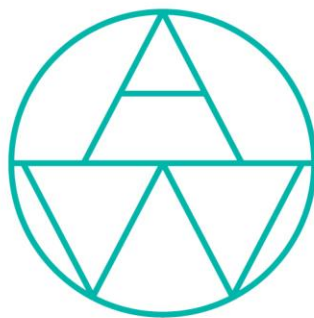


# Water quality evaluation aquifer storage and recovery (ASR) for the city of Abu Dhabi

HYDROGEOCHEMICAL ANALYSIS OF AQUIFER STORAGE AND RECOVERY (ASR) OF DESALINATED SEAWATER (DSW)

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## CLIENT

Environmental Agency Abu Dhabi (EAD): [www.ead.ae](http://www.ead.ae)

With an annual precipitation rate of less than 100 mm/year and limited fresh groundwater availability in the desert, serious **freshwater shortages** exist for drinking water production in Abu Dhabi. **Seawater desalinated through reverse osmosis** at a coastal water plant provides an **alternative freshwater source**. With this strategy, seawater can be transformed into high-quality freshwater. However, strategic reserves are desired to guarantee continuous water supply.

## CHALLENGE: CONTINUOUS SUPPLY OF HIGH-QUALITY FRESHWATER

Abu Dhabi (UAE) already produces its drinking water from desalinated seawater from the Arabian Gulf. However, in case of emergencies, e.g. when algal blooms prevent the intake of water from the Gulf, this system can supply Abu Dhabi with sufficient freshwater for a maximum of 3 days only. Longer emergencies would therefore result in **drinking water shortages** in Abu Dhabi.

A solution to the vulnerability of drinking water production in Abu Dhabi would be to store the desalinated water in periods when sufficient seawater is available, for later use in periods of calamities. However, storage in surface basins has several drawbacks, including its high costs, extensive spatial needs, and possible deterioration of the water quality during such 'open storage': warming, algal growth, atmospheric deposition, or even sabotage.

## SOLUTION: SUBSURFACE STORAGE AS ESSENTIAL LINK

The subsurface provides the space to balance water supply and demand over time. For this reason, the Abu Dhabi Water and Electricity Authority (ADWEA) is implementing **aquifer storage and recovery (ASR)** on a large scale in the Liwa desert within the Strategic Water Storage and Recovery (SWSR) project. The ASR-system consists of 3 underground infiltration basins, each surrounded by 105 wells, that together infiltrated approximately 21 million m<sup>3</sup> of desalinated seawater (DSW) into the aquifer to build up a subsurface reservoir of potable freshwater. The SWSR-project is **the largest desalinated seawater-ASR project in the world** and is designed by Dornier Consulting / GIZ.

Commissioned by the Environmental Agency Abu Dhabi (EAD), Allied Waters and the Dutch cooperative WaterFocus performed **hydrogeochemical analysis** to predict changes in water quality during storage and recovery of desalinated water, which should meet drinking water standards immediately after recovery, without any further treatment. Reassuring calculations show that freshwater stored for 10 years would be of sufficient quality and quantity to meet the drinking water demand of Abu Dhabi for a period of 80 consecutive days, long enough to bridge the time of a calamity.



FIGURE 1: REALISATION OF A SUBSURFACE INFILTRATION BASIN WITH 105 ASR WELLS IN THE LIWA DESERT.

## CHARACTERISTICS

Operator:	<b>Environmental Agency Abu Dhabi (EAD)</b>	Seawater is desalinated in a <b>coastal water treatment plant</b> to produce high-quality freshwater.
Target storage volume:	<b>21.2 million m<sup>3</sup></b>	
Infiltration rate:	<b>26 500 m<sup>3</sup>/d</b>	Since 2015, <b>3 underground infiltration basins</b> , each surrounded by <b>105 ASR wells</b> , stored desalinated seawater in an aquifer at a depth of 80 m in the Liwa desert, reaching its capacity in 2017.
Recovery rate:	<b>170 280 m<sup>3</sup>/d</b>	
Recovery efficiency:	<b>60 - 85%</b>	<b>In case of calamities</b> , stored freshwater can be recovered through these wells and can meet the drinking water demand for a period of <b>80 days</b> , without deterioration of the recovered freshwater.
ASR investment:	<b>\$ 435 million</b>	
Year of realization:	<b>2009 – 2017</b>	



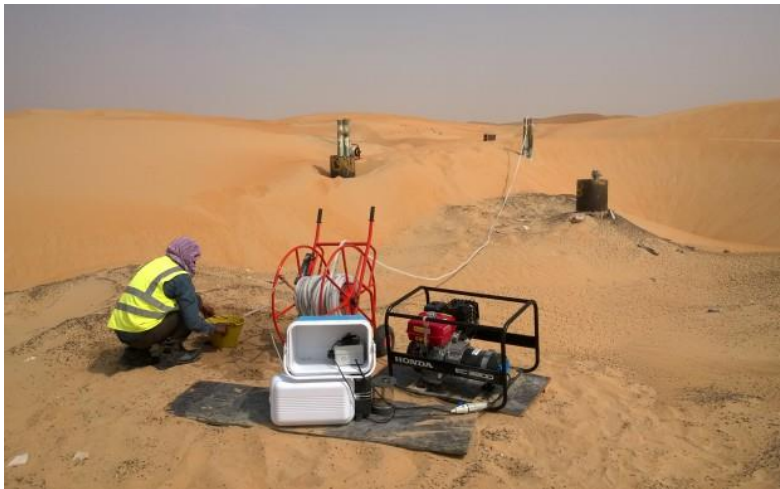


FIGURE 2: SAMPLING OF GROUNDWATER IN THE LIWA DESERT (ABU DHABI).

### SERVICES PROVIDED BY ALLIED WATERS

- Evaluation of the hydrogeological, geochemical, and hydrochemical stratification of the aquifer system targeted in the SWSR-project, based on available data.
- Research on unique water quality changes of freshwater stored in an eolian-fluvial sandstone aquifer system in a desert environment during an ASR-pilot with a six-year storage phase.
- Coordination and supervision of sampling desalinated seawater stored in the aquifer targeted within the SWSR-project.
- Inference of dominant/relevant hydrogeochemical reactions based on analysing the freshwater samples.
- Hydrogeochemical modelling to research and predict potential deterioration of water quality during storage and intensive recovery of desalinated seawater.
- Hydrogeochemical advice to the Environmental Agency Abu Dhabi (EAD) regarding the ASR-scheme and freshwater quality upon recovery, based on the hydrogeochemical analysis of stored freshwater and on hydrogeochemical modelling.

### SCIENTIFIC PAPER

Stuyfzand, P.J., Smidt, E., Zuurbier, K.G., Hartog, N., Dawoud, M.A. – Observations and prediction of recovered quality of desalinated seawater in the strategic ASR project in Liwa, Abu Dhabi – Water (Switzerland) 9(2017)3, art. no. 177.

### CONTACT

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