# THE PARIS-GALT MORAINE – ESSENTIAL GROUNDWATER SOURCE

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**Background**

In southern Ontario, the receding Wisconsin glacier left behind great mounds of sand, gravel, rock and soil (till). In the Grand River watershed, these overburden deposits, which can be up to 30 metres deep (Russell et al., 2015), are known as 'moraines' and "… form broad topographic ridges with irregular, hummocky topography, numerous closed depressions and kettle lakes (GRCA, 2009).

The Grand River Conservation Authority stated that: "Moraines are the backbone of the Grand River watershed and are critical to the health of the Grand River environment and, significantly, its cities, towns and farms." (GRCA, 2005). The Paris and Galt Moraines run parallel to each other and the complex represents one of the three most hydro-geologically significant moraines in the Grand River watershed. The 6 to 8 kilometer-wide complex extends for more than 70 km along the east side of the watershed through Wellington County, Waterloo Region and Brant County (Figure 1). "The Paris-Galt Moraines are unique landforms…they function as a support for hydrologic processes and features that influence groundwater and surface water resources at regional and local scales." (Wellington County, 2016). It is noteworthy that the Hidden Quarry proposed by James Dick Construction Limited is located at the east end of Rockwood, on the Paris Moraine.

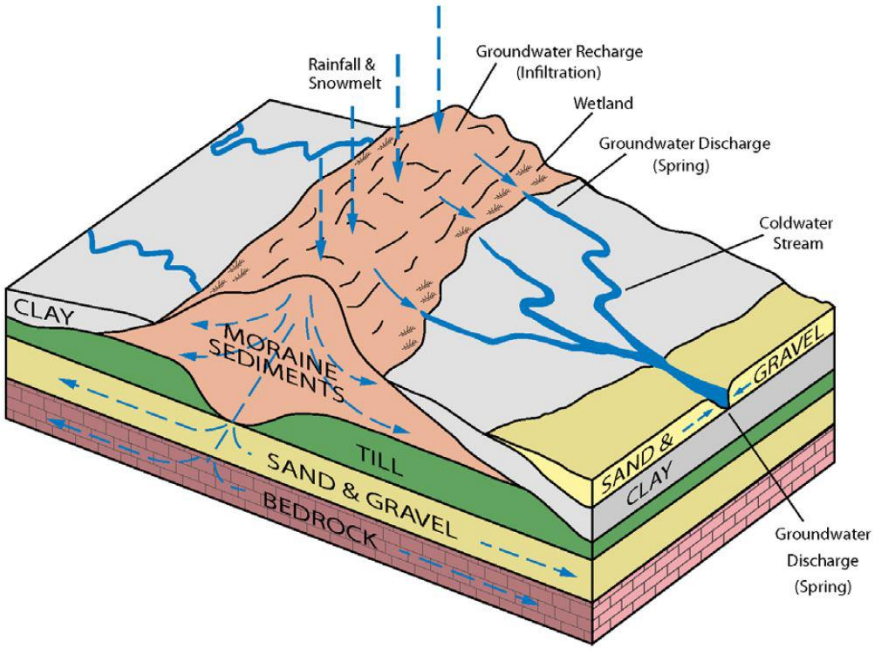



Figure 2: Illustration of the function of moraines as it relates to groundwater recharge, discharge, coldwater streams and wetlands.

The irregular, hummocky surface of the moraine "…gives rise to closed depressions which can collect runoff…" (Blackport *et al.*, 2009), thereby assisting in surface water detention

(confinement), infiltration (penetration) and groundwater recharge (regeneration). Recharge is the primary mechanism through which water enters an aquifer. Rain or melting snow on the moraine surface is naturally filtered and cooled as it soaks down through the porous material (Figure 2). Some of this water recharges aquifers in the overburden, while some percolates still deeper into underlying bedrock via sinkholes and exposed joints (Cowell, 2016) to recharge deep aquifers located within bedrock pores and cracks.

A number of local aquifers occur within the moraine sediments. The porous moraine overburden enhances groundwater contribution to baseflow of the Grand River via springs or seeps. Groundwater discharge areas within the watershed have created and maintained a significant habitat for cold water aquatic species such as rainbow trout and numerous coldwater streams supporting native brook trout originate in the moraine-wetland complexes. (GRCA, 2008).

**Status of Moraines**

There are currently no provincial policies that specifically protect moraines and prohibit development on them. In fact, aggregate extraction via pits or quarries is permitted – with certain restrictions - even within the Oak Ridges Moraine and on land designated as Greenbelt (OMMA, 2017). Responding to the provincial 'Places to Grow' proposal, the Grand River Conservation Authority stated that: "The province must evaluate and protect moraines and recharge areas in the Grand River watershed for their critical function in water supply, waste water assimilation and natural heritage systems." (GRCA, 2005). However, an Environmental Bill of Rights Review (OME, 2009) concluded that "…new provincial policy or legislation is not required to protect the functions of the Paris and Galt Moraines at this time." Responsibility for their protection largely falls on municipalities or counties through their local planning documents, such as official plans or zoning bylaws and implementation of provincial policies relating to water.

In the absence of a provincial policy, some municipalities have taken steps to protect moraines and their functions. A study for Guelph-Eramosa Township recommended that: "The Township should develop a Groundwater Source-Protection Plan and "…the potentially significant recharge areas east of Rockwood and in the vicinity of Oostic should be identified in the appropriate planning documents." (Gartner Lee, 2004).

The Wellington County Official Plan Amendment of 2016 includes numerous policies, including those relating to groundwater, source water, aggregate resources, and the Paris-Galt Moraine. The **Paris-Galt Moraine Policy Area** policies are intended to: *"…protect moraine processes and features in order to maintain and where possible enhance groundwater and surface water resources and also promote stewardship activities that maintain, restore or enhance these resources.* On moraine *lands "…that lie outside of Wellhead Protection Areas…Large scale development proposals including intensive recreation, mineral aggregate operations, new rural employment area designations and urban boundary expansions will be required to demonstrate that ground and surface water functions will be maintained and where possible, restored and enhanced. Small scale developments that do not rely on significant site alterations will not normally be required to demonstrate protection of the moraines."* (underlines added)

Unfortunately, the above policies still do not completely protect the moraine from aggregate operations such as the planned overburden removal and underwater blasting of bedrock of the Hidden Quarry proposal. Potential impacts on surface- and groundwater functions are:

Groundwater Recharge: The trapping of rainfall and snowmelt by the irregular moraine topography results in a significantly greater proportion of the precipitation being infiltrated compared with other environments. Consequently, removal of overburden for access to the bedrock will remove this significant component of groundwater recharge.

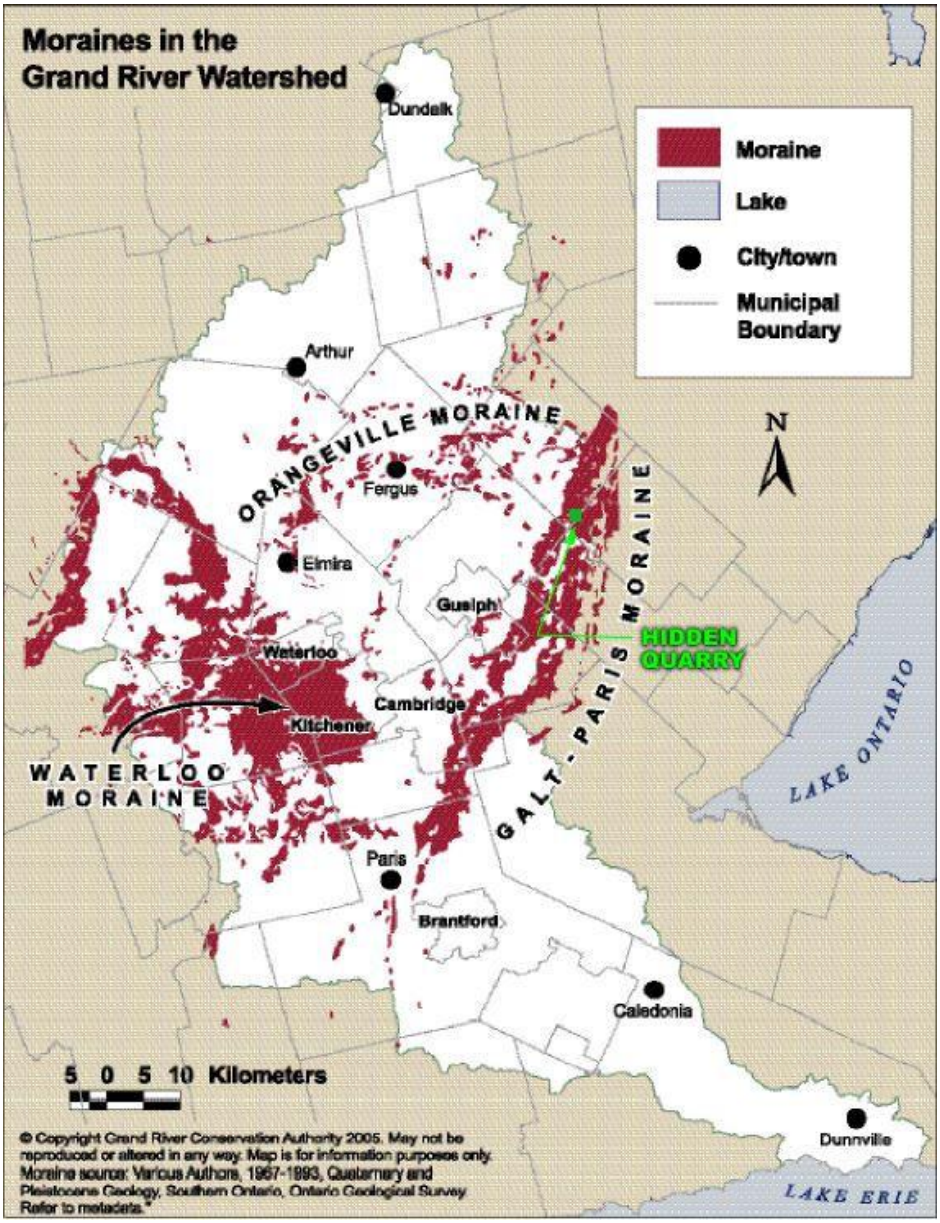
Initially, the proponent claimed that: "The subject property is not considered important for water protection as it does not represent a sensitive recharge, discharge or headwater area."(GWS, 2012). The proposed Hidden Quarry is located between upgradient recharge features (e.g., De Grandis springs and ponds) and a significant discharge feature, the Brydson Spring, and blasting and quarrying would occur within the connecting aquifer (Cowell, 2016). It is noteworthy that recharge values for the Paris-Galt Moraines vary from 100 to 360 mm/year (Blackport *et al*., 2009), but at the proposed quarry site, are among the highest, at more than 400 mm/year (Figure 3).

Groundwater Storage: "Groundwater storage within the Paris/Galt Moraines is likely significant in providing a level of resilience for associated groundwater discharge on a seasonal basis and during extended drought periods." (Blackport *et al*, 2009). Harden (2016) contends that the development of the Hidden Quarry will result in increased groundwater storage, since quarrying will gradually "…convert bedrock aquifer with low storage potential to a pond with 100% water storage potential." This completely ignores the loss in water filtration and storage capacity by the removal of 24.5 hectares of bedrock to a depth of 23 metres (Stovel, 2016), and in particular the water filtration capacity lost by removal of the 4 to15 metres of moraine overburden (approximately 4 million tones) comprised of sand, gravel and silt (Frind, 2017). Unfortunately, such a change has the strong potential of being a direct source of biological and chemical pollutants into bedrock groundwater and downstream watercourses. In fact, Harden (2012) stated: "First, the mining process introduces chemical explosives to the sub-aqueous environment to break the rock apart." and: "Secondly, the water body created will be susceptible to biological contamination introduced by wildlife." Similarly, OMECC (2013) expressed concern that: …"extraction below the groundwater without dewatering - also has the potential to have a detrimental effect on the groundwater quality since chemical explosives, in a water proof emulsion form, are brought in the sub-aqueous environment to break the rock." and that "… the quarry pond to be created by the aggregate extraction activities will be susceptible to biological contamination introduced by wildlife".

Groundwater Conveyance and Springs: Burnside (2015) expressed concern that "…the existing background studies did not definitively determine if water from the open water area of the quarry will be connected through groundwater to Brydson Creek beyond incidental infiltration…" Blackport *et al*. (2009) noted that: "Recharge into the Paris/Galt Moraines, and the subsequent groundwater flow, is interpreted to provide significant groundwater discharge to the reaches of the Eramosa River/Blue Springs Creek …" and "Coldwater reaches of the streams on and adjacent to the Paris/Galt Moraines have not been fully quantified."

Since the aquifer beneath the proposed quarry is a karst aquifer in which water may flow through conduits, the flow of water is not predictable (Cowell, 2016) Should major groundwater channels and their direction and flow be significantly altered or blocked by particulates as a result of blasting and bedrock extraction (Cowell, 2016, Whitely, 2016), numerous area residents (and the downstream fisheries) that depend on maintenance of the existing aquifer flow and water quality conditions could be affected

**Conclusion** There are major concerns that groundwater recharge, storage, flow, and direction, plus bedrock porosity, will be adversely affected in both the on-site as well as the surrounding moraine and bedrock once the overburden is removed and quarrying begins in proposed Hidden Quarry.



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