

WHI E-News

Waterloo Hydrogeologic, Inc.

March Edition 2005

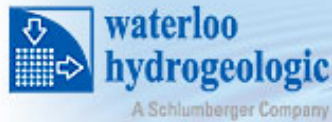
Protecting Groundwater Is Our Business

Press Release

[Waterloo Hydrogeologic
Inc. Acquired by
Schlumberger - Water
Services](#)

Press Release

Waterloo Hydrogeologic, Inc. Acquired by Schlumberger Water Services



Schlumberger

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- » [Contaminated Site Risk
Assessment and
Groundwater Modeling](#)
- » [Aquifer Test Analysis](#)

Product News

Collecting, Analyzing and Reporting Field Data Made Easy *A complete solution for groundwater projects*

Wondering about a complete field collection solution that ties field level investigation with comprehensive software technologies? Need to reduce the time you're spending in the field and more time reporting results? You're not alone!

Common challenges faced by many groundwater projects:

- Time consuming process of manual data collection
- Error introduced during collection and transfer to electronic media
- Data compatibility issues between software used for analysis
- Data transfer from analysis tools to modeling tools



WHI's Comprehensive Solution

Waterloo Hydrogeologic, Inc. (WHI) understands these challenges and offers a complete solution that will save you time, and allow you to focus on reporting your results.

Using [Solinst monitoring equipment](#) to automate the field data collection process, [HydroGeo Analyst](#) to analyze and visualize your groundwater and borehole data, and [Visual MODFLOW Pro](#) to create 3-dimensional flow and transport models, you will be able to save time in the field and focus more on analysis and reporting.

» [Finite Element Groundwater Modeling](#)

» [Water Quality Data Management & Modeling](#)

» [GIS Data Management for Groundwater Modelers](#)

» [Regulatory Review of Hydrogeology Studies](#)

» [The Remediation Course](#)

» [Groundwater Flow and Contaminant Transport Modeling for Risk](#)

Tips & Tricks

» [Transport Model Considerations Volume 2: Properties](#)

Solinst Levelloggers & Telemetry Equipment

- Reduces time in the field via automated water level collection
- Reduces the probability of error during data collection and entry
- Trusted brand of quality groundwater monitoring equipment

HydroGeo Analyst - Groundwater & Borehole Data Management

- All-in-One groundwater & borehole data management software
- A conceptual model builder for Visual MODFLOW models
- Powerful tools for GIS mapping, borehole logging, cross-section interpretations, report preparation, & 3D visualization of site data

Visual MODFLOW Pro - 3D Groundwater & Transport Modeling

- The industry-standard for 3D groundwater flow and contaminant transport modeling
- Import interpreted model layers from HydroGeo Analyst for your groundwater model
- Easy-to-use graphical user interface with many powerful features

Contact a [WHI Sales Representative](#) TODAY for more details on how this complete solution can save you time on your next groundwater project.

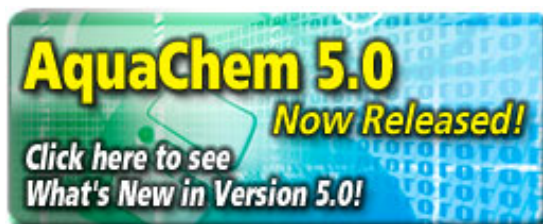


For more information about our software, please visit our website or contact us today:

Website: http://www.waterloohydrogeologic.com/software/software_main.htm

Email: sales@waterloohydrogeologic.com

Phone: (519) 746-1798



**The Professional Choice for
Managing, Analyzing, & Plotting
Water Quality Data!**

AquaChem 5.0 Highlights:

Data Management: Improved options for handling non-detect values following the US E.P.A.'s QA Guidance for Data Quality Assessment, Practical Methods for Data Analysis

Improved QA/QC: Quickly identify whether chemical concentrations exceed solubility or identify concentrations which fall outside the defined natural occurrence interval

Support for MS Excel: Import MS Excel (XLS) files, or export data and reports into a MS Excel spreadsheet format

Support for ESRI™ Files: Import Polyline Shape Files as project basemaps and export station locations with attributes in Point Shape File format for use in GIS

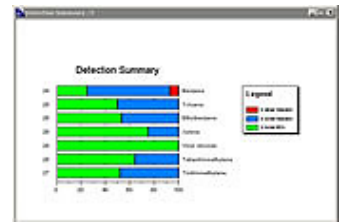
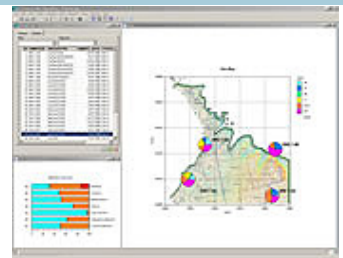
Analysis Plots: Brand new plots including Box & Whisker Time Series, Meteoric Water Line, Quantile Plots, Detection Summary, and Statistical Time Series Charts (with annotations)

Summary Statistics: Define Confidence Intervals, t-Statistics, Percentage Non-Detect, Skewness, Kurtosis, Tolerance Intervals, etc.

Trends Analysis: New Linear Regression, Sen's Test, & Mann-Kendall

Statistical Outlier Test: Dixon's, Discordance, Rosner's, Walsh's

Test for Normality: Studentized Range, Geary's, Shapiro-Wilk, & D'Agostino's



[*Download the AquaChem 5.0 Demo Today!*](#)

For more information, please visit our website or contact us today:

Website: <http://www.waterloohydrogeologic.com>

Email: sales@waterloohydrogeologic.com

Phone: (519) 746-1798



Consulting Services News

Environmental Solutions for Mining

Data Management + Numerical Modeling = Decision Making Tools

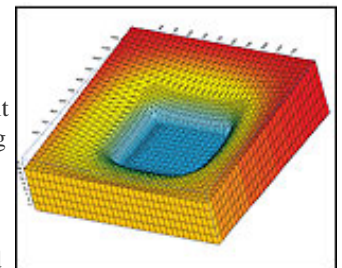
Initiation, operation, and rehabilitation of mining sites present several challenges for hydrogeologists and engineers. Such challenges can include obtaining a sufficient water supply for mine process activities, dewatering or water management activities, wastewater containment and impact analysis. Addressing these challenges requires a thorough understanding of:

- **Geologic setting**
- **Hydrogeologic conditions**
- **Geochemical processes**
- **Engineering requirements/specifications**

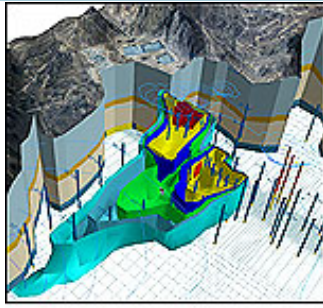
Numerical groundwater and surface water models provide an ideal means for integrating all of these aspects in making reliable business decisions. Waterloo Hydrogeologic offers clients a unique balance of technical expertise and applied experience in both developing and defending groundwater models.

Optimizing Mine Dewatering

Hydrogeologic assessments of mine dewatering are frequently carried out for open-pit and underground mines. Short-term issues facing mine dewatering include optimizing the locations and pumping rates of dewatering wells. Longer-term issues include controlling regional drawdown and the impact on the natural environment including nearby surface water. Our modeling team are experienced in applying 3D flow and transport models for analyzing the effects of mine dewatering for both short-term and longer terms effects.



Modeling Effects of Dewatering



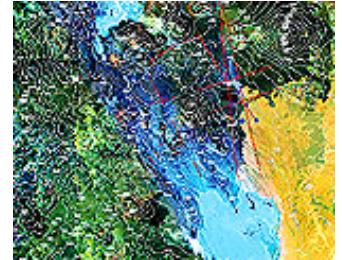
Mine Tailing Impact

Mining Process Water Supply

Groundwater models can provide an essential understanding of the availability of water for mine process activities and the potential for water takings to adversely affect surface water resources. Quantification of all of aspects of the hydrologic cycle is necessary to obtain a rigorous mass balance and effectively evaluate potential impacts. The true advantage of a groundwater model is the ability to optimize water extraction schemes by selecting one that minimizes potential environmental impacts, while maximizing extraction and / or drawdown. A model represents a management tool that can be further refined and applied to manage water and mine waste contamination issues.

Long-Term Geochemical Processes

Along with computing groundwater flow and contaminant mass transport, models can be used to assess how geochemical interactions between the waste stream and the host-rocks may impact the areas surrounding a mine. Recognizing the multi-disciplinary nature of such advanced applications, Waterloo Hydrogeologic's geochemistry specialists are available to provide reliable model predictions.



Site Management in GIS

For more information related to this topic, or if you would like more information about WHI's Consulting Services and capabilities, please visit our website or contact us today:

Website: www.waterloohydrogeologic.com/consulting/consulting_services.htm

Email: consulting@waterloohydrogeologic.com

Phone: (519) 746-1798



Training News

WHI's Line-Up of Environmental & Groundwater Modeling Courses!

The 2005 Waterloo Hydrogeologic Open Enrollment schedule has been set. In response to comments from groundwater professionals who have taken our Groundwater Modeling Courses in the past, and from those who would like to attend courses in the future, WHI has combined the strengths of our previous Groundwater Modeling, Advanced Groundwater Modeling, and Model Calibration courses into one [Applied Groundwater Flow & Contaminant Transport Modeling](#) course. This course includes updated lecture material, as well as new hands-on laboratories to support the new course material. WHI has also created a new short course entitled [GIS Data Management for Groundwater Modelers](#), which teaches the theory and hands-on application of GIS data integration and interpolation to support groundwater modeling efforts, as well as 3-dimensional visualization of modeling results in Visual MODFLOW, HydroGeo Analyst and GIS environments.

Click on the titles below and see which courses are appropriate for you!

- » [Applied Groundwater Flow & Contaminant Transport Modeling](#) - NEW
- » [Groundwater Contamination & Remediation](#) - UPDATED
- » [Finite Element Groundwater Modeling](#) - UPDATED
- » [Aquifer Test Analysis](#) - NEW
- » [Unsaturated Zone Modeling and Evaluation of Landfill Impacts](#) - UPDATED
- » [The Human Health Risk Assessment Course](#) - NEW
- » [Water Quality Data Management & Modeling](#) - UPDATED
- » [Regulatory Review of Hydrogeology Studies](#) - UPDATED
- » [GIS Data Management for Groundwater Modelers](#) - NEW

Who Can Benefit?

- » Experienced hydrogeologists with no prior groundwater modeling experience
- » Regulators who review modeling reports
- » Managers who want to understand what the modelers are doing
- » Experienced modelers who want to enhance their skills
- » Students who want to acquire new skills

- » Lawyers who want to understand some of the technical issues
- » Industry professionals who want to understand more about what their consultants are telling them

For further details on any of these courses, please visit our [website](#), or contact Miln Harvey, WHI Training Manager, at (519) 746-1798 x233.

*Can't make it to one of our Open Enrollment Courses?
Call us about our [On-Site Custom](#) courses designed to suit your specific needs!*

APPLIED GROUNDWATER FLOW & CONTAMINANT TRANSPORT MODELING



Theory and Hands-on Applications using MODFLOW-2000, MODPATH, MT3D & WinPEST

Simple to complex applications of groundwater flow and contaminant transport models are covered in this 4-day hands-on course. Groundwater resource topics include model development and calibration to groundwater heads and flows, new well development, capture zone delineation, well interference, and stream impact investigations. Contaminant transport topics include model development and calibration to contaminant concentration, source area design, concentration boundary choice, solver comparison, and 3D visualization of flow and transport results. This course is ideally suited for hydrogeologists and modelers with some field investigation and modeling experience who wish to advance their modeling knowledge, and whose responsibilities include model development, review, planning, and project management.

Course Objectives and Benefits

- » Apply Visual MODFLOW Pro to 3D groundwater flow and contaminant transport projects
- » Use MODFLOW-2000 to develop several groundwater flow models
- » Calibrate your groundwater models to observed field data
- » Use MODPATH particle tracking features to determine preferential flow paths and delineate capture zones
- » Use ZoneBudget to assess subregional water budgets within your groundwater model
- » Simulate 3D contaminant transport using RT3D, MT3DMS & MT3D99
- » Use WinPEST to improve model calibration and understand model uncertainty

[Vancouver, BC](#)
[March 8 - 11, 2005](#)

[Claveria, Mexico](#)
[April 5 - 8, 2005](#)

[Waterloo, Ontario](#)
[May 24 - 27, 2005](#)

[Delft, Netherlands](#)
[June 7 - 10, 2005](#)

[Register Now](#)

CONTAMINATED SITE RISK ASSESSMENT AND GROUNDWATER MODELING



Transport Processes, Natural Attenuation and Risk Assessment

This course provides a more complete understanding of groundwater contamination and remediation, and the use of fate and transport models and risk assessment software for analysis. Topics that will be covered include contaminant source area characterization, the risk assessment process, the fundamentals of natural attenuation, and risk-based corrective action. This course is suited for groundwater modelers and risk assessors who wish to develop a better understanding of groundwater contamination and remediation, the risk assessment process, and the use of groundwater models to assess risk-based site-specific standards and contaminant remediation.

Course Objectives and Benefits

- » Define the Risk Assessment process and Risk-Based Corrective Action
- » Enhance your understanding of contaminant transport and natural attenuation processes
- » Detail how to quantify the potential risks of exposure to

[Madrid, Spain](#)
[March 8 - 11 2005](#)

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- chemical contaminants
- » Link fate and transport models to risk-based decision making models
- » Quantitatively assess human health and ecological risk from environmental contaminants
- » Define site-specific target levels (SSTLs) for site clean-up goals

AQUIFER TEST ANALYSIS



Principles of Pumping Test Design and Techniques for Data Analysis

A wide variety of techniques can be applied to analyzing aquifer tests. This course covers the theory behind the techniques and provides an opportunity to obtain hands-on experience in analyzing aquifer test data collected from a variety of conditions.

Course Objectives and Benefits

- » Planning a pumping test
- » Principles of aquifer test analysis
- » Porous and fractured media
- » Isotropic/anisotropic conditions
- » Confined, leaky, and unconfined aquifers

[Waterloo, Ontario](#)
[July 13 - 14, 2005](#)

[Register Now](#)

FINITE ELEMENT GROUNDWATER MODELING



Advanced Applications for Saturated/Unsaturated Flow & Transport, Density-Dependent Flow, and Heat Transport

Advanced applications of groundwater flow and contaminant transport models using the Finite Element method are covered in this 4-day hands-on course. This course provides a more complete understanding of the use and applicability of finite elements in groundwater modeling, and includes such topics as groundwater flow and transport modeling, principles of unsaturated flow, fracture flow modeling, thermal transport, and density-dependent flow modeling. This course is ideally suited for groundwater modelers who wish to advance their modeling knowledge, and apply finite elements-using FEFLOW- to more complex modeling designs.

Course Objectives and Benefits

- » Understand when to use finite-element vs. finite-difference modeling
- » Apply FEFLOW to 3D groundwater flow and contaminant transport problems
- » Simulate unsaturated zone flow using FEFLOW
- » Simulate density-driven groundwater flow (e.g. saltwater intrusion) using FEFLOW
- » Simulate fracture flow modeling using FEFLOW, and compare to a research case study
- » Introduce the Interface Manager and the concept of model calibration to observed field data

[Waterloo, Ontario](#)
[March 15 - 18, 2005](#)

[Waterloo, Ontario](#)
[Sept 13 - 16, 2005](#)

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REGULATORY REVIEW OF HYDROGEOLOGY STUDIES



Approaches and Insights for Reviewing Modeling Reports

The overall objective of this course is to give regulators a greater understanding of how models work, and what to look for when reviewing a modeling report. Specifically, the objectives are as follows:

- » To understand the uses and applications of numerical models
- » To understand the uses and applications of the analytical WHPA model
- » To have a practical basis for reviewing models
- » To identify the points of focus for reviewing a modeling study
- » To recognize when review by a specialist is required.

The content of this course will be applicable to the following areas:

- » Alternatives for landfill or septic system design
- » Prediction of contaminant movement and impact from landfills, septic systems, and contaminated sites
- » Selection of remediation alternatives
- » Delineation of well capture zones and groundwater protection areas
- » Assessment of impacts from large groundwater extractions, and pit and quarry development in the context of the Permit To Take Water Program (PTTW) and groundwater interference investigations.

These applications could include review of modeling studies submitted by consultants, evaluation of workplans submitted by owners/proponents, and specification of modeling requirements for tendering hydrogeological studies.

[Waterloo, Ontario](#)
[April 26 - 29, 2005](#)

[Register Now](#)

WATER QUALITY DATA MANAGEMENT & MODELING



Applications using AquaChem and USGS PHREEQC

The large quantity and range of environmental groundwater data types presents a challenge to professionals who wish to develop a comprehensive interpretation of a suite of data. This course provides hands-on experience in temporal and spatial data interpretation, including the use of convenient computer software for organizing and plotting the data.

- » Planning a data collection program
- » Interpreting temporal and spatial data densities
- » Quality control issues
- » Applied geochemical modeling
- » How to use AquaChem

[Waterloo, Ontario](#)
[April 13 - 14, 2005](#)

[Waterloo, Ontario](#)
[Sept 21 - 23, 2005](#)

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GIS DATA MANAGEMENT FOR GROUNDWATER MODELERS



Understanding Data Sources, Data Analysis and Visualization

This 3-day hands-on course presents an introduction to the management and analysis of groundwater data for Visual MODFLOW modelers. Topics include the data types used in groundwater models, the coordinate systems, datums and map projections in a GIS, the interpolation of data within the GIS (kriging, natural neighbor analysis, ...), the development of model layers (cross-sectional analysis of site hydrogeology) and parameter fields for groundwater model construction, and the import and export of different types of data from the GIS system to the groundwater model and back to the GIS system. Other topics that will be covered include 2-D and 3-D visualization of model input and model output. This course is ideally suited for groundwater modelers who wish to develop a comprehensive understanding of the sources of data that are used in groundwater models, the interpolation of this data for modeling, and the interchange of information between the groundwater model and the GIS system.

[Waterloo, Ontario,](#)
[March 29 - 31, 2005](#)

[Register Now](#)

Course Objectives and Benefits

- » Understand the integration between the GIS system and Visual MODFLOW

- » Assess the applicability of MapInfo, Surfer and HydroGeo Analyst for developing a GIS
- » Use HydroGeo Analyst to develop model cross-sections and layer interfaces
- » Use HydroGeo Analyst to interpolate layer elevations and export them to Visual MODFLOW
- » Export Visual MODFLOW results to GIS and prepare report figures
- » Develop animation files of Visual MODFLOW results and insert them into client presentations

THE REMEDIATION COURSE



Princeton Groundwater's Remediation Course is the most comprehensive course on remediation available. Every aspect of this important subject is covered, from three-dimensional hydrogeochemical characterization, through practical details of all remediation technologies, to 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. 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 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.

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.

[Denver, CO](#)
[March 14 - 18, 2005](#)

[Register Now](#)

Groundwater Flow and Contaminant Transport Modeling for Risk

This 4-day hands-on groundwater modeling and risk assessment course provides the bridge between the risk assessment process for contaminated sites and groundwater modeling, which is used to assess the amount of contamination. The first 3 days consist of groundwater flow and transport modeling topics, which include model development, model calibration using groundwater heads and concentrations, well impact assessment, source area design, choice of appropriate concentration boundary conditions, comparison of transport solvers and 3D visualization of flow and transport results. The last day of the course is dedicated to introducing the Risk Assessment process and the place of groundwater modeling within it, which includes an introduction to data collection and evaluation, exposure assessment, toxicity assessment and risk characterization. Attendees will also gain a more complete understanding of Risk-Based Corrective Action for contaminated site management. This course is ideally suited for hydrogeologists and modelers with some knowledge of field investigation and groundwater modeling who wish to advance their modeling knowledge, and whose responsibilities include model development, review, planning and project management.

Course Objectives and Benefits

- » Apply Visual MODFLOW Pro to 3D groundwater flow and contaminant transport projects
- » Use MODFLOW-2000 to develop several groundwater flow models as part of hands-on laboratory exercises
- » Simulate 3D contaminant transport using MT3D and RT3D
- » Enhance your knowledge of contaminant transport and natural

[Santiago, Chile](#)
[Sept 27 - 30, 2005](#)

[Register Now](#)

- attenuation processes in the groundwater environment
- » Linking fate and transport models to risk-based decision-making models
 - » Understand the Baseline Risk Assessment process and Risk-Based Corrective Action (RBCA)
 - » Understand data collection and site characterization issues for risk assessment modeling
 - » Increase your ability to make environmental decisions on risk assessment
 - » Define potential exposure risks to chemical contaminants
 - » Discuss how to establish site-specific clean-up levels for remediation
 - » A complete set of course lecture notes and lab exercises



[For our full 2005 training schedule, click here!](#)



[To request your free 2005 Training Course Schedule Catalog, click here!](#)

For more information about our course offerings, visit our website or contact us today:

Website: www.waterloohydrogeologic.com/training/training.htm

Email: training@waterloohydrogeologic.com

Phone: (519) 746-1798



Tips & Tricks

Transport Model Considerations Volume 2: Properties

Waterloo Hydrogeologic's Technical Support department presents the second of two articles highlighting the Contaminant Transport component of [Visual MODFLOW](#).

Along with defining the sources of contaminants in your model (see Volume 1: Boundary Conditions), it is important to consider the Transport Properties of your model:

Bulk Density:

The Soil Bulk Density is used to calculate the Retardation Coefficient for each chemical species. The Retardation Coefficient is used to calculate the 'retarded' flow velocity of each chemical species. The retarded flow velocity is used to calculate the advective transport of each species.

The options available for customizing the Soil Bulk Density values will depend on the Transport Engine selected for the current transport variant.

Model Parameters:

This is only available for models where RT3D is the selected Transport Engine and the Reaction Parameters are Spatially variable (these settings are specified during the setup of the Transport Engine). Here you can define the soil Bulk Density and other reaction parameters (decay rates, reaction rates, yield coefficients, etc.) required for the selected Reaction model (the parameters required for each reaction model are described in Appendix C of your Users Manual).

Species Parameters:

Here you can specify the sorption and reaction parameters used by the selected Transport Engine. Each of the Transport Engines can handle a different set of sorption methods and reactions, so the options for customizing the sorption and reaction parameters will depend on which Transport Engine is selected for the current Transport Variant (see Appendix C of the Users Manual for a summary of the available sorption options for each Transport Engine). Some of the parameters that may need to be defined include: Distribution Coefficients (Kd), and first order reaction rates for the dissolved phase and for the sorbed phase.

Initial Concentration:

In many cases, the historical conditions of the site are unknown, and the contaminant source has been removed or remediated. However, the groundwater contamination is still present and the mass transport simulation must be run forward in time, starting from the existing conditions, to predict the potential downstream impacts. Here you can define the existing conditions (background groundwater concentrations) of each chemical species being simulated. Initial concentrations can be defined using the .ucn file from a previous simulation.

Dispersion:

Dispersion is a physical process that dilutes, or spreads, the contaminant mass in the X, Y and Z directions along the advective path of the plume, reducing the solute concentration. Dispersion is caused by the tortuosity of the flowpaths of the groundwater as it travels through the interconnected pores of the soil.

MT3D calculates the Dispersion tensor for the mass transport model using the following parameters:

- Longitudinal Dispersivity for each transport grid cell
- Ratio of Horizontal to Longitudinal Dispersivity for each layer
- Ratio of Vertical to Longitudinal Dispersivity for each layer
- Molecular Diffusion Coefficient for each layer

For more information about WHI's Environmental Information Technology (EIT) services:

Email: techsupport@waterloohydrogeologic.com

Web: <http://www.waterloohydrogeologic.com/support.htm>

Thank you for reading this month's edition of WHI E-News! For more information about our products and services please use the links below!

[Visit our Website](#) - See what Waterloo Hydrogeologic Inc. has to offer!

[Software Division](#) - Check out our groundwater modeling software.

[Consulting Division](#) - Visit our Consulting Division on the web to see how we can help you.

[Training Division](#) - Visit our Training Division on the web to find a course in your area.

[Equipment Division](#) - WHI is now selling groundwater monitoring equipment.

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hydrogeologic**

A Schlumberger Company

Waterloo Hydrogeologic, Inc.

Website: www.waterloohydrogeologic.com

Email: info@waterloohydrogeologic.com

Phone: 519-746-1798 Fax: 519-885-5262

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