AFCEC Environmental Restoration Innovative Technology Projects

Completed ITP Projects

FY	ITP ID	Title	Contractor/PI	Synopsis
2021	BAA2103	Ultrasound Technology for the Mineralization of PFAS	TetraTech Purshotam Juriasingani	Scale up laboratory-scale mineralization of PFAS using high-frequency ultrasound, to develop a commercial-scale device (100L) to treat high concentration PFAS waste. This project developed an intermediate scale multi-transducer reactor (10L) which will be used in a series of trials to enable design of a larger pilot-scale (100L) sonochemical reactor for field-scale application.
2018	–	Development of Coupled Physicochemical and Biological Systems for In Situ Remediation of Perfluorinated Chemical and Chlorinated Solvent Groundwater Plumes	–	This project developed combined in situ remediation technologies designed to treat contaminated groundwater containing mixtures of PFAS and chlorinated ethenes, and the corresponding rate parameters and treatment capacities of each system. The novel aspects of these systems include (a) treatment of PFOS, which has not been degraded in situ using either biological or chemical methods, (b) treatment of co-mingled PFASs and chlorinated solvents, and (c) characterization and treatment of PFAS reaction byproducts.
2018	–	In situ Remediation of Aqueous Film Forming Foams and Common Co-Contaminants with the Dual Approach of Chemical Oxidation and Bioremediation	–	Provided a greater understanding of the effects of the heat-activated persulfate in-situ chemical oxidation (ISCO) at AFFF contaminated sites on co-contaminant biodegrading microorganisms help guide engineers responsible for remediation of military sites in deciding the likelihood of success if biostimulation and bioaugmentation is employed following ISCO. Sequential batch studies investigating chemical oxidation (persulfate dose, timing, etc.) in combination of pre- or post-bioremediation strategies with aquifer solids inform engineers of vital factors for designing and implementing effective combined in situ chemical oxidation and bioremediation. Taken together, the information gained from this research addresses the military's need to achieve site closure by means of timely and cost-effective remediation.
2018	–	High Resolution Site Characterization Guidance Development and Demonstration for Air Force Complex Sites	–	Developed a high-resolution site characterization (HRSC) tools compendium and guidance document that highlight advances in the HRSC tools, define how they address specific data quality objectives (DQOs) to build more robust CSMs, and provide direction on selecting and using these tools to support improved remedial decision-making, followed by a demonstration of the HRSC guidance framework at an Air Force site. Using the processes developed in the HRSC guidance, a demonstration of HRSC technologies was completed, following the demonstration, a review of the implementation was completed, and updates to the guidance document were made as needed.

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2018	–	Comprehensive Evaluation and Guidance for In Situ Sorption-Degradation Technologies for Sustained Treatment of Chlorinated Solvents in Groundwater	–	Coupled sorption-destructive (S-D) technologies are an alternative in-situ remedy, offering combined benefits of contaminant sorption (typically activated carbon) and destruction (via an oxidizing/reducing agent or serving as a medium for microbial growth in situ). Design and execute a high-resolution field injection test and collect high-quality comprehensive data (i.e. groundwater transmissivity profiles.
2018	–	Synergistic Treatment of Mixed 1,4-Dioxane and Polyfluorinated Chemical Contaminations by Combining Electrolytic Degradation with Electrobio-stimulation	–	Remediation of groundwater contaminated with the highly persistent 1,4-dioxane and PFAS typically requires costly ex situ advanced oxidation processes, and in situ technologies are either limited or completely lacking. In this project, the researchers developed a practical and more cost-effective solution for managing mixed chemical of concern (COC) contamination. The testing of various performance-impacting parameters in combination with previously gained experiences in field implementation provided DoD site managers with financial and technical guidance on treatment options and design for specific remedial goals.
2018	–	Key Fate and Transport Processes Impacting the Mass Discharge, Attenuation, and Treatment of Poly- and Perfluoroalkyl Substances and Comingled Chlorinated Solvents or Aromatic Hydrocarbons	–	Comingled PFAS and hydrocarbon and/or chlorinated solvent plumes have become a concern of growing urgency for the DoD. Adverse PFAS impacts on groundwater are widespread at DoD facilities, and these mixed contaminant systems may pose a significant barrier to site closure. This work significantly enhanced our understanding of the role of polyfluorinated PFAS and the role of source zones and low permeability materials in PFAS release. These data enable the DoD to appropriately apply synergistic remediation technologies for these mixed contaminant plumes and source zones.
2017	–	Determining Preferential Pathways for Complex Sites	–	The stratigraphic flux technical demonstration was applied at the Air Force Plant 4 CRP3 site, which was a former disposal pit with high residual concentrations of chromium (Cr) and trichloroethene (TCE) in soil and groundwater. The stratigraphic flux evaluation showed more than 90% of the TCE mass flux in the alluvium occurs within the coarse-grained channel deposits in erosional channels on the bedrock surface. The highest concentrations occur in the slow advection and storage zones in the vadose and saturated soils beneath the former pit. The highest relative flux occurs near the CRP3, where the TCE concentrations are several orders of magnitude higher than those detected downgradient.
2017	–	Coupling Ion-Exchange Resin with Electrochemical Treatment for Complete Separation and Destruction of Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) in Groundwater	–	Mountain Home environmental staff collected groundwater samples from Well 4 at Mountain Home AFB in March 2018. Samples were sent to a commercial laboratory and 15 gallons were sent to the University of Georgia (UGA) for the laboratory study.

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2017	–	An Enhanced Contact Electrical Discharge Plasma Reactor: An Effective Technology to Degrade Per- and Poly-Fluoroalkyl Substances (PFAS)	–	Bench-scale testing and evaluation of PFAS-impacted samples from up to 17 Air Force bases and facilities. Analysis of PFAS, volatile organic compounds (VOCs), metals, anions, total organic compounds (TOC), total dissolved solids (TDS), and field parameters. Based on the outcomes of the investigation-derived waste (IDW) testing, samples of varying geochemistry from up to three installations were selected to support reactor design optimization.
2017	–	Innovative DNAPL Remediation Using High-Resolution Characterization and Low-Level Heat	–	Project focused on applying Flexible Liner Underground (FLUTe) high-resolution characterization technology for fractured rock sites to generate a state-of-the-art Conceptual Site Model (CSM) of DNAPL distribution, hydrogeology, and contaminant transport at Landfill 1. Applied thermal Natural Source Zone Depletion (NSZD), an established technology for measuring NSZD at hydrocarbon sites, to a chlorinated solvent site for the first time to obtain actual degradation rates for the DNAPL. Demonstrated how Data Fusion techniques can combine data to build a more reliable Conceptual Site Model. Pilot tested two remediation technologies: Natural Zone Depletion and Low Level Heating for enhancing NSZD.
2017	–	Development of Toxicity Reference Values (TRVs) for Birds Exposed to PFOS, PFOA and Associated Mixtures of Fluorinated Compounds	–	This project addresses the need to develop an improved understanding of the ecotoxicity associated with the release of aqueous film-forming foam (AFFF), which has been used by the DoD for over 40 years for fire-training and emergency response activities. The ultimate benefit of this project was the generation of data that assist in the development of site-specific risk assessments and decisions related to mitigation of exposure and/or future environmental cleanup of areas affected by use and release of AFFF.
2017	–	Development of Toxicity Data to Support Toxicity Reference Values for Perfluorinated Compounds	–	Provided benchmarks to develop defensible Toxicity Reference Values (TRVs) for mammalian wildlife. The strong body of toxicology data derived from the studies reduced the use and magnitude of uncertainty factors used to develop environmental remediation criteria. TRVs are critical components of environmental risk assessments that help determine if the risk of exposure is acceptable. These values directly assist in sustaining range and cleanup operations and lend support to Army Health System capabilities. The TRVs, along with the data collected were documented in substance specific WTAs which are used by the Defense Environmental Restoration Program and the Army and published on the Army Public Health Center (PHC) website and in peer reviewed journals and textbook chapters used by DoD contractors.
2017	–	Development of Amphibian Per- and Polyfluoroalkyl Substances Toxicity Reference Values for use in Ecological Risk Assessment at Aqueous Film-Forming Foam Sites	–	The core outcome of these studies were the development of amphibian Toxicity Reference Values (TRVs) for PFAS that can be used in the derivation of surface water, sediment and soil risk-based environmental criteria for assessments at PFAS-contaminated sites. The ultimate goal is not only to develop TRVs that are protective of the most sensitive amphibian species, but also that can be used for a more refined identification of surrogate species for the evaluation of specific amphibian taxa.

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2017	–	Advancing the Understanding of the Ecological Risk of Per- and Polyfluoroalkyl Substances	–	The lack of comprehensive, robust, and defensible ecotoxicity data on PFAS hinders risk assessment and represents a roadblock to sound environmental management decisions. The lack of a streamlined but robust approach for toxicity testing and decision-making regarding “other” PFAS that occur at high frequency and concentration at DoD sites slow environmental management decisions and lead to unsupported risk decisions potentially resulting in unnecessary costs. This research to better understand the ecological risk of PFAS help to ensure military readiness, range sustainability, and public health and environmental protectiveness.
2017	–	A Novel Reactive Electrochemical Membrane System for Treatment of Mixed Contaminants	–	Electrochemical treatment has been shown effective to remove and degrade many contaminants of concern (COCs) commonly present on DoD sites, and thus has a great potential to treat mixed contaminants, but its efficiency is still limited mainly by mass transfer issues that prevent its application in treatment of large volumes of water with relatively low concentrations of contaminants, such as in pump-and-treat scenarios. This study aims at a transformative way to increase the electrochemical treatment efficiency using a novel REM system that combines adsorption, filtration and electrochemical effects, which offer a powerful tool to treat mixed COCs at DoD sites.
2017	–	Catalyzing Rapid Information Transfer Among Key Stakeholders on Per- and Polyfluoroalkyl Substances (PFAS) at Contaminated Military Sites	–	Improved basic PFAS knowledge and awareness of issues among RPMs and their support teams. Facilitated better coordination between vendor laboratories and synthesis laboratories to bring requisite materials for quality data to market faster to support sites. Enhanced understanding of PFAS compounds potentially present at sites, which lead to better characterization of environmental media to aid in site characterization, PFAS source delineation, identification of the potential positive and negative consequences of remedial technologies that minimize the DoD future liabilities, such a preventing inadequate design of carbon-based drinking water treatment systems. Improved knowledge and implementation of analytical strategies, which may result in improved interactions with regulators asking for more data on PFAS contamination. Efficient transfer of information from funded Strategic Environmental Research and Development Program (SERDP) projects to RPMs and the consultant groups that support them.
2017	–	Demonstrate a high-resolution site characterization technique based on an integration of hydraulic tomography, geophysical tomography, and flux measurements	–	Tested the potential applicability of electrical resistivity (ER), seismic refraction (SR), multi-channel analysis of surface waves (MASW), and induced polarization (IP) methods for detecting more fractured zones in the subsurface; and identified candidate regions for more detailed subsurface delineation in the next phase of the project.
2016	–	Perfluorochemical treatment by nanofiltration plus sequential UV oxidative/reductive treatment of reject water	–	Demonstration and validation to extract, remove, and destroy PFAS in groundwater via a nanofiltration (NF) membrane and ultraviolet (UV)-activated redox treatment processes. Demonstrated a multi-barrier treatment train for PFAS-impacted groundwater and proposed treatment train combines NF with UV photochemical treatment of reject stream

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2015	–	Behavior of Perfluoroalkyl Chemicals in Contaminated Groundwater	–	The results of this project significantly helped the environmental restoration community's effort to develop conceptual site models of Perfluoroalkyl Acid (PFAA) at Aqueous Film Forming Foam (AFFF)-impacted sites as well as move closer to modeling PFAA plumes at these sites. PFAA fate and transport under conditions relevant to AFFF-impacted sites is a complex topic; though fundamental questions have been addressed through this project, many more questions remain. With further study, the results of this project meaningfully contributed to modeling and site assessment guidelines that can be used by engineers and contaminant hydrologists for practical implementation.
2015	–	Characterization of the Fate and Biotransformation of Fluorochemicals in AFFF-Contaminated Groundwater at Fire/Crash Testing Military Sites	–	The analytical tools developed for this project, including methods for quantifying individual per- and poly-fluoroalkyl substances (PFAS) as well as precursors, improving the ability to characterize AFFF-contaminated sites. The potential risks can be understood by having identified the potential precursors at Aqueous Film Forming Foam (AFFF)-contaminated sites, and by understanding their fate and mobility in the environment. Efforts can now focus on understanding the process that retain PFASs in source zones and the conditions that mobilize or immobilize them. Identifying precursors also can improve evaluations of the effectiveness of treatment technologies, such as the use of granulated activated carbon and other sorbents. The biotransformation pathway of the PFAS compounds in Ansul AFFF provides a framework for understanding the fate of other precursors, and insight into the conditions (anaerobic) that lead to high concentrations of persistent FTSAs and the potential for intermediates to be ultimately transformed to persistent PFCAs.
2015	–	Bioaugmentation with Vaults: Novel In Situ Remediation Strategy for Transformation of Perfluoroalkyl Compounds	–	Under Phase I of the study, INT-modified LiP and MnP were heterologously expressed in Sf9 insect cell lines intracellularly as nsLiP-INT and nsMnP-INT through Bac-to-Bac expression systems. Cell lysates containing nsLiP-INT or nsMnP-INT did not show significant peroxidase activities, suggesting that signal peptide processing contributes to correct folding of peroxidases and is likely required to activate these enzymes.
2015	–	In Situ Treatment Train for Remediation of Perfluoroalkyl Contaminated Groundwater: In Situ Chemical Oxidation of Sorbed Contaminants	–	Results of this research has enhanced knowledge and understanding toward the design and application of Granular Activated Carbon (GAC) treatment systems for removal of PFAS. Data collected can be used to design and predict treatment at pilot and full scale. Furthermore, results guide the development of new PFAS sorption materials through improved understanding of sorption mechanisms and approaches for enhancing sorption. While persulfate treatment is ineffective for PFOS, the conditions resulting from its use, including generation of low pH and excess sulfate, can impact sorption of PFAS. Results can be used to develop more effective sorption techniques and to extend the life of GAC.

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2015	–	Investigating Electrocatalytic and Catalytic Approaches for In Situ Treatment of Perfluoroalkyl Contaminants in Groundwater	–	With several studies showing the presence, or potential presence, of these compounds in groundwater associated with fire training areas, adverse PFAS impacts on groundwater are potentially widespread at DoD facilities. However, with conventional technologies ineffective or inefficient for treatment and the well-documented recalcitrance of PFAS compounds with respect to natural or enhanced degradation processes, cost-effective in situ treatment options for these compounds are currently not available. Development of electrocatalytic and catalytic approaches is expected to provide remedial tools that can be efficiently and cost-effectively applied for treatment of PFAS-impacted groundwater at a wide range of DoD facilities.
2015	–	Coagulant-enhanced Sorption for In Situ Remediation of PFAS Contaminated Groundwater Systems	–	Provided the DoD and the greater scientific community with a cost-effective remediation technology for in situ treatment of PFAS-contaminated groundwater that serve as an alternative to excavation or pump-and-treat technologies. The performance and limitations of the technology were determined for systems representative of fire training activity sites at military installations. Improved understanding of PFAS adsorption in heterogeneous systems, the effect of co-contaminants on adsorption, and the ability of commercially available coagulants to achieve sequestration of PFAS from groundwater systems.
2015	–	Quantification of In Situ Chemical Reductive Defluorination (ISCRD) of Perfluoroalkyl Acids in Groundwater Impacted by AFFF	–	This project addresses the reductive reaction mechanisms and pathways (intermediates) for defluorination of PFOS and associated PFAS, which facilitated design of an in-situ strategy for remediation of PFAS-contaminated groundwater at military sites with minimal adverse impacts. Site managers and consultants are able to use these results to improve long-term site management plans. The project also provided additional analytical tools for identifying and quantifying defluorination products and elucidate potential naturally occurring albeit abiotic processes that may be enhanced.
2013	–	Complete Mineralization of Fluorochemicals in Aqueous Fire-Fighting Foams Using a Novel Dual-Frequency Based Sonochemical Process	–	Technology uses sound waves to create small, oscillating stable or imploding transient bubbles that release shock waves and produce heat energy, ultimately capable of destroying the molecular structure of the foam's per- and poly-fluoroalkyl substances (PFAS), from stockpiles and leaving only fluoride, sulfate, carbon dioxide and water.
2013	–	Remediation of Perfluoroalkyl Contaminated Aquifers using an In Situ Two-Layer Barrier: Laboratory Batch and Column Study	–	Results from this study provide a better understanding of how fluoroalkyl substances (PFAS) may be transformed during natural humification processes. These interactions can be enhanced through system engineering to help address groundwater PFAS contamination; however, additional research is necessary to develop these techniques.
2012	–	In-situ Enzymatic Oxidative Treatment for Perfluorinated Compounds at Wurtsmith AFB, MI	–	Laboratory results demonstrated successful enzymatic oxidative treatment for per- and poly-fluoroalkyl substances (PFAS), including PFOA and PFOS.

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2012	–	Focused Remedial Investigation of Potential Ecological Effects of Perfluorinated Compounds and Associated Human Exposures from Fish Consumption at Barksdale AFB, LA	–	This demonstration evaluated fish and fish tissues for per- and poly-fluoroalkyl substances (PFAS) at Cooper Bayou. Results show there are consistent measurable concentrations of PFOS and perfluorohexane sulfonate (PFHxS) in fish tissues.
2011	–	Fungal Remediation of Legacy Pesticides in Soil around Air Force Base Housing	–	Laboratory results did not meet desired criteria. No field demonstration.
2011	–	Chemical Treatment of Soil and Groundwater Contaminated with Perfluorinated Compounds found in Aqueous Fire Fighting Foams	–	Perfluorooctanoic acid (PFOA) is oxidized by heat-activated persulfate within 72hr at 50 ºC. PFOA persulfate oxidation follows an unzipping pathway to PFCAs and fluoride. PFOA transformation rates increases with increasing temperature. Heat-activated persulfate oxidizes 6:2 FTSA simultaneously to perfluoroheptanoic acid (PFHpA) and perfluorohexanoic acid (PFHxA). Perfluorooctane sulfonic acid (PFOS) is not transformed with heat (85-90 ºC)-activated with persulfate (60-84 mM).
2011	–	In Situ Remediation of 1,4-Dioxane Contaminated Aquifers	–	Propane biosparging and bioaugmentation promoted in situ biodegradation of 1,4-dioxane. Results indicate that 1,4-dioxane can be treated by the demonstrated in situ bioremediation technology to meet regulatory standards.
2011	–	Enhanced In Situ Bioremediation of 1,2-Dibromoethane [EDB] at Massachusetts Military Reservation Using Alkane Gas Addition	–	Addition of ethane or propane gas with inorganic nutrients can be used as a remedial strategy to enhance rates of 1,2-dibromoethane degradation.
2011	–	Utilizing an Injection/Recirculation Approach to Enhance and Sustain Biogeochemical Transformation of Chlorinated Ethenes Plumes to Achieve Faster Site Closure	–	In situ biogeochemical reactions relied primarily on reduced reactive iron minerals to abiotically transform chlorinated ethenes.

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2011	–	Development of Molecular Biomarkers to Support Natural Attenuation and Bioremediation of 1,4-Dioxane	–	A set of genes is now available to serve as a specific biomarker for 1,4-dioxane biodegradation. Expression of biomarker genes is a better predictor of biodegradation activity than just presence of genes. Biomarker expression as well as 1,4-dioxane degradation is influenced by environmental factors. Cometabolic biodegradation can only be verified indirectly using nucleic acid-based biomarkers.
2011	–	Chemical Oxidation and Inclusion Technology for Expedited Soil and Groundwater Remediation	–	Injection of a peroxone activated buffered persulfate oxidant and cyclodextrin, commercialized as OxyZone®-C, degraded and destroyed perfluorinated organic compounds.
2011	–	Use of Boron-Doped Diamond Electrodes for Treatment of Perfluorinated Compounds	–	Innovative electrochemical oxidation technology decomposed perfluorinated compounds (PFCs), now referred to as per- and poly-fluoroalkyl substances (PFAS), in the laboratory. However, the Ellsworth Air Force Base demonstration was hindered by operational complications of the treatment facility and contamination inferences from the field. Therefore, field demonstration was inconclusive in breaking down PFAS compounds. More work would need to be done to implement this technology at field-scale.
2011	–	Is Bioremediation a Relevant Attenuation Mechanism for Perfluorinated Compounds?	–	Phanerochaete chrysosporium, a wood-rotting fungus, was found to transform 6:2 fluorotelomer alcohol (FTOH) towards more biodegradable compounds than bacterial transformation processes.
2010	–	Monitoring Toolbox for In Situ Biogeochemical Transformation	–	Factors for promoting biogeochemical transformation are: A) sulfate concentration, B) hydraulic residence time, C) electron donor availability, and D) presence of iron oxides such as magnetite and hematite. The optimal combination of these factors promotes a high volumetric sulfate consumption rate and a high rate of reactive iron sulfide generation.
2010	–	Demonstration of Low Intensity, Sustainable Passive Soil Vapor Extraction Technologies at Air Force Sites	–	Successfully demonstrated two passive soil vapor extraction technologies using MicroBlower™ and Baroball™ systems. Both technologies were highly effective at removing chlorinated solvents from vadose zone soils.
2010	–	Guidance Manual to Accelerate Closure of Low-Risk Sites	–	Guide to assist site managers in determining if they have a low-risk site by providing key concepts, information, and experience in one dynamic decision support tool. This information can be used to assist site managers in developing effective exit strategies for closing low-risk sites and/or reducing long-term monitoring intensity. The guide provides weight-of-evidence decision logic to build consensus between site stakeholders.
2010	–	Development of Cost Effective Air Exchange Rate Techniques: Building on Recent Work	–	Developed a protocol for estimating air exchange rates (AERs) using concentration decay of instantaneously released helium tracer gas. Results of this study demonstrate that the helium release methodology provides a cost effective, easy to implement method of measuring building specific AERs. The three LS methods help to determine the uncertainty in AER predictions.

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2010	–	LNAPL Detection for Lowering LTM Costs: Application of Leak Detection Cabling Sensor	–	Demonstrated and validated that commercially available leak detection cabling sensors (TraceTek-TT5000 cabling sensor) could be innovatively adapted for the detection and monitoring of Light Non-Aqueous Phase Liquid (LNAPL).
2010	–	Optimizing Key Aspects of Remediation Strategy & Operations to Accelerate Remedy In Place and Control Costs	–	Engaged key personnel and appropriate information/materials to identify/clarify best-practice methods and optimize technology transfer for the environmental restoration program.
2010	–	Collaborative Process for Whole-System	–	Examined the environmental management system framework and how it can be used to systematically improve the performance of AF environmental restoration program projects and incorporate green and sustainable remediation initiatives.
2010	–	Anaerobic Bioremediation of DNAPLs	–	pH adjustment with colloidal Mg(OH)2 was effective in increasing the pH of coarse sand layer to a level appropriate for reductive dechlorination. Settling of solid alkaline material in the bottom of the injection wells reduced the effectiveness of base addition in raising aquifer pH. Bioaugmentation was beneficial in enhancing both conversion of TCE to cis-1,2-dichloroethene (cDCE), and cDCE to vinyl chloride and ethene. Emulsified vegetable oil was effectively distributed in the coarse sand layer, accelerating reductive dechlorination, and reducing downgradient migration of contaminants.
2010	–	Demonstration/Validation of Multiple Incremental Sampling and High Purge Volume Sampling Versus Conventional Sub- Slab Sampling for Vapor Intrusion Investigations	–	High Volume Sampling (HVS) works best when material below the floor is highly permeable (e.g., construction aggregate, differential settlement, or soil shrinkage) and where the leakage is relatively low, because this combination results in the maximum lateral extent of vapor extraction in a practical test duration. Multiple incremental sampling works best in large buildings, where conventional sampling programs are considerably more expensive by comparison, and where the material below the floor is not very permeable (e.g., slab on native soil with high silt or clay content where HVS testing is less effective).
2009	–	Optimization of In Situ Biogeochemical Transformation Processes and Development of Engineering Guidance	–	Identified and evaluated geochemical parameters that encourage biogeochemical transformation of chlorinated solvents in biowalls/bioreactors.
2009	–	Implementation of & Enhancements to RPO Sustainability Remediation Tool	–	Developed tool to evaluate remediation technologies based on sustainability metrics such as greenhouse gas emissions, energy consumption, and resource service. Tool facilitates sustainability planning and evaluation.

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2009	–	Validation of New Tools to Better Manage Vapor Intrusion Liability	–	Vapor phase compound-specific stable isotope analysis, molecular biological tools, and additional analytics were employed to evaluate vapor intrusion (VI) and determine better ways to manage VI liabilities.
2009	–	Effects of Substrate Injections on Secondary Water Quality	–	Investigated secondary water quality impacts (SWQIs) respective of in situ biological reduction, in situ chemical reduction, in situ biological oxidation, and in situ chemical oxidation. Overall, results indicate that in situ remediation technologies are causing some SWQIs; however, the impacts on the environment are generally not severe.
2009	–	Innovative Monitoring for In Situ Bioremediation of DNAPL	–	Assessed the efficacy of the innovative in situ bioremediation- monitoring tool Bio-Trap® in selecting, evaluating, monitoring, and optimizing site remediation systems. Demonstrated how current and previous remediation systems (i.e., thermal, biowalls, soil-vapor extraction, and dual-phase extraction), may affect in situ bioremediation of chlorinated solvents and their degradation byproducts.
2009	–	LTMO MAROS Software Upgrade	–	Updated the existing LTMO Monitoring and Remediation Optimization System (MAROS) software. Project assists in reducing AF costs through optimization of long-term monitoring programs.
2009	–	Demo of "Green" and Stabilized Nanoparticles for In-Situ Destruction of Chlorinated Solvents in Soils & Groundwater	–	Used stabilized nanoparticles for the in-situ destruction of chlorinated solvents in soils and groundwater. Demonstrated feasibility (mobility, reactivity, and reactive longevity) of using the stabilized nanoparticles for degrading chlorinated solvents and determined optimal operating conditions.
2009	–	In Situ Treatmentof NDMA at Edwards AFB	–	Employed cost-effective in situ biological remediation approach for the treatment of N-nitrosodimethylamine (NDMA) in groundwater. Determined which gases are most effective for stimulating NDMA biodegradation.
2009	–	In Situ Biogeochemical Transformation	–	Evaluated in situ biogeochemical transformation technologies that reduce chlorinated solvent concentrations in soil and groundwater.
2008	–	Phytostabilization	–	Evaluated the effectiveness of Phytostabilization, which was found to have limitations, however, it can be a component of an overall remedial approach due to its low impact, low maintenance, and highly sustainable features.
2008	–	RPO Sustainability Tool extension of EDITT	–	Sustainable Remediation Tool (SRT) was designed to support decision processes for technology selection and optimization.
2008	–	Changes in Chlordane Volatility Produced During Construction Activity Around Air Force Housing Areas	–	Laboratory tests indicated that the specific mass transfer rates of chlordane from aged soil are low and are positively correlated with relative humidity levels and the temperature of the soil. Field demonstration suggested that construction activities may release measurable levels of chlordane below regulatory limits. Chlordane vapor intrusion risks resultant of new housing construction is unlikely.

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2008	–	Sustainable Bioreactors to Achieve Remedy in Place	–	In situ bioreactors are a simple and cost-effective application of enhanced reductive dechlorination technology.
2008	–	Accelerating Soil and Groundwater Restoration at Chlorinated Solvent DNAPL Sites Using Bioreactors	–	Lessons learned provided methods to advance the state-of-science and state-of-practice for design and implementation of bioreactors.
2008	–	P&T System – Expedited Contaminant Mass Removal Assessments and System Enhancements	–	Evaluated the performance of pump and treat systems in removing contaminant mass from groundwater plumes, the degree in which natural attenuation is contributing to plume mass reduction, and cost efficiency at 20 sites. Determined that site complexity affected the efficiency of contaminant removal by extraction and natural attenuation.
2008	–	A Decision-Making Tool for LTMO	–	Developed a comprehensive, freely distributable open-source, user-friendly Long-Term Monitoring Optimization (LTMO) decision support tool and associated training materials that augments and automates the Parsons 3-Tiered approach.
2008	–	Enhanced Biogeochemical Degradation of Chlorinated Organics	–	Evaluated the effectiveness of enhanced biogeochemical degradation of chlorinated organics in areas with high sulfate concentrations. Field tests confirmed that sulfide could be effectively precipitated from the groundwater by addition of ferrous chloride. Upon removal of the sulfide, complete degradation of the chlorinated ethenes to non-toxic ethene was achieved.
2008	–	Field Demonstration of an Innovative Sampler and MicroGC System for Groundwater LTM Program Optimization	–	Performance capabilities of available equipment were not sufficient to develop the proposed sensor.
2008	–	Dem/Val of Innovative Treatment Technologies to achieve RIP	–	Bioreactors can be installed in a broad range of climates and are effective for shallow aquifers with varied field-demonstrated results.
2008	–	Feasibility Studies of Sustainable Remediation Technologies and Biogeochemical Transformation	–	Compared commercial remediation product costs to the use of readily available, low-cost bulk iron and sulfate amendments to stimulate biogeochemical transformation of TCE. Technology reduces concentrations of trichloroethylene (TCE) and daughter products in soil and groundwater. Developed low-cost alternatives to stimulate in situ biogeochemical transformation processes.