

2004 March Edition

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Tips & Tricks

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



**Check out this month's
specials on Solinst Field Equipment &
WHI Software!**

**Call for
Guest
Columnists!**

[We want your articles! Please send your groundwater
related article to us today!](#)

Product News

Cost Savings on Solinst Field Equipment

Let Waterloo Hydrogeologic, Inc. (WHI) help you get a jump-start on the 2004 field data collection season with discounts on world class Solinst field equipment. WHI carries a variety of [level measurement devices](#), [dataloggers](#), [groundwater samplers](#), [interface meters](#), and [telemetry systems](#), designed to make your field season run smoothly. When you return from the field, you can analyze and display your data quickly with easy-to-use software from WHI.

[Leveloggers](#) are used by water professionals around the world, to collect real-time information for analysis of short and long-term water level trends. Leveloggers are perfectly partnered with WHI's [AquiferTest](#) and [Visual MODFLOW](#) software.

Use a Levelogger when...

- recording water levels in monitoring and production wells
- performing pump and slug tests to determine aquifer properties
- monitoring water levels in boreholes, lakes, rivers, tanks, and harbours

[AquiferTest](#) can now directly import your Levelogger readings for quick and easy analysis of your aquifer's hydraulic conductivity, storativity, or transmissivity. You can then use these values directly within [Visual MODFLOW](#) to develop a realistic groundwater model in minutes.

Buy [Visual MODFLOW](#) and/or [AquiferTest](#) with a [Levelogger](#) this month, and SAVE 10% on each [Levelogger](#)!

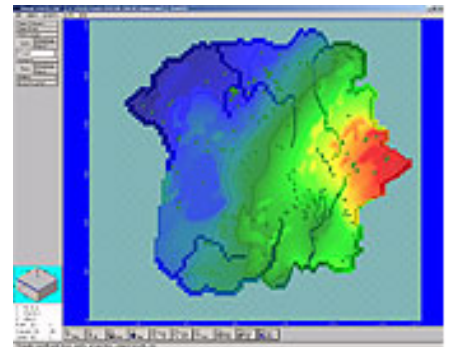
The Solinst [Peristaltic Pump](#) is ideal for sampling work in shallow wells and surface water. You can also utilize the pump for pressure delivery of liquids or gases. When you combine it with [AquaChem](#), you create a powerful and complete system for water quality data analysis, plotting, reporting, and modeling.

Use a Peristaltic Pump to...

- Sample surface water for bacteria levels in retention ponds
- Sample, analyze, and report water quality data from municipal groundwater supply wells
- Collect samples for identifying concentrations exceeding guideline limits at contaminated sites



[Leveloggers & AquiferTest](#)



[Visual MODFLOW](#)



[Peristaltic Pump](#)

When you buy [AquaChem](#) this month,
GET 10% off the price of a [Peristaltic Pump](#)!

For measuring the depth of water in wells, boreholes and standpipes, the [Model 101 Water Level Meter](#) is the most accurate and reliable of the Solinst Meters. It's easy operation, and ability to read depths within 1/100 of a foot, makes it a favourite of many field technicians. Use the popular [Surfer](#) software package to model your water level data both quickly and easily. [Surfer](#) is recognized as the most comprehensive software package for data interpolation, gridding, contouring and mapping. Creating concentration, layer, or water-table elevation contour maps in a snap!

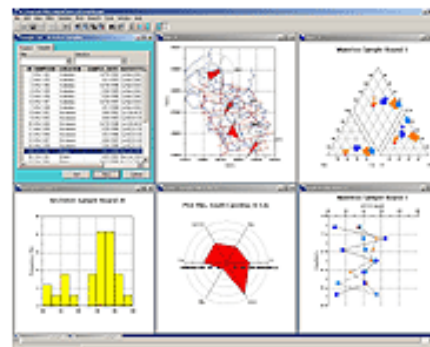
During the month of March, when you purchase [Surfer](#), you can also save 10% on the purchase of a [Water Level Meter](#).

The [Model 122 Interface Meter](#) is an invaluable tool when it comes to measuring product levels and thickness in the field. Use the [Interface Meter](#) to measure both floating non-aqueous liquids (LNAPL) and sinking non-aqueous liquids (DNAPL) easily. Model your results with WHI's [Visual Groundwater](#) software package to give you 3D results of product thickness, shape and extent of the plume.

Use the **Interface Meter** in...

- Hazardous sampling locations (Class I, Groups C&D) where there are explosive environments such as service station remediation
- Situations where you need access through narrow wells or openings into tanks

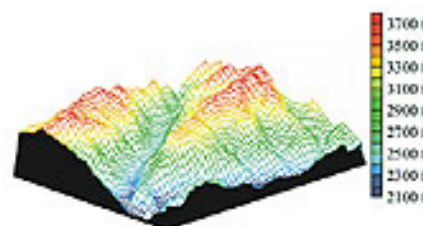
Order [Visual Groundwater](#) in March and receive 10% off the price of an [Interface Meter](#) for your field data collection needs!



[AquaChem](#)



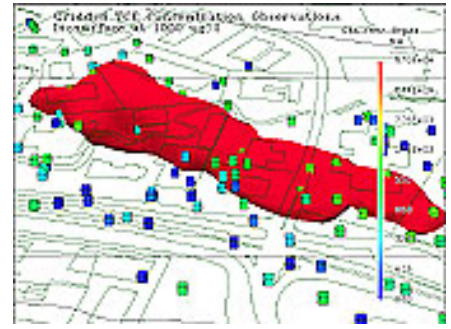
[Model 101 Water Level Meter](#)



[Surfer](#)



[Model 122 Interface Meter](#)



[Visual Groundwater](#)

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

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Email: sales@waterloohydrogeologic.com

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▲ TOP

Consulting News

Developing Source Water Protection Capacity in the North Bay - Mattawa Groundwater Study

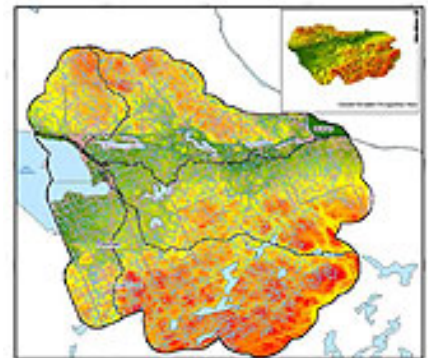
Managed by the North Bay - Mattawa Conservation Authority (NBMCA), the study area is located in central Ontario, 300 km north of Toronto. Groundwater is an important water source for urban and rural residents in the NBMCA. Groundwater also augments dry weather river flows, and sustains many wetland ecosystems within the area.

The Challenge:

The NBMCA has a number of water management concerns for the study area, including:

- the susceptibility of the groundwater system to potential contamination. A variety of potential groundwater contamination risks have been identified, including improperly constructed or abandoned water wells, septic systems, fertilizers and pesticides, road salt, landfill sites, and historic land use.
- the recharge areas for study area water supply wells. In addition to rural residents, two communities in the study area derive their drinking water from groundwater sources. Identifying the recharge areas is required to protect municipal water supplies.

The Solution:



Ground Surface Elevation Mapping

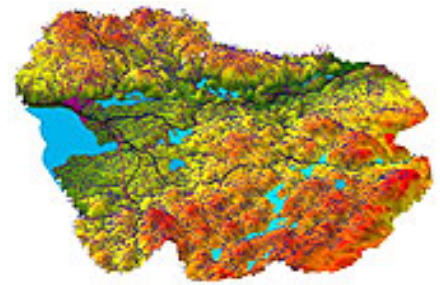
In recognition of these challenges, the NBMCA has contracted a watershed-scale study, and awarded the project to WHI's multi-disciplinary team of specialists. The study will improve understanding of the watershed's hydrogeology, and provide the basis for a recommended watershed and source protection management plan that addresses quantity and quality of groundwater within the watershed. As a main partner on this study, the Ontario Ministry of the Environment (MOE) is providing financial and technical assistance. The MOE will also provide a significant amount of data to support the analyses of groundwater resources within the study area.

The Objectives of the NBMCA Groundwater Study include:

- Characterize groundwater distribution and aquifers throughout the region;
- Delineate Wellhead Protection Areas (WHPAs) for all municipal groundwater supply wells;
- Complete a potential contaminant sources inventory and assessment of potential for aquifer contamination within the WHPAs;
- Quantify the groundwater uses throughout the area, and establish a regional water budget;
- Develop a groundwater protection plan to help ensure a clean, safe, water supply in the future.

Additional information about the North Bay - Mattawa Groundwater Study is available at the project web site, www.nbmcagroundwaterstudy.on.ca.

For additional information regarding Waterloo Hydrogeologic's experiences during this project, please contact [Alge Merry](#).



3D Perspective of Ground Surface



Visit our Study Website for
More Information

www.nbmcagroundwaterstudy.on.ca

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

Upcoming Professional Courses

WHI Now Offering a New Line-Up of Environmental & Groundwater Modeling Courses!

The 2004 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 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 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; 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!

Course Title

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

Dates/Locations

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

[Budapest, Hungary](#)
[May 10 - 13, 2004](#)

[Tokyo, Japan](#)
[May 11 - 14, 2004](#)

[Waterloo, Canada](#)
[June 1 - 4, 2004](#)

[Rome, Italy](#)
[June 22 - 25, 2004](#)

[Johannesburg, South
Africa](#)
[June 22 - 25, 2004](#)

[Lyon, France](#)
[June 29 - July 2, 2004](#)

[Buenos Aires, Argentina](#)
[July 5 - 8, 2004](#)

[Cambridge, UK](#)
[July 27 - 30, 2004](#)

[Waterloo, Canada](#)
[Sept 14 - 17, 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 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 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

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

[Gent, Belgium](#)
[April 27 - 30, 2004](#)

[Madrid, Spain](#)
[June 8 - 11, 2004](#)

[Waterloo, Canada](#)
[August 10 - 13, 2004](#)

[Ostrava, Czech Republic](#)
[Sept 7 - 10, 2004](#)

[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, Canada](#)
[May 12 - 14, 2004](#)

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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, Canada](#)
[April 5 - 8, 2004](#)

[San Francisco, CA](#)
[June 15 - 18, 2004](#)

[Register Now](#)

THE HUMAN HEALTH RISK/ASSESSMENT COURSE



Practical Approaches to Estimating Risk & Developing Site-Specific Target Levels

An introduction to the use of RISC Workbench for completing human health risk assessments is covered in this 2-day course of lectures and hands-on exercises. Topics that will be covered include hazard identification, exposure assessment, dose-response assessment and risk characterization. Lectures and exercises will be presented in partnership with Lynn Spence, the developer of RISC Workbench. This course is suited for risk assessors who wish to develop a better understanding of the risk assessment process and the use of groundwater models and RISC Workbench software for completing a human-health risk assessment.

Course Benefits

- » Learn the fundamentals of accepted risk assessment protocols
- » Acquire lots of hands-on experience using the RISC Workbench software
- » Understand the practical aspects of conducting a risk assessment
- » Learn from an experienced risk assessment professional with worldwide experience

[San Francisco, CA](#)
[June 21 - 22, 2004](#)

[Cambridge, UK](#)
[August 2 - 3, 2004](#)

[Register Now](#)

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.

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

[Waterloo, Canada](#)
[August 17 - 18, 2004](#)

[Register Now](#)

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, Canada](#)
[Sept 21 - 24, 2004](#)

[Orlando, Florida](#)
[Sept 28 - Oct 1, 2004](#)

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Email: training@waterloohydrogeologic.com

Phone: (519) 746-1798

Tips & Tricks

Troubleshooting AquiferTest problems

This month's tips and tricks article addresses some of the common problems that [AquiferTest](#) users encounter. Four issues will be discussed:

1. What input parameters are required for a pumping test?
2. How to handle single well pumping tests?
3. How many data points do I need to enter?
4. How are variable discharge rates treated by AquiferTest?

1. What input parameters are needed?

In AquiferTest, there are fields for well location and geometry, aquifer dimensions, pumping rates, and water level measurements. If you are doing a pumping test with multiple wells, you need to enter unique X and Y coordinates for each well, so that the program may calculate the radial distance from the monitoring well to the pumping well. However, the well geometry values (r , R , L , and b) are only required for a few analysis methods. The well geometry is as follows: (*See Fig. 1*)

r - casing radius

R - borehole radius

L - screen length

b - distance from bottom of well screen to the top of the aquifer, in both confined and unconfined conditions

The Moench and Moench (fracture flow) methods require data for the well geometry. The Gringarten and Papadopoulos methods also require the well dimensions in order to account for skin effects and well bore storage. The b value is only required if you are doing a Moench analysis, which accounts for partially penetrating wells. For all other methods, the well dimensions and the b parameter are not necessary, since they assume fully penetrating wells, and infinite radial flow; only the saturated aquifer thickness (D) is required in order to calculate the hydraulic conductivity value.

2. How to deal with single well solutions?

Quite often, a project budget only allows for a single well pumping test. In this scenario, the pumping well is used for both pumping, and for recording drawdown measurements. In AquiferTest Pro, you can analyze data from a single well using any of the following standard

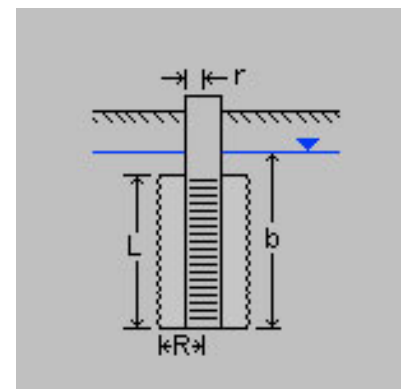
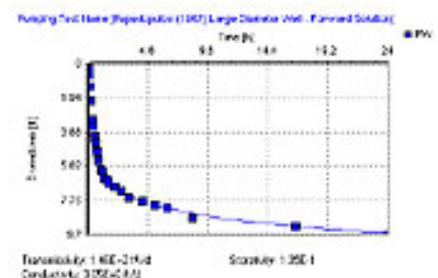


Figure 1



solution methods:

- Theis
- Theis-Unconfined
- Theis Recovery
- Neuman
- Cooper-Jacob
- Hantush-Jacob

However, with only a single well, you will only be able to obtain values for Transmissivity; it would not be possible to obtain storativity calculations since the calculation for storativity requires a radial distance (distance from an observation well to pumping well). In addition, when measuring drawdown in a pumping well, you may also encounter well effects such as skin effects, or well bore storage in a large diameter well. These factors can influence the calculation of the aquifer parameters. As such, it is advised that you use one of the following forward solutions, which account for well effects:

- Gringarten-Forward (skin effects)
- Papadopoulos-Forward (large diameter wells)

One of these forward solution methods may yield more reliable results for single well solutions (*See Fig. 2*).

3. How many data points should I use?

With more hydrogeologists using data loggers, the problem of generating too much data often arises. Data loggers are convenient data-collection devices, however, when you load too much data into AquiferTest, the program performance is affected. Quite often, all that data simply is not necessary to perform accurate analyses. Observe the comparison in the right hand bar (*See Fig. 3*).

In this example, data is downloaded from a data logger file, and copied directly into AquiferTest. The data set contains a total of 2,940 data points. Using a Cooper Jacob analysis, the aquifer parameters are determined (*See Fig. 4*).

In this example, the same data set is filtered down to include only those measurements where the water level changes by more than 0.05 m between sampling times. (The filter can be applied in AquiferTest during the data logger import routine). By applying this filter, you can remove 2,922 data points, leaving only 18 data points. Using the same Cooper Jacob analysis, you can see that the exact same aquifer parameters are calculated by AquiferTest (*See Fig. 5*).

4. How are variable discharge rates handled?

Figure 2

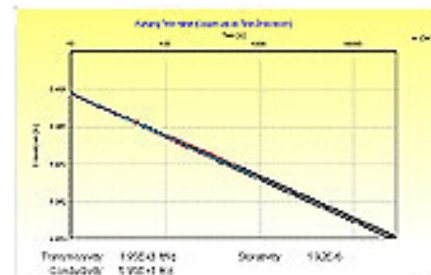


Figure 3



Figure 4

When using one of the standard solution methods with a variable discharge rate, AquiferTest will calculate one average constant rate for the duration of the pumping test.

True variable discharge rates are only considered when doing a Step-test, or when using one of the forward solution methods.

When entering discharge rates for forward solutions, variable rates should only be entered if there was an intentional change in the pumping rate. If your data logger recorded discharge rates, but the rate remained constant during the pumping test, then it is not necessary to enter time-varying discharge where the discharge fluctuated slightly. Simply enter one constant rate for the pumping test in AquiferTest. When using one of the forward solutions, variable discharge rates are taken into account using the theory of superposition. This requires additional drawdown calculations, and increases the demand on the system resources. This may be undesirable if the true pumping rate was constant for the test.

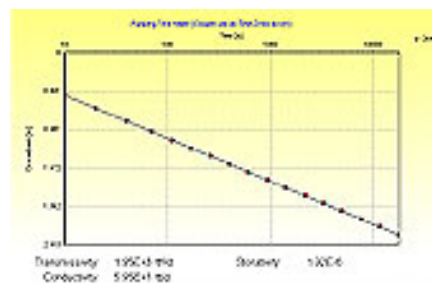


Figure 5

[Learn more about AquiferTest](#)

For more information about this tip, contact us at:

Email: techsupport@waterloohydrogeologic.com

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

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

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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