

**Strategic Environmental Research and Development Program
(SERDP)**

FY 2015 STATEMENT OF NEED

Environmental Restoration (ER) Program Area

**IMPROVED UNDERSTANDING OF LONG TERM NATURAL
ATTENUATION PROCESSES ON CONTAMINANTS IN
GROUNDWATER**

1. Objective of Proposed Work

The overall objective of this Statement of Need (SON) is to improve our understanding and estimation of the impact of several natural processes on the fate and transport of contaminants in groundwater. Ultimately the goal of this SON is to quantify the long term impacts of natural processes on contaminants in groundwater and to estimate the resulting contaminant attenuation rate. Specific objectives of interest include:

- Develop and validate field-scale methods for estimating important parameters such as back diffusion, sorption, and degradation (both biotic and abiotic) of contaminants. The degradation and diffusion of contaminants that occur in and around the interfaces of low and high permeability layers is likely to be especially important.
- Develop a greater understanding of the effect of physical, chemical, and biological processes and their associated rates on contaminant behavior in lower mobility zones to support improved predictive modeling of plume behavior.
- Develop tools to estimate the natural contaminant assimilative capacity of an aquifer.
- Develop mathematical and simulation estimation methodologies for these important natural processes that can be incorporated into commonly-used models to predict contaminant behavior in groundwater.
- Develop cost-effective diagnostic methods to determine whether natural attenuation processes are still occurring.
- Develop networks of relatively inexpensive sensors for key contaminant attenuation rate indicators that are capable of measuring parameters associated with each of the contaminant destruction processes.

Proposals may address one or more of the objectives listed above; however, all proposals must demonstrate how the knowledge developed will ultimately be used to better estimate the natural attenuation rate of contaminants in groundwater. Research and development activities at laboratory-, bench-, and field-scale will be considered, but work does not necessarily have to culminate in a field-scale effort. Technologies and approaches should be applicable to a variety of hydrogeologic settings. Proposals focused on the common chlorinated solvents found in groundwater (tetrachloroethene [PCE], trichloroethene [TCE], and their daughter products) are of most interest.

In August 2013, SERDP and the Environmental Security Technology Certification Program (ESTCP) co-sponsored a Workshop on *Long-Term Management of Contaminated Groundwater Sites*. This workshop identified high priority research topics addressing impacts of natural processes on contaminants in groundwater. A more detailed description of these issues can be found in the report from the workshop. Proposers are strongly encouraged to review the workshop report for additional detail. (http://serdp-estcp.org/content/download/22092/228039/version/5/file/Groundwater+Workshop+Report_November+2013.pdf).

2. Expected Benefits

Research should lead to improved site assessments and monitoring of long-term attenuation processes, and therefore more effective long-term management of contaminated groundwater sites. This information will be needed to: (1) obtain regulatory and other stakeholder concurrence that natural or enhanced attenuation is a viable, protective long-term remedial option; (2) support cost-benefit analyses of different methods for enhancing attenuation at a given site, if needed; and (3) track the progress of natural or enhanced attenuation. The resulting tools and understanding should improve the ability to assess the risks associated with residual contamination and manage those risks cost-effectively.

3. Technical Background

Several processes can impact the mobility and/or the transformation of contaminants in plumes, and these processes may provide adequate attenuation and protection after source control is implemented. However, a greater understanding of the spatial extent and rate of these natural attenuation processes is needed, both for currently understood processes and particularly for processes that previously have not been studied in detail. Of particular interest is the kinetics associated with contaminant back diffusion. Further, although some of these processes may have been previously identified, the extent to which they contribute to contaminant attenuation is still not known.

It would be particularly helpful to have a better understanding of the fluxes from less mobile regions and the degradation near and within those regions. These parameters can have significant impacts on the costs and risks associated with the long term management of contaminated sites following partial restoration. Unfortunately, the uncertainty associated with current measures or estimates of these key variables is large, limiting the confidence in predictions of future risks and restoration timeframes.

An important need is to develop and validate field-scale methods for estimating these parameters. These tests may include (but are not limited to) stressing the subsurface systems via activities such as push-pull tests or shut-down tests, if active remediation systems are currently in place. The stress imposed on the subsurface system by the field test must be large enough to allow for unambiguous interpretation of the results. At the same time, the new field tests must be practical enough to allow for widespread adoption at active sites. The field-scale methods developed need to take into account the likely spatial and temporal variability in the parameters.

It may be important at sites relying on natural attenuation to ensure that biological activity or other degradative processes persist over time. Cost-effective techniques are needed to provide ancillary diagnostic evidence during the long natural attenuation phase, when contaminant

concentration monitoring may occur infrequently. For instance, field-scale diagnostic evaluations, such as push-pull tests or tracer tests, could be performed at intervals to determine whether the natural attenuation processes are still occurring and to estimate the associated attenuation rate.

In particular, cost-effective methods are needed to verify that specific degradation processes are occurring, and to estimate the in situ degradation rates over time. Different tools will likely be needed for anaerobic or aerobic treatment systems, for evaluating biotic or abiotic processes and for reducing or oxidizing conditions. These diagnostic tools may be useful to assess initial rates, to determine whether natural attenuation mechanisms are still operating at original or predicted rates, and to determine whether degradation rates are equal to or greater than back diffusion rates so that the plume is contained. Similarly, diagnostic tests and data analysis methods are needed to determine whether degradation rates in a downgradient plume are in line with mass flux rates from a source area following source area remediation. Such data could be used to verify or modify the rates used in the original attenuation modeling or remedy decision basis.

4. Cost and Duration of Proposed Work

The cost and time to meet the requirements of this SON are at the discretion of the proposer. Two options are available:

Standard Proposals: These proposals describe a complete research effort. The proposer should incorporate the appropriate time, schedule, and cost requirements to accomplish the scope of work proposed. SERDP projects normally run from two to five years in length and vary considerably in cost consistent with the scope of the effort. It is expected that most proposals will fall into this category.

Limited Scope Proposals: Proposers with innovative approaches to the SON that entail high technical risk or have minimal supporting data may submit a Limited Scope Proposal for funding up to \$150,000 and approximately one year in duration. Such proposals may be eligible for follow-on funding if they result in a successful initial project. The objective of these proposals should be to acquire the data necessary to demonstrate proof-of-concept or reduction of risk that will lead to development of a future Standard Proposal. Proposers should submit Limited Scope Proposals in accordance with the SERDP Core Solicitation instructions and deadlines.

5. Point of Contact

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the SERDP web site at www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations.