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Date:
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ARCADIS Project No.:
IN000884.2013.00005

Subject:
Status Update for Pilot ISCO Treatment
RACER Trust - Former GM Delco Plant 5
1723 North Washington Street
Kokomo, Indiana

ARCADIS submitted the *Pilot ISCO Treatment Work Plan* in August 2013 with the following objectives:

- Demonstrate the effectiveness of sodium permanganate to treat elevated concentrations of trichloroethene (TCE) and its daughter products present in Site groundwater.
- Evaluate potential rebound of dissolved phase chlorinated volatile organic compounds (cVOCs).
- Determine the necessary design parameters for full scale system design and implementation of in-situ chemical oxidation (ISCO) based on measured injection flow rates, injection pressures, and water levels during the injection test.
- Evaluate the feasibility of implementing a full scale ISCO treatment to address groundwater contamination at or above a threshold treatment concentration of 4,000 µg/L of TCE.

In December of 2013, ARCADIS conducted an ISCO Injection at the Former GM Delco Plant 5 (Site). This memo serves as an update to the field activities completed to date.

Well Installation

Major Drilling installed the injection well network from November 24 through November 26, 2013 utilizing a mini-sonic drill rig. The installed network consist of one injection well (IW-1301-S1), one dose response well (DR-1301-S1) and the two performance monitoring wells (PM-1301-S1 and PM-1302-S1). These

locations were developed via a combination of surge blocking and pumping completed on December 3, 2013.

Fresh Water Injection Test

The target unit for the ISCO injections is the S1 saturated sand and gravel unit. As this unit is fully confined, a fresh water injection test was completed to determine the feasibility of gravity injection into the unit prior to obtaining the sodium permanganate. ARCADIS completed the fresh water injection test on December 4, 2013. The results of the fresh water injection test were used to determine an anticipated flow rate of the gravity feed injection manifold and develop design criterion for field implementation planning and scheduling. The fresh water injection achieved a flow rate of approximately 6.3 gallons per minute (GPM), with a total injection volume of approximately 220 gallons.

Pre-ISCO Baseline Monitoring

On December 16, 2013, ARCADIS completed pre-injection baseline monitoring. Groundwater samples were collected from the injection well (IW-1301-S1), the two dose response wells (MW-0620-S1 and DR-1301-S1) and the two performance monitoring wells (PM-1301-S1 and PM-1302-S1) via low-flow sampling and field parameters (turbidity, conductivity, pH, temperature and ORP). Groundwater samples were analyzed for VOCs, alkalinity, total and dissolved sodium and manganese. Upon completion of baseline monitoring, ARCADIS constructed a secondary containment system and security fencing to house the injection chemicals, the mixing system, and the injection manifold.

ISCO Injection

ARCADIS completed the ISCO injections from December 17 through December 20, 2013. Prior to the ISCO injection, data loggers were deployed in the dose response wells MW-0620-S1,DR-1301-S1, PM-1301-S1 and PM-1302-S2 to monitor conductivity, temperature and pressure and water quality were collected from performance monitoring wells. Due to cold temperatures, additional measures were taken to ensure the safety of the injection team and the success of the project. Anti-slip matting was installed in the secondary containment to provide the team with safe walkways and electric heaters and heat tape were used to prevent the mixing pump and injection solution from freezing.

A 40% by weight (wt.) stock sodium permanganate solution was diluted with clean water (obtained from a nearby fire hydrant) to the desired 10% by wt. sodium permanganate injection solution. ARCADIS utilized a mixing ratio of 60 gallons stock solution to 240 gallons of water. The injection was completed by gravity feed through the injection well at a rate of approximately 6 GPM. During the injection event, vertical profiling was conducted at the dose response wells to monitor for the arrival of the sodium permanganate solution. A total of 3,600 gallons of the sodium permanganate solution was injected. Following the injection of the sodium permanganate solution, water was injected at a rate ranging from 6 GPM to 11 GPM until a response was observed in the dose response well, DR-1301-S1. The total injected volume during the test was 9,050 gallons (3,600 gallons sodium permanganate solution and 5,450 gallons of water).

Post-Injection Monitoring

The post-injection monitoring phase of the Pilot Study started after injections were completed on December 20, 2013. Post-injection monitoring has consisted of periodic groundwater gauging, visual field screening and field monitoring for manganese at the five network wells (IW-1301-S1, MW-0620-S1, DR-1301-S1, PM-1301-S1 and PM-1302-S1). Groundwater from these wells is analyzed in the field for manganese using a HACH DR/890 colorimeter kit. In addition to the periodic field monitoring of the well network, a low-flow sampling event will be conducted after field screening indicates that the sodium permanganate solution is not observed in the performance monitoring wells (i.e. returned to baseline conditions). The groundwater samples will be analyzed for VOCs, alkalinity, total and dissolved sodium and manganese. Additional VOC sampling will follow approximately one month and two months after the initial post-injection sampling to monitor for constituent rebound in the target treatment area. A report summarizing the injection event and performance monitoring results will be submitted within 45 days of completion of the field activities.

Based on the hydraulic conductivity obtained by a historical slug test and the calculated groundwater velocity, ARCADIS estimates the arrival of the sodium permanganate in the performance monitoring wells to be within a week or up to two months. If the actual groundwater flow velocity varies significantly from the expected velocity, the performance monitoring event frequency will be increased or decreased to adjust for the movement of sodium permanganate through the aquifer.

Significant Points During Pilot Test to Date

- The injection flowrate increased from the projected injection rate of 1 GPM to a maximum of 11 GPM; therefore, the field implementation time of the full-scale injection may be reduced.
- The preliminary data suggests that the entire thickness of the S1 unit may need to be accounted for during the full scale implementation; therefore, more oxidant may be required to complete the injection.