

Princeton Groundwater, Inc.

P.O. Box 273776

Tampa, Florida 33688

PRINCETON GROUNDWATER PRESENTS...

**The
Groundwater
Pollution
and
Hydrology Course**

[See Website for Dates and Locations](#)

For more information or brochures, visit our website: <http://www.princeton-groundwater.com> or e-mail: Info@princeton-groundwater.com

Are you a member of the National Ground Water Association? If not, contact NGWA at (800) 551-7379 or ngwa@ngwa.org or visit their website at <http://www.ngwa.org> for information about this organization.



**The
Remediation
Course**

[See Website for Dates and Locations](#)

The Groundwater Pollution and Hydrology Course



Robert W. Cleary
Princeton Groundwater, Inc.

John A. Cherry
University of Guelph

Michael C. Kavanaugh
Geosyntec Consultants

Douglas G. Larson
Geosyntec Consultants

Bernard H. Kueper
Department of Civil Engineering
Queen's University

David Kaminski
QED Environmental Systems

[See Website for Dates and Locations](#)

The Remediation Course



Robert W. Cleary
Princeton Groundwater, Inc.

Bernard H. Kueper
Department of Civil Engineering
Queen's University

Michael C. Kavanaugh
Geosyntec Consultants

Murray D. Einarson
Haley & Aldrich

Douglas G. Larson
Geosyntec Consultants

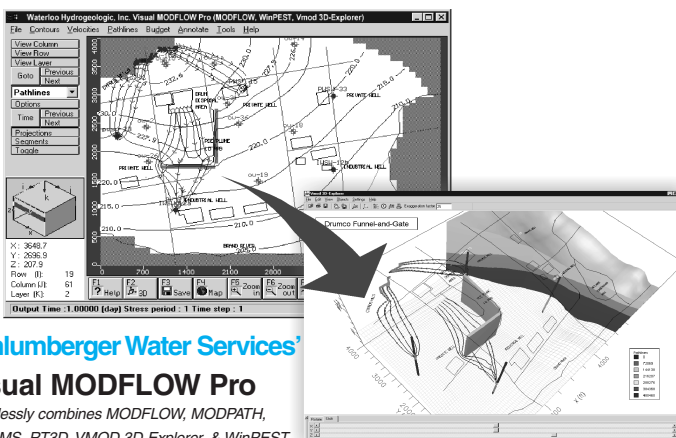
Richard Rago
Haley & Aldrich

[See Website for Dates and Locations](#)

Coordinated by **Princeton Groundwater, Inc.**
P.O. Box 273776
Tampa, Florida 33688-3776
(813) 964-0800
www.princeton-groundwater.com

Course Topics: The Groundwater Pollution and Hydrology Course

- **Overview and Introduction to Groundwater Pollution and Hydrology**
- **Fundamental Concepts of Groundwater Flow and Contamination**
- **Advanced Concepts and Principles of Groundwater Flow, Fate and Transport and Natural Attenuation (Anisotropy, Refraction, Lenses, Non-Horizontal Flow, Hydrodynamic Conditions, Multi-Phase Partitioning, Dispersion, Retardation, Biodegradation, etc.)**
- **Cleanup Goals, Guidelines and Standards in the Current Regulatory Context (RCRA, CERCLA, SARA, and others)**
- **Groundwater Monitoring: Fundamental Principles, Data Quality Objectives, Field/Laboratory Quality Assurance and Quality Control Procedures, Drilling Methods, Monitoring Well Designs, Sampling Devices and Techniques, Preservation and Decontamination Procedures, Data Validation and Interpretation**
- **Remediation Strategies for RCRA, Superfund and Brownfield Sites; Risk Based Decision Making; Use of Models in Technology Selection; Fluid Flushing Technologies; Application of Advanced Treatment Technologies to Aquifers and Unsaturated Zones**
- **Illustrative Case Histories of Groundwater Contamination, Cleanup and Management Costs and Aquifer Restoration Alternatives, including Monitored Natural Attenuation, Bioremediation and Permeable Reactive Barriers**
- **DNAPL's (Dense Non-Aqueous Phase Liquids): Occurrence, Movement and Implications with Respect to Site Monitoring and Remediation in Sedimentary Deposits, Clay Aquitards and Fractured Rock; Concepts Illustrated by Laboratory and Field Experiments with Emphasis on Chlorinated Solvents and Creosote**
- **Ground-Water Monitoring and Sampling Technology: Optimizing Monitoring Well and Screen Placement Through 3-D Site Characterization and Conceptual Site Models; Drilling and Direct-Push Technology for Monitoring Well Installation; Monitoring Well Design, Construction and Development - Chemical Interference Sources; Casing and Screen Materials; Well Screen and Filter Pack Design and Installation; Annular Seals; Surface Protection; Well Development Methods; Ground-Water Purging and Sampling Methods and Equipment - Well-Volume Purging; Low-Flow Purging and Sampling; Sampling Low-Yield Wells; Purging and Sampling Equipment Biases and Limitations**
- **Wellhead Protection under the Safe Drinking Water Act Amendments: Theory and Practice**
- **Theory and Practice of Mathematical Modeling in Groundwater Pollution and Hydrology: Emphasis on Practical Applications**
- **Pumping Tests in Confined, Leaky-Confined and Water Table Aquifers to Determine Aquifer Parameters; Slug Test Methods and Practices; Laboratory and Field Permeameters; Borehole Dilution and Flowmeters to Determine Vertical Velocity Stratification**
- **Fundamental Concepts and Theory of Water and Chemical Movement in the Unsaturated Zone; Laboratory Methods and Field Equipment to Characterize Soils and Sample Water/Gases in the Vadose Zone**
- **Introduction to Popular Software Programs and their Applications in Groundwater Pollution and Hydrology**
- **Field Techniques: Geophysical Methods, Soil Gas Sampling, Soil and Hard Rock Sampling/Coring Techniques, Multi-Level Samplers, Portable Gas Chromatographs, Mini-Piezometers, Seepage Pans to Measure River/Lake Fluxes and Hydraulic Conductivities, Dispersion Coefficient Measurements in the Field, Gasoline Evaluation Equipment, High Resolution Site Characterization Techniques, Geoprobos MIP, EC/HPT, etc.**



Schlumberger Water Services
Visual MODFLOW Pro
*Seamlessly combines MODFLOW, MODPATH,
MT3DMS, RT3D, VMOD 3D-Explorer, & WinPEST*

www.swstechnology.com
Phone: (519) 746-1798

This May Be The Only Groundwater Course You Will Ever Need!

■ The Groundwater Pollution and Hydrology Course

Introduction

Groundwater quality is a national priority issue of immense and ever-growing proportions. The Federal government has passed strict, comprehensive and long-term legislation such as the Resource Conservation and Recovery Act (RCRA), the Superfund Amendments and Reauthorization Act (SARA), the Safe Drinking Water Act and the Pollution Prevention Act. Many state governments have passed even stricter regulations to protect groundwater quality and to clean up currently polluted aquifers.

These laws and regulations affect all sources of groundwater contamination, including chemical industries, gasoline stations, industrial landfills and lagoons, refineries, hazardous solid waste management units, municipal and private solid waste activities, nuclear waste disposal practices, mining practices and pesticide/fertilizer agricultural practices. In addition, many state laws, banks and insurance companies require groundwater quality site assessments before commercial property can be financed or sold. The magnitude and extent of the problem is reflected in EPA's National Priorities List, which now numbers over 1200 sites, with an average cleanup cost of over \$20 million per location. This list grows each year as new sites are added through state and federal groundwater programs.

Hundreds of lawsuits against private industries, such as the Woburn, Massachusetts case involving the leukemia deaths of several children (documented in the book and film, *A Civil Action*), have brought a public awareness and determination which has rarely been seen in past environmental issues involving water and air pollution. A measure of this concern is the vigorously enforced state and federal regulations which cover all aspects of the problem from prevention to cleanup.

The most recent National Research Council's book on the subject ("Alternatives For Managing The Nation's Complex Contaminated Groundwater Sites") was chaired by Dr. Michael Kavanaugh who will lecture on their findings and recommendations.

Groundwater Short Courses

The widespread interest in groundwater has seen the offering of many two- and three-day training courses dealing with various aspects of the problem. There are very few one-week courses. The advantages of a longer course include time to cover and absorb more aspects of this expanding field and the opportunity for in-depth technical learning. Groundwater legislation, natural attenuation, risk assessment, wellhead protection techniques, monitoring equipment, DNAPL research, remediation alternatives and applications of computers adequately cover all these new developments. Most groundwater

have grown to such an extent in the last several years that intensive one-week courses, with a few early evening sessions, are needed to adequately cover all of these new developments. Most groundwater professionals prefer in-depth knowledge that they can apply as soon as they return to work. They also prefer a course notebook which is written and carefully covered in a textbook fashion and which will serve as a familiar guide or resource manual after the course. For those who are willing to take a week out of their busy schedules, the course meets these preferences with unparalleled technical information and applied knowledge.

Course Description

The course is the only one-week course being offered in the U.S. or Europe which comprehensively covers all aspects of groundwater pollution and hydrology from theory to practice. The instructors are recognized as the top six leading experts and teachers in the field and collectively have over 100 years of practical experience. The course is the established standard among groundwater training courses and for this reason has consistently had the largest attendance of all courses offered anywhere in groundwater.

Over 1,200 pages of lecture notes have been written specifically for this course. Practical aspects are particularly emphasized through the study of illustrative case histories of groundwater contamination and remediation developed by Geosyntec Consultants, and others. Based on the results of several hundred projects, these lectures stress a practical approach to cleanup which is acclaimed by industry and regulators alike.

One of the most widespread and difficult problems in groundwater contamination and remediation today is dense non-aqueous phase liquids (DNAPLs). Dr. John Cherry is recognized as one of top researchers in the world dealing with applied research assessment and remediation of DNAPLs. Dr. Cherry will present the basic concepts underlying the occurrence, behavior and movement of DNAPLs in sedimentary deposits, clays, and fractured rocks as well as the very latest field and laboratory results dealing with the difficult problem of DNAPL remediation.

The course will also cover the latest theory and applications of ASTM's RBCA (Risk Based Corrective Action), including Monitored Natural Attenuation and Tiers 1, 2 and 3 in assessing groundwater contamination and establishing cleanup criteria.

Over 1000 slides are shown throughout the entire course. Among groundwater professionals, the Princeton Course is considered a **must course** of outstanding educational value.

■ The Remediation Course

Course Objective

The objective of this course is to teach remediation from the key methodologies to collect hydrogeochemical data, through selecting and designing remediation systems based on geological and biological effects and air/water carriers. In addition, participants will use computers to simulate remediation hydrology, groundwater pathways, capture zones, mass transport, natural attenuation, and alternative remediation designs.

Course Description

Princeton Groundwater's Remediation Course is the most comprehensive course on remediation available. Every aspect of this important subject is covered including three-dimensional hydrogeochemical characterization, indoor air vapor intrusion, practical details of all remediation technologies and computer-simulated remedial alternatives such as Natural Attenuation, Pump & Treat, Funnel & Gate, Interceptor Trenches and complete Hydraulic Containment using barriers and capping. The course also covers many essential topics which are not found in any other courses or books.

For example, most professional hydrogeologists consider heterogeneity to be the single most important factor that influences remedial performance. Many remedial systems have failed because the spatial variability of the site's hydrogeology was not accounted for in the site hydrogeological Conceptual Site Model (CSM).

Throughout the U.S. there are tens of hundreds of examples where poor hydraulic and chemical characterization of an aquifer, source, and plume have resulted in unacceptable remedial performance, yet it is uncommon for these topics to be covered in depth in available remediation courses and books.

Finally, cost effective designs depend on the capability to evaluate the feasibility of many alternatives in a short time. Models are an important tool in this analysis, yet the software packages to do this are not taught concurrently in other current remediation courses.

The Remediation Course uniquely integrates the topics of heterogeneous geohydrology, aquifer / source / plume characterization, remediation technologies / strategies / designs, and computer simulation software. The result is the premier course on remediation.

Course Topics: The Remediation Course

- **Fundamental and Advanced Concepts of Remediation Hydrogeology [Microgeology Effects, Lenses, Non-Horizontal Flow, Anisotropy, Refraction....]**
- **Fundamental and Advanced Concepts of Fate and Transport (Natural Attenuation) of Dissolved Contaminants: Advection, Dispersion, Decay, Sorption, Retardation, Multi-Phase Partitioning...**
- **Field Methods to Determine Remediation Design Hydraulic Parameters: K_h , K_v , K_x , K_y , K_z , S_y , S_s and vadose zone air permeabilities**
- **DNAPL and LNAPL Source Zones and Dissolved Plumes**
- **Limitations and Biases of Traditional Characterization and Monitoring of Dissolved Contaminant Plumes**
- **Flux-Based (Mass Discharge rates) Corrective Action and Remediation Vs. Risk-Based Correction Action (RBCA) Based on Monitoring Well Concentrations**
- **The Remedial Investigation (RI)/Feasibility Study (FS) Process. A Case History Illustrating All Steps**
- **Expedited, High-Resolution Site Characterization Field Equipment and Multilevel Monitoring to Collect 3D Data to Support Mathematic Models and Remediation Designs**
- **Two-Dimensional vs. Three-Dimensional Capture Zones of Contaminant Plumes, Including Tidal Influences**
- **Strategic Approach to Cost Effective Remedial Design: Life Cycle Cost Assessments, Operational Constraints, Risk Based Remedial Decisions, Brownfields Application**
- **Bioremediation: Pathways, Stoichiometry, Kinetics, Engineering Design for In Situ Applications, Limitations and Natural Attenuation**
- **Remediation and Control Using “Water As A Carrier”: The Proper Use of Pump and Treat Systems**
- **Factors Controlling the Performance of Pump and Treat**
- **Monitored Natural Attenuation: Limitations And Applications In Remediation**
- **Remediation Using “Air As A Carrier”: Vapor Extraction Systems, Vacuum Enhanced Systems, Air Sparging Remediation Designs**
- **Ex Situ Treatment Technologies**
- **Principles of Advanced Remediation Systems: Fracturing, Reactive Walls, Waterloo’s Funnel and Gate, Reactive Zones, Phytoremediation and Enhancements To The Basic Carrier Remediation Designs**
- **DNAPL Migration in Heterogeneous Porous Media**
- **DNAPL Movement and Characterization in Fractured Hard Rock**
- **Practical Design and Operation of Soil Vapor Extraction and Air Sparging Pilot Studies Through Detailed Case Histories**
- **Practical Calculations Involving Remediation Designs of Vapor Extraction, Air Sparging Systems and Enhanced Vapor Recovery (High Vacuum)**
- **Permeable Treatment Walls and In Situ Chemical Oxidation**
- **Indoor Air Vapor Intrusion**
- **Ex Situ Treatment Technologies**
- **Use of Water Flooding and thermal Technologies for NAPL Removal**
- **5.0 Hours of hands-on practice with the USGS’s MODFLOW using Schlumberger Water Services’ Visual Modflow**
- **Computer Simulation of Exposure Pathways: for Initial Risk Assessment**
- **Computer Simulation of Capture Zones in Homogeneous and Heterogeneous Aquifers subject to Sources, Sinks and Boundary Conditions**
- **Computer Simulation of Natural Attenuation Accounting for Advection, Dispersion, Sorption and Decay Effects with an Application in Risk-Based Corrective Action (RBCA)**
- **Bioscreen AT. Using the EPA’s and Air Force’s corrected Bioscreen and Natural Attenuation to Establish Remediation Cleanup Goals**

What You Will Learn

- Practical remediation strategies and options drawn from hundreds of case histories.
- The geological and hydrochemical factors applicable to remedial designs for cleaning up soil and groundwater.
- Field methods to fully characterize aquifers, source zones and plumes to allow selection and design of effective remedial measures and set achievable cleanup levels.
- Ability to select remediation systems based on variable hydrogeology, life cycle design, air/water carriers, biodegradation, and monitored natural attenuation for dissolved phase, light and dense non-aqueous phase liquids (NAPLs).
- Strategic approach to cost effective remedial design.
- Hands-on experience with 2D and 3D computer simulations of flow and mass transport for applications in remediation strategies, design and field investigations. Natural attenuation simulations for use in Risk-Based Corrective Action (RBCA) studies.

This May Be The Only Remediation Course You Will Ever Need!



PRINCETON GROUNDWATER PRESENTS ...

The Groundwater Pollution and Hydrology Course

Check Location Desired:

- East Coast: Tampa, FL
 - West Coast: San Francisco, CA
- See Website for Dates and Locations

Princeton Groundwater, Inc.

P.O. Box 273776
 Tampa, Florida 33688
 Phone: (813) 964-0800
 Fax: (813) 925-4353
 E-mail: Info@princeton-groundwater.com
 Website: <http://www.princeton-groundwater.com>

Application

3.5 CEUs

Name _____
Last First Initial

Title _____

Company/Organization Name _____

Business Address _____
Number and Street

City/State/Zip _____

Business Phone _____ FAX _____
Area Code/Number/Ext Area Code/Number/Ext

E-mail address _____

Please help us process your application faster and more efficiently. Write the label code which appears above the name on the address label on the brochure _____

Fax Reservation Check enclosed for \$1,595, payable to **Princeton Groundwater, Inc.**

(813) 925-4353 Card # _____ Code _____ Exp. _____

(Check for \$1,595 and this original application form to follow) Date _____

Cardholder Name _____

Cardholder Billing Address _____

City _____ State _____ Zip _____

Please Cut Along Dotted Line.

Full payment due no later than 2 weeks prior to course.

Princeton Groundwater, Inc. is not affiliated with Princeton University

Who Should Attend

The course is designed for groundwater hydrologists, geologists, engineers, chemists, environmental scientists, state/federal regulators, project managers, compliance/regulatory program managers for industry and technical experts.

The emphasis is on acquiring an extensive working knowledge of the concepts, principles and professional practices underlying groundwater pollution, hydrology and remediation. Although some areas are necessarily surveyed in the interest of time, technical depth is the norm in the majority of sessions. Like any short course, some experience is helpful but not necessary as the course teaches basic principles before dealing with more advanced topics. The course succeeds in significantly enhancing the technical skills of all the participants without losing the neophytes and without boring those with 15 years of practical experience. This is the highest rated course in the industry - no course teaches so much!

Registration and Course Fee

Early registration is strongly advised for this popular course. Enrollment is limited and applications will be accepted in the order they are received. Please mail the attached application form with check or credit card information, purchase order or training authorization. For those requiring time to obtain authorization, we suggest faxing the same application form with payment to follow. Confirmed participants will receive an acknowledgement letter. The registration fee is \$1,595 and is payable in advance. It covers all course materials and coffee breaks. It does not include meals and hotel room expenses. Please make checks payable to *Princeton Groundwater, Inc.* The full fee is due two weeks before the first day of class unless prior arrangements for invoicing have been made. **This fee will be fully refunded if cancellation is received 2 weeks before the course, thereafter 50% of the fee will be refunded.** Substitutions may always be made.

Hotel Accommodations

A block of rooms has been reserved at a substantially reduced rate in both locations. You must, however, make your reservation at least **1 month** before the course, preferably sooner - **the block sells out fast.** Identify yourself as being with the **Princeton Groundwater Course.** On the East coast, the course will be held at Embassy Suites Tampa/USF; the rate is also good 5 days before and after the course, depending on availability; call them at (813) 977-7066. On the West coast, the course will be held at the Hotel Kabuki in San Francisco; call them at (415) 922-3200 or (800) 533-4567.

Course Schedule

The class will meet daily from 8:00 A.M. to 11:30 A.M. and from 1:00 P.M. to 4:30 P.M. Monday through Friday. Monday extends until 6:00 P.M. Half-hour breaks are at 9:30 A.M. and 2:30 P.M. Due to the enormous amount of material, two early evening sessions will be held on Tuesday (5:00 to 8:10 P.M.) and Thursday (5:00 to 6:30 P.M.). The Thursday evening session is a lecture on DNAPLs in fractured rocks and also an open session with Professor Cherry where participants may discuss particular problems and/or the course material. The class ends Friday at 1:00 P.M.

Course Materials and Continuing Education Units

Students will receive over 1,200 pages of lecture notes in an attractive binder. In addition, they will be given a certificate of satisfactory completion and qualify to receive 3.5 Continuing Education Units (CEUs). A record is kept of these units and transcripts may be requested at a later date.



PRINCETON GROUNDWATER PRESENTS...

The Remediation Course

Princeton Groundwater, Inc.

P.O. Box 273776

Tampa, Florida 33688

Phone: (813) 964-0800

Fax: (813) 925-4353

E-mail: Info@princeton-groundwater.com

Website: <http://www.princeton-groundwater.com>

Application

4.1 CEUs

Location:

Las Vegas, NV

Miami, FL

See Website for Dates and Locations

Name _____
Last First Initial

Title _____

Company/Organization Name _____

Business Address _____
Number and Street

City/State/Zip _____

Business Phone _____ FAX _____
Area Code/Number/Ext Area Code/Number/Ext

E-mail address _____

Please help us process your application faster and more efficiently. Write the label code which appears above the name on the address label on the brochure _____

Fax Reservation Check enclosed for \$1,595, payable to **Princeton Groundwater, Inc.**
(813) 925-4353 Card # _____ Code _____ Exp. _____
(Check for \$1,595 and this original application form to follow) Date _____
Cardholder Name _____
Cardholder Billing Address _____
City _____ State _____ Zip _____

Please Cut Along Dotted Line.

Full payment due no later than 2 weeks prior to course.

Princeton Groundwater, Inc. is not affiliated with Princeton University

Who Should Attend

The course is designed for groundwater geologists, engineers, hydrologists, and microbiologists working as project managers, regulators or consultants to industry or government. Some technical background and experience in groundwater contamination problems is presumed. Those who have taken Princeton Groundwater's *The Groundwater Pollution and Hydrology Course* should be well prepared as *this course is the next step*. The emphasis is on acquiring a comprehensive working knowledge of the concepts, principles and professional practices underlying groundwater remediation.

Registration and Course Fee

Please mail the attached application form with check, purchase order or training authorization. For those requiring time to obtain authorization, we suggest faxing the form to reserve your spot early. Confirmed participants will receive an acknowledgement letter. The registration fee is \$1,595 and is payable in advance unless prior arrangements for invoicing or payment have been made. **This fee will be fully refunded if cancellation is received 2 weeks before the course, thereafter 50% of the fee will be refunded.** Substitutions may always be made. The fee covers all course materials, use of computers/software and coffee breaks. The software packages may be purchased separately at a discount for course participants.

Hotel Accommodations

A block of rooms has been reserved at a substantially reduced rate. You must, however, make your reservation at least **1 month** before the course, preferably sooner - **the block sells out fast**. Identify yourself as being with **Princeton Groundwater's**

Remediation Course. The October course is held at the DoubleTree by Hilton Hotel Miami Airport & Convention Center in Miami, FL. The room block will be held until one month before the course -- so you should get your reservation in early to get the special rate. After that date reservations will be taken on a space and rate available, call them at (305) 261-3800. The course in Las Vegas is held at the Orleans Casino Hotel. For Reservations call them at (702) 365-7111

Course Schedule

With some exceptions the class generally meets from 8:00 A.M. to 11:30 A.M. and from 1:00 P.M. to 4:30 P.M. Monday through Thursday with a half-hour coffee break at 9:30 A.M. and 2:30 P.M. and lunch from 11:30 A.M. to 1:00 P.M. After Short breaks at 4:30 P.M.. Monday extends to 6:00 P.M. and Tuesday extends to 7:00 P.M. Due to the exceptional amount of material, after a short break, the class on Wednesday goes to 6:00 P.M., followed by a one hour dinner break and additional lectures from 7:00 P.M. to 9:10 P.M.. The formal part of the course ends Friday at 11:30 A.M.. Friday is an optional hands-on computer laboratory session from 12:30 to 5:30 P.M. Students will be introduced to the practical, remediation applications of Schlumberger Water Services Visual Modflow, and the EPA/Air Force Bioscreen/Bioscreen-AT software packages.

Course Materials and Continuing Education Units

Students will receive over 1200 pages of lecture notes in an attractive binder, including a computer manual which they can use at home to practice the optional 5,0-hour computer modeling course. They will also be given a Certificate of Satisfactory Completion and qualify to receive 4.1 Continuing Education Units (CEUs)