



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

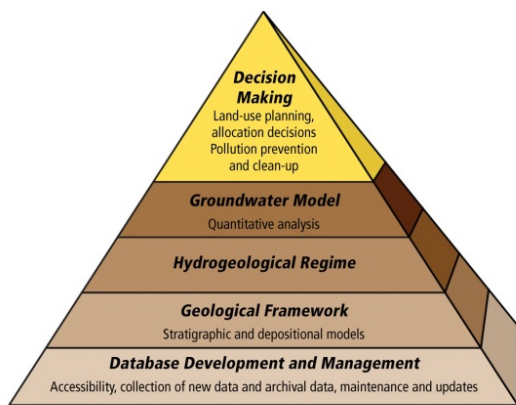


2017 PROGRAM OVERVIEW & 2018 WORK PLAN

TO: YPDT Executive Steering Team
 FROM: Steve Holysh & Rick Gerber
 DATE: March 19, 2018
 RE: **2017 Overview/2018 Work Plan – Oak Ridges Moraine Groundwater Program (ORMGP; aka YPDT-CAMC)**

Background

The Oak Ridges Moraine Groundwater Program (ORMGP) 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.”



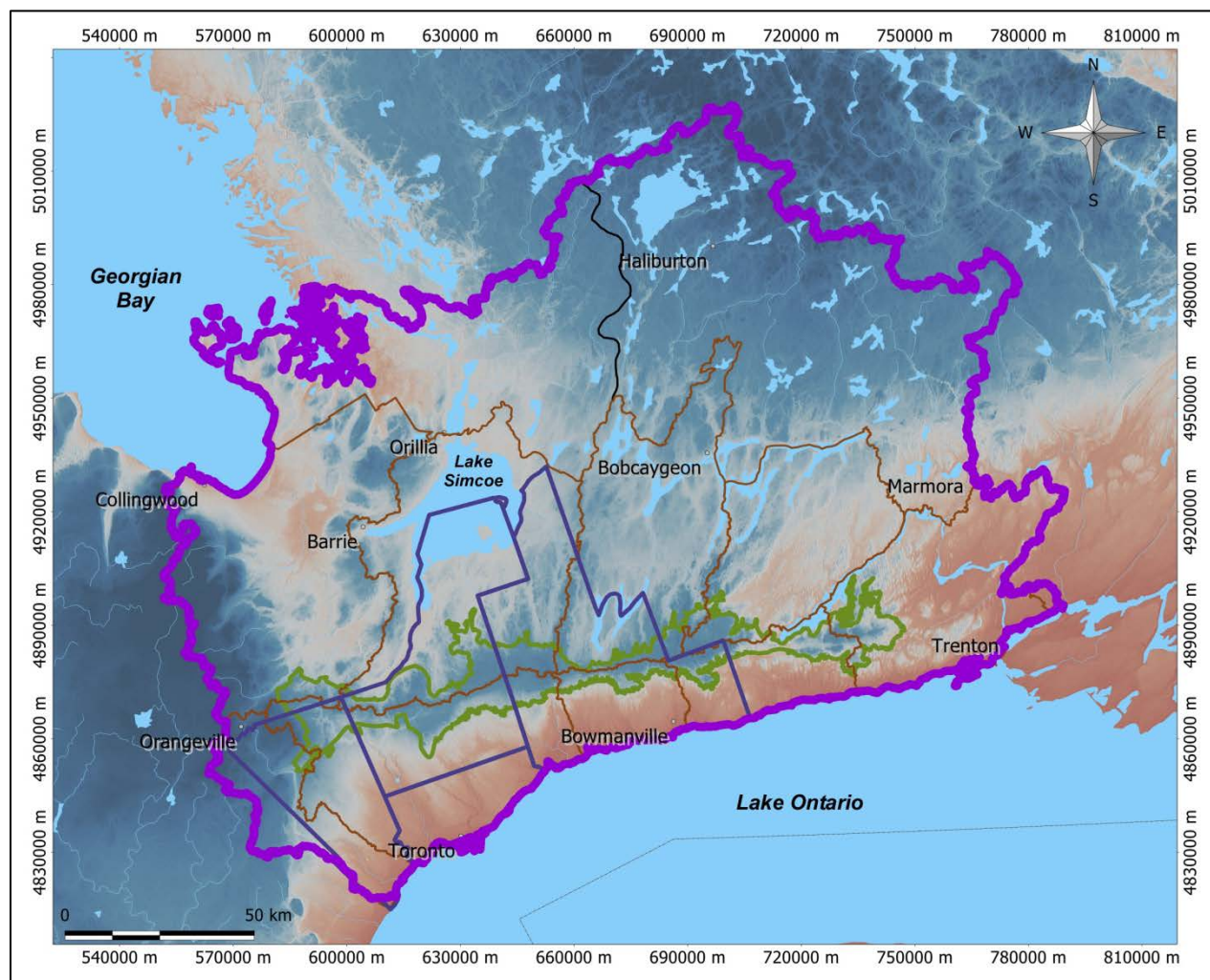
Mandate

The mandate of the ORMGP 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 ORMGP 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.



Program area - Note that for data management purposes the program area comprises the entirety of three Source Water Protection (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 – 2017 Highlights

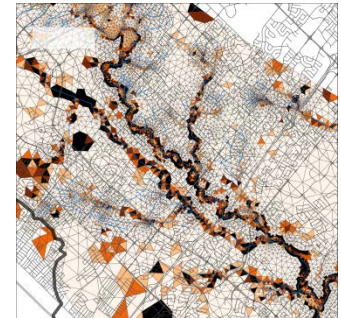


1. Database

- specialty tables created within database to enhance website functionality;
- incorporation of script to regularly update surface water data within the database;
- added this year - 28,000 boreholes; 1,500 reports; 20 million temporal data records;
- continued enhancement of website for quick access to program data and information;
- agreement from Executive Steering Committee to share data & website with consulting community.

2. Analysis & Modelling

- Completion and circulation of “A Guide for Actively Managing Watershed-Scale Numerical Models in Ontario”;
- Website tool created to assist in analysing surface water flows at gauged stations;
- Contributions to Terms of Reference for Durham and Peel Region modelling studies



3. Other

- Further enhancements to pass-worded section of website (www.oakridgeswater.ca); access provided to additional staff Provincial and Federal technical staff for peer review;
- Presentation to consulting community of pass-worded section of website (www.oakridgeswater.ca) and proposed collaborative hydrogeology initiative introduced;
 - Continued monitoring of 20 field sites to assist with infilling of data gaps;
 - Communications – continued technical collaboration with various agencies including MOECC (water quantity steering committee); GSC; Hydro One; Municipality of Clarington; Univ. of Waterloo; Guelph Univ.; Univ. of Western Ont.; York Univ.;
 - Communications – invited to speak at various forums including Ontario Water Works Association, Peel Region Managers, GSC/OGS Open House, TTC, BC Environment, City of Ottawa, University of Toronto.



4. Budget

- Program delivered within available funds - no planned increase for 2018;

Program Component	2017
Staff Costs (Wages + Benefits)	\$659,200
Office Costs + Disbursements	\$61,500
Computer + Software	\$16,600
Consultant/Services	\$28,400
Administration	\$12,900
Total	\$778,600



Review – 2017 (Detailed Summary)

The following provides a more detailed overview of activities undertaken through the Oak Ridges Moraine Groundwater Program through 2017.

1. DATABASE

The database was refined and improved through 2017 with continued use of SQL 2016 to manage the database. 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 2017 additions to the database included:

- An updated WWIS database was obtained in September 2017 from the MOECC and about 18,000 new well records were brought into the database – the MOECC well records are up-to-date as of March 2017;
- Approximately 1500 new documents were brought into the library;
- Updating of York Region water level and chemistry data that had not yet been imported into the master database owing to database divergence (note that a data merge tool continues to be investigated which will allow for water levels and chemistry data to be directly imported from York to the master database);
- Peel Region and Durham Region municipal monitoring data continued to be regularly appended to the database;
- An updated PTTW dataset was acquired from MOECC and the water taking permits updated;
- Miscellaneous well and associated data from several consulting reports were brought into the database;
- In total approximately 22 million temporal records (chemistry, water levels, etc.) were added in 2017 – this large number reflects the import of outstanding York Region data, as well as the updating of climate and stream flow data from Environment Canada.

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 owing to inaccuracies within the WWIS digital data (e.g. check that screen top is above screen bottom, check that geology layers have tops above bottoms, check water levels are not below bottom of the well, compare invalid coordinates against listed townships and maps on well record forms (i.e. checking of coordinates), etc.);
- Temporal data within the database was parsed into separate tables to allow for improved data accessibility, in particular for web site performance. All surface water related measurements were taken from D_Interval_Temporal_2 and moved to a newly created D_Interval_Temporal_5. Similarly climate related data was moved from D_Interval_Temporal_2 to D_Interval_Temporal_3. Note that Sitefx (database access software) is programmed to pull data from any temporal data table and can therefore still be used to view these data;
- With the ability to screen water wells on the website and readily access the original water well record via the MOECC website – corrections to individual wells was made much more simple.

1c Accessibility

- 2017 saw considerable changes and improvements to the website. Within the website's Geocortex mapping package a new map window now consolidates much of the information that was previously

found in several individual maps. This map provides users with the ability to present different information sets onto one map (i.e. geological layers and wells). The site allows for users to readily undertake various types of analyses via the internet;

- The movement of the database to SQL 2016, which was undertaken largely for the purposes of capitalizing on its compatibility with the R Statistical package, has already proven to be advantageous in that ORMGP staff have been able to use R to create and provide the high quality statistical analyses of streamflow information via the program's website;
- The Citrix Xendesktop platform that was established in 2016 on the ORMGP server at Central Lake Ontario Conservation Authority offices continued to be used by technical ORMGP staff, as well as partner agency staff, to interact with the master database. On the Citrix Server platform, users can access either: i) the master database - for users wishing (and permitted) to make permanent changes; or ii) the "weekly database" (see below) - for users looking to review and make use of the most recent data within the database;
- The system has been stable through 2017 and has performed up to expectations. Via the internet, the database and several related software programs can be utilized for viewing and interacting with the master database. Staff will continue to make use of this platform to provide ready access to the program's database and information.

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. 2017 was a year of general stability with respect to database management, minimal new equipment and/or software was required. In 2017, the following tasks have been undertaken with respect to the program's software and hardware management:

- Database switched in early 2017 to SQL 2016 version;
- Database management workflows reconfigured in early 2017 to work within Citrix platform. With respect to the backing up of the database, the following key points are relevant to the new system:
 - The database resides on a server at CLOCA which is continually backed up through VEEAM backup system server software – should there be a power failure or database glitch, the database can be restored from a short term backup in very short order; the VEEAM software stores multiple versions of the database which are eventually overwritten with subsequent, more recent backups;
 - on a weekly basis (every Sunday) the following steps are automatically transacted:
 - the database is written to a different CLOCA based server (this copy is dubbed the "weekly database") and is made available for use via the program's website to share data with the outside community;
 - this database is automatically transferred/written to an ORMGP server at TRCA's offices (this copy is used by ORMGP staff to interact with, review and check the database);
 - over the long term, copies of the weekly database are held off-site (along with backups at TRCA and CLOCA) and monthly copies are held indefinitely should they be required;
- 2017 saw the continued use and expansion of the "W" tables within the database in order to speed up the retrieval of data from maps on the website; "W" 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;
- To ensure partners have the ability at their own offices to use software products (e.g Viewlog, Sitefx, or other) to review/access/QA/evaluate their data held in the ORMGP database, a cut of each partner

agency data set is distributed (in SQL and or Access format) at least two times per year (more often if needed/requested).

2. ANALYSIS & MODELLING

The following initiatives either carried through from 2016 or were initiated in 2017.

Model Review

In 2017 the final numerical models provided to the program under the Model Custodianship program were reviewed and a brief report prepared for the Trent Conservation Coalition. As part of the ongoing model review, it should also be noted that staff continue to have communication with software developers to discuss modelling code, at a high technical level, and to provide input regarding suggested error bug fixes and/or improvements to existing software codes (e.g. discussions continue to be held with the developers of GSFLOW, HydroGeoSphere, Deflt3DFM, Mike SHE, and GWVistas). Under a technical review and assessment agreement, staff are in the process of acquiring, from Deltares in the Netherlands, an early version of proprietary hydrodynamic circulation modelling software that can potentially assist the Lake Ontario Collaborative group with modelling initiatives in Lake Ontario.

Model Subcommittee

At the LSRCOA office, staff hosted a summer meeting of the modelling subcommittee. The purpose of the committee is to exchange ideas and techniques for enhancing numerical model use across the program study area.

Model Management Report

The report for this project “*A Guide for Actively Managing Watershed-Scale Numerical Models in Ontario*” was finalized in 2017 and has been distributed to the province, and circulated through various SWP boards. The report provides direct guidance to water resource managers on various aspects of numerical modelling, including: i) common pitfalls in the commissioning of new numerical models; ii) how to make effective use of numerical models for water management decisions; and iii) recommended procedures for maintaining and updating numerical models so that they can continue to be relevant and effective in assisting staff with understanding and managing water resources.

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 carried on through 2017. A technical paper was submitted to the Canadian Journal of Earth Sciences. Peer review comments were received in December, and final submission is expected in 2018.

Ducks Unlimited

“*Wetlands and Flood Mitigation in Ontario: Natural Adaptation to extreme rainfall*”, the final report on this joint project with Ducks Unlimited was submitted in summer 2017. Work continues to transfer this ground-breaking study to a technical journal paper, planned for a 2018 submission. This study was focused on determining the economic value of wetlands in mitigating flooding, however it comprised many unique technical modelling approaches including an innovative “ensemble” modelling approach, the transfer of real storm dynamics from an actual 2015 Toronto storm over to Mississauga, and a unique approach to developing a finite element model mesh.

Surface Water Analyses

As an initial pilot project to test the capabilities of the R statistical package to work with the program’s SQL database, the program’s surface water data has been updated and a series of analysis packages have been offered on the program website. On the fly, users are able to select a stream gauge location and then to undertake analyses of the data. The user is able to change the selection of the range of days for which any

analysis will be undertaken and the statistics are updated dynamically as the date range is changed. Standard streamflow analyses such as baseflow separation, flow frequency analyses and trend analyses are all available on the website.

Miscellaneous technical support

York

- providing technical assistance in re-purposing the York Tier 3 numerical model to delineate capture zones for newly drilled municipal wells in the Newmarket area;
- technical assistance in working with Viewlog, a visualization and analysis software;
- continued to assist in facilitating data migration from York database into the ORMGP Master database (merge tool plus import of 2017 water level, pumping and chemistry data);
- continued work with Ross Hodgins (retired MOECC) to capture historical knowledge into the program's files;
- Provide technical support on Richmond Hill flowing well and area dewatering history.

Peel

- met with senior project management team to provide overview of program (March 2017);
- provided data and geological support to consultant for East-West Peel Trunk Sewer project;
- provided technical support in preparing Terms of Reference for Region-wide modelling initiative;

Durham

- met with monitoring consultant to establish process for migrating data into the database;
- checked Durham data within database to ensure consistency with data assembled by region's consultant - imported and updated database through fall 2017 in preparation for future numerical modelling initiatives;
- provided technical assistance in preparing Terms of Reference for renewed Durham-wide modelling initiative.

Toronto

- met with city staff to discuss groundwater program initiative and to foster better integration of city work with ORMGP work;
- provided overview of program's web-based data access/analysis site to the Toronto Transit Commission.

TRCA

- provided GSFLOW, PRMS and MIKE SHE support for modelling of three wetlands as background for the preparation of the Wetland Water Balance document;
- assisted in the siting and drilling of a new multi-level monitoring well within the Carruthers Watershed and partnered with Geological Survey of Canada and the University of Ottawa to ship core to Ottawa for further scientific analyses;
- currently assisting with the monitoring of new Carruthers well;
- provided technical support in preparing the geological and hydrogeological overview of the Carruthers Watershed in support of the TRCA's Carruthers Watershed Plan;
- assisted in adding new wells and importing of monitoring data into the program's database;
- in co-operation with TRCA, provided technical expertise to Town of Richmond Hill in the North Leslie Secondary Plan area where upward groundwater pressures must be properly considered prior to development approval;
- provided overview of ORMGP to TRCA management team.

LSRCA

- provided technical support to prepare technical Terms of Reference and in selecting preferred consultant to undertake environmental flows project in the East Holland Watershed;
- assisted in the development of environmental flow analysis for the Lovers Creek watershed. A journal paper has been prepared and planned for submission by mid 2018;

- currently helping on technical steering committee to assist in guiding of the East Holland modelling project;
- provided technical Viewlog training to assist staff with future geological mapping initiatives.

CLOCA

- continued to provide technical support with respect to the Ontario Hydro facility in the Municipality of Clarington;
- presentation of program and website to the board.

CVC

- provided overview of ORMGP (and in particular the program's website) to CVC technical water management staff (December 2017);
- provided technical assistance in terms of importing data into the database using Sitefx.

NVCA

- provided support to staff as they presented the program's website to numerous agencies across the NVCA watershed – most municipalities are now familiar with program;
- presentation of program and website to the board;
- provided a technical evaluation of Innisfil Creek drought modelling project.

3. OTHER PROGRAM INITIATIVES

Over the course of 2017 a number of other initiatives also formed part of the overall work program.

Website – Through 2017 the partnership with GIS staff from Central Lake Ontario Conservation Authority (CLOCA) continued with a focus on enhancing the program's pass-worded section of the website. Enhancements to the Geocortex mapping tool on site have improved the ability of technical staff to make use of the vast data and information sets assembled through the project. Staff hosted a ½ day session in October where local consultant companies were invited to see an overview of the website and to provide input into partnership arrangements with the ORMGP. Partnership with consulting companies was initiated early in 2018.

Report Library – in 2017 the Rural Development Consultants (RDC) reports were moved into the library resulting in a significant increase in reports being made available through the program. As in previous years, in 2017 a summer student was retained to further assist in getting other miscellaneous reports into the database resulting in the addition of some 1500 new reports to the library database. Of note was the effort made by Region of Peel staff in 2017 to incorporate over 200 reports to the library.

Field Work – Staff continue to monitor a suite of approximately 40 wells to help in characterizing 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.

Lake Ontario Collaborative – following on technical SWP work, the Regional Municipalities of Peel and Durham along with the City of Toronto have begun exploring ways of maintaining: i) a Lake Ontario dynamic circulation model for the purposes of assessing spills and potential impact to water intakes within the lake; and ii) real time data acquired from monitoring stations to be established out in Lake Ontario to provide necessary data for the modelling process. In 2017, staff have attended several meetings with the collaborative partners and have provided some preliminary ideas and costing for assisting the group.

Ontario Water Quantity Protection External Working Group – ORMGP staff were invited to sit on this advisory panel to provide expertise and advice to MOECC staff as they assess water use and future management procedures related to the current moratorium on bottled water permitting.

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/Analyses

In 2017 ORMGP staff were invited to present or meet with various external agencies on behalf of the partner agencies.

- Attended a January technical session hosted by the MOECC regarding possible enhancements to the Water Well Information System (WWIS) and, in February, provided follow up technical presentations and recommendations to the MOECC's consultant and project team;
- Presented two papers (“Database Management – A Path Forward for Ontario’s Groundwater”; and “Long Term Groundwater Monitoring”) at a local one day forum of the Ontario Water Works Association held in February in Mississauga, Ontario;
- Invited to present an overview of the program’s website to the annual Ontario Geological Survey (OGS)/Geological Survey of Canada (GSC)/Conservation Authority Open House held in March in Guelph, Ontario;
- Presented a paper “Application of a hydrogeological conceptual model, south central Ontario” at the Geological Association of Canada – Mineralogical Association of Canada (GAC-MAC) Annual Conference held in May in Kingston, Ontario;
- Provided overview presentations in May to the Board of the Central Lake Ontario Conservation Authority (CLOCA) and in October to the Board of the Nottawasaga Valley Conservation Authority (NVCA);
- Continued to provide technical expertise and peer review to the Town of Richmond Hill regarding development proposals in sensitive area of artesian pressures on the flank of the Oak Ridges Moraine;
- 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 Municipality of Clarington;
- 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;
- In 2017 the program became more well known around the province and staff were invited to present to staff at a number of different agencies including:
 - The Neptis Foundation as they worked on their project “Capacity and Constraints on Water and Wastewater Systems in the Greater Golden Horseshoe: Report on Phase 1” (June 2017);
 - City of Ottawa staff as they embark on a similar program to manage their subsurface geological and hydrogeological data (April 2017);
 - City of Barrie as staff also were interested in better management of their subsurface information;
 - Environment Canada’s Ottawa staff requested a web-based presentation of program’s website in July as they look for alternatives to provide public access to environmental assessment data;
 - British Columbia’s Environment Ministry staff requested a web-based presentation of program’s website in November as they evaluate alternate means of making groundwater data accessible to the public;
 - Toronto Transit Commission (TTC) requested overview presentation of the website to evaluate potential for collaboration in further understanding Toronto’s subsurface (November 2017);
 - Presentation (December, 2017) to Southern Ontario Stream Monitoring Assessment and Research Team (SOSMART) with a view to showcasing data management to this group of CA and provincial surface water researchers and managers.

4. BUDGET SUMMARY

The four senior partners (City of Toronto, Regional Municipalities of York, Peel and Durham) each contributed \$175,000 in 2017 (Total of \$700,000). In addition, work undertaken in collaboration with SWP, resulted in some additional technical work (website development and model harmonization) being contributed to the program. The program's base expenses for the 2017 are summarized below. 2016 base costs as well as estimated 2018 base costs are also provided.

Program Component	2016	2017	2018 (est.)
Staff Costs (Wages + Benefits)	\$635,000	\$659,200	\$675,000
Office + Disbursements	\$40,500	\$61,500	\$50,000
Computer + Software	\$76,800	\$16,600	\$17,000
Consultant/Services	\$44,200	\$28,400	\$25,000
Administration	\$12,500	\$12,900	\$13,000
Total	809,000	\$778,600	\$780,000

The program was completed within an acceptable budget in 2017. With the additional funds obtained through SWP, there is some flexibility in the program budget, and therefore no budget increase has been requested for 2018.

2018 WORK PLAN – ONGOING/UPCOMING TASKS

1. DATABASE RELATED

Task 1.1 – City of Toronto Library Capture

The city of Toronto, including the TTC, have expressed an interest in hiring summer students to assist with inputting hydrogeological/geotechnical reports into the library. Staff will work with the city to ensure smooth process for moving key reports into the database.

- **Benefits:** Improved access to subsurface information within the City of Toronto.
- **Estimated Timeline:** Start up – Summer 2018.

Task 1.2 - Assessment of Consultant Partnerships

Over the course of 2018 staff will monitor external partner agency interaction with the database, both through the program's website, as well as through the Citrix platform, and make any necessary adjustments as the year progresses.

- **Benefits:** This task will ensure continued ready access to the program data by technical staff. 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. For government agencies, this also allows for staff to utilize software that they do not have in-house.
- **Estimated Timeline:** Ongoing through 2018.

Task 1.3 – Knowledge Management Capture

Staff have been considering for some time the most effective means of capturing 'nuggets' of groundwater related knowledge into the program's management system and database. After some deliberation, staff intend to capture such knowledge into a new table within the database. The intent of this new table will be to capture hard to gather stories that might have significant bearing on future groundwater practitioners (e.g flowing conditions, buried valleys, areas of poor water quality, etc.). One way of capturing such information would be to interview experienced consultants to gain insights on their most unusual or surprising groundwater stories over their careers. Capturing this information as an x, y, coordinate along with some specific fields and a 'story' (case study) would round out the information capture.

- **Benefits:** This type of exercise would build on the types of data and knowledge capture activities that are already undertaken through the program. Frequently, this type of information would either not have been reported or reports might not constitute the main document library held at the ORMGP. Having a mapped layer of such 'cautionary locales' where a synthesized story is readily available via the ORMGP website would benefit the overall understanding of water resources across the study area.
- **Estimated Timeline:** Initial map available on website – Fall 2018.

Task 1.4 – Improved Elevation Control

Over the years, as improvements are made, specifically with respect to elevations and coordinates of wells/boreholes, staff have noted that periodically such changes/updates can necessitate a cascading need to also update other elevation related data tied to any particular well (e.g. water levels, geological picks, etc.). This is the case especially with values that have been imported into the database with elevation units of mASL (as opposed to depth units of metres). If such changes are not made to the data at the same time as the change is made, then having to return to a particular location at a later time and validate whether these data have been updated or not has proven difficult. In 2018 staff will implement some technical changes within the database to better record the well elevation at the time of a water level or geological pick entry so that a better tracking of

elevations and updates can take place. This will entail the creation of additional tables, changes to the existing underlying tables and modification to related views.

- **Benefits:** This task will provide for improved management of elevation related data within the database, particularly geological picks and water levels.
- **Estimated Timeline:** Fall 2018.

Task 1.5 - Improved migration of consultant data into the database

This task did not get fully carried out in 2017 and is repeated here given the opportunity it reflects, especially now that consultants are partnering with the ORMGP. 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 ORMGP 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 2018.

Task 1.5 - Continued improvement and expansion to the database

The database is now 62.3 gigabytes in size and continues to grow as new information is appended. Along with York Region staff, in 2018 there will be an attempt to contact golf course owners with a view to attain and import into the database long-term water related data from golf courses in the study area. 2018 will see continued work on a process to automate the import of York Region data into the master database. Updates to the MOECC WWIS and PTTW will take place over the course of 2018. Data from various partner agencies will continue to be imported into the database. Staff will enable search routines that will automatically acquire and add into the database new Environment Canada streamflow and climate data, thus keeping these data sets up-to-date moving forward.

- **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 2018.

2. ANALYSIS & NUMERICAL MODEL RELATED

Task 2.1 - Model Harmonization

With some 70 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. Having initiated this task in 2017, with a focus on the geological layering, future work will also harmonize other hydrogeological 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 2018

Task 2.2 Updated Water Budget Tool

The website currently holds a water budget tool that allows for users to select an area of interest and run a water budget analysis. There are additional ways for this part of the website to be enhanced including:

- adding the ability for users to view the value at any given cell while the mouse hovers over the cell;
- providing results that have been obtained using different analysis techniques;
- providing summaries on a more frequent basis (e.g. monthly);

Task 2.3 - Mapping of Known Groundwater Problem Areas

This task was initiated in 2017. A wealth of information exists within the program information and analysis system to better inform projects as to subsurface conditions to be expected prior to commencement of any large construction/infrastructure projects. This task will result in regional-scale mapping of areas that are characteristic of various hydrogeological settings (buried valleys, shallow water table conditions, confined aquifer settings, groundwater under pressure, etc.). 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 (both consultants and government) can provide preliminary knowledge regarding overall project cost and necessary efforts. Such regional maps can provide a screening tool prior to the detailed work necessary for project design.
- **Estimated Timeline:** Initial draft - summer 2018.

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. A possible solution is to develop on-line executables (e.g. input pumping rate, location, and aquifer – model run would return drawdown at a municipal well; run particle tracking routines, etc.) 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:** Such tools 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:** Initial application/tool – fall 2018.

3. OTHER INITIATIVES

A key initiative in activities related to communication and outreach activities will focus on continued enhancement of the program's website to deliver data, information and knowledge in an easily accessible manner. Over 2018 the goal for the website is to build upon the successes of 2017 by offering newer and better ways to access, view and analyze data, all to benefit partner agency staff. Staff will continue to explore additional statistical options that SQL 2016 presents in terms of its linkage with the "R" statistical software package (additional charts, graphs, etc.). The technical content currently available on the website will be enhanced by providing additional insight pieces that succinctly summarize different hydrogeological analyses that have made effective use of the vast store of data in the database. A prominent goal of the program's website continues to be to reduce the need for extensive knowledge regarding how to use various individual specialized software packages (e.g. Sitefx, GIS, SQL Management Studio).

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 maps on the website. Report ready and printable geological borehole logs are also expected to be generated on the fly within the website environment.

- **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, staff will continue to explore ways to provide users with more direct access to 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:** Winter 2018.

Task 3.3 GIS Platform

Staff are currently working on establishing a GIS platform (using freely available and powerful programs (Quantum GIS/QGIS and GRASS GIS) 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 2018.