CASE STUDY

Speeding the Pace of Cleanup

Over many years, grain fumigant solvents leaked from a tank at an active grain elevator into the underlying soil and groundwater. Remediation would be complicated not only by the nature and extent of the contamination, but also by the site's difficult-to-access location. Thanks to a multipronged, innovative remediation strategy, efforts to clean up the site have drawn to a successful close.

Challenge

When Bunge North America (Bunge) entered the Kansas Voluntary Cleanup Program in 2000 to address soil and groundwater contamination at an active grain elevator, the agribusiness company would face an uphill battle in the years ahead. After all, the former fumigant tank found to be leaking contaminants of concern (COCs) was virtually inaccessible, surrounded by steep slopes, grain tanks, an electrical substation and building, rotary grain conveyor, and a railroad line. In addition, COC concentrations were significantly elevated and extended 400 feet downgradient of the source. Access to the contamination source was further complicated by ongoing elevator operations and underground utilities.

Project Stats

Client
Bunge North America

Location
Kansas City, Kansas

12K
POUNDS OF CONTAMINANTS RECOVERED VIA DPE AND SEE

10M
GALLONS OF CONTAMINATED GROUNDWATER RECOVERED AND TREATED

4
REMEDIATION TECHNOLOGIES (DPE, SEE, ISCR, ERD)

$1.7M
IN COST AVOIDANCE

After three years of conducting site investigations to characterize the nature and extent of the contaminants (carbon tetrachloride, chloroform, chloromethane, methylene chloride and carbon disulfide), Bunge retained Burns & McDonnell to design, pilot test and implement a remedial action for soil and groundwater.

Solution

Approved by the Kansas Department of Health & Environment in 2007, the multiyear soil and groundwater remediation plan called for the use of a dual-phase vacuum extraction (DPE) system, including a custom-designed and built mobile extraction/treatment unit, along with eight extraction wells. Because of site constraints, an all-terrain drill rig was needed to install the wells, and the mobile treatment unit had to be transported into the source area by crane.

To treat potentially impacted groundwater migrating toward the site boundary, 75-foot-long in situ treatment barriers were installed perpendicular to the groundwater flow at the downgradient edge of the plume. The first barrier consisted of zero-valent iron (ZVI) to chemically reduce carbon tetrachloride, chloroform and carbon disulfide, while a second barrier consisting of a vegetable oil amendment enhanced degradation of methylene chloride.

After four years of operation, the DPE system had recovered 4,000 pounds of COCs, the footprint of the groundwater plume had been reduced, and COC concentrations at monitoring wells just downgradient of the treatment barriers dropped below levels in the cleanup goals. However, COC groundwater concentrations in the source area remained elevated. By 2010, as COC removal rates achieved by the original DPE system began to diminish, we took steps to expedite the remediation process.

Our team developed and tested several new DPE system configurations and operational schemes. The most effective of these, which involved cycling the system through multiple configurations, recovered 2,350 pounds of COCs in just seven months — a threefold increase in contaminant mass recovery. A subsequent system optimization effort conducted two years later netted more than 1,500 pounds of COCs over a four-month period. These optimization efforts significantly reduced the size of the contaminant source area and groundwater plume, as well as COC concentrations in several monitoring wells.

Elevated COC concentrations, however, persisted in a small number of wells located in the core of the source area. In 2014, using high-resolution site characterization technologies — membrane interface probe (MIP) and electrical conductivity (EC) logging — we identified a concentrated but relatively isolated and shallow zone of residual contamination. The nature and extent of this remaining COC mass favored a physical extraction technique over a chemical or biological method. In addition, a physical extraction technique that made use of the existing DPE infrastructure would significantly reduce the cost of the necessary remediation effort.

The technology chosen was surfactant-enhanced extraction (SEE). We conducted pilot tests in spring 2015 to evaluate the efficacy of using SEE to remove the residual bulk COC mass from the shallow aquifer. After the pilot tests proved successful, we proceeded with full-scale SEE remediation using the existing DPE equipment and infrastructure. The work was completed in multiple phases, each consisting of point-to-point delivery of the surfactant to the core source area, followed by groundwater extraction from the same wells used to inject the surfactant (i.e., push-pull).

The SEE remediation effort proved successful, recovering over 1,300 pounds of COCs over a seven-month period and reducing carbon tetrachloride concentrations in the most heavily impacted portion of the source area by at least 90%.

In July 2019, we updated the conceptual site model (CSM) and conducted a remedial alternatives evaluation (RAE) for the remaining groundwater plume. The updated CSM and RAE indicated that with the bulk COC source mass removed by the DPE and SEE technologies, it was appropriate to discontinue active extraction and transition to a lower-cost remedy that would address residual contamination diffusing from low- to high-conductivity zones. In situ chemical reduction/enhanced reductive dechlorination (ISCR/ERD) was selected as the final remedial action, and operation of the DPE system was discontinued in January 2020. In April 2020, we injected approximately 24,500 pounds of an ISCR/ERD formulation consisting of ZVI and organic electron donor.

Results

Successful optimization of the DPE remedy and transition to a passive final remedy is expected to result in $1.7 million in savings and achieve project goals 10 years sooner that would have been expected through continued DPE operation alone. Results of the first ISCR/ERD post-injection groundwater monitoring event showed COC reductions ranging from 90% to 99% at wells located in the most impacted portion of the groundwater plume. With the final in situ groundwater remedy in place, we are now developing a strategy to further reduce groundwater monitoring obligations and move the site toward regulatory closure.

Specialized Services

- Amendment injection via direct-push and high-pressure jetting
- Dual-phase vacuum extraction (DPE)
- Enhanced reductive dechlorination (ERD)
- Groundwater monitoring and reporting
- High-resolution site characterization (HRSC)
- In situ chemical reduction (ISCR)
- LNAPL/DNAPL remediation
- Operation, maintenance and optimization
- Permitting and compliance
- Pilot testing
- Remediation design
- Surfactant-enhanced extraction (SEE)

About Burns & McDonnell

Burns & McDonnell is a family of companies bringing together an unmatched team of engineers, construction professionals, architects, planners, technologists and scientists to design and build our critical infrastructure. With an integrated construction and design mindset, we offer full-service capabilities. Founded in 1898 and working from dozens of offices globally, Burns & McDonnell is 100% employee-owned. For more information, visit **burnsmcd.com**.

04080-0322