Fact Sheets

SRS

A/M Area Groundwater Cleanup

Background

The Savannah River Site (SRS) A/M Area Groundwater Cleanup program is one of the largest remediation programs aimed at cleaning up organic solvents from the soils and groundwater. The 350-acre A/M Area is located in the northern portion of the SRS, approximately one mile from the nearest SRS boundary. The area contains facilities that were used for the manufacture of reactor fuel and target assemblies, support services, administrative services, and laboratories. The manufacturing facilities were operational from the 1950s to the early 1980s. During that time, industrial solvents were used in several stages of the fabrication process to degrease fuel assemblies. Wastewater from the manufacturing operations flowed into the M Area Settling Basin and Lost Lake; these two units make up the M Area Hazardous Waste Management Facility (HWMF).

The M Area Settling Basin was an unlined, man-made depression (surface impoundment) used from 1958 to 1985 to settle out and contain uranium and other metals discharged from aluminum-forming and metal-finishing operations. Dimensions at the top of this eight- million-gallon earthen basin are 331 feet long by 279 feet wide by 17 feet deep. Although the M Area Settling Basin is estimated to be two acres in size, it periodically overflowed into Lost Lake, a natural, shallow depression approximately 25 acres in size.

Environmental Concerns

The M Area Settling Basin received effluent containing various heavy metals and chlorinated degreasing solvents, primarily trichloroethylene (TCE) and tetrachlorethylene (PCE). These solvents are similar to the chemicals used in the dry cleaning industry. Most of the heavy metals were effectively captured by the soil, and approximately half of the solvents evaporated. Sample results from monitoring wells installed in 1981 revealed that the remainder of the solvents had seeped into the water table and contaminated the groundwater. (Information on the closure of the M Area Settling Basin is found in the M Area Settling Basin Closure fact sheet.)

After detecting the contamination, SRS established an interim groundwater monitoring program. Multiple groundwater monitoring wells were installed around the M Area Settling Basin, which is the principal source of groundwater contamination in the A/M Area. Today an extensive monitoring well network extends throughout the A/M Area. Groundwater quality is analyzed at the wells on a regular basis in accordance with the M Area Resource Conservation and Recovery Act (RCRA) Part B Permit.

Environmental Actions and Plans

In 1983, SRS voluntarily instituted groundwater cleanup at M Area by installing a single groundwater pumping well and an experimental 70-gallon-per-minute air stripper system. The air stripping system pumps contaminated groundwater to the top of an air stripping column. As the groundwater cascades downward through the column, pumped air is forced upward from the bottom of the column. When the water mixes with air, solvents in the groundwater move from a liquid phase into a vapor phase, and volatile contaminants are stripped and released to the atmosphere. The cleaned water is discharged through a permitted outfall to a nearby stream.

In 1984, SRS upgraded the M Area groundwater recovery system by linking two more recovery wells to the air stripper. In 1985, a full-scale pump-and-treat system was constructed to treat contaminated groundwater from the shallow aquifer. Since that time, this system, which comprises 11 groundwater recovery wells and a 550-gallon-per-minute air stripper column, has operated almost continuously.

In 1992, a second pump-and-treat system was installed and began operations in the northern sector. This unit was replaced with a larger unit in 1996. The larger unit, which is fed by six wells, currently operates at approximately 250 gallons per minute. Combined, the two systems have removed more than 411,000 pounds of solvents from over 5 billion gallons of pumped groundwater. In 1992, SRS also began designing a program using soil vapor extraction (SVE) technology to remove solvents from the vadose zone, which is the layer of unsaturated soils above groundwater. By removing solvents from the vadose zone, the potential for further groundwater contamination is greatly reduced.

Starting in 1995, six SVE remediation systems were installed to assist the pump-and-treat systems. The SVE system is more cost-effective and expedites remediation five times faster than air stripping. Four of the SVE units have completed vadose remediation and retired while two units remain in operation. Combined, the six SVE units have removed more than 597,000 pounds of solvents from the subsurface.

Beginning in 1997, a series of 12 recirculation wells were brought online to treat solvents in the portion of the A/M Area Southern Sector groundwater plume migrating toward Tim's Branch Creek. The in-well stripping technology was selected to intercept the leading edge of the solvent plume (>500 ppb) for a more cost-effective treatment than conventional pump-and-treat systems. Together, the 12 recirculation wells have removed more than 5,000 pounds of dilute solvents from the groundwater. Monitored Natural Attenuation is also under evaluation to treat the distal (leading) portions of the Southern Sector groundwater plume.

Even with improving active and passive solvent removal technologies, a significant amount of source solvents remains trapped in the subsurface in the form of dense non-aqueous phase liquids (DNAPLs). To address the problem, SRS researched various technologies before selecting Dynamic Underground Stripping (DUS), a petroleum industry technology modified for environmental remediation. DUS was first developed by the Lawrence Livermore National Laboratory (LLNL) and the University of California, Berkeley with DOE funding.

Mobilization of the first DUS project at the SRS M Area Solvent Storage Tank Area began in March 2000. The treatment area was 100 by 100 feet, extending from a depth of 20 feet below ground surface to the first confining unit at a depth of 165 feet. Continuous well injections applied site steam at a temperature of 230 degrees C and a maximum rate of 20,000 pounds per hour. The full extraction and steaming process occurred from September 2000 to September 2001. Two months after initiation of the steaming and extraction process, steam breakthrough occurred at the central extraction well. The applied boiling point (90 degrees C) was reached throughout the soil block after another three months.

Over the 12 months of active DUS operation, approximately 70,000 pounds of DNAPL has been removed. It is estimated that DUS extracted material 15 times faster than the SVE unit and 75 times faster than the pump and treat configuration already operating within the remedial zone. Elimination of DNAPL resulted in the early retirement of an existing SVE unit and two recovery wells feeding the pump-and-treat system.

The second deployment of DUS is under way at the closed M Area Settling Basin to address the main source of the Western Sector groundwater contamination. Construction of the second DUS began in September 2002. The deployment is targeting a cleanup area over 10 million cubic feet (approximately seven times the size of the previous deployment). This deployment is unique because a portion of the targeted DNAPL is under the basin, which was grouted, capped, and certified closed in the early 1990s. The basin cap cannot be penetrated and must be protected from any increase in temperature or moisture. It is expected that approximately 1 million pounds of DNAPL may exist around the former M Area Settling Basin.

As with the first deployment, 350 pounds per square inch gauge (psig) steam will be supplied from the existing SRS powerhouse. Steam will be injected at a of 70,000 lbs/hour into three zones, extending to a total depth of 165 feet below ground surface that corresponds to the first confining unit. Steam will be injected through a complex matrix of 63 wells at various angles to ensure total steam flood and steam pressure will be regulated for each individual injection well. Vapor and groundwater will be removed from 33 extraction wells and transported to an equipment pad for processing. Construction of the second deployment is expected to be completed in September 2004.

Baseline technologies, including pump-and-treat and SVE, are currently employed at SRS. However, opportunities exist for significantly reducing the time frame and costs of these technologies. DUS presents an attractive alternative to pump-and-treat because the highly stratified coastal plain sediments in the western sector makes the latter inefficient at removing contaminants trapped in regions of low hydraulic conductivity. Source solvents slowly dissolve into the groundwater, providing a long-term source of contamination that requires several decades to recover. Aggressive and efficient source solvent cleanup will achieve low-cost monitoring end-states decades earlier than traditional technologies.