CASE STUDY

Results Proved Underground Storage Capacity with a Volume of Four Billion Imperial Gallons

Confirmed the Aquifer Storage and Recovery solution as a viable, cost-effective, and secure alternative to surface water storage

CHALLENGE
Sharp population growth is straining one of the lowest global renewable water resource capacities. The high cost and environmental risk of surface water storage was determined as not viable.

SOLUTION
Aquifer Storage and Recovery technology was selected. Many levels of evaluation and testing were used to select the final site.

RESULTS
A final system efficiency of 88% was achieved and the results proved that four billion imperial gallons could be successfully stored at this site. This project confirmed Aquifer Storage and Recovery as a viable, cost-efficient, and secure alternative to surface water storage.

Area has high population growth, limited groundwater resources, and non-viable traditional solutions
The arid climate of the United Arab Emirates (UAE) presents several challenges for maintaining sustainable water supplies for domestic, industrial, and agricultural uses. The UAE has one of the lowest global renewable water resource capacities due to low rainfall rates, high evaporation, no reliable surface water resources, along with a high per capita water consumption rate. This combination of factors has created an imbalance between water supply and demand, and has increased the region’s reliance on programs such as desalination, groundwater recharge initiatives, water reuse, and strict water conservation programs.

The economic expansion, coupled with the sharp population growth of the Emirate of Abu Dhabi has created an immediate need for water reserves not only to meet the increasing population demands, but also to secure a contingency plan. The use of surface water storage tanks was initially considered for the region, however it was concluded that this method was not a viable alternative for Abu Dhabi due to the high cost and risks to the environment that it posed.

Aquifer Storage and Recovery technology selected
Aquifer Storage and Recovery (ASR) provides a means of supplementing water supplies in arid climates and is a cost-effective option when compared with conventional surface storage because surface land requirements are significantly reduced.

ASR provides:
- Substantial underground water storage with high recovery rates
- Significant cost savings compared with surface water storage
- Reduced reliance on vulnerable, costly surface water reservoirs

The Abu Dhabi Corniche, United Arab Emirates.
CASE STUDY: Confirmed solution as a viable, cost-effective, and secure alternative to surface water storage

Schlumberger Water Services (SWS) recommended the adoption of an ASR site to the Mubadala Development Company (MDC). The project was designed to provide a secure method for strategic subsurface water storage with minor surface installations.

MDC focuses on the generation of sustainable economic benefits for Abu Dhabi through a careful selection of business ventures, in partnership with local, regional, and international investors. MDC invested in this project to diversify and support further development of a rapidly growing economy.

The Environmental Agency of Abu Dhabi (EAD), a governmental agency responsible for the protection and conservation of the environment, managed the technical aspects of this project. SWS worked in conjunction with the EAD to identify and test a potential site for the ASR project by defining the storage zone, aquifer thickness, and the related hydraulic parameters and subsequently testing the identified aquifer’s potential for ASR through pilot testing.

The initial phase of the project was to locate a potential ASR site. This was achieved through the compilation of geological and hydrological information such as lithology, geology, water levels, water quality data, seismic data, and base maps. The data was initially compiled in both GIS and the HydroManager* online information management system, then 3D hydrogeological models were developed using the Petrel* E&P software platform and ECLIPSE* reservoir simulation software.

Each proposed ASR location was ranked to determine an optimal location and to develop an exploratory drilling strategy. Wells were drilled on the sites that received the highest rankings, and data was collected using the latest Schlumberger logging technologies, including Platform Express* integrated wireline logging tool, CMR* combinable magnetic resonance tool, ECS* elemental capture spectroscopy sonde, and FMI* fullbore formation microimager.

Each well in the project area was also equipped with a Diver* groundwater datalogger to continuously monitor water levels, providing a reliable log of changes in response to hydraulic pumping tests or source water injection. The data collected was then analyzed using the AquiferTest Pro* advanced pumping and slug test data analysis software to determine the hydraulic properties of the aquifer. The results confirmed that the aquifer of the selected site exhibited the desired storage characteristics.

The pilot test phase of the project was conducted to confirm the feasibility of implementing a large-scale ASR project in the area. In this phase, an ASR well was drilled in addition to a number of monitoring wells within the project boundaries. The test included cycles of injection-storage-recovery, a thirty-day storage period to assess potential hydrochemical interactions, advanced water chemistry analysis, and the collection of monitoring data from the surrounding wells during the cycles. The Petrel software platform was used for advanced geological modeling; ECLIPSE software for dynamic groundwater simulations; AquaChem* water quality analysis and data management software and PHREEQC aqueous geochemical calculations program for water compatibility predictions; and Hydro GeoAnalyst* software for complete groundwater and borehole data management, analysis, and visualization.

Four billion imperial gallons could be successfully stored
All of the project objectives were achieved, confirming the value of ASR as a viable, cost-efficient, secure alternative to surface water storage. A final system efficiency of 88% was achieved and the results proved that four billion imperial gallons could be successfully stored at this site. The government of Abu Dhabi has adopted the ASR concept as a solution for strategic and seasonal storage of water.

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