



Credit Valley Conservation  
 Nottawasaga Valley Conservation  
 Toronto and Region Conservation  
 Lake Simcoe Region Conservation  
 Central Lake Ontario Conservation  
 Kawartha Conservation  
 Ganaraska Region Conservation  
 Otonabee Conservation  
 Lower Trent Conservation



## 2016 PROGRAM OVERVIEW & 2017 WORK PLAN

TO: YPDT Executive Steering Team

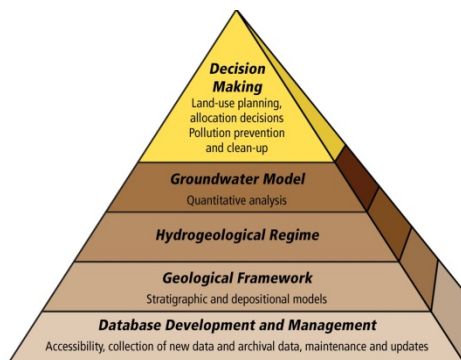
FROM: Steve Holysh & Rick Gerber

DATE: March 7, 2017

RE: **2016 Overview/2017 Work Plan – Oak Ridges Moraine Groundwater Program (ORMGP; aka YPDT-CAMC)**

### Background

The YPDT-CAMC (Oak Ridges Moraine) Groundwater program was initiated in 2001, driven by the encroachment of development onto the Oak Ridges Moraine and the recognition of an absence of high quality environmental data and analyses, particularly with respect to groundwater. Since inception, the program has provided partner agencies with an actively managed water-related database and the regional geological and groundwater context for on-going day-to-day water resource management activities (e.g. development review, PTTW review, watershed management, source water protection, etc.). The framework for the program is succinctly summarized in the adjacent figure, taken from the Council of Canadian Academies 2009 report “The Sustainable Management of Groundwater in Canada.”



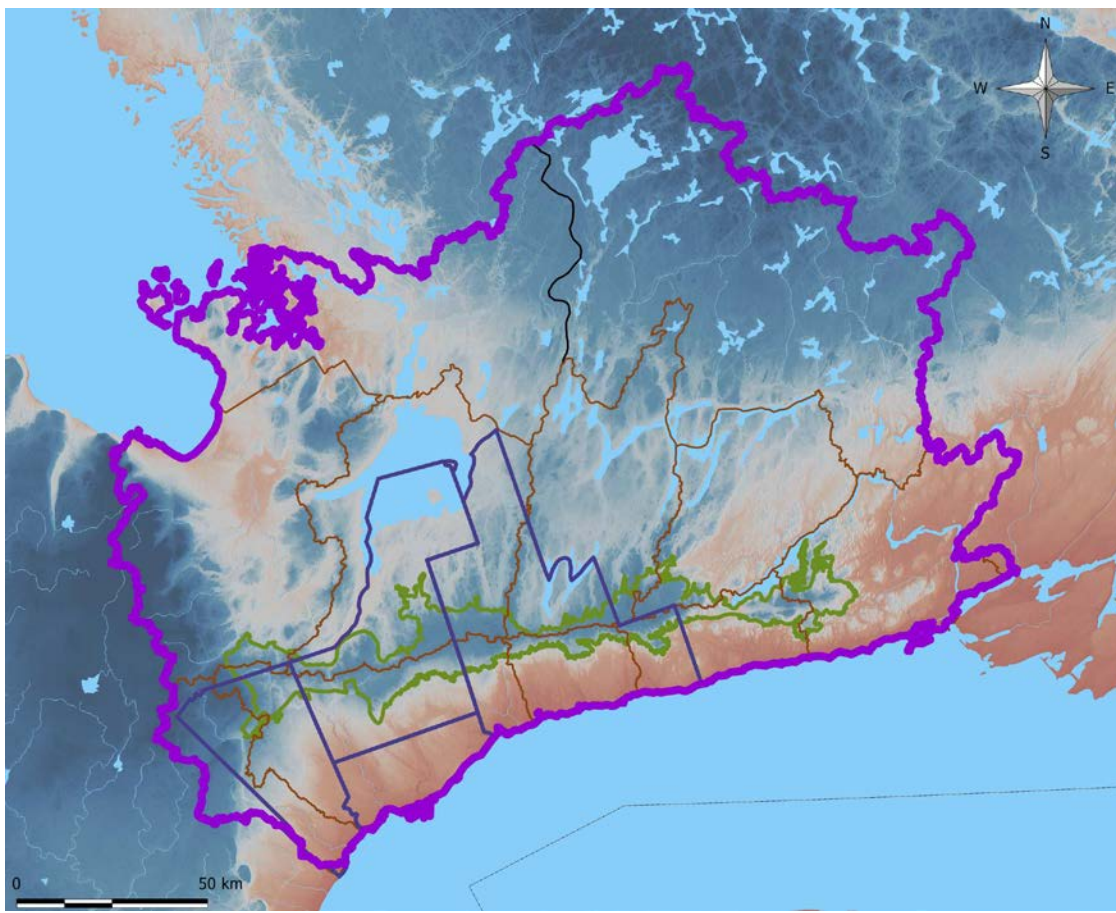
### Mandate

*The mandate of the YPDT-CAMC Groundwater Management Program partnership is to provide a multi-agency, collaborative approach to collecting, analyzing and disseminating water resource data as a basis for effective stewardship of water resources. The YPDT-CAMC Groundwater Management Program builds, maintains and provides to partnered agencies the regional geological and hydrogeological context for ongoing groundwater studies and management initiatives within the partnership area.*

As such the program will:

- *Build and maintain a master database of water related information that is accessible to all partner agencies;*
- *Build and maintain a digital geological construction of the subsurface layers that is accessible to all partner agencies;*
- *Build and maintain a numerical groundwater flow model(s) that can be used to address any number of issues that arise at any of the partner agencies;*
- *Coordinate and lead investigations that will acquire new field data that will strategically infill key data gaps;*
- *Provide technical support to Source Water Protection Teams to ensure that interpretations used in source water are consistent with the regional understanding;*
- *Provide technical support to planning authorities to ensure that Official Plan policies are developed in a manner which makes them consistent with up to date groundwater science as derived from the project; and*
- *Provide technical support to all partnered agencies for addressing other Provincial legislation.*

Further information regarding the program can be found at [www.oakridgeswater.ca](http://www.oakridgeswater.ca).



Program area - Note that for data management purposes the program area comprises the entirety of three SWP Regions: 1) Credit/Toronto/Central Lake Ontario (CTC); 2) Southern Georgian Bay - Lake Simcoe (SGBLS); and 3) Trent Conservation Coalition (TCC). Focus of work is largely directed to the GTA municipalities (York, Peel, Durham, and Toronto) and their associated Conservation Authorities (CAs).

# Review – 2016 (Highlights)

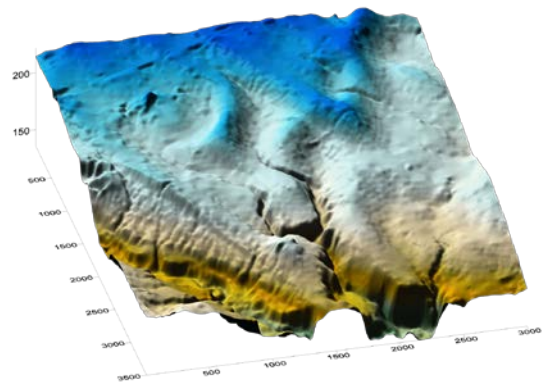


## Highlights – 1. Database

- database moved from SQL 2012 to SQL 2014 and then to SQL 2016 at the end of the year;
- new servers purchased and configured to accommodate new database accessibility through Citrix system;
- added in 2016 - 28,000 boreholes; 700 reports; 2.5 million temporal data records;
- website enhanced for ready access to program data and information;

## Highlights – 2. Analysis & Modelling

- Water budget model run across jurisdiction and maps made available on website;
- Water table and potentiometric surface maps regenerated and made available on website;
- Review and analyses of Yonge St. Aquifer geology and hydrogeology in support of technical paper;
- Obtain/inventory/archive and review additional partner agency numerical groundwater flow models;
- Complete technical work of “ensemble” modelling study for Ducks Unlimited to investigate economic benefit of CVC wetlands.



## Highlights – 3. Other

- Further enhancements to pass-worded section of website ([www.oakridgeswater.ca](http://www.oakridgeswater.ca)); access provided to Provincial and Federal technical staff for peer review;
- Continued monitoring of 20 field sites to assist with infilling of data gaps;
- Communications – continued technical collaboration with various agencies including MOECC; GSC; Hydro One; Town of Clarington; Univ. of Waterloo; Guelph Univ.; Univ. of Western Ont.; York Univ.;
- Communications – authored or co-authored three conference presentations; significant interest generated at City of Toronto’s “Lunch and Learn”.



## Highlights – 4. Budget

- Program delivered on budget;
- No increase for 2017;

<b>Program Component</b>	<b>2016 Budget</b>
Staff Costs (Wages + Benefits)	\$635,000
Office + Disbursements	\$40,500
Computer + Software	\$76,800
Consultant/Services	\$44,200
Administration	\$12,500
<b>Total</b>	<b>\$809,000</b>



# Review – 2016 (Detailed Summary)

The following provides a more detailed overview of activities undertaken through the Oak Ridges Moraine Groundwater Program through 2016.

## 1. DATABASE

2016 was a year of considerable change and progress with respect to the program's database with a considerable upgrade of the database from a SQL 2012 structure (version 20120615) to SQL 2014 and then quickly into SQL 2016 (version 20160831) to allow the program to take advantage of recent changes in SQL (i.e. the incorporation of the "R" statistical computing and graphics package into SQL 2016). As in previous years, the discussion of database issues has been broken into four categories: Additions; Corrections; Accessibility and Software/Hardware Management.

### 1a Additions

Key 2016 additions to the database included:

- An updated WWIS database was obtained in spring 2016 from the MOE and about 28,000 new well records were brought into the database – the MOE database was up-to-date as of September 2015;
- Approximately 700 new documents were brought into the library;
- Water chemistry from the MOE's 1997 report "The Hydrogeology of Southern Ontario";
- The 2016 chemistry, water levels and pumping records from various municipal wells owned/operated by the Regional Municipalities ;
- Long term York Region water level data that had not yet been imported into the master database owing to database divergence (note that a data merge tool is being completed and is expected in 2017 which will allow for water levels and chemistry data to be more regularly imported);
- Peel Region and Durham Region municipal monitoring data continued to be regularly appended to the database;
- Miscellaneous well and associated data from several consulting reports were brought into the database;
- In total approximately 2.5 million temporal records (chemistry, water levels, etc.) were added.

### 1b Corrections

- In a similar manner to what has been undertaken in the past, the import of an update of WWIS records necessitated the running of several quality assurance procedures needed to check and correct information coming into the database (e.g. check the screen top is above screen bottom, similarly check that geology layers have tops above bottoms, check water levels are not below bottom of the well, compared invalid MOE coordinates against listed townships and maps on well record forms (i.e. checking of coordinates etc.);
- Key wells that are monitored by others, mostly golf course operators, were flagged in the database by providing existing WWIS records with a proper well name that is in use by the well owners. This was done as part of an initiative to enable any temporal data associated with the wells to be imported and used into the future;
- In order to better manage changes to either the elevation or the UTM coordinates of any wells (or other locations) in the database new tables were added to help with change tracking. Under new database management policy, changes to these key attributes will only be allowed if the old values are stored within these new tables and if proper documentation for the elevation or UTM coordinates have been provided (e.g. new survey, incorrect original data entry, etc.);

### 1c Accessibility

Considerable efforts were expended through the first half of 2016 in constructing a new system that would allow for partner agencies wishing to load data into the database, direct connection to the program's master database via an internet browser. With the discontinuation of database replication in the fall of 2015, the database became temporarily inaccessible to some partners for data uploading. Advantages to the new connection methodology were numerous and included:

- Expanding access for staff to the database from any computer (e.g. other office computers, home office, etc.);
- Reducing the need for IT resources at each independent agency. Prior to this upgrade, partner agency IT staff had to establish internet pathways in order to maintain linkages between servers at the partner agency side and at the ORMGP side. This is now all handled on the ORMGP side;
- Less overhead and efficiencies gained in terms of managing the replication process that was formerly in place.

The new system is reliant on a Citrix XenDesktop platform that has been established on a server at Central Lake Ontario Conservation Authority offices to take advantage of the recently installed high speed fibre optic internet connection. Testing of the system took place in the latter part of 2016 with all partner agencies receiving an agency password and details on how to log onto the Citrix server. As of early 2017 it is available for partner use to access the database.

The program's comprehensive database management manual has been updated to reflect new structure (e.g. tables, relationships, views, etc.) as well as to reflect any MOE WWIS import methodology changes.

In addition to this direct connection to the database, the program's website has also been enhanced through 2016 to provide technical staff with ready access to a variety of program data and information. This is discussed in more detail below.

## **1d Software/Hardware Management**

In order to keep the database up-to-date and readily accessible to the partner agencies there is continual maintenance and review of the program's software and hardware capabilities. As in 2015, throughout 2016 these activities continued to be more involved than in previous years, owing to the establishment of the Citrix server and associated virtual computers that needed to be established at CLOCA. In 2016, the following tasks have been undertaken with respect to the program's software and hardware management:

- Implemented a new versioning and tracking system that is now carried within the database;
- Database switched from a 2012 version of SQL to SQL Server 2014 on YCDATABASE (and then in early 2017) to a 2016 version;
- As a temporary substitution for the removal of replication, direct database access via "Remote Desktop", was temporarily offered to all agencies to facilitate ongoing monitoring programs; Peel Region, TRCA, and NVCA took advantage of this accessibility option;
- New servers were purchased and configured (e.g. re-implemented VMWare Vsphere and VEEAM backup system server; re-implemented GIS server; implemented Ubuntu system instead of installed Red Hat system; include change to RAID 10 for protection against data loss) to replace dated equipment and to ensure that the Citrix environment would be stable and efficient for partner agencies logging in to the system;
- In order to speed up the retrieval of data from maps on the partner side of the program website, which directly access the database, several dedicated "Website" tables (prefixed with a "W\_" (e.g. W\_DOCUMENT)) were created within the database; these tables synthesize much of the temporal data within the database (e.g. min, max, avg. values) and are scripted/coded to refresh every weekend so that they are always providing up-to-date information to the website;

- Work was undertaken to evaluate options (e.g. SQLite) for distributing local cuts or copies of database for partner agencies;
- The method by which each well screen is assigned to a geological unit was reconfigured to be more efficient and flexible. This involved the creation of two new Reference tables (R\_Form\_Assign\_Code and R\_Form\_Model\_Code) which now allow for the user to select the Numerical/Geological Model (e.g. York Tier 3 Model, Core Model, etc.) to be used for tying a screen to a geological unit. As in the past, there is still a defaulted geological unit (our best interpretation) linked to each screen. All screens (including those tied to newly imported wells) had their geological unit re-linked and updated as part of this process.
- The water level data from York Region was incorporated back into the master database resulting in the addition of several million temporal records. Work remains ongoing to realign the divergent York Region database with the Master Database and to make the import of new data more streamlined.
- The processing of library reports through the optical character resolution (OCR) process and into a directory structure and then onto the Sharepoint environment on the website was restructured to make it more streamlined;
- The migration to the new version of the database (mentioned above) required considerable efforts to ensure that the database schema (tables, fields, relationships, etc.) remained compatible with the Sitefx software (which has also been upgraded during 2016) so that this program could still be used to connect to the database.

## **2. ANALYSIS & MODELLING**

The following initiatives either carried through from 2015 or were initiated in 2016.

### **Model Review**

Models provided to the program under the Model Custodianship program continued to be reviewed upon delivery. For example, models across the CTC jurisdiction were reviewed and a technical memo was provided to CTC documenting the work. Also, the SGBLS SWP group requested some assistance in terms of upgrading a few models to non-proprietary versions and this was completed in early 2016. As part of the ongoing model review, it should also be noted that we continue to have communication with software developers to discuss, at a high technical level, modelling code and to provide input regarding bugs in the code that need to be fixed as well as suggesting improvements to existing codes. Over the course of 2016, discussions were held with the developers of GSFLOW, HydroGeoSphere, and GWVistas.

### **Model Management Report**

Through early 2016 the Model Management Guidance report was being completed and made available for review by a peer review committee. Two peer review committee meetings were held in January and May and the report was completed over the summer months and forwarded to a technical editor for review in the early fall. The report will be finalized in early 2017.

### **Yonge Street Aquifer**

In partnership with staff from the Geological Survey of Canada and York Region, a detailed analysis of the geology and hydrogeology of the Yonge Street Aquifer is underway with the final product targeted as a technical paper to be submitted to the Canadian Journal of Earth Sciences.

### **Ducks Unlimited**

Mason continued to work on a modelling project with Ducks Unlimited that is ultimately focused on determining the economic value of wetlands in mitigating flooding. Through an innovative “ensemble” modelling approach that made use of the University of Toronto’s SciNet computing centre, 1000s of model runs were captured within the study to address the inherent uncertainty in understanding the Credit River

watershed's flow system. The model report is being finalized in early 2017 and the project is being transferred to Intact Insurance to run the follow-up economic analysis.

### **Water Budgeting**

Partner agency technical staff are commonly charged with reviewing hydrogeological reports that have been prepared in support of development applications. These reports frequently present water budgets that may not always be rigorous in their approach. To better support these types of reviews a regional scale continuous hydrologic model was run across the entire program area jurisdiction to provide average water budget parameter estimates (precipitation, runoff, evapotranspiration and recharge). These estimates can guide reviews and ensure that the numbers presented are reasonable.

### **Water Quality Overview**

To obtain an overview of the groundwater quality across the study area, Mezmure Haile-Meskale, a recently retired MOECC staff member, was retained. A water quality dataset was extracted from the database and Mezmure is working to provide a synthesis of the information both spatially across the study area and also with depth to characterize spatial, vertical and temporal trends in the groundwater quality across the study area. Key information that will be imported back into the database would be interpretations (e.g. saturation indices, water type, etc.) on the some 6,000 water quality analyses currently held in the database.

### **Water Table and Potentiometric Surface Mapping**

These two surfaces were re-mapped in 2016 to support a new map that was uploaded on the website. The water table was generated using shallow wells (less than 20m) coupled with the Strahler Class 4 and larger streams and was compared with modelling results from the YT3 model. The comparison was favourable. The potentiometric surface map was generated using wells greater than 40 m deep.

### **Miscellaneous technical support**

**CLOCA** – In their ongoing review of development applications staff were looking to make effective use of the PRMS modelling results that were provided under SWP. Assistance was provided in terms of guiding staff as to what model result layers were most applicable. Techniques for making effective use of the Viewlog model results in one location and applying them to other areas undergoing development were also recommended.

**TRCA** –

- TRCA, CVC and HRCA are all interested in more rigorous assessment of their wetlands. We have provided TRCA staff with wetland locations and monitoring results that they can capture into their ongoing wetland analysis work;
- finalized work with TRCA staff to develop a drought index by statistically combining soil moisture data with precipitation data;
- provided technical support to TRCA staff as they proceeded a process to evaluate various modelling platforms for evaluating wetlands;
- assisted in evaluating discharge in the Seaton area, Brampton Esker water levels, and in evaluating drawdown in the north Leslie area as development applications were being reviewed;
- preparing an existing geology and hydrogeology conditions report for the Carruthers Creek watershed in support of the TRCAs Carruthers Watershed Plan;
- assisted with logistics (core management, database support, etc.) for the re-drilling of a new well (with five different screens at varying depths) on Taunton Rd. (near Brock Rd) in Pickering after a long term IWA monitoring well was inadvertently destroyed by a developer.

**York** – worked with York Region consultant to ensure YT3 modelling files were in format (GW Vistas) that consultant was familiar with; ii) subsequent conversion of YT3 files to Surfer for use by consultant; iii) review of RFP and generation of cross-sections for incorporation into RFP for consultant to run model to generate new WHPA; provided accessibility to modelling software via remote desktop connections.

**CVC** – i) provided particle tracking support for development review in Hillsburgh and Erin; ii) provided Halton Tier 3 model to MTE Consultants for use in the Limehouse Quarry study; iii) Viewlog and database support.

**Peel** – provided WHPA files from West Model for new wells in Caledon East and Inglewood in preparation for the Matrix Solutions Inc. modelling update; ii) provided some technical support for the West Trunk sewer project where problems with advancing the tunneling .

**Durham** – Provided support for ongoing investigation into the drought and dry wells in Clarington; provided technical, logistical and financial assistance in the drilling of the new Port Perry well.

**LSRCA** – assisted with technical discussions regarding the integration of modelling of E-flow and LID studies.

**Toronto** – Met with staff and City consultant to discuss problem area near Don Mills Road, south of Hwy. 401 (Graydon Hall) and initiated project to further investigate the condo development in the area.

### **3. OTHER PROGRAM INITIATIVES**

Over the course of 2016 a number of other initiatives also formed part of the overall work program.

**Website** – In partnership with staff from Central Lake Ontario Conservation Authority (CLOCA), work continued on enhancing the program’s website, and in particular on the pass-worded section that is only available to technical staff at the partner agencies. New maps have been created to better allow technical staff to make use of the vast data and information sets assembled through the project. With recent talks at the Federal and Provincial level regarding the need to construct an accessible groundwater database for Ontario, it was decided that passwords to the website should be provided to key Provincial and Federal technical staff so that they could see how far the program has proceeded.

**Report Library** – in 2016, staff met with Rural Development Consultants (RDC), a small consulting firm whom maintain a file system of all reports they have prepared since the early days of the company in the late 1970s. RDC have agreed to make available their reports to the program and, through a pilot project, the reports are now being scanned, added to the database, and being made available through the website. Also in 2016 a summer student was retained to further assist in getting other miscellaneous reports into the database resulting in the addition of some 600 new reports to the database.

**Field Work** – Staff continue to monitor a suite of approximately 20 wells to help in charactering specific hydrogeological settings that have been identified across the study area.

**Ontario Climate Advisory Committee** – as part of the task of considering the future use and updating of the available groundwater flow models across the program study area, staff continued to attend and contribute to this working group that advocates for best management practices in terms of collecting, managing and distributing climate information in Ontario. The program’s modelling expert has become a member of OCAC and presented his Ducks Unlimited Wetland modelling project to the group in fall 2016.

**Isotope Project** – in collaboration with the University of Waterloo and York Region, staff continue to collaborate on a project to collect samples across the program study area for isotopic analyses. Results will be used to assist in groundwater flow system delineation with a view to providing independent field checks on numerical groundwater flow models.

#### **Communications**

- Presented a poster entitled “Multi-agency Co-Operation in Managing Ontario's Groundwater Resources” at the 2016 Blue Cities Conference in May 2016 in collaboration with staff from the Geological Survey of Canada.
- Presented a paper entitled “A Path Forward for Source Water Protection Numerical Models” at the 69<sup>th</sup> National Conference of the Canadian Water Resources Association.



- Co-Authored paper entitled “Collaborative Development of a Regional Groundwater Data Framework for Southern Ontario” presented at the 69<sup>th</sup> National Conference of the Canadian Water Resources Association.
- Presented a paper entitled “Multi-Model Custodianship: Needs, Development and Challenges” at the 8<sup>th</sup> International Environmental Modelling and Software Society Congress in Toulouse France in July 2016.
- Invited in May to present the program and website overview at the City of Toronto’s “Lunch and Learn” seminar series which attracted the largest crowd of city staff in recent memory. As a result some 15 Toronto staff asked for and were provided with passwords to the program website.
- Invited to provide a Keynote talk at Seneca College’s one day symposium “The Water Conundrum – Excess and Scarcity”.
- Invited to present an overview of the Ducks Unlimited Wetland Modelling project on three occasions; i) to CLOCA staff at a “Lunch and Learn”; ii) to CVC staff at a “Lunch and Learn”; and iii) to technical water management staff from the Ministry of Natural Resources and Forestry in Peterborough.
- Met with Peel Region to provide initial training to new staff on YPDT software tools and data access via the website.
- Interactive day with Grade 4 students discussing water and geology (Pleasantville Public School, Richmond Hill);
- Annual lecture on “Water Resources Management” to undergraduate and graduate students at the University of Toronto Scarborough;
- Field trip and presentation on Geology/Hydrogeology to Parks Canada staff regarding possible expansion of the Rouge Park; and
- Presentation regarding management of collaborative efforts at the Western Lake Ontario Workshop aimed at developing western Lake Ontario consortiums.

### Liaison with External Agencies

In 2016 staff met and corresponded with various external agencies on behalf of the partners.

- **CAMC** – staff continued to report quarterly to the CAOs of the Conservation Authorities having jurisdiction on the Oak Ridges Moraine.
- **Ministry of the Environment and Climate Change** – staff were invited to participate at the MOECC’s Water Quantity Technical Framework Workshop to provide input into future directions for this component of SWP; met with policy planning staff from MOECC to provide technical input and follow up assistance with their initiative to grow the Greenbelt; continue to try and secure agreement with Central Region staff to allow for importing of additional MOECC datasets into the database; retained services of Ross Hodgins, recently retired MOECC staff, to assist in liaising with Central Region and to enhance current database by flagging specific key locations that might have datasets tied to them (e.g. golf course wells).
- **Western University** – met with Dr. Rob Schincariol to discuss possible collaborative research initiatives.
- **University of Waterloo** – met with Dr. Martin Ross to discuss their approach to mapping geohazards for the National Security branch of Public Safety Canada across a broad part of Ontario and in particular the potential susceptibility of differing material types to earthquakes. Provided geological surfaces for use in the project and also discussed possible future collaboration.
- **University of Toronto** – Staff continue to be linked with the U of T, in particular at the Scarborough campus where Mike offers GIS related courses to 3<sup>rd</sup> year and graduate level students.
- **York University** – provided a borehole dataset for the York University campus to a technical academic team that is investigating the possibility of establishing a geothermal energy system on the campus. Associated technical support and interpretation of the information was also provided.
- **McMaster University** – continuing to provide assistance to PhD candidates with respect to modelling groundwater/surface water interactions.

- **Geological Survey of Canada** – set up an agreement to geologically log core from Taunton Rd. and Port Perry BHs – also provides for additional work if agreed to by both parties; working jointly with GSC staff on a paper (Canadian Journal of Earth Sciences) describing the geology and hydrogeology of the Yonge Street aquifer; provided background data and reports for areas in Simcoe County to support a research project.
- **Town of Richmond Hill** – continued to provide technical expertise and peer review regarding development proposals in sensitive area of artesian pressures on the flank of the Oak Ridges Moraine.
- **Hydro One** – continued with providing technical oversight and facilitation between different parties with respect to groundwater issues (including establishing a long term monitoring program) surrounding the construction of a transformer station on the Oak Ridges Moraine in the Town of Clarington.

#### **4. BUDGET SUMMARY**

The four senior partners (City of Toronto, Regional Municipalities of York, Peel and Durham) each contributed \$175,000 in 2016 (Total of \$700,000). In addition, work undertaken for SWP resulted in additional funds to the program of \$230,000. The program’s expenses for the 2016 are summarized in Table 1.

<b>Program Component</b>	<b>2016 Budget</b>
Staff Costs (Wages + Benefits)	\$635,000
Office Costs + Disbursements	\$40,500
Computer + Software	\$76,800
Consultant/Services	\$44,200
Administration	\$12,500
<b>Total</b>	<b>\$809,000</b>

The program was completed within an acceptable budget in 2016. With the additional funds obtained through SWP, there is some flexibility in the program budget, and therefore no budget increase has been requested for 2017.

# 2017 WORK PLAN – ONGOING/UPCOMING TASKS

## 1. DATABASE RELATED

### Task 1.1 - Training in the Use of New Database Access (Citrix System)

With the implementation of the new platform to allow partners access to the program's master database, there is a need to train technical staff from the various partner agencies regarding database access. Training is proposed to be delivered in a variety of ways over 2017 including via the web (e.g. GoToMeeting), face to face group training and face to face agency specific training.

- **Benefits:** Staff will be able to continue to upload data into the database thus ensuring its continued relevance to groundwater studies across the study area.
- **Estimated Timeline:** Ongoing through 2017.

### Task 1.2 - Assessment of the New System

Over the course of 2017 staff will monitor external partner agency interaction with the database through the Citrix system and make any necessary adjustments as the year progresses.

- **Benefits:** This task is necessary to ensure continued easy access to the program database by technical staff. This will also allow for staff to utilize software that they do not have in-house.
- **Estimated Timeline:** Ongoing through 2017.

### Task 1.3 – Release of Updated Database Manual

As changes have taken place in the database there have been amendments made to the program's extensive database manual. The manual will be re-released to partner agency staff in 2017.

- **Benefits:** Ensures continued partner access of the database.
- **Estimated Timeline:** Summer 2017.

### Task 1.4 – Broaden Database Accessibility

With the support of the Executive Steering Committee (to be requested in March 2017), the program will seek ways of broadening access to the program's store of data and information. It is proposed that a stakeholder meeting with the consulting community be set up in the spring to determine the best path forward on this initiative.

- **Benefits:** With an expanded number of hydrogeologists examining the database and the various maps, models and other products prepared under the program, it is more likely that errors and omissions will be discovered and reported, leading to overall improvements in the deliverables to the groundwater community for important water-related decision making.
- **Estimated Timeline:** Spring 2017.

### Task 1.5 - Improved migration of consultant data into the database

With the broadening of access to the program's database and website, the importing of newly collected consultant data (including all data from borehole geology information to water levels and water quality data) could be more efficient. Improvements can be made by offering standard data formatting templates (in either Microsoft Excel or Access formats) on the website. Contract documents from any of the thirteen partner agencies can be drafted to explicitly require the use of YPDT-CAMC templates from the website as a requirement of winning any particular groundwater related project.

- **Benefits:** With the movement to the digital collection of logger files via hand held devices, it would be beneficial to all agencies if consultants could readily transfer collected information directly into a standard template that would facilitate the importing of data into the database.
- **Estimated Timeline:** Fall 2017.

### **Task 1.5 - Continued improvement and expansion to the database**

The database is now 61 gigabytes in size and continues to grow as new information is appended. 2017 will see York Region water quality data migrated into the Program database as well as an update to the PGMN data. Work will continue, along with York Region and Earthfx staff, to try and make such updates from York Region seamless. Work will continue to encourage staff from Central Region MOECC Office to make use of the program's data (via the website) and to contribute additional data into the program.

- **Benefits:** Improved data quality and additional data input to the database will enhance any studies/work that would be undertaken in support of development or construction activities.
- **Estimated Timeline:** Ongoing through 2017.

## **2. ANALYSIS & NUMERICAL MODEL RELATED**

### **Task 2.1 – Numerical Model Guidance Manual**

Comments and suggestions received from the technical editor will be incorporated into the Model Management Guidance document and the report will be finalized.

- **Benefits:** The document will provide partner agencies with a practical guidance manual that can be used when commissioning future numerical modelling studies. From preparing legal contract documents to seeking technical guidance on what type of model to request from a consultant the document will seek to be the “go-to” reference guide for numerical modelling studies.
- **Estimated Timeline:** Completion – Spring 2017.

### **Task 2.2 - Model Harmonization**

With some 60 numerical models having been generated across the geographical study area of the program, there remains a need to move towards a single “authoritative” path forward. This would start with a focus on the geological layering and move forward to other attributes of the many models (e.g. hydraulic conductivity, porosity, etc.). As an initial key building block for numerical groundwater modeling, the geological/hydrostratigraphic layers need to be refined to incorporate any beneficial changes/insights obtained within the various modelling studies.

- **Benefits:** This task will initially see the consolidation of many phases of geological interpretation into a common “authoritative” set of surfaces that will extend across the entirety of the Oak Ridges Moraine drainage area. For each agency, this will continue to prove to be a significant benefit in that they can confidently provide a set of information and interpretive layers to any ongoing capital works project that involves subsurface excavation or tunneling. When provided to consultants, the set of layers allows for all parties (including staff and consultants working in adjacent agencies) to speak with a common language when referring to the subsurface stratigraphy.
- **Estimated Timeline:** Ongoing through 2017

### **Task 2.3 - Mapping of Known Groundwater Problem Areas**

A wealth of information exists within the program information and analysis system to better inform projects regarding subsurface conditions prior to commencement. This task will build on a presentation at a Canadian Geotechnical Society symposium regarding groundwater issues related to excavations to prepare regional mapping of various hydraulic settings that contain conditions pertinent to any subsurface works such as

groundwater under pressure (i.e. flowing conditions) and other high-capacity confined aquifer settings. The hydraulic head and water table surface maps for the various hydrostratigraphic units will be updated to incorporate all observed data.

- **Benefits:** By having an understanding of subsurface conditions prior to project commencement partner agency staff can provide preliminary knowledge regarding overall project cost and necessary efforts. The regional maps will provide a screening tool prior to the detailed work necessary for project design.
- **Estimated Timeline:** December, 2017.

#### **Task 2.4 – Investigation into Online Model Executables**

There has been an interest in ensuring that the numerical models developed over recent years are made available for more widespread use than is currently the case. One possible solution is to develop an on-line executable (e.g. input pumping rate, location, and aquifer – model run would return drawdown at a municipal well) that would allow for non-modelers to gain insights from models for various water management decision-making and quickly assess potential impacts to their water supply.

- **Benefits:** This tool, if developed, would allow for technical staff from partner agencies to gain insights from already constructed models thus extending the benefit of the models into the future.
- **Estimated Timeline:** Ongoing

#### **Task 2.5 – Yonge Street Aquifer Characterization**

In co-operation with staff from the Geological Survey of Canada and York Region, the geology and hydrogeology of the Yonge Street Aquifer is being assessed. Given the preponderance of data that has been collected over the years, it is surprising that this feature remains poorly described and understood. It is proposed that a paper that better characterizes the Yonge Street Aquifer geologically, as well as hydrogeologically, be submitted to a special upcoming issue of the Canadian Journal of Earth Sciences (Surficial Geology of Southern Ontario and Applications to Groundwater).

- **Benefits:** It is hoped that the Yonge Street Aquifer and the insights from the paper will equally apply to other similar channelized deep flow system (e.g. Thorncliffe Formation) related features found both to the east and west in the Regions of Peel, York and Durham and beneath the City of Toronto (e.g., Uxbridge, Grasshopper Road, etc.).
- **Timeline:** Summer 2017

### **3. OTHER INITIATIVES**

A key initiative in our application, communication and outreach activities will focus on enhancing the program's website to deliver information in an easily accessible manner. Over 2017 the goal for the website is to improve access to the temporal data and to generate additional mapping products that would be of benefit to partner agency staff. Staff will also be exploring the statistical options that SQL 2016 presents in terms of its linkage with the "R" statistical software package (additional charts, graphs, etc.). The website will also be used to enhance the technical content currently available by providing additional technical insight pieces that succinctly summarize different hydrogeological analyses that have made effective use of the vast store of data in the database. The goal of the program's website information search and analysis tools is to reduce the need for extensive knowledge regarding how to use various individual software packages (e.g. Sitefx, GIS, SQL Management Studio, etc). If approval is provided to broaden accessibility to the program's website, then in partnership with the consulting community, we will be seeking input as to other paths that can be opened up with respect to ready access to data and information.

#### **Task 3.1 – Ongoing WebSite Improvement**

As the website is used by staff from various agencies we will be seeking input and ideas for improving upon the maps and tools currently available on the website. Improvements are anticipated in terms of providing long term trends for pumping rates and for groundwater quality from various sites. Staff also intend to interlink some of the features available within the maps currently available, for example in any of the current maps when the user selects a well the MOECC WWIS record should be available for perusal, rather than having to go back to the WWIS map

- **Benefits:** all actions directed to the website will be focused on providing smarter and easier ways to explore the data within the database, thereby reducing the time needed to acquire data for decision making.
- **Estimated Timeline:** Ongoing

### **Task 3.2 – Website Database Access**

In order to make more effective use of the program’s database, we will explore ways to directly access the database, and in particular the “Views” since they succinctly synthesize much of the information within the database. It is proposed that access be provided through a searchable mapping interface as well as through forms that are linked to the database.

- **Benefits:** having on-line access to the database will allow practitioners from partner agencies to show and search for information while at meetings away from the office. This capability will allow outside agencies (e.g. consultants, environmental groups, provincial agencies, etc.) to gain an understanding as to the comprehensive nature and magnitude of the database and foster an appreciation as to how it can change work patterns at many agencies across the study area.
- **Estimated Timeline:** Fall 2017

### **Task 3.3 GIS Platform**

Staff are currently working on establishing a GIS platform (using a freely available and powerful program (Quantum GIS or QGIS) that will host a variety of groundwater related information (e.g. geological and model layers, etc.). This will enable other more common GIS applications to work with the vast amount of information currently available in the program. Staff having typical GIS skills will be able to much more easily access data via this platform.

- **Benefits:** wider access to information via tool sets that are readily used by many staff
- **Estimated Timeline:** Winter 2017