

# LSP ASSOCIATION CONTINUATION EDUCATION SEMINAR

## Long-Term Monitoring Optimization for Groundwater Remediation Using MAROS

### **Course Description**

This 1-day course is intended to provide technical personnel a comprehensive understanding of Long-Term Monitoring Optimization (LTMO), its place as part of comprehensive remediation optimization and its potential cost savings during long-term site operation and maintenance. Basic concepts and terminology will be integrated with hands-on instruction using the Monitoring and Remediation Optimization System (MAROS) software. The course will include a series of detailed case studies and software exercises. Participants will be shown how to incorporate MAROS to help develop robust and cost effective characterization and/or remediation decisions. Course attendees are expected to have a general technical background or understanding of environmental site management and contaminant hydrogeology.

### Course Agenda

8:00 a.m 8:10 a.m.	Introduce speakers, present class goals, objectives, and topics to be covered.
8:10 a.m 9:45 a.m.	<ul> <li>LTMO - overview and concepts</li> <li>EPA National Optimization Strategy</li> <li>Department of Defense optimization efforts</li> <li>Key concepts - Basic Steps <ul> <li>Conceptual Site Models</li> <li>Monitoring goals and ob ectives bj</li> <li>Data management</li> </ul> </li> </ul>
9:45 a.m 10:00 a.m.	Break
10:00 a.m 11:00 a.m.	<ul> <li>LTMO Overview - cont'd</li> <li>Key concepts - lines of evidence <ul> <li>Types of analyses</li> <li>Cost/benefit of LTMO</li> <li>Implementation and regulatory buy-in</li> </ul> </li> <li>Introduction to specific tool to be worked with during this class - MAROS</li> <li>Evolving methods - LT3MO, GTS</li> </ul>
11:00 a.m 11:40 a.m.	Qualitative vs. Quantitative Approaches <ul> <li>Hydrogeology</li> <li>Decision logic</li> <li>When to use statistics</li> <li>Combined approach</li> </ul>



11:40 p.m 12:00 p.m.	Case Study 1 - Qualitative Review of a Site <ul> <li>The exercises will illustrate how to use the qualitative methods to evaluate site monitoring plans.</li> </ul>
12:00 p.m 1:00 p.m.	Lunch Break
1:00 p.m 2:45 p.m.	<ul> <li>Hands-On Training - MAROS - Use of the MAROS software to perform LTMO analyses. Multiple exercises include:</li> <li>Data input and management</li> <li>Individual well trend analysis methods - Mann-Kendall and Linear Regression and when to use each.</li> <li>Plume-Level analysis - Method of Moments a</li> <li>Spatial Optimization</li> <li>Temporal Optimization</li> <li>Data Sufficiency</li> <li>Putting it all together</li> </ul>
2:45 p.m 3:00 p.m.	Break
3:00 p.m 4:50 p.m.	Hands-On Training - MAROS - Cont'd
4:50 p.m 5:00 p.m.	Wrap Up and General Discussion

#### **Course Instructors**

- Shahla K. Farhat, PhD. Dr. Farhat is a consultant scienttist with GSI En nvironmental Inc. She has over 16 years of experience in environmental research and engineering, with specialization in assessment and remediation of local and regional groundwater aquifer systems, fate and transport modeling, and decision support systems. She is the primary author of the "Mass Flux Toolkit" developed by GSI for ESTCP, the "SourceDK Remediation Timeframe Decision Support System Model" developed by GSI for the Air Force Center of Environmental Excellence, and several proprietary software for petrochemical industries. She received her Ph.D. in Environmental Sciences and Engineering from the University of North Carolina at Chapel Hill.
- Mindy Vanderford, PHD. Dr. Vanderford is a Senior Associate Environmental Scientist at GSI o and has technical experience in the chemical analysis and environmental fate of munitions, chlorinated solvents and polycyclic aromatic hydrocarbons. Dr. Vanderford consults with the USEPA on developing their National Remediation Optimiz zation Strategy. She has developed and conducted classes in Long-Term Monitoring Optimization for all USEPA Regions, DoD, and several state environmental agencies. Her project experience includes statistical analyses for remediation optimization, environmental site investigation, human and ecological risk assessment, monitored natural attenuation evaluation, and the application of geographic information system (GIS) tools. She is currently managing the MAROS software for GSI and has extensive experience using decision matrices to analyze and optimize long-term groundwater monitoring networks.



#### Software

MAROS: The Monitoring and Remediation Optimization System (MAROS) is a decision support tool based on statistical methods applied to site-specific data that accounts for relevant current and historical site data as well as hydrogeologic factors (e.g. seepage velocity) and the location of potential receptors (e.g., wells, discharge points, or property boundaries). MAROS was designed for Long Term Monitoring (LTM) optimization through trend analysis of monitoring data (e.g., Mann-Kendall analysis) to determine plume stability, sampling frequency, and well location.