



Soil and Groundwater Treatment Systems Are Upgraded

The end of 2004 was a busy time at the Terminal, with a number of remediation systems undergoing upgrades to reflect changing conditions at the site.

Soil Vapor Extraction: Highly Effective

Since 1997, BP has utilized a soil treatment method called soil vapor extraction (SVE) to remove volatile chemicals (meaning they can be found in a vapor form) that are found in the subsurface due to years of operations at the Terminal. Environmental experts, including the U.S. Environmental Protection Agency (EPA), consider SVE to be a highly effective way of removing volatile chemicals from soil.

SVE works primarily on chemicals that are in the ground above the water table. An underground vacuum is applied through extraction wells, and the air movement causes chemicals in soil particles (such as gasoline and solvents) to volatilize, or evaporate. At Paulsboro, the collected vapors are then treated with thermal oxidizers, which incinerate them at a high temperature, converting them into carbon dioxide and water. A portion of the heat generated from this process produces some of the energy needed to fuel the system and the safe gases are then released into the air. A permit from the New Jersey Department of Environmental Protection (NJDEP) requires greater than 99.9% removal efficiency.

Currently there are two on-site SVE systems, located in the former chemical and rail loading rack area and the area where Tanks 103 and 104 were located. These systems have been operating since early 2002 and have been effective at removing and treating almost 600,000 pounds of chemicals from the ground. Because a vacuum pulls soil vapors out of the ground between the ground surface and the water table, fluctuations in the water table can expose more or less chemical in the soil, depending on conditions, making the system more or less effective. In the Tanks 103/104 area, located in the northwest portion of the site, there has been a decrease in the amount of chemicals recovered over the previous two years, which is probably due to the rise in the water table after the 2001/2002 drought and the fact that the system has already worked so effectively. In order to address areas where more product is known to have accumulated and expand the area of treated soil, six additional wells were installed in this area in December and will be connected to the SVE system in early 2005. At the same time, because the water table is high and air flow was restricted in the former chemical and rail loading rack area, eight new wells were also installed and will be connected in March. The additional

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Oil Spill on the Delaware

At the end of November 2004, a 15-foot-long piece of metal at the bottom of the Delaware River ripped into the hull of a tanker bound for the Citgo refinery, causing a major oil spill.

Approximately 265,000 gallons of crude oil spilled into the river, affecting nearly 60 miles of shoreline, including the area directly in front of the Paulsboro Terminal site. Like many waterfront property owners in the region, BP is assessing the spill's possible lasting effects. BP's environmental activities at the site are not affected, however. Meanwhile, Miller Environmental, the prime contractor for the cleanup, had been renting a warehouse located at the Terminal near the docks, and with BP's cooperation, was able to launch cleanup activities from the site. In addition to facilitating access to the property for hundreds of workers involved in the cleanup, BP provided space for storing roll-off containers used to collect clean-up materials and oil-impacted debris.

The damaged tanker sailed out of the region at the end of December, heading for an Alabama shipyard where it



Oil around the Terminal's pier, one of many areas affected by the oil spill.

will undergo repairs. Cleanup operations are expected to continue for several months under the oversight of the U.S. Coast Guard.

Soil and Groundwater Treatment

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wells will tighten the spacing so that air flow is increased and the SVE system will operate more effectively, allowing for more chemicals to be recovered and processed and ultimately, a quicker cleanup.

Air Sparging: Getting to the Saturated Zone

SVE is an effective means of removing chemicals in soil located above the water table, but to remove volatile chemicals in the saturated zone (within the groundwater), it can be used in combination with another treatment method known as air sparging (AS). This process introduces compressed air into the saturated zone by way of



The air sparging system, which works in conjunction with soil vapor extraction, was activated in October 2004.

strategically placed sparge wells. The air causes the chemicals in the groundwater to volatilize and bubble up through the water table into the unsaturated zone, where they can be captured and extracted by the SVE system. An AS system for use in Paulsboro was approved by the NJDEP in 2000 and installed in 2001, but was not activated because the SVE system was already collecting concentrations of chemicals at its capacity. When those began to diminish in October 2004, the AS system was activated. A total of 10 wells are now on line in the former Tank 103/104 area. “The AS network is definitely adding to the effectiveness of the operation,” said Kevin Wheeler, senior hydrogeologist and remediation specialist for Sovereign Consulting, the firm supervising remediation operations at the site. “Soil vapor concentrations have significantly increased coming out of that area.”

LNAPL Removal: Upgrades Move Forward

Meanwhile, upgrades to the LNAPL removal system at the former truck loading area were approved by the NJDEP in late 2003, but were put on hold due to the demolition project that was performed through August 2004. LNAPL refers to light non-aqueous phase liquids, the petroleum compounds that float on top of groundwater. Once demolition was completed, the upgrades could go ahead as planned. In December 2004 a new groundwater recovery well was installed to a depth of 40 feet to enhance removal of LNAPL trapped in the area between the high and low water table. The underground piping network was extended to connect the well to the existing groundwater treatment system. The system was expected to be activated in March 2005 after all the final connections and tests have been performed.

“Remediation is an on-going process and we need to respond to changing site conditions in real time,” said Steve Pause, Environmental Manager for BP in charge of the Paulsboro Terminal. “The expansion and upgrades to the existing systems are moving us in the right direction.”

Off-Site SVE Investigation

In addition to the two on-site systems, an SVE system was installed in the residential neighborhood located next to northwest portions of the Terminal in 1997. The purpose of this system was to eliminate any potential vapor hazard in the basements of houses located in the area and to address soil and groundwater impacts.

The system has worked so effectively that LNAPL on groundwater have not been measurable for the past year and other dissolved chemicals in groundwater have continued to decrease. In order to quantify current soil conditions, BP has proposed a soil boring program, involving approximately 8 to 10 borings to a depth of 24 feet below ground surface. The results of the investigation will be presented to the NJDEP and will be used to further evaluate the performance of the SVE system and determine what needs to be done to complete remediation in this area.

A Close Look at Groundwater Containment

Since 1991, BP has operated a groundwater recovery system to contain and treat impacted groundwater at the Terminal. This system is continually monitored and evaluated to ensure that it is working properly. As part of this process, BP submitted a Groundwater Capture Evaluation Report to the NJDEP in February. The report examines the performance of the current groundwater extraction system and will be a helpful tool in upgrading its design.

Pipeline readers will remember that the Terminal sits above an aquifer system that is divided into three regions – Upper, Middle, and Lower. The groundwater recovery system was designed to maintain hydraulic control of groundwater in the Upper Aquifer along the western and southern boundaries of the site and to recover LNAPL in certain areas. Recovery wells are monitored on a quarterly basis to evaluate how the system is affecting groundwater flow patterns and to monitor the distribution of LNAPL on groundwater. In addition, BP began developing a groundwater flow model in 1997. This model is a computer-generated mathematical representation of the aquifer that helps BP predict groundwater flow under different conditions. The model has evolved over time and was recently refined to reflect the results of extensive soil and groundwater sampling that has taken place over the last several years. These changes were included in the Groundwater Capture Evaluation Report.

In the report, the groundwater flow model was used to predict the results of several different pumping well scenarios. The results showed that the rate of pumping has more of an effect on system performance than the location of recovery wells; the installation of additional wells or the repositioning of existing wells can therefore be assessed to enhance performance. “We can optimize the system by better placing recovery wells so that we’re pulling water from where there are higher concentrations of chemicals,” explained senior hydrogeologist Kevin Wheeler. The groundwater treatment system is currently operating at 330 gallons per minute (gpm), or almost 500,000 gallons per day, and has recovered over 200,000 pounds of

chemicals since 1995. The Groundwater Capture Evaluation Report indicated that a flow rate of 270 to 320 gpm is best for achieving optimal results.

The groundwater report will be useful during the current deep groundwater investigation as well, since it provides a technical basis to support the strategic placement of additional monitoring wells. In the coming months, BP plans to utilize a rapid-sampling technique combined with on-site analysis to determine where new recovery wells may be optimally placed. This investigation will help determine the extent and distribution of vertical impacts (i.e., how deep) under suspected on-site source areas.

In addition to the Groundwater Capture Evaluation Report, BP submitted a Groundwater Use Investigation Update Report to the NJDEP in February. This was a follow-up of a 1999 report that documented groundwater use in the vicinity of the site at that time. The latest report includes a larger well search area and reflects a better understanding of the hydrogeology underlying the Terminal. Like the 1999 report, it found that there is no private use of groundwater within the area where chemicals apparently related to site activities have been detected. A NJ DOT-owned well at the drawbridge over Mantua Creek, located just outside this area, was identified and will be sampled shortly. Meanwhile, the Borough's three public supply wells located just outside this area have been monitored by BP since 2002, in addition to the Borough's routine sampling efforts. To date, volatile organic compounds similar to those being remediated by BP have remained at levels below the maximum contaminant level (MCL) for safe drinking water in the water being supplied to the community by the Borough.

The results of the groundwater use investigations will be used in the on-going deep groundwater investigation, which calls for the installation and monitoring of three to five additional off-site wells in the deep zone of the Upper Aquifer and in the Middle Aquifer downgradient from the site. Installation of the wells is planned for the first quarter of 2005 and sampling results will be included in the third addendum to the Deep Groundwater Remedial Investigation Report, to be submitted in the summer.

Green Zone Beautifies Terminal Boundary

If you've driven down Mantua Avenue near the Terminal lately, you've probably noticed the recent landscaping that was completed at the end of October.

The fence line was moved back 10 feet onto Terminal property, allowing for the creation of a green zone to spruce up the site's boundary. Grass was replanted,



The landscaping project along the site's boundary helps beautify the area.

flower beds were installed on Mantua Avenue, and trees were planted along Mantua and Universal Avenues.

"Our goal was to spruce up the site periphery after tank demolition and make the neighborhood look a little better," said BP's Steve Pause.

In addition, BP helped with a beauti-

fication project at the Boys & Girls Club on Penn Line Road. The project involved resodding the front and side of the club, installing an irrigation system, planting shrubs and flower beds around the building and completing minor electrical work inside. "When you pulled up to our building before, it was really not a place that kids could be proud to say was their club," said Nicole DeFeo, Executive Director of the Boys & Girls Clubs of both Paulsboro and Glassboro. "Our tag line is 'The Positive Place for Kids,' so we needed to be positive not only on the inside, but on the outside as well. BP saw that need and was able to help fill it." Now the club's welcoming exterior goes hand in hand with the atmosphere within its walls.



The front of the Boys & Girls Club of Paulsboro got a face lift thanks to BP.

Milestones on the Road to Redevelopment

Two recent developments have paved the way for the Terminal's redevelopment plans to move forward: BP has leased the Terminal property to the Borough and Gloucester County has committed to building an overpass connecting I-295 to the site.

In January, BP entered into an agreement to lease almost all of the 130-acre property to the Borough for \$1 a year for 90 years. BP will retain a 6-acre parcel needed to complete on-going cleanup activities, which will continue to be performed by BP under the supervision of the NJDEP. BP will also continue to operate its solar field adjacent to the property, which powers roughly 30 percent of the site's environmental activities.

Transferring control of the property was a major step forward for the site's future plans, which call for the construction of a deep water port that is expected to revitalize the area by providing jobs and tax revenue. The South Jersey Port Corporation has committed to the project, which could be operating within the next three years. Meanwhile, one of the obstacles to the port facility has been removed: In February, Gloucester County announced plans to build a 400-foot overpass connecting the site to Exit 19 off of I-295. The overpass, which would cross Mantua Creek, will route truck traffic away from the residential neighborhood near the site, clearing the way for efficient cargo delivery to the port.

These developments come on the heels of a major demolition project completed in early 2004, in which all of the remaining above-ground storage tanks and approximately 26,000 feet of underground piping were removed. "We've always been committed to cleaning up the site with an eye toward future sustainable site reuse," said BP's Steve Pause. "We're very excited about these recent developments and look forward to continue working with the Borough to help make it a reality."

For more information about the Terminal's redevelopment, visit the website at www.bpaulsboronj.com.



PLACE
STAMP
HERE

Meet the Team



Kevin Wheeler,
*Project Manager and
Senior Hydrogeologist
for BP Paulsboro*

Meet Kevin Wheeler, the newest member of the BP Paulsboro team. Kevin joined Sovereign Consulting, the firm supervising the site's investigation and cleanup, as a project manager and senior hydrogeologist in September, 2004.

Kevin has more than 13 years of experience in remediation and project management, most recently at Malcolm Pirnie, Inc., an environmental engineering firm. His expertise includes remedial system design, installation, monitoring, and evaluation, and remediation technology selection. He received a B.S. in Geology from Temple University in 1991 and is a licensed NJDEP Subsurface Evaluator.

Since joining Sovereign, Kevin has been hard at work evaluating the SVE systems, assessing groundwater capture and treatment at the site and planning the next phase of the deep groundwater investigation. "I look forward to making a positive contribution to the site's remediation," he said, adding that he welcomes the opportunity to apply his experience to the work at Paulsboro.

Kevin resides in Moorestown, NJ, with his wife Marjorie, and his three children Kelsey, Mallory, and Ryan. When he isn't working at Sovereign, he can be found tinkering with one of the three antique cars in his driveway.

Upcoming in Next Pipeline

- Remedial Investigation Report
- Deep Groundwater Update
- Redevelopment Update

MEMO

To: Paulsboro Residents

Date: March 2005

**Re: Overview of Activities in
Upcoming Months**

- Prepare and submit Remedial Investigation Report
- Continue deep groundwater investigation
- Continue work expanding SVE system and groundwater containment system