Groundwater recharge

Omdel Dam, Namibia

water scarcity impact

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

volumetric impact
3 630 000 m^3/yr

capital cost
$16 800 000

estimated unit cost of water
25 ¢/m^3

Water Stress
Namibia

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

Many of Namibia's settlements are situated in very arid areas and depend entirely on groundwater for their water supply. Perhaps the most extreme examples are the coastal settlements of Walvis Bay, Swakopmund and Henties Bay which depend on groundwater stored in the coastal aquifers of the Kuiseb, Swakop and Omaruru Rivers. The sources of these ephemeral rivers originate more than 300km inland at altitudes of around 2 000m and rarely flow to the ocean. In the 1990's, the rapidly growing water demand associated with these coastal settlements and a large uranium mine increased to 8 460 000m^3/yr, 15 to 20% in excess of the mean annual exploitable recharge of the three aquifers combined. The situation had been further exacerbated by a series of very dry years and rapidly declining water levels in the Omdel aquifer.

In order to find a remedy, attention was focussed on the Omdel aquifer near the mouth of the Omaruru River which had the largest storage capacity at 150 000 000m^3. Previous research had also identified that natural recharge in the system was reducing as a result of heavily silt-laden flood waters clogging normal recharge pathways. The scheme involved the construction of a large dam just upstream of the aquifer to catch the occasional floodwaters for subsequent controlled release to the aquifer through enhanced infiltration. The result of the project was that extractable recharge of the Omdel aquifer was more than doubled from 3 500 000m^3/yr to around 7 130 000m^3/yr. This, combined with the sustainable yields of the Kuiseb and Swakop Aquifers, raised the total extractable volume to 10 930 000m^3/yr.

Key Elements

- Dam and associated storage in which the silt from silt-laden flood waters could be allowed to settle.
- Dam construction without foundations cutting off to bedrock, permitting natural recharge.
- A multi-level off-take to reduce silt-load transfer to the infiltration beds.
- Construction of two large infiltration areas situated downstream of the dam.

Key Outcomes

- The mean annual runoff into the Atlantic Ocean was reduced by approximately 35%.
- 100% increase in annual average recharge to the Omdel aquifer.
- The seawater desalination project was delayed until 2010.
- Increased awareness of critical need for improved watershed management practices.
- Reduced evaporation losses through maximum use of Omdel aquifer.

Namibia

Intervention Features

¬ Groundwater recharge ¬ Management of evaporation losses ¬ Capture of floodwaters

Project Levers

(1) Floodwater capture:

The central feature of the project was the Omdel Dam, constructed to capture flood waters and facilitate the infiltration of silt-free flood water to enhance recharge into the Omdel aquifer just downstream. Since construction was completed in 1994, on average 52% of the water stored in the reservoir has been successfully infiltrated each year, water which would have been otherwise lost to evaporation, or in the absence of the dam, to the Atlantic Ocean.

One of the challenges in the design of the embankment dam was that it should not stop the existing groundwater throughflow since this was part of the natural recharge process. Allowing for this complex natural alluvial foundation required the incorporation of several seepage control measures and the inclusion of a complex monitoring system.

(2) Reduced evaporation:

A key aim of the project was to reduce the impact of evaporation. By moving the stored surface water from the reservoir to the aquifer quickly, as much as 9 000 000m^3 in around 4-6 weeks meant that exposure to evaporation rates of nearly 3 000mm/yr could be minimised.

Enhanced infiltration and recharge requires the careful application of operational rules:

- Water is released when suspended solids are less than 20mg/l.
- Rate of abstraction to be controlled by sleeve valve.
- Maximum hydrostatic head to be maintained at all infiltration beds.
- Infiltration beds to be 'cleaned' twice yearly.
- Water levels and temperature at infiltration basin observation boreholes to be continuously monitored.

Outcomes and Challenges

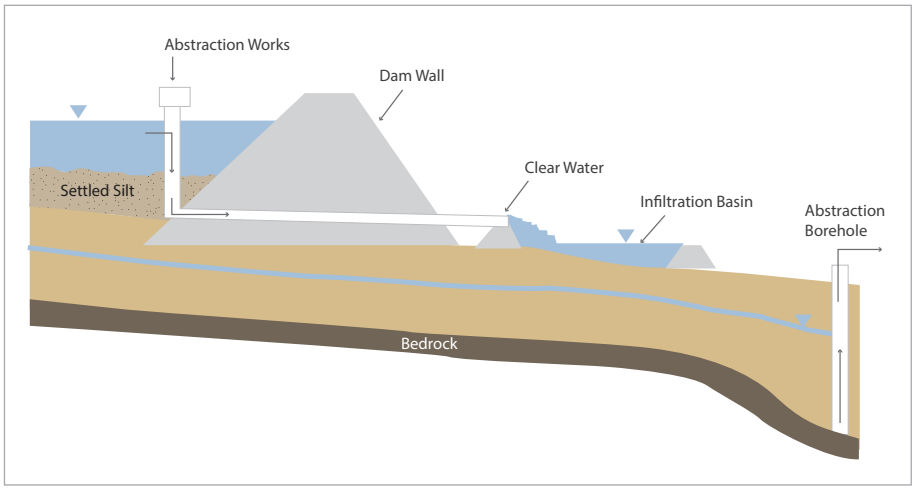
The main outcome of the project has been a doubling of the natural recharge to the Omdel aquifer estimated at 7 130 000m^3/year instead of 3 500 000m^3/year.

Other impacts of the project included:

- Increased awareness of the negative impacts of poor watershed management practices. The high profile nature of the project highlighted the fact that huge quantities of soil are lost every year through poor farming practices.
- Delaying the implementation of seawater desalination has permitted the use of newer and more cost-effective desalination technology than would have been possible in 1990.

Challenges include:

- The rate of reservoir sedimentation is a major concern and an inevitable outcome of the project. Removal of sediment from the reservoir during the dry season is not economically viable so the importance of reducing the rate of sedimentation thorough improved watershed management practices is underlined.
- Accurate flood warning is difficult given the nature of storms in the upland areas. Improved monitoring of floods as they progress downstream would facilitate better operation of the scheme.



Above: Schematic of the recharge process