Environmental Solutions

METAFIX® REAGENT

Case Study

MetaFix® PRB Prevents Migration of Heavy Metals into an Adjacent River and Exceeds Remedial Goals

Overview

As a result of historical site operations, soil and groundwater at an active manufacturing facility located in the Pacific Northwest was impacted by heavy metals and elevated pH. The remedial approach included excavation of the most highly impacted soil from the source area and the installation of a permeable reactive barrier (PRB) across the groundwater plume to prevent migration of residual metals into the adjacent river (Figures 1 and 2). The PRB was constructed along the downgradient wall of the excavation by physically blending MetaFix® reagent in to the clean backfill soil using a backhoe. Following the construction of the MetaFix PRB, subsequent performance monitoring conducted three, four, seven, ten, thirteen, and nineteen months after its installation has shown a gradual decrease in dissolved heavy metals downgradient from the PRB. The main contaminant of concern (COC), aluminum (Al), has decreased from a baseline concentration of 1,530 µg/L to 224 µg/L after ten months, which is well below the remedial goal of 750 µg/L. Al concentrations temporarily increased at thirteen months to 1,010 µg/L followed by a decrease to 389 µg/L after nineteen months. The thirteen month sampling point was preceded by exceptionally high precipitation, which may have reversed or interrupted the direction of groundwater flow given the proximity of the PRB to the river. Significant reductions also have been observed in dissolved arsenic (As) and copper (Cu) downgradient from the PRB.

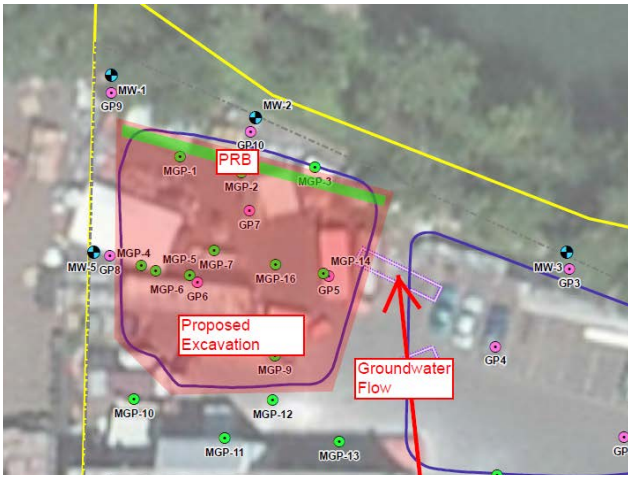

Figure 1. Site map of treatment area

Treatability Study

A lab treatability test was conducted to determine the optimal MetaFix reagent formulation and dosage. Three different MetaFix formulations were evaluated at two dosage rates of 4% and 8% (wt/wt) by soil mass. After a seven-day reaction period, the lab data indicated that the 4% dosing was just as effective as the 8% towards achieving remedial goals. To sustain a longer treatment term a 6% (wt/wt) dosing was chosen for field application.

Field Application

Impacted soil was excavated down to 18 ft below ground surface (bgs) and removed from the source area. Sheet piling was used to allow for excavation below the groundwater table, which is encountered at approximately 5 ft bgs in this area. A total of 24,000 lbs of MetaFix was applied to the backfill material along the downgradient wall of the excavation to form a PRB measuring approximately 80 ft long x 3 ft wide x 15 ft deep, targeted the saturated zone from 5 to 20 ft bgs. The MetaFix was applied in 1.25 ft lifts and was mixed to the backfill soil using a backhoe, with 1 metric ton of MetaFix applied per lift targeting a dosage rate of 6% MetaFix by soil mass.

Figure 2. River adjacent to manufacturing site

Figure 3. Installation of MetaFix PRB

Figure 4. MetaFix reagents blended in to backfill soil

Results

Following the construction of the MetaFix PRB, subsequent performance monitoring conducted three, four, seven, ten, thirteen, and nineteen months after its installation has shown a gradual decrease in dissolved heavy metals in groundwater downgradient from the PRB.

The transient post installation increase in dissolved metals at three months is presumably due to physical mobilization during remedial activities. Three months after the installation, aluminum concentrations had increased to 2,860 µg/L, but has since decreased to 622, 384, and 224 µg/L measured after 4, 7, and 10 months, respectively. After thirteen months, there was a temporary increase in aluminum concentration to presumably from a season of exceptionally high precipitation resulting in concentrations of 1,010 µg/L, followed by a decrease after nineteen months to 389 µg/L, well below the remedial objective. Similar decreasing patterns were observed for arsenic and copper with an initial increase followed by a gradual decline (Figure 5).

Prior to remedial efforts, dissolved concentrations of aluminum were relatively steady and ranged between 1,530 and 2,100 µg/L. After thirteen months, the remedial goals were achieved for aluminum (<750 µg/L), arsenic (<2.1 µg/L), and copper (<12 µg/L). Considering the downward trend, concentrations are expected to continue to decrease over time.

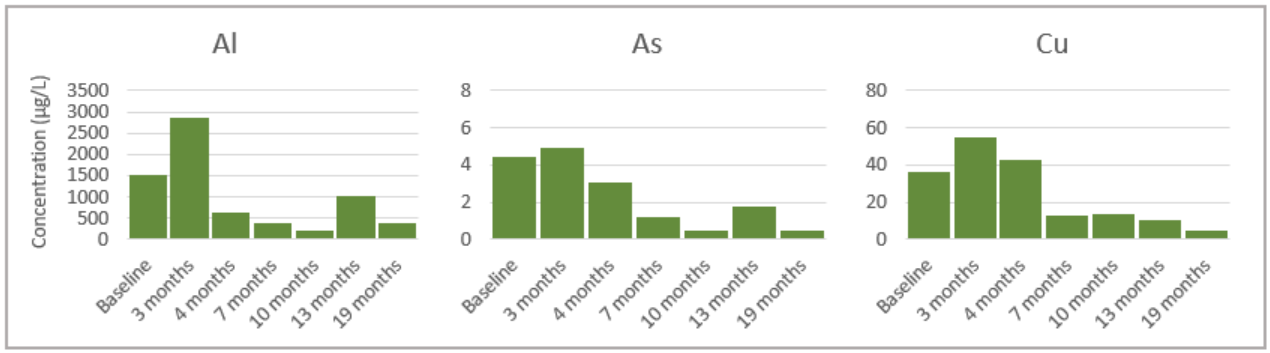

Figure 5. Soluble metal concentrations after MetaFix PRB installation to below remedial goals of Al (750 µg/L), As (2.1 µg/L), and Cu (12 µg/L)