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23.0 HALTON HILLS TIER 3 WATER BUDGET AND RISK ASSESSMENT

Under the requirements of the *Clean Water Act, 2006* the communities of Acton and Georgetown in the Town of Halton Hills were required to complete a Tier 3 Water Budget and Risk Assessment (Tier 3 Assessment) to assess the ability of their municipal water sources to meet committed and planned water demands.

The findings of the Tier 3 Assessment for Halton Hills are available in the report *Halton Hills Tier 3 Water Budget and Local Area Risk Assessment Final Risk Assessment Report* (AECOM and AquaResource, 2014). The report was extensively peer reviewed by a panel of municipal and provincial representatives, private consultants, and CVC staff prior to being accepted by the Credit Valley – Toronto and Region – Central Lake Ontario (CTC) Source Protection Committee (SPC). Although the Town of Halton Hills does not have wells located within the Grand River Watershed, the Wellhead Protection Area for Quantity (WHPA-Q) extends into the Grand River Source Protection Area (**Map 23-1**). Each SPC is required to develop policies to address any significant water quantity threats identified within their source protection area.

The Final Report, submitted in October 2014, details the Tier 3 Water Budget and Local Area Risk Assessment carried out for municipal drinking water systems within the communities of Acton and Georgetown in the Town of Halton Hills. The report summarizes background information relating to the geology and hydrogeology of the area, current and planned water demands, and the process and results of the Water Quantity Risk Assessment.

23.1 Tier 3 Approach

The Tier 2 Water Quantity Stress Assessment completed for the Credit River Watershed in 2009 by AquaResource Inc., identified the Black Creek Subwatershed (Subwatershed 10) and the Silver Creek Subwatershed (Subwatershed 11) as having a “Moderate” groundwater stress level. The identification of a moderate stress level lead to the requirement of a Tier 3 Assessment for Acton and Georgetown as their municipal wells are located in these two subwatersheds.

The Tier 3 hydrologic model improves on the Tier 2 Water Budget model for the model simulation and representation of groundwater movement between and across subwatershed boundaries. As part of the Tier 3 assessments surface water and groundwater models were developed and calibrated to simulate the existing drawdown at municipal pumping wells and stream interactions. The calibrated models were then used to assess the impact of changes in pumping and land use on surface water and other users.

As part of the Tier 3 Assessment, surface water and groundwater modelling tools were developed to help assess the sustainability of the municipal water sources. The models were developed based on a detailed characterization of the groundwater and surface water systems, and they were refined around wells to a level supported by available data. The groundwater and surface water modelling approach was designed to simulate average and drought conditions, represent the detailed hydrologic and/or hydrogeologic conceptual model, and integrate the inputs and outputs of the surface water and groundwater models (e.g., groundwater recharge, baseflow). The surface water model was developed using MIKE SHE (DHI-WASY, 2011a). The groundwater flow model was developed using FEFLOW (DHI-WASY, 2011b) based on the best geological and hydrogeological data.

The MIKE SHE model simulated hourly continuous streamflow, and the FEFLOW model simulated average annual groundwater discharge and baseflow conditions. However, each model estimates the same surface water flow system and they were calibrated to the same streamflow and high quality water levels and data. Outputs from the surface water model were used as the initial input into the groundwater flow model. The model was verified from the period between 1981 and 1990. The calibration and verification process resulted in a reasonable match between simulated and observed data for the region, which provides confidence that the groundwater recharge estimates of the model are appropriate for use in the FEFLOW groundwater flow model. This coupling was used to examine the impact of future land development on water levels in aquifers, and reductions in discharge to streams and surface water features. The combined results of the two water budget models produce an improved understanding of the hydrologic and hydrogeologic flow systems.

A detailed water budget for subwatersheds 10 and 11 was developed based on average pumping rates for 2005 through 2011. Subwatershed 10 receives on average 850 mm/year of precipitation and 30 mm/year of groundwater flows in from adjacent subwatersheds for a total inflow of 880 mm/year. Of this, approximately 66% leaves the subwatershed as evapotranspiration, 20% leaves as streamflow, 5% leaves via municipal groundwater extraction, and the remainder (9%) flows into adjacent subwatersheds. Subwatershed 11 receives approximately 850 mm/year of precipitation and 140 mm/year of groundwater flows in from adjacent subwatersheds. Of this, 58% leaves the subwatershed as evapotranspiration, 30% leaves as streamflow, 8% leaves via municipal groundwater extraction and the remainder (4%) flows out of the subwatershed as groundwater flow to adjacent subwatersheds.

The total groundwater discharge to surface water in Subwatershed 10 is approximately 31,500 m^3/d or 140 mm/year, and is 29,500 m^3/d or 220 mm/year in Subwatershed 11. Subwatershed 10 groundwater pumping is 8,300 m^3/d, or approximately 13% of the total groundwater inflow (recharge plus cross-boundary flows). Subwatershed 11 groundwater pumping is 10,200 m^3/d, or approximately 22% of the total groundwater inflow into the subwatershed. These values are within 10% of those estimated using the Tier 2 (watershed-scale) FEFLOW model. However, discharge to streams is better represented within the Tier 3 model based on the calibration to continuous gauges and additional spot streamflow measurements.

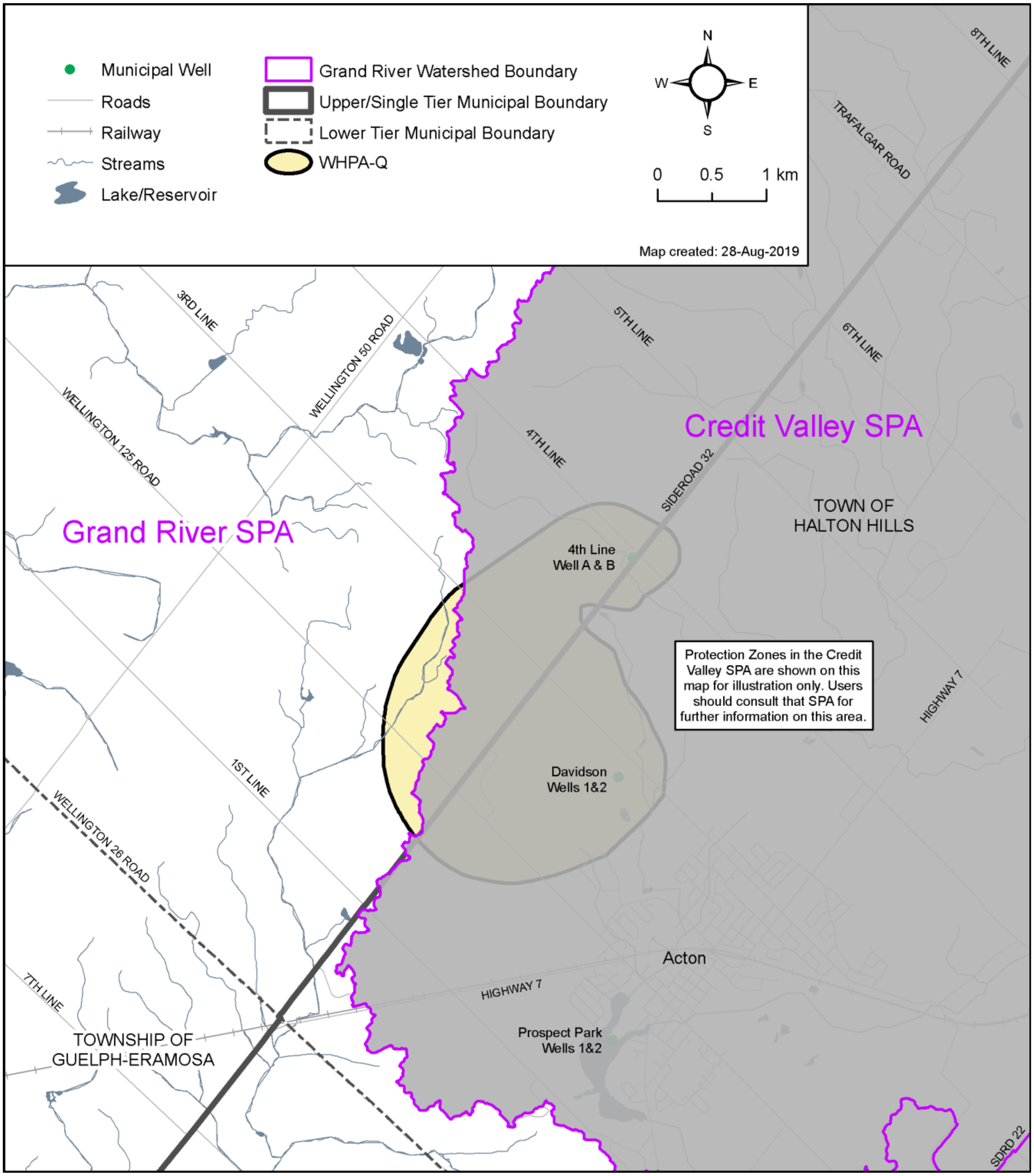
Municipal demand was identified as the largest consumptive use of groundwater in the Credit Valley Source Protection Area. Through the Sustainable Halton planning process, a water demand assessment was done to quantify future water supply needs in Halton Hills and identify the potential servicing options required to meet those needs. Modest growth is projected for Acton. Population projections were used to develop estimates of future residential water demand, and employment projections were used to develop estimates for future industrial, commercial and institutional uses.

The results of the water demand assessment showed that there was insufficient capacity in the Acton and Georgetown municipal supply systems to meet the average day demands for the 2031 planning horizon. Therefore, the full permitted capacity of all existing wells is required to meet the projected demand, but a deficit will still exist. Additional strategies to meet demand with groundwater supply have been developed. In addition, Halton Region is planning on integrating water takings from Lake Ontario to meet much of the demand associated with planned growth in Georgetown.

Two WHPA-Qs were delineated surrounding the municipal supply wells in Acton (**Map 23-1**). One of the WHPAQ-s includes a small portion of Grand River Watershed. WHPA-Qs were delineated following the Province's Technical Rules (MOE, 2009b) based on a combination of the cone of influence of each municipal well as well as land areas where recharge has the potential to have a measurable impact on the municipal wells.

A series of Risk Assessment scenarios were derived to represent the municipal allocated quantity of water (existing plus committed plus planned pumping rates); and current and planned land uses. The calibrated surface water and groundwater flow models were used to estimate both the changes in water levels in the municipal supply aquifer and the impacts to groundwater discharge and baseflow under average and drought climate conditions.

Map 23-1: Halton Hills WHPA-Q



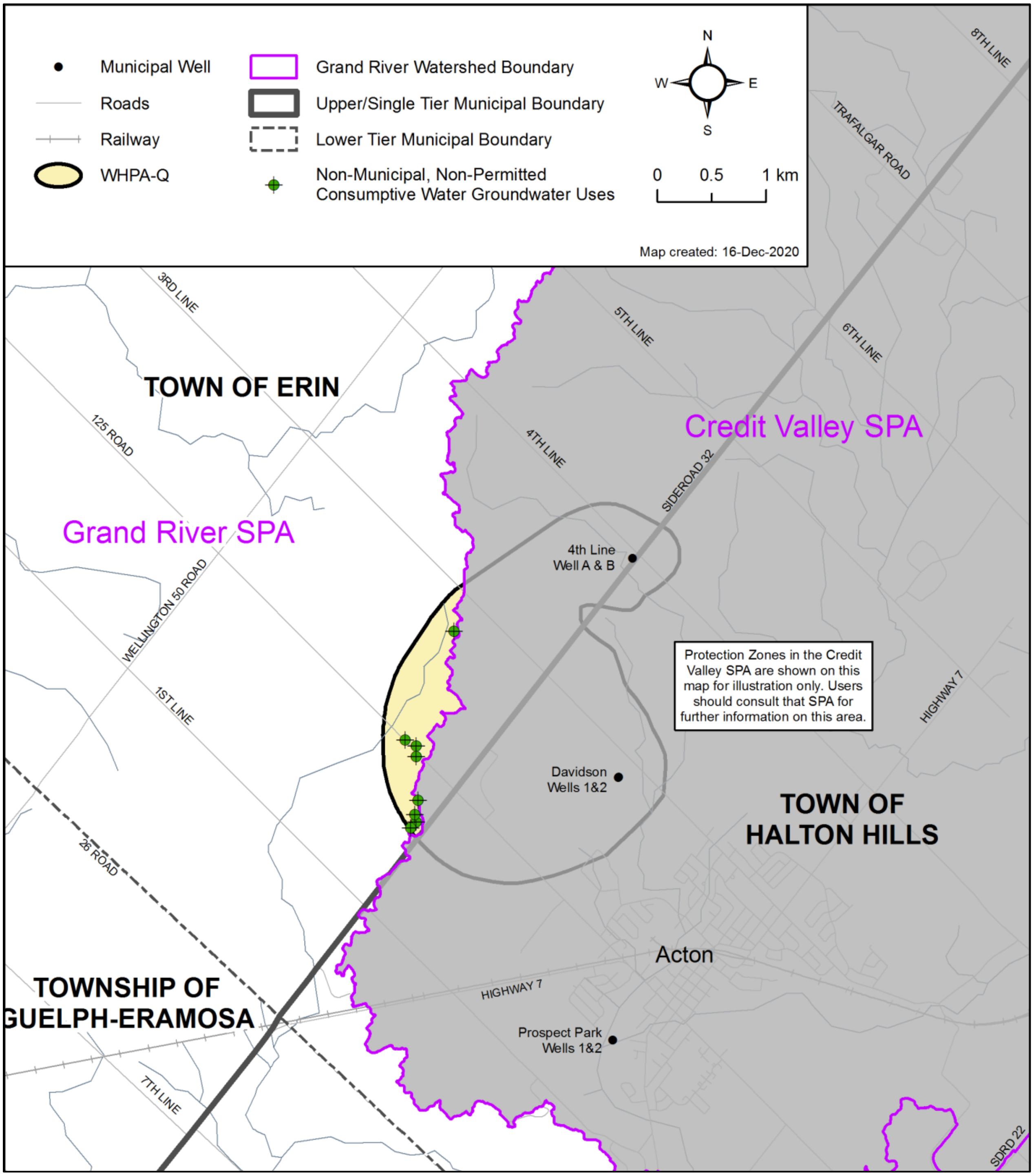
23.2 Risk Assessment Results

The results of the Risk Assessment modelling scenarios suggest that the tolerance of the Acton system is high, as they are able to meet their existing water demands. However, as outlined in the Technical Rules the WHPA-Q must be assigned a significant risk level if the existing or planned system wells are not able to meet their existing or future demands because the drawdown at a municipal well exceeds the safe available drawdown. This circumstance applies to Fourth Line A well in Acton under scenario H (10-year drought). The drawdown of the well was primarily due to increased pumping rates.

While these scenarios are conservative, they indicate where groundwater discharge is most sensitive to land use change, and where the Region of Halton and the Grand River Conservation Authority may wish to direct efforts to maintain groundwater recharge in the future.

Following the Technical Rules, all consumptive water users and reductions to groundwater recharge within the WHPA-Q are classified as significant water quantity threats. These consumptive water users include the permitted water demands (e.g., municipal pumping) and non-permitted water demands (e.g., domestic water wells). Consumptive uses within the Grand River watershed portion of WHPA-Q are 9 non-municipal, non-permitted water wells and shown on **Map 23-2**.

Map 23-2: Halton Hills WHPA-Q Water Quantity Threats



23.3 Tier 3 Assessment SGRAs

SGRAs were delineated in the Tier 2 Assessment (AquaResource, 2009c) across the Credit River Watershed using a peer reviewed methodology. The average annual recharge across the entire Credit River Watershed was calculated to be 200 mm/yr; consequently, the SGRA threshold was calculated to be 230 mm/yr. The SGRAs cover a large portion of subwatersheds 10 and 11, and are largely absent in the Acton and Georgetown urban areas and along groundwater discharge areas including lakes, ponds and wetlands.

The Credit Valley Conservation watershed SGRA threshold of 230 mm/year was considered in the Tier 3 Assessment. However, a consistent surface water model for recharge development over both watersheds within the Study Area was refined in the Tier 3 Assessment, which was particularly important as the cross-boundary flows between the two watersheds are a significant portion of the water balance. The locations of private and municipal drinking water wells were added to identify areas where the SGRAs contribute to drinking water sources. The groundwater recharge areas that do not appear to contribute to domestic or municipal supplies were not considered as significant. In addition, small isolated areas less than or equal to 40,000 m^2 were removed to create mapping that focuses the delineated SGRAs to larger geologic and physiographic features that are considered more representative of mapped geologic features.

23.4 Uncertainty

During the Tier 3 Assessment, some knowledge and data gaps were encountered, however the approach undertaken in the study was conservative, and as such, addressing these uncertainties is not considered necessary for protecting or managing the water resources within the subwatershed.

The Risk Level for the Acton municipal water supply wells was classified as “Significant”. This is appropriate considering the uncertainties associated with urban infiltration and the impact of enhanced recharge through subsurface infrastructure.

23.5 References

AECOM and AquaResource, A Division of Matrix Solutions Inc (AECOM and AquaResource). (2014): Halton Hills Tier 3 Water Budget and Local Area Risk Assessment Final Risk Assessment Report. Guelph, ON.

AquaResource Inc., 2009c. SPC Accepted Draft Integrated Water Budget Report - Tier 2 CreditValley Source Protection Area. Prepared for Credit Valley Conservation, July 2009.

DHI-WASY. (2011a): MIKE SHE. MIKE by DHI Software. WASY-GmbH, Berlin, Germany.

DHI-WASY. (2011b): FeFLOW 6.0 – Finite Element Subsurface Flow and Transport Simulation System. WASYGmbH, Berlin, Germany.