Measuring Diesel-Range Organic Concentrations in Groundwater

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Background/Objectives. Parsons designed, installed, operates and monitors remediation systems at several petroleum-contaminated sites at the former Galena Forward Operating Location (FOL) in Alaska. One of the contaminants of concern is diesel-range organics (DRO) which is measured using Method AK102. DRO is the contaminant of concern with the longest timeline to reach cleanup levels. DRO concentrations in groundwater at some wells have fluctuated above and below the cleanup level, raising concerns of entrained non-aqueous phase liquid (NAPL) during sample collection. DRO concentrations at other wells increased following initiation of remedial action. A variety of sampling methods have been used to better understand the DRO results.

Approach/Activities. Arctic diesel and JP-4 releases from pipelines and underground storage tank occurred over many years. The water table fluctuates over 25 feet annually due to influence of the nearby Yukon River, resulting in a large smear zone in an interval that is variably saturated; this interval is referred to as the variably saturated zone (VSZ). Alaska regulations require that monitoring wells be screened across the water table, and therefore wells across the VSZ have 25 to 30 feet screens.

To better understand DRO sample results, spilt samples were collected in 2020 through 2022 using low flow, passive diffusion bag, and HydraSleeve® sampling techniques. Some samples were further split and subjected to silica gel cleanup to remove polar compounds. These techniques can be effective in screening out NAPL blebs and separating polar metabolites from non-polar fuel constituents. The objective was to determine if NAPL blebs were being entrained in the samples, and to determine the impact of polar metabolites on the AK102 analytical result.

Results/Lessons Learned. On average, 94 percent of the DRO concentration in the low flow groundwater samples consists of polar compounds, assumed to be polar metabolites of DRO. Increases in DRO concentrations in groundwater following initiation of remedial action is attributed to increased biodegradation generating these more soluble polar metabolites. After two to three years of remediation, concentrations of DRO have started trending down. Results also showed that it is unlikely DRO fluctuations are due to entrained NAPL but are instead attributed to polar metabolites. A decision matrix was developed using low flow sampling techniques and low flow-silica gel cleanup DRO results to make decisions on remedial action operations (i.e., when to transition from active remediation to monitored natural attenuation). Polar metabolites are highly soluble and are primarily found in groundwater (as opposed to the unsaturated zone) and many polar metabolites will rapidly biodegrade under ambient conditions. Further bioventing treatment in the unsaturated zone is not anticipated to be an effective approach to enhancing their degradation. Therefore, the transition from bioventing to a natural attenuation remedy is recommended once DRO concentrations in groundwater are primarily polar metabolites and the presence of NAPL is unlikely. Sample results and the decision matrix provided weight-of-evidence to support shutdown of bioventing systems at three sites and transition to natural attenuation.