Clays Ferry Travel Plaza, Richmond, KY

Bedrock Characterization and Reduction of Contaminant Concentrations

OVERVIEW

Remediation of groundwater contamination in bedrock is challenging in most cases. Subsurface characterization is a key step to effective reduction of contamination concentrations. Petroleum contamination in groundwater was confirmed at the Clays Ferry Travel Plaza as far back as 1985. Multiple releases were reported over the years. The final portion of the site to receive No Further Action (NFA) status was a BTEX plume in groundwater in shallow bedrock near the pump island area. A number of technologies were used to characterize the subsurface prior to implementing corrective actions. Reimbursement for site characterization and remediation was made from the Kentucky Petroleum Storage Tank Environmental Assurance Fund. The Kentucky Underground Storage Tank Branch (USTB) worked with the tank owner and his consultant, Shield Environmental Associates of Lexington, Kentucky, and an injection contractor, AST Environmental of Midway, Kentucky, to achieve NFA. Mundell & Associates, a geophysics consultant from Indianapolis, Indiana, performed surface and borehole geophysics work.

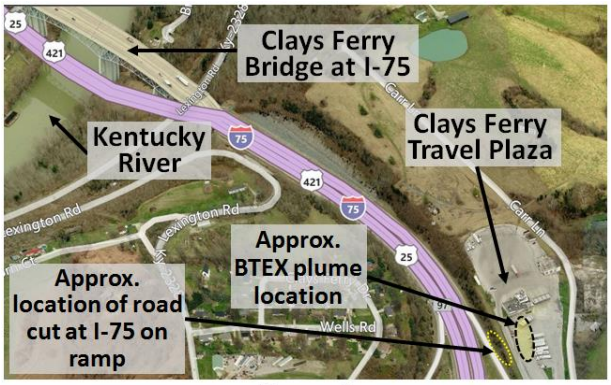

Figure 1

HISTORY

The Clays Ferry Travel Plaza (also called Clays Ferry Travel Center) is located south of Lexington and is situated near the Kentucky River just off Interstate 75 in northern Madison County (*Figure 1*). The property reportedly was undeveloped prior to initiation of retail gasoline and diesel sales, which began in the early 1970s.

During development of the site, two ridge tops reportedly were removed and pushed into nearby ravines to create a level area for the truck stop, which included UST systems, a restaurant, and a store. Bedrock identified during subsurface characterization work generally was encountered at less than 5 feet below grade and consisted of the Upper Ordovician Calloway Creek Limestone, which is underlain by the Garrard Siltstone and the Clays Ferry Formation. According to Kentucky Geological Survey maps, the area has a limited to moderate potential for karst development. Groundwater movement in near surface bedrock primarily is in fractures and along geologic contacts.

Because a portion of the UST systems were situated below the soil-bedrock interface, monitoring wells screened in bedrock were installed. Monitoring of BTEX in groundwater in bedrock in the plume area began in 1996.

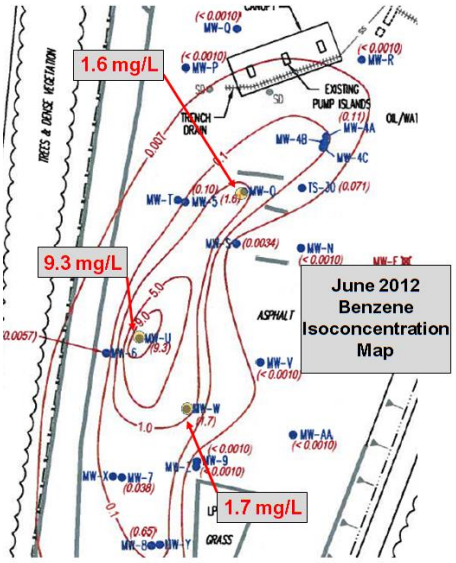

Figure 2

BEDROCK CHARACTERIZATION AND REMEDIATION

While Benzene had overall declining trends historically, concentrations remained above screening levels as of 2012 (*Figure 2*). Mobile dual-phase extraction was used a couple of times but results showed little change in groundwater elevation and no vacuum at nearby monitoring points. High-pressure injection of a carbon-based injectate into bedrock was suggested as a corrective action option. Before initiating injection into bedrock, which had been performed at a couple of Kentucky UST sites, additional bedrock characterization was required to better determine where contamination was located.

Bedrock characterization activities included assessment of groundwater at different depths in bedrock via the installation of sets of clustered monitoring wells (i.e., well screens were isolated at different vertical intervals) , collection of bedrock cores (*Figure 3*), surface geophysics (electrical resistivity survey to characterize bedrock surface and shallow bedrock), borehole geophysics (natural gamma, EM resistivity, three-arm caliper, and acoustic televiewer), downhole video, and discreet vertical groundwater sampling/pump testing using a straddle packer assembly. 2-dimensional electrical resistivity survey results helped identify near-surface bedrock features such as fractures and weathered zones that possibly control vertical and lateral contaminant migration. Based on the surface geophysics interpretation, bedrock injection points were advanced. The results of the borehole geophysics and discreet vertical groundwater sampling established that BTEX in groundwater was confined primarily to the upper few feet of bedrock. Data from the several methods mentioned above and geologic interpretations allowed the consultant and the injection contractor to identify specific vertical bedrock injection intervals for a test injection.

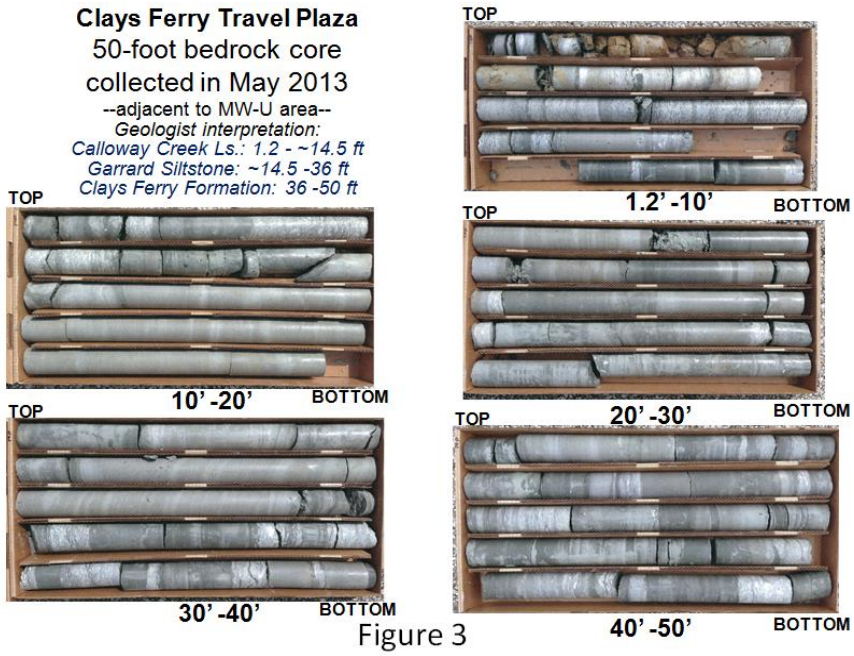

Figure 3

A high-pressure bedrock test injection of a carbon-based injectate through a straddle packer assembly was performed in May 2013. Based on test injection results, additional bedrock injection points were advanced and a full-scale injection of the plume was performed in April 2014. Injection pressures generally were in the 200 to 500 PSI range. Distance of influence from the injection points was determined by observation of daylighting and groundwater elevation changes measured by pressure transducers. For example, injection slurry was observed west of the site at more than 125 feet away from bedrock injection points along an Interstate 75 road cut (*Figure 4*).

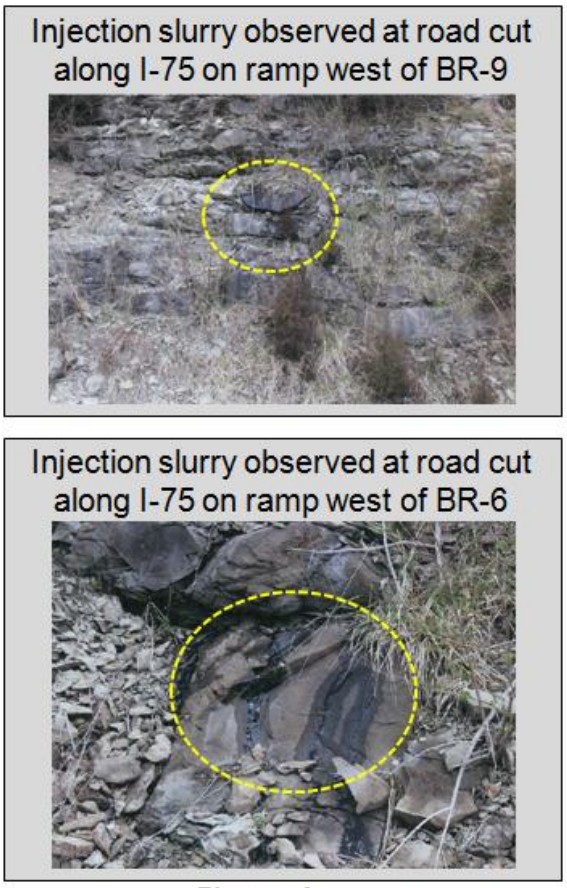

Figure 4

SUMMARY

After many years of only monitoring a BTEX plume in groundwater in bedrock at a site in northern Madison County, a relatively new remediation approach was proposed to the KY USTB. Numerous data gaps had to be filled in prior to performing a high-pressure test injection. A test injection of a carbon-based injectate into bedrock was performed in 2013. Because of results that showed reductions in BTEX, the larger plume area was injected in 2014. Post-injection data showed a reduction in contaminant concentrations across the plume. After several post-injection monitoring events, NFA status was given in 2015. Because USTs remain in the ground at the Clays Ferry Travel Plaza, the subsurface will be assessed again in the future.