Case Study

Schlumberger WATER SERVICES

About Schlumberger Water Services

We offer innovative groundwater solutions through professional expertise to meet the advancing technological requirements of today's professionals.

Schlumberger's Water Services division specializes in assessing, developing, and managing groundwater resources using some of the finest, advanced and cost-effective technologies available today.

Whether you're looking for field-scale data collection, data management, modeling, or resource decision-making solutions, our teams of specialists are here to help you address all your groundwater projects safely and efficiently.

Applied Technologies:

- HydroManager*
- Petrel*
- ECLIPSE*
- ECLIPSE-H2O
- PlatForm Express*
- CMR*
- ECS*
- FMI*
- CTD-Diver*
- AquiferTest Pro*
- PHREEQC
- AquaChem*
- HydroGeo Analyst*

Aquifer Storage and Recovery in Arid Environments

Abu Dhabi, United Arab Emirates

The Abu Dhabi Corniche, United Arab Emirates

Highlights:

- Implementation of Aquifer Storage and Recovery (ASR) to improve water supply in the United Arab Emirates
- The Environmental Agency of Abu Dhabi supervised the technical aspects of the ASR project
- Compilation of geological and hydrological data for conceptual model development
- Monitoring changes in response to hydraulic pumping tests or groundwater injection
- Advanced groundwater simulation to determine ASR feasibility

Background

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 new water resources including desalination, groundwater recharge initiatives, water reuse, and strict water conservation programs.

Challenges

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 (ASR) provides a means of supplementing water supplies in arid climates, and is a cost-effective option when compared to conventional surface storage as surface land requirements for ASR is significantly reduced.

Aquifer Storage and Recovery provides:

- Substantial underground water storage with high recovery rates
- Significant cost savings when compare to surface water storage
- Reduced reliance on vulnerable, costly, surface water reservoirs

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Case Study: Aquifer Storage and Recovery in Arid Environments

Solution

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, 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, geophysical logs, water levels, water quality data, seismic data, and base maps. The data was initially compiled in both GIS and HydroManager databases, then three-dimensional hydrogeological models were developed using Petrel and ECLIPSE, advanced groundwater modeling and simulation software developed by SWS.

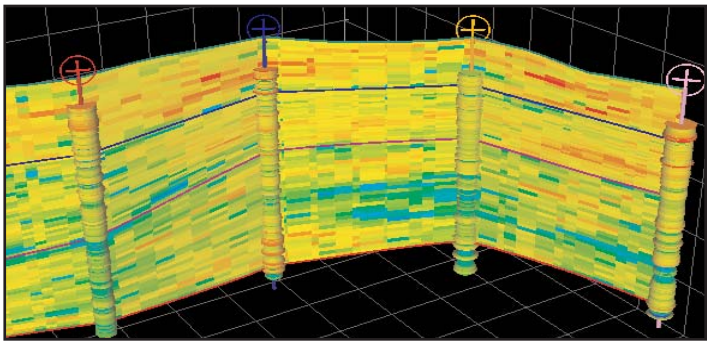
Each proposed ASR location was ranked to determine an optimal location and to develop an exploratory drilling strategy. Wells were drilled on the sites that received the highest rankings, and data was collected using the latest geophysical logging technologies developed by Schlumberger, including PlatForm Express (PEX), Combinable Nuclear Magnetic Resonance (CMR), Elemental Capture Spectroscopy Sonde (ECS) and Fullbore Formation MicroImager (FMI) tools.

Each of the wells in the project area were also equipped with Diver* dataloggers 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 AquiferTest Pro to determine the hydraulic properties of the aquifer. The results confirmed that the aquifer of the selected site exhibited the desired storage characteristics.

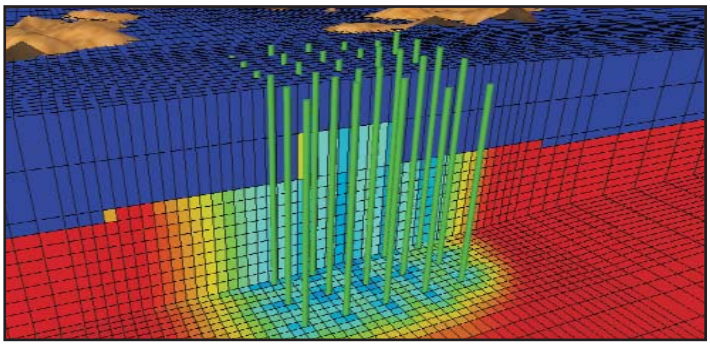
The pilot test phase of the project was conducted to confirm the feasibility of implementing a large-scale ASR project in the area. In this phase, an ASR well was drilled in addition to a number of monitoring wells within the project boundaries. The test included cycles of injection-storage-recovery, 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. Petrel was used for advanced geological modeling, ECLIPSE-H2O for dynamic groundwater simulations, AquaChem and PHREEQC for water compatibility predictions, in addition to HydroGeo Analyst for complete groundwater and borehole data management, analysis, and visualization.

Results

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 can 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.



Advanced aquifer modeling using Petrel



Simulation of ASR using ECLIPSE

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