Appendix B

Hydrogeology Assessment of Fullarton Conservation Area

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The hydrogeology assessment was a desk top exercise based on existing mapping and public information in the vicinity of the Fullarton Conservation Area.

Physiography and Surficial Geology

The Physiography was mapped by Chapman and Putnam (1966) and the Surficial Geology was mapped by Karrow (1977) (Figure 1). The Fullarton CA is located at a portion of the North Thames River where the river bisects two moraines: the Milverton and Mitchell moraines. The North Thames occupies the eastern margin of the Mitchell moraine which controls the river and Black Creek (southeast of the CA) borders the southern margin of the Milverton moraine. The CA is dominated by late glacial Rannoch till (diamicton/till) (Figure 3) which was deposited by the Huron Lobe (Mitchell moraine) as it retreated westward and outwash sand and gravel deposited associated with the esker to the west. The Rannoch till is a clayey silt till. In the low areas silt was deposited later on top of the till, through alluvial processes following deglaciation.

Topography

In general the topography is characterized by low relief with the steepest slopes adjacent to the river. The topography of Fullarton CA varies between 325-335 metres above sea level (MASL). Low areas are along Neil Drain and the North Thames River.

Monitoring wells, boreholes and private wells

There are no monitoring wells located on the CA site. The only subsurface information is from the Ministry of Environment, Energy and Climate Change (MOECC) that are well records from wells completed for domestic purposes (Figure 2). No additional well surveys were completed. There are no documented permit to take water sites nearby (https://www.ontario.ca/environment-and-energy/map-permits-take-water).

Hydrogeology

In the vicinity of Fullarton Conservation Area, drinking water wells are sourced in the shallow overburden or the deep bedrock. The shallow aquifer is limited in lateral extent and is relatively thin reaching up to 5 m in thickness and less than 15 m depth. The bedrock aquifer would be continuous across the regional area.

The shallow aquifer is limited in extent (see Figure 3) and if a well is located outside the extent of the shallow aquifer (e.g. 5002359), the only source of water is the deep bedrock aquifer. A sample of a few MOECC wells in the immediate area of the site (Figure 4) demonstrates the elevation of the ground and the shallow aquifer. The elevation of the shallow aquifer mimics the topography which is common in shallow aquifers. The shallow aquifer is in direct communication with the surface water in Neil Drain (parts of Neil drain are cold water which indicates groundwater discharge), the pond, marsh and wetland fringe and the North Thames River. Some of the ecosystems would be groundwater dependent

ecosystems. Thus, groundwater in the CA has potential to impact the surface water in terms of water quantity and quality.

The bedrock aquifer exists across the entire area. Based on MOECC well records, the water levels vary between 250-265 masl. The elevation of the bedrock surface is much shallower between 290 and 310 m elevation (Figure 6). This indicates that there is more than 40-50 m of dry bedrock above the bedrock water level (potentiometric surface) and the bedrock aquifer. This indicates a significant downward groundwater gradient between the overburden and the bedrock. Tens of metres of dry bedrock generally indicate a significant weathered bedrock (karst) environment. Wells completed in this aquifer can have fluctuating water levels, varying pressure changes and have potential to be influenced or impacted by surface water. However, this deep aquifer is below the depth of the surface water bodies and would not contribute to surface water quality or quantity.

Groundwater Quality and Quantity

No groundwater quality or quantity monitoring has occurred at the Conservation Area. The nearest Provincial Groundwater Monitoring Network (PGMN) site operated by the UTRCA is Well 54 which is a bedrock groundwater monitor. Well 54 is approximately 6 kilometres downstream of Conservation area and on the western bank of the North Thames River. The average water level is 303 m which is significantly higher than the bedrock aquifer located at the CA and likely is a different aquifer than present at the CA. The groundwater in PGMN well 54 varies up to 4 m since 2001 when the monitoring program was initiated. The quality of the water in the bedrock aquifer at Well 54 is excellent.

References

Chapman, L.J. and Putnam, D.F. 1966. The Physiography of southern Ontario; University of Toronto Press, Toronto 2nd ed. 386 p.

Karrow, P.F. Quaternary Geology of the St. Marys Area, Southern Ontario, 1977. Geoscience Report 148

Figures

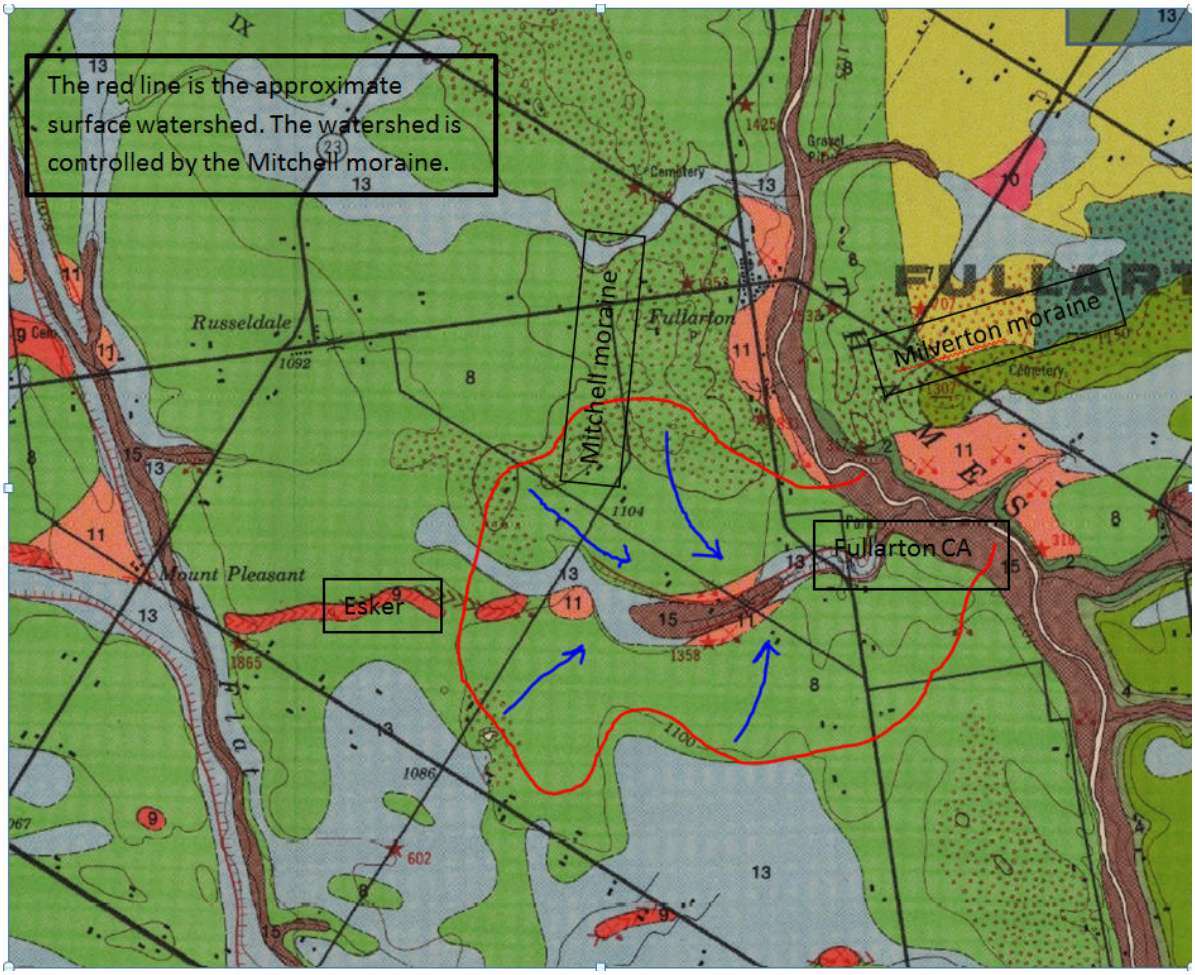

Figure 1: A portion of Ontario Geological Survey Map 2366 Quaternary Geology of the St. Marys area which illustrates the physiography of the Fullarton CA. Figure 3 is based on this mapping and more clearly represents catchment and legend. The Conservation Area is located at the confluence of the Mitchell moraine (stippled area north south orientation) and the Milverton moraine (stippled east- northeast). Black Creek runs parallel and south of the Milverton moraine and the North Thames runs adjacent to the Mitchell moraine. See Figure 3 for surficial geology and legend of the CA. An esker (9) west of the CA would contribute to groundwater at the CA.

Figure 2: Location of wells in the area and the nature of the aquifers at depth. There are both shallow overburden wells (less than 15 m depth) and deep bedrock wells tapping water between 70 and 120 m depth. The graphic superimposed on the aerial photography is a representation of the materials encountered at depth as described by the well driller. The colour indicates material and the aquifers are represented by gravel and limestone, depth of the well is indicated in meters. (http://analysis.gw-info.net/gin/publicgin.aspx)

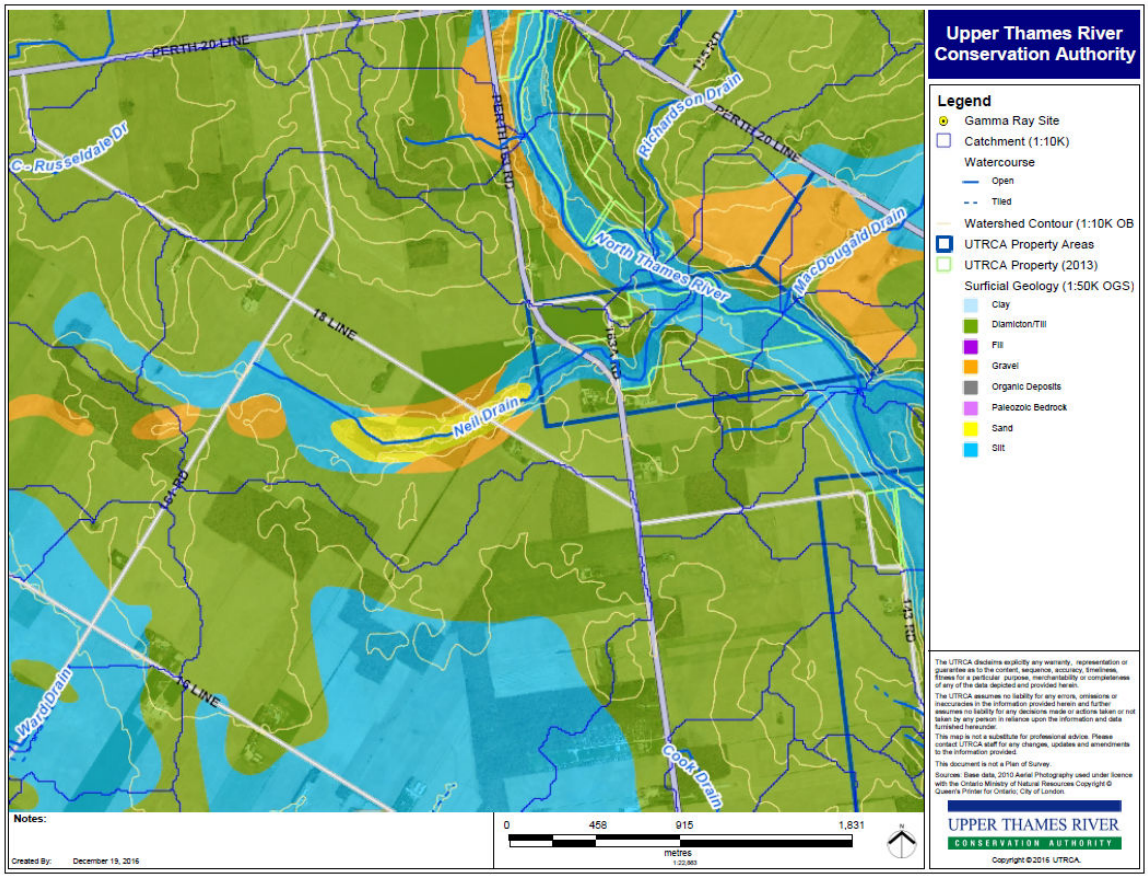

Figure 3: Surficial geology with legend and elevation contours (masl), based on Ontario Geological Survey Map 2366: St Mary's, Southern Ontario, 1974 by P. F, Karrow and assistants. Mapping is the same as Figure 1.

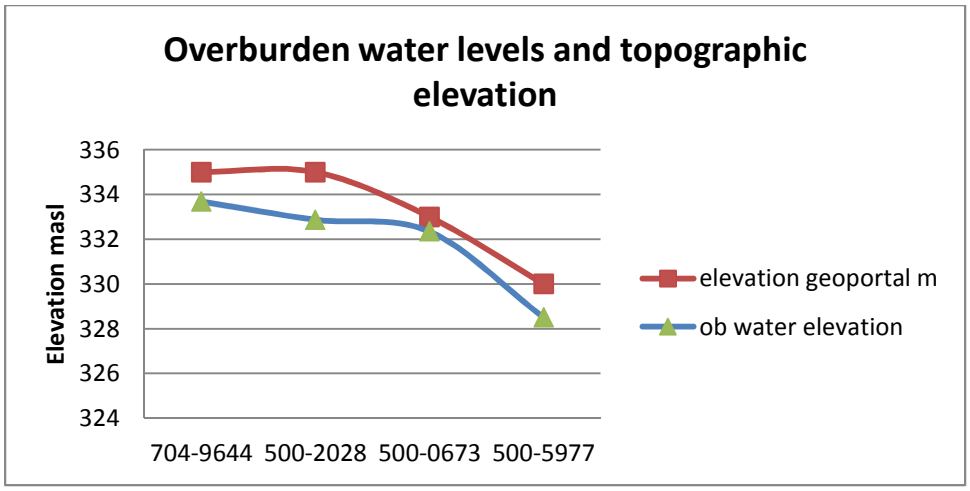

Figure 4: Ground elevation versus shallow water table based on MOECC well logs.

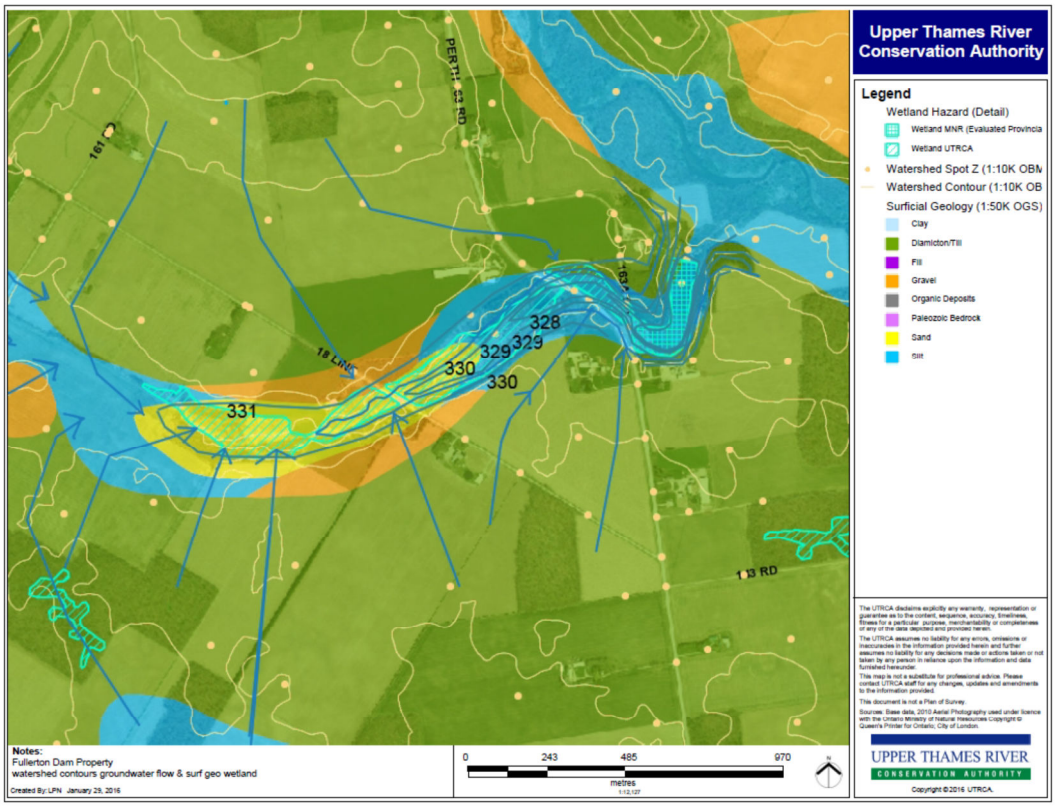

Figure 5: The arrows represent shallow recharge to the shallow groundwater aquifer and flow direction from the high areas to the low areas. The contours represent the approximate groundwater levels and are schematic based on MOECC water well records.

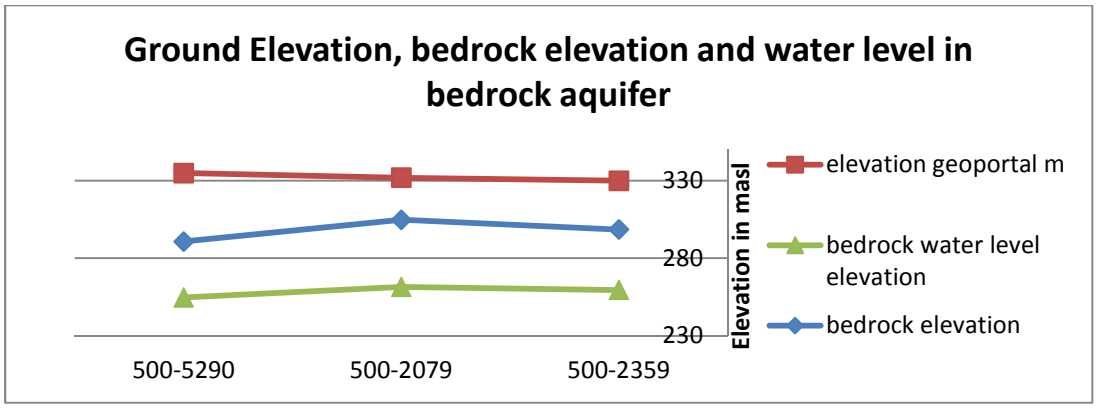

Figure 6: A representation of MOECC bedrock well logs in the Fullarton CA area. The bedrock aquifer water levels and flow direction are regional and generally do not show a correlation to the topography of the site.