

# Groundwater Aspects of Underground Construction in the Greater Toronto Area

One-Day Symposium

February 13, 2013  
(Wednesday)

Toscana Banquet and Conference Centre – Hilton Garden Inn

3201 Highway 7 West  
Vaughan, Ontario L4K 5Z7  
(Just NE of Hwy 400 and 407 Interchange)  
Tel: 905-660-5200

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Jointly Organized by:

Canadian Geotechnical Society  
Southern Ontario Section  
Toronto Group

and

International Association of Hydrogeologists  
Canadian National Chapter



# Groundwater Aspects of Underground Construction in the Greater Toronto Area

(One-Day Symposium by CGS-SOS / IAH)

## OVERVIEW OF THE SYMPOSIUM

Deep excavations and tunnels are becoming increasingly important as part of the infrastructure for buildings, road and rail traffic, water supply/disposal, hydroelectric stations and routing power or telecommunications. Within the Greater Toronto area, the growing importance of underground excavations reflects the sensitivity towards the environment and the ever increasing cost of land. Underground construction is more complex in urban areas and requires close collaboration between hydrogeologists, geotechnical and structural engineers, excavation, excavation support, tunnelling and dewatering contractors. The diverse nature of this type of civil engineering project presents a myriad of challenges.

The symposium speakers will address fundamental issues associated with groundwater in underground construction. The symposium will begin with a discussion of the importance of the regional geologic and hydrogeologic context in the Toronto area. The discussion will then move to reviewing approaches for estimating and reporting values of key hydrogeologic data. This will be followed by a review of analysis methods for estimating groundwater pressures and rates of groundwater inflows to excavations.

The afternoon session will resume where the morning left off, with a presentation on comprehensive groundwater modeling for the Southeast Collector Trunk Sewer. The following presentation will review the key factors to assessing ground movements, and address the inherent risks in underground construction. The symposium will conclude with a presentation of groundwater control from the contractor's perspective.

This one-day symposium will be of interest to Geotechnical Consultants, Hydrogeologists, Specialty Geotechnical and Groundwater Contractors, Government Infrastructure agencies, and University students.

Each participant will receive a handout with copies of all course materials and presentations.

## SPEAKERS

**Rick Gerber, Ph.D., P.Geo.**

Senior Hydrogeologist  
Oak Ridges Moraine Hydrogeology Program  
(YPDT-CAMC)

### Geological and Hydrogeological Controls on Groundwater Flow in the Greater Toronto Area

By Rick Gerber

A regional three-dimensional geologic and hydrogeologic understanding of subsurface conditions can be a very powerful tool to support site-specific investigations. With a regional conceptual model, specific sites under investigation can be placed into context within the regional flow system, and experience from projects in similar hydrogeologic settings can be drawn upon. Questions that can be addressed with a regional understanding include: Is the site in an area with high groundwater pressures? How extensive is the aquifer that occurs beneath the site? Good answers to these questions have ramifications for the construction methods proposed and can help guide the investigation techniques that will need to be employed.

Since 2001, the Municipalities of York, Peel, Durham, the City of Toronto and Conservation Authorities situated in south-central Ontario have been collaboratively conducting or overseeing regional and local hydrogeologic investigations and centrally collating this information. This presentation discusses the development and current state of the geologic and hydrogeologic conceptual models of the greater Toronto area, and how it can assist us in our future endeavours. It is acknowledged that the conceptual model is not perfect and can only be strengthened by increased testing and critique of the existing interpretations. Also discussed will be the critically important feedback loop to allow for future collaboration and conceptual model refinement.

**Stephen Di Biase, M.Sc., P.Geo.**

Senior Hydrogeologist and Associate  
Golder Associates

**Dirk Kassenaar, M.Sc., P.Eng.**

**E.J. Wexler, M.Sc., M.Sc. (Eng.)**

Senior Hydrogeologists, Earthfx Inc.

**Establishing Hydraulic Conductivity and Pumping Rate  
Baselines within Tender Contract Documents**

By Stephen Di Biase

Inadequate groundwater control is generally regarded as a common cause of scheduling delays and claims for deep excavation and tunnelling projects. To minimize this risk, the presentation of soil hydraulic conductivity values and construction dewatering rates continues to evolve within geotechnical baseline reports and contract specifications.

In this presentation, various approaches to estimating and reporting baseline values for soil hydraulic conductivity and construction dewatering rates are reviewed. Case studies will be presented to identify both common and atypical experiences encountered at construction sites.

**Christopher Neville, M.Sc. P.Eng.**

Senior Hydrogeologist and Associate  
S.S. Papadopulos & Associates, Inc.

**Applied Groundwater Hydraulics for Underground  
Construction**

By Christopher Neville

Three basic questions of groundwater flow with respect to underground excavations will be addressed.

1. How are the groundwater pressures that may be exerted on the impermeable walls of an excavation estimated?
2. How are the potential rates of groundwater inflow into an excavation estimated?
3. How is the extent of the area that may be affected by groundwater flow into an excavation estimated?

Relationships between hydraulic head and groundwater pressure will be examined for various flow patterns, with specific reference to pressure distributions presented recently for several underground excavations in the Toronto area. The range of analysis techniques that are available for estimating groundwater inflows to excavations will be reviewed, including a compilation of closed-form analytical solutions suitable for screening-level analyses.

**Groundwater Modelling for Tunnel Construction**

By Dirk Kassenaar and E.J. Wexler

Groundwater modelling can be a very powerful tool for evaluating the potential impact of dewatering for tunnel construction on nearby wells and streams. The Southeast Collector Trunk Sewer construction project utilized models early in the project to aid in route selection and to assess potential impacts of the final design. The alignment for the 15-km long sewer crosses through the centre of the Rouge River and Duffins Creek watersheds. To minimize the need for dewatering, tunneling is through the Newmarket Till unit over most of the route. The tunnel passes through aquifer units near the ends of the route where it joins existing systems. The route also crosses a number of streams.

A three-dimensional numerical model was developed for the study area based on earlier studies of the Oak Ridges Moraine. Water level and streamflow data were used to refine the model calibration. Moving constant-head cells simulated dewatering ahead of the four tunnel boring machines (TBM), which progressed at a rate of about 10 m/d. Dewatering for shaft installation and other water takings were simulated. Additional simulations were conducted to address contingencies such as extended dewatering at Shaft 13B (the connection to the existing York-Durham sewer line) and the TBMs becoming “stuck” at sensitive locations along the route.

**David Walters, Ph.D., P.Eng.**

Senior Geotechnical Engineer and Associate  
Golder Associates Ltd.

**Ground Movement in Response to Underground  
Construction**

By Dave Walters

Underground construction is inherently risky and characterized by projects that often involve lengthy disputes, eventually resolved by litigation. Underground construction risk arises from the variability of ground and groundwater conditions and the limits to which such subsurface conditions can be practically explored by Geo-Professionals prior to construction.

The greatest subsurface risk to Third Parties is considered to arise from ground movements, especially settlement, in response to underground construction. Ground movements can develop from dewatering/depressurization of water-bearing deposits and excavations for fixed facilities and tunnels. In this presentation, the key factors to assessing ground movements are reviewed. Empirical relationships are discussed between site geometry (tunnel/excavation depth, building founding level and set-back) and broad soil types that can be used to conservatively assess likely ground movements associated with conventional construction techniques.

**Steve Brett**

General Manager  
Atlas Dewatering Corporation

**Groundwater Control: The Contractor’s Perspective**

By Steve Brett

Atlas Dewatering Corporation has been completing water table lowering and depressurization since its incorporation in 1946. Groundwater lowering through a wide range of soil conditions has become more challenging recently, as a result of the tightening regulatory environment and intensification of urbanization. Permitting of water disposal, access restrictions, shortened system operational time for groundwater storage removal are common challenges that constrain the performance of groundwater control systems.

As municipalities promote intensification in lieu of sprawl, construction sites within urban areas have limited space available for shoring and dewatering systems that must function compatibly. Potential settlement of ground soils in proximity to excavation areas and adjacent utilities represents a significant risk in the congested downtown core. Infrastructure repair and replacement has become a concern in many municipalities, where crumbling infrastructure often requires immediate solutions. To accommodate these constraints and other aspects of successful groundwater control measures in today's construction environment, innovation and evolution of dewatering techniques is required. This presentation provides a contractor's perspective in the design and installation of active groundwater control systems, with a focus on common approaches for addressing the challenges of working in today's urban environment.

## AGENDA

7:30 to 8:00	Registration and Breakfast
8:00 to 8:15	Welcoming remarks
8:15 to 9:15	<b>Geological and Hydrogeological Controls on Groundwater Flows on Groundwater Flows in the Greater Toronto Area</b> – Rick Gerber, Oak Ridges Moraine Hydrogeology Program
9:15 to 10:15	<b>Establishing Hydraulic Conductivity and Pumping Rate Baselines within Tender Contract Documents</b> – Stephen Di Biase, Golder Associates
10:15 to 10:45	Coffee Break
10:45 to 11:45	<b>Applied Groundwater Hydraulics for Underground Construction</b> – Christopher Neville, S.S. Papadopoulos & Associates
12:00 to 13:00	Lunch
13:00 to 13:10	Introduction of the afternoon Speakers
13:10 to 14:10	<b>Groundwater Modelling for Tunnel Construction</b> – Dirk Kassenaar & E.J. Wexler, EarthFX
14:10 to 15:10	<b>Ground Movement in Response to Underground Construction</b> – David Walters, Golder Associates
15:10 to 5:30	Coffee Break
15:30 to 16:30	<b>Groundwater Control: The Contractor's Perspective</b> – Steve Brett, Atlas Dewatering
16:30 to 16:45	Closing Remarks
16:45	End of Symposium

## IMPORTANT SEMINAR NOTES

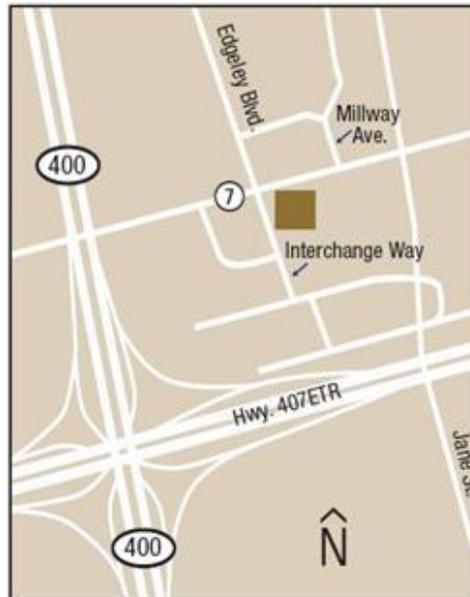
**Location:** Toscana Banquet and Conference Centre – Hilton Garden Inn  
3201 Highway 7 West  
Vaughan, Ontario L4K 5Z7  
Venue on south side of Highway 7 West, just east of Highway 400

**Contact:** Matthew Boucher  
Tel: 905-829-8666  
Email: mboucher@thurber.ca

**Attendance:** Due to arrangements at the venue, only a limited number of late registration attendees can be accommodated.

**Deadline for registration is Monday, February 6, 2013.**

## MAP



## REGISTRATION FEES

CGS/IAH Members	\$ 120
Non- Members	\$ 150
Students	\$ 50
Cancellation Fee	\$ 50

\* Registration fee covers printed material, continental breakfast, lunch and coffee breaks for both days.

Registration fees can be paid electronically through Eventbrite (link below).

<http://cgs-sos.eventbrite.com>

If payment cannot be made electronically cheques will be accepted. Please make cheques payable to the Canadian Geotechnical Society – Southern Ontario Section. Forward the following application along with your payment to:

Ms. Marcia Mora - CGS-SOS Treasurer  
c/o Ministry of Transportation Ontario  
Building C, Room 232  
1201 Wilson Avenue  
Downsview, Ontario, M3M 1J8  
Phone: 416-235-6667  
Fax: 416-235-3919  
E-mail: Marcia.Mora@ontario.ca

**REGISTRATION FORM AND OFFICIAL RECEIPT  
FOR INCOME TAX PURPOSES WHEN  
COMPLETED AND AUTHORIZED BY CGS-SOS**

Name: \_\_\_\_\_

CGS/IAH Member No. \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

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