Geo-Cleanse Remediation Summary
East Hartford, Connecticut
Goodwin College/Brownfield
Petroleum Hydrocarbons and LNAPL

Overview:
The site was a former petroleum bulk storage and distribution facility that is impacted with volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), including a light non-aqueous phase liquid (LNAPL), which has been identified throughout much of the 1.47 acre site. The VOCs present are primarily benzene, toluene, ethylbenzene, and xylenes (cumulatively referred to as BTEX), and the SVOCs present are polynuclear aromatic hydrocarbons (PAHs). Extractable total petroleum hydrocarbons (ETPH) are also present throughout the site. Products distributed and stored on-site included #2 heating oil, diesel fuel and kerosene. The tank farm was decommissioned in May 2009 and five bulk above ground storage tanks (ASTs), three fuel additive ASTs, two loading racks, and associated above ground piping were removed.

The site is currently a bituminous-paved faculty/staff parking lot for a higher education building. The majority of the parcel is flat with multiple utilities, including fiber optics, electrical and a storm water system, and existing PVC monitoring/recovery wells. Soil encountered throughout the site consists primarily of reddish brown fill material from approximately 1 to 4 feet below ground surface (ft bgs), overlying fine to coarse sand extending 14 to 22 ft bgs. Depth to groundwater is approximately 12 to 14 ft bgs.

The primary remedial goal was to address the petroleum hydrocarbon contamination sorbed to soil (vadose and saturated zones) and present as LNAPL. In accordance with the Connecticut Department of Energy and Environmental Protection Remediation Standard Regulations, it is required to remove all LNAPL from the groundwater table to the maximum extent practicable.

Active Injection with Catalyzed Hydrogen Peroxide

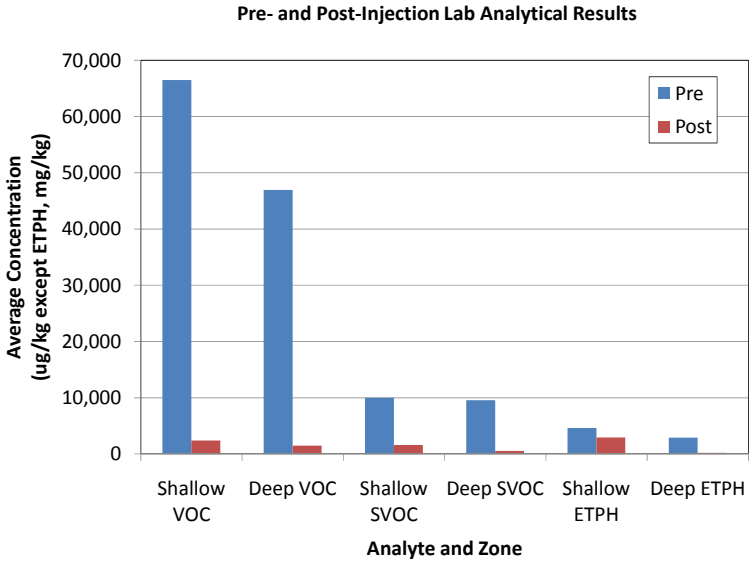
Treatment Program Design:
Geo-Cleanse International, Inc. (Geo-Cleanse) was contracted to design and implement a pilot-scale in-situ chemical oxidation (ISCO) treatment program to address the petroleum hydrocarbon contamination. Based on the site conditions, catalyzed hydrogen peroxide (CHP) was determined to be the most appropriate oxidant to address the contaminants of concern and LNAPL. The CHP injection program was coupled with an enhanced product recovery system (EPR) to more efficiently address the heavily impacted area. Benefits of coupling these systems extend beyond product recovery and contaminant destruction. The EPR system actively removes O_2 and CO_2 gases from the subsurface promoting a larger radius of influence and mitigating any potential damage to the bituminous-paved cap and utilities.

The pilot area was approximately 2,500 ft^2 with a vertical treatment interval from 4 to 16 ft bgs. A total of 18 injection and 12 vent wells were installed via direct-push drilling technology. The vent

wells were utilized to allow off-gases formed from the CHP to be released in a controlled manor and to protect the integrity of blacktop and underground utilities. The vent wells were also used as LNAPL recovery wells.

Remediation Operations:
The ISCO treatment program consisted of a pilot-scale injection event to confirm site design assumptions and determine potential contaminant mass reductions. A total of approximately 49,000 gallons of injectate with an average hydrogen peroxide concentration of 7% was injected over a 20 day period. The LNAPL was recovered actively with the EPR system or passively due to mounding through the vent wells. Daily process monitoring of the groundwater and off-gas allowed for "real-time" treatment program modifications to ensure that conditions were conducive for CHP and that the reagent was allocated to the most contaminated areas of the site.

Treatment Results:
The pilot test design, with respect to injection well layout, construction, and vertical distribution, was effective. The process monitoring data coupled with the lab analytical results confirm effective distribution of the reagents in both the saturated and unsaturated zones. Treatment in the saturated zone was widespread, with an average of 84 - 97% destruction of the VOCs, SVOCs, and ETPH. Treatment in the unsaturated zone was also effective, with an average of 84% - 96% destruction for the VOCs and SVOCs. The ETPH contaminant mass in the unsaturated zone was reduced, but not as effectively as the VOCs and SVOCs. The lower treatment effectiveness for ETPH in the shallow zone was reflected in the off-gas CO_2 concentrations measured during the field injection, which indicated that treatment was incomplete. The LNAPL was recovered through the vent wells and treated on-site, and LNAPL thickness decreased to an average of 0.01 ft from 0.10 ft over the course of the pilot test. The Geo-Cleanse® Process, combined with our constant process monitoring, ensured a safe and efficient injection and recovery program. Results demonstrated CHP can be effectively and safely implemented at this site despite the many site challenges.



This summary sheet is intended to provide a general overview of the referenced site. For more detailed information, please contact us at (732) 970-6696.