Transitioning to Monitored Natural Attenuation at Active Remediation Sites: A Moving Target

Zachary Wahl (zachary.wahl@arcadis.com) (Arcadis U.S. Inc., Portland, Oregon, USA)
Caitlin Bell (Arcadis U.S. Inc., San Francisco, California, USA)
Geoff Gay (Arcadis U.S. Inc., Atlanta, Georgia, USA)

Background/Objectives. Many sites contaminated with chlorinated solvent and/or petroleum hydrocarbons are tasked with remediation targets where monitored natural attenuation (MNA) alone is insufficient to meet remedial goals due to time constraints, required contaminant reductions, or potential exposure risk. Active remedies that rely on continuous or routine operations (e.g., reagent injection, groundwater extraction, sparging, vapor recovery, thermal treatment) can be transitioned to MNA prior to reaching identified cleanup goals in cases where these transition points have been built into the overall strategy or when regulatory approval is granted. For appropriate contaminants, MNA then leverages physical, chemical, and/or biological mechanisms to facilitate subsequent declines in contaminant concentrations. The ability of MNA to successfully meet remedial goals is highly dependent on site-specific conditions, so understanding when a given site can transition from active to passive operations is key for leveraging natural efficiencies and reducing cost. Screening-level criteria can help identify when active treatment could be transitioned to MNA, but United States guidance and statistical methods for MNA transition timelines and agreement vary widely by state.

Observations from a portfolio of remediation sites provide screening-level heuristics that, when coupled with site-specific data, can evaluate common statistical methods for determining the necessity of detailed MNA transition evaluations.

Approach/Activities. Results from groundwater monitoring data collected during active and passive remediation at a portfolio of chlorinated solvent sites were used to generate overall natural attenuation rates for trichloroethene. This overall natural attenuation rate includes the physical, chemical, and biological mechanisms influencing attenuation immediately after cessation of active remediation, as well as those contributing to long-term natural attenuation. For example, an active in-situ biostimulation approach increases the microbial biomass in the subsurface. This residual biomass is then consumed after active treatment is stopped which supports continued contaminant biodegradation at rates higher than that associated with long-term attenuation. The attenuation rate observed from the meta data evaluation along with available studies was used to evaluate the utility of common statistical methods in predicting the point at which natural attenuation processes alone could be relied upon to meet remedial objectives. A review of state guidance and statistical approaches was then performed to gain insight and develop pragmatic recommendations for application of these principals.

Results/Lessons Learned. The time at which a site undergoing active remediation can transition to MNA is a moving target. Approaches vary at the state level where techniques employ combinations of statistics and professional judgement. Ranges of natural attenuation rates for unique site settings can be a useful tool in benchmarking expected MNA timeframes and bracketing expectations for unique sites under review. Common practice integrates these expectations in advance of active treatment implementation, but these can also be incorporated as part of late stage project data review and decision making. Best practices ultimately leverage the combination of: available rates derived from chlorinated aliphatic hydrocarbon meta data, available statistical tools, and unique site data.