DAY ONE
7:30 – 8:00  Registration
8:00 – 8:15  Introductions and Course Logistics
8:15 – 9:00  Overview of Monitored Natural Attenuation
  • Overview of Natural Attenuation
  • OSWER Directive 9200.4-17P
  • Approach for Evaluating MNA from USEPA (1998)
  • Updated Approach for Evaluating MNA/Degradation Pathways/Selecting a Remediation Approach – Flowchart
  • MNA, Biostimulation, and Bioaugmentation
9:00 – 10:00  Overview of Contaminant Fate and Migration
  • Importance of NAPL Source Zone Characterization
  • Non-destructive processes versus destructive processes
  • Non-Destructive Transport Processes – advection, dispersion/diffusion, sorption, volatilization
10:00 -10:15 Break
10:15 – 11:00  Biological Degradation Mechanisms; Natural and Engineered
  • Biological Oxidation - Natural Organic Carbon / BTEX / DCE/VC
  • Biological Reduction - Complete Biological Reductive Dechlorination
  • Enhanced Biological Reductive Dechlorination – Biostimulation / Bioaugmentation
11:00 – 12:00  Abiotic Degradation Mechanisms ; Natural and Engineered
  • Introduction and History
  • General Overview of the Mechanism – Catalyst
  • Biologically-Mediated Abiotic Degradation (BiRD)
  • Zero Valent Iron
12:00 – 1:00  Lunch
1:00 – 2:45  Lines of Evidence for Evaluating Natural Attenuation/Data Requirements
  • 1st Line of Evidence - Historical Data Showing Plume Dynamics – Stable/Shrinking/Growing
  • 2nd Line of Evidence - Evidence for Degradation
  • 3rd Line of Evidence - Microcosms
2:45 – 3:00  Break
3:00 – 5:00  Site Characterization
  • Soil and NAPL Characterization - Vertical profiling, Flute Liners
  • Groundwater Characterization - Characterization Techniques / Vertical profiling / Chemical and Geochemical Analyses
  • Dissolved Oxygen, Nitrate, Fe(II), FeS, Sulfate, Methane, Ethene, Ethane, Compound-Specific Isotope Analyses, Magnetic Susceptibility, Molecular Biological Tools, etc.

DAY TWO
8:00 – 8:45  Introduction to Degradation Rate Constants
  • What Are Degradation Rates?
  • Deconstructing a Degradation Rate into its Components
8:45-10:00  Using BIOCHLOR to Estimate Rate Constants
  • Case Studies
  • General Discussion and Question and Answer
10:00-10:15 Break
10:15-10:45 Using BIOCHLOR to Estimate Rate Constants - Continued
10:45-12:00 Framework/Flowchart for Elucidating Pathways - Step-By-Step Approach for Each of PCE, TCE, DCE, VC
12:00 – 1:00  Lunch
1:00-2:00 Introduction to BioPIC, and Hands on
2:00 – 3:00  MNA Case-Study Workshop
3:00 – 3:15  Break
3:15-5:00  MNA Case-Study Workshop

Note: Workshop facilitated by Todd and supported by representatives from industry and EPA Victoria.
Many regulatory agencies recognize monitored natural attenuation (MNA) as a viable remediation approach, but this alternative must be supported by adequate evidence of its cause and effectiveness. In most cases, this requires that the investigator show not only that contaminant degradation is occurring, but why. Thus, a detailed understanding of degradation pathways and their identification is crucial for evaluating and supporting MNA. In addition, an understanding of site hydrogeology and biogeochemistry, in conjunction with knowledge of degradation pathways, is crucial for evaluating and selecting remediation approaches other than natural attenuation.

This two-day short course provides the conceptual and technical background necessary to evaluate MNA, with particular emphasis on degradation mechanisms and their interaction with source and non-degradative transport processes. Also provided are discussions of remediation technologies such as BiRD, Zero-Valent Iron, and Enhanced Biological Reductive Dechlorination, including both biostimulation and bioaugmentation that rely on the same degradation pathways as natural attenuation. The course will also provide in-depth discussions of data collection and analysis, quantification of contaminant transport and fate processes, and regulatory considerations involved in evaluating MNA as a remedy for groundwater contamination. More specifically, the course presents a systematic approach for evaluating MNA and represents an extension/update of the USEPA (1998) document for evaluating MNA. The new framework relies heavily on estimating degradation rates, and the course will cover this topic in detail. It also incorporates biogeochemical parameters and quantitative information on magnetic susceptibility, biomarker genes, and compound-specific isotope analyses. An Excel®-based tool, BioPIC, was developed to guide users through a decision tree to determine the most efficacious action to meet site-specific remediation goals using MNA, biostimulation, or bioaugmentation. The new framework takes into consideration a site’s biogeochemical profile in addition to site management requirements such as time constraints for regulatory compliance, cost, and risk tolerance. If MNA is the preferred remedial alternative, then BioPIC aids the user in determining site-specific degradation pathways, which often is required to fulfill the requirements of USEPA (1999).

LEARNINGS
Completion of this course will allow you to:

- Understand and Characterize Nonaqueous-Phase Liquid Source Zones
- Understand and evaluate natural attenuation as a remedial alternative
- Develop an appropriate field sampling strategy for cost-effectively evaluating natural attenuation
- Understand the mechanisms of natural attenuation and assess their importance, particularly the importance of degradation mechanisms
- Understand how the same degradation mechanisms that lead to natural attenuation are utilized by many of the popular engineered remediation approaches utilized today.
- Estimate degradation rate constants using solute transport models
- Understand and utilize BioPIC to evaluate degradation pathways
- Present a cogent argument for MNA, if appropriate, or select an alternative bioremediation approach should MNA prove not to be protective of human health and the environment

OBJECTIVES
The go-to document for evaluating monitored natural attenuation (USEPA, 1998) has been updated to include the latest analytical techniques (e.g., molecular biological tools, magnetic susceptibility, and isotopes) and knowledge gained over the last 15. To facilitate implementation of the new approach, a Microsoft Excel-based spreadsheet tool called BioPIC was developed. The objective of this course is to provide the participant the background and hands-on experience required to effectively evaluate degradation mechanisms, thus allowing the user to select the most efficacious bioremediation approach, including monitored natural attenuation. The potential audience includes environmental professionals; state and federal regulators engaged in the remediation of sites contaminated with chlorinated solvents; property developers; and community stakeholders.

The course will be highly interactive and, when completed, the participant will have the tools necessary to accurately evaluate MNA and bioremediation.