Effluent treatment and aquifer storage for agricultural use

Dan Region, Israel

water scarcity impact

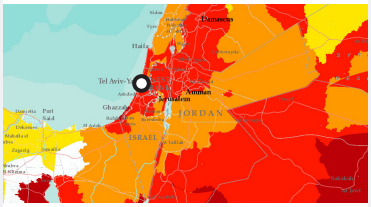
Reduced withdrawal	Main
Reduced consumption	Main
Improved water quality	
Increased productivity	
Net basin benefit	Main

volumetric impact
140 000 000 m^3/yr

capital cost
$4 000 000 000

estimated unit cost of water
170 ¢/m^3

Water Stress
Dan Region, Israel



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:
F. Gassert, P. Reig, T. Shiao, M. Luck and M. Landis, 2015. "Aqueduct Global Maps 2.1."

Confidence level
Low Medium High

Water Scarcity Impact Key
Main Minor

Credits
We would like to acknowledge Yossi Yaacoby, Avi Aharoni & Ariel Rejwan of Mekorot for their input in the preparation of this case study.

Project Overview

Effluent re-use for irrigation is vital in water conservation in Israel, helping to facilitate reduced freshwater withdrawal nation-wide. Now, over 40% of Israel's agricultural water needs are currently supplied by effluent water. The Shafdan Wastewater Treatment Facility is Israel's largest wastewater treatment and reuse facility. The facility is located south of Tel Aviv, close to the coast and supplies approximately 140 000 000 m^3 per year of reclaimed water to the Negev Desert in the south of Israel for agricultural use on 50 000 acres of irrigated lands.

The success of the Shafdan facility helped pave the way for a national strategy in effluent re-use. The impetus for governmental implementation was twofold: productively re-use the effluent for irrigation and systematically prevent further pollution via direct coastal marine disposal of urban sewage from Tel Aviv and its suburbs.

Key Elements

- Preliminary treatment of collected wastewater before injection into the aquifer.
- Filtration of partially treated wastewater within the aquifer.
- A pumped distribution system to transport the abstracted effluent from the Shafdan's SAT system for agricultural use in Southern Israel, over 100 km away.
- Energy demand at an average of 1.2 kWh per m^3 over the whole process covering pumping to Shafdan, the treatment process and pumping the finished product to the Negev.
- Operations at Shafdan are publicly funded by the cities that the effluent is extracted from (total population above 2 500 000 from seven main cities and fifteen adjacent cities).

Key Outcomes

- 140 000 000 m^3 per year of reclaimed water for agricultural use that would have otherwise been lost to sea.
- Reduced consumptive use from aquifer storage and recovery with minimal evaporation losses.
- More than 60% of agriculture in the Negev is irrigated by Shafdan water.
- Separation of groundwater and effluent introduced during SAT process ensures existing groundwater source is not contaminated.

Dan Region, Israel

Intervention Features

- Groundwater recharge
- Wastewater reuse for agriculture
- Non-potable water distribution system
- Reduced water rates for reclaimed water

Project Levers

(1) Wastewater Treatment

The preliminary stage of effluent treatment uses activated sludge to break down organic matter into carbon dioxide, water, and other inorganic compounds before the effluent is transferred to the recharge basins.

(2) Recharge

Wastewater is injected into specially designated recharge basins where it is naturally filtrated in the sands of Rishon Letzion and Yavne at a rate of 339 000 m^3 per day. However, to avoid contamination a complete separation exists between the reclaimed effluents introduced and the existing water there naturally. This separation is achieved by controlling the shape of an artificially created water level depression. This arrangement creates a hydrologic trough that prevents the reclaimed water from spreading. The water is collected by peripheral reclamation wells after six to twelve months and pumped to the Negev.

(3) Tariff Measures

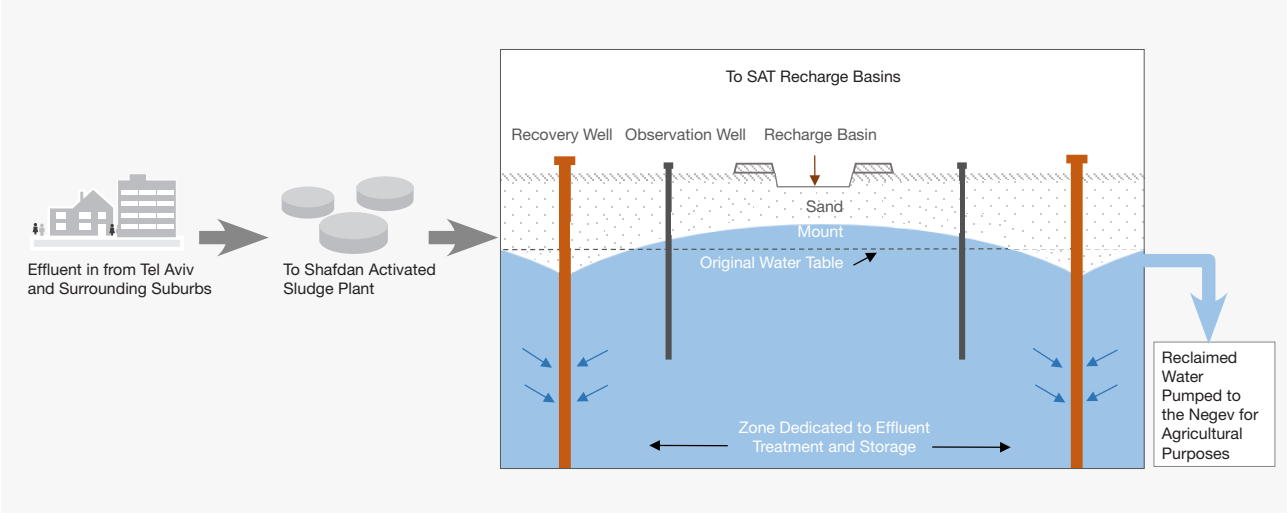
The water produced through the SAT treatment that is supplied to farmers in the south is done so at a unit of $0.35 per m^3 while fresh water tariffs are between $0.50 - $0.75 per m^3. Mekorot are able to provide the reduced tariff for reclaimed water due to a subsidy from the Ministry of Finance to cover the difference between supply costs and tariffs.

Outcomes and Challenges

After over thirty years of infiltration in the Shafdan recharge basins there are indications of deterioration in the infiltration interface. This clogging, caused by the biological and physical processes that occur, has slightly reduced the infiltration rate. This has led to new areas where the wastewater can be purified being considered.

In addition, a further treatment step using nanofiltration with 0.001-0.008 micron membranes prior to aquifer recharge is being trialled to limit the impact on the aquifer. This drastically increases the infiltration velocity from 2 m per day to 12 m per day and thus reduces retention times to approximately ten days. This allows for increased capacity but also for a reduction in land area needed.

This is beneficial for expansion into more densely populated areas.



Above: Effluent Treatment Process (© Arup)