

**TECHNICAL BRIEFING – FINAL 2011 ANNUAL MONITORING REPORT AREA D (PICA 076)
GROUNDWATER – AUGUST 2012**

The document reviewed was an annual report for post-remedy groundwater and surface water monitoring completed in 2011. The response action for the site involved the installation of a permeable reactive barrier (PRB) in April 2007 to protect surface water quality in Green Pond Brook. Groundwater containing volatile organic compounds (VOCs) in the plume upgradient of the PRB travels through the PRB and is passively “treated” during transit time through the barrier as it reacts with the iron filings within the barrier. The remainder of the plume is treated with monitored natural attenuation (MNA). The contaminants of concern (COCs) in the area consist of the following: tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). The predominant COC is TCE.

Several types of monitoring are performed in the area at a frequency specified in the Remedial Design Report and in subsequent approved modifications. The monitoring can be classified as follows:

- PRB performance monitoring
- PRB hydraulic performance monitoring
- Surface water compliance sampling
- MNA sampling
- Supply well sampling

Each of the monitoring programs and attendant results are discussed below.

PRB Performance Monitoring

Performance monitoring for the PRB is designed to evaluate the function and efficiency of the barrier. COC concentrations are examined upgradient and downgradient of the barrier to track the reduction in concentrations as groundwater travels through the barrier. Samples are analyzed for VOCs and for alkalinity, dissolved iron, and sulfate. Sampling in March 2011 was for VOCs only and in August/September 2011 was for VOCs and the other parameters. Influent TCE concentrations upgradient of the barrier were as high as 4,620 ug/L and most downgradient concentrations were less than 1 ug/L.

TCE concentrations greater than 1 ug/L have been detected downgradient of the barrier in one of the deep monitoring wells (PRB-6). The report also states the following: “Low concentrations of daughter products cis-1,2-DCE and VC were detected in some samples downgradient of the PRB. MNA processes act to decrease the remaining COC concentrations to reach the surface water cleanup criteria in GPB.” Most of the downgradient detections of VC were below 2 ug/L, the ROD comparison criteria, and the one exceedance of the comparison criteria was 3.82 ug/L. As for 1,2-DCE one of the exceedances was a concentration of 48.3 ug/L in reference to the comparison criteria of 10 ug/L; the exceedance was almost five times the comparison criteria. Detected concentrations may be low in comparison to the upgradient influent concentrations but in reference to comparison criteria the exceedances are from about two to five times the comparison criteria.

PRB Hydraulic Performance Monitoring

The report notes the following: “Wells located in both the shallow and deep unconfined aquifer in the vicinity of the PRB and indicate that groundwater flow is passing through the PRB and eventually discharging to GPB. No evidence of groundwater mounding upgradient of the PRB was observed, confirming the PRB is operating hydraulically as designed.” Based on reported flow conditions it appears that flow is entering the PRB as intended in the design and not bypassing the barrier nor is groundwater mounding occurring.

Surface Water Compliance Sampling

There are four surface water sampling locations located along Green Pond Brook. The annual report states that “no constituents were detected in surface water above the Area D Record of Decision comparison criteria in 2011, except for slight exceedances of the VC comparison criteria in June 2011 at D-SW-3 and D-SW-4.” The Area D ROD comparison criteria for VC is 0.083 micrograms per liter (ug/L). The detection of VC in June 2011 at D-SW-3 was 0.67 ug/L; the VC concentration was over eight times the ROD comparison criteria. During the same sampling event VC was detected at a concentration of 0.62 ug/L at D-SW-4 – that concentration at over seven times the comparison criteria. Both results were flagged with a ‘J’ indicating that concentrations were estimated. It is the reviewer’s opinion that such exceedances, despite being estimated concentrations, would not typically be characterized as “slight.”

Surface water discharge data for the U.S. Geological Survey (USGS) gauging station along Green Pond Brook shows the lowest flow recorded of the three monitoring events for the year (2.1 cubic feet per second [ft³/sec]) compared to March 2011 and December 2011 (61.0 ft³/sec and 51.0 ft³/sec, respectively). It is the opinion of the reviewer that it is probable that VC enters the stream at other times of the year but it's presence is not detected due to dilution by higher discharges in the stream.

MNA Sampling

MNA sampling includes monitoring wells both upgradient and downgradient of the PRB; the purpose of MNA sampling is to monitor the decrease in contaminant concentrations over time via natural processes.

The MNA monitoring wells are categorized by their location in the plume as follows:

- Upgradient and cross gradient background: D-13-1, D-111-1
- Former source area: D-9-H (not sampled in 2011 due to an obstruction in the well which has since been repaired)
- Plume centerline: D-92-3, D-112-6, D-112-7, D-MW21-1
- Plume fringe: D-41-8, D-41-9, D-CAF-2, D-CAF-6; and
- Sentinel: D-41-16, D-41-17, D-41-14, D-41-1, and D-MWD-1.

Three sentinel wells are located downgradient of the PRB (D-41-14, D-MWD-1, and D-41-1). Of the downgradient wells two are located between the PRB and GPB; D-41-1 is located on the opposite side of GPB. Wells D-41-16 and D-41-17 are side gradient of the PRB and seem to be situated to detect contamination that might be skirting the PRB. Sampling for VOCs is on an annual frequency; samples are collected using passive diffusion bags (PDBs). Biogeochemical parameters included the following which are sampled every 5 years: total organic carbon (TOC), nitrate, total and dissolved iron, sulfate, and field analytes (dissolved oxygen, oxidation-reduction potential, pH, and conductivity). These parameters are used to "evaluate aquifer chemistry." Biogeochemical parameters are sampled using HydraSleeves; the last sampling event was in 2010. A total of 15 monitoring wells comprised the MNA network for the 2011 sampling year. Results for each of the COCs

PCE

- No exceedances of the 1 ug/L cleanup standard in any of the MNA network wells

- No detection in Plume Fringe wells D-41-8 and D-41-9, or Sentinel Well D-MWD-1, which are located downgradient of the PRB
- No detection in Sentinel Well D-41-1 which is located on the opposite side of GPB from the PRB

TCE

- Exceedances of the 1 ug/L cleanup stand in ten MNA wells
- Maximum concentration of 903 ug/L detected in Plume Centerline well (D-92-3)
- No detection in Sentinel Well D-41-1 which is located on the opposite side of GPB from the PRB

Cis-1,2-DCE

- Exceedances of the 10 ug/L cleanup standard in four of the MNA network wells
- No detection in Sentinel Well D-41-1 which is located on the opposite side of GPB from the PRB

1,1-DCE

- No exceedances of the 2 ug/L cleanup standard in any of the MNA network wells

VC

- Exceedances of the 2 ug/L cleanup standard in two MNA network wells
- Maximum concentration of 166 ug/L detected in downgradient Plume Fringe well D-41-9

MNA Network Wells Data Trends

Results from MNA network wells were also plotted in concentration versus time plots for the COCs. Furthermore, statistical analyses were performed to evaluate data trends (analysis included as Appendix D within the annual report). MNA monitoring was initiated in 2007. Some of the wells have demonstrated a statistically significant decrease in TCE from 2007 to 2011. Concentrations in other wells have fluctuated considerably and not exhibited any clear trend. Results were described in the report for each of the wells in the various categories (sentinel, plume fringe, etc.). None of the results are especially notable and overall you would expect decreases of some contaminants as time goes on and increases in other (daughter products) as well as fluctuations due to the nature of the source and flow conditions.

Supply Well Sampling

Annual sampling of a drinking water supply well (D-PW-131) is included in the monitoring program. TCE was detected at a concentration of 4.54 ug/L. PCE and cis-1,2-DCE were detected but at estimated concentrations below cleanup standards (0.251 and 0.379 ug/L, respectively). Other Area D COCs were not detected.

Conclusions

The report concluded that the PRB is functioning as designed and that the remedy was protective of human health and the environment. The following general data trends were noted:

- Plume fringe/centerline wells: TCE concentrations were stable or decreasing in the monitoring period.
- Sentinel wells: Trends were stable for all COCs.
- Green Pond Brook: Historically, low concentrations of COCs have periodically been detected in some surface-water samples before the installation of the PRB. Reportedly all COCs have displayed stable trends at the upstream sampling location (D-SW-2) and no COCs have been detected since September 2007. The report also notes that “TCE has not been detected above the comparison criteria established in the Record of Decision (1.09 ug/L) in samples from D-SW-3, D-SW-8 (directly downgradient from the PRB) and D-SW-4 (the farthest downgradient location) since installation of the PRB indicating its continuing effectiveness. “ The report also concludes that VC was detected at “very low concentrations that slightly exceed the comparison criteria.” However, the detected concentrations, albeit estimated, are found at about seven times the comparison criteria concentration .