

2004 January Edition

WHI E-News Topics

Product News

- » [Multi-User License Discounts!](#)

Consulting News

- » [Watershed-Scale Water Budget Modeling](#)

Training News

- » [WHI Now Offering a New Line-Up of Environmental & Groundwater Modeling Courses!](#)
 - » [Applied Groundwater Flow & Contaminant Transport Modeling](#)
 - » [Groundwater Contamination & Remediation](#)
 - » [Finite Element Groundwater Modeling](#)

Tips & Tricks

- » [Understanding Field Data Integration with Visual MODFLOW](#)

Waterloo Hydrogeologic, Inc. is a recognized leader in the development and application of environmental software and services.



[See below for more details!](#)

Product News

Multi-User License Discounts!

The trends are clear - the environmental industry has entered a new period of growth where the demands on high-tech environmental software solutions have increased dramatically. Like many of our users, you're probably faced with balancing this increase in project demands with constantly increasing project costs.

In an effort to help our clients meet project deadlines and reduce project costs, WHI has developed a MULTI-USER LICENSE discount policy.






WHY MULTI-USER LICENSES?

- » Expand your workload capabilities and get more accomplished
- » Optimize billing time per project by performing simultaneous model runs
- » Resources are available to allow for increased project capacity
- » Improved version control between users, and satellite offices
- » Better position to grow your organization to meet future demands
- » Major cost savings for new licenses and future upgrades

GETTING ON TRACK WITH OUR PREFERRED PAYMENT PLAN

WHI is committed to helping organizations cope with the costs of upgrading existing license agreements to multi-user agreements through our new Preferred Payment Plan. Our plan is specifically designed to reduce your initial cost burden, and get you working with the tools you need NOW.

Ask us for a no-obligation price quote by calling (519) 746-1798 TODAY!

MULTI-USER LICENSE SAVINGS CHART					
Number of Software Copies				 x5	 x10
Consultants	13%	17%	32%	40%	50%
Government	15%	33%	44%	50%	60%
Education	NA	NA	NA	85%	90%

% represents savings per license based on number of copies purchased



Save on These Popular Packages!

- [Visual MODFLOW Pro](#)
- [Visual MODFLOW MT3D99](#)
- [Visual Groundwater](#)
- [AquiferTest Pro](#)
- [AquaChem](#)
- [Visual HELP](#)
- [WHI UnSat Suite](#)
- [Enviro-Base](#)
- [RISC WorkBench](#)
- [Visual PEST-ASP](#)
- [FLOWPATH II](#)
- [FRACTRAN](#)
- [GW-Base](#)
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For more information about our software, please visit our website or contact us today:

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

Email: sales@waterloohydrogeologic.com

Phone: (519) 746-1798

▲ TOP

Consulting News

Watershed-Scale Water Budget Modeling

A key component of a water resource management plan is developing an understanding of the groundwater system, and quantifying the volume of water flowing through a watershed. Managers of urban planning and development require a solid knowledge of potential impacts of development on the quantity, and quality, of water, to evaluate the sustainability of development from the perspective of water availability, and ecosystem function.

The question often raised is:

"How much water is available?"

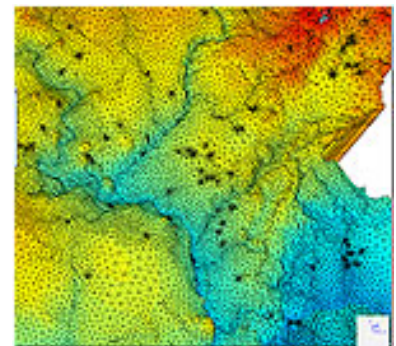
Unfortunately, this is generally the wrong question to ask, since any water removed from a watershed will impact some point(s) downstream. The question should instead be:

"What impact(s) will result if we withdraw a given amount of water?"

As many researchers have pointed out (Theis 1940, Sophocleous, 1997, and Bredehoeft 1997), this question cannot be answered by simply examining recharge.

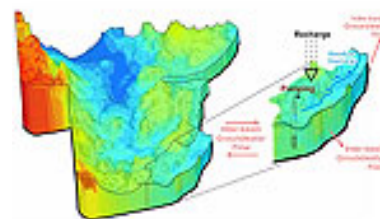
Progressive water management districts in Ontario (Conservation Authorities), who have historically used surface water models for flood control, are now coupling to regional-scale groundwater models to better quantify and manage water resources. Waterloo Hydrogeologic Inc. has been instrumental in developing many large-scale groundwater models, and linking them to existing surface water models such as GAWSER and HSPF. Our experience has been that an iterative linkage between surface and groundwater models, coupled using exchange fluxes, is a good approach to source water protection and water resources management. This approach utilizes the best available tools for both surface and groundwater studies.

At Waterloo Hydrogeologic Inc. we utilize both MODFLOW and FEFLOW to complete groundwater modeling projects at a variety of scales, and both modeling codes work well for establishing water budgets. FEFLOW (finite element method) offers the added bonus of



providing more detailed simulations of small-scale features within the watershed, by utilizing efficient discretization techniques. The finite element method facilitates local-scale refinement around wells and river features, allowing more detailed simulation of groundwater/surface water interaction, and local drawdown cones.

For more information regarding Waterloo Hydrogeologic's experiences in developing watershed-scale water budget models and coupling with surface water models, please contact our [consulting division](#).



If you would like more information about WHI's Consulting activities and capabilities, 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 Now Offering a New Line-Up of Environmental & Groundwater Modeling Courses!

The 2004 schedule for Waterloo Hydrogeologic's Training Course Series has been set. In response to comments from groundwater professionals who have taken our Groundwater Modeling Courses in the past, and 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 will include 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 both the Visual MODFLOW 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 of 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 their 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; and
- » 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 one of our Open Enrollment Courses? Call us about our On-Site Custom courses designed to suit your specific needs!

Upcoming Professional Courses

Dates/Locations

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 and MT3D99
- » Use WinPEST to improve model calibration and understand model uncertainty

[Waterloo](#)
[February 3 - 6, 2004](#)

[Vancouver](#)
[March 23 - 26, 2004](#)

[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 to analyze it. 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 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

[South Africa,
March 30 - Apr 2, 2004](#)

[Brazil
Apr 13 - 16, 2004](#)

[Belgium
Apr 27 - 30, 2004](#)

[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,
Apr 6 - 9, 2004](#)

[Register Now](#)

 [For our full 2004 training schedule, click here!](#)

 [To request your free 2004 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

 [TOP](#)

Tips & Tricks

Understanding Field Data Integration with Visual MODFLOW

A recurring question that both Visual MODFLOW users and Visual MODFLOW course participants have is this: How do I get my field data into Visual MODFLOW? Over the next several months, the Tips and Tricks section will present articles on field data collection and how to incorporate field data into a Visual MODFLOW flow and transport model. This month we will cover soil property data.

Volume 1: Collecting and Entering Soil Property Data

A Visual MODFLOW flow model requires the following inputs for soil properties:

- Conductivity (K_x , K_y , K_z)
- Storativity (S_s , S_y)
- Porosity (Effective Porosity, Total Porosity)

For a transport model, these additional soil properties are required

- Distribution Coefficient (KD) (if decay is considered in the reaction)
- Longitudinal Dispersivity
- Bulk Density

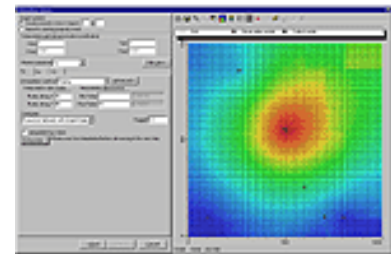


Figure 1

Soil conductivity can be determined in several ways; quite often, the project budget dictates which method is used. The following are some common methods:

- Grain Size Analysis - Hazen Method (used only for sandy soils)
- Permeameter Tests
- Slug / Bail Tests
- Pumping Test

If the conductivity is calculated using one of the first three methods, this will result in point observations. Though these methods are typically the least expensive, they are generally not the most accurate. With WHI's [AquiferTest Pro](#) software, you can utilize one of the popular Slug/Bail Test analysis methods (Bouwer-Rice, Hvorslev, or Cooper-Bredehoeft-Papadopoulos) to determine the conductivity value, with time-drawdown data from a slug or bail test.

If a GIS tool is available (such as MapInfo or ArcGIS), the conductivity points may be imported and interpolated to create a line or point shape file. This shape file can then be imported to create distributed conductivity zones in Visual MODFLOW. If a GIS tool is not available, then the point observations can be stored in an Excel spreadsheet, MSAccess database, or simple text file, and brought into Visual MODFLOW in one of these formats. Visual MODFLOW is capable of importing conductivity data from .TXT, .SHP, .XLS, .GRD, and .MDB. Using the Import and Interpolate options in Visual MODFLOW, these points may be input and interpolated (using Kriging, Natural Neighbor, or Inverse Distance interpolation routines) to produce distributed property zones. The image shown in *figure 1* displays the interpolation results for conductivity values observed at 7 observation well locations.

Once the data is imported and interpolated, the distributed zones are created, as shown in *figure 2*

Finally, the resulting property distribution is saved back to the Visual MODFLOW grid, to create 10 property zones, as shown here in *figure 3*

Data for Storage, Storativity, and Porosity may also be imported using the same procedure.

Alternately, if the project budget permits, one or more pumping tests may be conducted at the site to produce a more accurate representation of the conductivity. Once again, with WHI's [AquiferTest Pro](#) software, you can use one of the popular analysis methods (Theis, Cooper-Jacob, Hantush, etc.) to calculate the conductivity, storage, and/or storativity for an entire region of your model domain, based on time-drawdown data from a pumping test with one or more observation wells. The conductivity can then be assigned to an entire layer, using the **Assign > Window** option, as shown in *figure 4*

For Soil Transport Parameters, the properties for KD, Dispersion, and

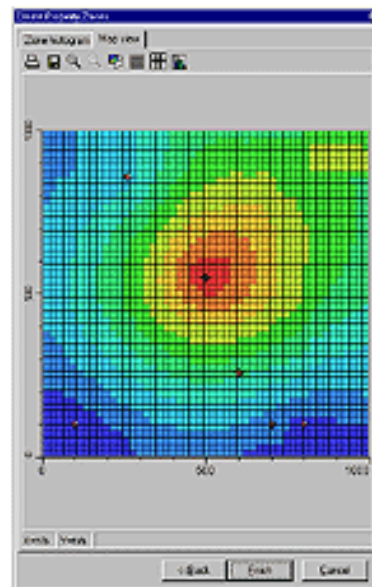


Figure 2

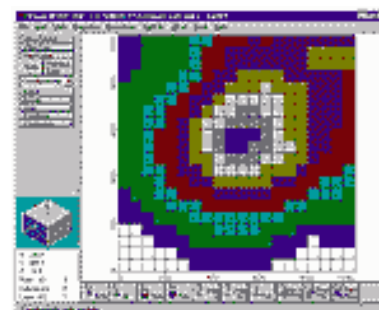


Figure 3

density may be defined in the model using the **Assign > Single**, **Polygon**, or **Window** option.

As you can see, [Visual MODFLOW](#) provides flexibility and easy to use functions, tailored to your project needs.

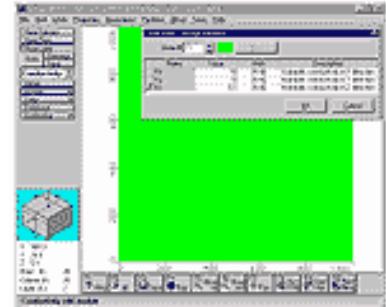


Figure 4

[Learn more about
Visual MODFLOW Pro](#)

For more information about this tip, contact us at:

Email: techsupport@waterloohydrogeologic.com

For more information about [Visual MODFLOW](#) , visit our website or contact us today:

Website: http://www.waterloohydrogeologic.com/software/visual_modflow_pro

Email: sales@waterloohydrogeologic.com

Phone: (519) 746-1798



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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