The Ontario Geological Survey’s Groundwater Initiative

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Ontario Geological Survey’s Groundwater Initiative

- Geoscience activities applied to groundwater resource assessment and protection have been ongoing at the OGS for well over half a century.
- The level of activity has fluctuated over this time period primarily in response to changing government priorities.
- The OGS groundwater initiative is part of an expanded geoscience mandate that went into effect in 2007.

The initiative consists of 3 main geoscience activities:

- 3-D Sediment Mapping (Bajc, Burt, Mulligan and Priebe)
- 3-D Paleozoic Bedrock Mapping (Brunton and Priebe)
- Ambient Groundwater Geochemistry Project (Hamilton)
**Logic Model: OGS Groundwater Geoscience Initiative**

**Issues/ Government Priorities**
- Improving Quality of Life for Ontario families:
  - Economy
    - water is essential to growth
  - Improving Quality of Life:
    - abundant clean water is a pre-requisite for healthy families + communities (Places to Grow; climate change)
    - understanding groundwater systems (Clean Water Act; Greenbelt) will enable protection of natural beauty + resources
    - identification of groundwater quality issues & geo-hazards mitigates public health & safety issues

**Outputs 3-5 years Final Geoscience Products**
- 3D Block Model synthesis of major stratigraphic units, Groundwater Resources Study synthesis that includes discussion of geometry and character of each unit, an evaluation of aquifer vulnerability and recharge potential as well as visualization tools; continued outreach
- Final 3D fence diagrams of study area, update regional stratigraphic (formational-scale) relationships and place within a chemostratigraphic and sequence stratigraphic framework in order to produce syntheses delineating extent of hydro-geological units including physical and chemical properties, Groundwater Resources Study synthesis report including detailed methods, analysis and interpretation; continued outreach

**Outputs 1-3 years Preliminary Geoscience Products**
- Maps, reports, data releases, borehole logs, geophysical data, talks and presentations to client groups, peer groups and stakeholders, field trips, press releases, workshops
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**Activities**
- **3D Sediment Mapping**
  - Development of 3D models of the glacial deposits that overlie bedrock
  - Characterization of the geometry and properties of aquifers and aquitards
- **3D Bedrock Mapping**
  - Development of a testable sequence stratigraphic framework
  - Delineation, characterization and mapping of regional scale groundwater flow systems
- **Ambient Groundwater Geochemistry**
  - Characterization and mapping of the chemistry of natural groundwater of southern Ontario
  - Evaluation of the relationship between rock and groundwater chemistry

**Outcomes**
- Safe and Sustainable use of groundwater by Ontario communities.
- The discovery and characterization of untapped groundwater sources
- Uptake by Municipalities, Conservation Authorities, consultants, and other Stakeholder Groups

**Key Performance Indicators:**
- Influence on decision by municipalities (cost savings, health)
- Discovery of new groundwater resources.

**Risk Identification and Mitigation:**
- Apply technologies that may or may not work – learn from mistakes
- Receptor awareness and understanding – communication strategy

**Maps, reports, data releases, borehole logs, geophysical data, talks and presentations to client groups, peer groups and stakeholders, field trips, press releases, workshops**
Thematic Mapping

- fully attributed
- seamless
- standardized legends

Bedrock Geology
Physiography
Surficial Geology
Drift Thickness
Bedrock Topography

Ontario Geological Survey
3-D Sediment Mapping

Ground Gravity
TDEM
GSC Seismic
Section Logging
Continuous Coring
3-D Model
GSC Borehole Geophysics
OGS/GSC Pub’n
Ambient Groundwater Geochemistry Project

Dissolved Oxygen Bedrock Wells

Legend:
- Blue: Shale
- Yellow: Evaporitic units
- Green: Carbonate
- Brown: Sandstone units
- Pink: Precambrian basement
- Gray: Precambrian marble
- Red: Outline of breathing well area

Subcrop Wells are completed in the subcropping bedrock unit as depicted by the underlying colour. They include wells in overburden installed to within 3 m of the estimated depth of the bedrock surface.

Deeper Wells are completed in a unit below the subcropping unit.

Legend:
- Subcrop wells
  - < 5.0
  - 5.0 - 30.0
  - 30.1 - 60.0
  - 60.1 - 90.0
  - > 90.0

Kilometres

Ontario
Dissolved Methane (CH$_4$) in Bedrock

Methane Percent Saturation
Bedrock Wells

Legend
- Shale
- Evaporitic units
- Carbonate
- Sandstone units
- Precambrian basement
- Precambrian marble
- Outline of breathing well area

Methane Study
Collaborative Agreement:
Ontario Geological Survey
Geological Survey of Canada
University of Arizona
Benefits and Applications

• Input to Source Water Protection Plans
  – Groundwater flow models; water budgets
  – Tier 2 and 3 water budgets
  – Aquifer recharge delineation
  – Well head protection areas
  – Identification of aquifers at risk

• Sanitary landfill planning and Remediation
• Remediation of Ontario’s brownfields
• Nutrient management plans
• Exploration models for municipal water supply
• Input to climate change models and drought response plans
• Health concerns over drinking water; defining natural background