

## Consolidating 25 years of GSC groundwater studies in glaciated terrain

Hazen A.J. Russell

Geological Survey of Canada, Natural Resources Canada [hazen.russell@canada.ca](mailto:hazen.russell@canada.ca)

### Introduction

Glacial sedimentary aquifers are the most commonly exploited groundwater resource in Canada. Rapid changes in the depositional processes and environments can result in rapid lateral changes, extremes in aquifer heterogeneity, abrupt aquifer boundaries, and large variability in aquifer yields. To better understand regional groundwater supply issues the Geological Survey of Canada (GSC) has been carrying out groundwater studies on 30 key Canadian aquifers (Table 1) over the past 25 years (e.g., Rivera 2014). To-date the GSC has relied for classification of aquifers on sediment-landform terminology for surficial aquifers and geological formation names for bedrock aquifers, with little regard for confining units and hydraulics. Thus there is a need to consolidate and synthesis knowledge from numerous case studies and the broader literature. This paper reviews plans for the consolidation of the past quarter century of work on surficial aquifers and how case studies may be consolidated within a classification of archetypal aquifers.

Table 1. Key Canadian aquifers grouped according to hydrogeological regions. Letters in parentheses refer to principal aquifer geology, namely bedrock (br), bedrock and sediment (br-s), or sediment (s). Numbers refer to map location in Russell et al. (2011).

Cordillera	Western Canada Sedimentary Basin		Southern Ontario	St Lawrence Platform	Appalachians
1. Gulf Islands (br)	6. Paskapoo (br)	12. Intertill (s)	18. Oak Ridges Moraine (s)	25. Mirabel (br-s)	23. Annapolis – Cornwallis (br-s)
2. Nanaimo Lowland (br-s)	7. Buried Valleys (s)	13. Manitoba Carbonate Rock (br)	19. Grand River Basin (br-s)	26. Châteauguay (br-s)	<b>Maritimes Basin</b> 24. Carboniferous Basin (br)
3. Fraser Lowland (s)	8. Upper Cretaceous Sand (br)	14. Manitoba Basal Clastic unit (br)	20. Credit River (br-s)	27. Richelieu (br-s)	
4. Okanagan Valley (s)	9. Milk River (br)	15. Odanah Shale (br)	21. Waterloo Moraine (s)	28. Chaudière (br-s)	
5. Shushwap Highlands (br)	10. Judith River (br)	16. Sandilands (s)	22. Upper Thames River (br-s)	29. Maurice (s)	
	11. Eastend – Ravenscrag (br)	17. Assiniboine Delta (s)		30. Portneuf (s)	

### Approach

A five step approach is being adopted to advance the study objectives. The approach is asynchronous, with parallel activities advancing the project objectives. The first step is an aquifer classification scheme, ideally moving beyond geological parameters to include aquifer hydraulics (recharge, storativity, etc) and confining units (Fig. 1). A case has been made for the need to describe both the container (sediment) and contents (fluid) in the general case of water

Figure 1. Possible elements that can be captured from case study reports to support characterization of archetypal aquifer in surficial sediment. Graphics from Gerber et al. 2018.

Brodaric, B., Hahmann, T., and Gruninger, M. 2019. Water Features and Their Parts. *Applied Ontology*. 14, 1–42. <https://doi.org/https://doi.org/10.3233/AO-190205>

Gerber, R.E., Sharpe, D.R., Russell, H.A.J., Holysh, S., and Khazaei, I. 2018. Conceptual hydrogeological model of the ‘Yonge Street’ aquifer, south-central Ontario: a glaciofluvial channel-fan setting. *Canadian Journal of Earth Sciences*. 55, 730–767. <https://doi.org/10.1139/cjes-2017-0172>

Miller, J.A. 1999. Groundwater Atlas of the United States, Introduction and National Summary. <https://water.usgs.gov/ogw/aquifer/atlas.html>

Rivera, A. 2014. Canada’s Groundwater Resource. Fitzhenry & Whiteside Limited, Markham, ON Canada. <https://doi.org/10.4095/296930>

Russell, H.A.J., Sharpe, D.R., and Cummings, D.C. 2011. Sediment-aquifer play types in a list of 30 key Canadian aquifers, in: *Geohydro 2011, Proceedings of the Joint Meeting of the CANQUA and International Association of Hydrogeologists*. pp. 1–8.

Russell, H.A.J., Arnaud, E., Bajc, A.F., and Sharpe, D.R. 2018. Quaternary geology of southern Ontario and applications to hydrogeology. *Canadian Journal of Earth Sciences*. 55, v–viii. <https://doi.org/10.1139/cjes-2018-0119>

Walker, R. G. (1976). *Facies Models 1. General Introduction*. Geoscience Canada. 3:1. Retrieved from <https://journals.lib.unb.ca/index.php>

