PARTNERS IN ENVIRONMENTAL TECHNOLOGY

SERDP ESTCP

INFORMATION BULLETIN

SPRING 2010
NUMBER 41

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Science and Technology Key to Improving DoD Energy Conservation and Adaptability to Climate Change Impacts

Project-of-the-Year Awards Showcase Innovations at Symposium & Workshop

When it comes to mitigating the catastrophic effects of global warming, humans could learn a lot from nature, says Dr. Peter Kareiva, Vice President and Chief Scientist, Conservation Science, at The Nature Conservancy. "Yes, climate change is a threat to nature and unfortunately we will see extinctions," said Dr. Kareiva. "But sometimes by focusing on the fragility of nature, we forget about the capacities of nature to adapt. And because it can adapt so well, nature can be and should be a resource for us to learn to adapt. It's not nature that's so at risk. Nature will recover, over time. It's people who are the most at risk with climate change. The reality is we're the polar bears," he said.

Three distinguished Plenary Session speakers—Dr. Dorothy Robyn (second from left), Dr. Peter Kareiva (middle), and Mr. James Balocki (far right)—discussed opportunities for Symposium & Workshop participants to help DoD improve energy conservation and adapt to climate change impacts through research and technology innovations. Also pictured are Dr. Anne Andrews, SERDP/ESTCP Deputy Director, and Dr. Jeffrey Marqusee, SERDP/ESTCP Director.

Dr. Kareiva spoke at the opening Plenary Session of the annual Partners in Environmental Technology Technical Symposium & Workshop, hosted by SERDP and ESTCP in Washington, D.C., December 1-3, 2009. Breaking attendance records once again, more than 1,100 environmental professionals from the military, government agencies, academia, private industry, and the regulatory community participated in this conference.

The expected effects of climate change, including increased flooding, storms, drought, and heat waves, are a major concern of the Department of Defense (DoD), which is responsible for managing hundreds of installations throughout the United States and around the world, many of them located in coastal areas. Even if efforts to slow carbon output in the coming decades succeed, tens of thousands of troops live and train in areas that will be affected by global warming and the changes that have already occurred to the earth's atmosphere. To maintain its own bases and to help protect vulnerable areas in the United States and around the world, DoD has a vested interest in researching ways to adapt to climate change and mitigate its potential impacts, said Dr. Kareiva.

To that end, he urged the audience of environmental professionals to use scientific research to determine how to harness nature's ability to adapt in order to better protect humans and preserve animal species and natural habitats. One example Dr. Kareiva cited was a cyclone that struck India in 1999, killing an estimated 10,000 people. Statistical modeling and analysis after the storm found that were it not for mangrove habitats acting as a buffer against flooding and storm surge, the cyclone would have killed more than 30,000 people.

See SYMPOSIUM, page 2

Using ecosystem science, which combines modeling, economic analysis, and field testing, researchers can determine how protecting nature can provide services to humans, said Dr. Kareiva. "Intact ecosystems are essential—things like mangrove habitats, arid lands that are well managed so they're not just exposed bare soil, flood plains and forests that hold onto water longer to maintain steady water supplies," he said. "All these intact ecosystems have tremendous economic value and health value, and they are a way of protecting humans confronted with climate change."

DoD can play a role in furthering ecosystem science by supporting research efforts in this area, said Dr. Kareiva. While preliminary research shows that ecosystems can provide services such as storm and flood protection, carbon storage, and soil erosion prevention, more extensive research and field tests are needed to assess and document how these services work, he said. "We know that natural ecosystems can serve as a safety net for vulnerable communities in the face of climate change," said Dr. Kareiva. "We need more scientific examples of how they work and how they can help us adapt."

ESTCP released a call for proposals on Ecosystem Service Methodologies and Tools for Department of Defense Installations as part of its FY 2011 solicitation. See page 12.

At the same time, as the nation's single largest energy consumer in the nation, DoD must also continue to develop and implement ways to reduce its carbon footprint, said Dr. Dorothy Robyn, Deputy Under Secretary of Defense for Installations and Environment. "Energy and the environment are high priorities for DoD," Dr. Robyn said. "Science and technology are the keys to the Department's ability to protect the environment and to reduce its energy use." Because of the wide variety of facilities on military installations, DoD can serve as a realistic testing ground for new energy technologies, and SERDP and ESTCP play an important role in these efforts, Dr. Robyn said.

Mr. James Balocki, Chief, Environmental Community of Practice, Headquarters, U.S. Army Corps of Engineers, then urged Symposium participants to focus on the long-term outcomes of technological advances in both energy conservation and climate change. "Research for us is the key to providing solutions the taxpayers need and deserve," said Mr. Balocki. "We collectively, on behalf of DoD, owe it to the American public to ensure that our solutions are sustainable for the long term and that they present holistic solutions to these problems."

At the conclusion of the Plenary Session, Dr. Jeffrey Marqusee, Director, and Dr. Anne Andrews, Deputy Director, presented five SERDP and two ESTCP Project-of-the-Year Awards to recognize research and technology developments with significant benefits to DoD.

SERDP Projects of the Year for Environmental Restoration (ER).

Phytoremediation for the Containment and Treatment of Energetic and Propellant Material Releases on Testing and Training Ranges (ER-1499)—Dr. Jerald Schnoor, The University of Iowa, Department of Civil and Environmental Engineering. *Sustainable Range Management of RDX and TNT by Phytoremediation with Engineered Plants (ER-1498)*—Dr. Neil Bruce, University of York Centre for Novel Agricultural Products, York, United Kingdom and Dr. Stuart Strand, University of Washington, Department of Civil and Environmental Engineering.

Deposition of energetic compounds occurs during training with live munitions, which is essential to maintain the readiness of our forces. These compounds may then percolate through the soils and, in some cases, migrate to contaminate groundwater and potentially drinking water in communities near the ranges. Recent research has demonstrated that enzymes in certain plants found on military installations can actually break down toxic energetic compounds such as TNT and RDX.

SERDP ER Projects of the Year

Dr. Jerald Schnoor (left) and Mr. Travis Anderson **Dr. Neil Bruce (left) and Dr. Stuart Strand**

Dr. Schnoor and his team advanced the understanding of how existing, naturally occurring native plants, through the process of phytoremediation, can degrade and contain energetic compounds such as RDX that contaminate subsurface soils on ranges. The fundamental molecular biology conducted by these researchers has vastly improved scientific understanding of the mechanisms that degrade these energetic compounds.

To address the challenge posed by TNT, an energetic compound that is toxic to many plants, Dr. Bruce and his team succeeded in creating transgenic grasses with unique abilities both to detoxify TNT and degrade RDX. "This work is a huge leap forward in developing grasses with specific abilities for use on training ranges," said Dr. Marqusee. Using genetic engineering techniques in greenhouse settings to develop the transgenic grasses, the researchers modified grasses that naturally grow on DoD ranges, so as to avoid introducing invasive plant species.

"The findings from these two projects provide the insight and technology to apply a radically new approach for long-term range sustainability," said Dr. Marqusee. "We can now envision a range in the future

See SYMPOSIUM, page 8

SERDP Conducts Sustainability Assessment of a Military Installation

Report Presents Framework for Sustainability Metrics and Reporting

The sustainable management of U.S. military bases is a matter of increasing priority. Effective management of all the relevant aspects of long-term stability, reliability, and resilience of operations requires a comprehensive framework as well as appropriate management metrics and reporting systems to highlight emerging issues and systemic problems. The primacy of the mission to the U.S. military, together with the complexity of base operations and their relationships with the surrounding environment and community, means that simple adaptation of existing sustainability metrics and management frameworks would not produce an adequate set of tools.

To fill this gap, SERDP working in collaboration with sustainability consultants, contractors, and military personnel developed a Mission Sustainability Framework (MSF) and set of sustainability metrics that can be adapted to virtually any military installation across the United States. Naval Base Ventura County (NBVC) in southern California was selected as the prototype and reference location for this effort.

Highly representative of U.S. military bases in general, NBVC consists of 73 commands in two separate locations, Point Mugu and Port Hueneme, housed in 1,500 buildings. NBVC fulfills three main functions—training, mobilization, and testing. NBVC operates an airfield and a seaport and has base housing and deploying units. This diversity of functions ensured that the MSF and metrics would be robust across different types of military bases.

To develop a framework that was relevant most importantly to the mission of NBVC, the effort included extensive interactions with key installation personnel, providing input that was critical in developing the MSF. The resulting MSF consists of six metric categories, with a set of sustainability metrics relevant to each category. The categories are mission, management, neighbors and stakeholders, operations and maintenance, environment, and quality of life.

The culmination of this project is a framework on which to build a comprehensive sustainability metrics system for U.S. military installations and enable them to respond to the requirements of Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance. The Final Report presents the key results, including (1) the MSF for categorizing and presenting metrics, (2) the issues of management interest, (3) examples of sustainability metrics in each MSF category, and (4) a conceptual design for a sustainability reporting system, which can be further developed to work in harmony with other metric reporting systems now in use or development. *Access the report in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org using MSF as the Search Phrase.*

The Role of Demonstration in Translating Conservation Science into Practice

Scientific funding organizations and researchers often tend to emphasize the exploration of fundamental scientific concepts, with the assumption that others will translate scientific understanding into management and policy. To emphasize the case that a scientist's responsibility does not end with a hand off, Dr. John Hall (SERDP/ESTCP Sustainable Infrastructure Program Manager) and Dr. Erica Fleishman (University of California, Santa Barbara) recently published an essay—Demonstration as a Means to Translate Conservation Science into Practice—in the journal *Conservation Biology*.

Dr. Hall and Dr. Fleishman contend that, to be relevant to societal interests and needs, conservation science must explicitly strive to solve real-world problems. They suggest demonstration as a logical step in the progression of fundamental research to field application and define demonstration as the translation of scientific understanding into metrics of performance and cost of implementation under real-world conditions. Demonstrations are useful in facilitating technology and methodology implementation because they reduce scientific uncertainty and validate the hypothesis that a management approach is both effective and sustainable from a cost perspective. Moreover, demonstrations enable researchers and resource managers to conduct unbiased assessments of management actions, avoiding trial-and-error approaches.

To further illustrate the potential role of demonstration in this field, Dr. Hall and Dr. Fleishman consider how the research described in three recent papers published in *Conservation Biology* might be implemented as demonstration projects. For each case, they develop hypothetical performance objectives, metrics, data requirements, and success criteria for an aspect of performance that the authors highlighted as uncertain.

Dr. Hall and Dr. Fleishman conclude by recommending four actions to better connect conservation science to the needs of resource managers via demonstration: (1) use demonstrations to formally document successes and failures; (2) budget adequately for demonstrations and execute them as a partnership between researchers and managers; (3) increase funding opportunities and incentives for academics to engage in demonstrations; and (4) further explore social influences on the adoption of new technologies and methods. Ultimately, demonstrations should provide end users the ability to evaluate explicitly whether a new approach is likely to achieve management objectives, save money, and reduce risk.

Citation: Hall, J.A., and E. Fleishman. 2010. Demonstration as a Means to Translate Conservation Science into Practice. *Conservation Biology* 24:120–127.

SPOTLIGHT on SERDP and ESTCP FY 2010

New initiatives in the SERDP and ESTCP focus areas are highlighted throughout

SERDP and ESTCP initiatives in **Environmental Restoration** (ER) focus on the technologies and strategies required to characterize, clean, and manage contaminated sites, both to ensure that the lands can continue to be used for military training and to protect the health of the people who live and work on and near these sites. In 2010, SERDP initiated research and development efforts to predict the impact of new munitions constituents on the environment, determine the impact of contaminant storage in low-permeability zones on chlorinated solvent groundwater plumes, assess interaction mechanisms between soil components and contaminants that impact contaminant bioavailability, and improve general understanding of contaminant bioavailability in aquatic sediments. ESTCP investigators began demonstrating state-of-the-art technologies and approaches for characterizing, remediating, managing, containing, and monitoring contaminants of concern in groundwater, soil, and sediments. Results from these initiatives will help DoD implement efficient and cost-effective approaches to remedy the effects of past practices.

SERDP Research

Additional information on these efforts can be found at www.serdp.org under the Research Projects *link.*

Energetics: Risk Assessment

Developing Quantum Chemical and Polyparameter Models for Predicting Environmentally Significant Parameters for New Munitions Compounds (ER-1734)
Principal Investigator: Dominic Di Toro – University of Delaware

The objective of this project is to develop models for predicting the physical and chemical properties (aqueous solubility, octanol-water partition coefficient, and Henry's Law constant) and the potential bioaccumulation and metabolism of new munitions compounds partitioning into soil organisms and plants. Development of these models will rely on quantum chemical methods to estimate properties. These models will enable risk assessment of new munitions compounds in the early stages of development, providing an early warning of potential environmental problems for further investigation.

Full In Silico Calibration of Empirical Predictive Models for Environmental Fate Properties of Novel Munitions Compounds (ER-1735)
Principal Investigator: Paul Tratnyek – Oregon Health & Science University

Predicting the environmental fate of novel munitions compounds requires data for the key properties that control contaminant fate, and the most common way to predict these properties is with empirical quantitative structure-activity relationships (QSAR). This project seeks to develop an in silico approach to QSAR development, in which all calibration data are calculated from molecular structure theory. Predictive models will be developed for the kinetics of the four reaction pathways that contribute most to the fate of explosives in the environment (hydrolysis and elimination reactions, homogeneous nitro reduction, heterogeneous nitro reduction, and polymerization of amino acid products). These models will demonstrate a novel method for chemical property estimation that can be applied to other environmental fate properties.

Development of an Environmental Fate Simulator for New and Proposed Military-Unique Munitions Compounds (ER-1736)
Principal Investigator: Eric Weber – U.S. Environmental Protection Agency-National Exposure Research Laboratory

The objective of this project is to develop a FRAMES-based environmental fate simulator (EFS) that will provide estimates of the vulnerability of aquifers and surface waters to new and proposed energetic materials and their potential transformation products. The EFS will provide physico-chemical properties of parent and progeny compounds for future use in modeling tool sets for assessing environmental exposure and subsequent human/ecological receptor health risks associated with loading and fate/transport of residual energetic materials. This information will enable range managers to assess the vulnerability of range sites, based on site characteristics and contaminant type, to off-site exposures.

Chlorinated Solvents: Site Characterization and Monitoring

Impact of Clay-DNAPL Interactions on Transport and Storage of Chlorinated Solvents in Low-Permeability Zones (ER-1737)
Principal Investigator: Avery Demond – University of Michigan

This project will evaluate the impact of contact between dense nonaqueous phase liquid (DNAPL) and clay on chlorinated solvent storage in and transport into and out of low-permeability regions. A numerical model based on DoD's Groundwater Modeling System will be developed to incorporate the temporally and spatially varying processes associated with changes in clay structures resulting from DNAPL contact. Improved understanding and modeling capabilities will help site managers properly account for the altered clay's impact on low-permeability layers when selecting a remedial strategy.

The Importance of Sorption in Low-Permeability Zones on Chlorinated Solvent Plume Longevity in Sedimentary Aquifers (ER-1738)
Principal Investigator: Richelle Allen-King – University at Buffalo, SUNY

This project will evaluate the relative impacts of partition coefficients and sorption heterogeneity on chlorinated volatile organic compound (cVOC) mass storage, mass removal, and concentration reduction in sedimentary aquifers. Laboratory experiments, field mapping, and numerical simulations will be integrated in a multiscale approach to elucidate fundamental rate controlling processes. The conditions in which to employ high and nonlinear sorption for cVOC plumes will be defined as will the effect of coarse sedimentary lithocomponents on mass storage and tailing.

Initiatives in Environmental Restoration

the year. Environmental Restoration efforts are featured here.

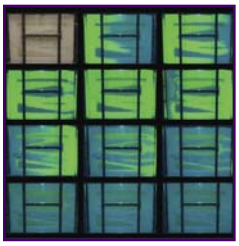
The Behavior of Compound-Specific Isotopes during the Storage of Chlorinated Solvents in Low-Permeability Zones through Diffusion and Sorption (ER-1739)

Principal Investigator: Orfan Shouakar-Stash – University of Waterloo

In heterogeneous aquifers or fractured rocks, contaminants enter the low-permeability zones via diffusion, creating a secondary storage area that ultimately serves as a long-term source for chlorinated solvent plumes. The objectives of this project are to test the behavior and usefulness of compound-specific isotopes during the storage of trichloroethene (TCE) and cis-dichloroethene (DCE) in low-permeability zones and to develop a cost-effective and reliable technique for predicting the occurrence of storage in low-permeability zones and monitoring the progress of treatment.

Basic Research Addressing Contaminants in Low-Permeability Zones (ER-1740)

Principal Investigator: Tom Sale – Colorado State University



The objectives of this project are to improve understanding of contaminant storage-release in low-permeability zones, demonstrate novel site characterization approaches, advance a set of validated predictive tools, and develop a foundation for selecting remedies. Technical guidance will be developed for parties who are characterizing sites and selecting remedies at sites where contaminants are present in low-permeability zones.

Soils: Risk Assessment and Bioavailability Issues

Antimony(V) Adsorption by Variable-Charge Minerals (ER-1741)

Principal Investigator: Michael Essington – The University of Tennessee

The objective of this project is to improve understanding of the mechanisms and permanence of the binding of antimony by soil components. Mechanisms of antimony retention by reactive soil minerals will be evaluated as will the thermodynamics and reversibility of antimony adsorption. This improved understanding of antimony adsorption behavior in soil in addition to new capabilities to predict antimony mobility and bioavailability will support efforts to define technically defensible cleanup goals at DoD sites.

Mechanisms and Permanence of Sequestered Lead and Arsenic in Soils: Impact on Human Bioavailability (ER-1742)

Principal Investigator: Nicholas Basta – The Ohio State University

This project will conduct basic research on the propensity of soils and soil amendments to decrease toxic metal bioavailability and increase long-term sequestration. The fundamental relationships between lead and arsenic soil-binding mechanisms will be determined with surrogate methods used to estimate human bioavailability for unamended and amended soils. A comprehensive evaluation of tools for human bioavailability measures will be completed. The results of this project will support the adoption of tools that provide reliable estimates of human bioavailability.

PAH Interactions with Soil and Effects on Bioaccessibility and Bioavailability to Humans (ER-1743)

Principal Investigator: Yvette Lowney – Exponent, Inc.

The objective of this project is to examine the fundamental physical and chemical interactions between polycyclic aromatic hydrocarbons (PAH) and soils and the way these interactions control the oral and dermal bioavailability of PAHs in soil to humans. An in vivo model will be developed for measuring site-specific PAH bioavailability. This work will lead to the development of an inexpensive and efficient method to predict the relative bioavailability of PAHs in soil on a site-specific basis. The new information and assessment tools developed will support more accurate human health risk assessments.

Lead and Antimony Speciation in Shooting Range Soils: Molecular Scale Analysis, Temporal Trends, and Mobility (ER-1770)

Principal Investigator: Thomas Trainor - University of Alaska, Fairbanks

This project seeks to improve the molecular and nanoscale understanding of lead and antimony transport and bioavailability in range soils. Traditional geochemical analyses and speciation methods will be used to study fine-grained soil materials for metal(loid) changes and to analyze pristine reactive substrates for use as passive sensors in impact berms. The results will help managers assess the weathering process of bullet fragments in training range soils and berms as well as the way soil physicochemical conditions control the rates and extent of metal(loid) transport.

Sediments: Risk Assessment and Bioavailability Issues

Bioavailability and Methylation Potential of Mercury Sulfides in Sediments (ER-1744)

Principal Investigator: Heileem Hsu-Kim – Duke University

This project seeks to establish a premise that links the age and chemical form of mercury in sediment pore water to the rate of methylmercury formation and incorporate the kinetic data in a conceptual model describing the fate of mercury. A framework to determine methylmercury potential as a function of environmental conditions will be developed. This framework will improve the ability to manage and restore contaminated sites through appropriate modifications that minimize bioavailable mercury, the formation of methylmercury, and its subsequent uptake by benthic organisms.

Coupling between Pore Water Fluxes, Structural Heterogeneity, and Biogeochemical Processes Controls Contaminant Mobility, Bioavailability, and Toxicity in Sediments (ER-1745)

Principal Investigator: Aaron Packman – Northwestern University

The objective of this project is to improve understanding of how the interplay of physical, chemical, and biological processes control the transformation, mobility, bioavailability, and toxicity of metals in sediments. Basic information needed to support management of contaminated sediments will be provided by advancing the understanding of processes that operate within contaminated sediments and by developing a set of practical tools that may be used to effectively characterize sites.

Predicting the Fate and Effects of Resuspended Metal-Contaminated Sediments (ER-1746)

Principal Investigator: G. Allen Burton – University of Michigan

This project seeks to determine the environmental significance of resuspended metal-contaminated sediments, considering spatial and temporal issues as they relate to exposure, fate, and effects. Strong resuspension events such as those caused by propeller wash will be the focus. Physical-chemical models will be developed that predict metal contaminant speciation, partitioning, and transport, and the resulting exposures will be linked to biological effects in these dynamic ecosystems. More accurate models for assessing metal flux and transport when linked to biological effects will lead to better definitions of risk.

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FY 2010 ER INITIATIVES, from page 5

Robust Means for Estimating Black Carbon-Water Sorption Coefficients of Organic Contaminants in Sediments (ER-1747)

Principal Investigator: Philip Gschwend – Massachusetts Institute of Technology

Sorption of a wide range of organic contaminants to black carbon (e.g., soots, chars, coal dust) reduces their bioavailability. The objective of this project is to improve fundamental understanding of organic chemical sorption to black carbon in sediments while at the same time providing a practical means for evaluating this interaction quantitatively. The polyparameter linear-free energy relationship (ppLFER) parameters will be elucidated. These parameters are needed to evaluate contaminant partitioning between aqueous solution and the water-wet surfaces of black carbon. By developing the means to estimate black carbon sorption in sediments of interest, the model for sorption coefficients will be improved, which will in turn enable better assessment of chemical fluxes, bioaccumulation, and availability for processes like biodegradation.

Development of an Electrochemical Surrogate for Copper and Lead Bioaccessibility in Aquatic Sediments (ER-1748)

Principal Investigator: Aaron Slowey – U.S. Geological Survey

This project seeks to develop an electrochemical methodology for measuring the potential bioaccessibility of copper, lead, and zinc in aquatic sediments. The capability of scanned stripping chronopotentiometry to measure the strength of aqueous metal complexes with dissolved organic matter and sulfide will be determined in model water systems. This evaluation has the potential to provide a surrogate for potential bioaccessibility of these metals.

Verifying Food Web Bioaccumulation Models by Tracking Fish Exposure and Contaminant Uptake (ER-1749)

Principal Investigator: Karl Gustavson – U.S. Army Engineer Research and Development Center-Environmental Laboratory

The objective of this project is to develop a fish tracking and recovery technology that monitors fish location over time and permits recovery of fish at specified time points. These innovative technologies and approaches will eliminate fundamental uncertainties in food web modeling by documenting contaminant exposure, chemical uptake, and growth over time in individual fish. This methodology will improve understanding of polychlorinated biphenyl (PCB) uptake, accumulation, and biomagnifications through the food chain and improve models used to predict the impact of sediment contaminants on higher trophic-level organisms.

The Biology of Bioavailability: The Role of Functional Ecology in Exposure Processes (ER-1750)

Principal Investigator: Todd Bridges – U.S. Army Engineer Research and Development Center-Environmental Laboratory

This project seeks to increase the accuracy of exposure assessments for contaminated sediment by developing a more complete understanding of exposure variation among benthic species caused by functional differences in how organisms interact with sediment particles, pore water, and overlying water. Through manipulative experiments, a quantitative understanding relating the functional ecology of a receptor with its realized exposure will be determined and incorporated into improved exposure models. This work will lead to a reduction in the uncertainty of risk assessment and better predictions about remedy performance, selection, and design.

Assessing Mercury and Methylmercury Bioavailability in Sediment Pore Water Using Mercury-Specific Hydrogels (ER-1771)

Principal Investigator: Karen Merritt - ENVIRON International Corporation

The objective of this project is to develop hydrogel engineering tools for cost-effectively assessing mercury and methylmercury bioavailability in sediment. In the laboratory and field, hydrogels will be studied to determine their representativeness of tissue residue concentrations for a range of benthic feeding guilds and to develop a methodology for screening the effectiveness of reactive amendments at mercury-contaminated sites and their effectiveness as a bioavailability screening tool. The resulting tool will assist efforts to develop remediation and site management strategies at mercury-impacted sites.

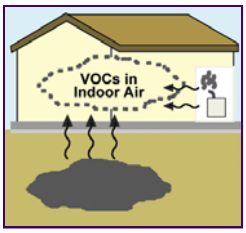
ESTCP Demonstrations

Additional information on these efforts can be found at www.estcp.org under the Technologies *link.*

Chlorinated Solvents

Use of Compound-Specific Stable Isotope Analysis to Distinguish between Vapor Intrusion and Indoor Sources of VOCs (ER-1025)

Principal Investigator: Thomas McHugh - GSI Environmental, Inc.



Distinguishing between vapor intrusion and indoor sources of volatile organic compounds (VOC) is a significant challenge during site assessments, greatly increasing the cost and complexity of investigations. The objective of this project is to validate compound-specific stable isotope analysis (CSIA) as a tool to distinguish between vapor intrusion and indoor sources of VOCs. Validation of this technique will reduce the effort and cost of testing indoor air at vapor intrusion sites.

Incorporating Aerobic Processes into Remedies for Large Chlorinated Solvent Plumes (ER-1026)

Principal Investigator: Brian Looney - Savannah River National Laboratory

Remediating large aerobic plumes of chlorinated solvents represents a major long-term challenge for both DoD and the Department of Energy (DOE). This project will synthesize data from multiple DoD sites using samples collected in unperturbed aerobic plumes and downgradient of various deployed source treatments to provide quantitative information about enhancement potential and synergies between technologies. The results will provide a basis for combining technologies and a path to complete remediation of many large DoD plumes.

Initiatives in Environmental Restoration

the year. Environmental Restoration efforts are featured here.

Enhanced Attenuation of Unsaturated Chlorinated Solvent Source Zones Using Direct Hydrogen Delivery (ER-1027)

Principal Investigator: Charles Newell - GSI Environmental, Inc.

At many contaminated DoD sites, unsaturated chlorinated volatile organic compound (cVOC) source zones located above the water table are producing and sustaining groundwater plumes. Current treatment options for the recovered vapors are both complicated and expensive. The objective of this project is to demonstrate that hydrogen-based treatment can serve as a new remediation technology for the unsaturated zone, either as the initial remediation technology applied at a site or as a polishing technology, and that it will enable site managers to shut down expensive, low-performance soil vapor extraction (SVE) systems.

Integrated Stable Isotope-Reactive Transport Model Approach for Assessment of Chlorinated Solvent Degradation (ER-1029)

Principal Investigator: Paul Philp - University of Oklahoma

Over the last decade, compound-specific stable isotope analysis (CSIA) has been applied to demonstrate the occurrence of in situ biodegradation or transformation for a variety of contaminants; however, its application for supporting remediation management decisions is often hampered by the difficulty in quantitatively interpreting results. This project seeks to improve the capabilities for quantitative assessment of chlorinated solvent mass destruction from natural attenuation processes using a combined CSIA and numerical reactive transport modeling approach. A guidance document and model will be developed to support demonstration of mass destruction, which could be used to reduce monitoring efforts, conclude active remedies, and facilitate property redevelopment.

Determining Source Attenuation History to Support Closure by Natural Attenuation (ER-1032)

Principal Investigator: Charles Newell - GSI Environmental, Inc.

One of the key constraints on the ability to select remedies for closing sites affected by chlorinated solvents is the typically short time interval for which monitoring data is available to assess trends. This project seeks to reduce the uncertainty associated with assessing long-term concentration trends for use in remedy selection at sites with chlorinated solvent contamination in soil and groundwater. A long-term source history could provide support for natural attenuation in particular.

Solar-Powered Remediation and pH Control (ER-1033)

Principal Investigator: Robert Steffan - Shaw Environmental, Inc.

This project will demonstrate a sustainable solar-powered system to support in situ biodegradation of DoD contaminants of concern and control aquifer pH. The technology uses electrodes inserted into the aquifer to consume hydrogen ions and generate hydrogen at the cathode. The consumption of hydrogen ions will increase the pH of the groundwater, and the generated hydrogen will be used as an electron donor to support in situ bioremediation. The use of solar power will make the technology suitable for sites where electrical power is not readily available, where system mobility is desirable, or where prolonged treatment is necessary.

Perchlorate

Passive Biobarrier for Treating Comingled Perchlorate and RDX in Groundwater at an Active Range (ER-1028)

Principal Investigator: Paul Hatzinger - Shaw Environmental, Inc.

Perchlorate and explosives (particularly RDX) are widespread soil contaminants at former and current military facilities, including many active ranges. Because these compounds are readily transported through soils to the subsurface, they impact groundwater and drinking water at numerous military facilities across the country. The objective of this project is to install a passive subsurface biobarrier to demonstrate that groundwater treatment and protection can be implemented long term on an active DoD range without affecting training and testing activities.

Validation of a Novel Bioassay for Low-Level Perchlorate Determination (ER-1030)

Principal Investigator: John Coates - University of California, Berkeley

Numerous research efforts have investigated diverse strategies for perchlorate remediation; however, implementation of any remediation strategy is dependent on accurate identification of the boundaries of the contaminant plume. The objective of this project is to demonstrate and validate a novel perchlorate-specific bioassay with field samples collected from sites with groundwater known to contain perchlorate. This technique has the potential to provide a rapid, specific, and sensitive method for the detection of perchlorate that obviates the need for expensive equipment and highly trained personnel.

Sediments

Evaluation of Resuspension from Propeller Wash in DoD Harbors (ER-1031)

Principal Investigator: Pei-Fang Wang - SPAWAR Systems Center Pacific

There is a lack of understanding of how effective contaminated sediment remedial efforts are, in both the short and long term, given various factors that cause resuspension of bottom sediments. This project will demonstrate and validate innovative methods to quantify resuspension and recontamination potential of contaminated sediments resuspended from propeller wash and use the validated methods to evaluate and quantify the resulting effects from propeller wash on the effectiveness and stability of sediment capping. Use of these methods will lead to more informed evaluation of remedial options and improve the predictive capabilities for potential recontamination of sediment remedial sites.

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which, through its own biology, prevents migration of these contaminants and self-remediates."

SERDP Project of the Year for Sustainable Infrastructure (SI). Application of Landscape Mosaic Technology to Complement Coral Reef Resource Mapping and Monitoring (SI-1333)—Dr. Pamela Reid, University of Miami School of Marine Atmospheric Science.

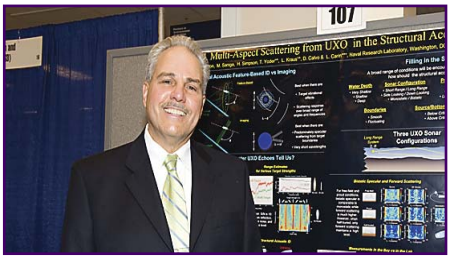
SERDP SI Project of the Year
Dr. Pamela Reid (center)

Coral reefs are threatened and in decline across the globe. To monitor the health of a reef and assess impacts and recovery, DoD needs an accurate depiction of large areas of the reef to compare its condition over long periods of time. In the past, divers would be sent down to characterize a reef's condition, but that approach was costly and inefficient and did not provide a consistent historical record or a quantitative assessment.

Dr. Reid and her research team have developed a technology in which remotely operated underwater video is used to create two-dimensional spatially accurate reef mosaics. These mosaics can serve as a tool for monitoring disease, injury, bleaching, and mortality—important indicators of reef health. "This innovative technology increases the speed and repeatability with which reef plots can be mapped and inventoried," said Dr. Marqusee.

SERDP Project of the Year for Munitions Management (MM). Wide-Area Detection and Identification of Underwater UXO Using Structural Acoustic Sensors (MM-1513)—Dr. Brian Houston, Naval Research Laboratory, Washington, D.C.

A significant number of active and former DoD installations have adjacent coastal and inland waters containing military munitions, some partially or completely buried in sediment and some lying on the sediment floor. There is little historical information about the locations or quantities of munitions in the underwater environment, so technologies are needed to efficiently assess potentially contaminated areas. Existing underwater search techniques are limited in part because they are unable to see beneath the sediment floor.



SERDP MM Project of the Year
Dr. Joseph Bucaro (co-performer)

Dr. Houston and his project team have developed an effective technique for wide-area detection and identification of underwater munitions using an innovative structural acoustic sonar system. Instead of using images, structural acoustics uses the "ringing" that objects make when hit by sound waves. By interpreting the sound patterns and tone, researchers are able to discern information about the size and nature of an object. "This technology holds tremendous potential to provide DoD with a new capability to identify and characterize underwater munitions sites at high coverage rates," said Dr. Andrews.

SERDP Project of the Year for Weapons Systems and Platforms (WP). Alternative for Perchlorates in Incendiary Mix and Pyrotechnic Formulations for Projectiles (WP-1424)—Dr. Trevor Griffiths, QinetiQ Ltd., Kent, United Kingdom.

Perchlorate is a contaminant of significant environmental concern. The military uses it as a high energy oxidizer in rocket propellants and pyrotechnics. Perchlorate can be released into the environment during manufacture, demilitarization, or when ammunition fails to function correctly.

SERDP WP Project of the Year
Dr. Trevor Griffiths

Dr. Griffiths and his colleagues developed environmentally benign, perchlorate-free incendiary and pyrotechnic mix formulations for projectiles such as those used in tanks and howitzers. The ingredients used in these formulations can be obtained readily, and their cost is comparable with those presently used for the incendiary compositions. The results of this project demonstrate that perchlorate can be eliminated from these applications without degrading performance. "Perchlorate-free alternatives will enable DoD to significantly reduce human health and environmental risks while sustaining essential training activities," said Dr. Andrews.

ESTCP Project of the Year. Validation of Sampling Protocol and Promulgation of Method Modifications for the Characterization of Energetic Residues on Military Training Ranges (ER-0628)—Mr. Alan Hewitt, U.S. Army Engineer Research and Development Center Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

The use of munitions during live-fire training exercises on DoD ranges presents a risk of contaminants leaching into the soil and groundwater and potentially migrating to areas outside the range. To determine the

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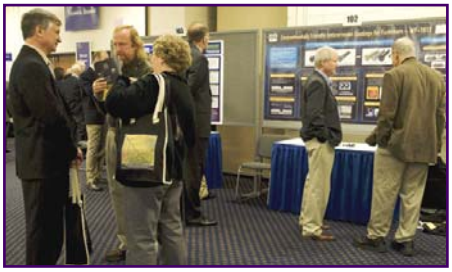
PLENARY SESSION

The Symposium & Workshop opened with a dynamic Plenary Session featuring three distinguished speakers and the presentation of the Project-of-the-Year Awards. Clockwise from top left: Dr. Dorothy Robyn, Deputy Under Secretary of Defense for Installations and Environment, U.S. Department of Defense; Dr. Robyn speaking with attendees during a session break; Dr. Peter Kareiva, Vice President and Chief Scientist, Conservation Science, The Nature Conservancy; and Mr. James Balocki, Chief, Environmental Community of Practice, Headquarters, U.S. Army Corps of Engineers.

H I G H L

NETWORKING

This annual event assembles environmental researchers and technology developers with the defense user and regulatory communities to communicate the most difficult challenges of our defense establishment. Numerous events over the three days provided the approximately 1,100 attendees opportunities to network.

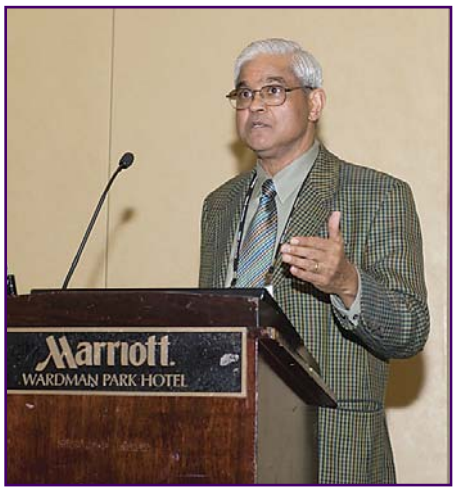


MENTAL TECHNOLOGY
IUM & WORKSHOP

ington, D.C. • December 1–3, 2009

TECHNICAL SESSIONS AND SHORT COURSES

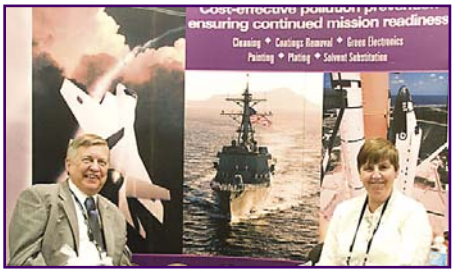
A comprehensive technical program including 11 technical sessions on environmental topics of high priority to DoD encouraged audience participation and follow-on discussion. Five short courses provided training opportunities on select technologies and methods in environmental restoration and munitions response.



I G H T S

EXHIBIT HALL

The record-breaking number of posters and booths in the Exhibit Hall showcased cutting-edge environmental science and technologies and fostered interactions focused on sharing information and developing partnerships for future collaboration.



Photos by Cassie Hayden

likelihood of such impacts, the military needs methods that provide accurate estimates of the amount and type of contaminants in the soil. Traditional environmental sampling techniques have proven inaccurate and expensive when deployed on ranges, where the form and distribution of contamination is qualitatively different from industrial pollution.

ESTCP Project of the Year
Mr. Alan Hewitt (right)

Mr. Hewitt and his team demonstrated a scientifically defensible sampling protocol designed specifically for characterizing energetic residues on training ranges, an approach for which they gained the approval of the Environmental Protection Agency (EPA). This new approach, EPA Method 8330B, addresses the uncertainty due to the heterogeneity of energetic residues on military ranges and provides an accurate sampling process. Cost savings for sample handling, processing, and analysis using these techniques are estimated at 50 to 80 percent.

"DoD needed a sampling approach that addresses the unique conditions of military ranges and that is accurate, reproducible, cost effective, and accepted by environmental regulators, and this team has provided just that," said Dr. Marqusee.

ESTCP Project of the Year. Robotic Laser Coating Removal System (WP-0526)—Mr. Timothy Hoehman, Tinker Air Force Base, Oklahoma.

Aircraft are routinely inspected for corrosion of metal components. These inspections require that paints be removed and, after the inspection is complete, the aircraft is subsequently repainted. Coating removal operations at military rework facilities involve chemical and mechanical processes that result in significant emissions of volatile organic compounds, organic and inorganic hazardous air pollutants, and hazardous waste.

ESTCP Project of the Year
Mr. Timothy Hoehman (right)

Mr. Hoehman and his team demonstrated and validated the Robotic Laser Coating Removal System as an alternative technology to remove coatings from large aircraft components. The system uses an integrated, advanced laser coating removal unit with a particle capture system. "This robotic system has the potential to reduce environmental impacts associated with coatings removal, reduce labor and chemical costs, and positively impact production schedules," said Dr. Andrews. Cost savings from Air Force-wide implementation are estimated at $67 million.

Technical Program

The Plenary Session set the stage for the Symposium & Workshop technical program, which offered attendees a selection of 11 technical sessions and five short courses. Technical sessions highlighted research and innovative technologies that are helping DoD address increasingly complex environmental and mission sustainability challenges such as contaminated sediments, emerging contaminants, aircraft emissions, and climate change impacts. Short courses provided unique training opportunities on emerging technologies and methods in munitions response and environmental restoration. Throughout the Symposium & Workshop, attendees took advantage of opportunities to meet with colleagues, exchange information, and discuss opportunities for technology transfer and partnerships in the Exhibit Hall, which featured more than 400 poster presentations and 17 exhibit booths showcasing technologies and scientific advancements from a variety of environmental research programs.

Presentations from the Plenary Session, technical sessions, and short courses, as well as webcasts for two of the short courses, Geophysical System Verification—Alternative to Geophysical Prove-Outs and Tools for Management of Chlorinated Solvent-Contaminated Sites, are available at www.serdp-estcp.org/symposium2009/.

Planning is now well under way for the 2010 Symposium & Workshop to be held November 30 – December 2, 2010, in Washington, D.C. Watch www.serdp-estcp.org/symposium for details. Note that the Call for Poster Abstracts will be released in mid-May with abstracts due July 31. ◆

In Memoriam

It is with great sadness that we acknowledge the death of **Mr. Alan Hewitt,** recipient of a 2009 ESTCP Project-of-the-Year Award. Mr. Hewitt was a research scientist at the U.S. Army Engineer Research and Development Center Cold Regions Research and Engineering Laboratory (ERDC-CRREL) in Hanover, New Hampshire, and well known for his work to develop sampling methods and protocols for energetic residues on military training ranges. The staff of SERDP and ESTCP extend deepest condolences to Mr. Hewitt's family and colleagues.

Program Update

SERDP

SERDP released a Federal Call for Proposals and a Broad Agency Announcement (BAA) for its FY 2011 Core Solicitation on October 29, 2009. By the January 7, 2010, deadline for the BAA, the Program Office received 299 pre-proposals responding to 15 Statements of Need (SON). SERDP Staff reviewed these pre-proposals and by early February extended requests for full proposals to investigators who submitted the most qualified pre-proposals. Full proposals responding to the Federal Call for Proposals and requested full proposals responding to the BAA were due March 11, 2010. The Federal Call for Proposals included one additional SON in the Weapons Systems and Platforms focus area open only to U.S. government organizations.

On October 29, SERDP also released its FY 2011 SERDP Exploratory Development (SEED) Solicitation with one SON each in Environmental Restoration, Munitions Management, and Weapons Systems and Platforms. Full proposals were due by March 11, 2010. SEED efforts are high risk and potentially high-payoff projects that last approximately one year, with a budget of $150,000 or less.

Visit www.serdp.org under *Funding Opportunities* for additional information.

ESTCP

The current ESTCP Solicitation was released on January 7, 2010. The BAA and non-DoD Federal Call for Proposals solicited pre-proposals in four topic areas (see box at right). The DoD Call for Proposals solicited pre-proposals in Energy, Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms. A total of 377 pre-proposals was received by the March 4, 2010, deadline.

For details regarding the Solicitation, visit www.estcp.org under *Opportunities*.

FY 2011 ESTCP BAA and Non-DoD Federal Topics

- Protection and Remediation of Contaminated Groundwater
- Military Munitions Detection, Discrimination, and Remediation
- Ecosystem Service Methodologies and Tools for Department of Defense Installations
- Energy Efficiency and Renewable Energy for DoD Installations

Congratulations to…

SERDP Principal Investigators **William M. Roquemore** of the U.S. Air Force Research Laboratory; **Arvind Menon, Seong-Young Lee, Robert J. Santoro,** and **Thomas A. Litzinger** of The Pennsylvania State University; and **Viswanath R. Katta** of Innovative Scientific Solutions, Inc. Their paper "Impact of Soot on Flame Flicker" was selected to receive a Distinguished Paper Award in the Laminar Flames colloquium at the 32nd International Symposium on Combustion held in Montreal, Canada. For 12 colloquia, the Combustion Institute awards Distinguished Papers that are "judged to be most distinguished in quality, achievement, and significance." Conducted as part of SERDP's soot science research, the computations described in this paper predicted that soot can greatly influence the dynamics of a jet diffusion flame causing it to be stable or unstable, depending on the soot loading. This prediction made about an unknown combustion phenomenon was then experimentally verified, one of a few rare cases in the field.

SERDP and ESTCP Sponsor Student Participation at ESA Annual Meeting

To increase awareness of research opportunities involving DoD by up and coming scientists, SERDP and ESTCP provided travel awards to 10 promising students to attend the 94th Ecological Society of America (ESA) Annual Meeting held in Albuquerque, New Mexico. The award-winning students and their paper topics follow.

- **Ms. Lindsey Albertson**
  University of California-Santa Barbara
  Streams or Dreams: Restoration Alters Invertebrate Assemblages that Support Juvenile Salmon

- **Ms. Kristin Hulvey**
  University of California-Santa Cruz
  Using Competitive Native Plants to Achieve Grassland Restoration Goals

- **Ms. Hannah Kalk**
  Southern Illinois University Carbondale
  Donor Seed Banks as Tools for Assessing Restoration Targets in Coastal Ecosystems Undergoing Climate Change

- **Ms. Kristen Kostelnik**
  North Carolina State University
  What Determines Rare Plant Population Persistence? How Biology, the Environment, and Population State Model Affect Species Conservation

- **Ms. Nicole DeCrappeo**
  U.S. Geological Survey
  Soil Fungal Community Dynamics under Elevated and Depleted Nutrient Conditions in Sagebrush Steppe and Cheatgrass-Invaded Ecosystems

- **Ms. Tanya Skurski**
  Montana State University
  Quantifying Changes in Density and Spatial Extent of Multiple Centaurea maculosa Lam (Spotted Knapweed) Populations

- **Ms. Lasha-Lynn Hāawinalani Salbosa**
  University of Hawaii at Manoa
  Analysis of Feral Pig (Sus scrofa) Movement in a Hawaiian Forest Ecosystem Using GPS Satellite Collars

- **Mr. James Angelo**
  University of Central Florida
  Using Lidar Remote Sensing and Support Vector Machines to Classify Fire Disturbance Legacies in a Florida Oak Scrub Landscape

- **Ms. Ailene Kane**
  University of Washington
  Tree Growth Responses to Snowpack and Competition across an Elevational Gradient at Mount Rainier National Park, Washington, USA

- **Ms. Elizabeth Wolkovich**
  Dartmouth College
  Grass Invasion Causes Rapid Increases in Ecosystem Carbon and Nitrogen Storage in a Semi-Arid Shrubland

Recent Additions to the Online Library

The following are selections of new publications now available in the SERDP and ESTCP Online Library (http://docs.serdp-estcp.org). Access them by entering the project number noted after the report title (e.g., 0125) under Search Phrase. Other documents may be accessed by entering an appropriate keyword or selecting relevant search filters.

Environmental Restoration

- Cost & Performance Report: Field Testing of Activated Carbon Mixing and In Situ Stabilization of PCBs in Sediment at Hunters Point Shipyard Parcel F, San Francisco Bay, California (ESTCP ER-0510)
- Final Report: In Place Soil Treatments for Prevention of Explosives Contamination (Grenade Range) (ESTCP ER-0434)
- Final Report: Engineering Transgenic Plants for the Sustained Containment and In Situ Treatment of Energetic Materials (SERDP ER-1318)
- Final Report: Anaerobic Biostimulation for the In Situ Precipitation and Long-Term Sequestration of Metal Sulfides (SERDP ER-1373)
- Final Report: Reduced Iron Sulfide Systems for Removal of Heavy Metal Ions from Groundwater (SERDP ER-1375)
- Final Report: Investigation of Chemical Reactivity, Mass Recovery, and Biological Activity during Thermal Treatment of DNAPL Source Zones (SERDP ER-1419)
- Final Report: Large-Scale Physical Models of Thermal Remediation of DNAPL Source Zones in Aquitards (SERDP ER-1423)

Munitions Management

- Final Report: UXO Detection and Characterization in the Marine Environment (ESTCP MM-0324)
- Technical Report: Use of Commercial Off-the-Shelf Vehicles for Towed Array Magnetometer: Geophysical Procedures for Vehicle Signature Measurements (ESTCP MM-0605)
- Final Report: Advanced UXO Discrimination Using Magnetometer: Understanding Remanent Magnetization (SERDP MM-1380)
- Final Report: Statistical and Adaptive Signal Processing for UXO Discrimination for Next-Generation Sensor Data (SERDP MM-1442)
- Final Report: Compact, Low-Noise Magnetic Sensor with Fluxgate (DC) and Induction (AC) Modes of Operation (SERDP MM-1444)
- Final Report: Phenomenology and Signal Processing for UXO/Clutter Discrimination (SERDP MM-1595)
- Final Report: Precision Geolocation of Active Electromagnetic Sensors Using Stationary Magnetic Sensors (SERDP MM-1643)

Sustainable Infrastructure

- Final Report: Demonstration/Validation of Low-VOC Barrier Coating for Industrial Maintenance (ESTCP SI-0301)
- Technical Report: ArchaeoMapper Beta Test (ESTCP SI-0611)
- Final Report: Assessing the Impact of Maneuver Training on NPS Pollution and Water Quality (SERDP SI-1339)
- Final Report: Development of Environmentally Benign and Reduced Corrosion Runway Deicing Fluid (SERDP SI-1535)

Weapons Systems and Platforms

- Final Report: A NIST Kinetic Database for PAH Reactions and Soot Particle Inception during Combustion (SERDP WP-1198)
- Final Report: A Comprehensive Program for Measurement of Emissions from Military Aircraft (SERDP WP-1401)

PARTNERS IN ENVIRONMENTAL TECHNOLOGY

STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM (SERDP)

&

ENVIRONMENTAL SECURITY TECHNOLOGY CERTIFICATION PROGRAM (ESTCP)

INFORMATION BULLETIN

SPRING 2010 NUMBER 41

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DSN 426-2117

The Partners in Environmental Technology Information Bulletin is written and published quarterly by HydroGeoLogic, Inc., under contract N00173-07-2069. All written information contained in the Information Bulletin is public and not copyrighted.

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INFORMATION

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FOR SERDP AND ESTCP

APRIL 2010

April 19-23
Weapons Systems and Platforms (WP) In-Progress Review (IPR) meeting

April 27-29
Munitions Management (MM) IPR meeting

MAY 2010

May 3-7
Sustainable Infrastructure (SI) IPR meeting

May 17-21
Environmental Restoration (ER) IPR meeting

JUNE 2010

June 8-10
SERDP Scientific Advisory Board (SAB) meeting
Arlington, Virginia

RELATED CONFERENCES & EVENTS

April 11-15
SAGEEP—Symposium on the Application of Geophysics to Engineering and Environmental Problems
Keystone, Colorado
For more information, visit www.eegs.org/sageep.

April 12-16
2010 Environmental Monitoring & Data Quality (EMDQ) Workshop
Louisville, Kentucky
For more information, visit www.regonline.com/builder/site/Default.aspx?eventid=780093.

April 13-14
The Alpha and the Omega and Points in Between Conference—A Joint Conference on Contaminated Sediment Sites
Chicago, Illinois
For more information, visit www.smwg.org/2010_Joint_Conference_Info.htm.

May 24-27
Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds
Monterey, California
For more information, visit www.battelle.org/conferences/chlorinated.

June 14-17
Environment, Energy Security, & Sustainability (E2S2) Symposium and Exhibition
Denver, Colorado
For more information, visit www.ndiae2s2.com.

June 14-17
The National Association for Surface Finishing (SUR/FIN) 2010 Conference
Grand Rapids, Michigan
For more information, visit www.nasf.org/Content/NavigationMenu/NASFEventsPage/SURFIN2010/default.htm.

July 3-7
24th International Congress for Conservation Biology
Edmonton, Alberta, Canada
For more information, visit www.conbio.org/activities/meetings/2010.

August 1-6
95th Annual Ecological Society of America (ESA) Meeting
Pittsburgh, Pennsylvania
For more information, visit www.esa.org/pittsburgh.

August 15-18
GovEnergy 2010
Dallas, Texas
For more information, visit www.govenergy.com.