

Protect Our Waters:

Building a Moraine Movement in the Greater Golden Horseshoe.

The Moraines of the Greater Golden Horseshoe



The Grand River, photo courtesy of Wellington Water Watchers

Save the Oak Ridges Moraine Coalition

Background and Context

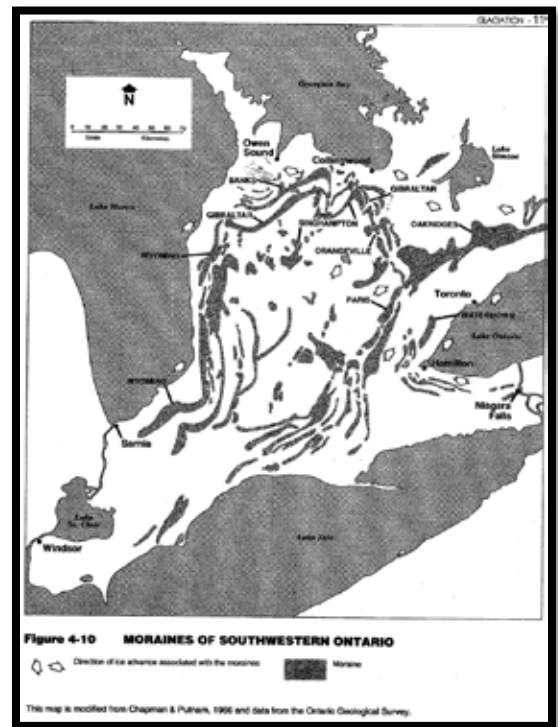
This report (*The Moraine's of the Greater Golden Horseshoe*) is part of a larger report prepared for the Greenbelt Foundation, entitled *Protect Our Waters: Building a Moraine Movement in the Greater Golden Horseshoe*. For the purposes of the Growing the Greenbelt consultation, what was Chapter 2 of the full report, has been recreated as a stand-alone report to showcase six moraine systems that are candidates for Greenbelt protection. The full report is available upon request.

Moraines in Southern Ontario: Creating a Map

Maps are interesting; there is a commonly-held belief that maps are just maps – they don't tell stories because they're just... maps. There is however an awakening in people to the complexity of our social and ecological systems such that the systemic and intrinsic power imbalances that manifest in our society are being exposed. Furthermore the 'what is,' is a product of many things, i.e., a construct made up of what we've learned, how we've been taught to view the world and how our worlds are reflected back to us. Maps too are tools of influence in that ...

“Maps are not neutral. They have political resonances. When you point the plots of an explorer's journey on a generic online map, the familiar format flattens the stories, giving the map the illusion of authority and turning history into just another map layer.” *The Atlantic, July 2013*

Given this, the first task was to find the right storyteller which was the easiest part of this project – Chris Brackley and As the Crow Flies Cartography. Chris and his team have been using maps to help people tell their own stories for a long time now. We approached Chris and his enthusiasm was palpable, made more so by the fact that he didn't know there were so many moraines in southern Ontario. The first stage was to convey what we wanted this project to say. Chris had worked on the original Bluebelt map and so he had access to a wide range of data layers – the trick is determining which layers were relevant to this story. The role of moraines in the hydrology and hydrogeology of



the GGH is a major theme as is the geomorphology (study of landforms and how they got to be the way they are) and physiography of southern Ontario. These data layers include: physiographic regions mapped by Chapman and Putnam; government-funded research data such as hummocky topography, ice contact stratified drift, end and terminal moraine attributes, permeability etc. Other key data layers are the touchstones of navigation – rivers and streams, lakes, roads, towns and cities, municipal boundaries, First Nation reserves and provincial planning areas. We chose not to use Source Water Protection layers due to their complexity and not being moraine-specific. Based on this, moraine boundaries were generated and mapped and to be on the safe side we decided to call them Moraine Areas.

On November 13, 2020 Steve Holysh (Program Manager, Oak Ridges Moraine Groundwater Program) and Fred Johnson (former Ministry of Natural Resources Oak Ridges Moraine expert) zoomed in to review the draft mapping with a particular focus on the relevance of the data layers. Both were satisfied that our Moraine Areas made sense, were defensible and constituted a satisfactory first step. Fred likened this to the first part of the multi-stage process undertaken by the Ministry of Natural Resources in defining the Oak Ridges Moraine boundary in the early 1990s. That boundary stood the test of time and was codified by regulation in 2001.

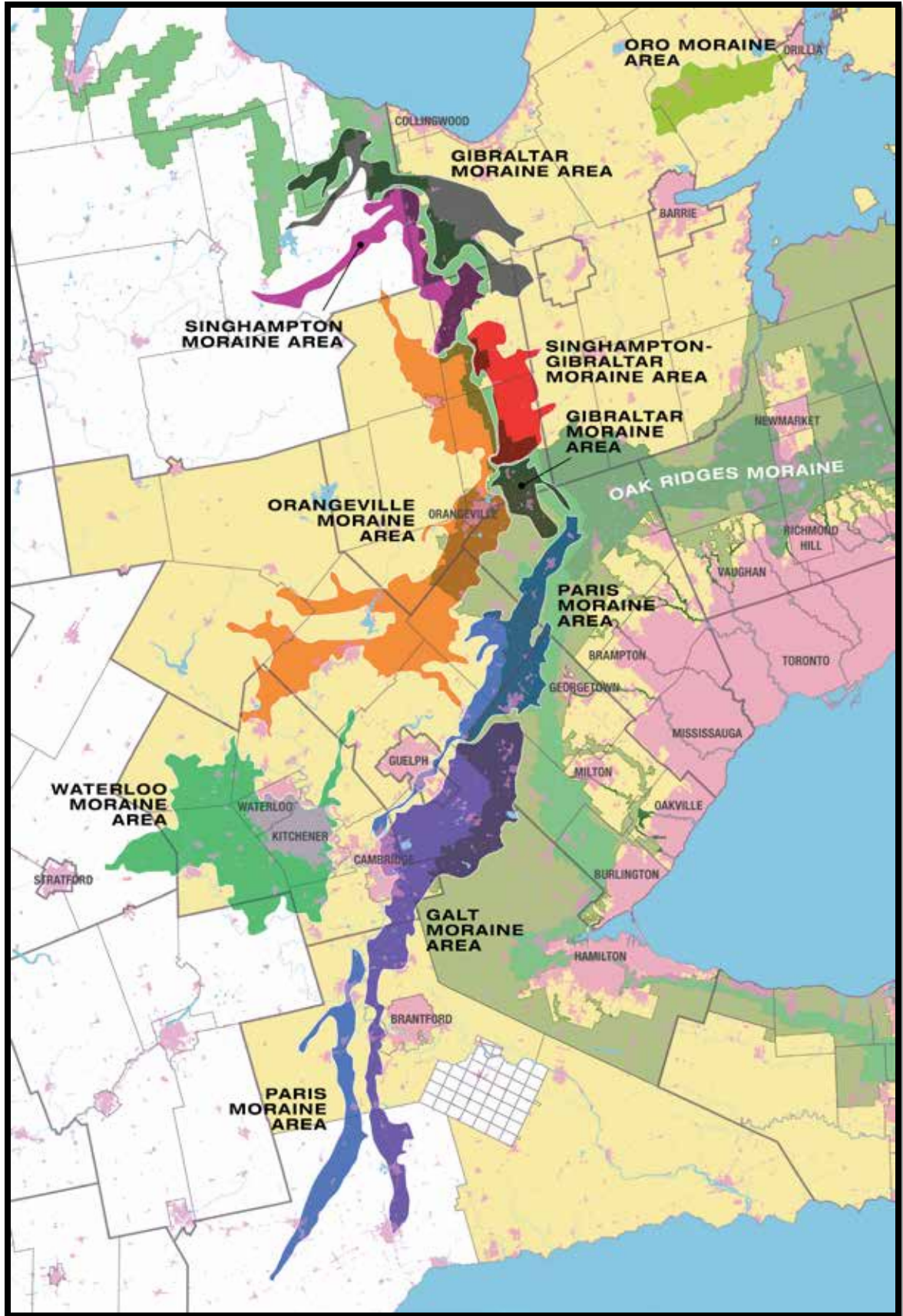
The Moraine Areas included in this report are a snapshot of this “war room” map, which remains a work in progress.

Acknowledgements

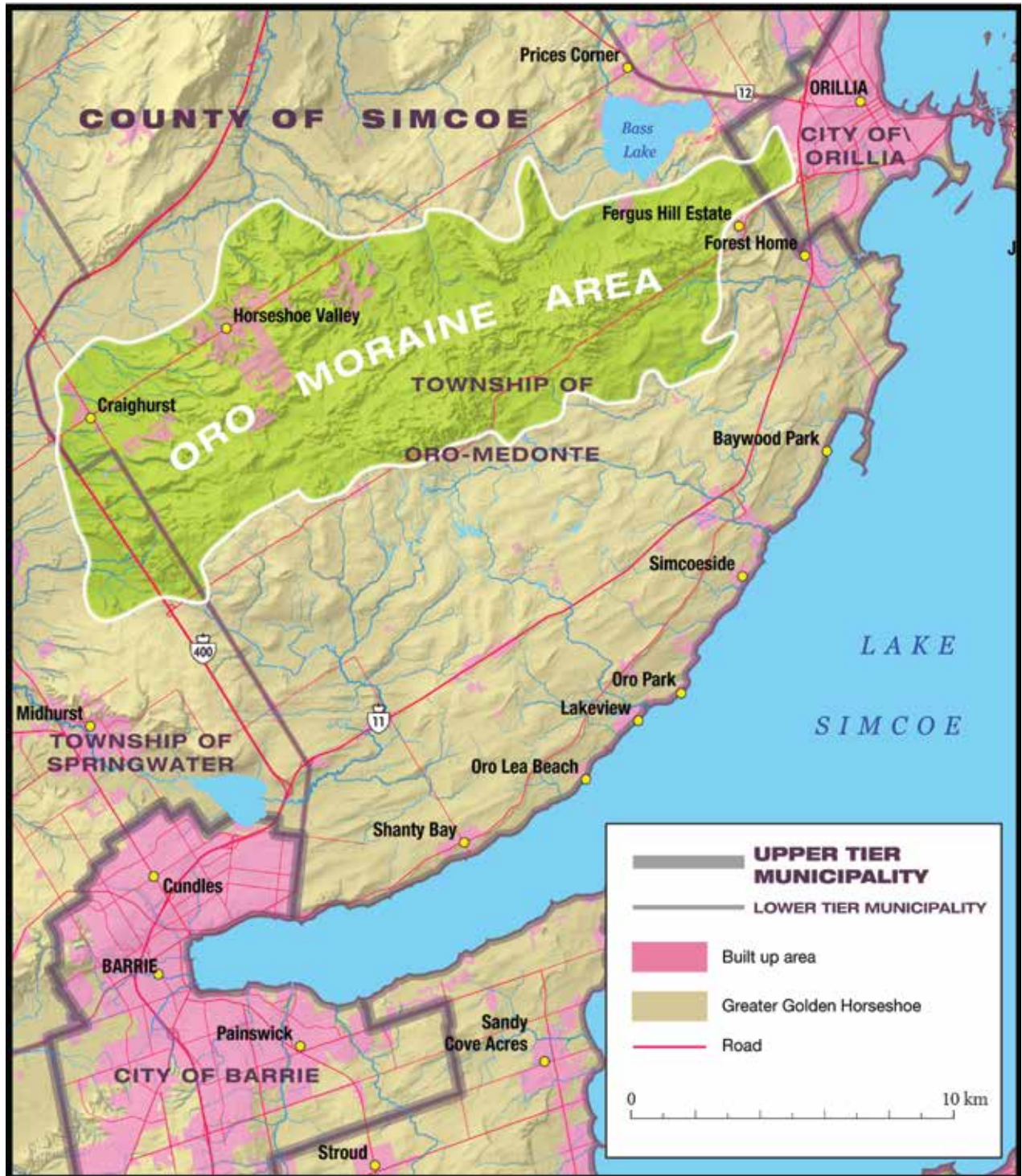
The moraines of the GGH landscape are the Traditional Territories of the Anishinaabe and Haudenosaunee in what is now known as Ontario, Canada. The author’s ancestors came to Turtle Island from Ireland, England, Wales and Germany over several centuries starting in the 1600s up to the 1890s. These ancestors took advantage of broken treaty promises and they in turn benefitted from them. I continue to benefit from these broken treaty promises. I acknowledge this and open myself to listen and learn. And I will work hard to be humble and worthy of being corrected.

And lastly but certainly not least, thank you to the Greenbelt Foundation for making this project possible.

Debbe Crandall, STORM Coalition



The Oro Moraine: *Small & Mighty*



Water-users: Sand and gravel extraction and processing, rural estate development, the expansion of recreational facilities such as ski hills and golf courses, water bottling

Interesting Tidbits:

Q: “Is the Oro Moraine a sustainable supply of our groundwater?”

A: “Yes, with continued monitoring and serious consideration in planning future development - but we shouldn't be complacent!”

*Mike Jones, Azimuth Consulting, November 2019
Speaker Series AWARE Oro-Medonte*

Gold Mountain Springs owns an 88-acre parcel of land in the Township of Oro-Medonte where there are naturally occurring springs on the property. “We sell natural bulk spring water throughout the Central and Southern Ontario area.”

Craighurst and Horseshoe Valley Ski-hills

Stewards/Champions: Couchiching Conservancy (13,500 acres in total protected lands; Elliot Woods Nature Reserve, East Coulson Swamp Nature Reserve (includes 87 acres on Oro Moraine donated by Margaret Atwood to protect forest interior habitat for red-shouldered hawk); moraine protectors in 1990s and in 2001 undertook an inventory of natural habitats and land uses.

Friends of Copeland Forest, Copeland Forest Resource Management Area (150 members, kick-ass garlic mustard control)

Oro Medonte Club stewards of 18.5 km of the 500-metre Ganaraska Hiking Trail

Severn Sound Environmental Association

Oro Moraine References:

Ganaraska Hiking Trail – Local clubs
<https://ganaraska-hiking-trail.org/>

Goldmountainsprings.com

Lake Simcoe Region Conservation Authority
<https://www.lsrca.on.ca/our-watershed>

Modeling the Oro Moraine Multi-Aquifer System: Role of Geology, Numerical Model, Parameter Estimation and Uncertainty,
Joseph Beckers, PhD Thesis, Earth Sciences, University of Waterloo, 1998

Oro Moraine, Neptis Foundation
<https://www.neptis.org/publications/case-studies/chapters/oro-moraine>

Oro Moraine Report Card, 2010, Nottawasaga Valley and Lake Simcoe Region Conservation Authorities

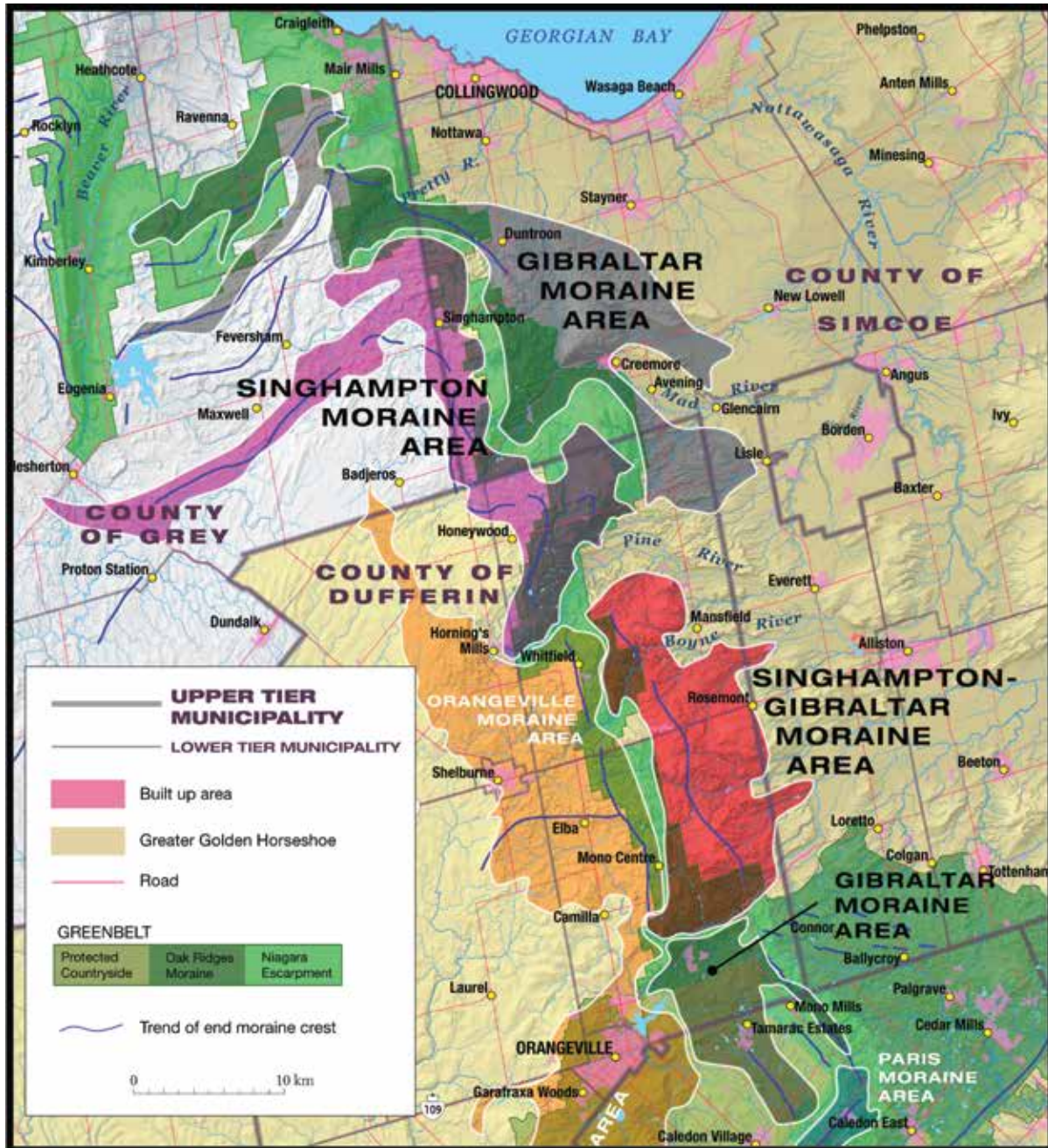
Oro and Hawkestone Creek Subwatershed Plan,
Lake Simcoe Region Conservation, 2013

Three-dimensional modeling of surficial deposits in the Barrie–Oro Moraine area of southern Ontario,
Burt, et.al., 2011, Ontario Geological Survey, Groundwater Resources Study 11

Township of Oro-Medonte Official Plan,
Office Consolidation 2020



The Singhampton & Gibraltar Moraines: Hidden Treasures



Profile: Low

Attributes: A series of individual hummocky mounds in southern part of Grey County extending down into Dufferin County.

Municipalities: Town of the Blue Mountains, Municipality of Grey Highlands (Grey County); Townships of Clearview and Adjala-Tosorontio (Simcoe County); Townships of Mulmur and Melancthon, Town of Mono (Dufferin County); Town of Caledon (Region of Peel)

Conservation Authorities: Nottawasaga Valley Conservation, Grey Sauble Conservation, Toronto and region Conservation

Quaternary geology: Singhampton Moraine is an interlobate moraine created between the Georgian Bay and Lake Huron lobes. The Gibraltar is a terminal moraine influenced by the Lake Simcoe lobe. Both could be considered complexed with the Orangeville Moraine (see below) two moraines are interlobate moraines that have been overridden by other ice advances and dissected by outwash.

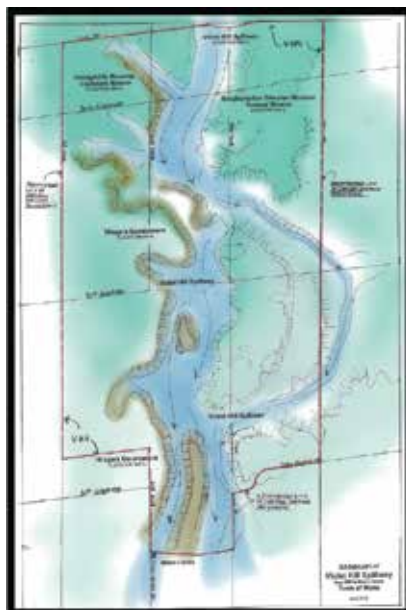
Hydrogeology: Major groundwater recharge / discharge functions associated with regional aquifer systems (ice-contact stratified drift) and kame and kettle topography. Hydrologic connections to buried tunnel valleys running north-south (as depicted in graphic above). Significant groundwater resources

Interesting Tidbits:

The Violet Hill Spillway (VHS)

has been described by Dr. Walter Tovell as: *“One of the few places where one can truly experience the role glaciation played in creating the magnificent landforms and resources...”*

It was formed around 13,000 years ago in the dying stages of the ice sheets; meltwaters would have been trapped between the two terminal moraines and the still frozen Singhampton-Gibraltar Moraine on the east flank and the Niagara Escarpment on the west.



The channel that was created by the power of the meltwater is known as the Violet Hill Spillway.

Protect Mono was formed in 2014 to oppose an application by Greenwood Construction for a sand and gravel pit on 410 acres in the middle of the VHS. In May 2016, the Town of Mono Heritage Advisory Committee recommended that the VHS be designated as a Natural Heritage Feature; alas the Town has not done so and today VHS remains undesignated. Greenwood appealed the Town's decision to not approval the application to LPAT; both the Town of Mono and Protect Mono were parties. A decision is expected in 2021.

Champions: Protect Mono, Water Protection Coalition of South Grey, Grey Association for Better Planning, Town of Mono 2018 OP Consolidation: Natural Heritage System Planning.

Threats/Issues: Water bottling plants, aggregate mining, provincial growth management policies that support urban sprawl



Singhampton-Gibraltar Moraines References:

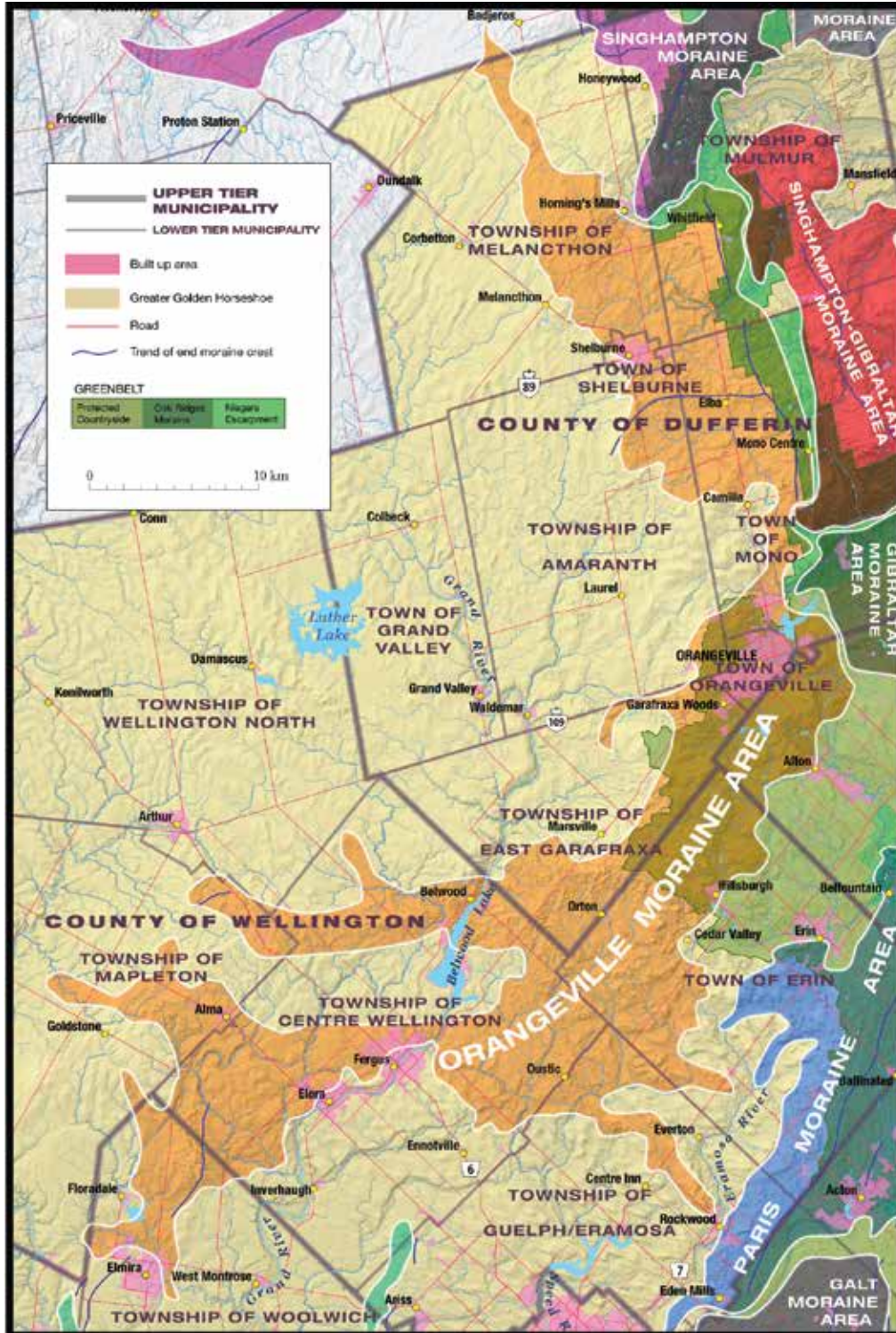
Aggregate Resources Inventory of Grey County, Jagger Hims Limited and D.J. Rowell, Ontario Geological Society ARIP 180, 2009 Grey Sauble Watershed Report Card, Grey Sauble Conservation Authority, 2018

In Support of Protecting the Violet Hill Spillway, Rosenbrock K., Farrugia J., Submission to Niagara Escarpment Commission, September 2016

Protect Mono; protectmono.com
Quaternary Geology of the Dundalk Area, Southern Ontario, Gwyn Q., Ontario Division of Mines, Geological branch, 1975

Town of Mono Official Plan Office Consolidation 2018, Township of Mono

Orangeville Moraine: Complex and Understated



Profile: Low

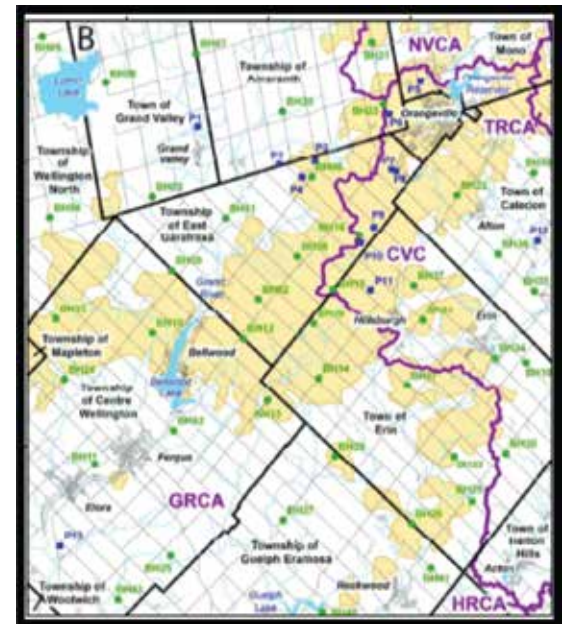
Attributes: North-south length ~ 45 kms and ~ 20km wide. Characterized by a hummocky surface and coarse sand and gravel sediments and significant groundwater recharge area

Municipal Jurisdiction: Municipality of Grey Highlands (County of Grey); Townships of Melancthon, Mulmur, Amaranth, Town of Mono & Orangeville (County of Dufferin); Town of Caledon (Region of Peel); Townships of Erin, East Garafraxa, Mapleton, Centre Wellington & Guelph- Eramosa (County of Wellington); Township of Woolwich (Region of Waterloo)

Conservation Authorities: Nottawasaga Valley Conservation, Credit Valley Conservation, Grand River Conservation

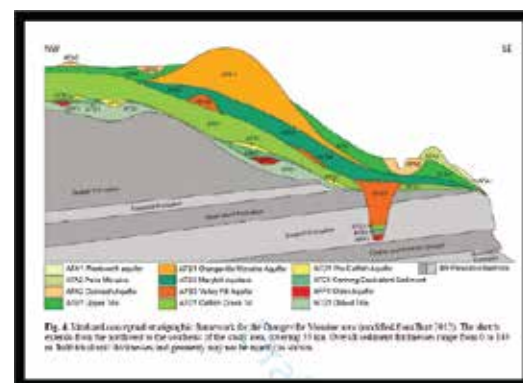
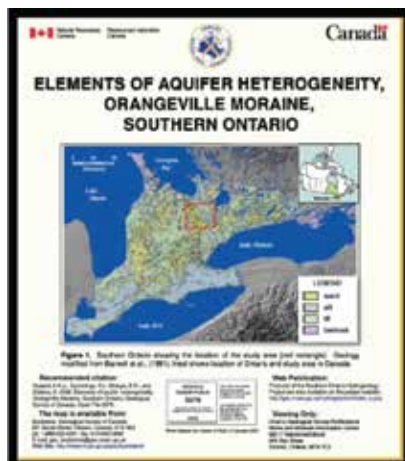
Quaternary geology: Highly complex geology with interlobate contributions from Lake Huron / Georgian Bay from north and west, Lake Ontario from south and east, Lake Simcoe from east and in southern sections glacial contributions from Lake Erie lobe. In northeast the Orangeville “coalesces” with Singhampton Moraine. Two distinct sections (i) a southern SW-NE thick section (ii) a northern discontinuous ridge of ice-contact stratified drift.

Hydrogeology: Highly significant municipal groundwater source for numerous communities from Orangeville, Grand Valley, Fergus, Elora, Rockwood, Action, Alton, Fergus, Erin. Intense agricultural areas for livestock and irrigation.



Headwaters to: Nottawasaga River and tributaries (the Boyne, Pine & Noisy Rivers); The Humber River rises east of Orangeville in the Orangeville / Gibraltar Moraines complex*; **Credit River** (main branch rises in Orangeville), West Credit and tributaries (Shaw’s and Caledon Creeks); **Grand River watershed** (the Speed and Eramosa Rivers rise out of the Orangeville Moraine plus major discharge contributions in upper watershed).
* Some sources claim the Humber River rises out of the Gibraltar Moraine

Claim to Fame: The Orangeville Moraine is one of the **most complex of the moraine areas in the GGH!** It is both a terminal and an interlobate moraine and where it ends and the Singhampton and Gibraltar Moraines begin remains anyone’s guess ... well maybe the Ontario Geological Survey (OGS) knows



Interesting Tidbits:

The Orangeville Moraine has, as an entity, low name recognition but the area has a highly developed sense of its self as Headwaters Country – here goes in no particular order: Headwaters Health Care Centre, Headwaters Physiotherapy, Headwaters Construction, Headwaters Landscaping, Headwaters Family Visit Centre, Headwaters Restaurant, Hills of Headwaters Health Collaborative, Headwaters Hills Montessori School, Headwaters Tourism (now defunct), Headwaters Fitness and Racquet Club, Headwaters Arts Festival, Headwaters British Car Club, Headwaters Food and Farming Alliance, Hills of Headwaters. Whew!

Orangeville Moraine References:

Elements of Aquifer Heterogeneity, Orangeville Moraine, Southern Ontario,

Russell H., et.al.,

Natural resources, Canada Poster, 2008

Geology of the Grand River Watershed: An Overview of the Bedrock and Quaternary Geological Interpretations in the Grand River Watershed,

Janzen B., Grand River Conservation Authority, 2018

Headwaters Country, Southwestern Ontario,

Mestern P., Blog, September 7, 2003

<http://www.mestern.net/festivals/orangeville/index.php>

Results of the Orangeville – Fergus Three Dimensional Sediment Mapping Project, Burt A., Included in Regional Scale Groundwater Geoscience in Southern Ontario: an Ontario Geological Survey, Geological Survey of Canada and Conservation Ontario Open House,

Compiled by Russell H., et.al., Geological Survey of Canada, 2017

Three Dimensional Hydrostratigraphy of the Orangeville Moraine Area, Southwestern Ontario,

Burt A., Ontario Geological Survey, Canadian Journal of Earth Sciences, 2017

Where Rivers Rise: A primer on the Rivers of Headwaters,

In the Hills Magazine, Tony Reynolds, June 20, 2016

The Paris & Galt Moraines: More than Meets the Eye



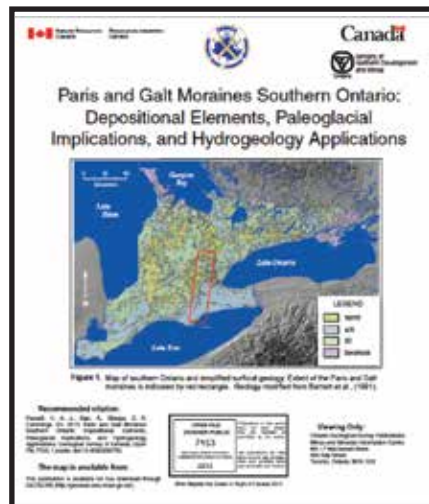
Profile: High

Attributes: Parallel systems that are 130 - 150 km long, 11 kms wide and ~ 30 m in elevation.

Municipalities: Town of Caledon (Region of Peel); Townships of Guelph-Eramosa & Puslinch, Town of Erin (County of Wellington); Towns of Milton, Halton Hills (Halton Region); City of Guelph; City of Cambridge; City of Brantford; County of Brant; Norfolk County

Conservation Authorities: Credit Valley Conservation, Grand River Conservation, Long Point Region Conservation

Quaternary geology: interpretations from bore-hole data indicate a fluctuating, retreating ice margin that varied along its length. In the south the strata indicate rapid deposition within a glacial lake basin (resulting in stratified, well-sorted materials) whereas the northern hummocky section was deposited in a terrestrial environment. In the south outwash plains separate the linear Paris and Galt moraines.



Hydrogeology: Detailed geotechnical studies have upended conventional wisdom that end/recessional moraines contribute little to regional recharge. The Paris [and Galt] Moraines' hummocky topography is instrumental in storing and delivering water to bedrock aquifers – a primary drinking water source for the City for Guelph and environs.

Headwaters to: Credit River Watershed (nos. 10, 11, 12, 13, 15, 20); **Grand River** watershed (Fairchild, Blue, McKenzie & Boston Creeks and direct discharging to the Eramosa, Speed, Grand and Nith Rivers); **Long Point** (headwaters of Big Creek, Nanicoke-Sandusk-Stoney Creek & Lynn-Black Creek watersheds)

Threats/Issues: Water taking for bottled water; Urban sprawl: provincial growth management policies regarding boundary expansion of adjacent settlement areas – Guelph, Cambridge, Brantford + small communities; aggregate mining, Hidden Valley (new application before the LPAT)

Champions: Mike Schreiner, MPP Guelph and Leader of the Ontario Green Party; Protect Our Moraine #Rethink Clair-Maltby; Wellington Water Watchers; Concerned Residents Coalition

Interesting Tidbits: Bill 71: The Paris-Galt Moraines Conservation Act, introduced by Mike Schreiner, MPP Guelph and Leader of the Green Party, received second reading with All Party Support and referred to Standing Committee on March 7, 2019.

“Paris-Galt Moraine is a major geological feature that supports groundwater recharge areas - hydrological function is important.”

Dave Belanger,
*M.Sc., PGeo, Water Supply Program Manager,
Guelph Water Services*

Paris & Galt Moraine References:

Fall Watershed Report,

Grand River Conservation Authority, 2005

Geology of the Grand River Watershed: An Overview of the Bedrock and Quaternary Geological Interpretations in the Grand River Watershed,

Janzen B., Grand River Conservation Authority, 2018

Hidden Quarry, Another Potential Hole in the Water-Giving Paris-Galt Moraine,

Linda Sword, Niagara Escarpment Views, Summer 2019

Lake Simcoe Watershed Report Card,

Long Point Region Conservation Authority, 2018

Paris-Galt Moraine Hydrogeology,

A Presentation by Dave Belanger, Water Supply Program Manager, Guelph Water Services

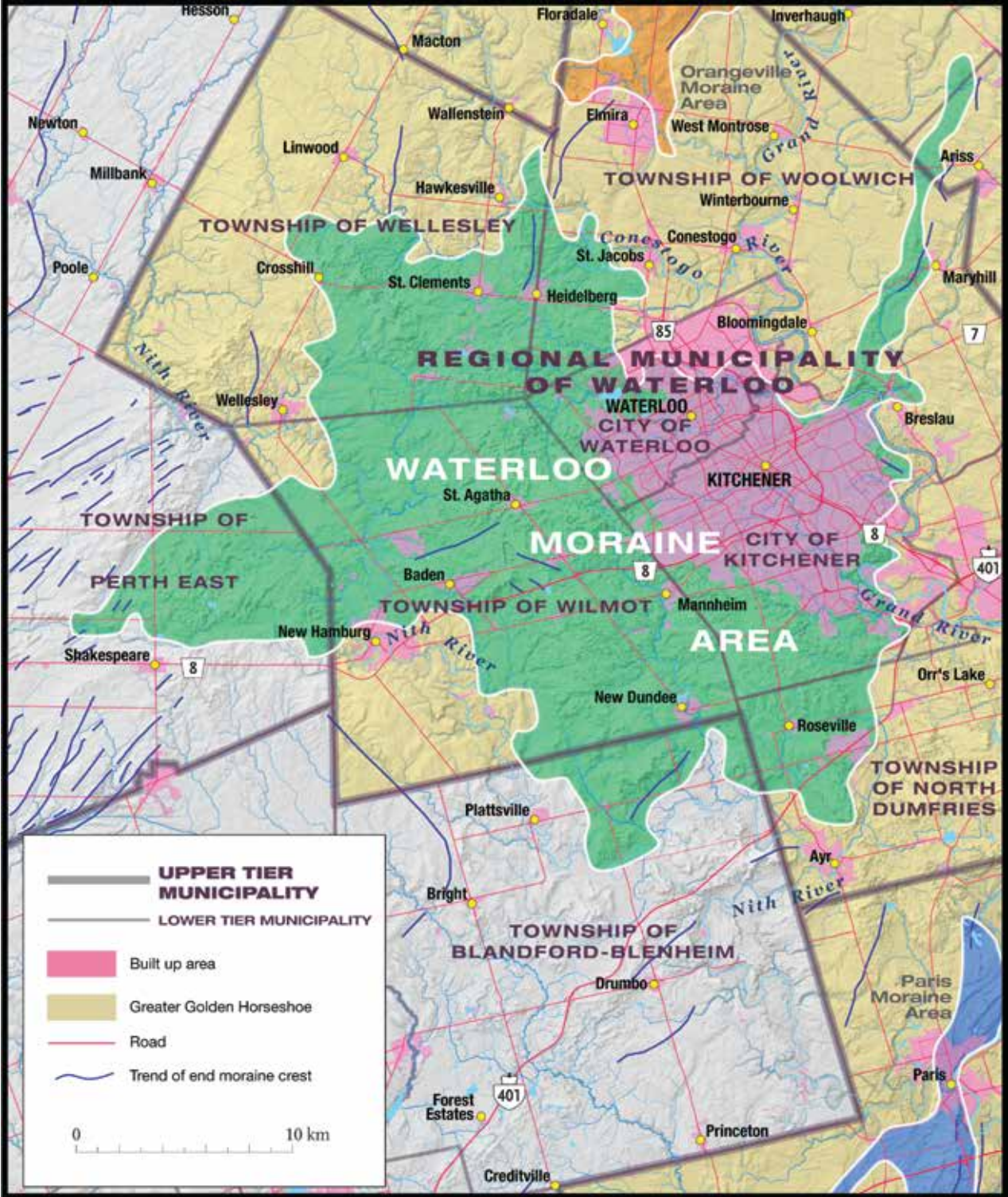
Regional Groundwater Monitoring in the Grand River Watershed,

Grand River Conservation Authorities Ground Water Resource Group

Review of the State of Knowledge for the Waterloo and Paris-Galt Moraines,

Blackport Hydrogeology, Prepared for Land and Water Policy Branch, Ministry of the Environment, 2005

Waterloo Moraine: A Model of Constraint & Innovation



Profile: Well Developed

Attributes: Sensitive recharge and discharge area, covering 400 square kilometres and plays a major role in the recharge of the local and regional groundwater system.

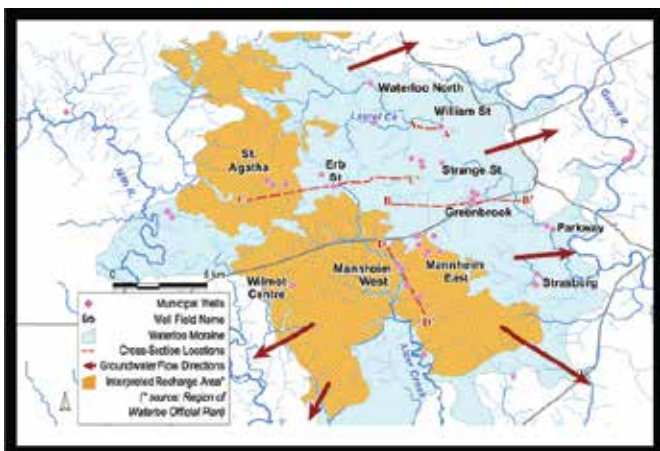
Municipalities: Municipalities: Townships of Woolwich, Wellesley, Wilmot, North Dumfries, Cities of Kitchener, Waterloo, Cambridge (Region of Waterloo); Township of Guelph-Eramosa (County of Wellington); Township of Perth East (County of Perth)

Conservation Authorities:
Grand River Conservation, contribution to Long Point Region Conservation

Quaternary Geology: Interlobate moraine created between the Huron/Georgian and the Erie / Ontario lobes

Hydrogeology: Provides drinking water to the majority of residents of Kitchener/Waterloo, as well as rural residents in the western part of the region. 10 activewell fields that feed K/W and rural municipalities

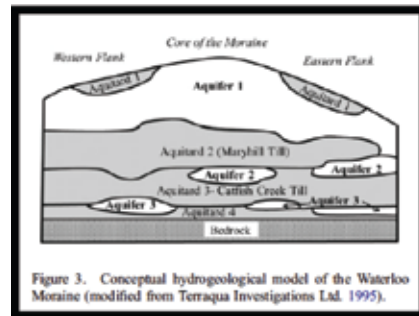
Headwaters to: Alder, Laurel, Strasberg Creeks (cold water streams that support brook trout), Doon South, Blair, Bechtel, Bauman Creeks. Environmentally Sensitive Landscapes & Wetlands: 70+ Provincially Significant Wetlands mapped within the moraine's boundary, most of which are within Laurel Creek subwatershed (northwest Waterloo). Twenty-five of the region's 80 Environmentally Sensitive Policy Areas (ESPAs) are within Waterloo Moraine



Threats/Issues: Urban sprawl: provincial growth management policies regarding settlement area boundary expansion, aggregate mining

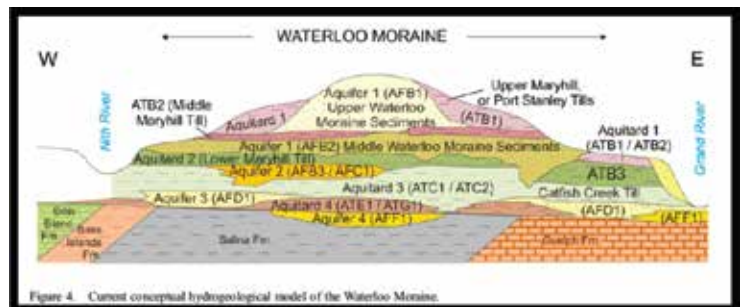
Champions: Region of Waterloo*, Grand River Environment Network (GREN), Hold the Line, University of Waterloo groundwater group (starting with Drs. Emil Frind and Robert Farvolden)

Interesting tidbits: *Local planning context: The new Regional Official Plan places a strong focus on directing growth to growing urban centres, while setting urban boundaries and ensuring sensitive natural areas such as the Waterloo moraine.



1995 Stratigraphic Model

After a lengthy process at the OMB, the new ROP was recently approved and represents an opportunity to bring the Greenbelt as an additional level of provincial protection and permanence; 80% of region's water supply comes from the ground with 20% from the Grand River directly; The Region of Waterloo was the first to establish an environmental advisory committee, the first to use official plan policies to protect ESAs and ESLs, early adopters (1990s) of ecosystem-based approach to urban development, turned away from pursuing Lake Erie pipeline through investments in groundwater exploration that lead to progressive water strategies



2007 Stratigraphic Model

Waterloo Moraine References:

***Geology of the Grand River Watershed:
An Overview of the Bedrock and Quaternary
Geological Interpretations in the Grand River
Watershed,***

Janzen B., Grand River Conservation Authority,
2018

2005 Fall Watershed Report,

Grand River Conservation Authority, 2005

Legacy of the Grand River,

Pathways to Peace (pdf)

***Review of the State of Knowledge for the Waterloo
and Paris-Galt Moraines,***

Blackport Hydrogeology, Prepared for Land and
Water Policy Branch, Ministry of the Environment,
2005

***Towards a Management Plan for the Waterloo
Moraine: A Comprehensive Assessment of its
Current State Within the Region of Waterloo,***

Poulin L., A Masters Thesis in Environmental
Studies in Geography, University of Waterloo,
2009

***Towards an Understanding of the Waterloo Moraine
Hydrogeology,***

Blackport et.al. Canadian Water Resources Journal,
February 2014

Hold the Line: www.holdthelinewr.org

