An Extensive Site Investigation

Conducting a CERCLA Remedial Investigation (RI) provided an understanding of the nature and extent of the chemicals in soil and groundwater. While conducting the RI NASA determined that significant levels of chemicals were not present in surface water or off-site soils, only in groundwater. NASA expanded groundwater monitoring that had been in place since the early 1990s. This extensive network of monitoring wells gives NASA information on a regular basis. Sampling performed routinely since the mid-1990s has provided data to better understand the complicated groundwater flow conditions and the movement and extent of the groundwater containing chemicals that originated at JPL. NASA also conducted human health and ecological risk assessments to identify possible exposure pathways to human health and the environment. The field work and laboratory analyses that NASA performed as part of site investigations were extensive both in terms of breadth and depth. (See sidebar.) Investigations looked at both the so-called source area beneath JPL where the highest concentrations of chemicals were found and also in the deep portions of the aquifer. Investigations confirmed what was and what was not associated with activities at JPL. NASA conducted a number of additional studies related to the Sunset Reservoir wells and those results showed that the chemicals there did not originate at JPL. (While Sunset Reservoir is not part of the CERCLA site, NASA continues to sample wells installed between JPL and the Sunset Reservoir area.) During all the investigative work, NASA worked closely with regulatory agencies. NASA takes the lead for environmental investigations and cleanup activities associated with JPL, and work is overseen by the U.S. Environmental Protection Agency, the California Department of Toxic Substances Control and the Regional Water Quality Control Board, Los Angeles Region.

A SAMPLING OF NASA'S SAMPLING

NASA continues with site investigations. To date, NASA's extensive work includes:

Installed
26 wells with 82 discrete sampling locations

Collected
more than 30,000 groundwater samples

Conducted
73 quarterly groundwater sampling events since 1996

Drilled
more than 40 soil borings

Installed
35 soil vapor wells with 200 discrete vapor sampling locations, resulting in a database of more than 1,500 soil and soil vapor samples

Performed
computer modeling and aquifer testing to characterize groundwater conditions and flow

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NASA Has Made Steady Cleanup Progress

OU-1 Treatment System

While looking toward a final cleanup remedy for the site during the lengthy CERCLA process, NASA took steps to clean up soils on site and groundwater on- and off-site. In January 2000, NASA completed a draft Feasibility Study that identified and evaluated various groundwater cleanup alternatives for both the source area and off-facility areas adjacent to the JPL facility. As part of this effort, NASA also conducted a number of different pilot tests to see which technologies might be the most promising for use. The technologies tested included reverse osmosis, a fluidized bed reactor, packed bed reactors, in situ bioremediation, and ion exchange. These evaluations helped guide the selection of remedies for a successful groundwater cleanup (see below) and helped NASA to make significant progress with groundwater cleanup to restore the aquifer.

Cleanup activities at the NASA JPL site include three areas referred to as Operable Units (OUs):

OU-1 Groundwater beneath the JPL "source area"

OU-2 On-facility soil

OU-3 Deep groundwater outside the JPL fence line

(NASA's final remedy addresses groundwater cleanup in OU-1 and OU-3.)

OU-2, On-Facility Soil Cleanup

The **successful** remedy for OU-2 included the removal of VOCs using soil vapor extraction (SVE). NASA had pilot-tested SVE in 1998 and based on its success, NASA implemented full scale operation in 2002 until completion of the soil cleanup in 2007. This cleanup activity removed the source of chemicals from on–facility soil and prevented further migration of chemicals to groundwater and away from the site.

OU-1, On-Facility Groundwater Cleanup

NASA conducted a number of studies to determine the best technologies to treat groundwater in the source area. Based on these studies, NASA installed a demonstration treatment plant located on JPL at the source area in early 2005. Success in the demonstration phase led to NASA receiving regulatory approval to expand the system as the interim remedy for OU-1 in 2007.

The treatment plant uses a fluidized bed reactor system with naturally-occurring microorganisms to break down and eliminate perchlorate from the groundwater and a liquid-phase granular activated carbon (LGAC) technology to trap dissolved VOCs, for subsequent disposal at licensed off-site facilities. With LGAC, water passes through a tank containing carbon particles. VOCs in the water attach to the carbon particles. After VOCs attach to the carbon particles, the carbon is removed and processed at a licensed facility off site, and fresh carbon is placed in the system. This full-scale 300 gallon per minute treatment system continues to clean up the source groundwater. Treated water, while it meets State drinking water standards, is reinjected to the deep aquifer and not used.

OU-3, Off-Facility Groundwater Cleanup

OU-3 includes off-facility groundwater treatment activities consisting of two "pump and treat" systems:

Lincoln Avenue Water Company (LAWC) Treatment System in Altadena and

Monk Hill Treatment System (MHTS) in Pasadena.

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Lincoln Avenue Water Company Treatment System (LAWC)

NASA has funded groundwater treatment at LAWC to remove volatile organic compounds using liquid-phase granular activated carbon (LGAC) technology since 1992. Its two drinking water supply wells are near the leading edge of the area of groundwater chemicals that originated at JPL according to data collected from NASA's extensive groundwater monitoring network. In 2004, NASA and LAWC added ion exchange technology to remove perchlorate. Ion exchange technology uses a perchlorate-selective resin to absorb or capture the perchlorate and remove it from the water. This full-scale 2,000 gallon per minute treatment system is currently operating. In early 2015, NASA began work to install a new well for LAWC which will further enhance the cleanup of groundwater and provide important infrastructure.

Ion exchange section of the Lincoln Avenue Water Company treatment system.

Monk Hill Treatment System (MHTS)

NASA funded groundwater treatment at four Pasadena wells to remove VOCs beginning in 1990. That system stopped operating in 2002. Then in 2011, NASA rehabilitated four Pasadena drinking water production wells – the Arroyo Well, Well 52, the Ventura Well, and the Windsor Well. As part of an interim remedy, NASA funded the construction of the MHTS. This groundwater treatment system removes volatile organic compounds using LGAC technology and perchlorate using ion exchange, similar to those used at LAWC. The City of Pasadena has been operating the full scale 7,000 gallon per minute capacity MHTS since then to supply water for their drinking water purposes and to continue NASA's cleanup of the groundwater.

Monk Hill Treatment System

Towards A Final Remedy

The three NASA-funded groundwater treatment systems have served as interim remedies in the CERCLA process. In 2014 NASA completed a Focused Feasibility Study (FFS) to evaluate overall effectiveness of the interim remedies and determine if additional cleanup measures or other types of treatment options would be appropriate. The FSS recommended a "Preferred Alternative" consisting of continuation of the three NASA-funded groundwater treatment systems, continuation of NASA's extensive system of groundwater monitoring, and the use of institutional controls (non-engineering measures that are administrative or legal in nature). With completion of the FFS, NASA moved on to the next step in the CERCLA process and presented to the public and to regulatory agencies a "Proposed Plan" for final cleanup that outlined a Preferred Alternative. Community members were able to provide their input during an extended public comment period before NASA moved towards a final decision on cleanup. That decision executed by the Federal Facilities Agreement (FFA) parties will be described in a final Record of Decision expected in 2015. Under CERCLA, the final remedy will be evaluated every five years to ensure that it continues to operate effectively to protect public health and the environment.

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