Managed Aquifer recharge

Background

Central valley supplies 40% of the of United States of Americas agricultural products. The arid Mediterranean climate of the central valley is ideal for year-round production; however, it requires vast amounts of groundwater extraction. The result of which is a continues lowering of the groundwater table across the central valley, with negative effects on groundwater availability and quality. Managing and reversing declining groundwater levels requires several measures, one is managed aquifer recharge.

What is MAR?

Managed aquifer recharge (MAR) is a strategy to store water underground for future use or to benefit the environment. The process involves increasing natural recharge, by directing water to areas where it can seep effectively into the ground or introducing recharge in dry regions where it doesn't occur naturally. The main benefits of MAR are that aquifers act like natural storage tanks for freshwater, holding large amounts of water that can be accessed during dry periods. Additionally, storing water underground is often cheaper and more efficient than building and maintaining large surface reservoirs i.e. lakes or dams. Essentially, MAR is a clever way to manage and save water by utilizing the natural storage capacity of the ground.

Case study central valley, California

The case study was carried out by the company Geophysical Imaging Partners (GIP). The purpose was to find the best location for an infiltration basin on a given area of farmland. GIP mapped the entire field using TEMcompany's tTEM instrument. The tTEM data was turned into resistivity models of the subsurface and using a simple color scale from dark blue/green (low resistivity) to red/purple (high resistivities) different subsurface materials could be identified. *In a MAR survey purple and red colors specify where to place the infiltration basin, as they indicate the highest resistivities which are typically areas with a high content of sand and gravel*.

tTEM

The advantage of the tTEM system is that compared to stationary soundings with limited spatial information, the output from a tTEM survey is continuous profiles, and therefore good resolution of potential structures is achieved, significantly improving the information and minimizing the risk of missing important features.

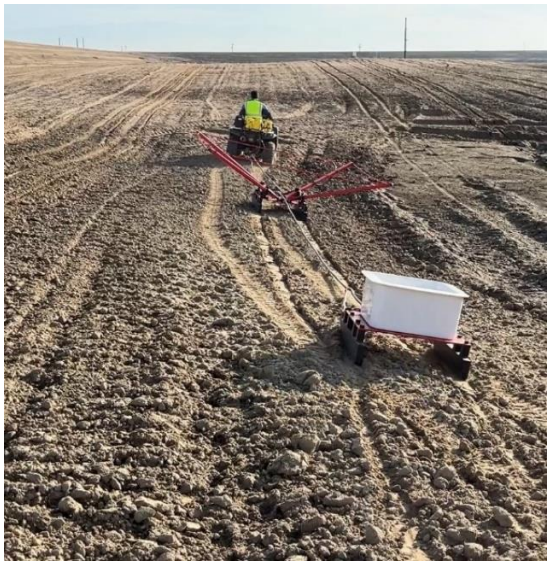

Figure 1. tTEM survey in central valley 2024 performed by GIP.

Results

Looking at the resistivity models of the subsurface a possible sand rich area (purple color) can be easily identified Figure 2, furthermore what appears to be sand channels can be seen across the field as elongated structures in red color.

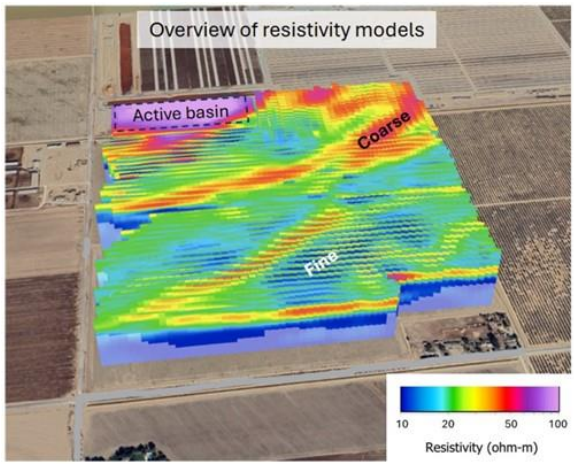

Figure 2. Data cube based on tTEM data, data acquisition lines are driven with 15 meters between and are each 800 meters long, data collection was done is less than a day.

It was also noticeable on arial photos of the field, that in the same area where tTEM data showed high resistivity, crops where less dense and green.

Figure 3 Arial photo of field, right corne crops are looking drier and crop coverage is less.

Benefits of the survey

Using the information, from the tTEM resistivity models the placement of the MAR infiltration basin was decided. The basin was placed in the part of the field where tTEM models showed the highest resistivities (purple color).

Figure 4 Establishing the MAR infiltration basin.

When the MAR infiltration basin was established, it achieved an infiltration rate of 2.300 AF in 125 days, which calculates to around 25 AF/day, about 30837 m3 pr. Day, achieving the goal of the project.

Figure 5 Pumping water from nearby canal to the infiltration basin.

Scientific papers

The case study resulted in two scientific papers, the first paper describes the geophysical survey and the transformation of data to lithology. The second paper describes the of a groundwater model with lithology input from tTEM survey. If you do not have access to the papers but are interested in them, please write to contact@temcompany.com and we will send them.

- Assessment of Managed Aquifer Recharge Sites Using a New Geophysical Imaging Method, Vadose Zone Journal, Behroozmand et al (2019) https://doi.org/10.2136/vzj2018.10.0184
- Managed aquifer recharge site assessment with electromagnetic imaging: Identification of recharge flow paths, Vadose Zone Journal, Pepin, et al., (2022) https://doi.org/10.1002/vzj2.20192