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Assessment of Post Remediation Performance of a Biobarrier Oxygen Injection System at an MTBE-Contaminated Site

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Background/Objectives. The DoD has funded numerous pilot- and field-scale demonstrations of in situ remediation technologies over the past 20 years. However, most such projects perform careful monitoring and assessment over only a few months to a few years, and questions regarding the long-term performance and impacts have been addressed only rarely. To address the need for understanding long-term performance, this project's goal is to conduct two rounds of rigorous long-term performance monitoring and evaluate the conditions fostering and limiting the long-term remedy performance of a biobarrier oxygen injection system at an MTBE-contaminated site. To that end, two primary objectives were identified: (1) evaluate the continued microbial activity to support ongoing attenuation of residual MTBE through the use of metagenomics and proteomics and (2) determine the influence on plume migration due to potential changes in formation permeability within the biobarriers including determining if aquifer clogging occurred and, if so, whether aquifer clogging could have caused a widening in the neck of the plume.

Approach/Activities. Groundwater samples were collected from locations in the contaminant plumes upgradient and downgradient of the two biobarriers as well as within the MNA zone between the two biobarriers and in areas outside of the plume. While both sets of groundwater samples have been collected, data evaluation is waiting on completing the metagenomics and proteomics analyses. One the analyses have been performed, trends over time will be investigated to determine if the mid-plume biobarrier had an impact at both of these wells. Metagenomic and proteomic data analysis will aid in the effort to determine if the biobarrier had a long-term (post shutdown) impact on the microbial composition and direct activity of bacterial populations within the area of treatment. This effort will provide further evidence on the natural attenuation capacity of the system for MTBE. Furthermore, it is hypothesized that the biosparging system contributed to clogging of the aquifer by the development of microbial biofilms. The metagenomic information may help improve understanding of the effect of these microbial biofilms on the aquifer. Slug tests were also conducted in order to compare to previously performed slug tests.

Results/Lessons Learned. Findings from proteomic and metagenomic analyses will be contrasted with results obtained using traditional geochemical analyses to evaluate benefits of incorporating omic technology in the monitoring toolbox as well as demonstrate the importance of incorporation of omic analyses to provide the most valuable, cost-effective site management information possible. Data collected within the radius of influence (ROI) of the biobarriers (mid-plume and leading edge) will be statistically compared using the analysis of variance (ANOVA) approach with data collected upgradient of the biobarriers. Additionally, the slug test results will be used to evaluate temporal and spatial changes in the formation to assess plume migration at the leading-edge and whether the impact of the biobarriers on the formation caused a widening of the plume footprint.