



REPÚBLICA DE MOÇAMBIQUE  
Ministério das Obras Públicas,  
Habitação e Recursos Hídricos  
Gabinete do Ministro

# Priority Project Summary

# Nonrevenue Water Reduction in Metro Maputo

## Ongoing Activities and Future Options

August 2021

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# 01 Need for the Project

## Brief background to nonrevenue water in Mozambique

Nonrevenue Water (NRW) is the volume of water supplied into the network that does not generate revenue. It either does not reach the customer due to leakage (physical loss) or is consumed but not billed (commercial loss).

The issue of NRW has a significant impact on all FIPAG operations throughout Mozambique. These impacts are both technical and financial in nature and vary from city to city in their severity. In 2020, it was estimated that NRW resulted in 100 million m<sup>3</sup> of lost water for FIPAG (51% NRW) at a value of circa. US\$ 56 million based on average costs of water production and billed consumption for each city.

In Metro Maputo alone, there was an estimated 46 million m<sup>3</sup> of NRW (56%) valued at US\$ 30 million in 2020 with the losses roughly split evenly between physical loss and commercial loss.

As a priority, it is critical that the ROC's (Regional Operating Companies), reduce NRW in Metro Maputo to improve financial sustainability and deliver a quality service to their customers. The phased targets are to reduce NRW to 33% (27.4 million m<sup>3</sup>) by 2024, and 25% (20 million m<sup>3</sup>) by 2030; an indicative saving of US\$ 17 million/year.

These interventions can then be upscaled at a national level

## Metro Maputo service area (2020)

- 255,000+ active customer connections of which 40,000 are unmetered
- 82 million m<sup>3</sup> of treated water supply
- 36 million m<sup>3</sup> of billed water with a 82% collection ratio
- 21 million m<sup>3</sup> of leakage valued at US\$ 15.5 million
- 25 million m<sup>3</sup> of commercial loss valued at US\$ 14.5 million

# 01 Need for the Project

## IWA Water Balance in Quantity and Estimated Value

Metro Maputo Water Balance 2020				
System Input Volume  82 million m <sup>3</sup> /year	Authorized Consumption 37 million m <sup>3</sup> /year (45%)	Billed Authorized Consumption 36 million m <sup>3</sup> /year (44%)	Billed Metered Consumption 22 million m <sup>3</sup> /year (27%)	Revenue Water 36 million m <sup>3</sup> /year (44%)
			Billed Un-metered Consumption 14 million m <sup>3</sup> /year (17%)	
		Unbilled Authorized Consumption 0.68 million m <sup>3</sup> /year (1%)	Unbilled Metered Consumption 0.64 million m <sup>3</sup> /year (0.8%)	Nonrevenue Water (NRW) 46 million m <sup>3</sup> /year (56%)
			Unbilled Un-metered Consumption 0.04 million m <sup>3</sup> /year (0.04%)	
	Water Losses 45 million m <sup>3</sup> /year (55%)	Apparent Losses 24 million m <sup>3</sup> /year (29%)	Unauthorized Consumption 9 million m <sup>3</sup> /year (11%)	
			Meter and Data Errors 15 million m <sup>3</sup> /year (18%)	
		Real (Physical) Losses 21 million m <sup>3</sup> /year (26%)	Leakage on Network Pipes 10 million m <sup>3</sup> /year (12%)	
			Leakage at Reservoirs 1 million m <sup>3</sup> /year (2%)	
			Leakage on Service Connections 10 million m <sup>3</sup> /year (12%)	

NRW Component	Estimated Value (US\$/year)
Unbilled authorized consumption	3.4 million
Unauthorized consumption	12 million
Meter and data errors	20 million
<b>Total commercial loss</b>	<b>35.4 million</b>
Leakage on network pipes	6.5 million
Leakage at reservoirs	0.5 million
Leakage on service connections	6.5 million
<b>Total physical loss</b>	<b>13.5 million</b>
<b>Total Nonrevenue water</b>	<b>47.9 million</b>

# 02 Root cause and rationale for actions

## Root Cause

- Obsolete network resulting in constant breaks / leaks;
- Under-reading and/or damaged customer water meters;
- Water theft via insecure points of supply
- Ease of making illegal connections and lack of detection / consequence
- High number of suspended customers with old debts
- Inconsistency of meter read and billing
- Lack of planned maintenance with quality interventions, including proactive leak detection
- Lack of knowledge and institutional capacity to manage NRW

## Rationale for actions

The water supply system of the Maputo Region currently presents high losses of around 56%. This negatively impacts the quality of service, deprecates the brand image and significantly contributes to the unsustainability of the water utility. Reducing NRW will:

- Free up an estimated 30% of the leaked water for supplying new customers to help achieve the 100% coverage target by 2030
- Contribute to a safe and continuous supply of water for all customers
- Reduce operational costs through reduced energy and chemical consumption
- Improve the environmental resilience of the water supply via reduced abstraction
- Increase revenues to provide financial sustainability
- Improve the brand image both locally and in the African context
- Induce and accelerate sound social wellbeing and economic development
- Enable an efficient way of managing the water system through the expansion of hydraulic zones

# 03 Project actions

- In 2019 AdeM created an Accelerated and Integrated Loss Reduction Program – PAIRP 2020/2024
- Pillar 2 of PAIRP is to reduce NRW to 33% in 2024 with a medium-term goal of 25% by 2030

## Present constraints

More understanding needed of the magnitude, cost and causes of NRW to make reductions in a prioritized and effective way. This is from a combination of poor technical capacity and insufficient funds to repair, replace and maintain infrastructure. Institutionally, there is a lack of managerial accountability and focus on NRW with a general unawareness from staff that NRW is everybody's responsibility.

## Technical solution

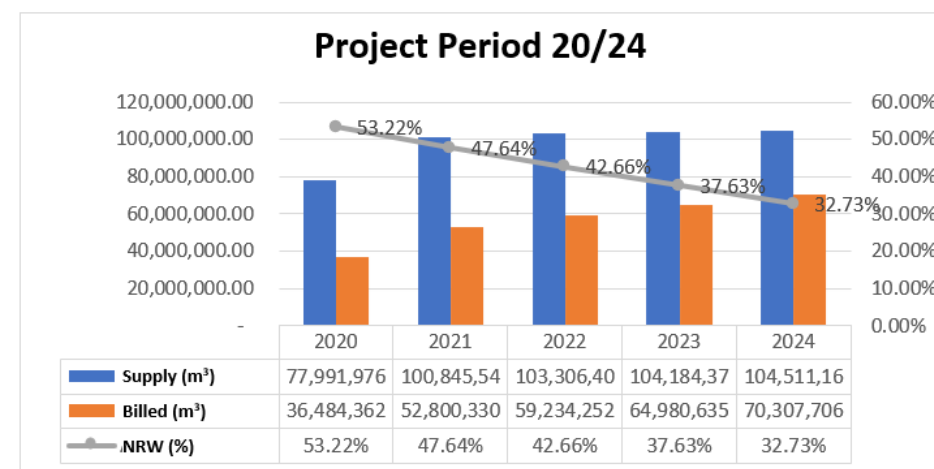
There are five components to Pillar 2 for reducing NRW:

1. Actions to reduce physical loss
2. Actions to reduce commercial loss
3. Loss reduction technologies
4. Improved bulk water metering
5. Training / capacity building

## Financing Options

There are 2 financing options:

1. The ROC receives external investment and pays back the loan through in-house NRW reduction interventions
2. A NRW Performance Based Contract (NRW-PBC) is initiated with DMAs constructed using a Bill of Quantities and the NRW reduction payment being performance based (Design, Build, Operate and Maintain type with staff training and knowledge transfer to ensure sustainability)



# 04 Project details

## Intervention Approaches

### 1. Reduce physical loss (leakage)

Recovery of 12 million m<sup>3</sup>/year of lost water will directly improve customer service quality via expansion of water to critical areas and increased distribution hours.

- Repair of 4 leaking reservoirs (Machava, Matola, Belo Horizonte and Tsalala)
- Rehabilitation/Reconstruction of Cell 2 of Maxaquene Reservoir
- Replacement of 61 km of obsolete network pipes and 90km extension of the piped network
- Decommissioning 11.4 km of overlapping network and the transfer / rehabilitation of 7,285 connections
- Intensified leak repair campaigns called "Zero Losses"

***Estimated Cost: US\$ 13,500,000***

### 2. Reduce commercial loss

The recovery of 14 million m<sup>3</sup>/year of unbilled water will directly improve FIPAG's financial sustainability.

- Recover 32,990 suspended customer debt and install 53,097 new connections
- Replace 143,634 old revenue meters and install 24,512 Prepaid meters
- Campaign for dismantling / conversion of illegals into legal, called "Zero illegal" initiative
- Automated meter reading and billing system

***Estimated Cost: US\$ 35,400,000***

1. Leak repair campaign
2. Geographically located leak detection and repair teams
3. Planned maintenance
4. Centralized control centre to manage leak reduction

1. Community involvement
2. Zero tolerance for illegal connections and water theft
3. Media campaigns
4. Introduce SAP system
5. Geo-tag customers to GIS to billing system



# 04 Project details

## 3. Loss reduction technologies

To improve the efficiency and effectiveness of NRW intervention activities.

- Design and implement telemetry and SCADA systems
- Hydraulic modelling of the network system to identify water losses
- Creation of 16 hydraulic management zones to accompany the 25 existing zones
- Implementation of other initiatives associated with loss technologies

**Estimated Cost: \$US 2,525,000**



## 4. Improved bulk water metering

To improve the management of system input flows and reduce commercial loss arising from large customer meters.

- Monthly inspection of 323 large customer meters
- Periodic flow measurement of 67 inlet and outlet meters
- Calibrate bulk water meters and replace 150 damaged large customer meters
- Installation of 20 zone meters for network sectorization and 45 ultrasonic meters in the transmission pipes
- Repair of damaged bulk water meters

**Estimated Cost: US\$ 2,500,000**



# 04 Project details

## 5. Training and capacity building

Human capital is the main asset and key player for successfully reducing NRW, and differing levels of training will be delivered to all employees.

- Training for front-line staff on reducing physical and commercial losses
- Training on the technological component of loss reduction (hydraulic modelling; design, management and monitoring of zones)
- Leadership training for Senior Management
- Company-wide lectures on the awareness and improvement of water losses "my role in reducing losses"
- Peer-2-Peer / Peer-2-Mentor exchange visits for NRW management

***Estimated Cost: US\$ 800,000***

### Estimated Project Cost

Component	Budget
Physical Loss Reduction	\$13,500,000
Commercial Loss Reduction	\$35,400,000
Management Technologies	\$2,525,000
Bulk Flow and Large Customer Meter Measurement	\$2,500,000
Training & Capacity Building	\$800,000
<b>Total</b>	<b>\$54,725,000</b>



Launch of the FIPAG training academy with IHE Delft, 2018

# 05 Outputs & Outcomes

Reducing NRW in Metro Maputo is a priority project as its technical outcomes are far reaching across both the organization and their customers. The benefits will also be felt socially and environmentally in the provision of SDG-6 supply of safe and sustainable water to an expanded service area.

Outputs: Year 2030 with NRW at 25%	Outcomes - Technical	Outcomes – Social & Environmental
<ul style="list-style-type: none"><li>• Up to 35,000m<sup>3</sup>/day additional water available to either serve new customers or reduce water supply</li><li>• Coverage increased by 30% @100l/cap/day</li><li>• Increased hours of supply and system pressures with a reduced risk to water quality</li><li>• Increased financial stability (US\$17m/year)</li></ul>	<ul style="list-style-type: none"><li>• Increased efficiency, sustainability and effectiveness in water supply services</li><li>• Improved financial stability</li><li>• Opportunity for private sector participation in NRW-PBCs</li><li>• Improved operational processes</li><li>• Improved organizational capacity and skilled workforce</li></ul>	<ul style="list-style-type: none"><li>• Improved access to water for approximately 100,000 people through up to 30% of the saved leakage being able to supply new customers</li><li>• Improved health and well-being for residents</li><li>• Reduction in water scarcity as a barrier to economic development and poverty reduction</li><li>• Improved climate resilience to reduced availability of water</li><li>• Financial savings can be passed onto customers as reduced or introduction of pro-poor tariffs</li></ul>

## Main benefits

- Up to 35,000 m<sup>3</sup>/day additional water with ability to expand supply into urban areas
- 100,000 additional inhabitants benefit from receiving clean and affordable water
- Significant improvement in water service resilience even during extreme events
- US\$17m p.a. additional revenues / cost savings for the water company

# 06 Main tasks and timeframe

Pillar 2 of PAIRP – the NRW reduction program for Metro Maputo has been mapped out along with the expected budget distribution. The program has been delayed and the anticipated start date is 2022 subject to sufficient finances being available.

In addition, FIPAG has also developed a high level budget for other prioritized cities in Mozambique.

Other prioritized cities

Strategic Objective	Strategic Actions	Capital Investment ('000s)									
		2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Reduce authorized unbilled consumption	Install flow meters for measuring fire-fighting, parks etc	300	500	500							1,300
Reduce apparent losses (illegal connections, theft + billing and metering errors)	Define and implement a commercial audit plan	50	100	100	100	100	50	50	50	50	650
	Install automated meter read and billing systems; meter replacement program; implement illegal disconnection / prepaid meter campaign	500	500	500	870	720	500	200	200	200	4,190
Reduce real losses (leaks in the transmission and distribution pipes + storage tanks and reservoirs + service connection pipes	Install equipment to measure and monitor physical losses	500	750								1,250
	Install DMAs with a Telemetry system to monitor, evaluate and improve performance	3,450	3,100	2500	2000						11,050
	Field audits to locate and repair visible leaks and perform pressure control.	125	125	125	125	125	125	125	125	125	1,125
	Proactive leak detection equipment and materials	2,700	4,700	3,700							11,100
	Leak detection and repair teams + training / capacity building	790	790	790							2,370
Total		8,415	10,565	8,215	3,095	945	675	375	375	375	33,035
Grande Maputo				51,700	515	510	500	500	500	500	54,725
Total NRW Investment ('000s)											87,760

# 07 Risks & Mitigations

As part of developing the Metro Maputo NRW project, FIPAG analysed the potential risks and identified possible mitigation measures.

Issue	Risk	Mitigation
<b>Technical</b>		
Lack of capacity within FIPAG/ROCs to: <ul style="list-style-type: none"> <li>• Undertake technical tasks</li> <li>• Identify operational issues &amp; constraints</li> <li>• Streamline administration and procurement procedures</li> <li>• Build DMAs (not included in the NRW strategy)</li> </ul>	Delay to project implementation <b>High Risk</b>	<ul style="list-style-type: none"> <li>• Identify constraints</li> <li>• Provide support as needed</li> <li>• Include DMA design, build and operate</li> <li>• Potential NRW Performance Based Contract – likely to be attractive to the private sector</li> </ul>
<b>Financial</b>		
Failure to secure funds for: <ul style="list-style-type: none"> <li>• Project procurement phase</li> <li>• Project delivery</li> </ul>	Delay to project development and delivery <b>High Risk</b>	<ul style="list-style-type: none"> <li>• Identify scale needed</li> <li>• Secure adequate resources</li> <li>• Streamline procurement to remove or transfer constraints</li> </ul>
Failure to recover financial savings from the NRW reduction program	Further financial stress on the utility <b>Medium Risk</b>	<ul style="list-style-type: none"> <li>• NRW Performance Based Contract removes the risk</li> </ul>
<b>Institutional</b>		
Organization not aligned for dedicated NRW reduction	Dysfunctional implementation of project with no allocation of responsibility for managing the different components of NRW <b>Medium Risk</b>	<ul style="list-style-type: none"> <li>• Organizational restructure, process alignment and management information systems centred around a dedicated NRW reduction team</li> <li>• Implement a NRW change management project with external support</li> </ul>
Lack of incentives to reduce NRW	Lack of motivation to tackle NRW <b>High Risk</b>	<ul style="list-style-type: none"> <li>• Introduce DMA caretaker approach with bonus scheme</li> <li>• NRW Performance Based Contract</li> </ul>

# 08 Project Summary: NRW Reduction in Metro Maputo

## NEED FOR THE PROJECT

NRW has a significant impact on all FIPAG operations. In 2020, it was estimated NRW resulted in 100 million m<sup>3</sup> of lost water (51% NRW) at a value of circa. US\$ 56 million.

In Metro Maputo, there was an estimated 46 million m<sup>3</sup> of NRW (56%) valued at US\$ 30 million in 2020.

As a priority, reduce NRW in Metro Maputo to improve financial sustainability and service to their customers.

The target is to reduce NRW to 25% (20 million m<sup>3</sup>) by 2030; an indicative saving of US\$ 17 million/year.

These interventions can then be upscaled nationally

## PROJECT DETAILS

**Actions to reduce physical loss:** Repair 5 reservoirs, replace / decommission 72km of pipe, expand 90km pipe, rehabilitate 7,285 connections & intensify leak repairs

**Actions to reduce commercial loss:** Recover 33,000 customer debt, install 153,000 new connections, replace 144,000 revenue meters, reduce illegal connections and introduce automated billing system

**Loss reduction technologies:** SCADA, telemetry, hydraulic model + zoning

**Improved bulk water metering:** Calibration of bulk meters and replace 150 large customer meters

**Training / capacity building:** front-line staff training, leadership development, centralized control centre

**Project Cost:** US\$ 54 million

## ROOT CAUSE OF NRW

- Obsolete network resulting in constant breaks / leaks;
- Under-reading and/or damaged customer water meters;
- Water theft via insecure points of supply
- Ease of making illegal connections and lack of detection / consequence
- High number of suspended customers with old debts
- Inconsistency of meter read and billing
- Lack of planned maintenance with quality interventions, including proactive leak detection
- Lack of knowledge and capacity to manage NRW

## FINANCIAL DETAILS

### Cost of NRW in 2020 (56%):

Component	Volume	Cost
Physical Losses	21 million m <sup>3</sup>	\$ 15.5 million
Commercial Losses	25 million m <sup>3</sup>	\$ 14.5 million
<b>NRW</b>	<b>46 million m<sup>3</sup></b>	<b>\$ 30 million</b>

### Estimated Savings in 2030 (25%)

Component	Volume	Savings
Physical Losses	12 million m <sup>3</sup>	\$ 9 million
Commercial Losses	14 million m <sup>3</sup>	\$ 8 million
<b>NRW</b>	<b>26 million m<sup>3</sup></b>	<b>\$ 17 million</b>

## RATIONALE

- Free up an estimated 30% of the leaked water for supplying new customers
- Safe and continuous supply of water for all customers
- Reduce operational costs
- Improve environmental resilience of the water supply
- Increase revenues to provide financial sustainability
- Improve the brand image
- Accelerate social wellbeing and economic development
- Enable an efficient way of managing the water system by the expansion of hydraulic zones

## OUTCOMES

### Technical:

- Increased service levels to customers
- Improved financial stability
- Opportunity for private sector participation in NRW-PBCs
- Improved operational processes
- Improved organizational capacity and skilled workforce

### Social and Environmental:

- Access to water for approximately 100,000 people
- Improved health and well-being for residents
- Improved climate resilience to reduced availability of water
- Financial savings can be passed onto customers as reduced or introduction of pro-poor tariffs

# Annex 1: Mozambique - overview

## Demographics

In 2014, 32% of Mozambique's 22m people lived in urban areas. By 2025 with urban population growth of 3.4%, this is forecast to be 12.5m (52%).

On current trends, population growth will become more concentrated into the 12 urban areas over 250,000, the largest of which are Maputo (2.5m), Beira (1.0m), Nampula (750,000) and Quelimane (600,000).

## Economy

Despite consistent growth for almost 2 decades Mozambique is a Low-Income Country (LIC) with a GNI/head of US\$460. Mozambique's economy has expanded rapidly over the last decade with annual GDP growth between 5% and 7%. This has slowed of late, with the impact of 2 major cyclones (2019) and COVID-19 (2020-1).

Growth and improvements in living standards have not been evenly spread across the country,, being mainly in urban areas and in the southern part of the country. The Government still faces the challenge of reducing poverty and inequality across regions and provinces

## Water resources

As a coastal country, Mozambique relies heavily on international water resources , with many of the larger rivers rising outside the country.

Water resources are also unevenly distributed across the country, with greatest limitations in the most developed southern part of the country.

The country is vulnerable to climate change and its related effects on water resources: recurrent droughts, which fail to replenish reservoirs and aquifers, and floods. Groundwater sources for the coastal cities are also affected by saline intrusion.

## Current performance

Supply coverage varies across the country even within existing urban districts. There are extensive under-served peri-urban areas . In 2020, the national water utility (FIPAG) provided water to 64% of the population in its service areas.

In Maputo and the Central Region, most received water via a household connection. Outside these areas around 20% of people receiving water from FIPAG did so via stand-posts.

Hours of service increased significantly from 2010, doubling in many cases and reaching 24 hours in some areas. Water quality also improved although recent cyclone damage to water infrastructure has set-back progress in this area .



# Annex 2: the water sector

## Delivery Organisations

In Mozambique's urban areas water is supplied by FIPAG, a wholly-owned autonomous public entity. FIPAG was founded in 1998 and functions as an asset-holder, fund raiser and operating utility.

At the operating level, the sector policy framework is for delegated management where services can be provided on a commercial basis by private companies. Specific arrangements can vary from area to area.

At the operational level, FIPAG has four regional companies; for Maputo Metropolitan area, South, Central and North. These cover all 29 major urban areas, and in 2019, served around 4m of the 7m population through 530,000 connections.

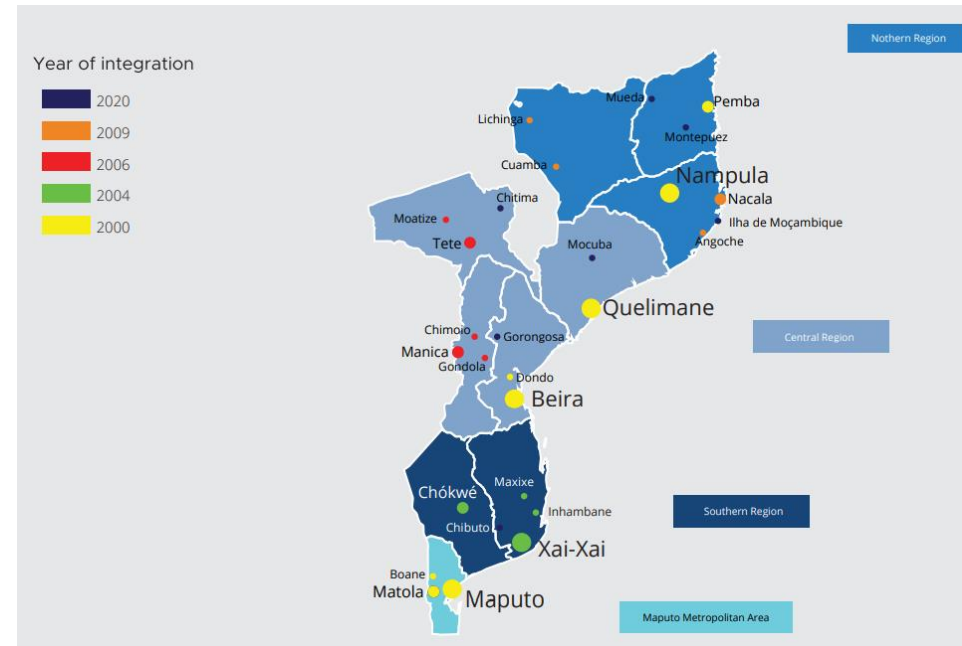
In 2009 AIAS was established to provide rural and small-town water supply and sanitation services.

## Governance and Regulation

FIPAG's Director-General is appointed by the Prime Minister, with other Directors appointed by the Minister of Ministry of Public Works, Housing & Water Resources (MoPHRH) on the recommendation of the D-G. Financial affairs are also supervised through representative of the Finance Ministry.

FIPAG's performance is set and monitored on a 3-yearly cycle through agreements with the MoPHRH.

The sector is regulated by the AURA (Water Regulatory Authority) who cover service quality economic and financial performance.



## Policy Framework & Objectives

The Government of Mozambique has set out the wider sector policy framework and objectives through the Five Year Programme and National Urban Water Supply & Sanitation Strategy (2011- 2025).

Within this Strategy the **Government of Mozambique has set a goal of universal urban population coverage with potable water supply and the achievement of the SDG targets by 2030.**