Unexpected Contaminant Transport Pathways Can Be Explained by "Hidden" Stratigraphy

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Background/Objectives. The lithology of many sites located in the Midwest USA and underlain by glacial till is often described as "sand" in hollow-stem auger boring logs. This oversimplification leads to an incomplete conceptual site model, which can reduce the ability to locate and remediate contamination beneath the site. Our conceptual site, based on multiple sites we've worked on, consists of two areas: a former industrial facility (Area A), and a capped former waste disposal area (Area B). Groundwater flows from Area A towards Area B. Shallow groundwater discharges into a lake downgradient of Area B.

Area A had ceased operating several years prior to the detection. During routine monitoring, a high level of cumene is detected in a previously "clean" well side-gradient of Area B. The sample is collected from 25 feet below the water table, whereas cumene, having a lower specific gravity than water, is expected to travel along the top of the water table. The detection of cumene may indicate a failure in the containment of the landfill in Area B. Our objective is two-fold: 1) discover the cumene source, and 2) determine potential downgradient impacts/ remedies.

Approach/Activities. Historical contaminant, water level, and boring log data are analyzed, using a GIS platform to understand and visualize the conceptual site model (CSM). A site visit is conducted to investigate potential sources. A round of sampling, including vertical aquifer sampling and synoptic water level measurements, is conducted. Continued monitoring provides on-going time series data, which shows the concentration of cumene fluctuating dramatically in the subject well and, years later, in a downgradient well. A series of membrane interface probes (MIPs) are advanced in strategic locations using a direct push machine. Immediate availability of the MIP results allows daily integration into CSM visualization tools, which supports accelerated, data-driven decision-making to direct probe advancement.

Results/Lessons Learned. A combination of complicated factors led to this plume's appearance. Using the MIP data, the plume source is traced to Area A. The pulsating nature of the plume suggests the contaminant release is influenced by stormwater events and/or groundwater fluctuations. The MIP data, along with a detailed review of historic boring logs, reveals the presence of a cemented sand layer in the subsurface. The cemented sand layer stretches from Area A to Area B, sloping downwards in the downgradient direction. In Area A, the cemented sand layer is above the water table, but by the time it reaches the subject well, the cemented sand layer is below the water table. The cumene traveling downgradient remains below this cemented sand layer, while the groundwater is able to pass through. Interpretation and visualization of the site geology and potential transport mechanisms are critical to understanding the presence and risks associated with unexpected detections of high levels of cumene at the site.

Targeted data collection and further detailed assessment of site geology and stratigraphy promote a holistic CSM and deeper understanding of the site, allowing stakeholders to avoid costly remedial activities that would not have addressed the true problem.