Integration of a Technical Impracticability Waiver and Groundwater Hydraulic Containment to Mitigate Risk at a Fractured Rock DNAPL Site

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Background/Objectives. We outline a strategy that we successfully deployed to integrate a Technical Impracticability (TI) Waiver with groundwater hydraulic containment and appropriate contingencies to mitigate risks at a former waste oil handling site in rural Maine. A groundwater plume of chlorinated volatile organics (cVOCs), attributable to a DNAPL source in fractured bedrock, is elongated along primary bedrock fractures, and discharges to surface water, wetlands and residential wells. A TI Evaluation was performed following publication of the Interim ROD in order to assess potential groundwater cleanup timeframes. Results of the TI evaluation supported the grant of a TI Waiver, predicated on implementation of a groundwater hydraulic containment system (GHCS) for the DNAPL source, institutional controls, provision of public water supply, and response to vapor intrusion (VI) if VI risks were identified.

Approach/Activities. Site characterization activities in support of the TI evaluation included monitoring well installation, borehole geophysics, packer testing, rock core and groundwater sampling and analysis, and a pumping test. A groundwater flow model was developed to evaluate fate and transport, and to screen remedial alternatives for potential effectiveness and cost. Results of the evaluation supported grant of a TI Waiver due to the challenges and limitations inherent in remediation of DNAPL in fractured bedrock, on the basis that exposure and plume expansion risks were mitigated. Groundwater modeling was utilized to evaluate effectiveness of extraction and re-injection design alternatives to contain the plume within the TI zone. GHCS design was complicated by relatively low bedrock transmissivity, location of the DNAPL source area on a topographic high point, and fluctuations in groundwater elevation in a low storage system. The groundwater model was also utilized to establish an institutional control zone (ICZ) and a basis for public water system supply. A VI evaluation of nearby residences identified a potentially complete pathway and vapor mitigation systems were installed at multiple locations.

Results/Lessons Learned. A robust site investigation and reliable conceptual site model are prerequisites for a defensible TI evaluation. A converging lines of evidence approach was used to demonstrate the likely presence of DNAPL in fractured rock in the absence of direct DNAPL observation. A well-calibrated groundwater flow model was an important tool for both the TI evaluation and design of the GHCS. Effective deployment of combined remedies were required to address human health risks under the TI Waiver scenario, including the GHCS, institutional controls, public water supply to serve homes within the ICZ, and vapor mitigation systems. Other elements include long term hydraulic and chemical monitoring in order to demonstrate plume containment, elimination of other potential exposure pathways, and progress towards reducing groundwater cVOC concentrations. The data demonstrate that the GHCS is effectively containing the plume, and that groundwater quality has improved both inside and outside of the capture zone. These data, coupled with open and frequent communication with regulatory and local stakeholder representatives, has provided for favorable public impressions and was a key factor for numerous property transfers near the site, and thus a favorable outcome for the public and the client.