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LAND RESEARCH PROGRAM

# RESEARCH PROVIDES REMEDIATION TOOLS TO MANAGE DENSE NON-AQUEOUS PHASE LIQUIDS (DNAPLS)

## Issue:

Dense Non-Aqueous Phase Liquids (DNAPLs) are contaminants that are denser than water and do not easily mix or dissolve in water. Groundwater contamination by DNAPLs poses one of the greatest remedial challenges in the field of environmental engineering because conventional pump-and-treat technologies have not been particularly effective in remediating contaminated aquifers. In fact, in certain situations, conventional pump-and-treat methods may actually extend existing contamination into previously uncontaminated areas. The remediation of subsurface formations contaminated by DNAPLs is a major challenge to the restoration of many hazardous waste sites.

DNAPLs have a relatively low solubility, a high specific gravity, a tendency to remain sorbed to organic materials in an aquifer and are not readily degraded. This makes DNAPLs difficult to locate and characterize in the subsurface. DNAPLs can migrate deep through the saturated zone in the subsurface and leave a trail of hydraulically trapped organic liquid. Additionally, they can act as continuing sources of groundwater contamination becausee of their tendency to be absorbed by organic materials in an aquifer and then slowly released.

## Scientific Objective:

The U.S. Environmental Protection Agency's Land Research Program in the Office of Research and Development (ORD) is contributing to the enhancement and development of DNAPL remediation technologies. The research program is developing better characterization methods of DNAPL and improving fate and transport models. Scientists have developed a systematic approach to addressing DNAPL groundwater–surface water interactions in the subsurface, which is a remediation challenge.

Researchers have contributed to the Interagency DNAPL Consortium (IDC), formed to evaluate successful technologies for DNAPL remediation in soils and groundwater at government sites and to develop and improve characterization, sampling, and analytical methods. The IDC is a collaborative effort by the Department of Defense, Department of Energy, National Aeronautics and Space Administration, and EPA. More information can be found at the following Web sites: www.brownfieldstsc.org/roadmap/spotlight14.cfm www.containment.fsu.edu/cd/DoubleClickToStart.htm.

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## Application and Impact:

Scientists have demonstrated that a high percentage of DNAPL mass can be rapidly depleted from source zones by using aggressive in situ (at source) thermal or chemical flushing technologies. Even with these aggressive technologies, the efficiency of DNAPL removal often decays exponentially as mass is removed. As a result, DNAPL source remediation research is focused on demonstration, evaluation, and optimization of DNAPL remediation technologies; assessment and prediction of the benefits of partial DNAPL depletion; and development and assessment of integrated DNAPL source remediation approaches. More information is available at: www.epa.gov/ada/download/issue/steaminj.pdf

Researchers also are focused on related remediation technologies, such as in situ treatment technologies, Monitored Natural Attenuation (MNA) and Permeable Reactive Barriers (PRB). These technologies also address the remediation of DNAPLs in groundwater by more passive methods that primarily address the plumes rather than the source zones. More information can be found at: www.epa.gov/ada/publications.html

In addition to the development of research products, scientists provide technical assistance to support and transfer research results to EPA's regional offices and to state and municipal environmental organizations.

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**CONTACT:**

Robert Puls, Ph.D., EPA's Office of Research and Development, U.S. Environmental Protection Agency, 580-436-8543, puls.robert@epa.gov

David Burden, Ph.D., EPA's Office of Research and Development, U.S. Environmental Protection Agency, 580-436-8606, burden.david@epa.gov

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