Naval Air Station Jacksonville; Environmental Restoration Team Award FY 2013
NAS Jacksonville Partnering Team

Background

Naval Air Station (NAS) Jacksonville (Jax) is a 3,400-acre facility located in northwest Florida. Its mission is to enable naval aviation warfighting readiness by supporting the Fleet, Fighter, and Family. NAS Jax was established on October 15, 1940, as an air defense strategic base to protect Florida's 1,200 miles of coastline from enemy attack. As a master anti-submarine warfare (ASW) and industrial base, NAS Jax maintains and operates facilities and provides services and materials to support aviation operations and units of the operating forces of the Navy and other activities and units, as designated by the Chief of Naval Operations. NAS Jax supports over 110 tenant commands and over 20,000 people during its daily operations. The installation consists of operational, industrial and administrative areas, housing units, a Navy Lodge, a Navy Gateway Inn and Suites, a hospital, restaurants, stores, a U.S. Post Office, a credit union, and other activities to accommodate its large population. Tenants include Fleet Readiness Center Southeast (FRCSE), Fleet Logistic Center Jacksonville, seven VP squadrons, four Helicopter squadrons, one reserve VP squadron, and two Fleet Logistics Support Squadrons.

Since the mid-1990s, several Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-based investigations, interim actions, and selected remedies have been implemented at NAS Jax under the direction of the NAS Jax Environmental Restoration (ER) Partnering Team (Team). The Team is comprised of representatives of the U.S. Department of the Navy, the U.S. EPA, the Florida Department of Environmental Protection (FDEP), and Navy contractors. The members are:

- Timothy Curtin, NAS JAX ER Program Manager
- Michael Singletary, Naval Facilities Engineering Command Southeast (NAVFAC SE) Technical Manager
- Adrienne Wilson, NAVFAC SE Restoration Project Manager
- Mark Peterson, Tetra Tech Project Manager
- Eric Davis, CH_2MHill Project Manager

A P-3 Orion, left, and the new P-8A Poseidon, both attached to VP-30 "Pro's Nest," fly in formation over NAS Jacksonville.

- Todd Haverkost, Resolution Consultants Project Manager
- Peter Dao, U.S. EPA Region 4 Project Manager
- Jennifer Conklin, FDEP Project Manager

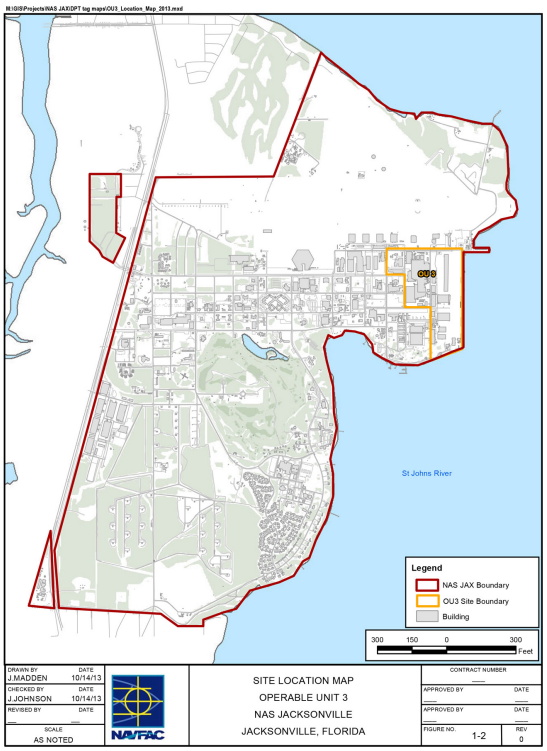
The NAS Jax Team was formed to navigate a path forward to successfully investigate, remediate, and manage the risks posed by contaminated waste sites located on the installation.

The Installation's hydrogeological, industrial, and ecological settings present unique opportunities to protect human health and the environment through the use of innovative technologies and methodologies for site restoration.

The ER Program at NAS Jax consists of 12 Operable Units made up of 58 potential sources of contamination. The Munitions Response program consists of 6 sites, and there are 27 sites under the Petroleum Program.

The NAS Jax Team has been successful in protecting human health and the environment through the use of emerging & innovative technologies. In addition, the NAS Jax Team has been able to significantly optimize the installation's remediation strategy, thereby reducing costs and the time required to complete the site investigation and remediation process.

Position Description



Map of NAS Jax showing OU3 location

The most challenging sites at NAS Jax are the chlorinated solvent plumes at Operable Unit 3 (OU3). OU3 is the largest site at NAS Jax and includes over 100 buildings that have historically involved dry cleaning, painting, stripping, degreasing, and electroplating operations. These operations resulted in significant soil and groundwater contamination. The OU3 primary tenant is FRCSE.

In 1993 the NAS Jax Team began a multi-phase Remedial Investigation and Feasibility Study (RI/FS) that supported the development of the September 2000 Record of Decision (ROD). The former dry cleaner (former Building 106) and a former solvent recycler (Building 780) were determined to be primary sources of groundwater contamination at OU3. As a result, interim remedial actions (IRAs) were conducted and adopted as final remedy components, which consisted of air sparging with soil vapor extraction (AS/SVE) at former Building 106 and groundwater pump & treat and SVE at Building 780.

Following implementation of these remedial actions, several optimization studies were conducted. Results of the optimization studies and Five Year Reviews in 2005 and 2010 revealed the following data gaps in the conceptual site model (CSM):

1) Dense non-aqueous phase liquid (DNAPL) contaminant mass that has diffused into an extensive clay layer and acts as a continuing source to the groundwater plume;

2) Risks posed to site workers and building occupants through potential indoor air vapor intrusion (VI).

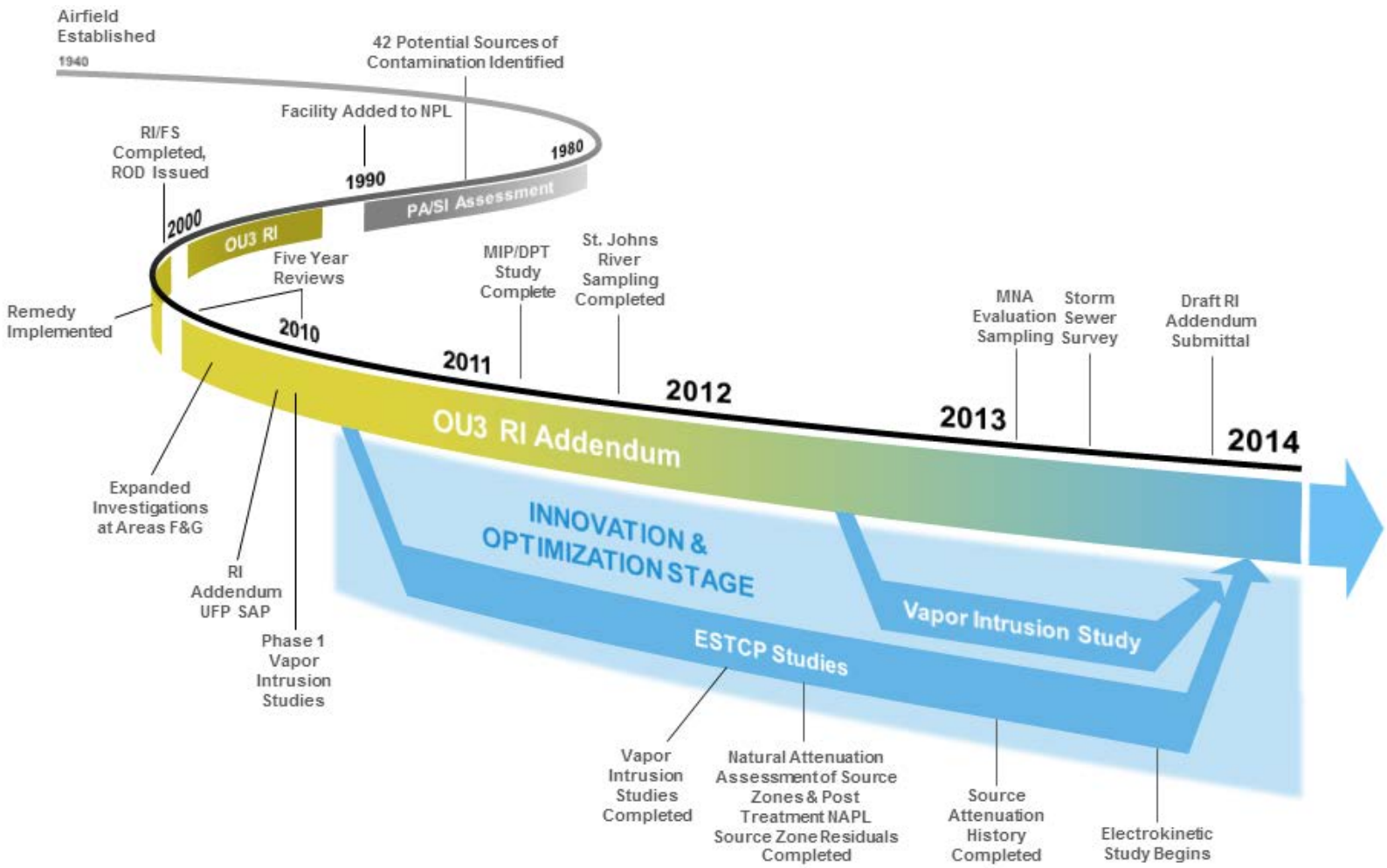
3) Verification that the groundwater plume had not discharged into the St. Johns River, adversely impacting surface water and sediment.

The NAS Jax Team reached consensus that an addendum to the RI/FS was required to fill in these crucial data gaps. The NAS Jax Team changed the remediation strategy from the original site-by-site multiple RODs approach to an OU3-wide, risk-based approach. The OU3-wide approach, which required a single ROD addendum to address the multiple commingled plumes at the site, was selected to minimize the administrative requirements, streamline the remedy evaluation and selection process, and allow for more creative risk-based approaches to site restoration.

Summary of Accomplishments

The NAS JAX Team set forth to implement a series of cutting edge, state-of-the-art investigations to support the development of an RI/FS Addendum, documenting current conditions that will support the development of an amended ROD for OU3. When complete, the amended OU3 ROD will be based on a site-wide, risk-based approach.

OU3 RI/FS Addendum activities have been conducted in part by using cutting edge technology demonstration projects, several of which have been conducted through DOD's Environmental Security Technology Certification Program (ESTCP). Site investigation activities have also included the development of advanced methods and approaches for evaluating VI into multiple industrial buildings. RI/FS Addendum activities have been conducted and the results communicated to FRCSE personnel and other stakeholders through a series of training sessions and meetings with union representatives. Public involvement has been achieved through the Restoration Advisory Board (RAB) and public meetings.



Partnership with ESTCP to Demonstrate Innovative Technologies at OU3

The NAS Jax Team successfully partnered with ESTCP in demonstrating innovative technologies for characterizing the distribution of DNAPL contamination present in low permeability layers at OU3. Recent field and laboratory research has demonstrated that DNAPL contamination can penetrate via molecular diffusion into low permeability layers present in aquifers, and can be stored there for many decades.

Stored contaminants can slowly diffuse out of low permeability layers over time, through a process called "back-diffusion," and serve as long-term sources to groundwater plumes. The following innovative technologies were demonstrated at OU3 to improve the CSM of DNAPL distribution and to aid in the design of future remediation systems:

a. High-resolution sampling of aquifer sediment and groundwater to delineate and estimate the amount of DNAPL mass diffused into low permeability layers,
b. Membrane interface probe to characterize the geotechnical properties of clay layers and the presence of DNAPL contamination,
c. On-site mobile laboratory and multi-level sampling equipment to delineate in real-time the presence of clay layers and to develop detailed profiles of contaminant mass in clay layers, and
d. Modeling tools to evaluate the natural attenuation of contamination through long-term diffusion and biodegradation in clay layers.

The NAS Jax Team collaborated with ESTCP from 2011 to 2013 to implement an innovative high-resolution sampling strategy and a fate and transport modeling study to evaluate the impacts of DNAPL contamination stored in low permeability layers on long-term groundwater quality.

Through detailed soil coring and groundwater sampling, the team was able to determine that tetrachloroethene (PCE), trichloroethene (TCE), and dichloroethene (DCE) have penetrated 3 to 5 feet into a clay layer since the original release at the former dry cleaner in 1962. Contaminant fate and transport modeling and concentrations profiles in the clay layer demonstrated significant natural attenuation of the DNAPL source area over time through biological degradation as well as diffusion and sorption of contaminant mass in the clay layer itself.

These data obtained through the ESTCP project were used by the NAS Jax Team to update the CSM and to guide the selection and design of an enhanced bioremediation system that will target both the low permeability clay layer and the more permeable sand unit directly above the clay. In December 2013, a second ESTCP project was implemented at OU3 to demonstrate an innovative bioremediation technology to address the PCE source area. The first phase of the project involved injecting an emulsified vegetable oil substrate and microbial consortium to stimulate the biological reductive dechlorination of PCE in the more permeable sand unit located directly above the clay layer.

High-resolution aquifer core sampling (Image courtesy of GSI Environmental, Inc.)

The purpose of the initial phase is to reduce PCE contamination in the shallow groundwater, which also acts as a potential source of VI at nearby buildings. Following the initial round of bioremediation targeting the sandy aquifer unit, an innovative technology will be implemented to directly address contaminants stored in the clay layer using an electro-kinetic (EK) process to distribute biological amendments through a direct current electric field.

The EK bioremediation project targeting the low permeability clay will begin in 2014. Much of the design for this project, including the location and distribution of DNAPL contamination present in the low permeability layer, was based on the high-resolution sampling data obtained through the previous ESTCP project.

These collaborative projects with ESTCP provided the NAS Jax Team with crucial, hard-to-acquire information regarding the distribution of DNAPL contamination at OU3, resulting in a much improved CSM and design basis for future remediation. Through the partnership with ESTCP, the NAS Jax Team was able to leverage the existing budget for site remediation at OU3 with an additional $1.5M in funding. Also, the NAS Jax Team was able to take advantage of cutting-edge research to solve real-world problems associated with managing complex groundwater sites.

Innovative Vapor Intrusion Assessment of Multiple Industrial Buildings

The NAS Jax Team developed and implemented groundbreaking, innovative methods to investigate subsurface to indoor air VI within and near FRCSE. This three-phase project included: (1) a systematic screening and prioritization process to select the highest priority buildings; (2) use of emerging field and laboratory analytical methods; and (3) stakeholder involvement throughout the project. Accomplishments included:

1. Screening and prioritizing identified 12 buildings out of 167 potentially impacted buildings, which significantly reduced investigation costs.
2. Implementation of emerging sampling techniques with potential to provide significant long-term cost-saving benefits to the Navy.

3. Minimization of impacts to operations at NAS Jax by selectively reducing the number of buildings identified for further evaluation through direct stakeholder involvement.
4. Demonstration of minimal potential for significant VI risks at the buildings of interest.

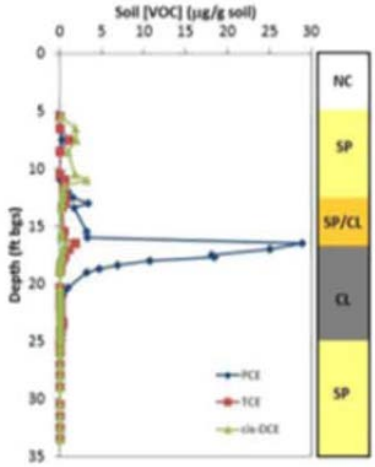
Phase 1 of the VI investigation identified buildings of potential interest for further investigation. From Phase 1, only 37 out of 167 buildings within the study area were retained. Phase 2 resulted in the selection of 12 primary buildings of interest. Phase 2 sampling consisted of traditional Summa canister sampling and emerging sampling techniques, including Vapor Pin™ sub-slab soil gas sampling equipment, HAPSITE portable gas chromatography/mass spectrometry (GC/MS) units, and passive samplers.

Cost Minimization

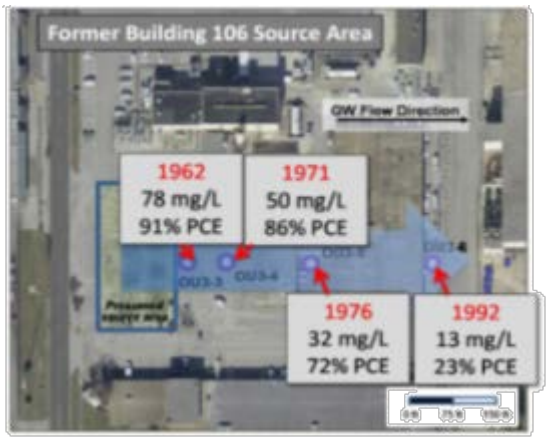
Cost avoidance was achieved through the following focused approaches:

- The NAS Jax Team prioritized buildings for investigation in lieu of a more traditional site-wide, building-by-building investigation method. This approach reduced the scope and cost of the investigation and minimized interruptions to installation operations. Experience throughout the Navy ER Program shows that VI investigation costs are in the range of $30,000 - $100,000 per building, inclusive of planning, implementation and reporting across multiple phases of investigation. The innovative VI investigation approach implemented at OU3 was presented to all Navy RPMs at the 2013 Navy Remediation Innovative Technology Seminar (RITS) as the preferred method for evaluating VI at multiple industrial buildings. Broader implementation of this systematic approach will result in millions of dollars in cost savings.
- Involving facility managers, union representatives, and building occupants during up-front planning and during information collection activities reduced costs, accelerated the schedule, and minimized concerns of building occupants.

(a)



(b)



(a) Detailed profile of DNAPL contamination diffused into clay layer. (b) Results of modeling demonstrating significant natural attenuation of PCE (image courtesy of GSI Environmental, Inc.).

- Utilizing emerging and innovative technologies:
  - Cox-Colvin Vapor Pin™ subslab soil gas sample ports to eliminate set-up time.
  - HAPSITE GC/MS unit to increase data resolution and reduce the number of sampling events.
  - Long-duration passive samplers to reduce sampling frequency. It is estimated that the use of passive samplers can reduce costs by as much as 50 percent as compared to traditional sampling methods.

Cox-Colvin Vapor Pin™

- The use of the HAPSITE to delineate subslab soil gas in real-time precluded at least one phase of follow-up/data-gaps sampling at Building 103. This eliminated planning, sampling, analytical, and reporting costs by approximately $10,000 - $20,000. This approach is applicable at most Navy buildings, and could result in substantial program-wide savings.

Innovative Technologies

Vapor Pin™ subslab soil gas sample ports were used in place of traditional stainless-steel probes installed with cement to eliminate the time needed for the cement to cure; this significantly reduced the sampling period. Installation and leak testing of the Vapor Pins takes on the order of 20 minutes or less versus at least one hour for traditional methods, and eliminates the need for expensive high-purity helium and the rental of helium detectors.

The use of the **HAPSITE GC/MS** unit enabled the field team to identify the source area beneath the slab in real-time. This allowed for a targeted investigation approach, reduced disruption to the building occupants, and minimized cost by avoiding spatial variability sampling.

The inclusion of long-duration **passive samplers** provided the opportunity to perform a field-scale test of the technology and to perform a comparative study with the traditional technologies. It is estimated that the use of passive samplers can reduce costs by as much as 50 percent compared to traditional sampling.

A **tracer gas study** was performed using naturally occurring radon gas at the site to calculate the attenuation of this tracer gas across the slabs of several buildings. The use of naturally-occurring radon concentrations to calculate attenuation factors eliminates the uncertainty of background interference when alternatively basing the calculation on volatile organic compounds alone.

Using innovative technologies, the NAS Jax Team saved approximately $250,000 on the VI assessment at OU3 compared to using traditional VI sampling and investigation methods. Through its phased VI investigation process, the NAS Jax Team demonstrated that VI does not represent a significant human health risk for any of the occupied buildings at OU3.

Stakeholder Involvement

In the absence of detailed VI policy and guidance at the state or federal level, it was essential to educate the team stakeholders (i.e., regulators and other partnering team members) on the current science, best practices, and policy of VI early in the investigation to minimize document review and approvals by creating early consensus on the technical approach.

Early involvement of stakeholders outside of the NAS Jax Team was critical to ensuring risk communication and effective public relations. Administering a comprehensive building questionnaire and distributing it to facility managers, union reps and building occupants, resulted in a vast database of information related to building histories and construction characteristics. Additionally, building occupants were extensively involved in the investigation planning process through day-to-day cooperation with the NAS Jax ER Program Manager.

Due to the presence of extensive sub-slab utilities and the large number of building occupants, it was determined the team would forego invasive sub-slab drilling at Buildings 101 and 780. As part of the public relations process, field team personnel were trained to interact with and to communicate accurate and timely information to building occupants during the field events to maintain trust. Finally, fact sheets were developed to quickly and easily communicate investigation status information to the stakeholders.

Long-duration passive samplers

Acquisition Strategy

The NAS Jax Team pioneered the use of the Environmental Technical Services (ETS) method of contracting. This approach to contracting uses previously negotiated costs for items specific to ER projects. The NAS Jax Team uses the ETS contract to quickly and cost-effectively award contracts to small businesses for long-term monitoring and remedial action services. Use of this contracting vehicle has significantly reduced the time to prepare an estimate for contract award and to receive a proposal from the contractor. Traditionally, a contract award would take 4 to 6 weeks. The ETS contracting method typically takes 1 to 2 weeks from the initial scoping process to final award.

Use of the ETS contract over traditional contracting methods has routinely resulted in cost savings of at least 25% for individual task orders. Additionally, this contracting option allows the NAS Jax Team to significantly increase the use of small business contractors on ER projects.

Conclusions

The NAS Jax Team has demonstrated excellence in environmental restoration by successfully implementing innovative and cost-effective technologies for investigating and managing the risks associated with complex chlorinated solvent plumes at OU3. The NAS Jax Team's success is the result of numerous effective partnerships, including DOD's ESTCP applied research program. Through this partnership, the NAS Jax Team was able to take advantage of cutting edge research on the delineation and assessment of DNAPL contamination stored in low permeability layers. This persistent contamination has shown to be extremely difficult to remediate using traditional technologies. Building on successful initial efforts to delineate and understand the DNAPL mass present in these clay layers, the NAS Jax Team will take the next step to demonstrate an innovative electro-kinetic bioremediation process to remediate DNAPL contamination.

The NAS Jax Team was also able to develop state-of-the-practice methods for evaluating VI at numerous industrial buildings at OU3 through the use of innovative technologies (e.g. real-time HAPSITE sampling equipment, long-term passive sampling devices, radon tracer studies) and effective partnering with state and federal regulatory agencies and NAS Jax building occupants. The NAS Jax team has shared these cost-effective and innovative VI investigation approaches with other Navy RPMs and remediation practitioners through publications and presentations at training seminars and technical conferences.

The NAS Jax Team's commitment to continuous optimization and the use of innovative technologies at OU3 has resulted in a total cost avoidance of approximately $2.5M to date. In addition, the successes and lessons learned through demonstrating innovative technologies at NAS Jax have been shared throughout the Navy.

Awards and Services

NAS Jax received the Commander-in-Chief's Installation Excellence Award in 2011, 2012, and CNRSE 2013. To transfer the innovative technologies and approaches implemented at NAS Jax, the Team has published technical papers and presented at the following technical conferences and training seminars:

Quantitatively Ranking and Selecting the Highest Priority Buildings for Application of Traditional and Emerging Investigative Technologies During a Phase 2 Vapor Intrusion Assessment. Presented at the 2012 Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA May 2012.

Vapor Intrusion: Where Are We Today? Case study information from NAS Jax used in the Navy's Remediation Innovative Technology Seminar (RITS). May 2013.

Membrane Interface Probe Protocol for Contaminants in Low-Permeability Zones in the Journal *Ground Water*. 2014

Field Application of Emerging Vapor Intrusion Investigation Methods to Reduce Uncertainties and Improve Efficiency. Accepted for Presentation at the 2014 Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA May 2014.

High Resolution Site Characterization. Case Study Information from NAS Jax will be in the Navy's RITS in 2014.