



GROUNDWATER PROGRAM NEWSLETTER

EARTH SCIENCES SECTOR / SECTEUR DES SCIENCES DE LA TERRE

BULLETIN DU PROGRAMME SUR LES EAUX SOUTERRAINES



GROUNDWATER News HYDRO Nouvelles

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Editor's MESSAGE

The fourth edition of the newsletter marks two important events, the completion of the first year of the Groundwater Program and the edition of the fourth Hydrogeology day which for this year, it was actually two days! This issue is entirely dedicated to inform our partners and stakeholders of the status of the program after its launching, one year ago, with a brief description of the status of each of its projects. This issue is a bit longer than usual, so I encourage you to read all through the end, there are many news to read.

April is also a month of hope, hope that it will finally bring a nice and long Spring time, which, after such a long and cold winter (my fifth already!), will be much welcomed. Because a new fiscal year begins today, there is also hope that our managers will reward our hard work and commitment to developing a quality program as we have shown all through last year, with a larger budget for the new year.

I continue the section dedicated to short stories with my personal impressions of trips across Canada, This time I tell you about my trip to the Oak Ridges Moraine current «Headquarters» in North York, ON.

Good reading and ... Viva la primavera!

MESSAGE de l'éditeur

Cette quatrième édition du bulletin marque deux événements importants : l'achèvement de la première année du programme sur les Eaux souterraines et la tenue de la quatrième journée d'hydrogéologie, qui cette année s'est échelonnée sur deux jours! Cette édition est entièrement consacrée à informer nos partenaires et intervenants de l'état d'avancement du programme, un an après son implantation, en présentant brièvement les réalisations de chaque projet. Cette édition est un peu plus longue que d'habitude, alors je vous encourage à la lire jusqu'au bout pour connaître toutes les nouvelles.

Le mois d'avril est un mois d'espoir. L'espoir d'un printemps clément, qui sera bienvenu après un hiver long et rigoureux (mon cinquième déjà!). Comme une nouvelle année débute aujourd'hui, j'espère aussi que nos gestionnaires récompenseront notre dur labeur et notre engagement à développer un programme de qualité, comme nous l'avons démontré tout au long de l'année, avec un budget plus substantiel en 2004-2005.

Je continue à vous rendre compte de mes impressions personnelles suite à mes voyages à travers le Canada. Cette fois, c'est de mon voyage au quartier général de la moraine de Oak Ridges, à North York en Ontario, dont je vais vous entretenir.

Bonne lecture et... Viva la primavera!



*Alfonso Rivera, Chief Hydrogeologist and
Groundwater Program Manager*

*Alfonso Rivera, Hydrogéologue en chef et gestionnaire de
programme sur les eaux souterraines*

4th HYDROGEOLOGY DAY

The 4th Hydrogeology Day was held at GSC-Québec on March 11. It was attended by 35 participants; the majority from ESS project teams, plus several provincial partners. It is with pleasure that we welcomed Laurent Tardif, senior analyst at the office of the Assistant Deputy Minister. He demonstrated a strong interest in this meeting and in our program and its various accomplishments, including strong links between the GSC and GC. The session, chaired by Alfonso Rivera provided a forum to discuss the accomplishments of ESS groundwater projects, inform on the planned activities of the ESS Groundwater Program for 2004-2005 and discuss future perspectives. A summary of projects' accomplishments is presented below.

Presentations were complemented by 2 plenary sessions on sustainability and vulnerability of regional aquifers. Both discussion sessions emphasized the need for increased data gathering and interpretation by federal agencies in order to support decision making for governments and agencies involved in groundwater management and protection. There was also a consensus on the fact that new data is required to improve regional aquifer inventories and to address thematic issues.

A lecture and training by Waterloo Hydrogeologic Inc. on groundwater modeling, with hands-on computer examples, took place on March 12. It provided ESS project teams with state-of-the-art models to be used for the assessment of regional aquifers, a major outcome of the program.

This 2-day meeting provided all with a great opportunity for scientific exchanges and communication with collaborators inside and outside the Sector. Thanks to all who attended and those who helped organizing it.



Projects' accomplishments: Regional Groundwater Assessments

Annapolis-Cornwallis Valley Aquifer study (ACVAS), Nova Scotia

Christine Rivard and Yves Michaud presented preliminary results on geology, aquifer characteristics and groundwater flow. A 3D geological model was developed. Work performed so far suggests a much more complex Quaternary sediment architecture and some



indications of narrow NE-trending buried valleys in the eastern portion of the study area. Good aquifer potential could be found in those units, in addition to main bedrock aquifers. The team was invited to submit a full proposal for the CCAF Water Resources program. Many fruitful collaborations were established with local participants

Christine.Rivard@nrcan.gc.ca

Transboundary aquifers of the Châteauguay River watershed, Quebec

Miroslav Nastev mentioned that the project is currently supporting 6 graduate students to focus on important issues related to Quaternary geology, regional recharge, regional groundwater quality, numerical modelling of regional groundwater flow, spatial distribution of hydraulic conductivity, and vertical distribution of transmissivity. The highlights of 2003-2004 are the development of the conceptual model for regional groundwater flow and the 3D model of Quaternary geology.

Miroslav.nastev@nrcan.gc.ca

Oak Ridges Moraine: A Hydrogeological framework for Southern Ontario and the Great Lakes Basin

Dave Sharpe stressed that the ORM study was completed according to the standards proposed in the «Canadian Framework for Collaboration on Groundwater» (hydrostratigraphic model, numerical modelling, vulnerability mapping, sustainable yield). Other highlights comprised isopach maps, protocols (i.e base flow surveys), 3D numerical modelling directly linked with new data gathering (coalition partners), collaboration with ORM Conservation Authorities Coalition and ORM Foundation, and participation in the Ontario Source Water Protection Expert Panel.

David.Sharpe@nrcan.gc.ca

Paskapoo Groundwater Study, Alberta

Steve Grasby presented initial results from the Paskapoo regional aquifer assessment. The Paskapoo Formation extends over 10'000 km² in southwestern Alberta; this formation alone accounts for a quarter of all water wells in Alberta. Spatial analysis shows strong regional relation with surface topography and regional trends in GW levels. Well log analysis has shown a thickness up to 700 m, with a sandstone/shale ratio of 0.34. Detailed core analyses was used to calibrate well logs and permeability measurements. A series of fracture measurements has shown a strong relationship between fracture spacing and bed thickness in channel sands. Bedrock

monitoring and well installation have been done in close cooperation with Albertan universities, in some cases these are tied with DNAPL transport studies. GW quality tends to be good in the western portion of the aquifer and degrades eastward, with notable increase in Na and SO₄.

Steve.Grasby@nrcan.gc.ca

**Projects' accomplishments:
Remote Sensing in support of groundwater assessments**

Richard Fernandes presented the major findings of this project after a year of intense monitoring focused on aquifer recharge and evapotranspiration (ET) at the regional scale in the ORM area. The team's findings are: lack of continuous point climate datasets; cost-effective production of large area image products; spatial variability in climate does not matter in ORM; actual ET can differ substantially from Potential ET; Sensitivity of recharge to vegetation depends on soils; and Model needs improvement in early winter freeze-thaw.

This team has developed good outreach activities promoting the project at the regional (poster), national (via ESS web sites) and international (France).

Richard.Fernandes@nrcan.gc.ca

**Projects' accomplishments:
Thematic Research**

Dynamique de l'écoulement des eaux souterraines dans un esker abitibien

Serge Paradis a présenté les principaux résultats de cette initiative: les travaux de 2003-2004 ont permis de vérifier l'hypothèse qui soutient le développement de l'outil d'acquisition-intégration (interprétatif-contrainte) pour la reconstitution stratigraphique semi-automatisée de coupes et de volumes de l'esker. Le travail effectué va permettre d'expérimenter l'outil avec des données provenant de différentes coupes réelles (stratigraphiques, électriques, etc.). Ces réalisations ont été atteintes malgré la difficulté d'accéder à d'importantes données, dans l'état actuel de crise à la compagnie Parmalat.

Serge.J.Paradis@nrcan.gc.ca

N-Cycle, PEI

Martine Savard reported that analyses of N and O stable isotopes of nitrates dissolved in waters is now available and in operation with the development of a field sampling protocol using ion exchange resins, a silver nitrate extraction protocol (modified from USGS) and protocols for existing GSC analytical equipment. Preliminary interpretation indicates that: the Wilmot River water (PEI) is mainly derived from GW from July to December; 22% of private wells surveyed exceed the health threshold and 5% are within the natural range (0-1 mg/L); July to December GW is the source of nitrates in the Wilmot River; denitrification does not seem to play a major role in the N cycling, but natural attenuation by dilution does; the NO₃ vs delta¹⁵N, and NO₃ vs delta¹⁸O trends could be mostly explained by mixing low- and high-nitrate concentration waters; 84% of Nitrates seem to derive from fertilizers; 14% derived from soil N (organic matter) and 2% from manures/septic waste, but these preliminary figures need to be further assessed.

Martine.Savard@nrcan.gc.ca

Bedrock Aquifers of the Lake Saint-Martin Area, Manitoba

Alexandre Desbarats presented highlights of project activities for 2003-2004. These included the geostatistical mapping of multiple hydrogeochemical parameters using indicator kriging, water balance and evapotranspiration calculations for Lake Saint-Martin, and barometric efficiency calculations for monitoring wells in order to estimate aquifer storage properties. He also reported on his application of the logistic regression approach to aquifer vulnerability mapping in the study area. A significant finding of the past year, based on geological, hydrogeochemical and piezometric evidence, is the apparent role of the ring of uplifted Ordovician rocks surrounding the Lake Saint-Martin Impact Structure as a major regional discharge area. This feature also appears to control the spatial distribution of elevated fluoride levels that afflict the area. The main project output was GSC Open File Report # 4624 «Groundwater Resources of the Lake Saint-Martin area, Manitoba» consisting of 6 sheets of maps at 1:100 000 scale.

Alexandre.Desbarats@nrcan.gc.ca

Information Management

National Groundwater Database

Éric Boisvert presented major highlights of the National GW Database, including the development of a user requirement questionnaire; a prototype for metadata collection (data entry tool and web service) and distributed databases interoperability using OGC standards; a draft design of the architecture; and a common water well schema based on the report from the John Gilliland's workgroup of groundwater data in 1992.

Eric.Boisvert@nrcan.gc.ca

PathWays Project: Groundwater science for decision-makers (joint project with SDKI)

Boyan Brodaric presented the results to date concerning resource assessment modelling (aquifer vulnerability), risk assessment modelling (sustainable yield), integrated assessment modelling, as well as a decision support toolbox. Shannon Denny presented a demo. Boyan.Brodaric@nrcan.gc.ca



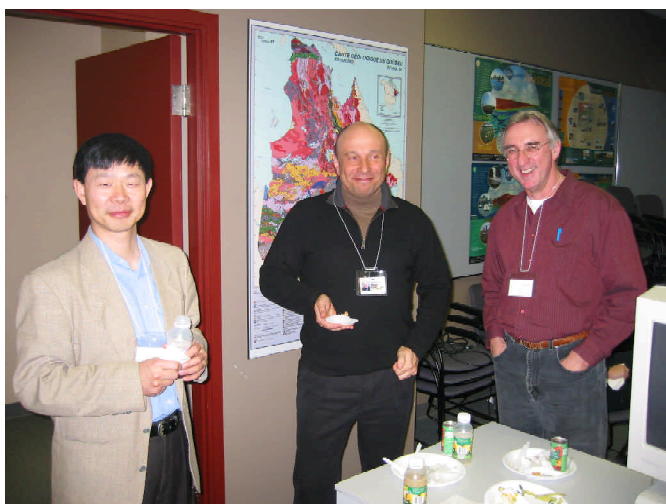
Shannon Denny giving her presentation

ESS Groundwater Program for 2004-2005 and future perspectives

Alfonso provided a quick overview of the second year of the Groundwater program. At the time of the meeting the new budget was not known, but he announced that chances were high for keeping the same resource level in fiscal year 2004-05 as in last year. All Responsibility Centers at the project level will remain the same: J02, J03, J04 and J05. Three sub-projects will be completed by March 2004: ORM, Gypsumville and Gulf Islands, and 4 new sub-projects will begin in April 2004: the Great Lakes Basin, the monitoring network of networks, the Okanagan basin, and the Waterscape outreach initiative.

Given the impact the program is having, Alfonso announced that the perspectives related to leverage will continue to grow in the second year of the program. He mentioned 3 important ones, Climate Change Action Fund (CCAF), Government related initiatives Program (GRIP) and MC with MSC. Furthermore, partnership agreements will be either completed or in progress with Quebec, Ontario, Alberta and British Columbia.

Finally he outlined a detailed outlook for the preparation of a book on groundwater in Canada, due in 2006, marking the end of the first phase of the Groundwater program. For more info you may contact him directly at arivera@nrcan.gc.ca.



Informal discussions during lunch break. Zhuheng Chen, Alex Chicagov and Normand Rousseau

TRIP TO ORM HEADQUARTERS

Allow me to share with you my impressions of the trip I made on January 14, 2004, to the Oak Ridges Moraine (ORM) Headquarters. David Sharpe accompanied me and **Steve Holysh** was our host.

I call it ORM «headquarters» simply because the *EarthFX* offices in Northern Toronto (*quartier* York) is where the action is these days relative to the Oak Ridges Moraine assessment. Since about a year, Steve Holysh had convinced the Conservation Authorities Moraine Coalition to immerse into a detailed numerical modeling of the ORM aquifer system. I call it *system not aquifer*, because the ORM is not one aquifer but a series of 3 aquifers and one aquitard. The

Conservation Authorities Moraine Coalition includes 9 Conservation Authorities, YPD (for York, Peel and Durham) and the city of Toronto located along the Oak Ridges Moraine.

Dave and I spent the whole day with Dick Kassenaar, E.J. Wexler, Rick Gerber and Steve Holysh discussing the three-dimensional model of the ORM. Our host was so kind to share with us all the details of the modelling work.

I must admit that I was a little bit skeptical at the beginning (before the meeting) but as we discussed and I saw and heard, I got impressed by the work done so far. I liked not only the technical part of the work but all other actions that *led* to the modeling. This is a very good example of how the protocols of numerical models should be conceived and built. There was a clear purpose, a pre-defined conceptual understanding, partnerships who «bought» the modeling idea, real application and, very importantly, a certain degree of «freedom» of the modellers to do their work. All this might sound standard, but it is not. Let me add that I was impressed by the database and the direct integration into the modelling.

In particular, I'd like to mention that the work done by Dave and his team at the Geological Survey of Canada has been acknowledged and integrated into the ORM 3D numerical model. We are very proud of this work, being one on the sites where we have collected the highest quality data. I understand that it is not easy to numerically «discretize» everything we've conceptually «seen» at the ORM region, but the modelling efforts to account for our geological framework, if truth be told, are very good. The hydrogeologic model that has been built is indeed excellent. In particular I'd like to commend Steve for putting those teams and convincing people in the CAs and municipalities.

From the technical point of view, there is still some work to be done to calibrate the model in its various layers, and if possible to evaluate transient effects for the case of sustainable yield predictions, and for testing the boundary conditions to the west. Once there is confidence in the model, it would be very helpful to simulate regional sustainable yield linked to exploitation (pumping), environmental conditions (linkages with surface water), and socio-economical conditions (resource management and land change practices, and protection). These are some of the issues we are planning to do at the GSC in our regional aquifers assessments, in view of the inventory of the groundwater resources of Canada. The Oak Ridges Moraine is certainly one of the most important regional aquifers in Canada, and it could set the standards for future regional characterizations and assessments.

It was remarkable to learn how the model estimates indicate the groundwater in storage and the fluxes, in and through the Moraine and adjacent aquifer formations, sustain close to 90% of all surface water base flows in rivers and creeks in the study area, as well as a smaller percentage of discharge to Lake Ontario.

Discussing modeling issues really takes you away from reality sometimes, so at about 16:00, I hadn't realized I still had to catch a plane to go back home, and given the weather conditions of that day I had to leave and literally run to catch a taxi. But that is easier said than done in Toronto as I learned later, specially when it is snowing heavily. I didn't know it could snow as much as in Quebec City!

It was already chilly with a light snow when we left the hotel in the morning. During the day, the weather quickly changed to heavy snow, colder and windy. By the time I went out to catch a taxi it was rush hour and, without knowing what that meant in Toronto, I plunged into the city. I have lived in other large cities before (Mexico City, Paris) but the chaos I'd seen in those cities seems *kindergarten* compared to what I saw that day in Toronto! It took the taxi 2 hours to reach the airport (and the meeting was in the north) -But I must admit that the ride was very funny seeing and listening to the show offered by the Torontonian taxi driver (from Asia) who was in a great mood that day. Parisian taxi drivers are always in a bad mood and may be very aggressive against your «ignorance» of the city. Mexico City taxi drivers, on the other hand, may be very dangerous in the sense that they don't watch the streets as much as they enjoy «guiding» a stranger through their city.

But the Torontonian taxi driver was very eloquent asking five questions per minute (!) and offering a different view to each of my replies. However, he was very patient through the traffic chaos and even encouraged me with positive thinking, thereby turning my negative comments and anxiety into a more relaxed mood. At the end, I missed my flight but it *didn't matter*, for I'd had a piece of philosophy through the chaos of Toronto's traffic under heavy snow. A city with a mosaic of cultures indeed.

A. R.

CONSULTATION AND COOPERATION

ESS Groundwater Program at the Federal Prairie Water Committee (FPWC) meeting

Steve Grasby represented the ESS GW Program at the FPWC meeting held in Regina on February 24-25, 2004. The meeting was attended by 54 representatives from Environment, Health, Public Works and Government Services, Forest Service, Parks, National Defense, Indian and Northern Affairs, Fisheries and Oceans and the Prairie Farm Rehabilitation Administration (Agriculture and Agri-Food). Copies of the *Canadian Framework for Collaboration on Groundwater* were distributed to all participants, sharing NRCan's vision and leadership for collaboration on groundwater research in Canada. Ideas for collaborative studies were proposed, among which: the integration of federal water databases, the initiation of a survey on water resource and water use in the Prairies, and the development of a pilot project to study source to tap water issues, in which each department would contribute their own expertise on human health, ecosystems, water distribution, and water resources.

ESS Groundwater Program invited by the Manitoba Water Stewardship to attend Provincial-wide Water Workshop

Alexandre Desbarats represented the ESS GW Program at the Watershed & Basin Boundary Workshop in Winnipeg, February 26, 2004. With the release of the Manitoba Water Strategy in April 2003 and the increasing priority placed on water related issues by the public and governments, this workshop was organized by Manitoba Water Stewardship in order to focus on the standardization of watershed and basin boundaries in Manitoba. The workshop provided a forum for the exchange of technical information of interest to federal and provincial government agencies working on programs that rely on watershed and basin boundaries.

Approximately 60 people from various federal and provincial departments attended the workshop.

Water Think Tank, Vancouver

Alfonso Rivera was invited to participate as one of the members of the Water Think Tank. In May 2002, Simon Fraser University and UBC hosted the very successful «Water and the Future for Life on Earth» workshop. A Think Tank associated with that workshop gathered the expert presenters with representatives of government, industry and environmental non-governmental organizations. Following the conclusions of that workshop, a follow-up dialogue on the Water and the future for life on earth think tank deliberations reunited again at the Morris J. Wosk Centre for Dialogue, Vancouver, on March 15-16 2004. The theme of this new meeting was «Moving the Water Agenda Forward». This meeting was centered on developing a Canada Water Council. Various strategies to move forward with solutions and actions, were discussed by the think tank, generating strong consensus on the need for an independent body to oversee effective water policy and protection in Canada.

COMMUNICATIONS

New Groundwater Program website

I am glad to announce that you will soon be able to access the Groundwater Program newsletter on our updated website, which is in development and will be accessible at : <http://gwp.nrcan.gc.ca>. Visitors will have access to one-pagers on each project and sub-project websites. The site will also provide information on on-going collaborations, activities, major outputs from the program, such as the Canadian Framework for collaboration on Groundwater, etc. Any suggestion for content can be forwarded to myself and Pascale.

Canadian Science Writers' Association (CSWA) 33rd Annual Conference

The Groundwater Program will play an active part in the meeting (June 5-7, Toronto), whose theme is: «**Water — the science of water and how it affects our lives**». The other federal departments present are Environment and Health Canada. Alfonso will prepare a scientific article ad-hoc for the meeting, to be published in English in «Science Link», the CSWA Newsletter and in both official languages on the association's website. Dave Sharpe will deliver a keynote speech; and there will be 3 posters presentations from the GWP project teams. Participating to this meeting is an excellent opportunity to reach an audience of national science reporters and writers for various media (press, TV, radio, magazines).

Additional photos from the Hydrogeology Day workshop are available upon request. The scientific article on groundwater to be presented at the CSWA will also be available at the end of April. Please send all requests to Pascale.

