

Strategy for Site Closure of a Large and Dilute MTBE Groundwater Plume

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Background/Objectives. Remedial actions at a Marine Corps Base in San Diego County, California, were performed from 1997 through 2012 to address groundwater contamination from a gas station site. This active gasoline service station is located in a heavily pumped groundwater basin on Base. Remedial actions at the site have included the successful implementation of soil vapor extraction (SVE) and in situ air sparging (IAS). However, as a result of underground storage tank (UST) releases from the 1940s through 1990s, a 3,500 ft-long dissolved-phase methyl-*tert*-butyl ether (MTBE) plume migrated downgradient of the gas station site. Two oxygen injection biobarriers were installed in 2004 to address the midpoint and leading edge of the MTBE plume. After 6 years of biosparging and development of an updated fate and transport (F&T) model, site closure and no further action (NFA) were requested of the regulatory agencies. The request was denied, in an abundance of caution to protect production wells that were within 1 mile of the leading edge of the MTBE plume (i.e., human health) as well as protect ecological receptors. This abstract details the various approaches and activities conducted to ultimately obtain site closure and NFA of a large and dilute MTBE plume.

Approach/Activities. Various lines of evidence were presented to the regulatory agencies to obtain site closure and NFA of the site. The activities and techniques utilized to do this are as follows:

- Perform a cone penetrometer test (CPT) investigation at the leading edge of the dissolved-phase MTBE plume to identify the most permeable pathways in the subsurface, followed by subsequent installation and sampling of groundwater monitoring wells in these locations. Sample these wells to ensure Base production wells are not creating preferential pathways for vertical transport of MTBE below the groundwater table;
- Couple F&T modeling with a sensitivity analysis and capture zone analysis to demonstrate that the plume is relatively stable, production well demand changes would not affect the MTBE plume, and that MTBE concentrations would continue to degrade below the secondary maximum contaminant level (MCL; i.e., 5 µg/L);
- Perform statistical trend analysis on all historic data using the Sen's non-parametric and Mann-Kendall techniques;
- Implement a mobile and temporary (i.e., two years of operation) air sparge unit to address hot spot areas;
- Implement the State Water Resources Control Board Resolution No. 2012-0016 Low-Threat UST Case Closure Policy Questionnaire;
- Collect monitored natural attenuation (MNA) analytes to determine if biodegradation is still occurring at the site;
- Perform a correlation analysis to demonstrate the stability and immobility of the plume's leading edge under drought and non-drought conditions; and
- Perform two additional semiannual groundwater monitoring events to demonstrate continued plume stability.

Results/Lessons Learned. After implementing all of these activities, the regulatory agencies granted site closure with NFA in September 2016. Although the highest concentration of MTBE detected at the time of site closure was 17 µg/L (i.e., above the secondary MCL of 5 µg/L), multiple lines of evidence presented to the regulatory agency were sufficient to show that the

large and dilute plume was, stable, shrinking, and no longer a potential threat to human health and ecological receptors.