

## Wastewater reclamation to meet potable water demand

Windhoek, Namibia

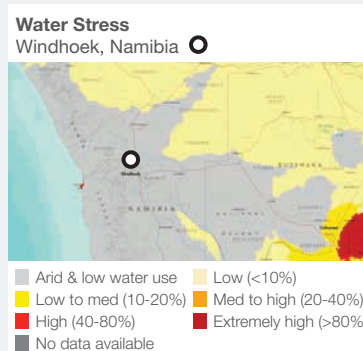
### water scarcity impact

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

volumetric impact  
**6 700 000m<sup>3</sup>/yr**

capital cost  
**\$27 700 000**

estimated unit cost of water  
**35¢/m<sup>3</sup>**



**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

**Credits**  
We wish to acknowledge the input of the City of Windhoek in the preparation of this case study.

### Project Overview

Flanked on both sides by deserts, Namibia is amongst the most arid countries in the world. Windhoek, its capital is situated in the central highlands with a mean annual precipitation of 370mm, evaporation of over 3 000mm and 750km from the nearest perennial river. For more than five decades Windhoek has managed to stretch its limited potable water resources through strict water management, including wastewater reclamation and direct potable reuse. After years at or near the top of the media agenda, water conservation habits are well ingrained in the minds of the city's residents. Per capita use is 180 litres/day and unaccounted for water is only 10%. Water supply is based on a combination of limited surface water and groundwater resources and due to their highly uncertain nature, the city council put in place a comprehensive integrated water demand management programme in 1994 to ensure water security for the city. Direct potable water reuse started in 1968 and has been a feature of the city's water supply ever since. The original scheme was replaced by a new plant in 2002. Operating at 73% of its capacity the new plant provides more than 18 000m<sup>3</sup>/day of drinking water. This is 26% of Windhoek's water demand and is part of a total re-use system in which very little water is either wasted or returned to the river system.

### Key Elements

- Multibarrier approach to ensure safe and aesthetically acceptable potable water.
- Guaranteed water quality values.
- Blending of reclaimed water with freshwater.
- 20 year operation and maintenance agreement.
- Public awareness campaigns for water saving and acceptability of direct potable water reuse.
- Project financing: by the KFW (Kreditanstalt für Wiederaufbau) (40%), the European Investment Bank (55%) and the City of Windhoek (5%).

### Key Outcomes

- Availability of additional 7 500 000m<sup>3</sup>/yr of potable water at a similar cost to other sources.
- Availability of reclaimed water from the old plant for the irrigation of parks, sports fields and pasture.
- Deferment of expensive infrastructure to transport water from alternative water sources at a greater distance.
- Continued acceptance by the public of potable water from reclaimed waste water.
- Reinforcement of high levels of water demand management and conservation practices.
- The impact of returned downstream flows on the basin is minimal as there is little downstream water demand.



Windhoek, Namibia

## Intervention Features

- Wastewater recycling for potable use
- Stakeholder engagement

## Project Levers

### (1) Multibarrier approach:

In order to ensure that the drinking water was safe for human consumption at all times, a “multiple barrier” approach was taken in the design of the process technology. The treatment processes used ensure that at least two (in many cases three or more) unit processes are provided for removing each crucial contaminant. Key processes included powdered activated carbon dosing, pre-oxidation and pre-ozonation, flash mixing, enhanced coagulation and flocculation, dissolved air flotation, dual media rapid gravity sand filtration, ozonation, BAC filtration, GAC filtration, ultra-filtration (UF), disinfection and stabilisation.

### (2) Guaranteed water quality values:

The water produced by the plant had to adhere to 'guarantee values'. These were based on WHO Guidelines (1993), Rand Water (South Africa) Potable Water Quality Criteria (1996) and the Namibian Guidelines for Group A water (1998). Water samples are taken every four hours at various points throughout the plant and analysed in the plant laboratory for basic quality control purposes.

### (3) Blending of reclaimed and fresh water:

Although it was shown that the specified guarantee parameters could be met without it, blending the reclaimed water with treated surface water and/or groundwater provides an additional level of safety. The maximum portion of reclaimed water fed into the distribution system is 50% in times of water scarcity and low water demand.

### (4) Operation and maintenance agreement:

The plant is operated and maintained under a twenty-year operation and maintenance contract between the city of Windhoek and a consortium of three major international water treatment contractors.

### (5) Public awareness campaign:

Efforts to introduce waste water reclamation for potable water have failed in many cities around the world with the perception of reclaiming drinking water from municipal secondary effluent generally unacceptable to the public. Experience in Windhoek showed that with persistent, well designed and targeted marketing, this perception can be changed. The people of Windhoek generally take pride that they are the only city in the world where direct potable water reuse is practised.

## Outcomes and Challenges

Construction of the new Goreangab Water Reclamation Plant in 2002 replaced the old plant and provided a cost-effective and acceptable solution to meet the city's medium term water requirements. The capacity of the plant (7 500 000m<sup>3</sup>/yr), together with a programme of groundwater recharge to increase the contribution of groundwater, should ensure that very expensive water supply alternatives such as a transfer of water from the Okavango River 750km away can be deferred for many years. The cost of production is virtually the same as the cost of potable water coming from the existing surface water storage. The old reclamation plant continues to operate, recycling industrial waste water for the irrigation of fodder and of domestic waste water for the irrigation of sports fields and parks. Since potable reuse started in Windhoek 45 years ago no outbreak of waterborne disease has been experienced and no negative health effects have been attributed to the use of reclaimed water. Public acceptance of the product is illustrated by the fact that less than 5% of the population uses additional point source treatment in their homes.



Above: Covered reservoirs and greenery maintained with purified effluent in Windhoek (© WRP (pty) Ltd)