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Natural Resources Canada 3rd National Workshop on Groundwater

N. Jacob, Y. Michaud, H.A.J. Russell, A. Rivera and B. Brodaric

2015

Canada

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Executive summary

Discussions on groundwater have been ongoing for more than a decade between the provinces, territories and federal government (Parties) through the Canadian Framework for Collaboration on Groundwater and other mechanisms. As groundwater continues to be a concern for many industrialized and developing countries, it seems appropriate for Canada to enhance science collaboration between the Parties to reach a better understanding of this hidden resource.

An internal strategic review of the Groundwater Geoscience Program was released in June 2013 and made recommendations to the program http://www.nrcan.gc.ca/evaluation/reports/2013/11142
The following workshop objectives were aligned with these recommendations:

1. Re-affirm the long standing collaboration in the field of groundwater science;

2. Discuss common opportunities for collaboration and research priorities;

3. Obtain jurisdictional input to guide strategic planning of the NRCan groundwater geoscience program.

To date, 19 of the 30 key Canadian aquifers have been mapped and assessed from the original list established more than a decade ago. Discussion about the 11 remaining aquifers is well underway. In parallel, a Groundwater Information Network (GIN) was built as a web portal to disseminate data and knowledge obtained from key Canadian aquifer studies and to enhance data gathering from provincial and territorial partners. Data is submitted for distribution via the web portal in different formats and is translated into a standardized format.

Regional water quantity and quality of some aquifer systems are known but with an enhanced coverage, Canada will have a better understanding of its groundwater resource at a national scale.

Further discussions on data gathering and dissemination are still needed as well as additional collaboration on the integration of science and policy about groundwater.

As it has been 13 years since the 2nd workshop a 3rd workshop was long overdue. It allowed fruitful discussions on the state of knowledge and the emerging issues in groundwater science, which led to the following proposed action plan:

- Pursue and enhance the long standing collaboration in the field of groundwater science under the Canadian Framework for Collaboration on Groundwater through an improved coordination system that would help increase the collaboration and knowledge delivery.

- Initiate research on the five emerging issues (water budget, climate change impacts, surface water / groundwater interactions, characterization of groundwater systems, deep groundwater vs shallow groundwater) identified during the workshop while pursuing the mapping and assessment of the remaining 11 key Canadian aquifer systems; encourage regional collaborative efforts between the provinces, the territories and the GSC for both thematic and regional studies.

- Improve communication among partners to allow better synergies by reconnecting at least every three years through an NRCan National Workshop on Groundwater.

- Investigate the establishment of an *ad-hoc* committee on data gathering and dissemination, as well as for methodologies or others as required.

- Continue to assess groundwater availability and sustainability for the entire country. This activity requires more provincial-federal-OGDs collaboration as well as a clear path forward to estimate water budgets at national scale.

Introduction

Responsibility for managing Canada's groundwater resources is shared across several federal departments, provinces and territories. By the authority of the federal *Resources and Technical Surveys Act [1985 Section 3 (c)*], "the Minister of Natural Resources Canada shall (c) make a full and scientific examination and survey of the geological structure and mineralogy of Canada", which includes aquifers. However provinces have direct responsibility for the management of groundwater.

Following 10 years (1993-2002) of research on groundwater at the Geological Survey of Canada (GSC), Earth Sciences Sector (ESS), Natural Resources Canada's (NRCan), the Groundwater Geoscience Program (GGP) was created in 2002. The program objectives were to characterize 30 key aquifer systems in Canada, assess groundwater resources, and make the data available through a national groundwater portal to help inform stakeholders in their decision-making processes.

At the inception of the GGP, 2 National Workshops on Groundwater were organized to develop the *"Canadian Framework for Collaboration on Groundwater"* (CFCG) that outlined guiding principles for intergovernmental co-operation on groundwater issues throughout Canada along with the standing groundwater committees under the Canadian Council of Ministers of the Environment (CCME).

National collaborative initiatives on groundwater

- First national groundwater workshop, June 2000, Québec City
- Second National Workshop on Groundwater, September 2001, Calgary
- Canadian Framework for Collaboration on Groundwater, 2003, Winnipeg
- Federal-Provincial Workshop on groundwater levels and groundwater quality monitoring networks, October 2003

(*See References for web links*)

An internal NRCAN evaluation of the GGP conducted in 2012 recommended that the program reconnects with its partners and stakeholders in order to ensure its activities are in line with its role and responsibilities, to promote awareness of the Groundwater Information Network portal, and to agree on a way forward for characterization of the remaining 11 key aquifers in the original list of 30, as stated in the Standing Senate Committee report of 2006. The evaluation of the Groundwater Geoscience Program is publicly available: http://www.nrcan.gc.ca/evaluation/reports/2013/11142

This report is a summary of the third national workshop on groundwater, held in Gatineau, Québec, on November 6 and 7, 2014. It outlines the discussions that took place on the ongoing collaboration, the emerging issues, the groundwater knowledge delivery and the Canadian availability and accounting.

Participants were from seven provincial (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Nova Scotia) and one territorial (Northwest Territories) governments, as well as from federal departments (Environment Canada and Statistics Canada), universities (Saskatchewan) and abroad (United States Geological Survey, USGS). Forty-six participants attended the workshop (see annex 1).

The three main objectives for this workshop were to:

1. Re-affirm the long standing collaboration in the field of groundwater science;
2. Discuss common opportunities for further collaboration and research priorities;
3. Obtain input from partners and stakeholders to guide strategic planning of the NRCan groundwater geoscience program.

Format

The workshop was held during 1 ½ days, divided into three sessions. Within each session, speakers were invited to present on predefined topics followed by roundtable discussions to better understand issues, gaps, success stories, priorities and to encourage communication.

The detailed agenda can be found in the annex 2 of this document and presentations are available via the Groundwater Information Network portal:
http://gin.gw-info.net/service/api_ngwds:gin2/en/workshop.html

Results

Day 1 – Taking stock of the past and present to build the way forward
The objective of this session was to re-affirm the long standing collaboration between Parties in the field of groundwater science in Canada.

Session 1a – Collaboration in the field of groundwater science in Canada

Recognizing that provinces have the main legislative-constitutional responsibility for water, including groundwater, the federal government has a very unique role to play in both expanding the public's understanding of this national resource and coordinating a collaborative approach to the management of groundwater- related issues that are encountered throughout the country.

The Earth Sciences Sector (ESS) provides Canada with a comprehensive geoscience knowledge base contributing to *economic development, public safety* and *environmental protection* under the auspice of the Resources and Technical Surveys Act and the Canada Water Act.

Vision and mission statements (from CFCG)

Vision: *To ensure a healthy and sustained groundwater resource for all Canadians.*

Mission: *To improve the knowledge base of Canada's groundwater resources and make the information readily available to assist all levels of government, communities, industries, and individuals in making timely and informed decisions to protect, manage, and sustain Canada's groundwater resources.*

The Geological Survey of Canada operates collaboratively with multiple provincial and territorial agencies by disseminating geoscience information as well as maintaining national databases and providing coordination with international geoscience agencies. The assessment and characterization of key aquifers within Canada is an example of this collaboration. To date, 19 of the 30 key aquifers have been assessed, providing knowledge about Canada's groundwater resources and creating partnerships between the provinces, territories and federal departments.

The Canadian Framework for Collaboration on Groundwater (CFCG) was a catalyst that brought about changes in the perception of groundwater in Canada, and highlighted inter-jurisdictional collaborations on groundwater.

CONCLUSION

Discussions on the ***Canadian Framework for Collaboration on Groundwater*** highlighted that the principles of the CFCG are still valid and endorsed by the participants, but an improved coordination system would be useful to increase collaboration and knowledge delivery.

Some questions have yet to be addressed on the subject of:

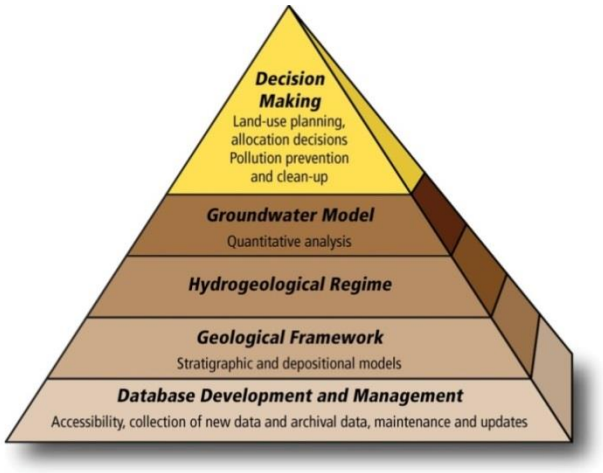
Coordination:

- How can we lever existing cooperative mechanisms to address current and emerging groundwater issues (water management consultants, Canadian Council of Ministers of the Environment (CCME), others…)? or
- Should we put in place a new committee to address these issues (e.g. Canadian Groundwater Advisory Committee)?

Capacity and Resources

- Data, funding and HR resources

Presentations were made on: 1) a review of the Canadian Council of Academies (CCA) Report of 2009; 2) best practices and lessons learned from key Canadian aquifers studies; and 3) the status of four provincial programs.



It was concluded that all provinces and territories have the same goal of increasing the understanding of groundwater systems and that partners are generally following the principles outlined in the CCA report (2009) as presented in this figure, modified from Sharpe et al., 2002.

In addition, it was shown that provinces and territories are not taking the same approach or are not at the same level of understanding on their aquifer systems, thus, enhanced collaboration on prioritized areas and issues would be of significant benefit to all.

Session 1b – Emerging issues in Groundwater science

In this session, roundtable discussions allowed exploration of common priorities and opportunities for collaboration. Participants in each table were asked to answer a single question that lead to a list of emerging issues in groundwater science at local, regional, provincial and national scales.

The question was:

What groundwater issues should be considered when prioritizing groundwater science in Canada?

The issues (see annex 3) were grouped into seven categories, the bolded themes below were deemed to be five emerging issues where more research is needed in the study of groundwater in Canada. The unbolded themes focus on communication and collaboration to ensure the relevance and use of groundwater science:

1. Communication / outreach / future scientists
2. **Climate change impacts**
3. **Surface water / groundwater interaction**
4. Multidisciplinary science fields (methodologies, approach, models, etc.)
5. **Deep groundwater vs shallow groundwater**
6. **Water budget**
7. **Characterization of groundwater systems**

Session 2 - Groundwater knowledge delivery

The second session was designed to address 2 themes:

1. Raise awareness of the role of national groundwater data networks, including GIN, among all levels of groundwater decision-makers;
2. Identify common data that, at a minimum, should be collected nationally, and identify data gaps as well as barriers to data access.

Presentations were made on the US National Monitoring Network, the Canadian Groundwater Information Network (GIN) and a provincial perspective (Nova-Scotia) on managing and disseminating data.

Presentations focussed on the importance of having access to a wide variety of data from multiple data providers organized into a network of networks that follows a set of data standards to ensure easy accessibility and dissemination. Examples provided in the 3 presentations showed the importance of good quality data and tools to enhance database interoperability.

Geologists, hydrogeologists and other earth sciences researchers working on groundwater issues across Canada and North America need to improve their data management. It is well acknowledged that field work is the basis for data gathering but these data need to be managed and disseminated.

A plenary discussion on: 1) national data gaps; 2) barriers to open access to data; and 3) key mechanisms for enhanced access to data, focussed mainly on data gathering and the lack of high quality data on some key hydrogeological parameters, preventing a fair assessment of groundwater resources. Further discussion is needed to understand and address the issues of data gaps and, more importantly, the barriers to open access.

CONCLUSION

The first day of the workshop focused on the past and the present. The participants acknowledged that collaboration has been valuable and agreed that it should continue under the auspice of the CFCG. The discussion on groundwater knowledge delivery allowed the GSC to raise awareness of the Canadian Groundwater Information Network, and to reiterate the importance of good data management. It was proposed to consider the formation of an *ad-hoc* committee to continue the discussions on groundwater data gathering and dissemination.

Day 2 – Confirm Canada's top priorities of national interest and ways to enhance collaborative work

Session 3 – Canadian Groundwater Availability and Accounting

The two objectives of this session were to:

1. Present and discuss the basis of how to convert local and regional groundwater knowledge into national groundwater integrated knowledge.

2. Seek further collaboration from the provinces and territories, and from the US for transboundary aquifers.

This session also provided an opportunity to continue the discussions on the 5 emerging issues identified during session 1.

Two presentations highlighted the need to emphasize understanding of the groundwater resources, specifically for groundwater availability and accounting at a national scale. This exercise should accelerate the understanding of groundwater resources by providing estimates of groundwater quantity available for any type of usage. An understanding of groundwater availability will require data on groundwater quantity and use, while groundwater accounting will require knowledge on groundwater status, changes and fluctuation trends at a national scale. In the U.S. this kind of approach is used to achieve a sustainable water strategy by providing baseline information and tools to stakeholders, allowing them to answer questions they face on water availability, such as:

- Does the U.S. have freshwater in sufficient quantity and quality to meet both human and ecological needs?

- Will this water be present to meet future needs?

Because national-scale groundwater availability and sustainability have never been assessed in Canada, a national approach was presented to the participants to seek their interest in collaborating in this activity. With the lens of the national approach to groundwater availability and accounting, table discussions on the 5 emerging issues identified previously were undertaken with the goal of providing an action plan for groundwater science in Canada. The details of the roundtable discussions can be found in Annex 4.

Five emerging issues

WATER BUDGET

More directions are required on how to calculate a water budget. During the discussion many technical issues were raised regarding how to estimate the water budget. Perhaps a Canadian methodology is required, or possibly one with a regional approach. The issue of appropriate scales was discussed in length.

CLIMATE CHANGE IMPACTS

Climate change impacts the water budget and there is an absence of standard methodologies for this assessment by provinces and territories. The establishment of an *ad-hoc* committee on data gathering could help toward obtaining an improved view on this issue.

SURFACE WATER / GROUNDWATER INTERACTIONS

The discussion on surface water and groundwater interactions led to the conclusion that ecological needs and effects are not well understood. Specifically, groundwater and surface water interactions in the Great Lakes area are a major knowledge gap.

CHARACTERIZATION OF GROUNDWATER SYSTEMS

Changing from a local scale to a national scale is a difficult concept; more discussions will be required to advance the national understanding. In order to achieve national-scale groundwater understanding, remote sensing methodologies need to be better integrated to support groundwater knowledge.

DEEP GROUNDWATER VS SHALLOW GROUNDWATER

There exist differing regional views on deep and shallow groundwater. Managing deep groundwater systems is necessary to avoid competition between groundwater users and to help establish key areas to be protected.

As an action plan and recommendations for the advancement of our understanding of groundwater resources in Canada, it is proposed:

- To pursue and enhance the long standing collaboration in the field of groundwater science under the Canadian Framework for Collaboration on Groundwater through an improved coordination system that would help increase the collaboration and knowledge delivery.
- To initiate research on the five emerging issues (water budget, climate change impacts, surface water / groundwater interactions, characterization of groundwater systems, deep groundwater vs shallow groundwater) identified during the workshop while pursuing the mapping and assessment of the remaining 11 key Canadian aquifer; encourage regional collaborative efforts between the provinces, the territories and the GSC for both thematic and regional studies.
- To improve communication among partners to allow better synergies by reconnecting at least every three years through an NRCan National Workshop on Groundwater.
- To investigate the establishment of an *ad-hoc* committee on data gathering and dissemination, as well as for methodologies or others as required.
- To continue to assess groundwater availability and sustainability for the entire country. This activity requires more provincial-federal-OGDs collaboration as well as a clear path forward to estimate the water budget at national scale.

Workshop Conclusion

Groundwater issues remain a national concern. Formal and informal collaborations have been ongoing for more than a decade on groundwater research. They should continue and be enhanced for efficiency. The mapping and assessment of 19 of the 30 key Canadian aquifer systems, some of which have been performed in collaboration with or by provincial partners have produced significant advances in groundwater sciences. Baseline information on groundwater resources in many geological contexts is now available and new tools and methods to characterize aquifer systems and managing the resulting data have been developed. This work has been instrumental in supporting provincial programs such as Source Protection Program in Ontario, the Water for Life Program in Alberta and PACES *(programme d'acquisition de connaissance sur les eaux souterraines)* in Québec. Nevertheless, significant work remains to be completed to address the key data and scientific emerging issues identified in this workshop, issues on data dissemination (GIN), and national scale understanding of groundwater resources.

The three key objectives of the workshop were achieved. Firstly, there was general agreement on the successful long term collaboration that developed from the Canadian Framework for Collaboration on Groundwater published in 2003. More discussions are needed to increase the momentum on collaboration. Secondly, common opportunities have been identified and possible work in Ontario, Saskatchewan and British Columbia are under discussion. Thirdly, provincial and territorial representatives provided strategic input on how NRCan could prioritize research in the future. The Groundwater Geoscience Program will address the five emerging issues by incorporating them within the projects of phase four.

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ANNEX 2 – Detailed Workshop Agenda

NRCan 3rd National Workshop on Groundwater

Logistics

Where:	11, rue Laurier, Gatineau, Québec, J8X 4A6 (Place du Portage Phase III (Tower C) -room I-514)
Date:	November 6-7, 2014

Meeting Objectives

- Re-affirm the long standing collaboration in the field of groundwater science
- Discuss common opportunities for collaboration and priorities
- Obtain jurisdictional input to guide strategic planning of the NRCan groundwater geoscience program

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Day 1 November 6, 2014

Goal for the Day: Groundwater science responsibilities that lead to collaboration: Taking stock of the past and present to build the way forward.

Agenda

Welcome		
8:00 am	Registration (hot and cold beverages and snacks provided)	
8:30 am	Welcome, introduction and expectations	Donna Kirkwood and Yves Michaud
	The Past	
9:00 am	Introduction	Hazen Russell
9:05 am	Federal Mandate on Groundwater	Andrée Bolduc
9:15 am	Perspectives on Groundwater since the Canadian Framework for Collaboration	Alfonso Rivera
9:30 am	ESS (GSC/CCMEO) Aquifer studies	Hazen Russell
9:45 am	Q's & A's	Facilitated
9:55 am	Break (hot and cold beverages provided)	
10:05 am	Provincial Overview	Steve Holysh

10:20 am	Alberta: Water for Life Overview	Dan Palombi & Steve Wallace
10:35 am	Québec: PACES (Programme d'acquisition de connaissance sur les eaux souterraines)	Diane Myrand
10:50 am	Ontario: Clean Water Act and Source Protection Program Overview	Scott Bates and Kathryn Baker
	The Ontario Geological Survey's Groundwater Initiative	Andy Bajc
11:15 am	British Columbia: Water Sustainability Act	Mike Wei
11:30 am	Interactive Q's & A's session	Facilitated
11:40 am	Lunch (not provided)	
	Emerging Thematic Groundwater Science	Hazel Russell
1:00 pm	Table discussion with plenary	Facilitated
2:00 pm	Break (hot and cold beverages provided) & Voting on Topics for Discussion on Friday	
	Present - Groundwater Knowledge Delivery	Boyan Brodaric
2:20 pm	Introduction	Boyan Brodaric
2:30 pm	U.S. National GW Monitoring Network	Bill Cunningham
2:50 pm	Canadian Groundwater Information Network (GIN)	Boyan Brodaric
3:10 pm	A Provincial Perspective on Managing and Disseminating Data	Gavin Kennedy
3:30 pm	Interactive Discussion: Towards a Better Tool	Facilitated
4:25 pm	Wrap-up for the Day	Andrée Bolduc

Day 2 November 7, 2014

Goal for the day: Confirm Canada's top priorities of national interest and ways to enhance collaborative work.

Agenda

Welcome		
8:00 am	Registration (hot and cold beverages and snacks provided)	
8:15 am	Welcome, Report on progress and Key Messages from Thursday	Andrée Bolduc and Yves Michaud
Future -	Canadian Groundwater Availability and Accounting	
8:40 am	Introduction	Alfonso Rivera
8:50 am	U.S. Water Census	Kevin Dennehy
9:15 am	Approaches and Methods for National Groundwater Evaluation and Accounting	Alfonso Rivera
9:40 am	Break (hot and cold beverages provided)	
Future: Collaborative work on priorities of national interest		Alfonso Rivera
10:00 am	Table Discussion (top issues from Thursday)	Facilitated
11:00 am	Results of Plenary	Facilitated
11:30 am	Wrap-up for the Workshop	Donna Kirkwood

ANNEX 3 – Results of the roundtable discussions, Day 1

1. Communication / Outreach / Future Scientists

    - Improve communication between policy and science
        - Implementation from science to planning policy (knowledge transfer, maps, indicators, web tools…)
    - Costs and timelines: explain to key people (driving force needed + communication)
    - Reactive instead of proactive (rushing to solution as oppose to look for solutions)
    - Data management access
    - Need to better explain how much it costs to do the work (driving force)
    - Work should be relevant to Canadian society
    - Too much approach on desktop approaches
    - Tailored tools for different access (e.g. science useful for infrastructures)
    - Increase more formalized collaboration (around the framework)
    - Need for: formalized collaborative framework / agreements / processes
    - Increasing numbers of ways to use geological information
    - Monitoring program challenges…keeping the future in mind (integrate the gaps)
    - Extend knowledge as much as possible
    - Priorities around the next generation of scientists

2. Climate Change Impacts

- Gaps in science related to permafrost knowledge
    - Impact of climate change on aquifers
    - Groundwater multidisciplinary issues (quality versus quantity)
- North: lack of science resources and capacity

3. Groundwater / Surface Water Interactions

    - Environmental flow-surface

- Measure of water in subsurface
- GRACE –quantification of groundwater storage
- Improve stream flow data (improved locations, snap shot –low flow)
- Interaction between groundwater and the Great Lakes (quality aspects)
- Groundwater–surface water (improve communication between geologists and hydrogeologists and focus studies)
- Human health, private well: water quality issues
- Disconnect between practitioners that work on groundwater and surface water interactions (multidisciplinary approach?)

4. <u>Multidisciplinary science fields (methodologies, approach, models, etc.)</u>
    - Mountain hydrogeology
    - Fieldwork
    - Flood – drought
    - Better certification of groundwater professionals (drillers, pump installers) -regulations
    - Airborne survey application / geophysical survey best methods
    - Emerging tools (methods development deployment)
    - Standard data + drive models
    - Relevant scale (transferable thematic)
    - Managing groundwater models into future
    - Validation of model
        - Stratigraphy
        - Extend knowledge to public
    - Better program design with integration of monitoring
    - Protocols, toolkits systematic data / research

5. <u>Deep groundwater vs shallow groundwater</u>
    - Potential connection between deep formations and shallow aquifers
    - Geothermal: potential impacts

- Interference of cumulative effects

- Deep groundwater (interaction between deep and shallow aquifers, CO2, shale gas, nuclear storage)
- Lack of knowledge in geothermal (how to use it?)
- Natural groundwater contamination

6. Water budget

- Water budget (recharge)
- How much potable water is available to use in society?
- Scales: limitation of dataset
- Use of emerging tools to reach the answer on recharge.
- Gaps in groundwater assessments
- Cumulative effect of water taking

7. Characterization of groundwater system

- Aquifer geometry: more beyond point source data
- Aquifer geometry
  - Regional approach to collecting data
- Human health, private wells, water quality interest for government (lack of well, sceptic systems).
- Verify models developed over time
- Aquitards
- Groundwater modeling…put protocols together to ensure quality of data (what tools people will need?)…NEED NATIONAL METHODOLOGIES!
- Well construction / integrity
- Modelling, data, knowledge
- Aquifers studies gap