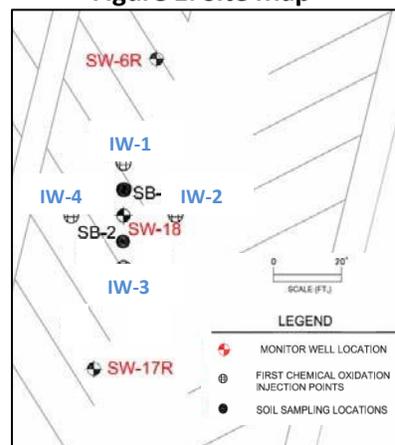


CASE STUDY: SOIL BOUND BTEX TREATMENT AND ACTIVE REMEDIATION SYSTEM INTEGRATION

Purpose: The purpose of this pilot study was to demonstrate the feasibility of using PetroCleanze™ to desorb petroleum contaminants from the soil into the dissolved phase where they can then be treated by physical extraction or an active remediation system.

Background: A biosparge system was used at the site until groundwater concentrations dropped below cleanup target levels (approximately 2 years), then it was shut down. Rebound occurred during post-active remediation monitoring and groundwater concentrations increased above natural attenuation default concentrations. The observed increase in dissolved contaminant concentrations, combined with high organic vapor analyzer readings in saturated soil samples, and elevated fraction of organic carbon and total organic carbon concentrations in the soil, suggested petroleum contamination was likely absorbed to organics in saturated soils and was slowly desorbing into the groundwater. An approach was needed to liberate bound hydrocarbons for additional treatment using the biosparge system.

Figure 1. Site Map

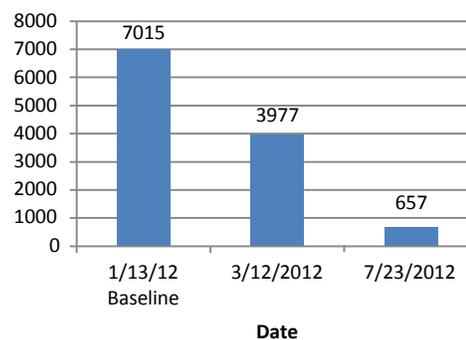


Pre-Injection Baseline Analytical: On January 12, 2012, baseline groundwater samples from monitoring wells SW-6R, -17R, and 18 (Figure 1) were collected for BTEX (benzene, toluene, ethylbenzene, xylene) and TRPH (total recoverable petroleum hydrocarbons) analysis (Figure 3, 4). On January 13, 2012, two soil borings (SB-1 and SB-2) were completed and baseline soil samples were collected from 12-14 feet below land surface for BTEX analysis (Figure 2). Figure 2 shows the average soil BTEX concentration for SB-1 and SB-2 before and after PetroCleanze injection.

PetroCleanze Injection: On February 2-3, 2012, a total of 2,220 gallons of 5% solution of PetroCleanze was injected into four injection points surrounding SW-18. Each point received a total of 550 gallons of solution, including 220 lbs of RegenOx Part A, 240 lbs of PetroCleanze, and 500 gallons of water. The biosparge system was reactivated for the duration of the treatment event.

Post-Injection Analytical: On March 12, 2012 and July 10th, 2012, groundwater samples from groundwater monitor wells SW-6R, -17R, and -18 were collected for BTEX and TRPH analysis (Figure 3, 4). Also on March 13th and July 23rd, 2012, two soil borings (SB-1 and SB-2) were completed and soil samples were again collected for BTEX analysis (Figure 2).

Figure 2. Average Soil BTEX





Results: Performance parameters were evaluated for SW-6R, -17R, and -18 and a marked increase in ORP values was observed in each of the three wells following the PetroCleanze injection indicating chemical oxidation activity. Additionally, the pH in wells SW-17R and -18 increased significantly, providing evidence that alkaline conditions resulted from the application of PetroCleanze. As anticipated, increases in TRPH and BTEX concentrations in the sampled wells were observed following PetroCleanze injection as compared to baseline (Figure 3, 4). SW-17R was slightly unique in that BTEX concentrations went down. When looking at the average soil BTEX concentration of the two soil samples (Figure 2) in January, March, and July 2012 (7,015, 3,977, and 657 µg/kg, respectively) there was a **43% reduction** between January and March and a **91% reduction** between January and July 2012 after continued biosparging treatment.

Figure 3. Total BTEX

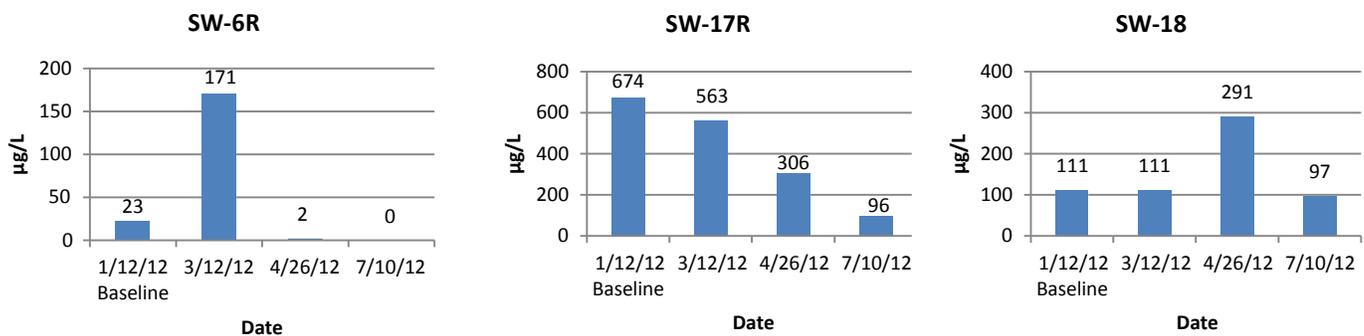
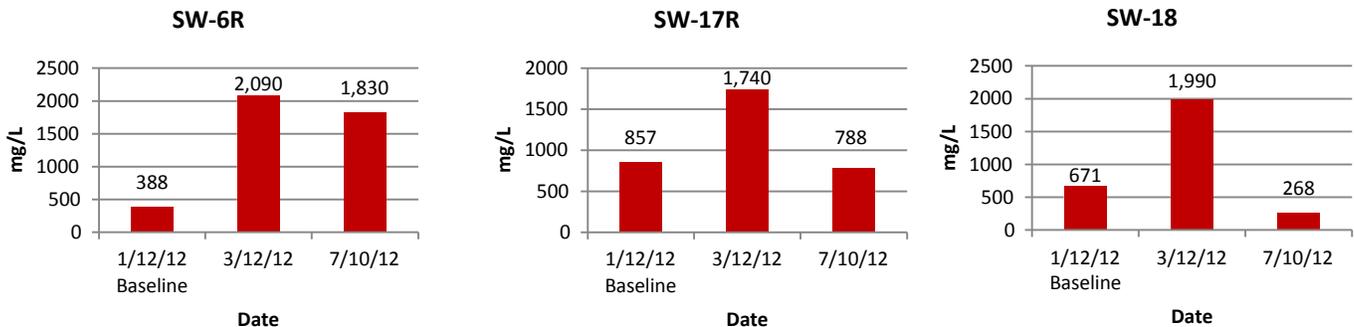


Figure 4. TRPH



Conclusion and Recommendations: The PetroCleanze application was successful and the material easily applied. Performance exceeded expectations as only one injection was needed to strip **91%** of the BTEX contamination from the soil into the dissolved phase. The reactivated biosparge system was able to treat the increased dissolved phase contaminants in the treatment area.

The current groundwater concentrations at the site are very low in key monitoring wells; therefore, the project does not require additional treatment at this time. However, should a change in contaminant concentration be observed at the site once active remediation has been ceased then additional treatment will be considered.