Consulting Inc. was signed on February 17th, 2012, two months after project approval. Taking into account the program's duration, it was agreed at the outset that the IDB loan would only finance the first five years of the contract's expenses (estimated at US\$49 million) and that WSC would finance the following five years. Under the contract, Miya was required to reduce NRW in the New Providence from an annual average of 5.5 MIGD (estimated) to 2.5 MIGD by 2017 and 2.0 MIGD by 2019.⁶ To meet these goals Miya proposed a four-stage comprehensive approach: (i) baseline survey; (ii) development of a water balance and a NRW reduction strategy; (iii) strategy implementation phase, where physical and commercial losses would be actively reduced and monitored; and (iv) maintenance and training phase (years 6 to 10).

Baseline Survey. The baseline survey was conducted in 2012-2013 to determine the level of NRW in New Providence in accordance with IWA guidelines and procedures. Based on the water audit for 2012, the report concluded that the average system input volume was 11.9 MIGD and that the billed authorized consumption was 5.02 MIGD, resulting in a total validated volume of NRW 6.87 MIGD. The overall annual average pressure in the water distribution network was

⁶ MIGD is the abbreviation for Million Imperial Gallons per Day. One Imperial gallon is equivalent to 4.546 liters (approximately 1.2 US gallons).

calculated to be 25.1 psi. Thus, the NRW levels found were above the initially estimated level of 5.5 MIGD.⁷

NRW Reduction Strategy. A strategy was prepared in 2012 to reduce current NRW levels to 2.5 MIGD within five years, 2.0 MIGD within seven years, and to maintain this reduction until year ten, in accordance with the contract objectives (See Annex C, Table 2 - Annual NRW reduction targets).

The strategy was primarily focused on reducing *real losses*, which were estimated at 92% of the total NRW volume. A *breaks and background estimate* (BABE) was conducted to determine how much of the overall *real losses* were attributable to different components of the distribution system (mains, service lines, valves, hydrants, reservoirs, meters, etc.). The analysis showed that losses on service lines accounted for 89% of all *real losses*, confirming the need to focus on reducing the number of breaks on service lines and to detect unreported breaks on service lines more quickly. Key components of the strategy were: (i) active leak detection, proper leak repairs, (ii) pressure management in district metered areas (DMA), (iii) selective service line replacement, (iv) disconnection of inactive service lines, (v) selective main replacement, (vi) large customer meter sizing and replacement, and (vii) adequate asset maintenance. Other essential strategy components included hydraulic modeling, system optimization, GIS data updating, SCADA systems, and data management hardware and software (NETBASE).

Leak detection campaign, replacement of unreliable system components and establishment of *district-metered areas* (DMAs). As explained, one of the key components of the strategy was leak detection and repair, which comprised several activities designed to identify and repair leaks, control pressure, and properly maintain assets. Until July 2018, the total number of breaks or leaks located on mains was 1,757 and on service lines 4,137. Apparent and commercial losses were also addressed through the testing and replacement of large customer's meters (See Annex C, Table 3 - Activities carried out under the NRW, from 2012 to June 2019).

Management and operating tools. The management and operating tools installed or implemented to monitor results and measure performance were: (i) NETBASE, to facilitate management of the distribution network; (ii) SCADA, installed at pumping stations and tanks; (iii) GIS improvements and data updates; (iv) distribution system modeling. The annual reports submitted by Miya contained explanations of how different variables were calculated and what adjustments had to be made to account for unforeseen circumstances. In developing annual water balances, particular attention was paid to calculating system input volumes and billed and unbilled authorized consumption,⁸ as these calculations play a crucial role in determining NRW. Emphasis was also placed on calculating average pressures for each DMA and for the island as a whole, given the impact of pressure on water losses.

Technical supervision and support. A five-year US\$783,000 contract was signed on November 21st, 2012, with Water Management International (WMI) and SCE to supervise the NRW contract performance and provide objective, third-party review and support to WSC. The supervision contract was scheduled to end in November 2017, but was extended to November 6, 2018, to provide enough time to review Miya's 2017 Annual Report. This periodic supervision fell short of expectations with few field visits which did not result in an effective engagement with day-to-day

⁷ Baseline developed by MIYA, 2013.

⁸ Unbilled authorized consumption was estimated to be 50.93 MIG/year in 2017 (0.14 MIGD) and was caused mostly by flushing mains to resolve water quality problems (98% of the total), but also included fire fighting and water used for testing new mains.

activities. The Mid-Term Evaluation (MTE) also experienced the limited usefulness of the Technical Consultant's reports after reviewing WMI's Mid-Term Report. It opined that the report would have been more beneficial if it had been prepared in such a manner as to clearly and succinctly present the NRW contract progress to date. The MTE also pointed out that WMI-SCE's Terms of Reference distinctly stated that the Technical Consultant should have participated in the IDB mid-term review of the NRW contract and that WMI-SCE's mid-term report should have focused on the progress made towards attaining the Project's objectives as stated in the PMR system and in the Results Matrix, among other requirements.

WMI's completion report (Aug. 2018), which provides a description of Miya's performance compared to the objectives and targets, is particularly forthcoming in congratulating "the actors for the great work that has been carried out since the beginning of the contract

Outputs and outcomes achieved. The outcomes and outputs achieved under the NRW reduction component during seven years of project execution, are shown on Table 2. It is important to recognize that the targets for *outputs* 1.2 and 1.3 were established before the baseline and reduction strategy were developed and were thus preliminary estimates. A review of the NRW component's **outputs** achieved indicates that:

NRW strategy. The NRW reduction strategy was prepared in 2012 to serve as a guide for effective action.

Service connections. 17,077 service connections have been replaced and 5,724 have been disconnected. In practical terms the output achieved the estimated initial target.

Leaks repaired. 5,640 leaks had been detected and repaired in priority areas. Since April 2017 WSC has taken over the responsibility of repairing all leaks found, replacing service lines and carrying out disconnections in accordance with the Service Level Agreement (SLA) negotiated in February 2018. The SLA requires WSC to repair 95% of all leaks within 2 working days and the remaining leaks within 5 working days. Failure to achieve these service levels increases the leak run-time and adversely affects the volume of NRW and average pressure reached.

Asset management. A NRW asset management information system was developed in 2013.

Training. Two training workshops on NRW management have been conducted but most of the remaining ones had been planned for the final two years of the 10-year Miya contract. Given the limited progress to date on this output, a review of its objectives is recommended to indicate how to best address the medium and long-term needs of the NRW project.

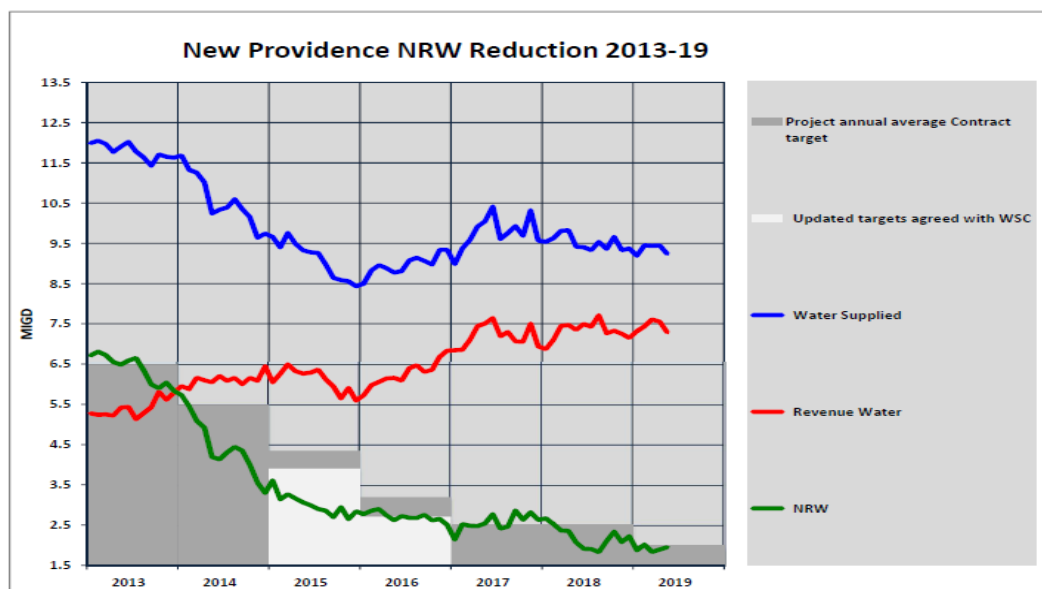
A review of the NRW component's **outcomes** achieved indicates that:

NRW reduction. In 2017, the average system input volume was 9.77 MIGD and the billed authorized consumption was 7.19 MIGD, resulting in a NRW volume of 2.57 MIGD. This number in itself did not reach the original target, but proper consideration had to be given to the following: (i) the average water pressure during that year was 24.0 psi, slightly below the contract requirement of 25 psi, and (ii) not all leaks were repaired by WSC within the stipulated times. Thus, the pressure adjusted NRW, after also considering the impacts of delays on leak repairs, was 2.44 MIGD, meeting the target for that year. It is of interest to note that about 77% of this volume was due to *real losses*, such as leaks, breaks, overflows.

In 2018, the water balance showed that the average system input was 9,53 MIGD and the billed authorized consumption had increased to 7.32 MIGD, resulting in a NRW level of 2.21 MIGD, well on target towards the 2.0 MIGD required contractually by MIYA by the end of 2019. By the end of 2018, this represented a 68% reduction in NRW between 2012 and 2018 (See Annex C, Table 4 - NRW reduction levels attained between 2012 and 2018). As shown, there was an overall and steady progress on the most essential element of the strategy: reducing the large amounts of water lost. The average NRW for the first half of 2019 dropped to 1.99 MIGD, below the target established for the year 2019. \ The average water pressure for 2018 reached 25.5 psi, above the contract requirement.

Figure 2 summarizes the results obtained in NRW reduction from 2013 to mid-2019, as reported by MIYA. This graph also shows the variations in drinking water supplied (blue curve) and the increase in revenue water (red curve).

Figure 2. NRW Reduction Achieved (2013-2019)



The economic impact of the NRW reduction program are significant. Annual cost savings were calculated as a result of a reduction of the system input volume purchased and the increases in revenues compared with the baseline. At the end of 2018, the cost savings due to reductions in *system input volumes* had already amounted to US\$31.5 million, based on marginal production costs of US\$8.18 /1,000 gallons. The increase in revenue, compared to the baseline, amounted to US\$37.2. Thus, MIYA estimates that the total financial benefits added to US\$68.7 million by 2018. (See Annex C, Table 5 -- Estimated Financial Benefits of the Project)

Improved access to drinking water. From the work on leak detection and repairs, service lines and mains replacement, as well as pressure management throughout the island, it was expected that 38,000 households would benefit from an improved access to drinking water (better pressure, quality and volume). The value reported in the PMR is 21,570 for 2018. This value was encoded incorrectly, as improvements in pressure, quality and volume were achieved in the totality of the 89 DMAs administered in the system. The correct value is 34,920 households. The achieved result is 97%.

New access to drinking water. 2,000 new households were expected to connect and receive drinking water from WSC taking into account the additional volumes of water available (i.e., recovered through leak control). The number of new households connected has been estimated at 1,987, which in practical terms is equivalent to reaching the target. Some of these new connections may be due to normal growth in WSC customers, but their service would not have been possible before the project's contribution to available volumes.

Reduction in use of private wells. It was also expected that 5,000 households would refrain from using private wells, given that WSC could provide a more reliable service. The PMR reports that approximately 1,500 households had made this decision in 2017, mostly as a result of the post-Huracan decline in water quality. These figures reflect a partial compliance (approximately 30% of the established target).

Based on an analysis of the *infrastructure leakage index* (ILI), conducted by MIYA, there could still be more NRW reductions beyond the target set for 2019 (2.0 MIGD), in the New Providence water distribution system. The ILI index provides a measure of how well a system is being managed for the control of real losses, in terms of repairs, active leakage control, and infrastructure maintenance, at current operating pressures. It is a dimensionless ratio between the *current annual real losses* (CARL), based on a water balance, and the *unavoidable annual real losses* (UARL) for a given system. UARL is calculated using the IWA system-specific approach, which takes into account the length of mains, the number of service lines, the location of customer meters, and the average operating pressure.⁹ The ILI values in New Providence, as reported by Miya, have steadily decreased from 29.7 in 2012 to 6.0 at the end of 2018. This marks an important achievement if we consider that this ILI value already fall within reasonable range of performance globally,¹⁰ In practical terms, ILI values close to 1.0 mean that leakage management is excellent, ensuring that annual losses are close to the 'unavoidable' or 'technical minimum' at current operating pressures. However, such low ILI values are only economically justified when marginal costs of water supply are relatively high (e.g. desalination) or where water is a scarce resource. If we compare the ILI system with the WBI's Bands for developed countries, the 6.0 value in 2018 for New Providence falls already within a more acceptable "B" Band (within the ILI range for developing countries, that is ILI= 4 to 8), which prescribes "potential for marked improvements; consider pressure management, better active leakage control practices and better network maintenance". Thus, WSC has moved from an intolerable/ emergency-like situation (in Band "D" in 2012) to a manageable problem that requires good systems management.

Counterfactual analysis

The reduction in NRW expected under component 1 was the central and most crucial *outcome* of this component since it encapsulated the component's overall yearly progress and allowed for the other three *outcomes* to occur. To determine the level of attribution of the achievement observed, it was important to understand that drinking water in New Providence is supplied by two sources, and that these two are adequately measured and controlled: the Blue Hills Treatment Plant (80%) and the Windsor Treatment Plant (20%). Blue Hills supplies water solely from reverse osmosis (desalination) plants and Windsor from both reverse osmosis plants (desalination) and well fields.

⁹ A user-friendly pressure-dependent formula for estimating UARL values is: $UARL \text{ (liters/day)} = (18 \times L_m + 0.8 \times N_c + 25 \times L_p) \times P$, where L_m is mains length (km), N_c is number of service connections, L_p is length of underground pipe between the edge of the street and customers meters (km), and P is average operating pressure (m).

¹⁰ From a data set comprised of 27 water distribution systems in 20 countries, an IWA Water Losses Task Force found ILI values to range between 0.7 and 10.8, with an average value of 4.38 (Lambert and McKenzie, 2002).

The '*system input volumes*' from these two plants are recorded by electromagnetic meters and, through the SCADA system, transferred into NETBASE. Adjustments are made to account for infrequent meter problems or missing data on storage tank levels, or other unusual circumstances. NRW is calculated as the difference between the *system input volume* and the *billed authorized consumption*, since there is no unmetered consumption in New Providence. The distribution system is composed of 705 miles of water mains and approximately 43,000 active connections, all metered, and suffering from leaks and increasing deterioration. From 2012 to 2019, as remedial activities were being conducted (see Table II.1), all water inputs and outputs were measured or estimated through detailed water balances (audits), following IWA methodologies. The values calculated were verified by the Technical Supervision Consultant and approved by WSC, starting with a detailed water balance conducted in 2012, which set forth a solid baseline from which to measure future performance. Although small inaccuracies might have occurred, these would not have invalidated the yearly results shown on Figure 2. Furthermore, since no other parallel efforts were conducted by WSC to reduce NRW, the results achieved can be safely attributable to the program activities under this component. In fact, the volumes of water lost through system leaks and breaks could have been reasonably expected to increase during these nine years, in the absence of the project.

With respect to the other three *outcomes*, the following observations can be made: (i) the 21,570 *households with improved access* reported correspond to the homes located in areas where clear advances were made in water pressure and service continuity, thanks to the DMA's developed and the increasing availability of water in the network – due to decreasing losses; (ii) nearly 2,000 *households with new access to drinking water* was only possible with the increasing volumes of water available within the distribution network; (iii) likewise, the current estimate of 1,500 *households reducing the use of private wells* was most likely the result of the public relations campaigns conducted by WSC and the availability of water in the system, since no parallel efforts were conducted to reduce the use of private wells over this period.

Results of the Counterfactual Analysis are included in Annex A. The analysis shows a steep decline in NRW and NRW per-capita over the first two years of program operation (2013-2014). During 2015 and thereafter, NRW per-capita continued to decline, with a total decline in NRW per-capita of 35% between 2014 and the first semester of 2019. Water pressure increased steadily, from 14.0 psi in the initial observation period to above 20.0 psi by 2019¹¹. The analysis also shows results on the impact of repairs on mains and service lines on NRW, NRW per-capita and pressure. There is clear evidence of an increase in NRW in the month preceding and the month of the repair for both mains and service lines, consistent with the presence of a leak in the system requiring repairs. Significant effects of the maintenance work on reducing NRW and improving pressure are evident in the months following the repairs. The repairs produce a reduction in NRW mainly in water mains. There are no detectable effects of repairs on NRW to service lines. However, repairs to mains and service lines are both significantly associated with improvements in pressure in the three periods following the repairs. Taken together, these results provide evidence that the maintenance activities conducted under the program contributed causally towards the aggregate improvements in NRW and water pressure.

2.4.2 Specific objective 2. WSC Institutional Strengthening

From a long-term sustainability perspective, the WSC institutional strengthening component was considered a critical addition to the program. Its initial cost was estimated at US\$5.5 million,

¹¹ The average water pressures presented in this PCR were calculated based on household densities (weighted values) for each the 89 DMAs in the MIYA database. Those values show compound water pressure values increasing from 21.8 psi in 2013 to 25.5 psi in 2018.

equivalent to 7.5% of the total direct program costs. It included activities designed to improve: (i) WSC's supervisory systems; (ii) staff productivity; (iii) customer service; (iv) staff training; (v) tariff assessments; and (vi) WSC's organizational structure. The following activities were carried out:

SCADA system. In 2013 a Supervisory Control and Data Acquisition system was purchased, installed and integrated with NETBASE as part of Miya's contract. SCADA allowed WSC to: (i) control of water distribution devices or equipment, (ii) monitor, gather, display and process real-time data, (iii) interact with sensors, valves, pumps, and (iv) record events into a log file. Thus, SCADA helped to increase efficiency, process data and communicate system issues.

Automated meter-reading (AMR). WSC retained the NRW reduction technical supervisor, Water Management International (WMI), to conduct a review of automated meter reading technologies to improve metering durability and accuracy. WSC also sought to standardize its meters and attain compatibility with those of the Bahamas Electricity Corporation (BEC). WMI submitted a report, along with pilot testing, in an attempt to identify the most advantageous technological options and ensure proper system compatibility. No further action has been taken, as WSC is currently considering a complete customer meter renovation (approx. 45,000 meters) in New Providence, which would require a substantial investment (estimated at more than US\$20 million).

Tariff study. The preparation of the tariff study was postponed until 2015-2016 as a result of the delays experienced by the regulatory reform component (see below). A contract was awarded to Castalia Strategic Advisors in January 2015 for US\$250,000. The study was completed in 2016. Its recommendations are still under analysis.

Reorganization strategy. A consulting contract was awarded to Castalia Strategic Advisors in August 2010, a year before the program's approval, to develop a strategy for implementing a new WSC organizational structure. During program preparation the Bank accepted the request from WSC for using the 'single source method' to hire Castalia to develop this strategy under a contract initially estimated at US\$700,000. The assignment was considered a 'continuation of service' under the Bank's procurement policy, since the company had won two international competitive bids in 2008 and 2009 for the preparation of a legal and regulatory framework update¹². The Bank also approved retroactive financing in order to reimburse the expenditures incurred on the organizational restructuring strategy before the program's approval.¹³ On August 21, 2012, Castalia submitted the following reports on WSC's organizational strategy: (i) The strategy describing the structure that would allow WSC to become an efficient company; (ii) A transition strategy; (iii) An outsourcing strategy of key activities; and (iv) An employee effectiveness program (EEP) to incentivize productivity and measure performance. This activity has not advanced significantly during the last few years and is currently pending review by the Government elected in 2018? [confirm month and year]. Consulting payments made to Castalia amounted to approximately US\$1.2 million, which included US\$891,000 to cover the scope of the original contract plus US\$332,000 for the development of the EEP.

Public relations campaign. A US\$1,5 million public relations campaign was conducted as part of this component.¹⁴ To lead and coordinate the campaign, a US\$250,000 contract was awarded to Barefoot Marketing on October 29, 2013. The campaign intended to improve WSC institutional

¹² Financed under Technical Cooperation ATN/WP-11596-BH.

¹³ See Loan Contract 2624/OC-BH. Special Conditions. Section 3.04. December 16, 2011.

¹⁴ Under its NRW reduction contract, Miya, carried out some of the public relations activities, especially those related to educational activities in schools. Approximately US\$500,000 was spent on these aspects of the campaign.

image and expand WSC's customer base started on November 5, 2013. It included: (i) community outreach and educational activities; (ii) broadcast, social media --Facebook, Twitter, YouTube-- and print media coverage; (iii) informational videos; (iv) Website enhancements; (v) an online payment project; and (vi) the development of a Mobile App. The contract officially ended in November 2017.

Institutional Strengthening outputs and outcomes achieved. The outcomes and outputs achieved under the WSC institutional strengthening component during seven years of project execution are shown on Table 2. A review of the component's **outputs** achieved indicates that:

SCADA system functioning. The target was achieved in 2013 and the system continues to function as anticipated.

AMR/Intelligent system for large customers installed. This output was not achieved. Discussions were held with the Bahamas Electricity Corporation (BEC) to consider meter standardization and allow integration with water meters. The NRW Technical Consultant reviewed metering options and AMR solutions. WSC is considering a complete meter renovation (45,000 meters) in New Providence.

Public relations and win-back customers campaigns implemented. Public relations campaigns were conducted between 2014 and 2017 to improve WSC institutional image and expand WSC's customer base. The campaign to win back former WSC customers was not carried out.

New organizational structure implemented. No significant changes have been introduced into WSC's organizational structure.

Tariff study. The tariff study was completed in 2016.

With respect to **outcomes**, the following observations can be made:

Overtime spent by staff. According to the Results Matrix, staff overtime was expected to decrease to 75% of the baseline value (100%) due to the introduction of SCADA, AMR, institutional restructuring, employee effectiveness programs, etc. This outcome was slightly modified during program execution in order to report improvements in monetary terms, from a baseline value of US\$109,000 to US\$81,750, which is equivalent to the initial 75% target. WSC reports that this target was achieved in 2015 and exceeded in 2016 and 2017.

Win-back customers reconnected. The PMR reports that approximately 1,000 customers returned to WSC in 2017 (reported by WSC as an estimate based on internal commercial reports).

Large commercial customers billed by metered consumption. The anticipated target was achieved as part of the NRW contract.

Of the five *outputs* listed on the Results Matrix and PMR, only the Supervisory Control and Data Acquisition system (SCADA) and the Tariff Study were completed as anticipated. The other three did not advance to the level expected: (i) the implementation of organizational restructuring activities encountered some initial opposition in 2013, from WSC personnel, mainly its labor unions, which made requests to allow employees to participate in outsourcing opportunities. More recently, the reorganization proposals are waiting for a review by the new WSC administration. Thus, results could not be achieved.. (ii) The new WSC administration is reviewing options with

respect to automated meter reading (AMR) with no actions planned in the immediate future. (iii) As explained before, only one of the two public relations campaigns was carried out.

Of the three *outcomes* registered on the PMR, two achieved their targets and one accomplished 50% of the expected number. These results illustrate the fact that the indicators developed for this component could be better elaborate to identify key measures of institutional strengthening or operational performance. Thus, in spite of the fact that small action was taken with respect to organizational efficiency, outsourcing, or employee effectiveness, the overall results were rather favorable.

Counterfactual analysis. The level of attribution of the results obtained to the activities carried out under this component can be described as follows: (i) the decrease in the annual amount of financial resources spent on staff overtime reflects efficiency gains from the installation of the SCADA system and other activities carried out under component 1. This achievement, however, constituted a rather modest improvement (25% reduction) with respect to the baseline. The fact that it was unexceptional and that it was actually exceeded by WSC makes attribution easier; (ii) the percentage of large commercial customers billed in accordance with metered consumption was possible thanks to the installation of 71 large customers meters under component 1; (iii) the number of households reported as “reconnected” constitutes an estimate provided by WSC, which could be mostly attributable to the public relations campaign conducted. The concern with groundwater pollution during floods, caused by hurricanes, is considered a factor taken into account by returning customers, as proved with the post-hurricane re-connections.

2.4.3 Specific objective 3. Rehabilitation and upgrade of sewerage infrastructure and preparation of a wastewater treatment Master plan

The sewerage infrastructure rehabilitation was the second largest component and one of critical importance from a public health and an environmental perspective. Its inclusion within the program was motivated by the fact that the existing sewerage system serves only 15% of the population and that the rest of the population uses on-site disposal systems, posing unacceptably high risks of groundwater contamination. The following activities were carried out under this component:

Wastewater Master Plan and Detailed Designs. A US\$1.1 million contract to develop a Master Plan for wastewater collection, treatment and disposal in New Providence was awarded to Adin Holdings LTD in association with HGM Consulting Engineers and Planners, and Integrated Building Systems (IBS) in December of 2013, after more than a year of delays¹⁵. The Final Report, submitted in October 2015, listed the following, as the main objectives of the plan: (i) Phasing out on-lot disposal systems, diverting sewage into centralized sewerage facilities, and providing sanitation services to about 70% of the households; (ii) Improving and increasing the capacity of existing centralized systems to cope with the projected incoming flows; (iii) Building-up new facilities to serve expanding residential areas; (iv) Strengthening the position of the WSC as the leading wastewater service provider, increasing the number of customers, restructuring and improving the sewerage infrastructure; and (v) Achieving a least-cost solution that results in an efficient sewerage system serving most of the population, while yielding public health, social and economic benefits.

¹⁵ This tendering process was started in April 2012, in a timely manner, when expressions of interest were received by WSC. Subsequently, on June 29, 2012, five firms submitted proposals out of eight short-listed, and their proposals were evaluated by WSC. On October 2012, the non-objection to award the contract was granted by IDB. WSC Board of Directors delayed approval of the contract for 14 months by raising questions about the scope of services being sought, and seeking a sole-source award.

The proposed Master Plan contained three implementation phases: (i) immediate stage (2015-2020), (ii) mid-term development (2021-2025) and (iii) long-term stage (2026-2035). The number of connections would be expanded from a current baseline of 15% of population served, to 22% in 2020, 36% in 2025, and 67% in 2035. Implementation of the Plan would require large capital investments, estimated at about US\$638 million, including the cost of house connections, or about US\$70 million, which would be taken on by the consumers. US\$79 million, or 12% of the total investment, was allocated to the first or immediate stage. This first stage was further subdivided into a smaller initial phase of approximately US\$20 million, labeled “Priority Works”, that was within reach of the limited resources available for this component. These priority works were only intended to solve critical problems and delayed maintenance, and to assure service continuity for the existing limited network.

The plan recommended a reduction in the number of drainage basins from nine to three, with three regional WWTPs located at Fox Hill, Gladstone Road, and Airport Industrial Park (AIP). Adhering to the Plan’s recommendations and taking into account the amount of resources allocated to the component (US\$15.6 million), WSC further prioritized the works to be carried out, postponing the expansion of the Gladstone Road WWTP and the construction of a combined septage and sludge treatment plant at the same location. Thus, the works included in the program were divided into: (i) a ‘major works’ contract to address the rehabilitation needs of four large pumping stations, and (ii) a ‘small works’ contract to rehabilitate 10 smaller but critical pumping stations throughout the island.

Major works. A US\$14.2 million contract for the ‘major works’ was signed on March 30, 2017, between WSC and Island Site Development Ltd. The initial bidding price was over US\$20 million, which exceeded the budgeted amount. After careful consideration, one of the five work packages, the Gladstone WWTP expansion, was postponed, thus reducing the scope of the contract. The time stipulated to carry out the works was 18 months, but an extension of the contract was granted until December 2018 due to delays in obtaining construction permits from the Ministry of Public Works. The four work packages included in this contract were: (i) Fox Hill: construction of a new PS with mechanical bar screens before injection of effluent into deep well on-site (US\$1.6 million); (ii) Malcolm Park: construction of a new PS with mechanical bar screens before injection of effluent into deep well on-site (US\$6.8 million); (iii) Lynden Pindling International Airport (LPIA): construction of a new PS with mechanical bar screens and a force main to connect LPIA to the AIP WWTP, phasing out the existing WWTP (US\$2.9 million); and (iv) Flamingo: construction of a new PS with mechanical bar screens before injection of effluent into deep well on-site (US\$2.9 million).

Due to the progress delays by the civil works during the month of September, the construction milestones could not be achieved by December 2019, and construction had to be extended to 2019 under a Special Extension of the IDB loan execution period. The works were completed in April, with a total contract cost reaching US\$16.1 million, including value-added taxes.

Small works. A US\$2.4 million contract for the rehabilitation of small pumping stations and other related work was signed on November 10, 2016, between WSC and Island Site Development Ltd. The bidding process was conducted through national competitive bidding procedures, in accordance with IDB policies. Construction started on April 18, 2017, with an intended completion date of June 30, 2017. However, the works were finished on February 20, 2018, after the initial six-month construction period was granted extensions, needed to satisfy construction delays. The ‘defects liability period’ ended on February 19, 2019. The ten pumping stations included for rehabilitation, with pumping capacities ranging from 110 IGPM to 1025 IGPM (See Annex C,

Table 6 -Pumping Stations in 'Small Works' Contract). According to the construction supervision Monthly Report (Sep. 2018), one pump and one ultrasonic level sensor were not working, and clogging of pumps have been reported at Fox Hill PS and Flamingo PS.¹⁶ The construction contractor is required to solve these problems to the satisfaction of WSC.

Construction supervision. A US\$728,000 contract was signed on November 11, 2016, between WSC and Hydroplan Ingenieur – Gesellschaft mbH to supervise both the 'major works' and the 'small works' construction contracts. The purpose of this supervision was to ensure the quality and timeliness of the rehabilitation and construction works. Consequently, the supervisor's assignment was to track progress and identify risks or potential problems that needed to be addressed. The consultant has submitted 22 monthly reports since January 2017 and will end after the completion of the 'defects liability periods. It was originally expected to end in June 2019, but it may need to be extended once again to cover one year after construction completion of the 'major works'.

Outputs and outcomes achieved by the previous activities. The outcomes and outputs achieved under the sewerage infrastructure rehabilitation component are shown on Table 2. A review of the component's **outputs** indicates that.

Lift stations. 10 pumping stations were rehabilitated and/or replaced as part of the 'small works' contract. This is equivalent to 17% of the initial target, which was set under very optimistic cost assumptions.

Collections systems and force mains. Only a relatively short 1320-ft., 8" gravity sewer, connected to the East St. Cinema PS was included in the 'small works' contract. Along with a 300 ft. force main. The gravity sewer, along Lewis Street, had 40 house connections. This is also well short (8%) of the intended target due to the aforementioned limited resources vis-à-vis the construction costs encountered.

Wastewater Master Plan. The Master Plan was developed in 2014-2015 and constituted the basis for the selection of both the small and major works financed under this component.

Wastewater treatment plants and disposal wells. Four large pumping stations and one disposal well at Malcolm Park were constructed and/or rehabilitated, as part of the 'major works' contract. It should be clarified that these facilities do not constitute conventional treatment plants, as the only 'treatment' provided at this stage is bar screening before injection into deep disposal wells. It should also be emphasized that the works under this outcome were still under construction, and therefore not operating, at the time of this report.

With respect to **outcomes**, the following observations can be made:

Households connected to improved network. An estimate of the households connected to the large and small pumping stations rehabilitated under the program (7,266), indicates that this outcome was achieved to the extent possible within the scope of the works carried out.

Wastewater flow treated. Similarly, the wastewater flow treated was estimated based on the flows handled by the four pumping stations rehabilitated within the 'major works' contract. As explained, only a preliminary level of treatment (i.e., screening) was provided at this stage, but

¹⁶ Hydroplan. Supervision Assistance for Pumping Station Construction Contract. Monthly Report 22. Sep 2018.

this initial level of treatment was considered compatible with the disposal method for a limited period of time.

Households with treated wastewater. This indicator appeared on the PMR, but not in the Results Matrix, as this new outcome (3.3) was added during the early years of implementation (2013). The indicators incorporated for this new outcome (Households with treated wastewater), were incorrect (baseline target of 62,491, and original target of 67,000). The correct baseline target should have included only households with wastewater connections under the WSC's service, as improvements in WW treatment apply to these households and not to households with other individual systems, such as septic tanks and other individual systems. The correct numbers are 8,850 and 11,700, respectively (see table 2). The households with WWT reported in 2018 are 11,300. These are households that benefitted from WWT investments in Component 3, as clearly stated in Annex B (Socio-economic Analysis Ex-post). This represents a 79% achievement of the baseline target established for the project.

Counterfactual analysis. The level of attribution of the results obtained to the activities carried out under this component, can be summarized as follows: (i) the 11,300 *households connected to an improved sanitation network* was estimated based on the sewerage systems directly impacted by the rehabilitation works carried out at 14 pumping stations. These results can be fully attributable to the Program, and not to any other activity conducted by WSC in parallel with the program; (ii) the *wastewater flows treated daily* were estimated based on the total flows handled by the pumping stations rehabilitated under this component, and therefore are fully attributable to the Program.

2.4.4 Specific objective 4. Legal & Regulatory Framework Upgrade

This component sought to contribute to the restructuring of the sanitation sector by upgrading the legal and regulatory framework, clarifying the roles of the various entities, and strengthening their capacity to comply with their new or redefined institutional objectives. Thus, it extended WSC restructuring activities, outlined under Component 2, to the larger institutional environment in which WSC operates. By doing so, it sought to promote institutional efficiency, accountability, and long-term sustainability. This project component included two major outputs

Economic and Environmental regulators' licenses. These two outcomes were not achieved. For the actual establishment of economic and environmental regulators, no action has been taken on this activity.

The achievement of these institutional/regulatory objectives is highly dependent on external factors that cannot be controlled within the timespan of this project, and with resources and capacities provided within the project design and implementation. This is especially relevant when policy and regulatory reforms need to undergo a long, uncertain and often politicized process, such as the enactment of signing of a law, which requires parliamentary approval. Under outcome 4 of the project (Legal and regulatory Framework Upgraded), the PMR encoded two end-results, whose nature and impact differ completely from other outputs in the project, which reflect measurable outcomes derived from infrastructure outputs and investments. Given this drastic difference, the evaluation performed for this component in this PCR recognizes the important contributions of several component outputs, adding three additional outcomes, direct resulting from the executed resources in this component:

Formation of an Inter-institutional Regulatory Reform Committee. This was required under the IDB loan contract to assist and oversee this process initiated by the project under the

institutional component. The Committee was established, which in itself mark an important milestone in institutional coordination.

Drafting by-laws and guidelines. A three-year, US\$249,434 consulting contract to draft by-laws and guidelines was awarded to Hunton & Williams LLP, Ferreira & Co., and SEV Consulting Group on April 1, 2014. The first report on restructuring the legal and regulatory framework was submitted on August 18, 2014. It included the proposed Utilities Regulatory and Competition Authority (URCA) bylaws, and the proposed environmental regulator bylaws for the Ministry of the Environment - MOE. The drafts were presented to the inter-institutional Regulatory Reform Committee and WSC. These drafts have been under review by the Attorney General's Office during the last three years of the program. Once approved, the consultant's contract includes a final set of activities for the application of the by-laws, including the provision of operating manuals, organizational structures, business plans, skills assessments and training plans for URCA and MOE.

Water Development Strategy with Legal/ Institutional proposals for the Family Islands. A Family Islands Water Development Strategy was prepared as part of the program in 2018. The justification underlying this adjustment to the Program outputs was based on the premise that WSC required a comprehensive analysis of water and sanitation needs in the Family Islands, supported by strategic and planning guidance in order to direct future investment to the Islands. To achieve this, resources in the amount of US\$250,000 were directed for a consulting contract, (Hydroconseil, June 2018), as part of an important institutional development and capacity building program. The consultants assessed the current situation and provided options to adequately confront technical, institutional, financial, and social bottlenecks, including the need for climate change adaptation to improve water security in the Islands. One key objective of the Strategy was to deliver a flexible approach in terms of corporate governance that allows a decentralized management of WSC's operations on the Family Island. This included recommendations that address directly the institutional-legal-regulatory requirements for interventions, as well as improved Standard Operation Procedures for the specific context in the Family Islands. A multi-step, transitional decentralisation/devolution process from the central level to the Island is proposed. The Strategy is viewed as a central piece in solving water and sanitation problems in the Family Islands, and informing national policy making regarding the sector reforms and regulatory frameworks needed, in line with the National Development Plan, specifically its Strategy 2.2. (one of the key indicators being the "reduction of the cost per unit delivery of public goods').

Counterfactual analysis. The outcomes of this component were partially achieved. The economic and environmental regulators were not approved/ licensed as a result of institutional concerns. However, several critical outcomes were generated as a result of the delivery of key instruments and mechanisms in this project component which are fully attributable to the project: a) The Inter-Institutional Regulatory Reform Committee is a permanent Committee that resulted from an elaborate coordination and convening process between national authorities, WSC and other key stakeholders. This remains as a key instrument and platform of national policy in the water sector of the Bahamas; b) The By-laws for Economic and Environmental Regulators involved a process of regulatory build-up, supported by high-level legal advice, which created a critical inter-mediate result required in the legislative process for the constitution of the regulatory and environmental regulatory bodies; and c) the Water Development Strategy with Legal/ Institutional proposals for the Family Islands is a critical result for advancing new programs and planning/regulatory instruments in the Family Islands, based on decentralized mechanism to improve effectiveness in water coverage, water quality, and water administration under WSC. The final result will only materialize during the implementation phase, with full funding.

2.4.5 Unanticipated outcomes

No unanticipated outcomes were produced under the Project.

2.5 Efficiency

A standard ex-ante cost-benefit analyses was carried out during project preparation (2011-12), centered on NRW reduction component and the sewerage infrastructure rehabilitation components.¹⁷ The results of this evaluation yielded net present values of US\$3.5 million and US\$3.0 million, respectively. The internal rates of returns were 14% and 15%, respectively. The main benefits, in the case of the NRW component, were obtained as a result of households eliminating the use of their private wells and from the value associated with increased water consumption. In the case of the wastewater infrastructure rehabilitated, the benefits were due to operating cost savings and environmental benefits. It should be also noted that, following program agreements, a service contract for a socio-economic survey was awarded to the Bahamian firm The Counsellors Ltd., on December 2, 2013. The household survey was conducted to obtain data to establish a baseline for evaluating the program's economic impact.

For the preparation of this PCR, an ex-post economic feasibility analysis was conducted for the works financed with this program. The methodology and results of this ex-post evaluation are presented in Annex B. The overall methodology updated, with actual observed data on costs and updated benefits, the estimates of the ex-ante analysis. This was carried out for components 1 (NRW) and 3 (sewage infrastructure). There was no ex-ante economic analysis for components 2 and 4. In general, unless specifically noted, some of the main assumptions established in the ex-ante analysis have been kept in this ex-post analysis. Actual project data has been obtained mainly from WSC sources and Miya Annual reports. This ex-post evaluation also incorporates some data provided by a socioeconomic survey carried out in 2014 (awarded to the Bahamian firm The Counsellors Ltd.) designed to estimate willingness to pay for the different type of works provided by the project, as well as additional data on the services provided by WSC.

The results of the ex post economic evaluation show that the program is economically feasible with rates of return above 12% and benefit cost coefficients above 1. The main results for the NRW reduction contract to address water losses in New Providence component indicate that the project is feasible from the point of view of Bahamas, with a Net Present Value of \$ 39 million, and an Internal Rate of Return of 40%, if only the IDB financed investments are considered. If we add the payments made by WSC the NPV declines to \$25.6 million, and an IRR of 29%. A comparison of the ex-ante results (adjusted to Feb. 2019 currency) with the ex-post analysis is shown in the following table. Investments plus O&M costs increased by less than 2% of the IDB program. However, when WSC investments are added, total investments costs increased by 32% in real terms. The major change is observed in the cost savings to WSC. According to these figures these savings increased from an expected \$1.8 million, to about \$26 million. This is because, since 2012, Miya has been reducing the NRW at rapid rates, while demand has barely increased, if not declined. Therefore, the savings of WSC from buying desalinated water have been substantial. Under Miya's contract, the overall measurements in water supply, billed authorized consumption and NRW improved considerably: water supply managed in the system declined by 20%, the billed domestic consumption increased by 24%, the billed non-domestic consumption increased by 87%, and NRW was reduced by 49% (in volume of water), achieving a low 23% of NRW in the entire system, that is a reduction from 6.92 mgd in 2012, to 2.0 mgd set contractually for 2019 . Data for the first 5 months of 2019 delivered by the system operated by

¹⁷ WSC Support Program -- New Providence Water Supply and Sanitation Systems Upgrade, Socio-Economic Analysis, August 2011.

MIYA already reflect an NRW level of 1.99 mgd, confirming a continued downward trend in NRW. Long-term results, however, depend on whether WSC will be able to maintain this level of performance. Given the larger availability of water, and spite of the slow incorporation of new customers to the system, benefits to consumers have increased by about 25%.

For the Wastewater Treatment Plant Upgrades and Preparation of a wastewater treatment Master Plan component, the main results indicate that the project is economically feasible with a net present value of \$ 6 million, and an Internal Rate of Return of 16%. The Benefit/Cost ratio is 1.28 which gives a somewhat large margin for unfavorable changes in the main assumptions and parameters. The IRR of the first year indicated that the project should not be postponed. The investment is recovered in year 11. A comparison of these ex-post results with the ex-ante shows that given an increase of 30% in investment costs, in 2019 present value, due to the delay of works, and a reduction of 6% of O&M savings, an increase of 501% of estimated benefits (number of households and value of the willingness to pay), relative to the ex-ante estimates, account for the feasibility of the works. The minimum increase of 167% would be needed to obtain a feasible economic result.

Table 3 presents the financial progress by outputs (*The amount disbursed during the first four months of 2019 at project closure are not reported in this progress report. The amount of \$10,009,632, to be reported under output 5 (Family Islands strategy), and outputs 3.1, 3.2 and 3.4, are pending for reporting in the PMR system.

Table 3. Financial Progress

RESULTS MATRIX													
OUTPUTS FINANCIAL PROGRESS (US\$)													
Component No.1: Non Revenue Water (NRW) Reduced								Component revised cost					
								49,550,000					
Output	Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019		
1.1	Non Revenue Water strategy developed (including baseline study)	Strategy	P	2,500,000	500,000						3,000,000		
			P (a)	2,500,000	435,155						3,000,000		
			A	2,564,845	435,155						3,000,000		
Output	Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019		
1.2	Service connections replaced, maintained	Connections	P	600,000	1,100,000	3,500,000	4,200,000	4,100,000			13,500,000		
			P (a)	600,000	2,400,000	4,820,000	2,000,000	0	129,328		12,950,000		
			A	500,000	2,400,000	7,875,705	274,295	1,770,672	0		12,820,672		
Output	Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019		
1.3	Leaks detected and repaired	Leaks	P	2,100,000	5,100,000	7,600,000	7,600,000	7,600,000			30,000,000		
			P (a)	2,100,000	7,500,000	8,840,000	9,500,000	0	411,406		31,100,000		
			A	3,250,000	7,645,138	8,289,646	10,815,216	688,594	0	1,603,722	32,292,316		
Output	Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019		
1.4	Non Revenue Water (NRW) asset management information system developed	System	P	700,000	1,000,000	300,000					2,000,000		
			P (a)	700,000	1,002,422						2,000,000		
			A	997,578	1,002,422	0					2,000,000		
Output	Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019		
1.5	Training workshops on Non Revenue Water (NRW) management	workshops	P	100,000	100,000	100,000	100,000	100,000			500,000		
			P (a)	100,000	100,000	100,000		0			500,000		
			A	100,000	100,000	0	300,000	0			500,000		

Component No.2: Water and Sewerage Corporation (WSC) Strengthened				Component revised cost								
				4,678,849								
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
2.1	Supervisory Control And Data Acquisition (SCADA) system purchased and installed	System	P	100,000	800,000	100,000						1000,000
			P (a)	100,000	620,756					1000,000		
			A	379,244	620,756	0				1000,000		
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
2.2	Automated meters reading/intelligence system for large commercial customers installed	System	P		400,000	100,000						500,000
			P (a)		400,000	500,000	500,000	500,000	500,000		500,000	
			A		0	0	0	0	0		0	
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
2.3	Public relations campaign for project and customer win-back campaign implemented	Campaign	P	200,000	350,000	350,000	300,000	300,000				1500,000
			P (a)	200,000	350,000	350,000	500,000	255,842	450,000	25,385		1699,999
			A	0	21,325	197,705	494,336	408,217	553,031	0		1674,614
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
2.4	New organizational structure implemented (including staff training)	Structure	P	400,000	600,000	600,000	400,000					2,000,000
			P (a)	400,000	100,000	450,000	600,000	205,766	242,511			1233,900
			A	290,756	81,597	123,784	251,072	244,180	242,511			1233,900
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
2.5	Tariff study for economic regulation prepared	Study	P	100,000	350,000	50,000						500,000
			P (a)	100,000	49,500	200,000	250,000	24,495	0			244,950
			A	0	0	0	220,455	24,495	0			244,950

Component No.3: Wastewater treatment plants upgraded and wastewater treatment acti													Component revised cost	
													17,063,656	
Output			Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019	
3.1	Lift stations rehabilitated/upgraded	Lift stations	P		160,000	315,000	315,000	160,000					950,000	
	P (a)			160,000	160,000	200,000	500,000	300,000	575,776		886,377			
	A			0	0	0	0	310,601	335,598		646,199			
Output			Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019	
3.2	Collection systems and force mains rehabilitated/installed	Miles	P		1,000,000	1,000,000	1,000,000	850,000					3,850,000	
	P (a)			200,000	200,000	500,000	1,000,000	1,000,000	500,000		1,000,000			
	A			0	0	0	0	500,000	292,500		792,500			
Output			Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019	
3.3	Wastewater master plan for New Providence pre	Plan	P	200,000	580,000								780,000	
	P (a)		200,000	780,000	681,557	216,067	150,959	53,641		1,132,314				
	A		0	34,393	529,540	359,533	155,207	21,396		1,100,069				
Output			Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019	
3.4	Wastewater infrastructure (treatment plants and disposal wells) rehabilitated or constructed	Infrastructure	P		2,500,000	2,500,000	2,500,000	2,500,000					10,000,000	
	P (a)			220,000	818,443	0	2,100,000	4,000,000	11,198,870		14,044,965			
	A			0	0	0	0	2,846,095	7,210,220		10,056,315			

Component No.4: Legal and regulatory framework upgraded					Component revised cost							
					1,500,000							
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
4.1	Draft legislation presented	Legislation	P	50,000	200,000							250,000
			P (a)	50,000	200,000	230,000	217,500	204,536	0	130,271	250,000	
			A	0	0	12,472	0	0	107,257	0	119,729	
Output		Unit of Measure		2012	2013	2014	2015	2016	2017	2018	2019	EOP 2019
4.2	Regulators established	Regulators	P		100,000	900,000	1,150,000	600,000				2,750,000
			P (a)		120,000	500,000	250,000	500,000	0	1,250,000	1,250,000	
			A		0	0	0	0	0	0	0	

Other Cost												
		Output		2012	2013	2014	2015	2016	2017	2018	2019	Cost
		Engineering and supervisory services	P	220,000	400,000	400,000	400,000	400,000				1,820,000
			P (	220,000	455,043	387,480	500,000	261,150	300,000	559,652		1,308,827
			A	0	250,618	180,132	125,044	86,150	107,231	502,277		1,251,452
		Audits	P	24,000	24,000	24,000	24,000	24,000				120,000
			P (	24,000	30,000	37,500	7,500	9,000	6,000	9,000		50,339
			A	0	7,500	7,415	8,509	8,939	8,976	11,621		52,960
		Monitoring and Evaluation	P	22,000	22,000	172,000	22,000	222,000				460,000
			P (	22,000	145,000	160,000		0	0	25,000		154,631
			A	0	26,283	103,348	0	0	0	230,511		360,142
		Contingencies	P			1,040,000	1,040,000	1,040,000				3,120,000
			P (a)			700,000	1,005,000	1,420,000	0	0		0
			A	0		0	0	0	0	0		0
		Financial charges	P	480,000	480,000	480,000	480,000	480,000				2,400,000
			P (	480,000	500,000	760,006	500,000	600,000	566,171			2,400,000
			A	47,845	242,894	365,395	591,263	586,432	10,721			1,844,550
Total Cost												
	Output			2012	2013	2014	2015	2016	2017	2018	2019	Cost
	Total Cost		P		7,796,000	15,766,000	19,531,000	19,531,000	18,376,000			81,000,000
			P (a)		7,796,000	15,767,876	19,894,986	16,746,067	7,731,748	7,959,057	14,273,954	76,706,302
			A		8,130,268	12,868,081	17,685,142	13,439,723	3,972,886	4,707,819	10,186,449	70,990,368

2.6. Sustainability

a. General Sustainability Aspects

The program sustainability evaluation was based on a review of institutional, financial, social, and environmental aspects, and takes into account potential obstacles or impediments for a proper operation of the water and wastewater facilities, equipment and other program investments, as well some assets present at WSC as a result of the implementation of the Program that contribute to the Program sustainability. The possible risks can be endogenous or exogenous to WSC, and therefore include those related to the water and sanitation sector's legal framework. It should also be recognized that the risks exhibit various probabilities of occurring and different impact severities on future WSC operational activities.

Institutional and governance risks. *'Institutional strengthening'* and *'upgrading of the legal and regulatory framework'* were the components with less progress when their accomplishments were measured against their anticipated outcomes. They had been included in the program to enhance WSC's operational efficiency, institutional autonomy, level of accountability, and long-term sustainability. The existence of a modern regulatory framework was also considered highly desirable, based on international best practices, as it would enable specialized and independent regulation of economic aspects and overseeing of service quality. From an institutional and governance perspective, the shortcomings experienced by these two components could pose a moderate risk to maintaining suboptimal management conditions, or in delaying needed reforms. This could in turn negatively affect WSC's financial and operating capacity to properly operate and maintain the equipment and facilities built or installed under the NRW reduction and the wastewater infrastructure rehabilitation components.

As explained, key components of the NRW reduction strategy included proactive leak detection, expeditious repairs, proper maintenance, adequate pressure control, selective service line and mains replacement, and careful asset management. These tasks may become harder to accomplish once the NRW reduction contract winds down and WSC acquires a larger share of 'maintenance' responsibilities that, thus far, had fallen on the private contractor. The leak-repairing task illustrates the challenges that WSC may have to address in the immediate future. Since April 2017 WSC has taken over the responsibility of repairing all leaks (identified by Miya), replacing service lines, and carrying out disconnections in accordance with the Service Level Agreement (SLA) negotiated with the contractor. The SLA requires WSC to repair 95% of all leaks within 2 working days and the remaining leaks within 5 working days. Failure to achieve those targets increases the leak run-time and adversely affects the volumes of NRW and average pressures reached. Preliminary results obtained after leak repairing activities were transferred to WSC indicate that this work has not been fully satisfactory, pointing to the need to review WSC's performance and, if necessary, allocate more manpower and/or proper materials to this critical task. In 2019, the NRW target will become 2.0 MIGD at an average system pressure of 25.0 psi. This challenging target will be harder to reach and maintain if WSC does not strengthen its field operations.

Financial risks. As explained before, the absence of an independent economic regulator, such as the Utilities Regulatory and Competition Authority (URCA), creates unfavorable conditions that could result in further delays in tariff adjustments, with deleterious effect on WSC's revenues, and inadequate signals to customers on the real costs of drinking water provision. As already stated, the current tariff regime has not been adjusted since 1999 in spite of the increases in the costs of production and distribution. The need for yearly Government transfers, to offset low revenues,

decreases WSC's necessary autonomy and readiness to address operational and administrative challenges in a timely and effective manner. Two examples of the financial challenges that WSC may have to address in the near future are: (i) The frequent appearance of grey PVC pipes throughout New Providence, a material that was not supposed to be used as conduit for pressurized water and, thus, has been repeatedly failing. According to preliminary estimates 176,000 feet of sub-standard PVC piping, with 8,500 feet considered as of a higher priority, would need to be replaced. (ii) The Wastewater Infrastructure Management Master Plan, developed as part of Component 3, contained three implementation phases to increase network's range to 67% of the population by 2035. Implementation of the plan will require substantial capital investments, estimated at US\$638 million.

Social and environmental risks. The use of private wells, combined with the use of individual septic systems for wastewater disposal, causes some social and environmental concerns in the long-term. The risks of contaminating groundwater resources, especially those shallow aquifers used by large segments of the population as sources of untreated drinking water, still poses risks. Since the current public sewerage networks cover only 15% of the New Providence population, there is a need to expand this infrastructure, as recognized by the Master Plan, but at a significant cost, as previously mentioned. Alternatively, the reach of the potable water distribution network could be more effectively expanded to try to insulate the areas of New Providence most vulnerable to groundwater contamination (due to higher population density or other factors). One aspect that curtails this network expansion is the water quality problem described as 'red' or 'rusty' water caused by chemically aggressive water, from RO plants, flowing through old scaled pipes. This condition is not well received by customers, driving many of them to install private wells. It seems that if WSC aspires to grow its customer base, to help protect vulnerable population against groundwater pollution, it would need to confront this issue in a comprehensive and determined manner.

b. Environmental and Social Safeguards

The main stakeholders of this operation were the residents of New Providence that are WSC customers, as well as the commercial establishments and public and private institutions whose water is supplied by WSC. These stakeholders had been negatively affected by the problems derived from lack of pressure, insufficient volumes and 'rusty' water. Therefore, they had a great interest in supporting improvements to the system. The Environmental and Social Assessment (ESA) prepared before approval considered measures to minimize construction impacts, which were generally applied. The main environmental and social difficulties encountered by the program occurred during the construction phase, which entailed street closings, trench excavation, dirt removal, noise, dust, pipe and equipment installation, and other potentially disturbing activities. These temporary impacts were addressed in a generally satisfactory manner through the corresponding construction contracts, by requiring adequate mitigation measures.

III. NON-CORE CRITERIA

3.1 Bank Performance

The Bank's performance assessment took into account two stages in the program's preparation and execution process: (i) Bank performance in ensuring quality at entry and (ii) quality of Bank supervision during execution. The quality at entry was considered satisfactory based on the following observations: (i) the Bank facilitated the preparation of this operation through a Technical Cooperation (ATN/WP-11596-BH) in 2009-2010 to formulate an update of the legal and regulatory framework. (ii) It also accepted retroactive financing for the preparation of WSC's Organizational Restructuring Strategy, which was being carried out by specialized consultants at

the time of project approval. (iii) The risk assessment conducted adequately identified most of the obstacles later encountered, although it fell short on identifying effective mitigation measures. (iv) The monitoring and evaluation plan, composed of an Operations Manual, annual operations plans (AOP), MIYA's semi-annual and final progress reports (a total of 11 in the Project File), Results Matrix, PMR, etc., although fairly standard in IDB operations, seemed adequate for this specific operation. Thus, the shortcomings encountered during execution seemed to be more a result of changing political climate, unavoidable in seven-year operations, than a product of an inadequate recognition of the complexity of some the components and the potential difficulties that could emerge.

During the government transition, the Bank provided critical support to the incoming administration and helped lift the profile of the WSC as a critical player in the water sector. The Bank assisted WSC in the organization of its "Water and Sewerage Corporation Business Plan Workshop" (October 2017) that laid the ground for strategic decisions and the continuous support to the Project. Also, the Bank managed to incorporate into the Project the development of a Strategic Plan for the Family Islands, a new output that proved critical to address the needs of the underserved and critically important Islands.

Finally, the Bank proactively identified the need for some actions to improve WSC's position during the last stage of its contractual agreement with MIYA. This involved facilitating discussions and agreements for MIYA to provide the necessary training to the WSC staff ahead of the pre-established plan, instead of waiting until the last year of the contract. MIYA collaboration to this end was very positive, as so was the Management team at WSC.

3.2 Borrower Performance

WSC's General Manager was very supportive of the program. The management and technical team at WSC was receptive, proactive and responsive to the different needs of the project. The Program Executing Unit (PEU) established by WSC included a Program Manager and two senior engineers. WSC established a Program Executing Unit (PEU) composed with a Program Manager (PM) and senior engineers. However, during the last four years the PEU did not retain a Program Manager (PM), although WSC's General Manager was by and large supportive of the program. The absence of a PM for such an extended period of time constituted a managerial weakness, which created operational delays in some of the components. Overall, the borrower's performance was satisfactory. There was full compliance with the monitoring and evaluation mechanisms required under the contractual agreement.

IV. FINDINGS AND RECOMMENDATIONS

A set of findings and recommendation are presented in Table 4. A summary of such findings is presented for each dimension as follows:

4.1 Technical – Sectorial Dimension

- The NRW reduction levels achieved between 2012 and 2017 were significant and constitute the single most important accomplishment of the program. They reflect the overall success of the NRW reduction strategy.
- The key elements of the strategy were proactive leak detection, rapid repairs, use of adequate materials, pressure management, selective replacement of network elements, disconnection of inactive service lines, large customer metering, and asset maintenance.

Other essential components were hydraulic modeling, system optimization, GIS updating, SCADA, and the use of data management hardware and software (NETBASE).

- WSC has been experiencing water quality problems in the distribution network, commonly known as 'red' or 'rusty' water. These have been caused by the change in water sources from underground wells (hard water) to reverse osmosis (desalination) plants. This problem has hampered WSC efforts to improve its corporate image, and hindered project activities such as the public relation efforts to win-back customers. WSC is aware of this issue and has been considering affordable post-treatment solutions.
- The three-phase Master Plan developed under component 3 proposes an expansion of the sewerage network from 15% of the population currently served to 67% by 2035. Implementation will require substantial capital investments which are beyond the scope of the program. The wastewater infrastructure rehabilitation works conducted under the program only addressed the most critical problems to assist continuity of service.

4.2 Organizational and Managerial Dimension

- WSC's operating cost recovery, one of the program's impact indicators, revealed an improvement from a baseline of 61% to 71% in 2017. While this represents significant achievement, it did not reach the 80% target.
- The organizational restructuring activities, planned under the institutional strengthening component, included the development of a comprehensive strategy to make WSC a more efficient and sustainable company. However, no significant changes were introduced on this matter.
- The program did not achieve the creation and/or activation of independent entities to function as economic and service quality regulator in one case, and as environmental regulator in the other.
- WSC established a Program Executing Unit (PEU) composed a Program Manager and two senior engineers. However, during the last four years the PEU did not retain a Program Manager (PM), although WSC's General Manager was by and large quite supportive of the program. This managerial weakness could have contributed to achieve less results than expected..

4.3 Processes and Actors Dimension

- A technical consulting firm was hired to provide WSC objective, third-party review of the performance displayed by the NRW reduction contractor. Although the purpose of the consultancy was justified, the periodic supervision could have been more frequent since there were few field visits planned (one per semester), which did not result in an effective engagement with day-to-day tasks and activities. Nonetheless, WSC's capacity to directly supervise all NRW reduction activities were notable. It is recommended that the mechanics of this type of supervision contract in similar future projects be carefully analyzed to optimize their value added.

4.4 Fiduciary Dimension

- The use of a long-term performance-based contract significantly contributed to the outcomes under component 1, as it entrusted the most crucial activities of the strategy to the contractor. However, for greater efficiency these needed to have been done within

administrative decisions with the program's objectives in mind and within the timeline required.

4.5 Risk Management Dimension

- The program's Risks Matrix identified 11 potential risks associated with the execution of the four components. Two risks, related to component 4, were classified as "high" based on their probability of occurrence and potential impact: (i) *"Legislature approval is delayed"* and (ii) *"Independent economic and environmental regulators are not established"*. Two additional risks, associated with component 2, were classified as "medium": (i) *"Win-back strategy does not work"* and (ii) *"WSC is not prepared to operate in a regulated environment"*. Based on the program results, it can be concluded that the matrix reasonably assessed the potential problems that the program could encounter, accurately anticipating the challenges experienced. It is also clear that the 'mitigation measures' offered by the Risk Matrix were not sufficiently effective to surpass the difficulties confronted during execution.

4.6 Lessons Learned

- This program has highlighted the importance and effectiveness of comprehensive NRW reduction approaches, that include: (i) detailed and quantitative analysis of the problem, (ii) development of a complete water loss reduction strategy, (iii) the assiduous implementation of all tasks within the strategy, (iii) the necessary maintenance of assets, (iv) the training provided to the operator's staff, and (v) an effective network management system. It should be pointed out, however, that local factors might have been instrumental in leading to the success reported within the program. Among them: (i) the extensive previous work on the topic, which provided sufficient knowledge of the drinking water supply system to utilize a results-oriented, performance-based, long-term contract; (ii) high levels of users with metered consumption and reasonably good macro-metering of the sources of water, which facilitated calculations under the IWA methodology; (iii) high levels of NRW; and (iv) high cost of water.
- Institutional strengthening activities involving significant utility reorganization, outsourcing and employee effectiveness programs tend to be controversial and therefore difficult to implement. They required a minimum level of consensus among upper management, technical staff, workers unions, and sometimes, external actors, such as the overseeing government entities. It is also risky to leave intermediate targets undefined, dependent on unfinished studies, even if the latter are to be financed by the corresponding program or project. It seems that a more gradual approach, with pre-agreed priorities and milestones, would be a more realistic, if protracted, strategy.
- The introduction and approval of national legislation as part of an IDB investment program or project is exceedingly risky, as it requires significant political will to be maintained over a relatively long period of time. In the case of this program, two national elections were held over the seven-year period, precipitating the need to familiarize new administrations with the program objectives and goals. The new administrations often turn these 'reviews' into instruments to indefinitely delay action on critical elements of a program, thus undermining their execution. However, the advances generated as a result of component 4 of this project are recognized as very positive, as it created critical mechanisms and instruments without which are critical for completing the full regulatory process, from creating the institutional process for convening actors and coordinating decisions, to designing and putting into place the By-laws required for regulatory adoption.

Table 4
Findings and Recommendations

Findings	Recommendations
Dimension 1: Technical and Sectorial	
Finding # 1: The NRW reduction levels achieved were significant and constitute the single most important accomplishment of the program. They also reflect the overall success of the NRW reduction strategy. In 2019, the NRW level was reduced to 2.00 MIGD, once average water pressure and the impacts of delays on leak repairs were taking into consideration. Key elements of the strategy were proactive leak detection, rapid repairs, use of adequate materials, pressure management, selective replacement of network elements, disconnection of inactive service lines, large customer metering, and asset maintenance. Other essential components were hydraulic modeling, system optimization, GIS updating, SCADA, and the use of data management hardware and software (NETBASE).	<p>Recommendation # 1: In similar future projects, IDB should require that NRW service contract agreements (including obligations under de Service Level Agreement (SLA) consider all the necessary training and assistance to the operator for the adequate allocation of manpower and materials for all NRW reduction activities, including sufficient attention to, and resources for leak repairs and service line replacement. This, in order to maintain and/or improve the NRW levels attained.</p> <p>Recommendation # 2: In similar future projects, IDB should emphasize the importance of possessing detailed and comprehensive NRW reduction strategies, which should be applied and actively supported over a substantial period of time in order to assure successful results.</p>
Finding # 2: The 6.0 ILI value (infrastructure leakage index) for New Providence falls already within a more acceptable WBI's "B" Band (within the ILI range for developing countries, that is ILI= 4 to 8).	Recommendation # 3: In similar future projects, IDB should require that during the last phase of implementation enough resources are allocated for building-up of the in-house capacities once the private contractor's obligations are completed. Based on the results of the project, there is still room for additional NRW reduction in the New Providence water distribution system which will be WSC's responsibility after Miya's contract ends. This based on the infrastructure leakage index (ILI), and the WBI Bands, especially Band "B" establishes that potential for marked better improvements, pressure management, better active leakage control practices and better network maintenance.
Finding # 3: WSC has been experiencing water quality problems in the distribution network, commonly known as 'red' or 'rusty' water. Although this problem has been reduced to some extent thanks to leak repairs and improvements in the	Recommendation # 4: In similar future projects, IDB should require that any partial results achieved in water quality improvements be adequately reported and communicated to all relevant stakeholders and customers. This should be done

network, the “rusty water” problem has not been eliminated totally. Some post-treatment solutions have been considered by WSC to achieve full results. Even with partial positive results, not enough effort was made to report and communicate the improvements achieved in water quality has hampered WSC efforts to improve its corporate image, and hindered project activities such as the public relation efforts to win-back customers. WSC is aware of this issue and has been considering affordable post-treatment solutions.	through directly, systematically and methodically supported by specialized and experienced technical assistance and with sufficient allocation of resources.
Finding # 4: The Wastewater Management Master Plan developed under component 3 proposes an expansion of the sewerage network from 15% of the population currently served to 67% by 2035. Implementation will require substantial capital investments, estimated at about US\$638 million. The wastewater infrastructure rehabilitation works conducted under the program, with investments of the order of US\$20 million, only addressed the most critical problems to assist continuity of service.	Recommendation # 5: In similar future projects, and when working on the attainment goals that that are part of a broader sector plan (such as city-wide master plan) IDB should adopt a results framework that is realistic with the investments provided, specifying how the operation will “contribute” to the broader goal, commensurate with the financial and technical resources mobilized. If possible, the Bank should guide the client in the development of a realistic financial strategy to confirm the viability of the development stages indicating the specific contributions of the Bank operation at any specific stage.
Dimension 2: Organizational and Managerial	
Finding # 5: WSC’s operating cost counterfactual, one of the program’s impact indicators, revealed an improvement from a baseline of 61% to a value of 71% in 2017. However, the progress reported did not reach the 80% target, illustrating the persisting weak financial state of the company.	Recommendation # 6: In similar future projects, the Bank should develop specific technical assistance-policy support products (as project support) aligned or in tandem with the loan operation. Tariff and institutional restructuring studies should be developed ahead of –or in parallel-- of the loan operation, providing de adequate framework for financial sustainability of the new investments.
Finding # 6: The organizational restructuring activities, planned under the institutional strengthening component, included the development of a comprehensive strategy to make WSC a more efficient and sustainable company. Regrettably, no significant changes were introduced on this matter.	

Finding # 7: The inability to support the creation and/or activation of independent entities to function as economic and service quality regulator in one case, and as environmental regulator in the other, constitute unaccomplished program results.	Recommendation # 7: The continuation of the efforts to more effectively reorganize the sector institutions, as well as to promote autonomy and accountability from the service provider, remain desirable objectives that should be pursued with or without an international support.
Finding # 8: WSC established a Program Executing Unit (PEU) composed with a Program Manager (PM) and senior engineers. However, during the last four years the PEU did not retain a Program Manager (PM), although WSC's General Manager was by and large supportive of the program. The absence of a PM for such an extended period of time constituted a managerial weakness that may have contributed to the modest results of two of the program components.	Recommendation # 8: The Bank should adopt contingency measures, agreed upon with the client, to maintain the Program Management functions of the program being executed when the client's management structure undergoes changes.
Dimension 3: Public Processes and Actors	
Finding #9: A technical consulting firm hired to provide WSC objective, third-party review of the performance displayed by the NRW reduction contractor was clearly justified, but the manner in which it was carried out and fell short of expectations. This may have occurred because of the generally satisfactory performance of the NRW reduction contract, or because of the periodic nature of the field visits planned, or because of WSC's capacity to directly supervise NRW reduction activities.	Recommendation # 9: The Bank should analyze carefully the goal and mechanics of this type of supervision contract in order to optimize their value added in similar future projects
Dimension 4: Fiduciary	
Finding # 10: The use of a long-term performance based contract significantly contributed to the positive outcome under the NRW reduction contract, as it entrusted the most crucial activities of the NRW strategy to the contractor, insulating these tasks from administrative decisions that may not always be made with the program's objectives in mind or within the timeline required.	Recommendation # 10: For similar future projects, the Bank should consider the use of this type of contract to better guarantee well-coordinated and timely execution.

Dimension 5: Risk Management	
<p>Finding #11: The program's Risks Matrix identified 11 potential risks associated with the execution of the four components. Two risks, related to component 4, were classified as "high" based on their probability of occurrence and potential impact, and two additional risks, associated with component 2, were classified as "medium". Based on the program results, it can be concluded that the matrix reasonably assessed the potential problems that the program could encounter.</p>	<p>Recommendation # 11: The Risk Matrix accurately anticipated the challenges experienced by the program during execution. A greater effort should be directed to identifying, during project preparation, effective 'mitigation measures.</p>