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National Dialogue on Groundwater (NDGW)

Dialogue National sur les Eaux Souterraines (DNES)

June 6, 2021 (1-2PM (ET)) / 6 juin 2021 (13h00 à 14h00 (HNE))

OVERVIEW

- Greetings
- Presentations
 - Heather Brodie-Brown: **Ontario Ministry of Environment, Conservation and Parks - Groundwater Activities Update**
 - Hazen Russell (GSC)& Steven Frey (Aquanty)– **Canada One Water: Integrated Groundwater – Surface Water - Climate Modelling for Climate Change Adaptation**
- Questions
- Discussion
- Wrap-up and next meeting: September 8, 2021 (1-2pm)

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Groundwater Activities Update

National Dialogue on Groundwater
June 2, 2021

Heather Brodie-Brown
(heather.Brodie-brown@Ontario.ca)

Purpose

Recent Ontario groundwater related activities:

- Water Quality Management Review
- Permit to Take Water Program Updates
 - Centralization of Permit Approvals
 - Environmental Activity and Sector Registry (EASR) Amendments
- Wells Regulation Amendments
- Canada – Ontario Agreement on Great Lakes Water Quality and Ecosystem Health
 - COA 2014
 - COA 2021

Water Quantity Management Review - Context

ENVIRONMENT PLAN COMMITMENT

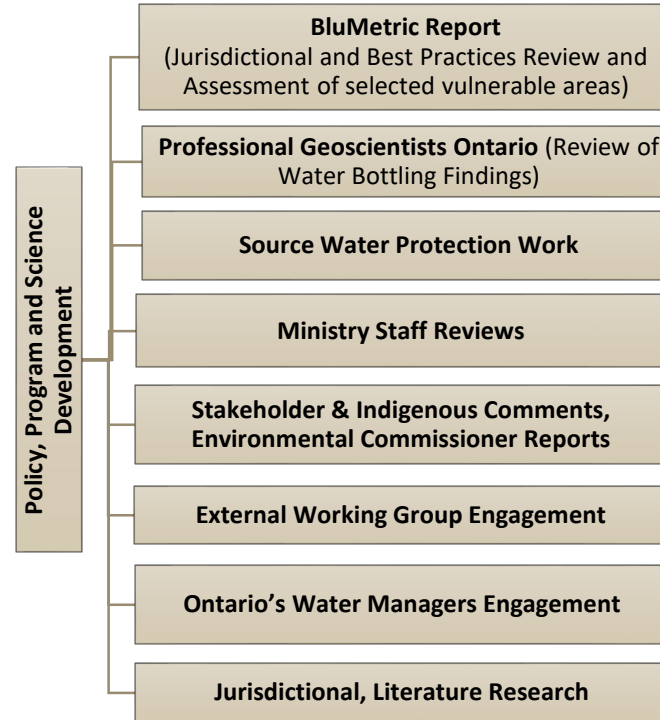
Ensure sustainable water use and water security for future generations

OVERALL REVIEW QUESTION

Is MECP's existing water quantity management framework adequate to manage existing or anticipated regional water scarcity considering a changing climate and population growth?

WHAT WE DID

- Reviewed policies, programs and science tools for managing water takings .
- Assessed water resources sustainability in selected areas to better understand the challenges of managing water takings under different resource conditions and water use scenarios.
- Met with water managers and other stakeholders.



Preserving and Protecting
our Environment for
Future Generations

A Made-in-Ontario
Environment Plan

[https://www.ontario.ca/
page/made-in-ontario-
environment-plan](https://www.ontario.ca/page/made-in-ontario-environment-plan)

Water Quantity Management Review - Findings

Water Resources in Ontario

- Managed in Ontario using best scientific and management practices.
- Sustainable with a few local exceptions and where in the future, population growth, water demand and climate change may bring some uncertainty. For example, where:
 - Takings use shallow groundwater sensitive to drought.
 - Irrigation takings use creek waters to water crops (summer or drought)
 - Municipal water supply takings in areas of increasing population growth may result in demand overwhelming existing infrastructure.



Water Bottling in Ontario

- Bottled water takings are not impacting the sustainability of groundwater resources in Ontario or of other water resources users.
- Overall, water takings for bottling in Ontario are managed sustainably under existing legislation, regulation and guidance.
- The science does not support the need to regulate water bottlers any differently than other takers.

Water Quantity Management Review – Changes

Regulatory Changes - April 1 2021

- Water bottling moratorium expires
 - Establish clear provincial priorities of water use
 - Updated approach to managing water takings in stressed areas (new option for Area-Based Management (ABM))
 - Make water taking data more accessible
 - Give host municipalities direct input into water bottling decisions
- Consulted on proposed amendments in June 2020
 - Water taking related Regulations under the Ontario Water Resources Act updated
 - New guidance on area management and priorities of water use

<https://ero.ontario.ca/notice/019-1340>



Other Permit to Take Water (PTTW) Program Updates

Centralization of Permit Approvals

- **Transition of PTTW program** from Drinking Water and Environmental Compliance Division (DWECD) to the Environmental Assessment and Permission Division (EAPD) – April 2020
 - Centralized program delivery within EAPD (processing, evaluation and issuance of applications)
 - Technical hydrogeological and surface water reviews provided by DWECD
 - DWECD and EAPD work closely to guarantee smooth program delivery

Environmental Activity and Sector Registry (EASR) Amendments

- EASRs allow the ministry to focus its resources on higher risk and more complex water taking activities through the Permit to Take Water process
- April 21, 2020 Amendments to regulations **modify EASR requirements and add exemptions for low risk short-term water taking activities:**
 - Construction site dewatering and road construction – requirements modified to remove certain restrictions that do not further environmental outcomes but were burdensome
 - Certain pumping tests (those 7 days or less in duration) have moved to registry
 - Diversion exemptions modified to remove certain restrictions that did not further environmental outcomes

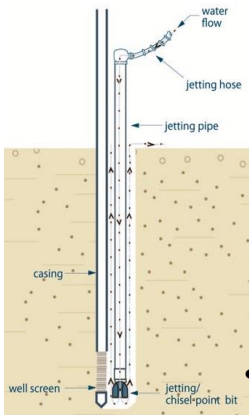
<https://ero.ontario.ca/notice/019-2525>

Amendments to the Wells Regulation

January 1, 2020 **amendments to the Wells Regulation** reduce administrative burden for the well construction industry, while maintaining protections for the environment, human health and public safety, and consumers.



- **Modifies insurance requirements** for licensed well contractors to match insurance policies available
 - Must maintain general third-party liability insurance
 - Limit per occurrence of not less than \$2 million
 - Annual aggregate limit (total claims paid out) of not less than \$5 million
- **Updates well casing specifications** harmonizing with international standards
 - Updated references to international standards
 - Add provision that standards “may be amended from time to time” to reflect latest versions
 - Reference to ‘high yield wells’ removed and standards (Table 2 of AWWA A100) added for steel and plastic casing to allow for professional judgment.
 - All diameters of plastic casing are now allowed if they conform to international standard ASTM F480.
- **Allows placement of shallow well screens** for long-term test holes and dewatering wells to be installed shallower than 2.5 metres below the ground surface



COA 2014 - Annex 8: Groundwater Quality

Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health

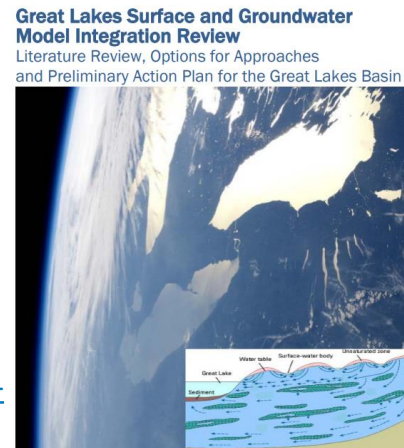
Key Accomplishments

Canada-Ontario collaboration on the binational “**Groundwater Science Relevant to the Great Lakes Water Quality : A Status Report**” 2016 (<http://binational.net/wp-content/uploads/2016/05/GW-Report-final-EN.pdf>)

- Update currently underway

Participation in IJC Great Lakes “**Surface and Groundwater Model** Integration Literature Review” (2018) and preliminary action plan “A New Vision for a Great Lakes Surface and Groundwater Model” (2019) (<https://ijc.org/en/new-vision-great-lakes-surface-and-groundwater-model>)

- Development of a hydrological conceptual model for the entire Great Lakes basin (both US and Canadian sides) currently underway by IJC



Prepared by the
Great Lakes Science Advisory Board
Research Coordination Committee

Submitted to the International Joint Commission
October 2018

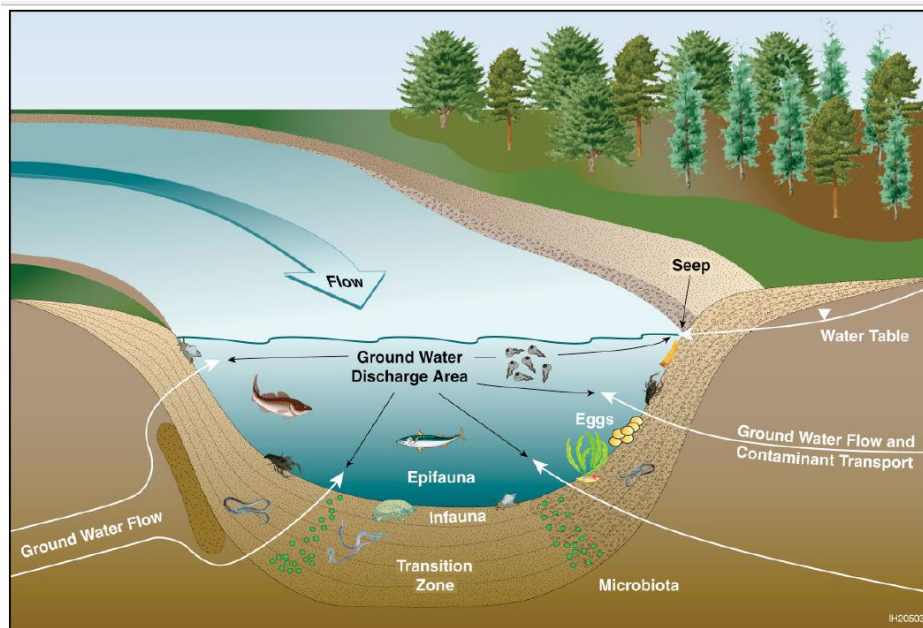
COA 2021 - Annex 9: Groundwater Quality

Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health

Purpose: To understand how groundwater influences Great Lakes water quality and ecosystem health and identify priority areas for action.

New concepts/actions:

- Recognition that the continued flow of good quality groundwater plays an important role in Great Lakes water quality and ecosystem health
- Improve understanding of groundwater-surface water interactions and how groundwater influences Great Lakes waters and ecosystems
- Maintain provincial monitoring networks and undertaking and promoting monitoring, research and modelling



<https://www.ontario.ca/document/canada-ontario-great-lakes-agreement>

COA 2021 - Annex 9: Groundwater Quality

Key actions

- Improve understanding of groundwater impacts and stressors on Great Lakes water quality and ecosystem health
- Identify priority areas for monitoring, management and action
- Update binational Groundwater Science Report

Ongoing and New Research

- Regional Scale Groundwater Modelling / Water Quantity
 - groundwater levels on a watershed scale with real time weather forecasting data
 - groundwater - surface water discharge modelling at reach, watershed and regional scale
 - direct vs. indirect groundwater discharge from western Lake Ontario basin
 - updating low flow stream statistics last undertaken 30 years ago
- Climate Change: 7 integrated climate change research monitoring stations (weather - surface water - groundwater monitoring)
- Contaminated Groundwater
 - framework to identify likely sources of PFAS contamination in groundwater being developed
 - leachate from old closed landfills as a potential source of harmful pollutants (inc. PFAS) and a potential risk to aquatic systems
 - loadings to surface water from septic systems in the Lake's Erie and Simcoe basins, focus on preferential pathways
 - groundwater as a source and pathway for road salt contamination of surface water and aquatic ecosystems in the Great Lakes Basin



CONTACTS

ONTARIO MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS

Environmental Monitoring and Reporting Branch

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Canada One Water: Integrated Groundwater – Surface Water - Climate Modelling for Climate Change Adaptation

Steven K. Frey and Hazen A.J. Russell
Aquanty Inc.
Geological Survey of Canada, Groundwater Geoscience
Program



Colleagues



- Science Leads

- Climate modelling: Andre Erler
- Historic climatology: Dan McKenney
- Soil characterization: David Lapen and Xiaoyuan Geng
- Geology: Hazen Russell and Boyan Brodaric
- Permafrost: Brendan O'Neill
- HydroGeoSphere modeling: Steve Frey
- Decision Support and Risk Analysis: Aquanty
- Validation
 - Watershed water balances – Shusen Wang
 - GRACE modelling – John Crowley

- Science Advisors:

- Ed Sudicky and Richard Peltier

Scientific Expertise

- Nicolas Benoit
- Eric Boisvert
- Melissa Bunn
- Eric De Kemp
- Michael Hillier
- Eric Kessel
- Omar Khader
- Heather MacDonald
- Daniel Paradis
- John Pedlar
- Dave Rudolph
- Shamalisha
- Amanda Taylor
- Xiaoyong Xu

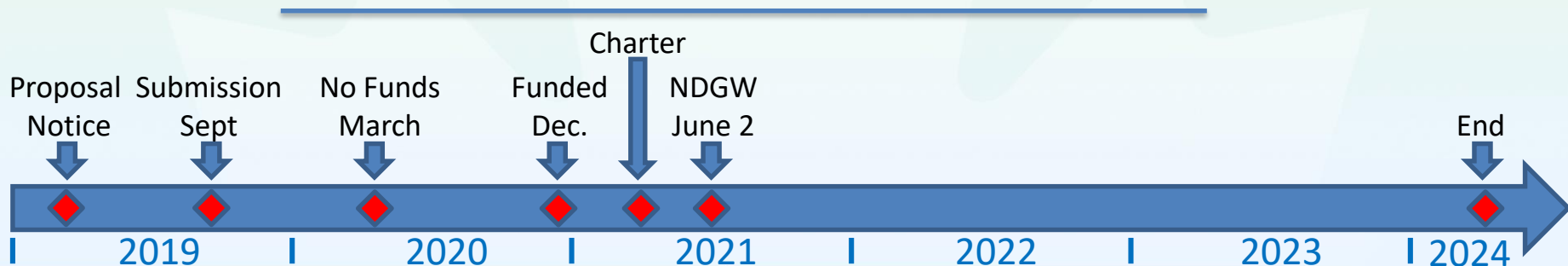




The Partnership (Charter)

- Proposal to DRDC (2019-09), Funded (2020-12), Approved (2021-05)
 - Aquanty – proponent
 - NRCAN – GSC – Lead government department
 - NRCAN – CFS, CCRS, SGB
 - AAFC
 - Universities – U of Toronto and U of Waterloo

Core Funding
DRDC
Canadian Safety and
Security Program



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Talk Objective



- Announce the project initiation
- Communication of scope and objectives of the project
- Seeking external input and additional collaboration

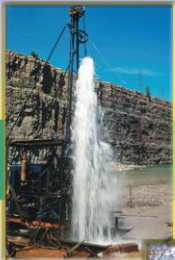


Collaboration on Water

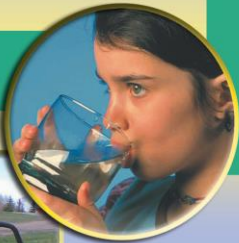


Government of Canada
Gouvernement du Canada

Canadian Framework for Collaboration on Groundwater



2003



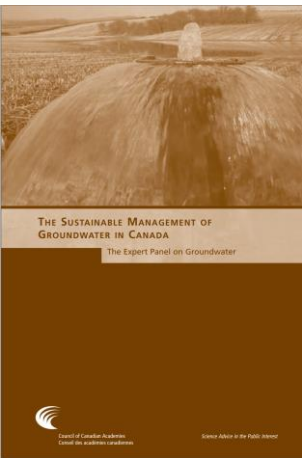
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- Coordination and collaboration mechanisms
- National co-operative programs
- Communication
- Performance standards and uniformity across Canada

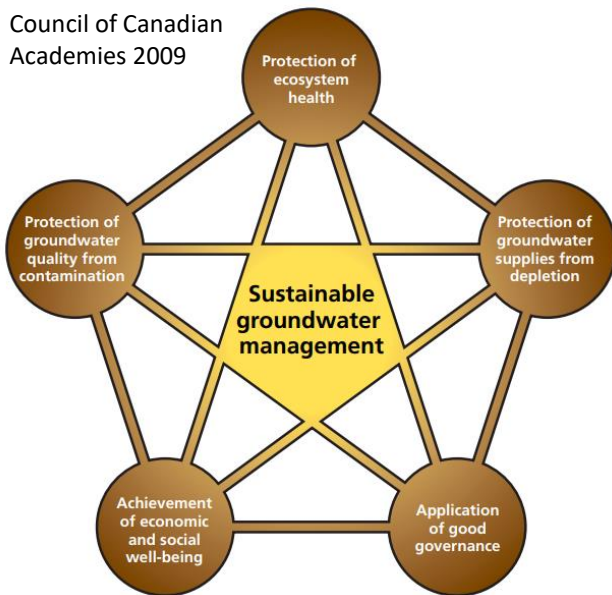
Evolution of national workshops
to
National Dialogue on Groundwater



Groundwater Sustainability



Council of Canadian Academies 2009



- Integrated resource management
- Climate change scenarios
- Decision support
- Communication
- Open access



Area of Interest – Continental Canada



~ 10,000,000 km²

Following from the work of
Chen et al. (2020)

CANADIAN WATER RESOURCES JOURNAL / REVUE CANADIENNE DES RESSOURCES HYDRIQUES
<https://doi.org/10.1080/07011784.2019.1671235>

Taylor & Francis
Taylor & Francis Group

Check for updates

Towards a climate-driven simulation of coupled surface-subsurface hydrology at the continental scale: a Canadian example

J. Chen^{a,b}, E. A. Sudicky^{a,d}, J. H. Davison^c, S. K. Frey^{a,d}, Y.-J. Park^a, H.-T. Hwang^{a,d}, A. R. Erler^{c,d},
S. J. Berg^{a,d}, M. V. Callaghan^d, K. Miller^d, M. Ross^a and W. R. Peltier^c



Continental Modelling Timeline



1969'

Freeze and Harlan (1969) – Fully integrated modeling blueprint

Therrien and Sudicky (1996) – HydroGeoSphere foundational work

Lemieux et al. (2008) Canada scale groundwater recharge and seepage modeling

Lemieux et al. (2008) Canada scale glacial impacts on GW flow

Lemieux and Sudicky (2009) Canada scale density dependent groundwater flow

Sudicky – CWN (2009) Canada-scale fully integrated GW-SW modeling initiative begins

Aquanty (2012) formed to bring fully-integrated modeling to mainstream geoscience

Hwang et al. (2014) HGS parallelized, drastically increased model size

Bierkens et al. (2015) Large scale hyper-resolution modeling –visions for future

Davison et al. (2015) HGS fully coupled with WRF

Canada 3D (2016) initiated at GSC

HydroGeoSphere Real Time (2018) released operationally

Erler et al. (2019) Framework for coupling HGS to WRF for CC projections

Chen et al (2020) Proof of concept Canada Scale fully-integrated model

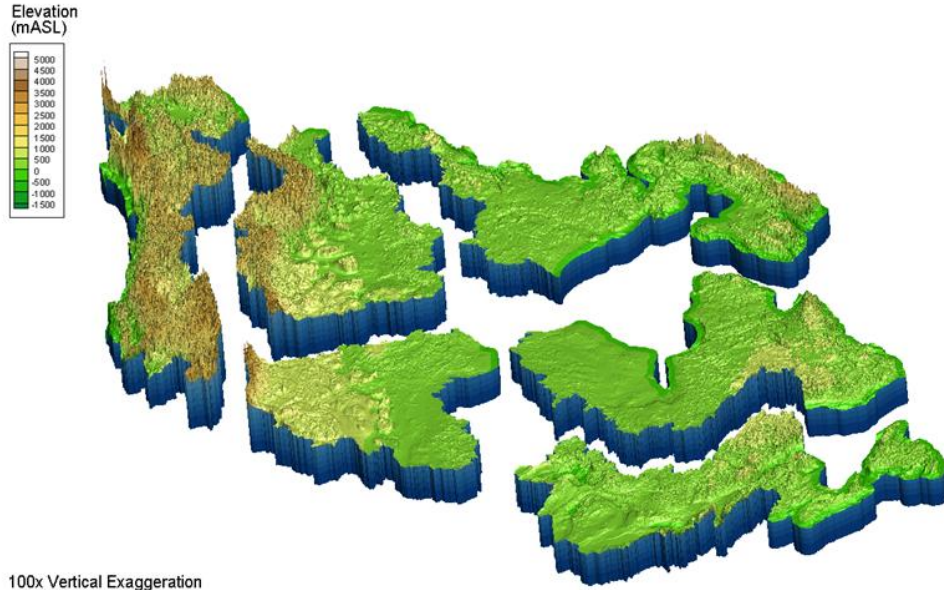
Canada 1 Water (2021)

**The path to continental-
scale fully integrated
modeling**

2021'



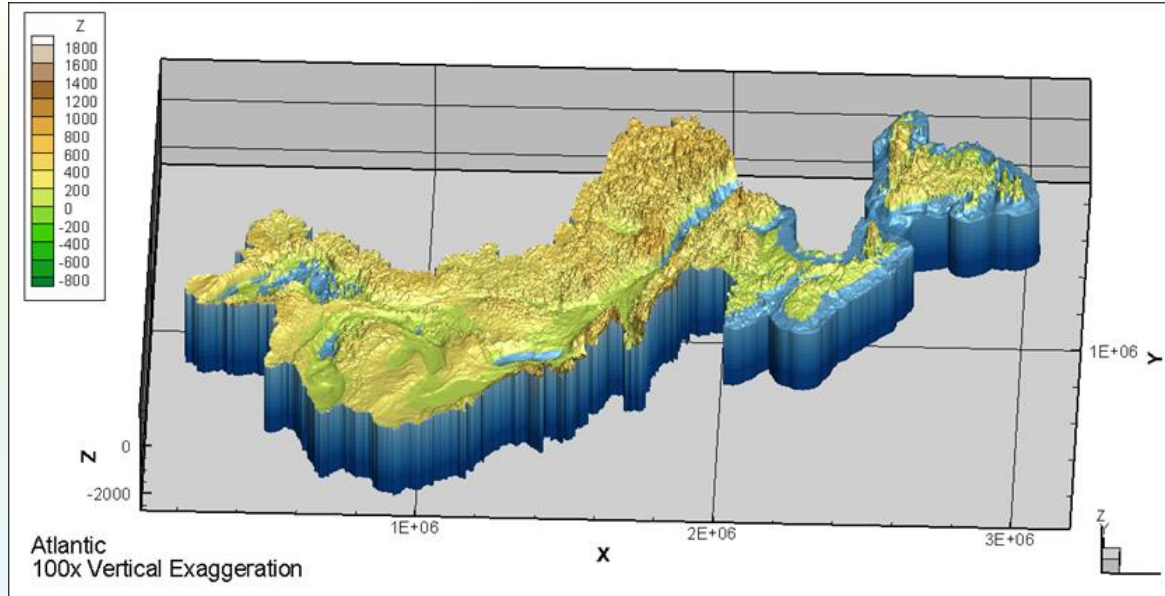
Model Development Strategy



- Subdivide the continental domain into 6 drainage regions
- Regions are approximately similar in size
- Physiographic characteristics taken into account for drainage region delineation

Model	2Dmesh Nodes	2Dmesh Elements	Land Area (km ²)	Coast Area (km ²)	Total Area (km ²)	Land Proportion of Canada (%)
Arctic	244346	484146	1.72E+06	6.20E+05	2.34E+06	17%
Hudson	243689	483269	2.02E+06	3.19E+05	2.34E+06	20%
Atlantic	195899	387132	1.60E+06	2.77E+05	1.87E+06	16%
Nelson	164883	326903	1.57E+06	1.58E+04	1.58E+06	16%
Mackenzie	188744	374161	1.80E+06	1.13E+04	1.81E+06	18%
Pacific	187883	371833	1.62E+06	1.79E+05	1.80E+06	16%
Total	1225444	2427444	1.03E+07	1.42E+06	1.17E+07	103%
Canada			9.99E+06			

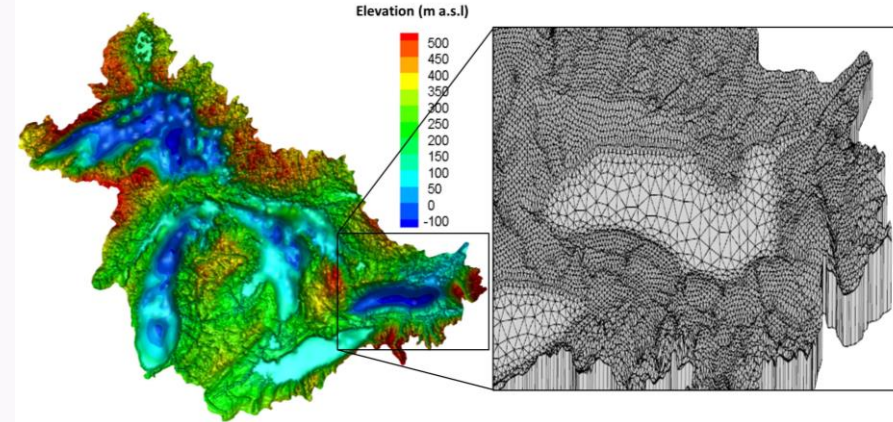
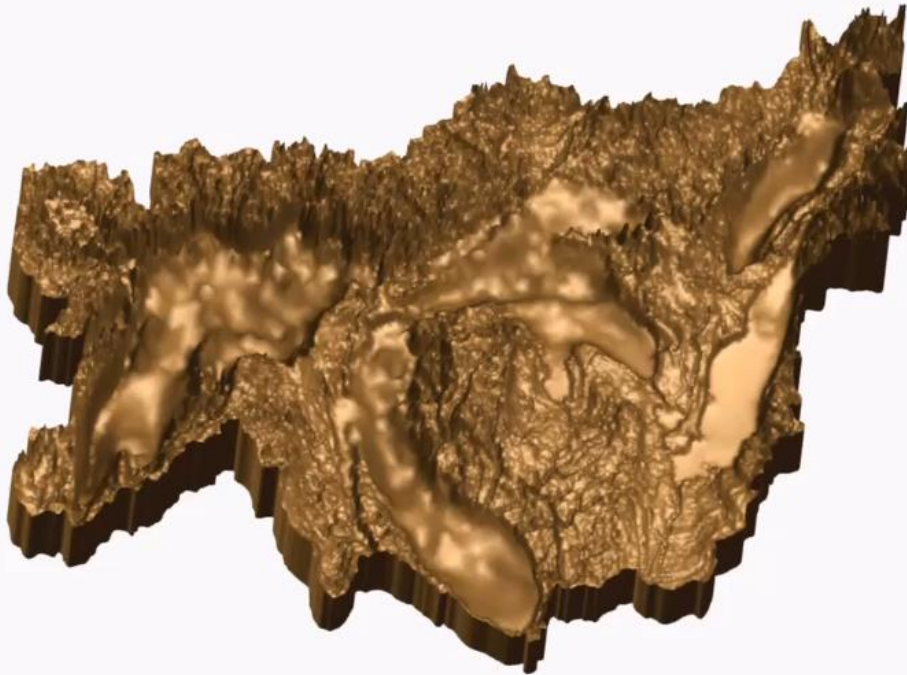
Spatial Resolution Targets



- Element edge length
1000 to 5000 m
- 6 to 8 subsurface layers
- 2.5 to 4 million 3D
elements

Model	2Dmesh Nodes	2Dmesh Elements	Land Area (km ²)	Coast Area (km ²)	Total Area (km ²)	Land Proportion of Canada (%)
Atlantic	195899	387132	1.60E+06	2.77E+05	1.87E+06	16%

Equivalent Resolution Example



Research papers

Investigating groundwater-lake interactions in the Laurentian Great Lakes with a fully-integrated surface water-groundwater model

Shu Xu^a, S.K. Frey^{a,b,*}, A.R. Erler^{a,d}, O. Khader^a, S.J. Berg^{a,b}, H.T. Hwang^{a,b}, M.V. Callaghan^a, J.H. Davison^c, E.A. Sudicky^{a,b}

^a Aquantx, 564 Weber St. N., Waterloo, ON N2L 5C6, Canada

^b University of Waterloo, Department of Earth and Environmental Sciences, 200 University Ave. W., Waterloo, ON N2L 3G1, Canada

^c The Catholic University of America, Department of Civil and Environmental Engineering, 620 Michigan Ave., N.E., Washington, DC 20064, United States

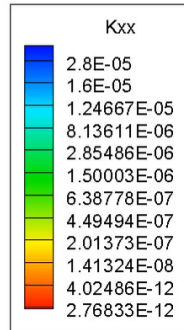
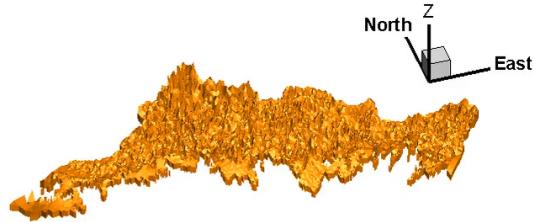
^d University of Waterloo, Department of Geospatial and Environmental Management, 200 University Ave. W., Waterloo, ON N2L 3G1, Canada



Hydrostratigraphic Challenge



Precambrian



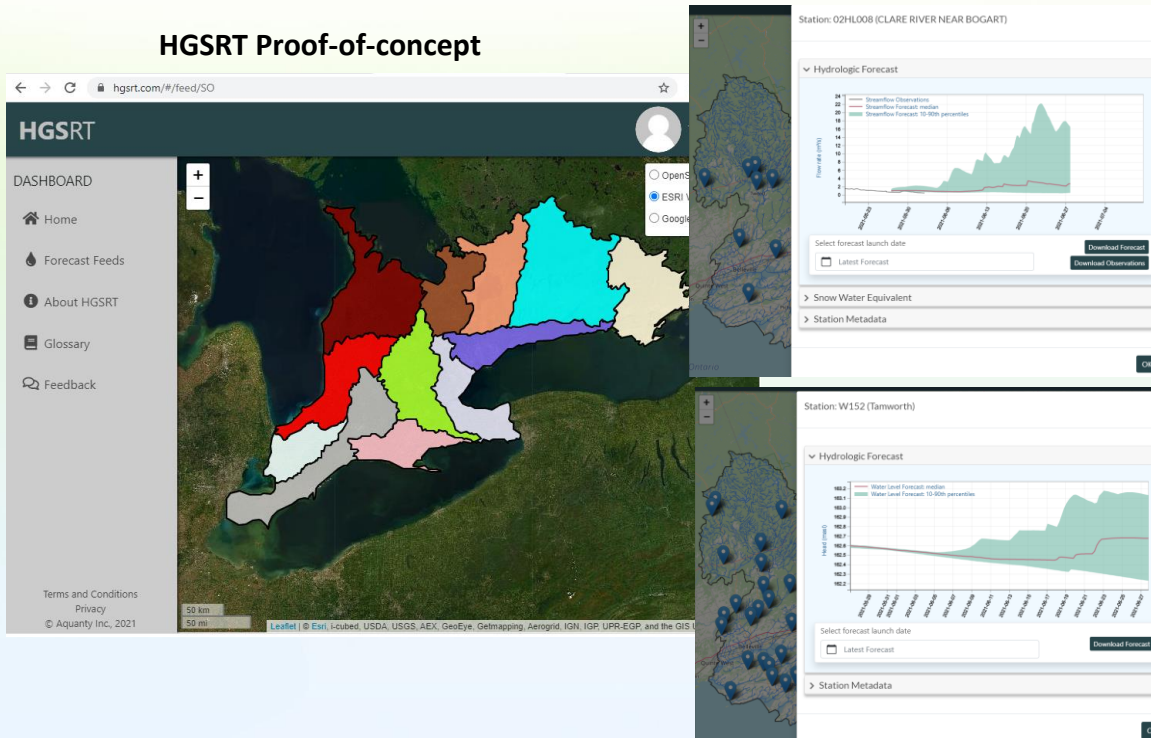
Hydrostratigraphic data needs to be harmonized and simplified for large ($\sim 2,000,000 \text{ km}^2$) areas



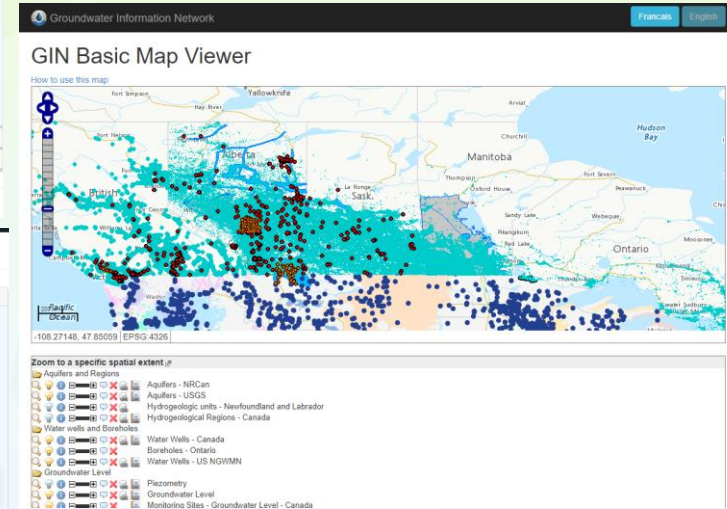
Decision Support Framework



HGSRT Proof-of-concept



Groundwater Information Network



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Engagement P&T



- Collaboration
 - Data support (input, validation)
 - Model results assessment
 - First Nations
 - Client
 - Identified applications
 - ???
 - Funding
 - Proposal development
 - Direct
- Geological data
Hydrostratigraphic data
Permafrost data
GW monitoring data



Summary



- 3 year funded project (DRDC; NRCAN, AAFC, Aquanty)
- Fully physically based GW-SW models with CC scenarios
- Monthly historic transient model
- Decision support pilot tests
- Industry application for resource development endpoints
- Open access data and results



Contact Info



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- Groundwater Geoscience Program
 - Eric Boisvert GSC:
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Impacts des changements climatiques sur les eaux souterraines et de surface pour un développement durable au Canada

Canada 1 Water

Projet
Ressources naturelles Canada (RNC) lance le projet **Canada 1 Water (CIW)** : une plateforme de modélisation des eaux souterraines et des eaux de surface intégrée à des informations sur les changements climatiques et sur l'utilisation du sol afin de fournir une aide à la prise de décision pour les évaluations fondées sur les risques. Des modèles de pointe seront construits et des scénarios de changements climatiques seront simulés pour les six principaux bassins de drainage du Canada, couvrant près de dix millions de kilomètres carrés.

Pour la première fois, le Canada disposera d'une plateforme complète basée sur la physique de l'écoulement de l'eau pour simuler le système intégré d'évaluation des risques climat / eau souterraine / eau de surface. Il pourra aussi bénéficier d'outils d'aide à la prise de décision sur les sécheresses, les inondations, la capture du carbone, les risques d'incendie, les changements du pergélisol, les services écosystémiques et la quantité d'eau de surface et d'eau souterraine.

Le projet contribuera à relever un défi de longue date identifié par le Conseil des académies canadiennes, c'est à dire de comprendre la durabilité des ressources en eau du Canada. Le cadre d'aide à la prise de décision de la plateforme fournira un moyen intégré d'évaluer les réponses, les risques associés aux produits utiles (c.-à-d., foresterie, agriculture, exploitation minière), et les risques associés aux changements climatiques projetés et aux changements induits par l'utilisation des sols.

CIW abordera les questions relatives aux ressources en eau de surface et en eau souterraine associées aux préoccupations des autochtones, telles que les effets cumulatifs, les impacts de la perte de pergélisol et les inondations.



Partenaires et financement
CIW est une initiative de RNC (Programme géoscience sur les eaux souterraines) et d'Aquanty Inc. ainsi qu'Agriculture et Agroalimentaire Canada (AAC), et les universités de Toronto et de Waterloo.

Le projet est cofinancé par l'appel de proposition 2019 du Programme canadien pour la sûreté et la sécurité (PCSS) de Recherche et développement pour la défense

Canada (RDDC) dans le cadre du volet Sécurité et sûreté publiques. Le projet contribue à la mission du PCSS, qui consiste à renforcer la capacité du Canada à s'adapter au changement climatique. L'engagement avec d'autres partenaires stratégiques du projet est en cours.

Nouvelles
Surveillez le fil de nouvelles du Réseau d'information sur les eaux souterraines pour obtenir des mises à jour sur l'avancement du projet à : <https://ries-es-info.net> et <https://canada1water.ca>

Contact
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THANK YOU

Next meeting: September 8, 2021 (1-2pm)

Happy summer to all!! / Bon été à tous!!

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