Soil-Vapor Sampling near Seward, Nebraska – Project Summary

U.S. Geological Survey, Nebraska Water Science Center

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In partnership with the City of Seward, Nebraska, the United States Geological Survey (USGS) has conducted soil-vapor sampling within the City of Seward's south well field wellhead protection area, specifically along a one-mile section of TransCanada's Keystone pipeline. The focus of the sampling has been the detection of volatile organic carbon (VOC) compounds (specifically benzene, toluene, ethyl benzene, and xylene (BTEX)) that may be present in the soil as a result of contamination from crude oil emanating from the pipeline.

Soil-vapor samples were collected at 10 equally spaced locations along a one-mile section of the pipeline where it passes through the 5-year capture zone for the City of Seward south well field (Figure 1). In this area, groundwater takes 5 years or less to travel into the City of Seward municipal water-supply wells. Due to the close proximity of TransCanada's high-pressure Keystone oil pipeline and to ensure that the same locations could be analyzed over an extended study period with multiple rounds of sampling, the pipeline location and sample locations were surveyed and recorded using real-time kinematic global positions systems (RTK GPS). Each sample was obtained by directly pushing a sampling port to the desired depth with a tractor-mounted hydraulic probing unit (Geoprobe Systems, model 54TR). Samples were collected at a distance of 10 feet down-gradient from the center of the pipeline and a depth about 2 feet below the bottom of the pipeline. For most sampling locations this equated

Figure 1. Site and sampling locations near Seward, Nebraska.

to a sampling depth of 8 feet. A vacuum pump was then used to purge the sampling line and extract vapors from the subsurface soils (Figure 2).

A 100-microliter (µL) syringe was used to obtain a sample directly from the sampling line while under vacuum. Each sample was analyzed immediately in a field laboratory using a portable gas chromatograph (GC) with two analytical detectors: a photo ionization detector (PID) and a flame ionization detector (FID) (SRI Instruments, Inc., model 8610C). Calibration and detection limits for the GC were developed prior to field work in the laboratory at the USGS Nebraska Water Science Center using BTEX standards and following USGS protocols (Oblinger Childress and others, 1999). The established detection limit for the GC is an injection mass of 1 nanogram (ng) of a BTEX component, equating to a concentration in the soil vapor of 10 micrograms per liter (µg/L). In order to independently verify the

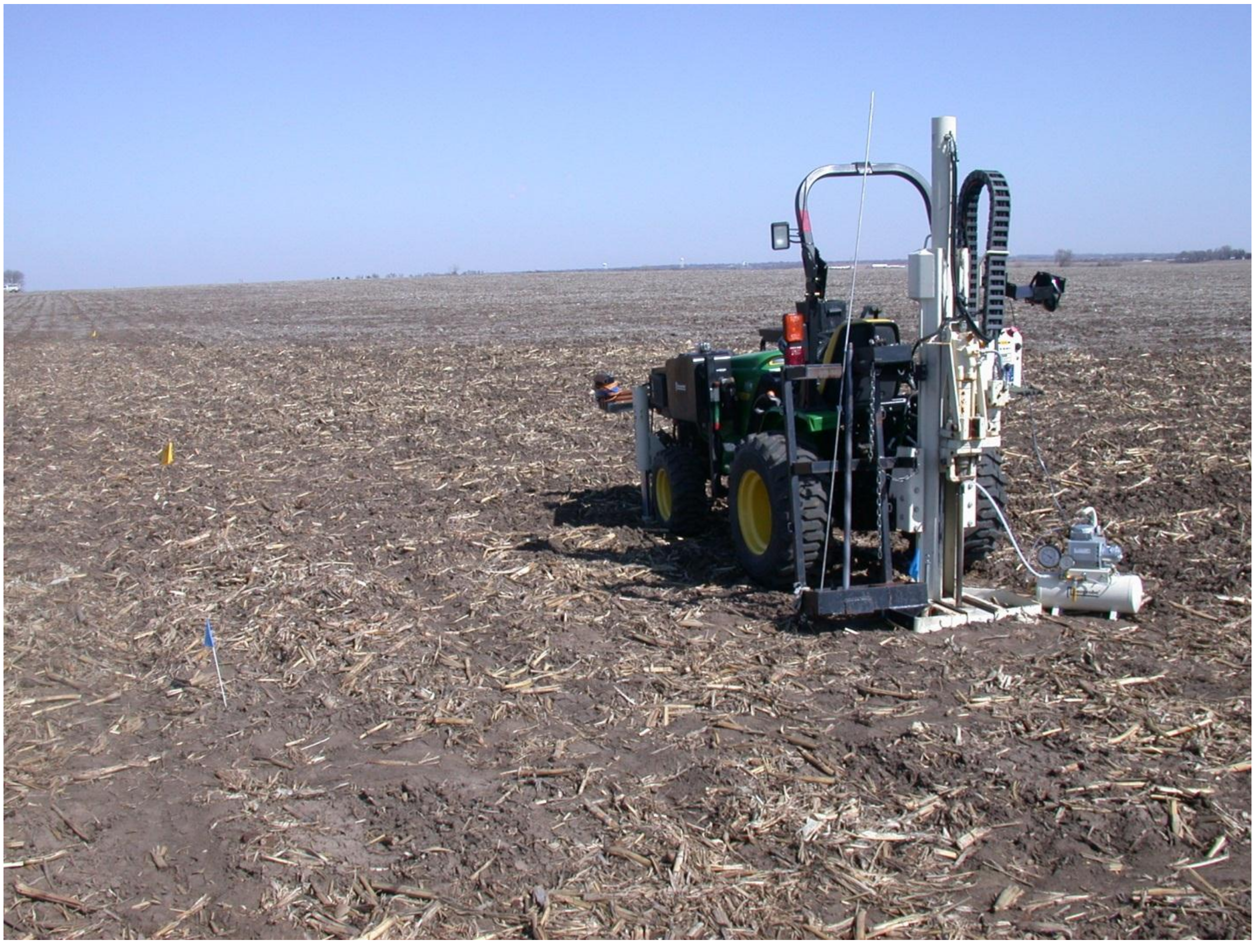

Figure 2. Hydraulic probing unit with attached sampling line and vacuum pump.

results obtained from the GC, a subset of the samples (usually three) was also collected for laboratory analysis by placing a glass vial containing activated carbon into the vacuum sampling line. The samples were stored on ice and shipped cold to TestAmerica Laboratories, Inc., where they were analyzed using a GC following the NIOSH 1501 protocol (Centers for Disease Control and Prevention, 2003).

The preliminary plan was to design and install a permanent vapor sampling system at the site, however, the location of the pipeline underneath active agricultural land did not allow for this option since this would require sampling ports to protrude from the ground. This limitation led to the selection of the direct sampling protocol with a sampling point inserted temporarily into the soil subsurface. A semi-annual sampling timeframe was utilized to occur in the spring (before the sowing of crops) and fall (after harvest).

Soil vapor sampling was conducted in December 2011, March 2012, and November 2012 at all 10 sampling locations and at a background site located up-gradient of the pipeline. Throughout the course of the study there was no detection of any BTEX component in any sample that was analyzed either in the field by the portable GC or in the samples collected on the activated carbon and analyzed by Test America, Inc. The study determined that to date there are no BTEX in the soil vapor at the sampling locations.

References

Center for Disease Control and Prevention, 2003, Hydrocarbons, Aromatic: Method 1501, *in* NIOSH Manual of Analytical Methods (4th ed.): Washington, D.C., U.S. Government Printing Office, 7 p.

Oblinger Childress, C.J., Foreman, W.T., Connor, B.F., and Maloney, T.J., 1999, New Reporting Procedures Based on Long-Term Method Detection Levels and Some Considerations for Interpretations of Water-Quality Data Provided by the U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 99-193, 24 p.