

June 18, 2018

**Re: eForm 27 Remediation Summary
Kerr-McGee Oil and Gas Onshore, LP
Anderson 41-27/Bohlender 2-27
Form 27 Document # 401529152
COGCC Remediation # 3613
Facility ID # 329995
API # 05-123-18172
NWNE Sec 27-T4N-R65W
Weld County, Colorado**

In November 2005, two gallons of MicroBlaze[®], a concentrated solution of facultative microbes, nutrients, and surfactants designed to bioremediate petroleum hydrocarbons, was applied to the groundwater immediately prior to backfilling the excavation. The excavation was backfilled with clean fill and restored to pre-release grade.

2014 Carbon Slurry Injection

As of the September 2013 quarterly monitoring event, the benzene concentrations in monitoring well MW01 exceeded the Colorado Oil and Gas Conservation Commission (COGCC) Table 910-1 allowable level for benzene at a concentration of 45 micrograms per liter ($\mu\text{g/L}$). Following the September 2013 quarterly monitoring event, Kerr-McGee Oil and Gas Onshore LP (Kerr-McGee) contracted LT Environmental, Inc. (LTE) to design and implement a carbon slurry injection program to remediate the residual dissolved-phase benzene, toluene, ethylbenzene, and total xylenes (BTEX) impacts to groundwater. Kerr-McGee submitted an Underground Injection Control (UIC) Permit Application to Region 8 of the United States Environmental Protection Agency (USEPA) on November 12, 2013.

The carbon slurry injection program was implemented, as outlined in the UIC Permit Application, with the objective of reducing the residual dissolved-phase BTEX concentrations in the injection area surrounding monitoring well MW01 to less than the COGCC Table 910-1 allowable levels. On January 14, 2014, LTE oversaw the injection of approximately 750 pounds (dry weight) of BOS 200[®] that was mixed with potable water and cultured facultative microbes to form an injectable carbon slurry. The BOS 200[®] product is designed to enhance petroleum hydrocarbon degradation by capturing the dissolved-phase petroleum hydrocarbons in a carbon matrix and promoting microbial metabolism of the hydrocarbons under both aerobic and anaerobic conditions.

As of the June 2014 quarterly monitoring event, the benzene concentration in monitoring well MW01 exceeded the COGCC Table 910-1 allowable level for benzene at a concentration of 69.8 $\mu\text{g/L}$. On July 31, 2014, the area surrounding monitoring well MW01 was polished by injecting 450 pounds (dry weight) of BOS 200[®] carbon slurry via direct-push injection technology. Static groundwater monitoring continued on a quarterly basis following completion of the injection programs.

2015 Hydro-excavation

As of the December 2014 quarterly monitoring event, the benzene concentration in monitoring well MW01 exceeded the COGCC Table 910-1 allowable level for benzene at a concentration of 70.5 µg/L. Between February 17 and 19, 2015, petroleum hydrocarbon impacted soil around monitoring well MW01 was excavated using a hydro-vacuum rig. Monitoring well MW01 was abandoned during the excavation activities. The hydro-excavation extent measured approximately 12 feet north to south by 14 feet east to west and was excavated to a depth of approximately 13 feet below ground surface (bgs). Groundwater was encountered in the excavation at approximately 12 feet bgs. Prior to backfilling, 50 pounds of BOS 200[®] were applied to the base of the excavation. The February 2015 hydro-excavation area is depicted on the Site Map provided as Figure 2.

2015 Carbon Slurry Injection

As of the March 2015 quarterly monitoring event, the benzene concentrations in monitoring well MW01R exceeded the COGCC Table 910-1 allowable level for benzene at a concentration of 28.0 µg/L. On August 26, 2015, the area surrounding monitoring well MW01R was polished by injecting 200 pounds (dry weight) of BOS 200[®] carbon slurry via direct-push injection technology. Static groundwater monitoring continued on a quarterly basis following completion of the injection programs. The July 2014 and August 2015 injection areas are depicted on the Site Map provided as Figure 2.

AS System

Due to persistent, elevated benzene concentrations in monitoring well MW01R, an air sparging (AS) system was installed in September 2016 at the site to remediate the dissolved-phase petroleum hydrocarbon plume.

Kerr-McGee submitted a UIC Permit Application to USEPA Region 8 in October 2016, that was subsequently approved on November 21, 2016. A copy of the November 2016 Rule Authorization: Aquifer Remediation Well approval letter from USEPA Region 8 is attached. The AS system was designed to introduce ambient air into the subsurface water column to promote volatilization and aerobic microbial decomposition of dissolved-phase petroleum hydrocarbons. The system was comprised of three AS wells (AS01 through AS03) connected by ground surface high-density polyethylene piping to a remediation trailer powered by a Kohler gasoline generator. The remediation system included a manifold with valves to allow for uninterrupted flow control, measurement, and adjustment. AS was accomplished using a 1.5 horsepower GAST regenerative blower. At times, a tow-behind diesel-powered air compressor was used to conduct additional remediation. The layout of the AS system is depicted on Figure 2. Boring logs for the AS wells are included as an attachment to the eForm 27.

Conclusions

Based on post-remedial analytical data, BTEX concentrations in groundwater have been in full compliance with COGCC Table 910-1 allowable levels for four or more consecutive monitoring events. Kerr-McGee is requesting a No Further Action status for this site.