Impact of Land Development on the Stability of a TCE Plume

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Background/Objectives. Landau Associates has been investigating, monitoring, and performing various interim actions related to a roughly 3,000-foot long trichloroethene (TCE) plume originating from beneath a stormwater detention basin at an aerospace manufacturing facility in the Pacific Northwest. Long-term monitoring of the mature TCE plume has identified stable plume boundaries for the past decade or more, with steadily declining concentrations across most of the plume as a result of proactive interim actions. The conceptual site model for the plume indicates the boundaries of the leading edge of the plume are primarily controlled by a gaining stream (Powder Mill Creek) which is also the downgradient terminus of the plume. The influence of Powder Mill Creek has historically been sufficient to maintain the configuration of the plume and prevent migration of TCE toward another gaining stream located to the west of Powder Mill Creek. In 2015, a large commercial development occurred on the ridge located between the two streams where around 25 acres of previously wooded land was developed and covered almost entirely with impervious surfaces (buildings and parking lots). Monitoring of sentry wells along the leading edge of the plume successfully detected TCE in this area, indicating a never before seen shift of the plume boundary to the west/northwest as an apparent result of the development.

Approach/Activities. Within approximately 1 year of completion of the land development, TCE was detected for the first time at elevated concentrations in the sentry wells along the northwest edge of the plume. New monitoring wells were subsequently installed in this area to the north and west of the former sentry wells to evaluate the shift in the plume configuration. Additionally, the stormwater management system for the development was evaluated for potential influence on groundwater recharge, including reviewing the design of a stormwater detention/infiltration pond and observing seasonal conditions (i.e., presence of standing water) in the pond and an adjacent wetland. The groundwater data and site observations were used to determine whether the plume was actively migrating in a previously unobserved manner and direction, or whether it had only shifted and restabilized under the changed site conditions.

Results/Lessons Learned. It was determined that a relatively significant shift of the TCE plume to the northwest occurred, likely as a direct result of the elimination of most of the groundwater recharge across the 25 acre land development area. The concentrated infiltration of stormwater runoff at the detention pond and wetlands to the northwest of the plume has apparently slowed or halted the shift and even partially reversed it during the wet season. Based on current information, it appears that the plume has stabilized in its new configuration with some smaller seasonal shifts back and forth around the northwest edge of the plume. However, careful monitoring and observation will be needed to ensure that data fluctuations due to seasonal shifts are not masking a slow progression of contaminant migration in the northwest portion of the plume, especially in years with lower levels of precipitation or extended dry seasons. Plans for injection of treated groundwater to the west of the plume to enhance hydraulic containment have been developed as a contingent action if continued westerly migration is observed.