AQUIFER STORAGE AND RECOVERY ASSESMENT FOR THE LOWER VALLEY WATER DISTRICT, EL PASO COUNTY

TWDB Report 391 Snapshot | April 2025

AQUIFER STORAGE AND RECOVERY AND AQUIFER RECHARGE IN TEXAS

Aquifer storage and recovery (ASR) utilizes injection wells for the local storage and subsequent recovery of water within an aquifer for beneficial use, and aquifer recharge (AR) is the intentional recharge of an aquifer through an injection well or other means of infiltration. The Innovative Water Technologies Department at the Texas Water Development Board (TWDB) promotes the development and use of alternative water supplies in Texas such as ASR and AR. In 2019 the Texas Legislature tasked the TWDB to conduct ASR and AR studies for interested persons across the state and report the results of these studies to the regional water planning groups and interested persons.

Currently, there are five operational ASR and three operational AR projects in Texas, with five additional projects being tested and four more projects authorized for testing (Figure 1). Many areas in Texas are looking into ASR and AR projects to diversify their water supplies and improve their drought resiliency and preparedness. According to the 2022 State Water Plan, there are 37 new ASR and 4 new AR projects being investigated—these projects are projected to produce 193,000 acre-feet of water per year by 2070.

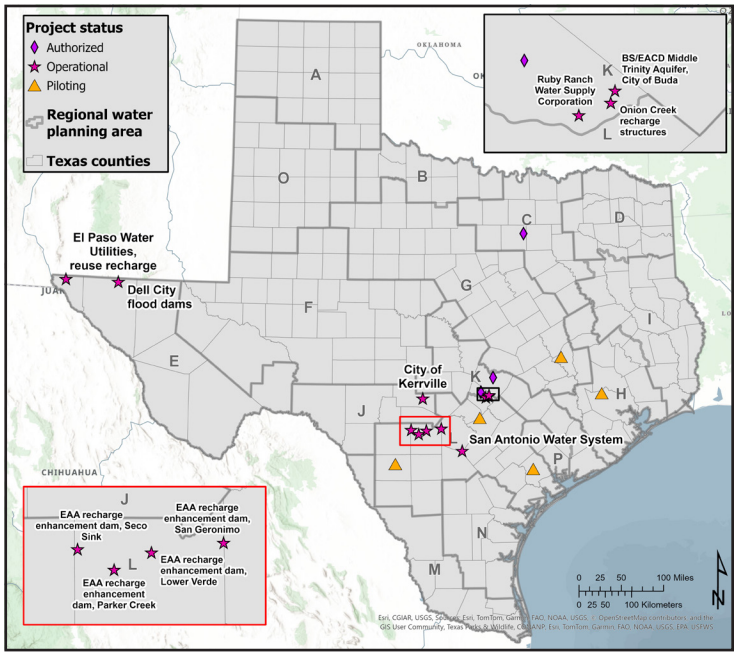

Figure 1. Map of the current operational, piloting, and authorized aquifer storage and recovery and aquifer recharge projects in Texas.

THE LOWER VALLEY WATER DISTRICT STUDY AREA

TWDB Report 391 evaluates the suitability of an ASR or AR project for the Lower Valley Water District (LVWD) in El Paso County (Figure 2). The LVWD is constructing a new wastewater treatment facility to treat municipal wastewater and is interested in using the excess advanced treated wastewater effluent to recharge the Hueco Bolson aquifer. This arid region of Texas is characterized by scarce water resources, which impacts the quality of life and economy of the region. Most development and agriculture in the area is along the Rio Grande, where access to shallow water and surface canals has historically been available. The LVWD currently receives its water supply from El Paso Water; however, it is projected that water demands will significantly increase in the future (WSP and Freese and Nichols, 2021).

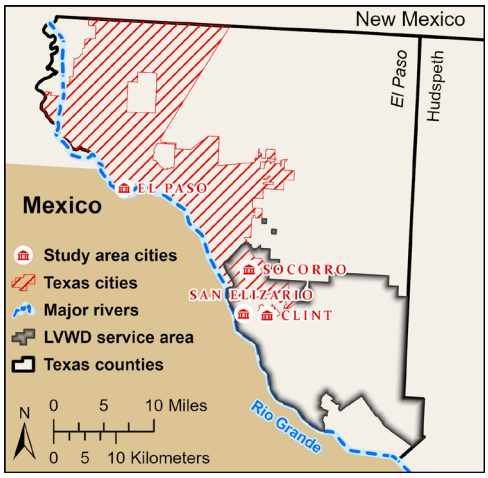

Figure 2. Study area location in El Paso County, Texas, showing the LVWD service area.

THE HUECO BOLSON AQUIFER

Stratigraphy

The LVWD overlies Hueco-Mesilla Bolsons Aquifer, a major Texas aquifer located in West Texas. Being unconfined to semi-confined, this aquifer is relatively unique in Texas. This aquifer has a complex geological history and are composed of Tertiary and Quaternary deposits consisting of heterogeneous basin-fill deposits of gravel and sand with interbedded lenses of silt and clay. Three geological units were mapped within the study area (Figure 3):

- **Paleozoic and Mesozoic carbonate bedrock** – interbedded limestone, sandstone, shale, and calcareous mudstone deposited in marine environments with abundant fossils.
- **Hueco basin-fill deposits** – unconsolidated to poorly-consolidated sands and clays deposited in fluvial, alluvial, and lacustrine environments.
- **Unconsolidated surficial deposits** – shallow sand and gravel units deposited by modern Rio Grande and eolian processes. Gravel beds likely reworked older basin-fill deposits.

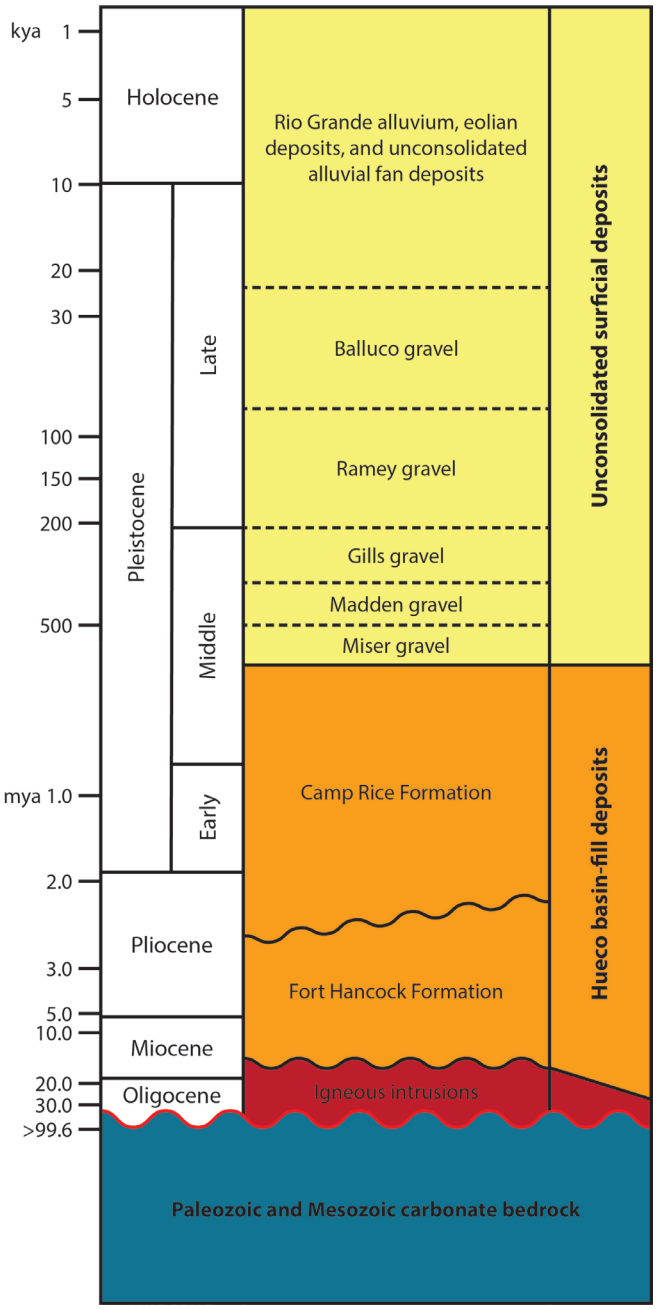

Figure 3. Stratigraphic column of the Hueco Bolson aquifer in El Paso County showing the three mapped units for this study.

Stratigraphic analysis for this study was completed using a combination of geophysical well logs, drillers logs, surface geologic maps, and previous studies on the structure and stratigraphy of El Paso County using seismic and airborne geophysical methods (Figure 4). Only 6 well logs were used to find the top of the Paleozoic–Mesozoic carbonate bedrock, which can be identified by a distinct change in the character of the resistivity signatures. Due to the lack of well control, seismic depth contours from Davis and Leggat (1967) were used to fill in areas where there was no data. Depths in the mapping area ranged from 179–4,032 feet below the surface. The deepest area of contact is in the center of the mapped area, likely caused by the presence of the Clint Fault. These carbonate units are relatively deep, and fluid flow is restricted to faults and fractures, which potentially act as conduits allowing saline water to enter the overlying aquifer units. These carbonates are likely not ideal for an ASR or AR project.

The TWDB used 39 geophysical well logs to identify the top of the Hueco basin-fill deposits; however, only six were located within the mapped area. The contact between the basin-fill deposits and the overlying surficial units was identified using the base of the overlying gravel beds, which have a distinct, high resistivity signature and a negative spontaneous potential kick. The depth of the contact ranges from 0–567 feet below the ground surface. In general, the units are shallowest in the east, at the outcrop, and the units become deeper westward. However, the depth map is somewhat complicated by

surface features such as the San Felipe Arroyo and the Clint Fault. These units are relatively thick and contain areas that would be suitable for ASR or AR. Few wells in the LVWD service area penetrate to these units, so further testing would be needed. The overlying surficial units are used extensively for agricultural and industrial water production. These surface units are unconfined and not generally suitable for an ASR project but could be suitable for an AR project.

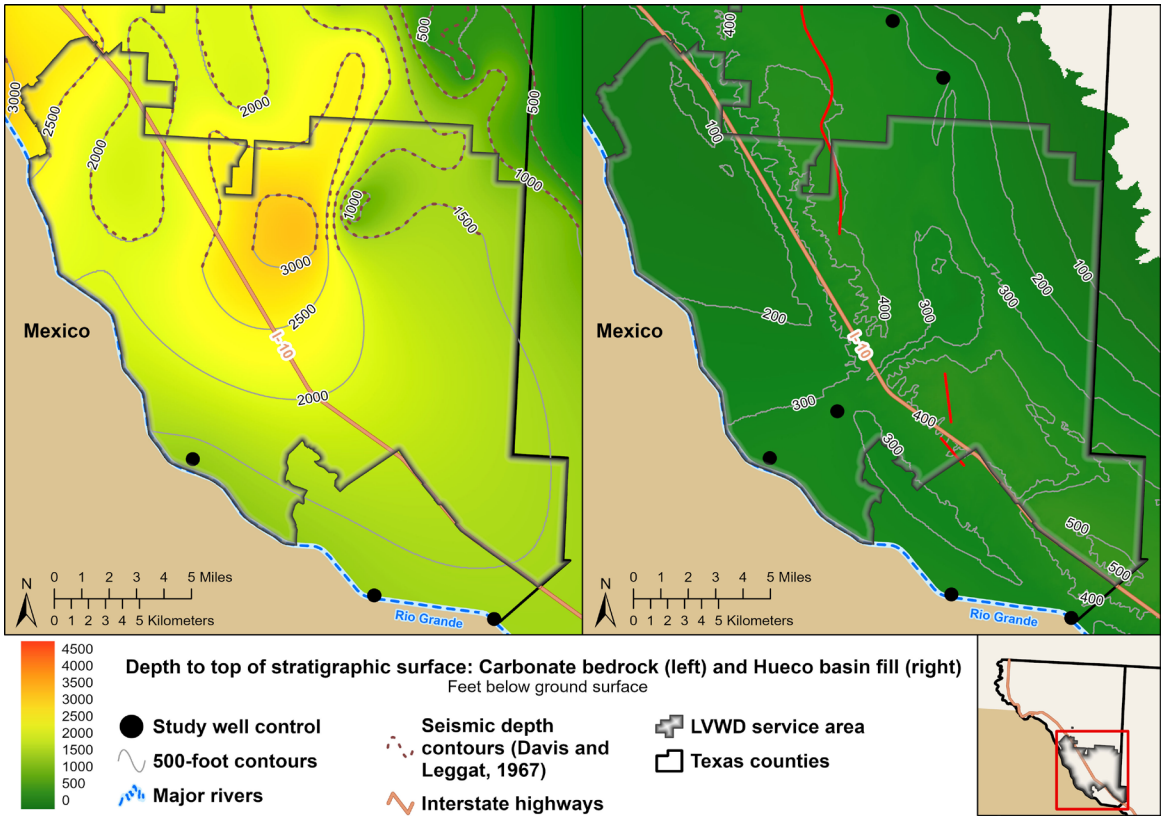

Figure 4. Depth to the tops of stratigraphic surfaces. Paleozoic-Mesozoic carbonate bedrock is on the left and the Hueco basin-fill deposits are on the right.

Water Quality

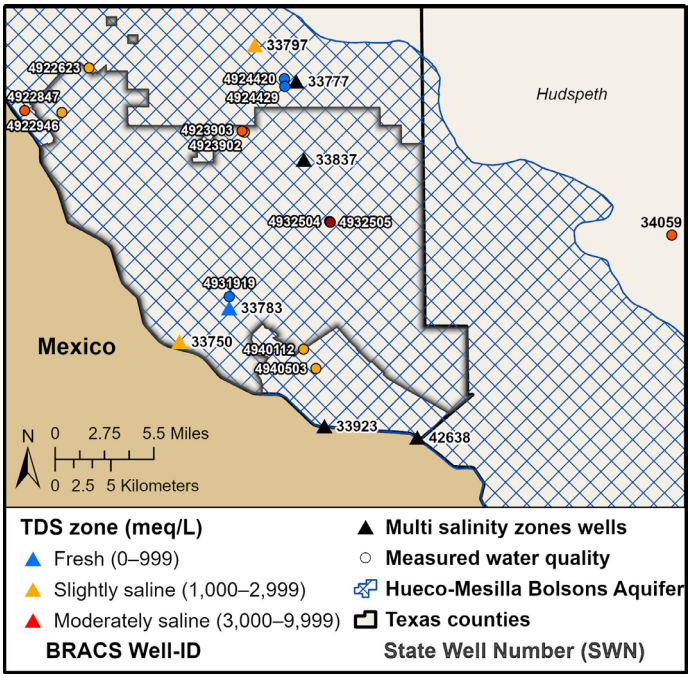

Figure 5. Measured and calculated water quality samples within the study area.

Water quality analysis was completed from publicly available measured samples and from total dissolved solids estimation from geophysical well logs (Figure 5). The complex geology of the Hueco basin-fill deposits means that the subsurface geochemistry is very complex. In general, it is not possible to map out zones of specific salinity levels due to this complexity and limited data; however, some interpretations could be made. Salinity levels generally increase with depth, but the depth of the saline water is highly variable across the study area. Subsurface structures, such as the Clint Fault, allow more saline water to move upward from deeper portions of the aquifer and the carbonate bedrock below. Additionally, wells in locations near extensive municipal and irrigation pumping have higher salinities due to upconing.

CONSIDERATIONS FOR ASR AND AR PROJECTS

While successful ASR projects have been implemented in a variety of groundwater conditions, understanding the hydrogeological characteristics of an aquifer is critical for design. A primary consideration for well construction is the native groundwater's Langelier Saturation Index, which shows whether the water will be corrosive or encrusting to the well materials. The Langelier Saturation Index values are variable within the study area but generally corrosive, which will necessitate additional site-specific testing (Figure 6).

El Paso Water began investigating ASR and AR projects in El Paso County and developed a feasibility study with the U.S. Geological Survey in 1952. A full-scale ASR project using reclaimed water began in 1985. However, as the injection wells ran over time, they began to experience problems with corrosion and decreased efficiency. El Paso Water transitioned to AR using surface infiltration basins, which has prevented costly maintenance.

All ASR injection and recovery wells in Texas must be authorized by the Underground Injection Control Program at the Texas Commission on Environmental Quality (TCEQ). At this time, authorizing an ASR system using reclaimed water as the injectate and would need to be accomplished on a case-by-case basis. The TCEQ permits disposal of municipal-treated wastewater adjacent to waters in the state through a Texas Land Application Permit. This process may be used to develop an AR project.

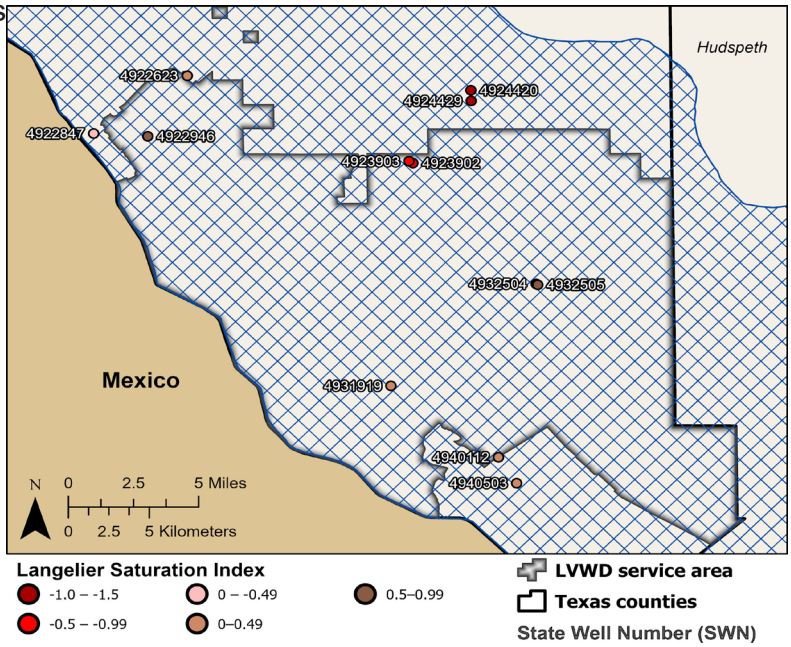

Figure 6. Langelier Saturation Index calculations for the study area.

FUTURE WORK

TWDB Report 391 highlights the gaps in the hydrologic data required to perform a full-scale aquifer characterization for LVWD's service area. Additional data collection will be needed for the design of an ASR or AR system. Covering a large portion of the study area may be possible using airborne geophysics. The sparsely populated study area makes airborne geophysical studies ideal, as there is less potential electromagnetic interference from electrical lines, industry, or houses. Seismic surveys may also be a viable alternative and provide a better understanding of the complex stratigraphy.

REFERENCES

Davis, M.E. and Leggat, K.R., 1967, Preliminary Results of the Investigation of the Saline-Water Resources in the Hueco Bolson Near El Paso, Texas: U.S. Geological Survey Open-File Report.

Ewing, T.E., 1991, The Tectonic Framework of Texas: Bureau of Economic Geology, The University of Texas at Austin, 36 p.

Reinert, S., 2017, Use of Spreading Basins for Managed Aquifer Recharge - The El Paso Experience: ASR for Texas, Presentation, May 04, Austin, Texas.

TWDB (Texas Water Development Board), 2022, Water for Texas, 2022 State Water Plan, 167 p.

WSP and Freese and Nichols, 2021, Far West Texas Regional Water Plan – Region E, prepared by Far West Texas Water Planning Group for the Texas Water Development Board, 21 p.