Reducing water losses in a large distribution network

City of Johannesburg, South Africa

water scarcity impact

Reduced withdrawal	●
Reduced consumption	●
Improved water quality	
Increased productivity	●
Net basin benefit	●

volumetric impact
51 250 000 m^3/yr

capital cost
$98 000 000

estimated unit cost of water
20 ¢/m^3

Water Stress
Johannesburg, South Africa

Arid & low water use
Low (<10%)
Low to med (10-20%)
Med to high (20-40%)
High (40-80%)
Extremely high (>80%)
No data available

Water Stress Map:
Gassert, F., M. Landis, M. Luck, P. Reig, and T. Shiao. 2013. "Aqueduct Global Maps 2.0."

Confidence level
Low Medium High

Water Scarcity Impact Key
Main Minor

Project Overview

Reducing water losses is a priority for Johannesburg Water. These are made up of leakages on transmission and distribution mains, reservoir and storage overflows and leakages on service connections. With its customer base of nearly four million, 11 300km of water distribution network, 86 reservoirs, 33 water towers, 108 bulk water supply meters and an average daily demand of 1 366 000m^3, this is a significant challenge.

There is real pressure on the city to reduce and stabilise demand. Johannesburg Water is the biggest user of water from the Vaal River which depends on transfers of water from the Senqu River in Lesotho via the Lesotho Highlands Development Project (LHDP) to satisfy demands on its resources. Furthermore, the Orange-Senqu is a transboundary system and the other riparians, Namibia and Botswana also have growing demands on the system.

Key Elements

- Replacement of water mains across the city's 11 300km of water reticulation mains of highly variable condition.
- Pressure management aimed at reducing night times pressures, water losses through background leaks and consumer demand in areas experiencing high on-property leaks.
- Active and passive leakage control through improvement of repair response times.
- Continuous monitoring of reservoirs and towers aimed at reducing overflow losses to zero.
- Soweto infrastructure upgrade including rehabilitation of water network, improved levels of service, retrofitting and education and awareness activities.
- The funding source is a combination of operating and capital expenditure which is offset against the savings from the reduced bulk water purchases and additional income from metered customers.

Key Outcomes

- In the first 12 months the replacement programme led to a 77% reduction in pipe bursts. A total of 85km of mains have been replaced to date.
- Improvements to the level of service for leakage repairs resulted in water savings of around 10 000 000m^3/year.
- Improved level of service and reduction of net consumer demand in key target area of Soweto through installation of nearly 160 000 new meters.
- Deferment of major water resources development infrastructure by at least ten years.
- Water saving of 102 500 000m^3 over two years, over 10% of the annual demand.
- It is estimated that only a small proportion of leakage from Johannesburg is ultimately returned for use by downstream users, therefore a reduction in leakage results in a decrease in consumptive use.

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Intervention Features

- Municipal leakage detection and repair
- Pressure management in municipalities
- Water metering in municipalities

Project Levers

(1) Replacement of water mains:

A prioritised pipe replacement programme was drawn up according to burst frequencies, analysed and visualised on GIS. Thity three suburbs were prioritised and the work carried out in phases. More than 90% of the mains have been surveyed and 85km replaced.

(2) Pressure management:

Key target areas were reducing night time pressures, water losses through background leaks and consumer demand in areas experiencing high on-property leakages. Three different types of pressure management were used; fixed outlet, time modulated and flow modulated. More than 500 pressure reducing valves were installed throughout Johannesburg to control water pressures in more than 300 pressure zones. At the heart of the system are two major pressure management systems handling the arrival of bulk water, one in Sandton and one in Parktown. The identification of further areas where pressure management could be applied continues and areas with high static pressures are being identified through hydraulic modelling.

(3) Active and passive leakage control:

The passive leakage control system is based on a 24/7 call centre and target response times of 48 hours for burst pipes and four days for leaking meters. Response performance has been improved from 80% within target in 2006 to 89% in 2011.

Active leak control uses a pro-active approach using night flows to identify the worst areas to be targeted with intensive leakage detection surveys. 15 full-time teams survey the water reticulation mains on a daily basis guided by the analysis of night flows.

(4) Reservoir and tower monitoring:

A 24hr manned control room monitors levels at all 86 reservoirs and 33 water towers and uses an “early bird” system for the detection of potential overflows. Overflows have been brought down to almost zero over the last five years.

(5) Focus on rapid returns through Soweto actions:

A major component of the water demand management programme is the Soweto Infrastructure Project which aims to rehabilitate the water network, improve the level of service, reduce consumer demand through retrofitting and to educate consumers through the creation of awareness. The project includes the implementation of pre-paid water meters to all Soweto residents, the largest project of its kind in Africa involving the installation of almost 160 000 new meters. Unaccounted for water at the start of the project stood at 69%. This should be reduced to less than 25% by project end.

Outcomes and Challenges

Based on the various interventions carried out to date it is possible to accurately estimate the anticipated water savings over the next two years.

- $60.2m spent in Soweto to save 43 000 000m^3.
- $15.65m spent on active leakage control for an anticipated saving of 20 800 000m^3.
- $2.86m spent on pressure management to generate savings of 38 000 000m^3.

Including the education and awareness programme the total cost is estimated to be $98m and will generate 102 500 000m^3 of water savings, equivalent to $0.96/m^3.

The savings on the purchase of bulk water are estimated at $113.7m over the two years.

The water savings are equivalent to 10.2% of current demand or around 3 to 4% when annual growth in demand is taken into account. This has resulted in the deferment of additional investments in infrastructure by ten years. Once the effects of the education and awareness programme fully materialise it is anticipated that the period of deferment can be extended further.