

Remediation of a CVOC Plume Using TreeWell® Phytoremediation Technologies as Part of a Combined Remedies Approach

Christopher Gale (ans.cgale@treewell.com) (Applied Natural Sciences, Encinitas, CA)
Bruce Smith (bsmith@cecinc.com) (Civil & Environmental Consultants, Inc, Monroeville, PA)
Doug Riddle (riddlefdk@aol.com) (RELLC, Morriston, FL)
Duane Wanty (duane.wanty@se.com) (Schneider Electric)

Background/Objectives. The site is a former manufacturing facility in western Pennsylvania. Groundwater and soil at the site were affected by chlorinated VOCs. A combined remedies approach was implemented to address soil and groundwater impacts at the site. Source area remedies included targeted excavations, soil vapor extraction, in situ bioremediation and in situ chemical reduction. Dissolved phase CVOCs were identified to be migrating off-site in shallow (up to 15 ft bgs) surface soils and in the upper portions of fractured marine unit bedrock (approximately 15-35 ft bgs) and underlying fractured sandstone (up to 47 feet deep). This talk will focus on the implementation of a *TreeWell* unit-based phytoremediation system to address groundwater impacts downgradient of the source area and mitigate the off-site migration of CVOCs in groundwater.

Approach/Activities. *TreeWell* unit-based phytoremediation system is a sustainable nature-based remedial alternative that is designed to isolate targeted groundwater intervals and encourage downward root growth towards the targeted interval. The system is designed to prevent infiltration of surface water or non-target zone groundwater, thus ensuring the trees are using groundwater from the target interval. An initial pilot study plot of 52 *TreeWell* units was installed in December 2012 with a combination of willows and hybrid poplars. The pilot *TreeWell* units were installed in the groundwater in three parallel rows. One row was completed in the soil layer, one completed in the upper bedrock horizon and one row where the *TreeWell* units alternated between the two zones at the site. Based on positive initial results observed in the pilot study area, an additional 166 *TreeWell* units were installed downgradient of the pilot study. The full-scale installation included a combination of willows, hybrid poplars, black locust, London plane trees, and red twig dogwoods installed to target groundwater in the shallow surface soils and the upper two fractured bedrock horizons.

Results/Lessons Learned. Since installation, tree growth and health have been observed to overall be very good in both the pilot study and full-scale installations. Overall, tree mortality has been low and trees have exhibited vigorous growth since installation despite total CVOC concentrations that exceeded 260,000 µg/L near the source. Since installation of the full-scale system, concentrations of VOCs in groundwater in both the shallow surface soils and the upper two fractured bedrock horizons have exhibited decreasing concentrations trends. Groundwater monitoring results also indicate the *TreeWell* units are effectively providing hydraulic control of the VOC groundwater plume and preventing further off-site migration. Groundwater monitoring data demonstrate that this nature-based system has been an effective, sustainable, and cost-efficient alternative for addressing the dissolved phase plume at this site.