Thin Treatment Depths: A Thorn in Thermal's Side

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Background/Objectives. Designing and effectively implementing an in situ thermal remediation (ISTR) system begins with a heat balance model, calculating theoretical levels of energy input to the treatment volume and energy lost to the surrounding environment. The delta between energy input and energy lost defines the residual energy that will generate heat within the treatment volume. It is this residual energy that heats a treatment volume and ultimately performs contaminate removal.

The required level of residual energy necessary to reach the remedial goals on a specific site dictates overall system design, total project energy requirements, and remediation timeline. Historically, if a treatment interval is too thin, the effective vertical heat loss out the top and bottom of a treatment interval can be too great to overcome with engineering measures. This presentation will discuss novel innovations implemented at an electrical resistance heating (ERH) project in Northern California, including angled electrode designs that allowed the ERH system to effectively heat a thin treatment interval. Furthermore, other engineering considerations for this unique Site will be discussed, including:

- · Mitigating electro-magnetic interference (EMI) impacts to a main telecommunication line running through the middle of the treatment volume.
- · Considerations for safely applying ERH at a site with shallow groundwater.
- · ERH designs to allow un-interrupted traffic patterns above an electrode field.

Approach/Activities. The Site contains a 15,595-ft2 area of contaminated soil and groundwater extending from 2 to 11-ft bg, providing an impacted volume of 5,198- cy. Contaminants of concern (COCs) included PCE with appreciable amounts of BTEX and gasoline range total petroleum hydrocarbons (TPH-G). Several site attributes, made remediation efforts technically challenging and required unique design and operational considerations. The shallow treatment depth, small vadose zone, and shallow confining aquitard demanded that electrodes be installed on an angle. Additionally, a large portion of the contamination source area extended beneath a busy public road where subsurface utilities, including AT&T's main West coast fiber-optic and communication conduit, are buried within the treatment volume , requiring special design considerations to minimize traffic impairments, thermal impacts, and electro-magnetic interference (EMI) to the buried utilities.

Results/Lessons Learned. Remediation goals were reached and the project site was closed in early 2017. Confirmatory sampling results showed an overall reduction of PCE in site soil of 99.75% and an overall reduction in groundwater concentrations of approximately 99%. Furthermore, angling the electrodes allowed for increased electrode surface area and ultimately permitted higher energy flux into the thin treatment depths, allowing the system to overcome vertical heat loss impacts without an engineered site cap. Similarly, engineering controls put in-place during system installation and operation allowed the ERH system to operate without impacting the inter-state telecommunication lines or traffic patterns on the busy city street.