

SHORT COURSES

Courses will be offered on Monday, June 27, before the Symposium program begins. Courses are open to both Symposium registrants and nonregistrants. To register, go to www.battelle.org/biosymp, or use the form on page 46.

Note: The maximum discount applies to fees paid by April 25. Classroom space allocations and production of materials will be determined by the number registered for each course by May 16. If insufficient registrations are received for a given course by that date, the course may be canceled, with registrants' fees being transferred to other courses selected by the registrants or refunded. Registrations will be accepted after May 16 if space is available. Cancellations received by May 16 will be refunded less a \$10 service fee. For cancellations received after this date, no refunds will be made, but paid no-shows will receive all course materials. Substitutions will be accepted at any time, preferably with advance notice.

The description for each course is followed by information on whether participants will need to bring a laptop to class for use in doing exercises. Course materials will include the instructors' presentation slides and other supporting materials as appropriate to the course, such as references from the literature, reprints, files, or publicly available software.

MONDAY, 8:00 A.M.–5:00 P.M.

1-hour break at 12:00 for lunch on own

Geochemical Evaluations of Metals in Environmental Media: How to Distinguish Naturally Elevated Concentrations from Site-Related Contamination (8 hours)

Instructors: Jonathan Myers, Ph.D., and Karen Thorbjornsen, P.G. (Shaw Environmental, Inc.)

Objective: Provide practical geochemistry-based approaches for identifying metals contamination in soil, sediment, groundwater, and surface water. Course is recommended for regulatory personnel, consultants, and site managers.

Overview: Do you really have metals contamination at your site? Metals concentrations in environmental media often exceed screening criteria, but they may be naturally elevated. It is well known that trace elements naturally associate with a limited number of minerals in sediment or soil (or with specific suspended particulates in groundwater and surface water) under a given set of environmental conditions. In most oxic soils, for example, arsenic and vanadium are almost exclusively associated with iron oxide minerals at consistent ratios. These processes result in positive correlations between specific trace vs. major element concentrations, which can be visualized with scatter plots. Contaminated samples are identified by their anomalously high elemental ratios relative to uncontaminated samples. For groundwater and surface water, additional factors considered include pH, redox effects, aqueous complexation, salinity gradients, and (for groundwater) well-construction materials. Unlike a purely statistical approach, geochemical evaluation greatly reduces the probability of falsely identifying contamination; does not require a statistically valid background data set; identifies contaminated locations, thereby focusing remediation efforts; and provides mechanistic explanations for elevated concentrations. During this course, you'll learn geochemical evaluation techniques that use existing data to distinguish natural metals concentrations from potential contamination, without performing geochemical modeling or adding significantly to project cost. Insightful case studies are presented from the instructors' work

at hundreds of investigation sites across the U.S. and its territories. The material is presented in an accessible style, and prior knowledge of geochemistry is not required.

Agenda:

1. Standard Techniques for Dealing with Inorganics Data: Limitations of Purely Statistical Approaches
2. Geochemical Mechanisms Controlling Trace Element Concentrations in Solid and Aqueous Media
3. Preparation and Interpretation of Geochemical Correlation Plots and Elemental Ratio Plots
4. Supporting Lines of Evidence
5. Case Studies
6. Worst-Case Scenarios
7. How and When to Apply Geochemical Evaluations
8. Keys to the Successful Presentation of Geochemical Evaluations to Regulatory Agencies and Project Teams.

Participants will not need laptops to use during the course.

Attenuation Processes and Decision Framework for Metals and Radionuclides in Groundwater—An ITRC Course (8 hours)

Instructors: Ann Charles (New Jersey Department of Environmental Protection)

Ryan Fimmen, Ph.D. (Battelle)

Jennifer Nyman, Ph.D. (ARCADIS/Malcolm Pirnie)

Matt Charsky (U.S. Environmental Protection Agency)

Miles Denham, Ph.D.; Maggie Millings; and Karen Vangelas

(Center for Sustainable Groundwater and

Soil Solutions, Savannah River National Laboratory)

Objective: Introduce a new Interstate Technology and Regulatory Council (ITRC) initiative that provides recommendations for evaluating and documenting attenuation-based remedies in a consistent and technically defensible manner. The decision framework builds upon the U.S. EPA's recently issued three-volume technical guidance specifically addressing monitored natural attenuation of inorganic contaminants. Developed jointly by the ITRC and the Center for Sustainable Groundwater and Soil Solutions, the class is intended for regulators, stakeholders, site owners, and practitioners involved in site remediation.

MONDAY, 8:00 A.M.–Noon

**Incorporating Bioavailability Considerations in the Evaluation of Contaminated Sediment Sites—
An ITRC Course (4 hours)**

Instructors: John G. Cargill, PG (Delaware Department of Natural Resources and Environmental Control)
Stephen R. Clough (Haley & Aldrich, Inc.)
Stephen C. Geiger, Ph.D. (AECOM)
Tamara Sorell, Ph.D. (AMEC Earth and Environmental)

Objective: Present the fundamental concepts of bioavailability and provide information on the available tools for assessing bioavailability. This course will benefit state regulators and practitioners as they determine the appropriate application of bioavailability concepts and processes.

Overview: As defined by the National Research Council (NRC 2003), “bioavailability processes” are the “individual physical, chemical, and biological interactions that determine the exposure of plants and animals to chemicals associated with soils and sediments.” The ITRC Contaminated Sediments Team has developed Technical and Regulatory Guidance on the use of bioavailability. The Web-based operation of the Guidance offers streamlined access to items that are the most important to the user, providing insight on how bioavailability assessments can be used to understand, mitigate, and manage risk at a contaminated sediment site, often at a reduced overall project cost. The Guidance covers the concepts, process, and use of bioavailability in a risk-based decision-making framework at a contaminated sediment site. Bioavailability assessment tools aid in assessment of human and ecological exposure and in development of site-specific remedial objectives. The Guidance identifies where bioavailability considerations may be pertinent in the human-health and ecological-exposure assessment process. It provides a description of available tools for the evaluation of bioavailability in the context of assessing exposure in humans, benthic invertebrates, wildlife, fish and aquatic invertebrates, and plants. Case studies referenced throughout the document demonstrate the practical application of bioavailability measures. State regulators and practitioners can use the Guidance to assist them in understanding and incorporating fundamental concepts of bioavailability such as:

- Developing conceptual site models (CSMs) that include bioavailability considerations in prospective exposure pathways.
- Identifying and describing available tools (biological, chemical, and physical) and models that can be used to measure and characterize the fate and transport and potential bioavailability of contaminants.
- Modifying remedial goals based on application of bioavailability concepts in evaluating potential risk and taking advantage of bioavailability concepts in designing remedies and managing risk.
- Communicating these bioavailability-based conclusions, especially to the public.

Overview: Many sites across the United States have groundwater contaminated with metals or radionuclides, often at low levels but above standards. Monitored natural attenuation (MNA) often seems an appropriate remedial option, but, to date, MNA of metal- and radionuclide-contaminated sites has received limited acceptance by regulators and the public. Among the hurdles to acceptance are the lack of regulatory guidance, the lack of familiarity with the attenuation processes and with the subsurface chemistry (geochemistry) that controls these processes, and the discomfort that “contaminants” will be left in the environment. To address these hurdles, this course will provide both an introduction/refreshers to geochemical terms and concepts and an introduction to new guidance by the ITRC that (1) fosters building a technically defensible evaluation of the inclusion of attenuation-based remedies (monitored natural attenuation and enhanced attenuation) into remediation strategies and (2) is consistent with the U.S. EPA’s policy and technical guidance on MNA for metals and inorganics. The morning will be devoted to the review of geochemistry as related to attenuation processes for metals and radionuclides in groundwater, information needed by all personnel involved in any capacity with the cleanup of sites with metals and radionuclides in groundwater. The review will start with the concept that sorption, precipitation, co-precipitation, redox transformations, and aqueous speciation are all chemical reactions that can be quantified using the same calculations used for other types of chemical reactions. Concepts such as equilibrium constants, oxidation and reduction, and Eh-pH diagrams will be presented. From these, the geochemical controls on attenuation mechanisms of metals and radionuclides will be explored. Exercises will be provided to foster understanding of the key concepts. The afternoon will introduce the ITRC-developed decision framework that incorporates the U.S. EPA’s 4-tiered process for evaluation and implementation of MNA for metals and inorganics. EPA’s policy on MNA for metals and inorganics will be reviewed. Case studies will provide insight into site characteristics that have potentially greater impact on sites with metals and radionuclides than on sites with organics.

Agenda:

1. Introduction and Review of Geochemistry—*key terminology; basic chemistry concepts; exercises to apply concepts*
2. Viability of MNA as a Remedial Alternative for Metals and Radionuclides
3. Overview of Attenuation Processes Applicable to Metals and Radionuclides
4. Overview of U.S. EPA Policy and Tiered Process for Evaluation of MNA for Metals and Inorganics
5. Decision Framework—*a stepwise process through a series of decisions to foster developing a technically defensible set of documentation to support incorporation of attenuation processes into a site remedy*
6. Case studies—*evaluating attenuation processes and their long-term sustainability consistent with newly released U.S. EPA guidance; identifying and understanding how controlling parameters affect conceptual site model development and evaluation of attenuation*
7. General discussion and Wrap-Up

Participants will not need laptops to use during the course.

Agenda: Case studies will be integrated into each section of the training to demonstrate how bioavailability concepts can be applied in a sediment evaluation.

1. Introduction to Bioavailability—*defining bioavailability and the processes that may affect contaminant bioavailability*
2. When to Apply Bioavailability to Assess Risk—*developing a CSM that considers contaminant bioavailability; integrating the risk assessment results with technical, political, legal, social, and economic objectives; incorporating bioavailability into a site investigation at four steps: scoping, screening level assessment, characterization of exposure and effect, and response action/risk management*
3. Available Tools to Assess Contaminant Bioavailability for Benthic and Human Health Pathways and for Fish, Wildlife and Plant Pathways—*chemical measures, biological measures, predictive measures*
4. Using the Information to Make Risk Management Decisions—*case studies demonstrating the use of exposure assessments; regulatory perspective; communication to the public; implementation barriers*

Participants will **not** need laptops to use during the course.

In Situ Chemical Reduction (ISCR) Technologies: Differentiators and Technology Implementation (4 hours)

Instructors: Jim Mueller (The Adventus Group)
Richard Brown (ERM)

Objective: Examine important considerations in the selection and application of ISCR technologies under various site settings; present a decision tree to aid in remedial design of effective ISCR of targeted COIs. Course is recommended for regulatory personnel, consultants, remedial contractors, graduate students, and site managers.

Overview: Although biologically mediated reductive dechlorination continues to be a significant focus of chlorinated solvent remediation, there has been an increased interest in synergistic reductive processes. This course will examine factors important in remedial design and selection of in situ chemical reduction (ISCR) technologies. ISCR uses technologies based on zero-valent iron (ZVI) and other reduced metals, as well as naturally occurring reduced minerals (e.g., magnetite, green rust, and iron sulfides) capable of dechlorinating solvents. A recent area of development in ISCR has been in combining biological and abiotic processes. There are several ways biological and abiotic processes can be combined. First, the interaction between the two may be “causative.” For example, BiRD (biogeochemical reductive dechlorination) technology, which was developed by the Air Force Center for Engineering and the Environment, combines a mulch barrier with hematite and gypsum to create an iron sulfide-based reducing zone. Biodegradation under sulfate-reducing conditions produces sulfide, which may combine with iron from naturally occurring minerals such as hematite, magnetite and siderite to form iron sulfides. As such, the BiRD technology is “causative” in that the biological processes create reducing minerals. The biological generation of other reducing minerals, such as magnetite, siderite and green rust, is feasible and is, with magnetite, observed in nature at some petroleum sites. A second type of interaction between abiotic and biotic processes is “synergistic”; for example, biological processes can enhance the activity of reduced metals/minerals. This is the basis of the

EHC® ISCR technologies, which combine ZVI with a slowly degradable carbon substrate. This combination rapidly creates buffered, strongly reducing conditions, resulting in more complete solvent degradation (i.e., direct mineralization). The extent and level of reducing activity commonly observed are much greater when both the carbon substrate and the ZVI are present. When the carbon substrate is expended, the reducing activity due to ZVI alone is typically less.

Agenda:

1. Overview of ISCR Technologies
2. ISCO vs. ISCR? Factors to Consider in Technology Selection
3. Engineering Optimization Tests: Bench-Scale and Pilot Studies
4. Applicability to Residual DNAPL Source Areas, Hot-Spot Treatment, Plume Control or Permeable Reactive Barriers (PRBs)
5. Remedial Design and Engineering—*baseline parameters, engineering calculations*
6. Remedial Construction/Remedial Application—*soil mixing, trenching, direct injection, hydraulic fracturing, liquid amendments for well applications*
7. Validating Radius of Influence/Amendment Distribution
8. Field Performance Monitoring: (i) *sampling and analysis requirements*, (ii) *emerging monitoring tools*
9. Addressing “unanticipated” results: (i) *problems associated with aquifer acidification/pH buffering requirements*; (ii) *monitoring physical, short-term sequestration of targeted compounds as a primary removal mechanism*; (iii) *potential accumulation of recalcitrant catabolic intermediates*; (iv) *physical displacement of COIs via substrate addition and water flushing*; (v) *avoiding mobilization of arsenic or other heavy metals yielding secondary plumes*; (vi) *transient production of fermentation products*; and (vii) *various construction issues*
10. Environmental Longevity/Sustainability
11. Optional Use of Inoculants/Chase water
12. Case Studies—*cost, successes and failures, lessons learned*

Participants will **not** need laptops to use during the course.

The SRT™ and SiteWise™ Sustainable Remediation Tools (4 hours)

Instructors:

Erica Becvar (U.S. Air Force Center for Engineering and the Environment)
John Claypool (AECOM)
Carol Lee Dona (U.S. Army Corps of Engineers)
Sriram Madabhushi (Booz Allen Hamilton)
Robert Nash (U.S. Navy)
Doug Ruppel (AECOM)
Mohit Bhargava and Russell Sirabian, PE, PMP (Battelle)
Tiffany Swann (GSI Environmental, Inc.)

Objective: Provide users with the knowledge necessary to apply the tools confidently to site remediation projects, using their understanding of how the tools work and what they calculate. The intended audience includes remedial project managers, consultants, regulators, or anyone interested in either performing sustainability reviews for remediation projects or reviewing sustainability reviews performed by others.

Overview: To support green and sustainable remediation (GSR), the U.S. Department of Defense has developed tools that calculate the environmental footprint of remedial alternatives. One such tool is the Sustainable Remediation Tool (SRT™), developed by the U.S. Air Force Center for Engineering and the Environment (AFCEE) and its partners. Another is the SiteWise™ Tool, developed in a collaborative effort by Battelle, the U.S. Navy, and the U.S. Army Corps of Engineers. These tools, which are free and available to the public, calculate similar metrics, including (1) energy consumption, (2) greenhouse gas (GHG) emissions, (3) air emissions of criteria pollutants, (4) water consumption, and (5) accident risk. Both tools can be used to support decision-making during the remedy selection process as well as to help optimize planned or existing remedies to reduce the overall environmental footprint. The structure and inputs of the two tools are quite different, the SRT being technology-based and SiteWise being activity-based. Knowledge of both tools allows users to determine which tool best fits their particular situations. Both SRT and SiteWise have been expanded and improved over the past year, and during the course, emphasis will be placed on recent changes made in both tools. Participants will receive detailed training on how to use the tools, best procedures for modeling real-world remedial actions, the assumptions behind the tools, and their respective benefits and limitations. Highlights of case studies where the tools were used will be presented along with trends of the findings. Copies of the SRT (along with the AFCEE-developed Performance-Tracking Tool) and the latest version (Version 2) of the SiteWise software will be distributed to participants at the conclusion of the class.

Agenda:

1. Description of the tools—*GSR metrics calculated; structure; basis of calculations*
2. Live demonstrations of sustainability evaluations performed with each tool—*description of subject sites; developing inputs; inputting data; discussion of outputs*
3. Case study highlights—*presentation of results; discussion of trends and lessons learned*

The live demonstrations will be shown on a projector, but participants are encouraged to bring laptops to the class to enable them to follow along on their own copies of the software.

Measurement and Use of Mass Discharge and Mass Flux to Improve Decisions at Contaminated Sites—An ITRC Course (4 hours)

Instructors:

Naji Akladiss (Maine Department of Environmental Protection)
Tamzen Macbeth (CDM)
Charles J. Newell (GSI Environmental Inc.)
Alec Naugle (California Regional Water Quality Control Board)
Grant Carey (Porewater Solutions)

Objective: Provide information about various methods and potential uses of mass flux and mass discharge to support decision-making at contaminated sites. Practitioners, regulators, and others working on groundwater sites should consider this course.

Overview: This short course provides valuable insights into the use of mass flux and mass discharge to improve remedial efficiency and reduce site management costs. The basis of the course is “Use and Measurement of Mass Flux and Mass

Discharge (MASSFLUX-1),” a document prepared by ITRC’s Integrated DNAPL Site Strategy Team in 2010 and available at www.itrcweb.org. This course includes a description of the concepts, uses, and measurement methods for mass flux and mass discharge, as well as a review of case studies demonstrating the benefits of using these data for site management. Most decisions at contaminated-groundwater sites are driven by measurements of contaminant concentration. Decisions can be improved by using mass flux and mass discharge estimates to assess contaminant load into an aquifer. Evaluating and managing contaminant loads often provides a framework for better-informed management decisions regarding site prioritization, remedial design, and optimization. Mass discharge-based interim remedial goals often are more realistic for complex sites containing residual sources of contamination. The use of mass flux and mass discharge is increasing and will accelerate as field methods improve and practitioners and regulators become familiar with their applications, advantages, and limitations. The decision to collect and evaluate mass flux data is site specific. It should consider the reliability of other available data, the uncertainty associated with measurements, the specific applications of the data, and the cost-benefit of collecting mass flux and mass discharge measurements.

Agenda:

1. Mass Concepts—*why mass estimates are used; definitions and description; uncertainties; advantages and limitations*
2. Measurement Methods—*transect method; well capture/pumping methods; passive flux meters; using existing data (isocon-tours); solute transport models*
3. Uses—*site characterization; potential impacts and exposure evaluation; remediation selection and design; performance monitoring; site prioritization*
4. Regulatory Precedence and Acceptance
5. Case Studies

Participants will not need laptops to use during the course.

MONDAY, 1:00 A.M.–5:00 P.M.

Utilization of Stable Isotopes in Bioremediation Studies of Contaminated Sediments (4 hours)

Instructor: Paul Philp, Ph.D. (University of Oklahoma)

Objective: Provide an introduction to the concept of stable isotopes and their potential utilization in applications related to bioremediation of contaminated sediments. The intended audience includes environmental chemists and engineers, regulators, attorneys, and hydrogeologists.

Overview: The first part of the course will introduce the basic concepts of stable isotopes—what is meant by a stable isotope; how stable isotope values are determined; isotope standards; instrumentation; bulk stable isotopes; compound-specific isotopes; the Rayleigh equation; isotopic enrichment factors and other basic concepts needed to understand these applications. The focus will be on stable isotopes of C, H, Cl, and N because currently these are the major isotopes of interest in

environmental studies. The second part of the workshop will describe applications of this technology to studies involving bioremediation of contaminated sediments. There are two major applications. The first is the use of isotopes as a tool for determining the source of the contaminant. With this application, it is also essential to integrate isotope data with data from the other commonly used analytical tools, such as gas chromatography and gas chromatography-mass spectrometry. The second application to bioremediation of contaminated sediments is to use the extent of isotopic enrichment as a tool to measure the onset and extent of degradation of organic compounds present at the site. These applications will cover utilization of carbon, hydrogen and chlorine isotopes in these remediation studies. In addition to monitoring the onset and extent of degradation, the utilization of isotopes to differentiate degradation mechanisms also will be discussed. It is as important to discuss why this approach is not always going to be useful or successful as it is to discuss the successful applications. Similarly, reasons why this approach will not be as useful for monitoring remediation of semivolatile compounds will be discussed. In addition to the above, some general applications of stable isotopes to other areas of environmental studies will be provided.

Agenda:

1. Introduction
2. Stable Isotopes 101—*methodology; fractionation; Rayleigh equation; bulk isotopes; compound-specific isotope analysis*
3. Application to Bioremediation Studies—*enhanced bioremediation, natural attenuation, abiogenic degradation*
4. Isotope Effects Resulting from Physical Effects Such As Volatilization and Sorption
4. Quantification of Isotope Data and Incorporation into Transportation Models
5. Why variations in the isotopic composition of smaller molecules but not larger molecules can be used in bioremediation studies
6. Distinguishing Source Signatures from Degradation Signatures—*integration with GC and GCMS data*
7. Other Applications of Stable Isotopes in Environmental Studies
8. Summary

Participants will not need computers during class.

Life Cycle Assessment (LCA) and Other Approaches to Estimating Impacts for Remediation Systems (4 hours)

Instructors: Paul Favara, PE (CH2M Hill)
Todd Krieger, PE, LCA Certified Professional (DuPont)
Mohit Bhargava (Battelle)
Angela Fisher (General Electric)

Objective: This course provides guidance on how to plan and document an LCA and other impact-estimating approaches so that the value of the results can be recognized and reporting can be conveyed clearly. The intended audience includes remediation project managers, consultants, regulators, and anyone interested in performing impact assessments for remediation systems or reviewing such assessments performed by others.

Overview: Have you ever wondered how to estimate environmental impacts, or how to apply Life Cycle Assessment (LCA) principles to your remediation project? The course will examine current impact assessment approaches used in the remediation industry, including LCA and impact analyses that do not address the full “cradle-to-grave” life cycle of the remediation system. The primary focus will be on environmental impacts, but social and economic impacts also will be considered. The content is based on guidance developed by the Sustainable Remediation Forum (SURF). This guidance is the compilation of input from more than 30 environmental professionals, representing consulting companies, site owners, the Department of Defense, and regulatory agencies. The following topics will be addressed in this course: (1) setting objectives for the assessment; (2) defining the basis for which comparisons will be made (i.e., the functional unit); (3) defining the boundaries of the assessment to document what is and what is not included in the assessment; (4) establishing the metrics or impact categories that will be estimated for decision making; (5) identifying data for the assessment; (6) completing the assessment computations; (7) conducting sensitivity and uncertainty assessment on results; (8) interpreting the results; and (9) reporting. Several case study examples will be carried through the instruction to demonstrate how the above knowledge can be applied to a range of tools, including SiteWise™, SRT™, SimaPro®, and project-specific spreadsheets. Utilizing the guidance provided in this class will increase stakeholder confidence in sustainability assessment results and provide more complete information for decision making. The guidance will be published in the summer 2011 edition of *Remediation Journal*. A prepublication version of the guidance will be provided to attendees.

Agenda:

1. Overview of available tools
2. Overview of planning and implementing the sustainability assessment
3. Case study overview of four different tools and how the guidance can be applied to a range of tools
4. Answers to frequently asked questions. *What is a Life Cycle Assessment? Do my results rise to the standard of an LCA? What is the easiest way to access data for my assessments? How do I determine which boundaries are appropriate for my study? What resources (cost and schedule) are needed for the different types of assessments? What should be considered in an effective review of an LCA or impact analysis?*

Participants will not need computers during class.

Advances in Permeable Reactive Barrier (PRB) Design, Application, and Assessment—An ITRC Update (4 hours)

Instructors: John Doyon (New Jersey Department of Environmental Protection)
Kimberly Wilson, PG (South Carolina Department of Health and Environmental Control)
Bruce Henry, PG (Parsons), *representing the Air Force Center for Environment and Engineering (AFCEE)*
Cannon Silver, PE (Battelle)
Scott Warner, CEG, CHG (AMEC Earth and Environment)

Objective: Help guide state and federal regulators, consultants, project managers, and other stakeholders and technology imple-

menters through the decision-making process when deciding whether PRBs may be considered as part of a remedy to address contaminated groundwater.

Overview: A new Interstate Technology & Regulatory Council (ITRC) technical/regulator guidance document addressing Permeable Reactive Barriers (PRBs) will be released in April 2011. Since the inception of PRB technology more than 15 years ago, PRBs have generally proven an effective and sustainable technology. Recent innovations have reduced costs and broadened the applicability of PRBs to address more contaminants, including mulch biowalls to degrade chlorinated solvents or reduce and immobilize metals and zeolites to control radionuclide plumes. In addition, PRBs convey the concept of a green and sustainable system, with a long track record for providing groundwater remediation without the need to pump water or use supplied power. Members of the ITRC team will highlight lessons learned through case studies illustrating a range of media and injection methods.

Agenda:

1. Introduction
2. What is a PRB, and why consider it?—*history of innovations, sustainability*
3. How Remedial Objectives Drive Technology Selection—*PRB strategies, when to apply as part of treatment train; regulatory acceptance; community considerations*
4. Science of PRBs—*contaminants addressed; treatment processes; matching media to the contaminants*
5. PRB Design—*importance of site characterization; role of treatability studies; land use considerations; impacts of hydraulic changes*
6. Constructability—*conventional methods; injection methods*
7. Longevity and Monitoring—*key parameters to monitor; anticipated longevity; rejuvenation*
8. Enhancing Cost Effectiveness—*cost of construction and monitoring; ideas to enhance cost effectiveness*
9. Case studies—*ZVI PRB at Elizabeth City, NJ; mulch biowall at McGregor, TX; zeolite wall at West Valley, NY*
10. Lessons Learned—*limiting factors and how to mitigate them; what's on the horizon; resources*

Participants will not need computers during class.

Framework and Metrics for Incorporating Sustainability into Remediation Projects (4 hours)

Instructors: Karin Holland (Haley & Aldrich, Inc.)
Stella Karnis (Canadian National Railway)
Ray Lewis (Sunpro, Inc.)—*representing the Sustainable Remediation Forum*
Carol Lee Dona (U.S. Army Corps of Engineers)
Deborah Taege (The Boeing Company)
Karina Tipton (Brown and Caldwell)
P. Brandt Butler (URS Corporation)

Objective: Present a user-friendly sustainable remediation framework and associated metrics that can be applied during the planning and implementation of each phase of remediation. The framework is relevant to sites of varying size and complexity and is complementary to existing regulatory programs. The intended

audience includes remediation project managers, consultants, regulators, or anyone interested in integrating sustainability into remediation projects.

Overview: During the past few years, significant breakthroughs have occurred in the sustainable remediation field, enabling more and more remediation project teams to effectively incorporate sustainable practices during remedy selection and implementation. However, the methodologies employed for the integration of sustainable practices generally have been inconsistent. This inconsistency has stemmed partly from the lack of a broad-ranging, widely applicable framework, making it difficult for different remediation project teams to evaluate and account for sustainability during their projects and to compare sustainable practices across a range of remediation sites. Substantial benefit is therefore to be gained from a framework that provides a consistent methodology for considering and balancing sustainability efforts throughout the remediation lifecycle. Recognizing the need, the Sustainable Remediation Forum (SURF) has developed a flexible framework that integrates sustainable concepts throughout the remediation project while continuing to provide long-term protection of human health and the environment and achieving public and regulatory acceptance. Quantitative and qualitative metrics have also been developed for use in conjunction with the framework to evaluate actual (or predicted) sustainability impacts associated with a project. Scheduled to be released in spring 2011 as two separate documents, the framework and metrics initiatives are the combined contribution of more than 20 environmental professionals, representing site owners, the Department of Defense, and regulatory agencies. This course will present and discuss the SURF framework and metrics and the value offered to its intended users. The following topics will be addressed in this course: (1) sustainable remediation framework attributes; (2) description of the framework; (3) the importance of preferred end-use for the site in the framework; (4) the framework's approach to evaluation of sustainable practices; (5) revision of the conceptual site model based on the results of the sustainability evaluation; (6) balancing sustainability considerations; (7) integration of the framework within the regulatory framework; (8) identification of key stakeholders; (9) selection of metrics; and (10) documentation of sustainability efforts. Several examples of the use of the framework and associated metrics will be provided during the course to demonstrate how the framework and metrics can effectively be applied to a range of sites and implemented during different phases of remediation.

Agenda:

1. Overview of Framework
2. Attributes of the Framework
3. Description of the Framework
4. Application of the Framework
5. Framework's Relationship with Published Sustainable Remediation Guidance
6. Selection of Metrics
7. Illustrative Examples

Participants will not need computers during class.