MONITOR

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LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater and Environmental Engineering Services

TURNING UP THE HEAT

Thermally-Enhanced Air Sparge/Soil-Vapor Extraction Accelerates VOC Removal at a Retail Service Station

TODAY, MANY OWNERS OF GASOLINE SERVICE STATIONS WHERE LEAKING UNDERGROUND STORAGE TANKS (USTs) were removed 15, 20, or even 25 years ago are still dealing with the expenses associated with ongoing groundwater monitoring and reporting requirements, and repeated unsuccessful efforts to remediate historical petroleum contamination. An existing owner, or one who purchases a property or assumes environmental liability, may seek a fresh approach to investigate, clean up, and close out the site for good.

In November 2006, LBG was retained by a leading Northeast petroleum supplier/retailer to investigate and remediate historical petroleum contamination dating from 1994 at an active gasoline service station in East Hartford, CT. Our client's goal was to identify and implement a cost-effective long-term remediation solution and close out the site. After completing interim remedial measures at the site, LBG tested and implemented an air sparge/soil-vapor extraction (AS/SVE) system, which produced operational results that exceeded expectations—reducing by several years the operational period that is normally required to remediate groundwater when using AS/SVE. The success of the system is attributed to the injection of heated air into the groundwater, thereby increasing the effectiveness of the air to strip volatile organic compounds (VOCs) from the saturated soil and groundwater. In fact, after only three months of operation, VOCs were no longer detected in groundwater samples at concentrations above the laboratory reporting limits.

Moreover, approximately 98 percent of the costs associated with the investigation, interim remedial actions and pilot testing have been approved for reimbursement by the Connecticut Department of Environmental Protection UST Petroleum Clean-Up Account. LBG prepared and managed the claims for the owner throughout the approval process. Connecticut is one of 46 states that provide funding or reimbursement of costs associated with the investigation and remediation of releases from regulated USTs.

Early Remediation Efforts

In 1994, petroleum-impacted soil and groundwater had been identified at the site during UST replacement activities completed by the former property owner. Approximately 240 tons of petroleum-impacted soil and over 300,000 gallons of petroleum-impacted groundwater were removed from the site at that time. Groundwater sampling has been completed at least semiannually since 1995, demonstrating residual contamination.

By Paul M. Jobmann
Associate
and John G. Zbell, CPG
Associate
Shelton, CT office

LBG field technician reading vacuum measurements from guages on the system piping. Steel AS piping is on the left side of the photo.

Over the years, prior consultants completed soil and groundwater investigations and implemented remedial measures, including injection of oxygen-releasing compounds (ORCs) in 1999 and natural attenuation monitoring. The injection of ORCs did not result in a significant decrease in the residual source, and the dissolved phase groundwater plume appeared to have reached a steady-state.

Next Steps: Interim Remediation and Investigation

LBG became involved in November 2006, when our client assumed the environmental liability. The team began by implementing interim remedial measures, including enhanced fluid recovery and rapid-aquifer depression and recovery from the impacted monitoring wells. These measures were also used to assess other potential long-term remedial alternatives, including multi-phase extraction and groundwater pump and treat.

The LBG team also completed a soil boring program in the area adjacent to and hydraulically downgradient of the present UST system to define the nature and extent of residual source

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BREATHING EASIER

Difficult Clean-up Makes a PCE-Vapor-Contaminated Building Usable Again

RESTORING INDOOR AIR QUALITY IN A BUILDING PERMEATED BY VAPORS FROM SOIL OR GROUNDWATER contaminated by chlorinated volatile organic compounds (CVOC) requires some heavy lifting — figuratively *and* literally. In a recent project at a former printing plant, the process required excavation and removal of part of the concrete building slab and more than 10,000 tons of impacted soil.

Vapor intrusion is a common and potentially serious indoor air-quality problem in buildings located above or near soil and/or groundwater that has been contaminated with CVOC. Vapor intrusion occurs when gases from contaminated soil or groundwater enter a building through openings in building foundations or slabs and accumulate in basements, crawl spaces, or occupied spaces. Short-term exposure to CVOC vapors are associated with eye irritation, respiratory irritation, headache and nausea, while long-term exposure is associated with an increase an individual's risk for respiratory diseases and cancer.

In 2002, the United States Environmental Protection Agency (USEPA) issued a Draft Vapor Intrusion Guidance to address this problem, and some states, such as New Jersey and Ohio, have followed up by developing their own guidance for investigating and remediating contaminated sites. Yet the problem may remain undetected until a real estate transaction prompts an investigation.

Real Estate Transaction Prompts a Clean-up

In October 2005, the New Jersey Department of Environmental Protection (NJDEP) finalized the Vapor Intrusion Guidance, incorporating state-specific policies that include more stringent Indoor Air Screening Levels (IASL). As a result, many contaminated sites in New Jersey have required investigation and remediation activities.

A case in point is a commercial building located in the Borough of Fair Lawn, Bergen County, where past printing operations resulted in a discharge of solvents to the soil and groundwater beneath the building. Evidence of contamination under the slab was discovered during assessment activities performed in 2006 in association with a property refinancing transaction by the current owner. An initial remedial investigation was performed to delineate the extent of CVOC in soil, groundwater and indoor air.

The investigation identified a mass of tetrachloroethylene (PCE)-impacted soil and groundwater contamination beneath a corner of the building. The presence of the elevated soil and groundwater contaminant concentrations beneath the floor slab impacted the building's indoor air quality at a level well above the NJDEP Indoor Air Screening Level for PCE of 0.5 parts per billion per volume (ppbv)

The building owner was eager to restore the tenant space to a usable condition.

Soil Excavation Poses Challenges

It was determined that removal of the impacted soil under the floor would aid in the reduction of contaminant impact to groundwater and indoor air. As a result, LBG performed a remedial action to address impacted soil at the source area of the contamination inside the building underneath the floor slab. The project involved the excavation and removal of the source area soil beneath the floor slab down to the water table approximately 25 feet below. In order to facilitate the excavation, five interior ceiling columns were supported using mini-piles anchored into bedrock. The work area was sealed off from the adjacent tenant spaces and a work-site ventilation system was installed to reduce the risks to building occupants and remediation workers.

By Matthew Ayers, P.G.
Hydrogeologist

Ramsey, NJ office

Installation of multi-level vapor barrier system 18 feet beneath building floor slab

After cutting and removing the concrete slab, PCE-impacted soil was removed with a backhoe and transported to a soil disposal/recycling facility. The excavation extended 20 feet below the original floor slab under four supported ceiling columns. Excavation and backfilling proceeded around one column at a time to ensure the integrity of the building. Steel shoring boxes were used to keep the backfill in place around each column. Altogether, more than 10,000 tons of PCE-impacted soil was excavated for disposal, and the excavation was backfilled with 3/4-inch clean quarry process stone.

Piping Systems Address Ongoing Issues

As part of backfilling operations, LBG installed remediation injection piping and ventilation piping, along with a plastic liner system, to address ongoing issues. Remediation injection piping allows for possible future treatment of residual PCE-impacted soil and the groundwater at depth through injection of biological or chemical remediation amendments. Ventilation piping, also known as sub-slab depressurization piping, is designed to apply a vacuum under the areas of the building that are above the

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areas for petroleum impacts. The results indicated petroleum-impacted soils hydraulically downgradient of the gasoline dispenser islands.

Pilot Testing AN AS/SVE System

In 2009, LBG completed a feasibility study and conducted pilot testing using an AS/SVE system obtained during the liability transfer. The feasibility study considered the nature, degree and extent of soil and groundwater impacts, site hydrogeology, and proximity of hot zones to the existing UST system. Excavation was considered, but ruled out because the gasoline station remains operational. Based on the results of the feasibility study and pilot test, AS/SVE was identified as the most appropriate and cost-effective remedial alternative.

The pilot test also demonstrated that the compressor created sufficient air pressure to operate the system using direct injection of air into the groundwater without use of a receiver tank. A receiver tank may be required to store compressed air when the compressor is not powerful enough to provide sufficient pressure or if the duty cycle of the compressor is not meant for continuous operation.

LBG's AS/SVE system design comprised ten 1-inch-diameter air-sparge points and six 4-inch-diameter vapor-extraction wells, a rotary vane compressor directly connected to the air-sparge points, a regenerative blower to recover VOC vapors from the unsaturated soil, and vapor-phase carbon to treat the recovered vapor.

Operational Results Exceed Expectations

Data obtained during operation and maintenance visits indicated the system was injecting air into the subsurface at approximately 170 to 210 degrees Fahrenheit. After approximately three months of operation, the AS/SVE system was shut down for one week to allow the groundwater to equilibrate and to facilitate groundwater sampling. The laboratory analytical results indicate that VOCs were not detected at concentrations above the laboratory reporting limits.

In contrast, AS/SVE systems using a compressed air receiver tank have the potential to inject cooler air and may require operational periods of one to three years to yield such results. The results obtained in this project are consistent with scientific studies that have shown that increasing the temperature of injected air increases its effectiveness in stripping VOCs from soil and groundwater.

The system will continue to operate until June 2010 at the earliest, when the system will be deactivated. The system will remain inactive for three months and groundwater sampling and laboratory testing will be completed to confirm the system's effectiveness. Nevertheless, the results to date have exceeded both LBG's and our client's expectations, and LBG will consider thermally-enhanced AS/SVE as an alternative at similar sites in the future. ■

BREATHING EASIER

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remaining CVOC groundwater plume. This allows for active ventilation of the sub-slab soil vapor to protect indoor air from contamination by the remaining residual PCE-impacted groundwater.

LBG was responsible for all phases of the project from design through construction. The LBG team completed design of the remediation and ventilation systems, including the preparation and submittal of work plans, photographic documentation, site health

caption

and safety plans, and contractor selection, as well as construction permitting. Site supervision, construction management and documentation activities involved oversight and coordination of five primary contractors and three sub-consultants/laboratories. Construction management activities included implementation of construction plans, project scheduling and tracking, project budget tracking, and processing and approval of change-order requests. The complex nature of the project also required regular verbal and written communication with the client and regulatory agencies, as well as coordination with building tenants. LBG will continue to investigate the extent of the groundwater plume by monitoring on-site and off-site groundwater monitor wells. As a result of this project, both the tenants and owner will be breathing easier. ■

PROJECT UPDATES

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well. The acidic liquid is recovered from the groundwater, neutralized and treated through the system. The work significantly increases the well performance and reduces the need for regular O&M to address the bacteria and replacement of system equipment.

LBG is also updating the 3-dimensional groundwater flow and solute transport model for the project to re-evaluate the time necessary to achieve the aquifer restoration goals; verifying that capture and containment of the VOCs (volatile organic compounds) plume at the site is possible with the pumping rates currently achieved by the recovery wells; and evaluating various well-closure scenarios to determine the most effective reduction in recovery wells while still ensuring adequate plume capture and mass reduction. The updated model will be used to petition the EPA to shut down several of the off-site recovery wells to focus the remedial effort where the remaining groundwater plume has been detected.

PROJECT UPDATES

Remdiate Dam Seepage, Naugatuck, Connecticut

LBG Connecticut has been subcontracted to conduct geologic logging and monitoring during installation of a grout curtain designed to remediate seepage and stabilize the embankment at the Hop Brook Lake Dam in Naugatuck, Connecticut. The Hop Brook Dam was constructed in 1968 and consists of an earthen fill dam with stone slope protection, an earthen fill dike, a gated concrete conduit and a chute spillway with a broad crested weir. The United States Army Corporation of Engineers identified the Hop Brook Lake Dam as a high hazard dam, the failure of which could result in loss of life and cause serious damage to homes, main highways, railroads, commercial facilities, underground utilities, etc. LBG was retained by Layne Geoconstruction, a division of Layne Christensen Company, to observe and complete geologic logs for drilling of tightly-spaced, grout-curtain boreholes in unconsolidated dam soils and underlying bedrock across the topography of the dam. LBG will monitor groundwater conditions and relative permeability of fractured bedrock to provide subsurface details necessary for completing a properly structured grout curtain. The grout curtain will be installed by pressure injecting grout directly into the completed borehole in stages, based upon subsurface geology. The layout and spacing of each borehole is selected so that each pillar of grout intersects the next forming a continuous wall or curtain. The finished grout curtain will limit the seepage of upgradient waters penetrating through the earthen materials, stabilizing the structure of the dam. Preliminary test drilling and grouting was completed in late 2009. The final grout curtain will be installed from April through September 2010.

Preliminary testing for grout curtain in earthen dam

Confidential Client Superfund Site Long Island, New York

LBG is currently conducting recovery well rehabilitation activities on a groundwater pump and treat system at a Superfund Site in Long Island. New York. The recovery wells and piping become encrusted with iron bacteria growth during regular system operation. The bacteria growth reduces the performance of the recovery wells and causes operation and maintenance (O&M) issues with the system pumps and piping. The rehabilitation activities include mechanical cleaning of the well screen and surging an acidic liquid into the subsurface to kill the bacteria near the recovery

Iron bacteria growth in the groundwater remediation system influent piping

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LEGGETTE, BRASHEARS & GRAHAM, INC.

4 Research Drive
Shelton, CT 06484
203-944-5000

Farmington, CT
860.678.0404
Orlando, FL
407.644.8955
Tampa, FL
813.968.5882
Atlanta, GA
678.594.9893
Freeport, IL
815.297.8888
Wetmore, MI
906.387.1966
St. Paul, MN
651.490.1405
No. Kansas City, MO
816.421.7766
St. Louis, MO
314.845.0535
Ramsey, NJ
201.818.0700
White Plains, NY
914.694.5711
Columbus, OH
614.416.9100
West Chester, PA
610.430.7764
Sioux Falls, SD
605.334.6000
Madison, WI
608.441.5544
Essex Jct., VT
802.288.9600

LBG-GUYTON ASSOC.

Austin, TX
512.327.9640
Houston, TX
713.468.8600

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