CASE STUDY

Multilevel Well System Improved Understanding of Groundwater Conditions in Deep Aquifers

Westbay System delivered detailed data in less time and at a reduced cost

CHALLENGE

Characterizing the plume in a shallow aquifer is simple, but investigating deeper aquifers poses several challenges.

SOLUTION

MACTEC evaluated various monitoring technologies and determined that Westbay System modular instrumentation was the only system not limited by insufficient sample capacity in a single borehole.

RESULTS

Use of the Westbay System for multilevel monitoring of the groundwater made it possible for MACTEC to investigate the deeper aquifers in greater detail over much less time and at considerably less cost than singlescreen wells could accomplish.

Standard wells proved incapable of accurately monitoring deep aquifers

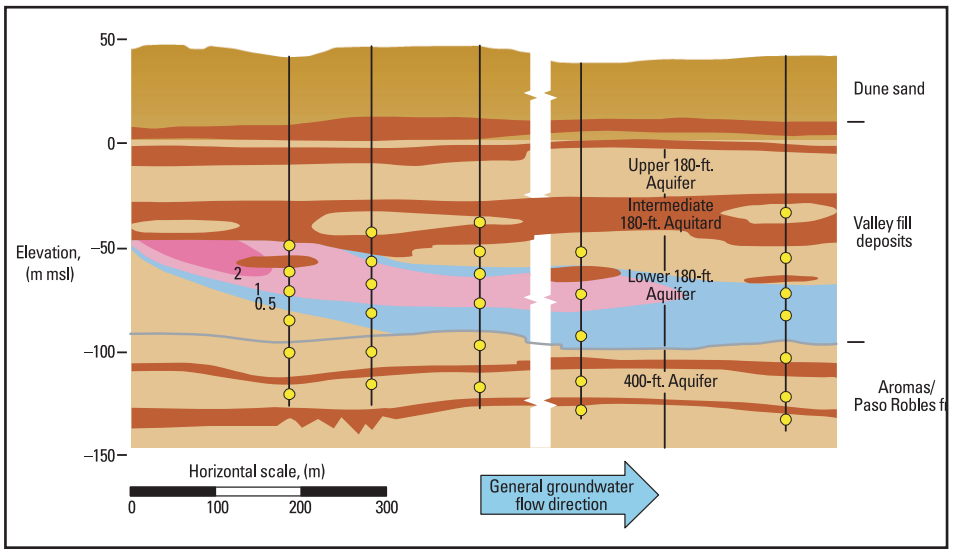
MACTEC E&C was contracted by the U.S. Army Corps of Engineers to conduct a groundwater investigation and remediation design at Fort Ord, a former army base near Monterey Bay, in central California, USA. Carbon tetrachloride had migrated from shallow aquifer to two underlying aquifers.

Characterizing the plume in the shallow aquifer was easy, but investigating the deeper aquifers posed several challenges. Located 350 to 500 ft [100 to 150 m] below grade, the deeper aquifers consist primarily of coarse sands and gravels. Historical flow directions in the deepest aquifer have varied significantly because of the effects of municipal and agricultural pumping, which have also resulted in regional seawater intrusion. Even after dozens of standard monitoring wells had been installed, there were significant gaps in the data available.

Westbay System was selected for its comprehensive monitoring capabilities

MACTEC evaluated various monitoring technologies and determined that Westbay System* modular instrumentation was the only system not limited by insufficient sample capacity in a single borehole. Westbay System wells were selected to provide the most cost-effective solution to monitoring groundwater at the depths required in addition to other beneficial features such as quality control that were not available with the alternative technologies.

The Westbay Systems were installed in two phases. In the first phase, six wells were installed with packers inside cased wells completed with 4-in. [100-mm] PVC casing and multiple well screens. In the second phase, nine Westbay Systems were installed by direct backfilling in holes drilled with a sonic drill rig.



Cross-section from Fort Ord, California, shows the carbon tetrachloride concentration (µg/L) (after Taraszki et al., 2002).

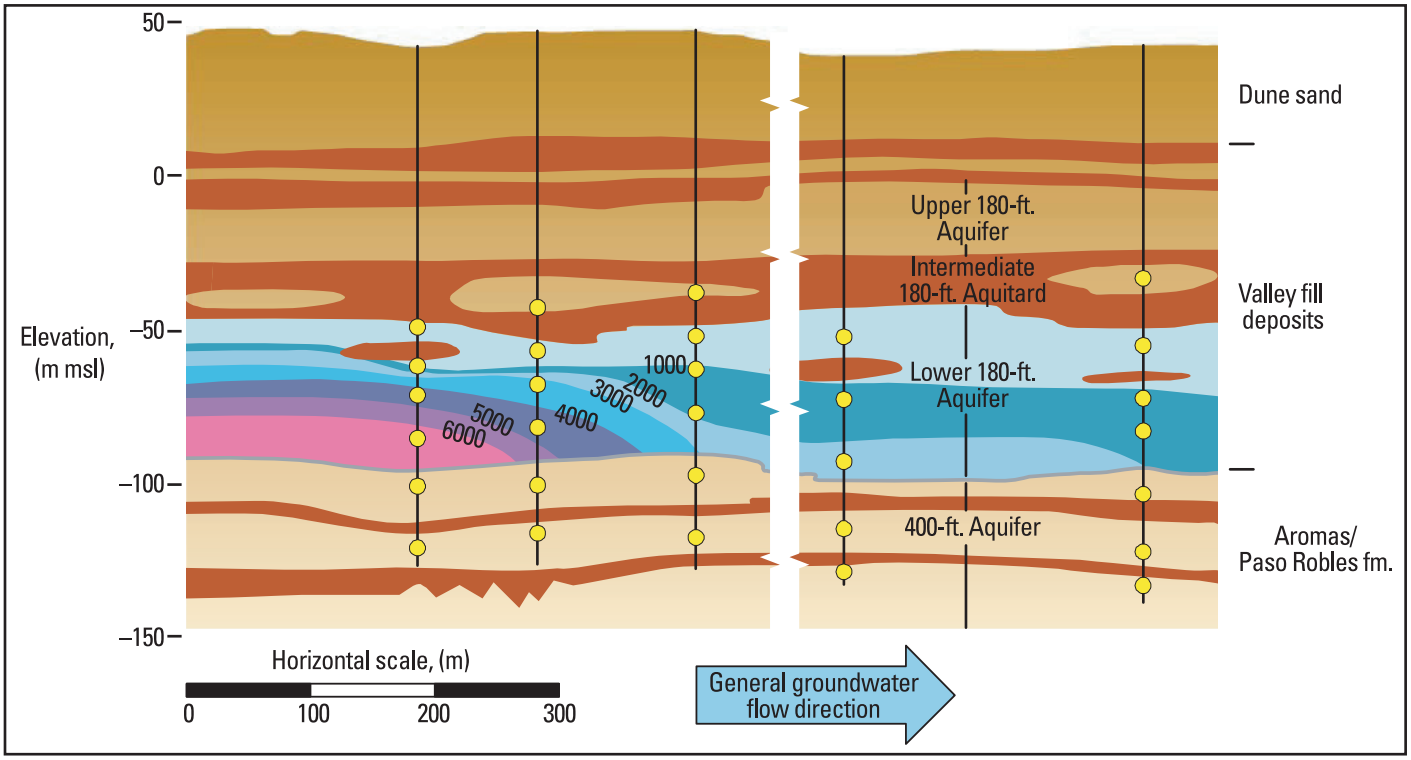
Westbay System delivered accurate characterization of deep aquifer system

The value of monitoring at multiple depths in the same aquifer is demonstrated by the cross sections overleaf. The upper figure shows early results of sampling for the distribution of carbon tetrachloride. The detailed interpretation of the distribution would not be possible if only one screened interval were positioned at each drilling location. In particular, if the screens were fully penetrating, the carbon tetrachloride distribution would be grossly misrepresented. Although characterization of the carbon tetrachloride distribution was the main objective of the project, the availability of multilevel data also provided new insight into seawater intrusion in the area. The lower figure shows the distribution of chloride concentrations, with the west (left) end of the cross section approximately 1.5 miles [2.4 km] inland from the Pacific coast of California.

The depth-specific nature of Westbay System monitoring has significantly advanced understanding of the extent of seawater intrusion within the site boundary. Although technically not a chemical of concern for the Army, the chloride concentrations clearly indicate that density variations must be accounted for in the groundwater model and proposed remedies.

Because the Army and Monterey County share data, these depth-specific chloride concentrations have greatly increased the county's ability to monitor seawater intrusion. Historically Monterey County relied on data from agricultural wells, for which the typical installation with multiple screens over significant depth intervals can have the effect of diluting the measured chloride concentration. Whereas previous data indicate possible chloride concentrations on the order of 500 mg/L at the site, depth-specific samples from the Westbay wells contain more than 6,000 mg/L of chloride at the bottom of one of the main drinking water aquifers in the area. Data from shallower ports in the Westbay System wells illustrate a textbook version of a seawater intrusion wedge. Continued monitoring will indicate whether intrusion is continuing to migrate inland or if the county's efforts to mitigate intrusion are effective.

Use of the Westbay System for multilevel monitoring of the groundwater made it possible for MACTEC to investigate the deeper aquifers in greater detail over much less time and at considerably less cost than single-screen wells could accomplish.



Cross-section from Fort Ord, California, shows the chloride concentration (mg/L) (after Taraszki et al., 2002).

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Taraszki, M., Merey, C., and Mitchell, G.: "Groundwater Quality Evaluation Using Westbay Monitoring Well Systems, Former Fort Ord, California," Proceedings of the National Monitoring Conference, 2002: Washington, DC, USA, National Water Quality Monitoring Council.

Westbay® Instruments