

**PROPOSED AMENDMENTS TO THE SOUTH GEORGIAN BAY
LAKE SIMCOE SOURCE PROTECTION PLAN ASSESSMENT
REPORT FOR YORK REGION**

CHAPTER 13: REGIONAL MUNICIPALITY OF YORK

13 YORK REGION

13.1 INTRODUCTION

This chapter contains information on ten drinking water systems for the Regional Municipality of York in the South Georgian Bay-Lake Simcoe Source Protection Region. Various consultants have completed the work presented, all of which was reviewed by South Georgian Bay Lake Simcoe Source Water Protection staff and members of the Technical Work Group. In this chapter, each of the groundwater systems and surface water systems is discussed separately for easier readability.

Each municipal system section begins with an introduction of the characteristics of the drinking water system. This includes an overview of the location, number of people served, and source of the water supply. The sections following the system introductions are comprised of a Vulnerability Assessment and Issues and Threats evaluation of the system. The Vulnerability assessment includes the delineation of the Vulnerable Area(s) (Wellhead Protection Area or Intake Protection Zone), and the assignment of Vulnerability Score for the delineated area. An Uncertainty Rating is also provided for the Vulnerable Area delineation and the Vulnerability Assessment as per Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a) to express the level of confidence in the results based on the information that was available for the study.

The Issues evaluation is intended to identify chemical parameters or pathogens in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. Any Issues identified for the systems will be listed in this section, along with a map illustrating the Issues Contributing Area if an Issue is known. The Threats evaluation identifies potential Significant Drinking Water Threats within the delineated Vulnerable Areas. This process includes creating lists for Drinking Water Threats for Activities and Conditions, generating maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats, and a final enumeration of Significant Drinking Water Threats. This report has been updated with information gathered from residents and property owners at the Assessment Report Open Houses hosted by South Georgian Bay Lake Simcoe Source Water Protection Staff as well from calls to South Georgian Bay Lake Simcoe Source Water Protection Staff and the Regional Municipality of York in the months of September and October, 2010. The updated information is current up to and inclusive of ~~October 12th~~ July 4, 20~~19~~¹⁰.

For more information, readers are encouraged to read Chapter 5: Methods Overview as well as, the responsible consultant reports and memos (found in Appendix MO and Y)

Formatted: Superscript

for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

13.2 DRINKING WATER SYSTEMS

York Region operates surface and groundwater based drinking water supplies in fourteen (14) communities. As shown in Table 13- 1 eight (8) of the groundwater supplies and two (2) surface water intakes are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR), the remainder are in the Credit Valley, Toronto and Region, Central Lake Ontario (CTC) SPR. **Error! Reference source not found.** also indicates the Source Protection Region and corresponding lead conservation authority (CA) for each of the municipal water supplies.

Table 13- 1: Municipal Groundwater Supplies in York Region (Those included in this report are highlighted in grey).

Local Municipality	Community Water Supply	Source Protection Region / Lead Conservation Authority (CA)
Town of Georgina	Georgina Surface Intake	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
	Keswick Surface Intake	
Town of Aurora	Aurora	
Town of East Gwillimbury	Holland Landing	
	Mount Albert	
	Queensville (York Region)	CTC SPR Toronto and Region CA
Township of King	Ansnoerveldt	
	Schomberg	
	King City	
	Nobleton	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Town of Newmarket	Newmarket	
Town of Whitchurch-Stouffville	Ballantrae-Musselmans	
	Stouffville	
Vaughan	Kleinburg	CTC SPR Toronto and Region CA

Studies conducted for the Toronto and Region Conservation Authority Source Protection Region have identified that the WHPAs for the Stouffville Well Supply extend into the SGBLS Source Protection Region. The WHPAs, which are primarily within the Toronto and Region Source Protection area, extend to the north and a small portion crosses the boundary with the SGBLS SPR. Also, two wells of the Bradford/Bondhead Distribution and Supply Wells are located within York Region. Information on these is presented with the rest of the system within this report, Chapter 9.

Table 13- 2: WHPA that cross into York Region in the SGBLSSPR.

Local Municipality that WHPA extends into	Municipality where wellhead is located	Name of Water Supply	Source Protection Region / Lead Conservation Authority (CA)	Location where entire Assessment can be obtained
York Region	Town of Bradford West- Gwillimbury	Bradford/Bondhead Distribution and Supply Wells	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This report (Chapter 9)
York Region	Stouffville	Stouffville Well Supply	CTC SPR Toronto and Region CA	CTC SPR Assessment Report

13.3 AURORA/NEWMARKET WELL SUPPLIES

The Town of Aurora is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). The Town is almost entirely within the SGBLS SPR but borders the CTC SPR. Approximately 52,000 residents in the Town of Aurora are serviced through a blended municipal supply, which includes surface water from Lake Ontario and groundwater supply for ~~six-seven~~ (76) municipal wells: Wells 1, 2, 3, 4, 5, ~~and 6~~ and 7.

The Aurora wells are grouped together with the Newmarket, Holland Landing, and Queensville wells as the Yonge Street Area (YSA) wells. As noted in Kassenaar and Wexler (2006), the “Yonge Street Aquifer” is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

Aurora’s groundwater water system lies within a large tunnel channel with fine-grained glaciolacustrine sediments and possibly a thin clay till unit - the Kettleby Till – at or near surface. The channel fill sediments consist mainly of silt and sandy silt underlain by fine sand and gravel. The screens for closely grouped wells 1 to 4 and well 6 and 7 are in gravels in what is interpreted as the Thorncliffe Formation, but could be the base of the channel fill sequence. The Newmarket Till is entirely absent. Well 6 and 7 ~~is-are~~ on the eastern margin of the tunnel channel where there is thick Newmarket Till capped by thin glaciolacustrine silt and clay and Kettleby Till. This well is screened in the Thorncliffe Formation (or its equivalent). Table 13- 3 provides more information on the Aurora municipal wells.

Table 13- 3: Municipal Well Information – Aurora.

Well No.	Depth ¹ (mbgs ²)	Screened Interval ¹ (mbgs ²)	Aquifer ³	Geochemical Type of Water ⁴	Permitted Capacity (m ³ /day) ³
1	98.45	92.35 to 98.45	Thorncliffe Formation	Calcium bicarbonate	3,270
2	103.63	91.44 to 103.63			5,892
3	102.11	91.44 to 102.11			5,237
4	101.19	89.00 to 101.19			7,856
5	101.80	89.60 to 101.80	Scarborough Formation		5,892
6	91.80	79.99 to 91.80	Thorncliffe Formation		3,470
7	99.70	89.60 to 97.50	Thorncliffe Formation		4,752

1. Information provided by York Region

2. Metres below ground surface (mbgs)

3. Earthfx (2007 and 2009)

4. Genivar (2007)

The Town of Newmarket is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). The Town is entirely within the SGBLS SPR. Approximately 81,800 residents in the Town of Newmarket are serviced through a groundwater supply consisting of ~~six-five (56)~~ municipal wells: Wells 1, 2, 13, ~~14~~, 15 and 16. ~~The previous groundwater supply well, Newmarket well 14, was removed in 2019 due to poor performance and water quality issues.~~ Periodically, the southern portion of Newmarket may also receive potable water through a small feed from the Aurora water supply system.

The Newmarket wells are grouped together with the Aurora, Holland Landing, and Queensville wells as the Yonge Street Area (YSA) wells. As noted in Kassenaar and Wexler (2006), the “Yonge Street Aquifer” is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

Most of the wells in Newmarket are near the margins of a major north-south tunnel channel, but the wells penetrate thick Newmarket Till. Three of the wells are screened in the Scarborough Formation and two are screened in the Thorncliffe Formation. The sandy ORAC sediments overlying the Newmarket Till vary greatly in thickness, ranging from less than 5 m to more than 20 m thick. ~~Well 14 is shallower than the other wells and its screen is in fine sand of the ORAC beneath a fine-grained surface till interpreted as Kettleby Till.~~ Surface sediments in the area are glaciolacustrine silt and clay in low lying areas, Newmarket and Kettleby Till, and glaciofluvial deposits. Table 13- 4 provides more information on the Newmarket municipal wells.

Table 13- 4: Municipal Well Information – Newmarket.

Well No.	Depth ¹ (mbgs ²)	Screened Interval ¹ (mbgs ²)	Aquifer ³	Geochemical Type of Water ⁴	Permitted Capacity (m ³ /day) ³
1	91.90	84.3 to 91.9	Thorncliffe Formation	Calcium bicarbonate	2,290
2	94.18	86.2 to 94.2			4,580
13	109.11	100.4 to 108.2	Scarborough Formation		5,890
14	48.77	40.84 to 48.86	Oak Ridges Moraine		2,290
15	-	84.12 to 85.65	Scarborough Formation		3,270
16	106.68	98.76 to 106.68			5,630

1. Information provided by York Region

2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)

WHPA delineation and Vulnerability ~~presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while~~ the Issues and Threats Assessment ~~presented in this section was updated in 2019 and is based on the Stantec, 2010 report.~~ York Region, 2019 and Golder, 2019 reports.

13.3.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by anthropogenic activities, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability categories (High, Medium and Low) to Vulnerability Scores (10, 8, 6, 4 and 2) results in a new map for each WHPA that expresses the relative degree to which a land use or activity could affect the drinking water supply aquifer. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Towns of Aurora and Newmarket water supplies have been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Towns of Aurora and Newmarket WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in ~~Earthfx and Azimuth, 2007 and Earthfx, 2009~~ York Region, 2019 and Golder, 2019.

13.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Towns of Aurora and Newmarket well systems, as delineated by ~~Earthfx Incorporated and Azimuth Environmental Consulting, Inc~~ Golder in ~~2019~~ 2007 (revised 2009) are shown in **Error! Reference source not found..**

The time-of-travel (TOT) method is the approach specified by MOE Guidance Module 3 (MOE, 2006) for delineating Wellhead Protection Areas around municipal supply wells. The WHPA were delineated using a 3-dimensional numerical groundwater flow model. Because the model covers all of York Region, mutual interference between supply wells and the effect of surface water features on the groundwater flow patterns can also be

represented. The U.S. Geological Survey (USGS) MODFLOW code was selected for use in this study because this code is recognized worldwide and has been extensively tested and verified. To simulate groundwater flow paths and travel times which, in turn, were used to define TOT zones for the York Region municipal wells, the U.S. Geological Survey MODPATH code was used.

MODFLOW/MODPATH results were used to delineate the primary WHPAs for each municipal well (2-, 5- and 25-year TOT zones, which correspond to the WHPA sensitivity zones B, C, and D, respectively). WHPA-A was created by drawing a circle with a 100-metre radius around each well.

The maximum pumping rates used in the simulations were determined on the basis of the current Permit To Take Water (PTTW) issued by the MOE. For each well or wellfield, the PTTW specifies limits on the maximum daily pumping rates and maximum peak pumping rates.

Historically, the Newmarket, Aurora, Holland Landing, and Queensville wells have been grouped together as the “Yonge Street Aquifer” wells. The term implies that there is a single, bounded aquifer that supplies these wells. In reality, the permeable deposits in these areas are part of three different regional aquifer complexes that may or may not be separated locally by the regional aquitards. In this report, the wells are referred to as the Yonge Street Area (YSA) wells. The permit for the YSA wells has a limit on the total annual withdrawal which translates to an average daily limit of 42,000 cubic metres per day (m³/d). To be conservative, it was assumed that any well could, for operational reasons, be pumped at its maximum permitted rate for an extended period of time (as long as the pumping rates at other wells were adjusted to keep the total withdrawal below the maximum limit). Therefore, each YSA well was simulated at its maximum permitted rate even though the combined rates used in the model exceed the maximum allowable taking. The WHPAs delineated using these rates will be larger and more conservative than if reduced pumping rates were used.

The municipal wellfields and their reported annual average pumping rates for 2006 (data provided by York Region) along with maximum permitted average pumping rates are provided in Earthfx and Azimuth, 2007 (revised 2009).

13.3.1.2 Groundwater Vulnerability

The intrinsic Groundwater Vulnerability within the WHPAs of the municipal wells in Aurora and Newmarket are shown in **Error! Reference source not found.**

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. The WWAT method calculates travel time from the water table to the well screen but does not factor in unsaturated zone travel time. While there are approximate methods available to estimate the additional time-of-travel through the unsaturated zone, the amount of data available to accurately assess UZAT (Unsaturated Zone Advective Time) is minimal and the level of uncertainty involved is high. Accordingly, York Region decided to take a conservative approach (i.e. resulting in

higher groundwater vulnerabilities than otherwise expected) and not include UZAT in the Vulnerability Analysis.

Since the WWAT method is not listed as an approved method of assessing Groundwater Vulnerability under Technical Rule 37 (MOE, 2008a), a request (under Technical Rule 15.1 (MOE, 2008a)) was submitted April 1, 2009. Director's Approval was given on July 17, 2009 to use an alternate method of determining Groundwater (intrinsic) Vulnerability based on the following reasons (see Appendix Y for approval letter):

1. There is a high degree of uncertainty in determining unsaturated zone advective times (UZATs) due to numerous variables and limited data associated with them.
2. The WWAT may provide a more realistic approach for representing water supply vulnerability where the potential contaminant is located below ground
3. Where potential sources of contamination are located at ground surface, the WWAT would be a conservative estimation of travel time to the well, which is favorable when protecting municipal drinking water well supplies.

The calculation of WWAT times within the WHPAs allows the Vulnerability results to be compared to the TOT zones with a common unit of measure. It should be noted that the travel times are advective travel times and are therefore independent of the nature of the potential contaminants, release mechanisms, and attenuation processes (e.g., diffusion, dispersion, adsorption and chemical transformation). Appendix 4 of Guidance Module 3 (MOE, 2006) recommends translating the travel times obtained from the WWAT analyses into relative measures of intrinsic vulnerability as summarized in Table 13- 5.

Table 13- 5: High, Medium and Low intrinsic Vulnerability categories as related to WWAT values (from MOE, 2006).

WWAT Value	Intrinsic Vulnerability Category
> 25 years	Low
5 to 25 years	Medium
0 to 5 years	High

With regards to the Aurora and Newmarket wells, the resulting WWAT travel times indicate that the entire area has a Low intrinsic Vulnerability, with travel times from the water table to the well being greater than 25 years. The long travel times are likely a result of the multiple confining units overlaying the screened aquifers. colour shaded areas around Newmarket Well 14 (which is screened in the ORAC) generally match the corresponding TOT zones. Newmarket Wells 1, 2, 13, and 16 have relatively large zones of Medium to High intrinsic Vulnerability around the wells. The reason for the short travel times (0 to 5 years) is that the particles were started in Layer 5 (TAC) because the simulated heads were below the base of the Newmarket Till. As a result, the travel times do not account for the extremely long time of travel through the unsaturated Halton and Newmarket Tills. This may be an instance where including

~~travel times in the unsaturated zone (UZAT) would provide a more realistic assessment of aquifer Vulnerability.~~

~~Newmarket Well 15 and the Aurora Wells generally have small areas of Medium intrinsic Vulnerability surrounded by areas of Low Vulnerability. The analysis shows that, even though the 25-year TOT zones from the different wellfields coalesce, much of the 25-year TOT for the eastern part of the Aurora/Newmarket 25-year TOT have Low intrinsic Vulnerability.~~

13.3.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec (2010) report for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.3.1.4 WHPA-E / WHPA-F

None of the wells in this study have been identified as GUDI; therefore delineation of a WHPA-E was not required. Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.

13.3.1.5 Vulnerability Score

The Vulnerability Scoring and mapping originally from Earthfx and Azimuth (2007; updated in 2009) was revised by Golder, 2019 as a result of an increased understanding of the hydrostratigraphy and hydrogeology within the region by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Aurora and Newmarket water supplies, as shown in **Error! Reference source not found.**, and the intrinsic Groundwater Vulnerability (**Error! Reference source not found.**) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Error! Reference source not found. and Figure 13a-4 illustrates the Vulnerability Scores for the Aurora and Newmarket water supplies and will be used to assess Drinking Water Threats in Section 13.3.3.

13.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. The Uncertainty Assessment for WHPA delineation was undertaken by both Earthfx and Azimuth, 2007, (revised 2009) and through an independent peer review commissioned by the SGBLS Region. In situations where different uncertainty estimates are provided (i.e. Low and High), the most conservative (High uncertainty) has been applied. Uncertainty of the Vulnerability Assessment was only undertaken by Earthfx and Azimuth (2009).

The independent peer review of WHPA delineation was undertaken by Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Barrie WHPAs is High. The full results of the WHPA delineation Peer Review process, for York is available in Appendix B and discussed in Chapter 5 (Methods Overview). Based on the rationale provided for the Vulnerability Assessment (see below), Earthfx and Azimuth, 2007 (revised 2009) characterized uncertainty of the WHPA delineation as Low. As this differs from that provided by the peer review, the most conservative, 'High' Uncertainty ranking will currently apply.

The Earthfx and Azimuth, 2007 (revised 2009), approach to determining WHPA delineation and Vulnerability Uncertainty also used a qualitative process (see reports for full details). The uncertainty in the analyses can be ascribed to the three processes involved in developing the final intrinsic Vulnerability Scores: (1) the numerical groundwater flow model, (2) the TOT delineation, and (3) the WWHAT assessment.

Appendix 6 of the MOE Guidance Module indicates that it would be reasonable to expect a Low level of uncertainty in areas where data density is high, where hydrogeologic studies have been conducted, and where numerical models have been developed. The study completed by Earthfx and Azimuth, 2007 (revised 2009), generally satisfies all three of these MOE criteria. It is recognized, however, that all hydrogeologic analyses have an intrinsic level of uncertainty because one can never have enough data to fully know how conditions vary in the subsurface.

There are one or two monitoring wells in the immediate vicinity of each pumping well. However, there are few shallow or deep wells within the 25-year TOT zones. There are some clusters of monitoring wells outside the 25-year TOT south and east of Aurora Well 1. The geology of the Yonge Street Area is complex but it has had a great deal of attention as part of the YPDT-CAMC and earlier studies. There are also a large number of high quality wells in the area. Overall, this resulted in a Low Uncertainty Rating for Vulnerability Assessment.

The Uncertainty Rating for the Aurora/Newmarket well supplies was not changed as part of the 2019 updated and was left as a Low Uncertainty Rating. Although additional

knowledge has been obtained since the original Uncertainty Analysis, the current rating was maintained in order to be conservative.

13.3.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now, or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues methods can be found in Technical Memorandum A1 (Appendix Y).

Aurora Municipal Wells

The Genivar (2007) results indicate that the groundwater supply from Aurora municipal wells 1 to 6 met the ODWQS (MOE, 2006) with the exception of iron which exceeded the Aesthetic Objective (AO), and manganese, which generally met but occasionally exceeded the ODWQS AO. -However, Genivar (2007) reported that elevated iron and manganese concentrations are common to the deep aquifers in York Region and are related to natural rock-water interactions. The results also indicated that sodium concentrations in ~~the~~ wells 1 to 6 were consistently near 20 mg/L. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of *E.coli* at this well field. For Aurora municipal well 7, Golder (2019) results indicate that the well met the ODWQS (MOE, 2006) for all parameters with the exception of hardness (as CaCO₃) and iron.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York

Formatted: Subscript

Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Aurora municipal wells from as early as February 1995 to February 2009 for evaluation in the current study. The results of the water quality Issues identification and evaluation process for the Aurora municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Aurora Water Supply.

Newmarket Municipal Wells

The Genivar (2007) results indicated that the groundwater supply from the Newmarket municipal wells met the ODWQS (MOE, 2006). Concentrations of all key indicator parameters showed a consistently stable trend with time in all wells ~~except Well No. 14 which showed an increasing trend in chloride and sodium. Well No. 14 also showed elevated concentrations of nitrate and sulphate.~~ Sodium concentrations in all wells were consistently near 20 mg/L, which is the Medical Officer of Health reporting limit. Elevated concentrations of iron in exceedance of the AO were reported in all wells, with manganese occasionally detected near the AO in select wells. Genivar (2007) reported that elevated iron and manganese concentrations are common in deep aquifers in York Region. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Newmarket municipal wells from January 1993 to February 2009 for evaluation in the current study. The results of the water quality Issues identification and evaluation process for the Newmarket municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Newmarket Water Supply.

~~Sodium concentrations in Newmarket Wells 1, 2, 13, 15, and 16 show slight upward or stable trend over time. Sodium concentrations have recently been slightly above the recommended local health officer notification level of 20 mg/L for Newmarket Well No. 14. The AO for sodium in drinking water is 200 mg/L. In accordance with the ODWQS, York Region notifies the local medical officer of health when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets (MOE, 2006). Elevated concentrations of sodium and chloride observed in the unconfined Oak Ridges Moraine Complex aquifer well (Newmarket Well No. 14) indicates limited system isolation from the surficial activities.~~

13.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Aurora and Newmarket Water Supplies was originally completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). Since the effective date of the Source Protection Plan (July 1, 2015), risk management officials within the Regional Municipality of York have conducted threats verification for all existing and potential significant threats to determine if they exist. In 2019, following threats verification and updates to the WHPA mapping and vulnerability scoring the assessment of existing Drinking Water Threats for the Aurora and Newmarket Water Supplies was updated. A Drinking Water Threat is defined as “an Activity, or Condition that adversely affects or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Aurora and Newmarket Drinking Water Supplies builds on the information from the Vulnerability Analysis and Issues Evaluation and includes preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

13.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Aurora and Newmarket Drinking Water Supplies is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

13.3.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. As part of the 2019 update, significant condition threats were re-evaluated with new information obtained since the Stantec (2010 report), and no potential conditions were identified (York, 2019).

No confirmed Conditions have been identified for the Aurora and Newmarket Water Supplies. ~~Stantec, 2010 identified 176 potential Conditions (e.g. spills) within the Aurora and Newmarket WHPAs that may require further investigation.~~

13.3.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the table of drinking water threat circumstances include references to a series of tables prepared by ~~MOE-MECP~~ to can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at Ontario.ca: <https://www.ontario.ca/page/tables-drinking-water-threats> ~~found at: <http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php>~~

13.3.3.3.1 Pathogen Parameters

The MECP table of drinking water threats can be used in conjunction with the Vulnerability Scores ~~Key Table on Figure 13a-5~~ **Error! Reference source not found.** ~~and Figure 13a-6 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Aurora and Newmarket Water Supplies. Activities that are or would be Significant Drinking Water Threats for

pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.3.3.3.2 Chemical Parameters

The ~~Key Table~~MECP table of drinking water threats can be used in conjunction with the Vulnerability Scores on ~~Figure 13a-7~~ **Error! Reference source not found.** and ~~Figure 13a-8~~ can be used in conjunction with the Vulnerability Scores to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Aurora and Newmarket Water Supplies. Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

13.3.3.3.3 DNAPL Chemical Parameters

~~Figure 13a-9~~ **Error! Reference source not found.** and ~~Figure 13a-10~~ illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of at least 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Aurora and Newmarket Water Supplies. The ~~Key Table~~MECP table of drinking water threats can be used in conjunction with the Vulnerability Scores on ~~Figure 13a-9~~ **Error! Reference source not found.** and ~~Figure 13a-10~~ can be used to can be used to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

13.3.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 13.3.3.2, no Conditions have been confirmed within the WHPA for the Aurora and Newmarket Water Supplies.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A4 (Appendix Y). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant:** where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.

- **Moderate:** (1) where the Vulnerability Score ≥ 6 and < 8 , and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low:** Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Error! Reference source not found. ~~and Figure 13a-4~~ illustrates the Vulnerability Score map for the Aurora and Newmarket well supplies that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.3.3.5 Enumerating Drinking Water Threats

The number of existing and potential activities that were considered to be Significant Drinking Water Threats for the Aurora and Newmarket Water Supply ~~has was originally been~~ determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. Since the effective date of the Source Protection Plan (July 1, 2015), risk management officials within the Regional Municipality of York have conducted threats verification for all existing and potential significant threats to determine if they exist. As such, There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 6 documents the enumeration of existing and confirmed and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Aurora and Newmarket Water Supply. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Within the Aurora and Newmarket well fields, a total of 151 significant threats were originally identified on a total of 133 land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. As of 2019, following threats verification, and updates to the WHPA mapping and vulnerability scoring, there are now a total of 92 significant threats on a total of 81 land parcels within the Aurora and Newmarket well fields. The current Significant Threats identified were related to ~~waste disposal sites (9),~~ systems that store or transmit sewage (~~13~~), handling and storage of pesticide (1), ~~handling and storage of fuel (20),~~ handling and storage of DNAPLs (~~87106~~), and handling and storage of ~~organic solvents~~ commercial fertilizer (12).

~~Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential presence of municipal sanitary sewers and one threat activity has been included to represent the potential for subsurface storage of fuel for home heating purposes. These Threats are included in the counts above and in Table 13-6.~~

Table 13- 6: Number of Significant Drinking Water Threats for the Aurora and Newmarket Drinking Water Supplies.

Enumeration of Significant Threats (Wellhead Protection Areas)			
Threat		Significant Threat Counts	
		# threats	# parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	<u>09</u>	<u>09</u>
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	<u>133</u>	<u>133</u>
3	The application of agricultural source material to land.	0	0
4	The storage of agricultural source material to land.	0	0
5	The management of agricultural source material.	0	0
6	The application of non-agricultural source material to land.	0	0
7	The handling and storage of non-agricultural source material.	0	0
8	The application of commercial fertilizer to land.	0	0
9	The handling and storage of commercial fertilizer to land.	<u>01</u>	<u>01</u>
10	The application of pesticide to land.	0	0
11	The handling and storage of pesticide.	<u>01</u>	<u>01</u>
12	The application of road salt.	0	0
13	The handling and storage of road salt.	0	0
14	The storage of snow.	0	0
15	The handling and storage of fuel.	<u>200</u>	<u>200</u>
16	The handling and storage of dense non-aqueous phase liquid.	<u>10687</u>	<u>10676</u>
17	The handling and storage of an organic solvent.	<u>02</u>	<u>02</u>
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0	0
<u>22</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>	<u>0</u>
TOTAL NUMBER OF SIGNIFICANT THREATS:		<u>151*92</u>	
TOTAL PARCELS WITH SIGNIFICANT THREATS:		<u>81133</u>	
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.			
<u>*90-verified existing Threats and 61-potential Threats that require further verification</u>			

Formatted Table

Enumeration of Significant Threats (Wellhead Protection Areas)			
Threat		Significant Threat Counts	
		#	#
		threats	parcels
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	9	9
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	13	13
3	The application of agricultural source material to land.	0	0
4	The storage of agricultural source material.	0	0
5	The management of agricultural source material.	0	0
6	The application of non-agricultural source material to land.	0	0
7	The handling and storage of non-agricultural source material.	0	0
8	The application of commercial fertilizer to land.	0	0
9	The handling and storage of commercial fertilizer.	0	0
10	The application of pesticide to land.	0	0
11	The handling and storage of pesticide.	1	1
12	The application of road salt.	0	0
13	The handling and storage of road salt.	0	0
14	The storage of snow.	0	0
15	The handling and storage of fuel.	20	20
16	The handling and storage of a dense non-aqueous phase liquid.	106	106
17	The handling and storage of an organic solvent.	2	2
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0	0
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard.	0	0
TOTAL NUMBER OF SIGNIFICANT THREATS:		151*	
TOTAL PARCELS WITH SIGNIFICANT THREATS:		133	
Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel.			
*90 verified existing Threats and 61 potential Threats that require further verification			

13.3.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and -E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a threat in the Table of Drinking Water Threats.

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Aurora and Newmarket Water Supplies as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.3.3.5). ~~Figure 13a-11 Error! Reference source not found. and Figure 13a-12~~ illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Aurora and Newmarket Water Supplies ~~where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.~~

13.3.3.5.2 Livestock Density

Technical Rule 16(10) (August 2009) requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and -E. This mapping is not required where the vulnerability scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones for the Aurora and Newmarket Water Supplies as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.3.3.5). As described in the memorandum, estimation of Livestock Density was initially undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities. In 2019, livestock densities were re-calculated using aerial imagery and then confirmed with a windshield survey.

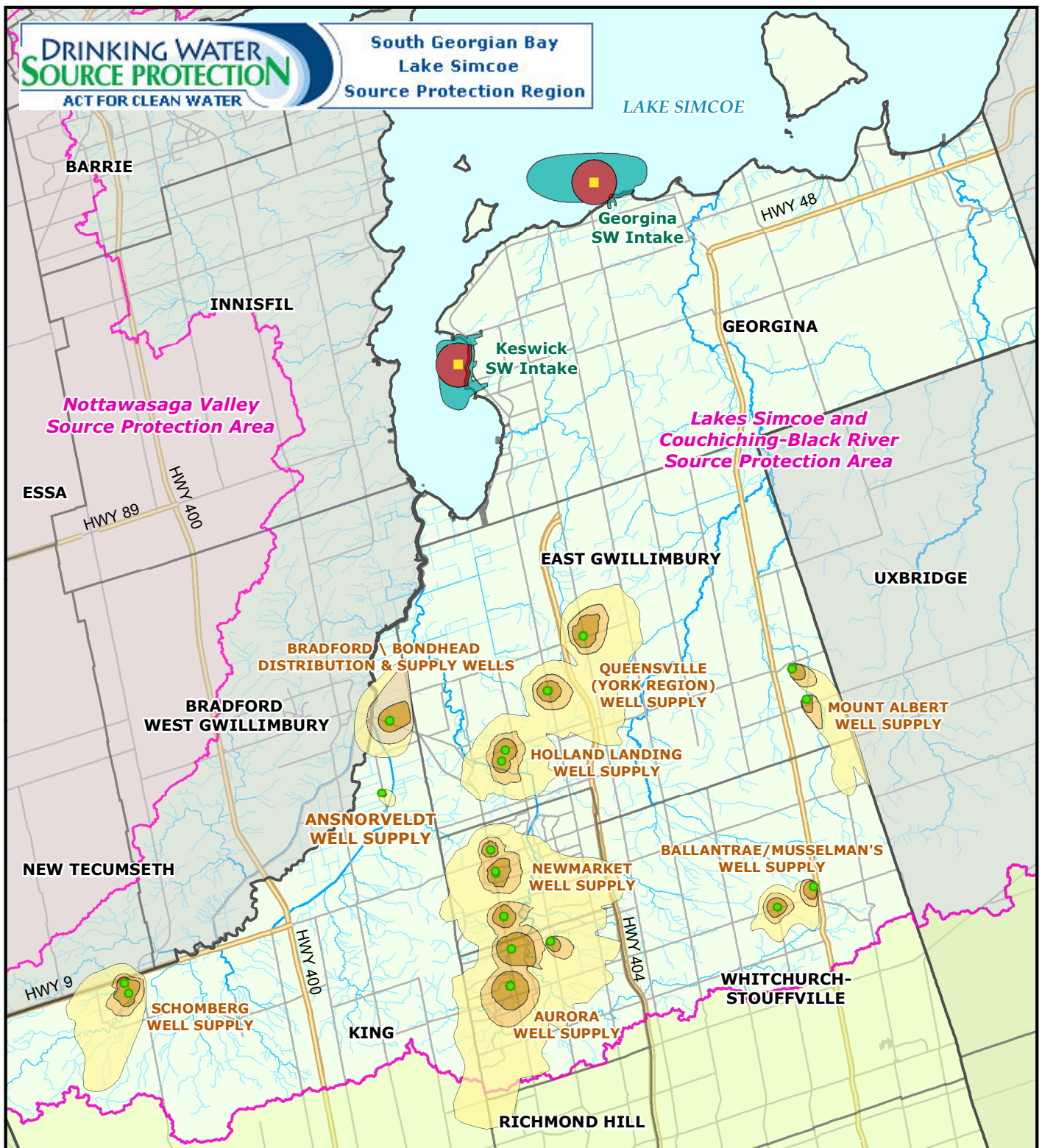
~~Figure 13a-13 Error! Reference source not found. and Figure 13a-14~~ illustrates the distribution of Livestock Density within the delineated WHPA zones for the Aurora and Newmarket Water Supplies ~~where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.~~ The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A3 (Appendix Y).

13.3.3.5.3 Impervious Surfaces

Technical Rule 16(11) (August 2009) requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and -E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Table of Drinking Water Threats.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Aurora and Newmarket Water Supplies was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.3.3.5).

~~Figure 13a-15~~ **Error! Reference source not found.** ~~and Figure 13a-16~~ illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Aurora and Newmarket Water Supplies.



- Municipal Surface Water Intakes
- IPZ-1 (1000m on water or 120m inland)
- IPZ-2 (2 hr time of travel)
- Municipal Supply Well in Regional Municipality of York
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-C1 (10 years time of travel)
- WHPA-D (25 years time of travel)

Drinking Water System Vulnerable Areas in Regional Municipality of York

Created by: LSRCA
Date: 2019-09-18



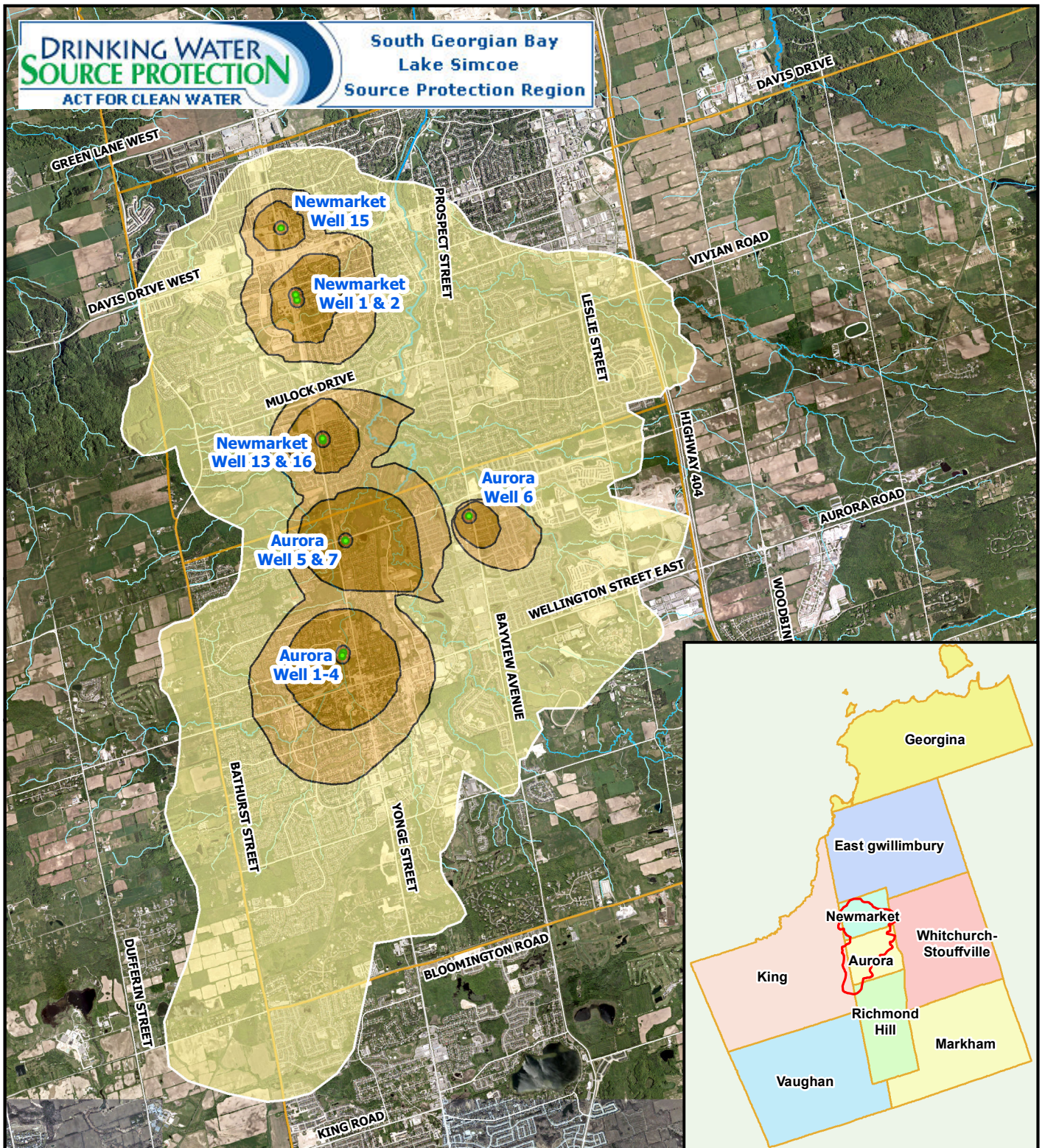
Scale: 1:250,000

0 2.5 5km

UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Wellhead Protection Areas

- WHPA-A
- WHPA-B

- WHPA-C
- WHPA-D

- Municipal Supply Wells



**Golder
Associates**



York Region

**Wellhead Protection Areas
in Aurora and Newmarket**

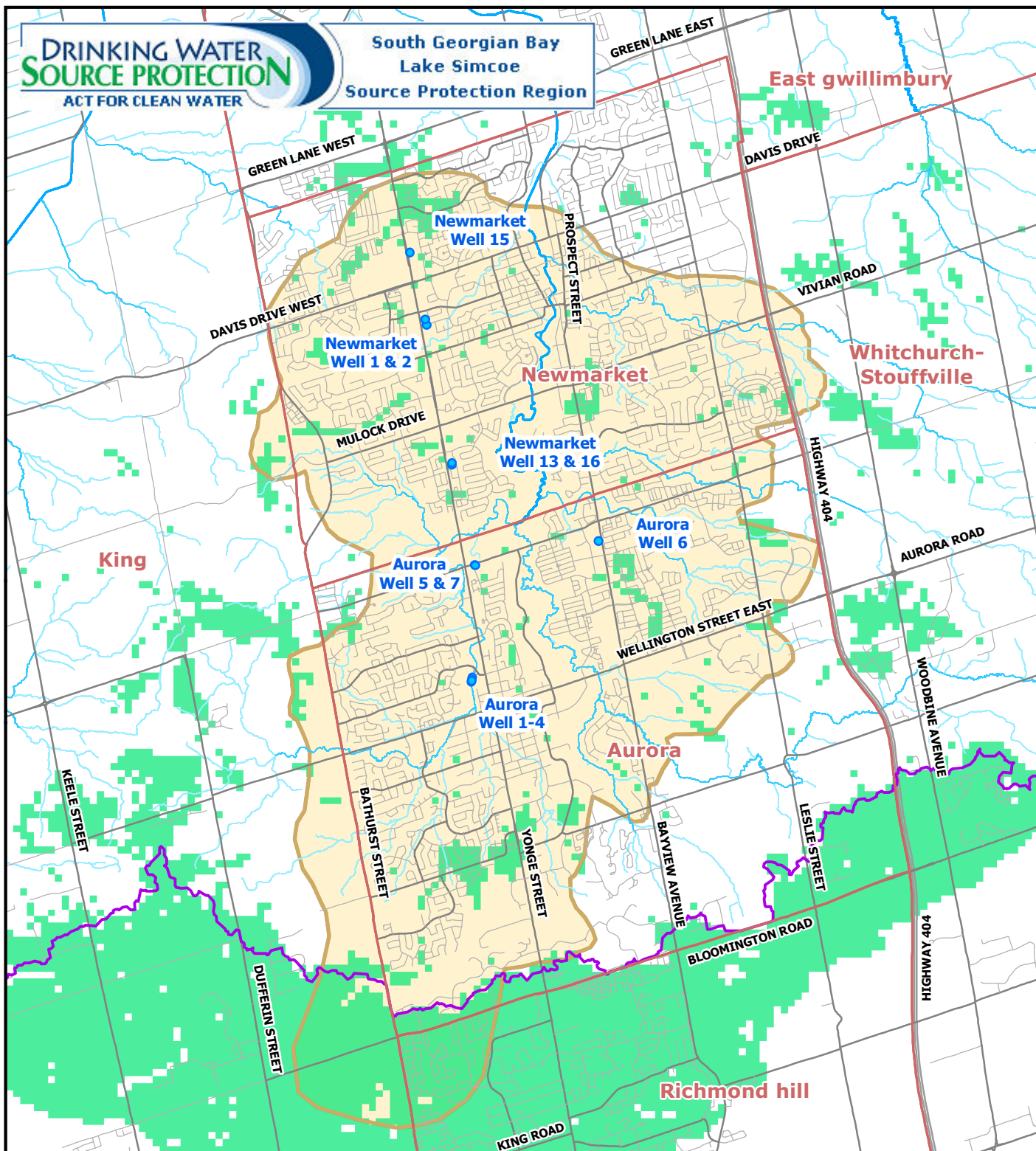
Created by: LSRCA
Date: 2019-09-18



Scale: 1:80,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Intrinsic Vulnerability

Low (>25 years)

Medium (5-25 years)

High (0-5 years)

● Municipal Supply Wells

WHPA-D (25 yr time-of-travel)

SWP Watershed Area



**Golder
Associates**

York Region

WWAT Intrinsic Vulnerability values for the Aurora and Newmarket wells

Created by: LSRCA

Date: 2019-09-18



Scale: 1:80,000

0 1 2km

UTM Zone 17N, NAD83

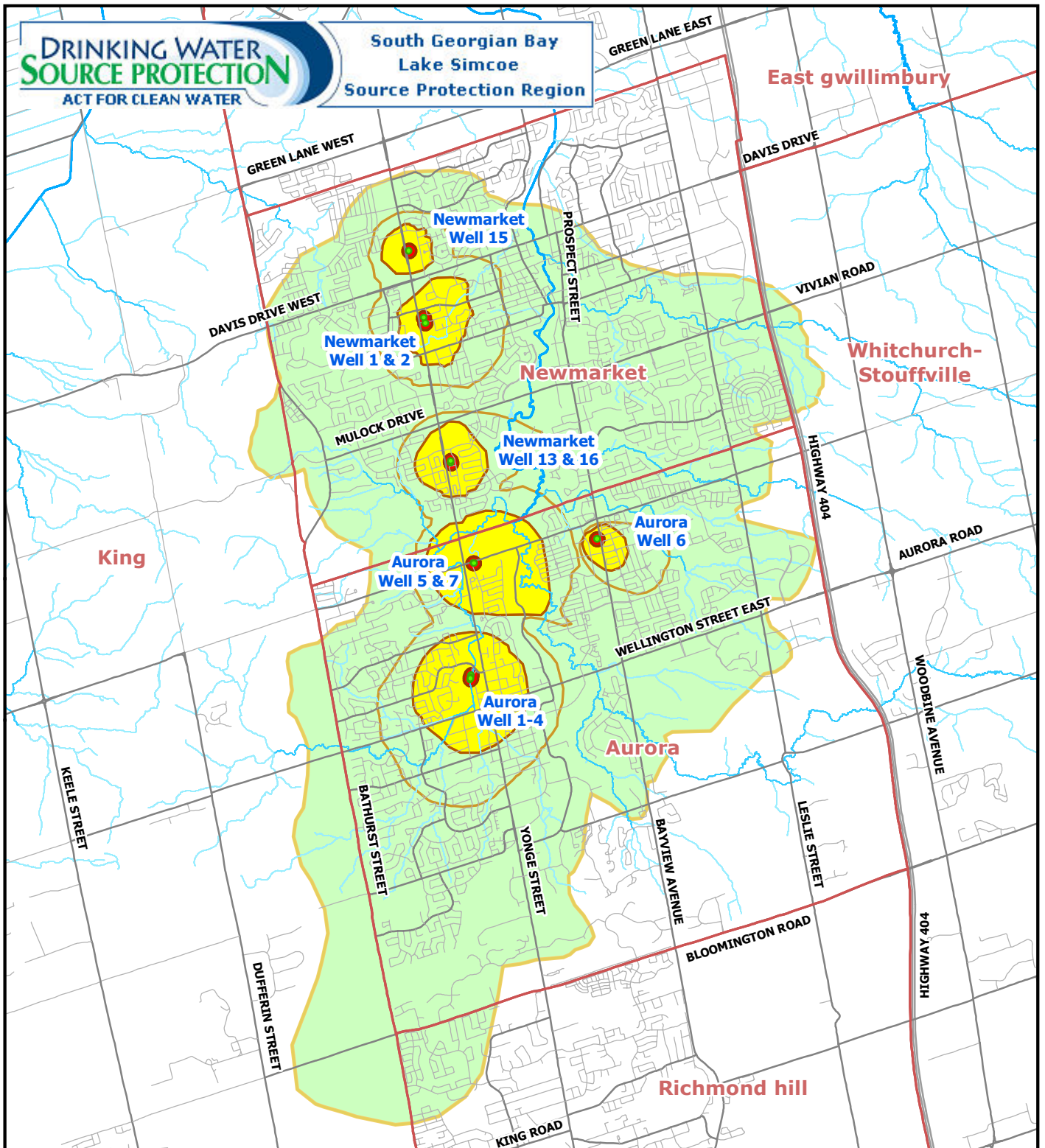


This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

Ontario



Figure 13a-2



● Municipal Supply Wells
Vulnerability Score
■ 10 (High)
■ 6
■ 2 (Low)

Wellhead Protection Area
 WHPA-A
 WHPA-B
 WHPA-C
 WHPA-D



Vulnerability Score in Aurora and Newmarket

Created by: LSRCA
Date: 2019-09-18

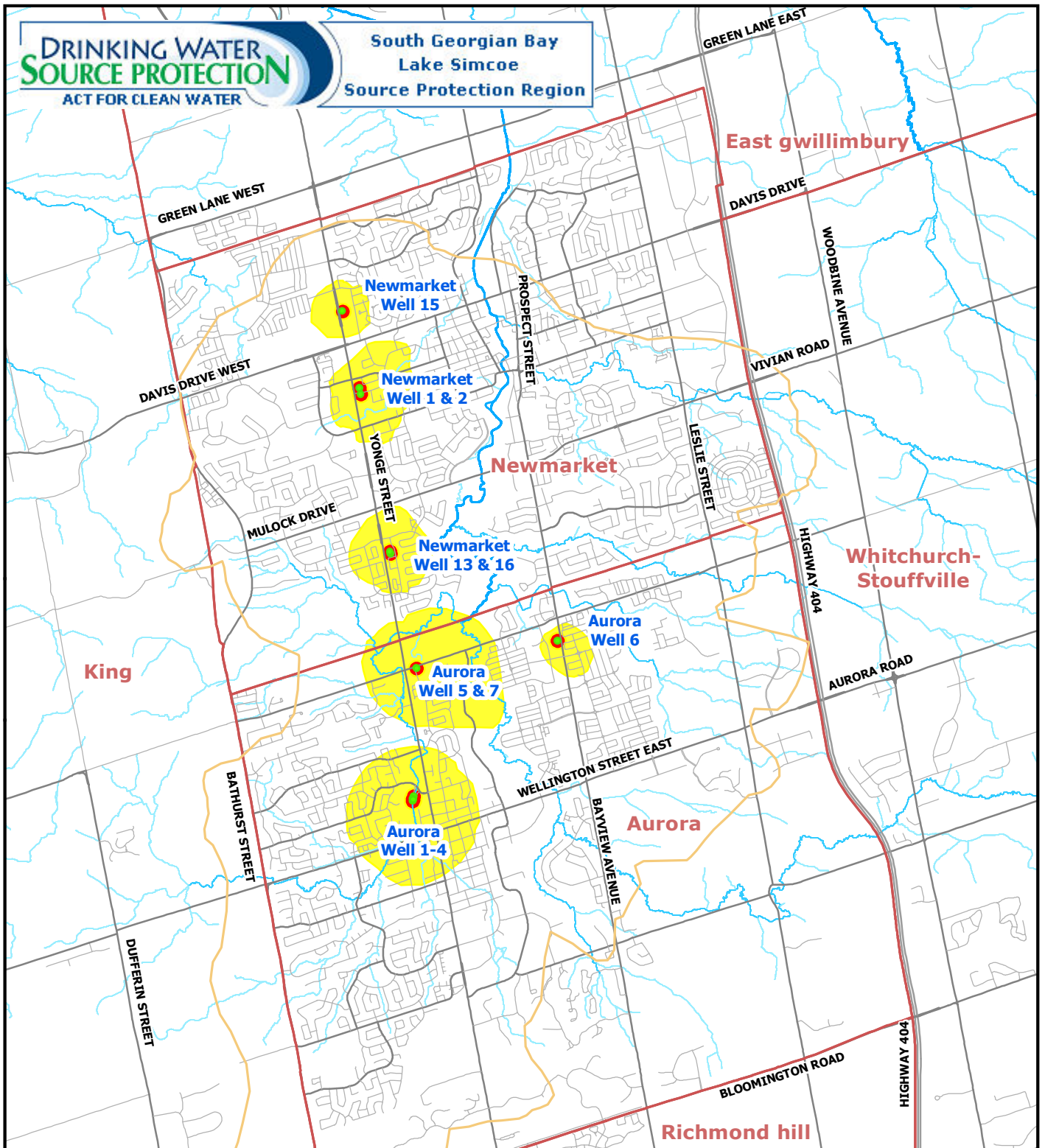
Scale: 1:80,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Figure 13a-3



- Municipal Supply Wells
- Vulnerability Score**
- 10
 - 6



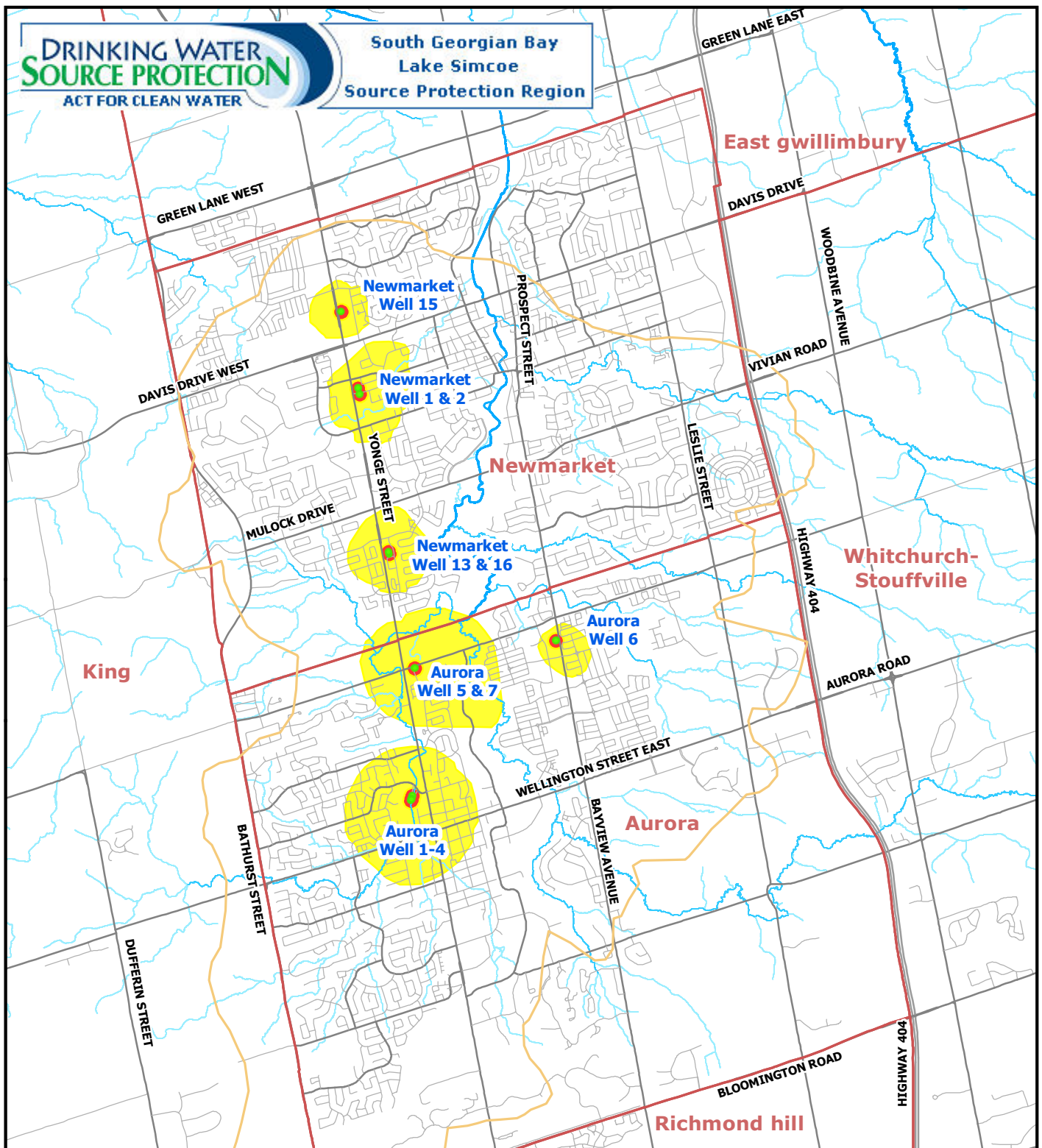
Areas of Significant, Moderate, or Low Threats - Pathogens

Created by: LSRCA
Date: 2019-09-30

Scale: 1:70,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



- Municipal Supply Wells
- Vulnerability Score**
- 10
 - 6



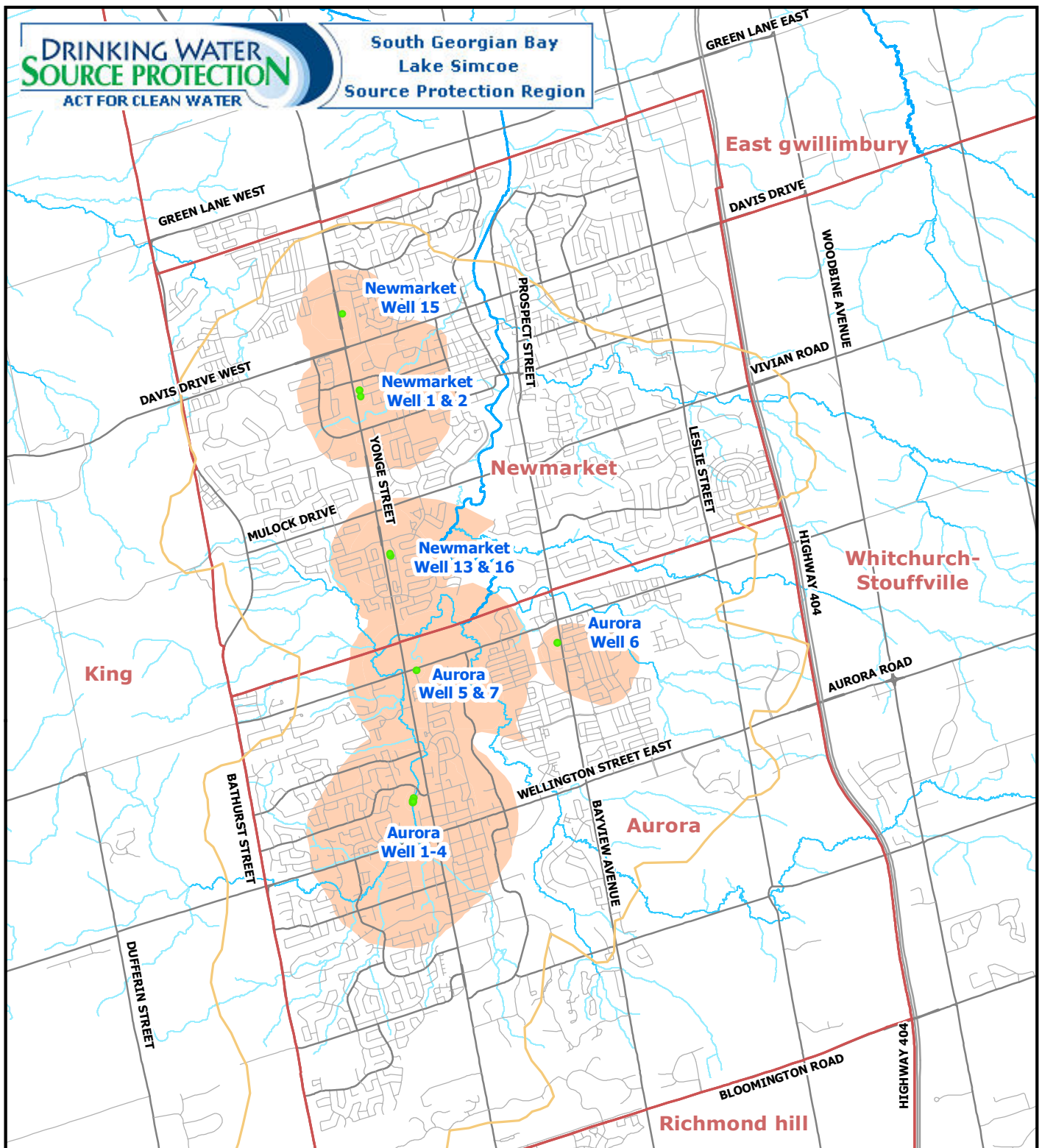
Areas of Significant, Moderate, or Low Threats - Chemicals

Created by: LSRCA
Date: 2019-09-30

Scale: 1:70,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



- Municipal Supply Wells
- WHPA-C: 5 year time of travel



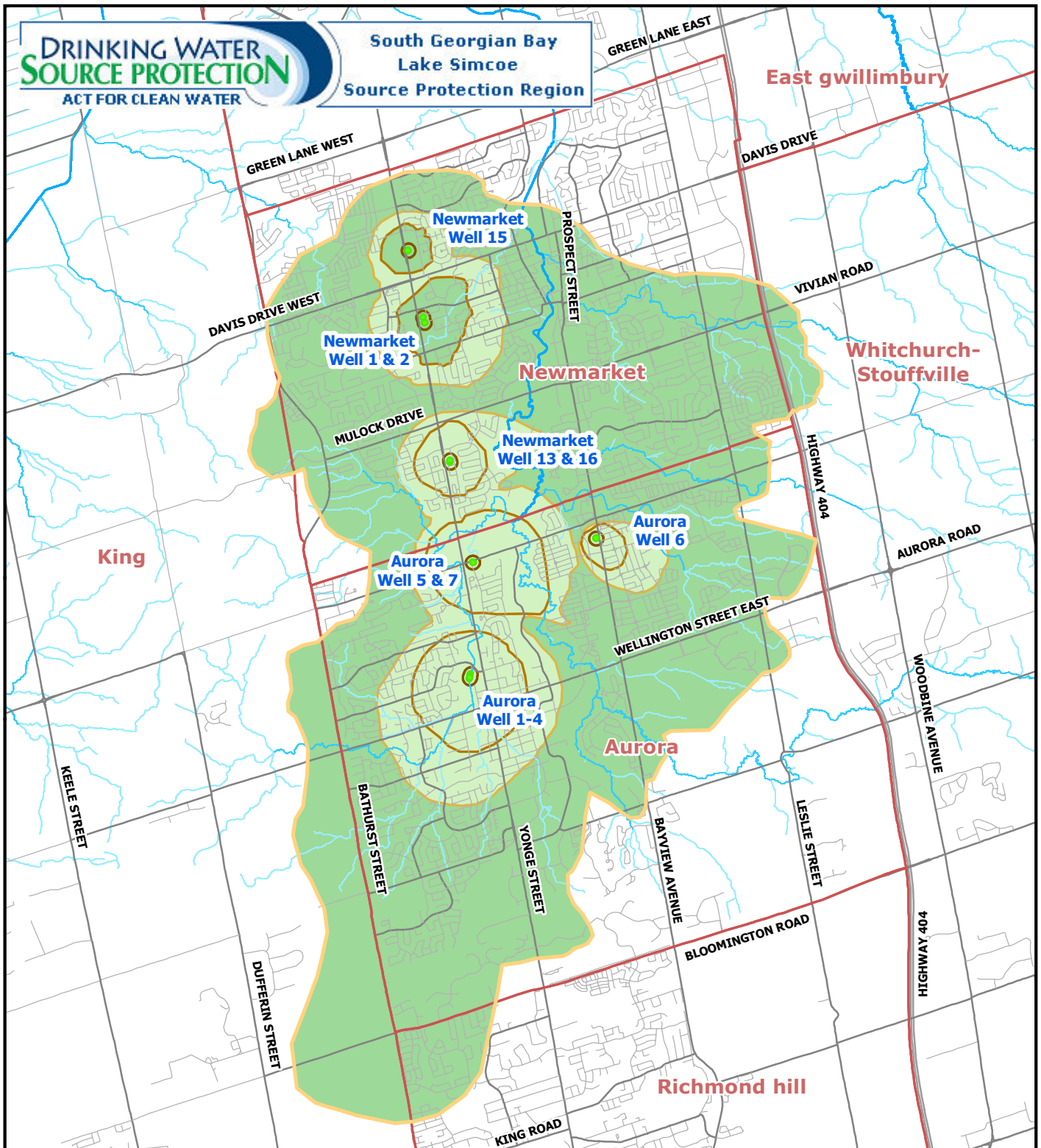
**Areas of Significant, Moderate,
or Low Threats - DNAPLS**

Created by: LSRCA
Date: 2019-09-30

Scale: 1:70,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



● Municipal Supply Wells

Managed Land

< 40%

40-80%

> 80%

Wellhead Protection Area

WHPA-A

WHPA-B

WHPA-C

WHPA-D



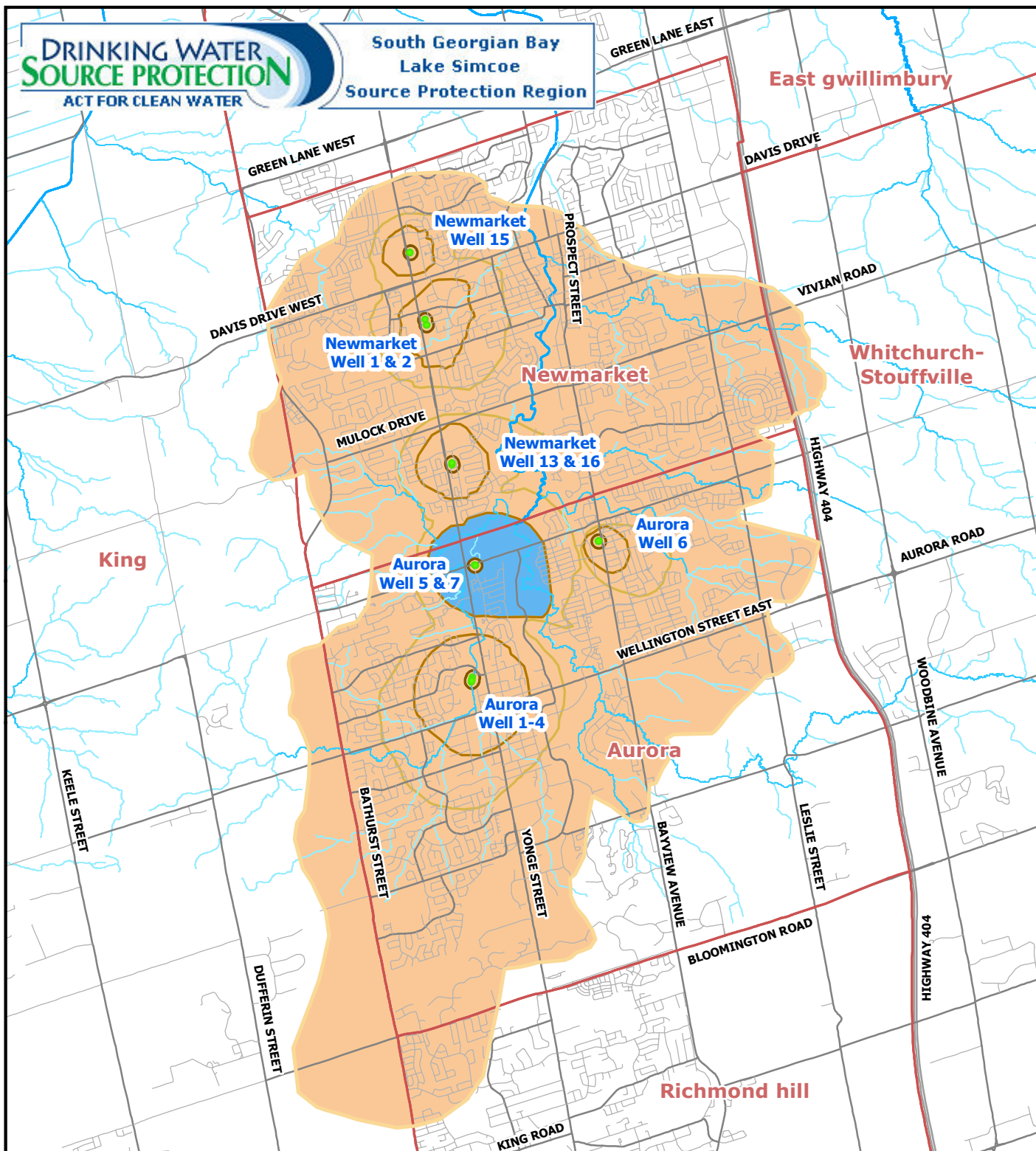
**Managed Land
in Aurora and Newmarket**

Created by: LSRCA
Date: 2019-09-18

Scale: 1:80,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



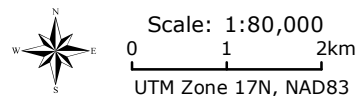
- Municipal Supply Wells
- Nutrient Units/Acre**
- < 0.5
 - 0.5 - 1.0
 - > 1.0

- Wellhead Protection Area**
- WHPA-A
 - WHPA-B
 - WHPA-C
 - WHPA-D



Livestock Density in Aurora and Newmarket

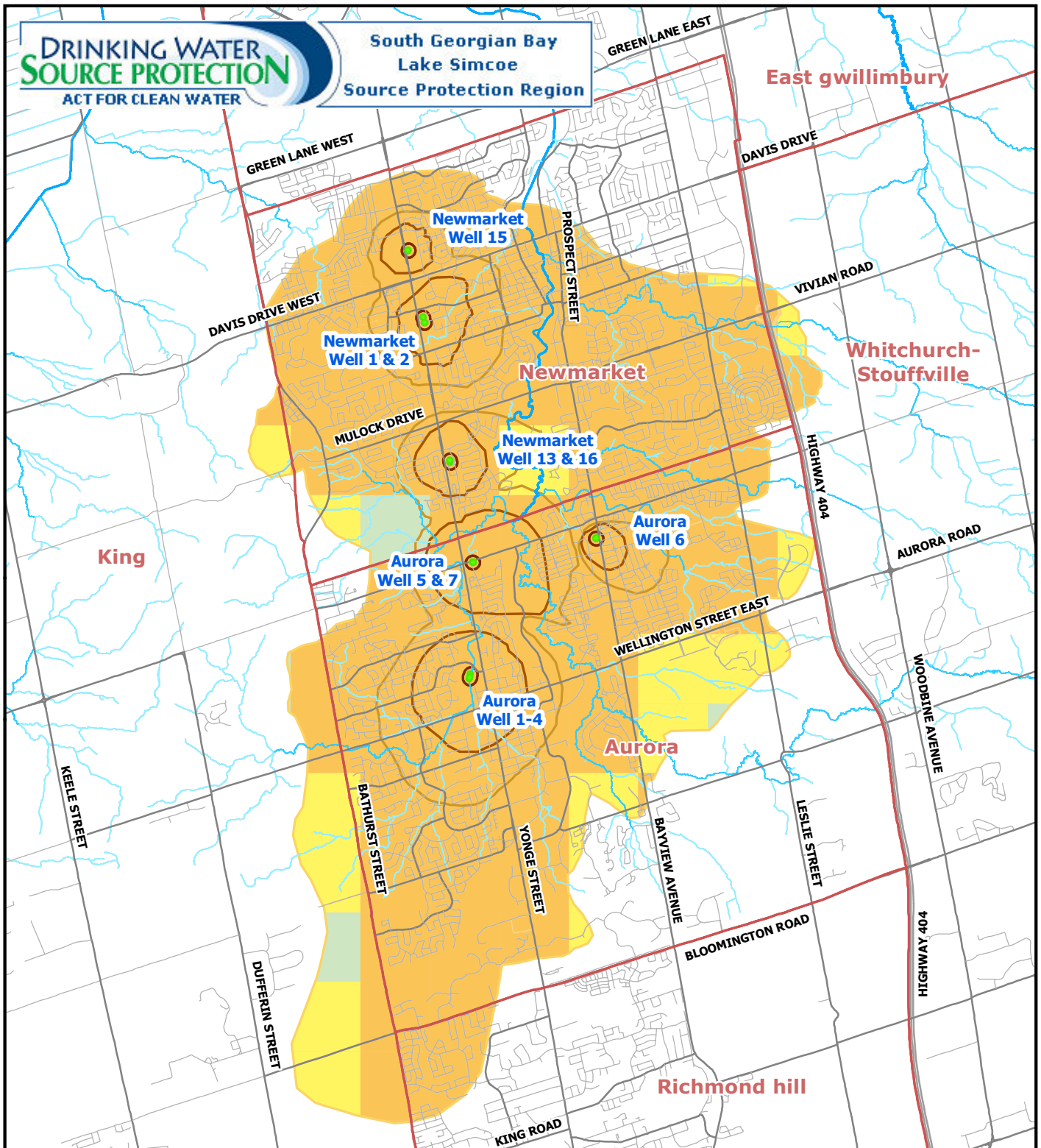
Created by: LSRCA
Date: 2019-09-18



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Figure 13a-8



Impervious Surface

- < 1%
- 1% - 8%
- 8% - 80%
- > 80%

Wellhead Protection Area

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D



**Impervious Surface
in Aurora and Newmarket**

Created by: LSRCA
Date: 2019-09-18

Scale: 1:80,000
0 1 2km
UTM Zone 17N, NAD83



This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.