



Groundwater Program Newsletter

Groundwater News

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Edition: **Alfonso Rivera**

Coordination: **Cintia Racine**

Layout: **Marie-Josée Tremblay**

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Editor's Message

"Politicians can make us more fearful and thereby be disablers, or they can inspire us and thereby be enablers." – Thomas L. Friedman

Who drives whom in Canada? Is government driving the country? Is society driving the country or government? And what does science do? Is science setting the basis for good government, peace and order in this country or is society doing so? Are scientists being listened to? Are politicians listening to citizens? Are they listening to scientists? Does society care about science? Is there a well-established dialogue between politicians and citizens and between politicians and scientists? Is there a dialogue between scientists and citizens? Does a "trialogue" exist in Canada where government, society and science converge? (A triologue is a conversation or discussion in which three people or groups participate.)

These and many other questions were discussed at the Hydrogeology Day 5 (HgD-5) held in Ottawa from February 28 to March 2, 2007. I wanted to evaluate how Natural Resources Canada's (NRCan's) Groundwater Program fits into a potential triologue in Canada. Because the outcomes of that meeting were so rich and interesting, this issue of Groundwater News is dedicated to this theme.

The idea of discussing this issue within the Groundwater Program, and between its program and stakeholders, came to me after I attended an international meeting in Cairo, Egypt, in 2005. That was one of the best meetings I had attended in many years, for its content and the participants passion. The meeting, organized by the United Nations

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World Meteorological Organization, was on managing groundwater in arid and semi-arid countries. More than 70 experts participated from 45 countries, most of them located in difficult geographical conditions relative to the availability of water resources (mostly in Africa and the Middle East). I was surprised to see that many (almost half!) of the participants were not hydrogeologists; most were not scientists. They were decision-makers, water managers, politicians and lawyers!

These experts covered a broad range of domains dealing with technical, economic, social, environmental and legal matters linked to groundwater management in their countries. Most of the issues discussed centred on the extent to which government, society and science are engaged in and effectively contributing to water management decisions. In most countries, water governance aspects are improved when stakeholders are involved in the management process. The key issue: Who has the voice in the various aspects of groundwater management? Workshop participants pointed out that in today's governance processes and products, the voice of scientists is important but often muted.

I was both relieved and shocked by what I heard. There is a high level of interactions between the three components of the triologue in some countries (e.g. South Africa). In some, less democratic countries (Africa and the Middle East), there is not even a dialogue – there is only a monologue. In those cases, governments take unilateral decisions to managing resources. In other cases, given that water resources cross political boundaries, management decisions are strategic, a matter of potential wars and conflicts.

Upon returning to Canada, I realized how lucky we are in this country. But I asked myself: How are we doing in this highly democratic Canada? Are we (i.e. hydrogeologists and other scientists) relevant when it comes to managing this precious resource in our country? What is the level of interactions between the three elements of a triologue? I wanted to find answers to these questions through a panel discussion. From this emerged the main theme of the Hydrogeology Day.

At the HgD-5, I particularly enjoyed the Triologue panel and plenary discussions that followed. I was surprised to see the high level of interactions among the three elements of the triologue as it slowly develops in Canada. So I invite you to plunge into this newsletter and, if you are interested, to visit the program's Web site, where you will find the full minutes and presentations of the HgD-5.

Alfonso Rivera

Chief Hydrogeologist and Groundwater Program Manager



The Trialogue

Governance as a Trialogue

The book entitled *Governance as a Trialogue: Government–Society–Science in Transition* (Turton et al., 2007) handles the basic elements of governance, with a specific focus on **Integrated Water Resources Management** (IWRM) issues. This book analyses the linkages between key variables of governance to increase our understanding of what makes governance good. The authors are mainly specialists in IWRM and scientific communication.

The concept of governance and especially “**good governance**,” according to the authors, is pivotal to the achievement of IWRM. The definition of IWRM as “a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” clearly expresses that governance is a fundamental element in the process.

The authors propose a **trialogue model** of governance that is structured around three groups of actors: **Government, Society and Science**. These groups are structured in a manner to enable interrelations among them in a configuration named the “trialogue” (triangular shape). Relations among the three groups of actors are based on the communication and the feedback. The efficiency of these relations is a function of the interface quality among each of the groups of actors. The authors identify three main interfaces.

First, the **Government-Society interface** determines the needs and requirements of society, the legitimacy of the political process, and the permeability of government to new ideas from civil society and the corporate world. This interface also represents the degree to which government satisfies the needs of society.

Second, the **Government-Science interface** determines the extent to which science and technology form the basis of the political economy. It also determines the extent to which scientific knowledge informs the decision-making processes that are a principal function of government.

Finally, the **Science-Society interface** can be thought of as science in the service of society. It consists of a number of elements, including the ways that scientific knowledge is diffused into society.

Rosenberg International Forum on Water Policy

The Fifth Biennial Rosenberg International Forum on Water Policy took place in Banff, Alberta, in September 2006. The overarching theme of the forum was to reduce conflict in the management of water resources. In relation to this theme, the forum discussed governance elements related to water resources based on a triologue model (discussed in “Governance as a **Trialogue**,” above).

In the forum, the first Regional Rosenberg Workshop took place. This new workshop brings together an international panel of experts to consider a regional water resources problem, or problems, and to offer scientific advice on the nature of the problem and the ways it could be addressed. For the first workshop, the Government of Alberta requested the panel to review its water strategy, “Water for Life,” and Groundwater Action Plan.

The Government of Alberta’s approach to developing these water resources policies falls under a governance **trialogue** model.

With the increase in the exploitation of fossil energies in Alberta (i.e. gas and oil), citizens and some non-governmental organizations (NGOs) expressed their concerns to the government on the risks of water resources contamination and the potential for water-use conflicts. Concerned about these apprehensions, the Government of Alberta conducted public consultations regrouping citizens, municipalities, NGOs, other government departments and industries. These consultations led to the Government of Alberta’s development of “Water for Life.” This strategy recognizes that there are important gaps in the knowledge of water resources in the province, in terms of quantity and quality, especially in groundwater. After it developed this strategy, the government approached different scientific groups to review it, such as the Alberta Research Council. Recommendations on groundwater management led to the development of Alberta’s Groundwater Action Plan.

The expert panel’s review of Alberta’s water strategy and Groundwater Action Plan during the Regional Rosenberg Workshop allowed the participants to formulate recommendations on how to strengthen the recognition and applicability of these policies. These recommendations reflect the vision of each expert on the panel, including that of NRCan’s Groundwater Program, represented by Alfonso Rivera.



The international panel of experts put together by the Rosenberg Forum and representatives of the Government of Alberta (from left to right): Colin Fraser (Alberta), Uri Shamir (Israel), Ramon Llamas (Spain), Paul Perkins (Australia), Ben Rostron (Alberta), Helen Ingram (U.S.), Henry Vaux (U.S.), William Jury (U.S.), Peter Watson (Alberta), Gna de la Cruz (Alberta), Kevin Parks (Alberta), Robert Sandford (Alberta), Kate Rich (Alberta), Alfonso Rivera (Canada), Robert Georges (Alberta) and Heather von Hauff (Alberta).

Study of Nitrogen Cycle of P.E.I. Aquifers – A Successful Trialogue

The ESS-Groundwater Program project called Study of Nitrogen Cycle of Prince Edward Island (P.E.I.) Aquifers at Risk constitutes a good example of a successful triologue. In 2003, the Department of Environment, Energy and Forestry of P.E.I. exposed the following problem:

The environment is greatly affected by intensive agricultural activities that reject, in the soils, surface water and groundwater, nitrogen in different forms; nitrates [NO₃] being the most common. Agriculture being the first economic activity of the province, the increased nitrogen rejection in the environment in the climate change context constitutes a long-term problem that must be solved. (P.E.I.-EEF)

With the agreement of Environment, Energy and Forestry, Martine Savard (scientist) of NRCan's Groundwater Program, supported by the Climate Change Action Fund and in collaboration with Agriculture and Agri-Food Canada (AAFC), developed a research project. Called "Study of Prince Edward Island Nitrogen Cycle of Aquifers at Risk," it would bring solutions to solve this problem.

In this project, the interactions between government, science and society were efficient and multiple. NRCan (science) directed the project and allowed hydrogeology expertise in modelling and isotopes geochemistry. AAFC (science) provided expertise in land use and soil sciences. The Department of Environment, Energy and Forestry of P.E.I. (government) supported the project's logistics and was involved in groundwater characterization and modelling. The domestic well owners (society) provided access and allowed groundwater sampling from their private wells.

Continued interactions between these actors from 2003 to 2007 produced recommendations to initiate targeted actions towards addressing the problem. At the end of the project, NRCan and AAFC developed new analytical methods and new approaches to quantifying the nitrogen cycle. Also, a new science/technology transfer from NRCan to the Department of Environment, Energy and Forestry of P.E.I. would give the population access to complete data on groundwater quality.

Hydrogeology Day 5

The Hydrogeology Day 5 (HgD-5) meeting was held in Ottawa between February 28 and March 2, 2007. This year, the motto was "Groundwater Program: Recent past, 2003–06; the future, 2006–09; and beyond 2009." This motto reflects the strategic approach of the event. Participants were asked to reflect on what the program has done during the past five years, what it is doing now, and most importantly, where it is going. In brief: What is the next, best strategy of this program and team within the context of the political, social, economic and environmental issues facing our country?

The HgD-5 also differed from the previous four meetings in that the program now considers new aspects and issues regarding groundwater resources – social, political and environmental – to frame its scientific work. In that context, the past, the present and what the program should plan for the future were debated in great depth. Identifying the best strategy to adopt for the program's present and future had to agree with political, economic, social and environmental issues in Canada.

Moreover, the HgD-5 differed from the previous meetings by integrating the concept of a trialogue based on the communication and feedback among actors from government, science and society. The discussions either took the form of a trialogue or referred to this concept.

The four main themes discussed at the HgD-5 were as follows:

- the Groundwater Program results
- the trialogue among the government-science-society interactions on current groundwater issues

- the partnerships across Canada
- the critical analysis of the first and second phases of the program, as well as strategic planning for a future phase

Day 1

The first day of the HgD-5 included discussions on the two phases of the Groundwater Program: 2003–06 and 2006–09. Alfonso Rivera detailed the timing of the events leading to the design and launch of the Groundwater Program, from the Canadian Geoscience Council's report in 1993 to the two national workshops on groundwater in 2000 and 2001 and the publication of the Canadian Framework for Collaboration on Groundwater in 2003. Rivera also discussed the progress on the upcoming book on groundwater resources in Canada, being prepared by the program's members and its provincial, and university partners.

The sessions that followed presented updates of the inventory of groundwater resources of Canada with the aquifer characterization and assessments carried out at the regional scale. Presenters summarized the work done, or in progress, in their domains. These presentations are available on the program's Web site at http://ess.nrcan.gc.ca/gm/index_e.php.

Day 2

The second day of the HgD-5 comprised two panel discussions, two ceremonies and the presentation of 13 posters.

Panel A – the trialogue

The discussion panel addressed the theme of "Trialogue" – i.e. the government-science-society interactions – and the lack of these interactions in groundwater management. The panel comprised a decision-maker, George Somers; a representative of society, Scott Findlay; a scientist, Martine Savard; and a politician, David Boerner.

The central element of their discussion was the collaboration between government, the scientific community and society to ensure efficient groundwater governance in Canada. The central question asked was: How effectively are we working together to manage Canada's groundwater resources? The panellists' remarks are briefly reported below.

George Somers, decision-maker

George Somers focused on three points: (1) public awareness about groundwater increases, (2) the new effort for science/technology transfers toward society and government, and (3) decision-makers requiring hard facts to make their decisions.

Scott Findlay, social scientist, representing society

Scott Findlay said that the effective management of groundwater needs local-scale participants when the problem is local. He mentioned the elements for good resources management related to society: provide enough science capacity to resolve the problem, obtain the public trust, possess and maintain scientific credibility, and show, by their attitude, that scientists understand that constraints can exist.

Martine Savard, scientist

Martine Savard mentioned some elements of success and failure in groundwater resources management. The success elements: (1) identify and thoroughly examine the socio-economic questions motivating the scientific research, (2) involve decision-makers at the beginning of a project, (3) design scientific activities aimed at solving socio-economic problems and issues, (4) prepare reports and outputs tailored for use by decision-makers, and (5) inform the main stakeholders throughout project. The failure elements: (1) at the government level, its short-term vision, sensitivity to lobbies and inertia; (2) at the society level, the research of economic benefits; and (3) at the science level, the individualism of scientists.

David Boerner, politician

David Boerner said that to obtain efficient resources management, we all have to work efficiently in all elements of management. The work can be improved if we all make an effort to listen, communicate and comprehend and better recognize successes, challenges, constraints, main ideas and goals.

Panel B – partnerships

The panel discussed partnerships in groundwater resources management in Canada. The panel comprised government representatives John Lawrence, Environment Canada; John Oosterveen, Agriculture and Agri-Food Canada; Daniel Lebel, Natural Resources Canada; and Bob Betcher, Manitoba Water Stewardship.

The central element discussed was the existence of knowledge gaps of the groundwater resources of Canada at country scale. To fill in the gaps, federal and provincial governments have launched a series of initiatives.

In concluding, the panel discussed pursuing the collaboration between federal and provincial governments in developing groundwater projects in Canada. It also concluded that increased collaboration among social, scientific and government actors is required to:

- adequately identify knowledge gaps of groundwater resources of Canada;
- determine projects that fill these gaps; and
- develop projects that satisfy the needs of stakeholders and use specific services and knowledge of each stakeholder

Ceremony for MOU between B.C. Ministry of Environment and Natural Resources Canada's Earth Sciences Sector

A memorandum of understanding (MOU) was signed by the Groundwater Program manager of Natural Resources Canada, Alfonso Rivera, and the Water Stewardship Division director of the British Columbia Ministry of Environment, Fern Schultz. The MOU became effective March 1, 2007, and will be valid until March 31, 2009. It will try to follow the principles outlined in the *Canadian Framework for Collaboration on Groundwater* in developing joint groundwater projects in British Columbia and assessing the quality and quantity, etc. These projects will fit into the Groundwater Program's long-term vision of an inventory of groundwater resources of Canada.



Vicki Carmichael from B.C. Ministry of Environment and Alfonso Rivera from Natural Resources Canada celebrate the signing of the MOU.

Following the ceremony, the rest of the afternoon session was dedicated to showcasing the posters listed below.

- Waterscape Posters (B. Turner)
- GRACE (J. Huang)
- Atlas maps of GW issues (P. Paul)
- GW Database (E. Boisvert, B. Brodaric)
- Pathways (B. Brodaric)
- GW Earth Observation: Land cover LAI, permeability (S. Chalifoux)
- GW Earth Observation: recharge modeling (R. Fernandes)
- Eskers, Abitibi (S. Paradis)
- Statistics Canada's Environment Program: New Water Surveys (F. Soulard)
- Canadian Environmental Sustainability Indicators: Socio-Economic Information and the Water Quality Indicator (F. Soulard)
- Shallow seismic reflection methods for the delineation of the Sarsfield – Winchester Esker aquifer system, South Nation, Eastern Ontario (A. Pugin and S. Pullan)
- Web-mapping visualization and analysis of Canadian groundwater data (D. Sharpe, H. Russell and C. Logan)
- Evaluation of Resistivity and Magnetic Resonance Sounding Surface Geophysical Methods to Provide Data to Directly Enhance Groundwater Models (J. Stefanov)

Day 3

On the third day of the HgD-5, three plenaries discussed the Groundwater Program. Participants critically analysed phases 1 and 2 and discussed the visions and objectives that the program should adopt beyond 2009.

Discussion plenary 1: critical analysis of program's phase 1

In the first discussion plenary, participants analysed the first phase of the Groundwater Program. They discussed what worked and what didn't, shared success stories, and discussed the progress of groundwater knowledge in Canada.

Alfonso Rivera began by mentioning some successes in the first phase. These include the review of "Water for Life," the Government of Alberta's water strategy; the science/technology transfers carried

out in some program activities; P.E.I (the study of aquifers in Prince Edward Island); Esker/Abitibi (the study of groundwater flow dynamics in an esker, Abitibi region); and the award attributed to the RésEau project by Government On-Line (see "RésEau Award Ceremony" below).

Thereafter, the critical analysis of the first phase of the program began. The discussion centred on its successes and limitations.

First, participants recognized that the work of the first phase increased the level of knowledge of groundwater resources in Canada. For example, in British Columbia, the population is more aware about groundwater resources of their province. Consequently, their knowledge of this resource is increased, and more data is available to use for resources management. The work done in phase 1 changes the citizens' mentality in matters of groundwater management. For example, before the program, concerns about groundwater, such as managing contamination cases, were short term. Now, a long-term vision is adopted, such as that for resources assessment and protection.

Despite the work achieved in the first phase of the program, participants identified a shortage in the budget and in the number of staff for different projects. Some projects did not achieve their objectives in the three years.

To counter these limitations, participants proposed some elements of a solution. The Earth Science Sector could offer more support for the program, a phase could last five years, and the program could better target the provinces' needs in developing its projects.

Discussion plenary 2: critical analysis of the program's phase 2

The second plenary constituted a critical analysis of the second phase of the program. Participants discussed the following: Do we understand the outcomes, outputs and implications expected of this second phase? How can we prove that we will reach our goals and anticipated outcomes? How can we measure the program's success? What are the best performance indicators? What is our role in managing data and information? What are the strengths and weaknesses of the program's current approach? What should the program focus on in the next two or four years, etc.?

It was impossible to answer all these questions in one plenary. It was suggested that program projects be managed in ways to achieve expected outcomes. With this intention, a longer period of five years could be granted for the projects. To measure performance results of the projects, some indicators must be defined. However, several participants mentioned the difficulty of this task.

Also, some participants indicated that several projects related to the groundwater inventory in Canada constitute a long-term accumulation of knowledge about the resource and are not simply a series of results and products obtained by a limited date.

Discussion plenary 3: plan of phase 3, beyond 2009

The third plenary focused on the plan for a third program phase beyond 2009. Participants discussed the following: Should we re-direct our program so that it is driven by policy, social, environmental and economic issues? What can groundwater science do, and can it do so alone? How can we interact with policy makers and handle

social impacts? Do we want or need a third phase of this program?

In concluding this plenary, it was clear that a third phase for the Groundwater Program is wanted. In terms of direction, the program should give more importance to social issues and account for the needs of provinces and other partners in developing projects that will fill the gaps in knowledge of groundwater resources in Canada. A book that will present the state of knowledge on this subject is due for publication in 2009. It will serve as reference in defining the gaps to be filled in the next program phase. A longer period of five years could be considered for the next phase, which will allow projects to be finished in only one phase.

Advances in Groundwater Research

Drilling in Kelowna

The Geological Survey of Canada (GSC) conducted a drilling project in Kelowna, British Columbia, as part of the Groundwater Assessment of the Okanagan Basin project. The well, located on a corner of Mission Recreation Park, in Kelowna, had a successful completion of drilling and core recovery of about 90 percent. The well reached 88 metres (m) (288 feet [ft.]), at which point flowing artesian conditions appeared, and the drilling had to stop. This work generated significant media interest, with regional coverage on CTV and Shaw TV, as well as in the local Kelowna newspaper (visit www.kelownacapnews.com/portals-code/list.cgi?paper=113&cat=23&id=862518&more=1).

The core samples will be analysed in the GSC laboratory in Calgary, Alberta. As well, a groundwater monitoring station for the British Columbia Ministry of Environment will be installed in the drilling hole to monitor groundwater in the area.

Principally, the Kelowna drilling's main objective was to describe stratigraphically the core material; its secondary objective, to assess the groundwater resources. More than half of the 88 m sampled constituted a clay layer, which is a good news for providing protection for the aquifer below. The drilling also reached glacial till, which will allow scientists to determine when the valley was inundated with glaciers.

Another objective of this drilling was to prepare a three-D geological model of Quaternary deposits. This model will be used as a framework for developing a hydrogeological model of the region. Aquifer recharge, capacity, quality and sustainability are among the issues to be explored with the three-D model.



Serge Paradis (right) working on the drilling of Mud Bay



Steve Grasby (right) working on the drilling of Mud Bay



Steve Grasby identifying the core material recovered

People in the News

RésEau Award Ceremony

Government On-Line and the Treasury Board of Canada Secretariat's Service Improvement Initiative attributed an award to the RésEau project for Outstanding Teamwork in Developing Online Client-Centric Services. The RésEau project was developed by Natural Resources Canada and its partners – Environment Canada, Health Canada, provincial governments, non-governmental organizations and public research institutes. The main objective of the project is to regroup in one interactive Web portal all of the available information on water resources in Canada. RésEau system will provide to the Canadians through the country to access to reliable information about water resources.

Program manager Doug O'Brien, Earth Science Sector, received the award on behalf of the RésEau project at a ceremony organized by Government On-Line. Later, at the Hydrogeology Day 5, O'Brien passed the award to Alfonso Rivera to recognize the Groundwater Program's involvement in the project.



Alfonso Rivera (left) receives the RésEau project's award from Doug O'Brien

ESS Award to the Groundwater Inventory Team

The team leading the activities for the project "Assessment of Regional Aquifers: Towards a National Inventory" in the Groundwater Program received an Earth Sciences Sector Award for its work. Steve Grasby, David Sharpe, Christine Rivard, Miroslav Nastev and Richard Fernandes increased knowledge of the main aquifers of Canada by mapping and assessing their groundwater resources.

The work conducted by the inventory team over 2003–06 will have a substantial impact on groundwater management at all levels of government. Since the beginning of the project, the data it collected and analysed are used by government, universities and the private sector. Elements considered in the inventory are as follows:

- How much groundwater does Canada have?
- What are the major regional aquifers in Canada, and what is the state of their development?
- What are the groundwater volumes stored, recharged and discharged, and the production rates and groundwater residence time of our aquifers?
- What is our understanding of the interactions among groundwater, surface water and aquatic ecosystems?
- How sustainable is the current use of Canada's groundwater resources?

The inventory team also identified gaps in knowledge of Canada's main aquifers. Bravo, good work, team!



Left to right: Mark Corey (Assistant Deputy Minister, ESS), Steve Grasby (GSC Calgary), Christine Rivard (GSC-Québec), Miroslav Nastev (GSC-Québec), Richard Fernandes (Canada Centre for Remote Sensing [CCRS], Ottawa), Alfonso Rivera (GSC-Québec) and Denis Hains (CCRS, Ottawa)

Suggesting Readings

Rivera, A., 2007. Minutes of the 5ième Hydrogeology Day. Report on line at: <http://ess.nrcan.gc.ca/gm>

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World Meteorological Organization, 2007. Management and Governance of Groundwater in Arid and Semi-Arid Countries. Unedited Proceedings, International Workshop 03-07 Aril 2005, Cairo, Egypt. 370 p. WMO, Geneva.



HgD-5 Pictures

