

Chapter 6: Regional Municipality of Durham

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6 Regional Municipality of Durham

6.1 Introduction

This chapter contains information on six drinking water systems for the Regional Municipality of Durham, four of which are in the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). The other two are located just outside the SGBLS SPR but have Wellhead Protection Areas (WHPAs) that cross over. Various consultants have completed the work presented, which has also been reviewed by South Georgian Bay-Lake Simcoe Source Water Protection staff and members of the Technical Work Group or the Source Protection Committee~~Various consultants have completed the work presented, all of which was reviewed by, among others, municipal staff, SGBLS Source Water Protection staff, and members of the Source Water Protection Committee.~~ 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 a 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 new WHPAs and current threat enumeration data for the Cannington and Sunderland drinking water supply systems. The updated information is current up to and inclusive of X, X, 202X (TBD).

For more information, readers are encouraged to read Chapter 5: Methods Overview as well as the applicable consultant reports and memos (found in Appendix MO and D) for a more in-depth description of the methods used, and the Glossary for any unfamiliar terms.

6.2 Drinking Water Systems

The Region of Durham operates groundwater-based water supplies in eight (8) communities and surface water-based supplies in six (6). As shown in Table 6-1 and Figure 6-1, three (3) of the groundwater supplies and one (1) of the surface water supplies are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). Table 6-1 also indicates the SPR and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

Table 6-16-1: Municipal Surface and Groundwater Supplies in Durham Region (Those included in this report are highlighted in grey).

Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) Number	Permit To Take Water (PTTW)	Source Protection Region / Lead Source Protection Authority (SPA)
Township of Brock	Beaverton Surface Water Intake	220004929	6556-863K95	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Township of Brock	Cannington	220000745	555BATLPP	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Township of Brock	Sunderland	220004910	4812-BJ4M7K	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Municipality of Clarington	Orono	220004769	3577-7WLJ9P	TCC SPR & Ganaraska Region SPA
Municipality of Clarington	Newcastle Surface Water Intake	220004787	4548-863LMN	TCC SPR & Ganaraska Region SPA
Township of Scugog	Greenbank	220003760	1671-6MMNB6	TCC SPR & Kawartha SPA
Township of Scugog	Blackstock	220003751	1503-AHFUFV	TCC SPR & Kawartha SPA
Township of Scugog	Port Perry	220004830	0765-6BDQKL	TCC SPR & Kawartha SPA
Township of Uxbridge	Uxbridge Urban Area	220000763	3588-6TKLAA	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA

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Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) Number	Permit To Take Water (PTTW)	Source Protection Region / Lead Source Protection Authority (SPA)
Township of Uxbridge	Uxville Water Supply System	730002312	2331-6NJJN6L	CTC SPR & Toronto and Region SPA
Town of Ajax	Ajax Surface Water Intake	220008890	2170-6KARNS	CTC SPR & Toronto and Region SPA
Community of Bowmanville	Bowmanville Surface Water Intake	220000852	7767-84XMF4	CTC SPR & Central Lake Ontario SPA
City of Oshawa	Oshawa Surface Water Intake	220000772	3010-862RTS	CTC SPR & Central Lake Ontario SPA
Town of Whitby	Whitby Surface Water Intake	220000754	3663-862S4Q	CTC SPR & Central Lake Ontario SPA

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Studies conducted for the Trent Conservation Coalition (TCC) Source Protection Region have identified that Wellhead Protection Areas (WHPAs) for the Greenbank Drinking Water System extend into the SGBLS SPR. The WHPAs, which are primarily within the Kawartha Conservation Area, extend to the west and a small portion crosses the boundary within the SGBLS SPR. Similarly, the Uxville Water Supply System, which is located near the York-Durham regional boundary, extends over from the Credit Valley, Toronto and Region, Central Lake Ontario (CTC) Source Protection Region into the SGBLS SPR in the Town of Uxbridge. While the full assessment of these systems can be found in their respective Assessment Reports (see Table 6-2), the last sections of this chapter provide a detailed assessment of the Green Bank and Uxville Drinking Water Systems.

In addition, a small section of the Mount Albert WHPA crosses the York Region municipal boundary into the Town of Uxbridge—see the York Region chapter (Chapter 13) for more information on this system.

Table 6-26-2: WHPA that cross into the Durham Region of the SGBLS SPR.

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
Township of Uxbridge	York Region (East Gwillimbury)	Mount Albert Well Supply	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This report (Chapter 13)
Township of Uxbridge	Township of Uxbridge	Uxville Water Supply System	CTC SPR Toronto and Region CA	CTC SPR Assessment Report
Township of Brock	Township of Scugog	Greenbank Water Supply	TCC SPR Kawartha CA	TCC SPR Assessment Report

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6.3 Cannington Well Supply

The Community of Cannington is located 4.7 kilometres east of Highway 12, approximately 50 kilometres north of the City of Oshawa, in the Township of Brock, Regional Municipality of Durham. Approximately 2,100 residents in Cannington are serviced by municipal water and sewers (R.V. Anderson Associates, 2018). The Cannington drinking water supply system includes five operating wells, MW2, MW3, MW4, MW7, and MW8, the decommissioned well, MW6, and two recently installed wells, MW9 and MW10. The drinking water system also includes one above ground standpipe (reservoir), and approximately 13.6 kilometres of water main. The Cannington Groundwater Supply, identified as Drinking Water System #220000745, operates under Permit To Take Water #555BATLPP, which expires May 17, 2029.

The Cannington Gravel Pit Wellfield, located at the west end of the community, comprises the supply wells MW2, MW7, MW9 and MW10. Wells MW7, MW9 and MW10 are screened in the sediments of the Cannington Esker, while MW2 is open across the bedrock beneath the esker. Bedrock in the Cannington area is comprised of shale with interbedded limestone of the Blue Mountain Formation.

The Cannington Arena Wellfield comprises wells MW4, and MW8. Well MW6 was also located in the Arena Wellfield and was included in the 2010 threats assessment (GENIVAR, 2010), however well MW6 was deactivated in 2012 and decommissioned in 2016. The two wells in the Arena Wellfield are open across intervals of the bedrock. Well MW3 is located between the Gravel Pit Wellfield and the Arena Wellfield and is also open across the bedrock.

The direction of groundwater movement, in the bedrock aquifer in the vicinity of the Arena Wellfield, is to the northwest. Near the Gravel Pit Wellfield shallow groundwater moves in a more northerly direction. The wellhead protection areas (WHPAs) reflect the direction of local groundwater flow towards the municipal supply wells.

Information presented for the Cannington section of this Chapter is based on the S.S. Papadopoulos memorandum (2021) and WSP 2021 report and builds upon previous studies done on behalf of Durham Region by GENIVAR (2010b) and Jagger Hims Limited (2004 and 2007).

6.3.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats 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 man-made (anthropogenic) structures, 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 Threat could affect the drinking water supply. 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 Cannington drinking water supply has been updated by S.S. Papadopoulos (2021) following the process recommended in the Technical Rules (MOE, 2008a). The areas determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The groundwater vulnerability within the WHPA was assessed and included consideration for the effects of man-made (anthropogenic) structures that may increase the vulnerability. The WHPA and the intrinsic vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Community of Cannington. Details of the methods for the vulnerability analysis are provided in S.S. Papadopoulos (2021). Updates to the Vulnerability Assessment by WSP (2021) are outlined in Technical Memorandum A1 – Vulnerability Increase – Transport Pathways - Methods (Appendix A) and in Technical Memorandum B1 –Vulnerability Increase for Transport Pathways - Cannington (Appendix D).

6.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Cannington Municipal Water Supply wells, as delineated by S.S. Papadopoulos (2021), are shown in Figure 6a-1. WHPA-A has been added to include the 100 m radius from each municipal well. The WHPAs were delineated using a 3-dimensional numerical groundwater flow model. Further details can be found in S.S. Papadopoulos (2021).

6.3.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the seven municipal wells in Cannington is shown in Figure 6a-2. The Groundwater Vulnerability has been determined by S.S. Papadopoulos (2021) using a SWAT approach. The Groundwater Vulnerability is typically considered to be high in the areas near the municipal wells, adjacent to the Beaver River and in other areas where the overburden thickness is known to be relatively thin. The Groundwater Vulnerability is observed to be variable throughout WHPA-B and -C.

6.3.1.3 Transport Pathway Increase

Technical Memorandum B1, WSP, 2021 (Appendix D) documents the consideration of Transport Pathways as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial transport pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, or that are no longer used and/or that have not been sealed, present the greatest potential for increasing the rated vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was reviewed to identify wells that penetrate to the water supply aquifers and have potential to increase the vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells. A vulnerability increase is reasonable for areas within the WHPA where wells are known to intersect the water supply aquifers.

In general, the delineated WHPAs are not in areas where there are building foundations and municipal services. The areas closest to the wellheads are typically assigned a high vulnerability therefore, a Transport Pathway increase is not recommended for the Cannington Drinking Water Supply aquifers to deal with building foundations and buried infrastructure.

The Groundwater Vulnerability for the 30 m radius around each well identified as a potential pathway has been increased by one step from “Medium” to “High” or from “Low” to “Medium”. Mapping of the transport pathways and increased vulnerability were presented in the technical study completed by WSP (2021). Ultimately the locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 6.3.1.4).

6.3.1.4 Vulnerability Score

The WHPA zones for the Cannington Water Supply, as shown in Figure 6a-1, the Groundwater Vulnerability, as shown in Figure 6a-2, and vulnerability increases due to Transport Pathways were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 6a-3 illustrates the Vulnerability Scores for the Cannington Water Supply. Figure 6a-3 will be used to assess Drinking Water Threats in Section 6.3.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

6.3.1.5 WHPA-E ~~WHPA-F~~

Municipal well MW8 in the Arena Wellfield of the Cannington Drinking Water Supply is designated as Groundwater Under Direct Influence of Surface Water (GUDI) with effective in-situ filtration and therefore, analysis was undertaken to assess the value of delineating a WHPA-E. Technical Memorandum B-2, WSP, 2021 (Appendix D) provides details of work to assess the requirement for a WHPA-E for the Arena Wellfield at the Cannington Drinking Water Supply. ~~A WHPA-F is not required as the Drinking Water Issue identified for the Arena Wellfield~~

~~(See Section 6.3.2) is not associated with a surface water pathway.~~ Review of the available groundwater monitoring results demonstrates that the capture zones for MW4 and MW8 of the Arena Wellfield, are not connected to local surface water sources in a manner that the security of the water supply would benefit from establishing a WHPA-E (WSP, 2021). The previously established WHPA-E has therefor been removed.

6.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part 1.4 – Uncertainty Analysis – Water Quality (MOECP, 2017)). The Uncertainty associated with the WHPA delineation and the groundwater vulnerability scoring was assessed by S.S. Papadopoulos (2021).

The Uncertainty Rating for the delineation of the Cannington WHPAs is High. The Uncertainty Rating for the Cannington groundwater vulnerability scoring of WHPAs is High. The full results of the uncertainty assessment are available in S.S. Papadopoulos (2021). A High Uncertainty Rating corresponds to a relatively low degree of confidence that the Vulnerability Assessment for the water supply wells reflects the conditions that dictate the Vulnerability of the municipal wells to contamination from activities at surface.

6.3.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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(1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring, or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Cannington Drinking Water Supply was reviewed by GENIVAR (2010) to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Water quality monitoring data for the active municipal wells and the available groundwater monitoring well network were reviewed to identify potential changes to the identified issues since 2010. Details of the Drinking Water Issues Evaluation for Cannington are provided in Technical Memorandum B3 – Drinking Water Issues Evaluation - Cannington, WSP, 2021 (Appendix D).

One (1) Drinking Water Issue was identified for the Arena Wellfield (no Drinking Water Issues were identified with the Gravel Pit Wellfield and MW3).

Trichloroethylene (TCE) was identified as a Drinking Water Issue for the Arena Wellfield. Low concentrations of TCE were measured in the raw water at the Arena Wellfield. Durham Region is currently monitoring the situation and dissolved TCE concentrations have not exceeded the Ontario Drinking Water Quality Standard (ODWQS) in MW4 and MW8. Durham Region currently operates MW4 and MW8 in an alternating pattern to manage the TCE concentrations. This action has resulted in a decreasing concentration trend since 2008. The MECP is investigating the sources of the TCE. Durham Region has developed alternate groundwater supply sources (MW9 and MW10) to reduce the reliance on the Arena Wellfield in the future.

The [Wellhead Protection Area - Issue Contributing Area \(WHPA-ICA\)](#) that has been delineated for TCE at the Arena Wellfield in Cannington is shown in Figure 6a-4. This area has been identified based on review of potential sources of TCE, groundwater quality monitoring data, and evaluations using the numerical groundwater flow model constructed to delineate the WHPA.

When a Drinking Water Issue is identified, the Technical Rules require the following to be prepared:

- A List of prescribed drinking water threats activities that may lead to the Issue is to be prepared (See Section 6.3.3.1). No additional local circumstances were identified by the SPC that may ~~be~~ lead to the Drinking Water Issue.
- Conditions that may contribute to the Issue were investigated. While none were confirmed additional studies are required to confirm if a Condition is present (Section 6.3.3.2)
- A list of the threat activities, land uses and circumstances that could contribute to the Drinking Water Issue has been prepared and a Map has been prepared to illustrate the Issues Contributing Area where these activities are or would a Significant, drinking water threat (Section 6.3.3.3).
- All current activities, land uses and circumstances that could contribute to the Drinking Water Issue within the Issues Contributing Area have been identified and included in the table of enumerated Significant Threats (Section 6.3.3.5)

6.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Cannington Drinking Water Supply was completed in accordance with the methodology presented in Technical Memorandum – A4.

WSP, 2021(Appendix D). 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 Cannington Drinking Water Supply 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.

6.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Cannington Drinking Water Supply 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.

6.3.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Cannington Water Supply system:

- Files provided by the Ministry of the Environment, [Conservation and Parks](#) local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment, [Conservation and Parks](#) website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.

- Interviews of Durham Region staff to identify potential conditions within the identified WHPA for the drinking water supply.

Durham Region staff were consulted in 2021 to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Community of Cannington Water Supply.

6.3.3.3 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~~ [Technical Rules](#) threat circumstances -prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The ~~circumstance~~ [tables](https://threats.swpip.ca/) can be found at: <https://threats.swpip.ca/>. ~~https://swpip.ca/~~

6.3.3.3.1 Pathogen Parameters

The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6a-3](#) to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Cannington Water Supply. ~~(Figure 6a-7)(Figure 6a-5)~~. 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 a significant, moderate, or low threat within WHPA-A and WHPA-B.

6.3.3.3.2 Chemical Parameters

The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6a-3](#) to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Cannington Water Supply ~~(Figure 6a-6)(Figure 6a-8)~~. 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.

6.3.3.3.3 DNAPL Chemical Parameters

~~Figure 6a-7~~ [Figure 6a-9](#) 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 Cannington Water Supply. The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the

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Vulnerability Scores on [Figure 6a-3](#) to identify the circumstances in which these activities associated with DNAPL threats would be Significant or Moderate Drinking Water Threats.

The [TCE](#) Issues Contributing Area for the Arena Wellfield is within WHPA-C and therefore the activities that would be Significant Threats within the Issues Contributing Area are considered in [Figure 6a-4](#)[Figure 6a-4](#).

6.3.3.3.4 Drinking Water Issue (TCE)

TCE was identified as a Drinking Water Issue. As per the Technical Rules, land use activities that can release parameters that are identified as a Drinking Water Issue within the identified Issues Contributing Area are to be considered as Significant Drinking Water Threats. Table 6-3 provides a list of the activities and circumstances that can potentially release TCE to the environment within the identified Issues Contributing Area for the Arena Wellfield. This list of activities is a subset of the activities identified as DNAPL Chemical Parameters as it contains only circumstances related to TCE and not all DNAPLs.

Table 6-36-3: Number of Significant Circumstances that are or would be Significant Threats for TCE in ~~Issues Contributing Area~~the WHPA-ICA.

<u>Parameter</u>	<u>Threat Subcategory</u>	<u>Quantity Threshold for a Significant Threat (ICA)</u>
<u>Trichloroethylene (TCE)</u>	<u>Landfilling (Hazardous Waste or Liquid Industrial Waste)</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Landfilling (Municipal Waste)</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Liquid Industrial Waste Injection into a well</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Storage of Subject Waste at a Waste Generation Facility: site requires generator registration under Section 3 of O. Reg. 347</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Industrial Effluent Discharges</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Wastewater Collection Facilities and Associated Parts</u>	<u>Any quantity for IPZs/WHPA-Es; > 1000 m3/day for WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Wastewater Treatment Facilities and Associated Parts</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>
<u>Trichloroethylene (TCE)</u>	<u>Handling and Storage of a Dense Non-Aqueous Phase Liquid (DNAPL)</u>	<u>Any quantity for IPZs/WHPA-Es and WHPAs</u>

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Threat Subcategory	Quantity Circumstance	RIM Circumstance	Chemical Of Concern	Circumstance Number
Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The below grade handling of a DNAPL in relation to its storage	Tetrachloroethylene (PCE)	104
Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The below grade handling of a DNAPL in relation to its storage	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	105
Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The handling of a DNAPL at or above grade, in relation to its storage	Tetrachloroethylene (PCE)	109
Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The handling of a DNAPL at or above grade, in relation to its storage	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	110
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent < 500 m3/d on an annual average	STP holding tank that is installed at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	913
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent < 500 m3/d on an annual average	STP holding tank that is installed completely below grade, except for the access points	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	926
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent < 500 m3/d on an annual average	STP holding tank that is installed partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	999
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2500 m3/d but < 2,500 m3/d on an annual average	STP holding tank that is installed at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	952
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2500 m3/d but < 2,500 m3/d on an annual average	STP holding tank that is installed completely below grade, except for the access points	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	965
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2500 m3/d but < 2,500 m3/d on an annual average	STP holding tank that is installed partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	978
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	991
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed completely below grade, except for the access points	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1004
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1017
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1030
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed completely below grade, except for the access points	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1043
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent 2,500 m3/d or < 17,500 m3/d on an annual average	STP holding tank that is installed partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1056
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent > 250,000 m3/d on an annual average	STP holding tank that is installed at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1069
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent > 250,000 m3/d on an annual average	STP holding tank that is installed completely below grade, except for the access points	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1082
Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)	Sewage Treatment Plants that discharge treated effluent > 250,000 m3/d on an annual average	STP holding tank that is installed partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1095
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL at or above grade	Tetrachloroethylene (PCE)	1100
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL at or above grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1101
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL completely below grade	Tetrachloroethylene (PCE)	1105
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL completely below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1106
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL partially below grade	Tetrachloroethylene (PCE)	1110
Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	Any quantity	The storage of a DNAPL partially below grade	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1111
Waste Disposal Site - Landfilling (Municipal Waste)	Landfill area < 1 ha	The land disposal of municipal waste	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1648
Waste Disposal Site - Landfilling (Municipal Waste)	Landfill area 1 - 10 ha	The land disposal of municipal waste	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1660
Waste Disposal Site - Landfilling (Municipal Waste)	Landfill area > 10 ha	The land disposal of municipal waste	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1672
Waste Disposal Site - Landfilling (Solid Non Hazardous Industrial or Commercial)	Landfill area < 1 ha	The land disposal of solid non hazardous industrial or commercial	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1684
Waste Disposal Site - Landfilling (Solid Non Hazardous Industrial or Commercial)	Landfill area 1 - 10 ha	The land disposal of solid non hazardous industrial or commercial	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1696
Waste Disposal Site - Landfilling (Solid Non Hazardous Industrial or Commercial)	Landfill area > 10 ha	The land disposal of solid non hazardous industrial or commercial	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1708
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of < 380 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1732
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of 380 but < 3,800 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1756
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of 3,800 but < 38,000 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1780
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of 38,000 but < 380,000 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1804
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of 380,000 but < 3,800,000 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1828
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of 3,800,000 but not < 38,000,000 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1852
Waste Disposal Site - Liquid Industrial Waste Injection into a well	Throughput rate of > 38,000,000 cubic metres per year.	The land disposal of liquid industrial waste by discharging the waste into a geological formation by means of a well	Trichloroethylene or another DNAPL that could degrade to Trichloroethylene	1876

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

Further to Section 6.3.3.2, no Conditions have been confirmed within the WHPA for the Cannington Water Supply.

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 A5 (Appendix MO). 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.

Figure 6a-3 illustrates the Vulnerability Score map for Cannington well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

6.3.3.5 Enumerating Drinking Water Threats

6.3.3.5

The number of Significant Drinking Water Threats for the Cannington Water Supply has been determined using the methodology outlined in Technical Memorandum A4, WSP, 2021 (Appendix D). There are no Drinking Water Threats identified associated with Conditions.

Table 6-4 and Table 6-5 document the enumeration of existing Activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Cannington Drinking Water Supply. Table 6-4 has been prepared for the Gravel Pit Wellfield and the WHPA associated with MW2, MW3, and MW7, MW9 and MW10. [Table 6-5](#) has been prepared for the Arena Wellfield and the WHPA associated with MW4 and MW8. Potential Significant Drinking

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Water Threats were identified within areas where the Vulnerability Score is 10 and for two parcels within WHPA-B and -C at the Arena Wellfield that were previously identified as potentially having a threat related to DNAPL.

Thirty-three (33) activities that are potential Significant Threats to Drinking Water were identified in association with twenty-nine (29) land parcels in the WHPA for the Gravel Pit Wellfield. Twenty-five (25) of the identified activities relate to potential Significant Threats due to homes with private individual sewage disposal systems and the possibility of fuel storage for home heating purposes. Three (3) parcels were identified with activities involving potential application of agricultural source material, one (1) parcel with activities involving storage of agricultural source material and, one (1) parcel with activities involving application of pesticide and, one (1) parcel with livestock grazing.

Twenty-four (24) activities that are potential Significant Threats to Drinking Water were identified in association with twenty (20) land parcels in the WHPA for the Arena Wellfield. Twelve (12) of the identified activities relate to potential Significant Threats due to homes with private individual sewage disposal systems and the possibility of fuel storage for home heating purposes. There are ten (10) potential threats that are agricultural-based, associated with five (5) land parcels. Four (4) activities involve the potential application of agricultural source material, one (1) activity involve the storage of agricultural source material, and five (5) activities involve the application of pesticide. One (1) parcel is identified as having potential for the handling and storage of DNAPL and/or organic solvents.

The land use activities on one (1) parcel within the WHPA for the Arena Wellfield was identified as having potential to be a Significant Threat to Drinking Water for specific circumstances in the [Table of Drinking Water Threats Technical Rules](#) (MECP, March 2017) that relate to the establishment of a waste disposal site. Additional information is required to confirm whether the actual activities on the property correspond to the circumstances that would produce the Significant Threat.

Table 6-46-4: Number of Significant Drinking Water Threats for the Gravel Pit Wellfield - Cannington Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	30
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	25 ²⁵²⁹
3	The application of agricultural source material to land.	36 ³
4	The storage of agricultural source material to land.	11 ²
5	The management of agricultural source material.	0
6	The application of non-agricultural source material to land.	0
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	42 ⁰
9	The handling and storage of commercial fertilizer to land.	40 ⁰
10	The application of pesticide to land.	2 ¹
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0
14	The storage of snow.	0
15	The handling and storage of fuel.	0

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Threat Number	Threat	Significant threat counts Number of threats
16	The handling and storage of dense non-aqueous phase liquid.	1
17	The handling and storage of an organic solvent.	1
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	121
<u>22</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals	3335 significant threats (on 29 31 properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

Table 6-56-5: Number of Significant Drinking Water Threats for the Arena Wellfield - Cannington Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	30
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	311212
3	The application of agricultural source material to land.	4124
4	The storage of agricultural source material to land.	611
5	The management of agricultural source material.	0
6	The application of non-agricultural source material to land.	0
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	01900
9	The handling and storage of commercial fertilizer to land.	18300
10	The application of pesticide to land.	45
11	The handling and storage of pesticide.	00
12	The application of road salt.	0
13	The handling and storage of road salt.	0
14	The storage of snow.	0
15	The handling and storage of fuel.	0
16	The handling and storage of dense non-aqueous phase liquid.	1

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Threat Number	Threat	Significant threat counts Number of threats
17	The handling and storage of an organic solvent.	1
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	509
<u>22</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals	2824 significant threats (on 2320 properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

6.3.3.5.1 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~~Technical Rules.

Managed Lands were identified and the managed lands proportions were determined for the Cannington WHPA as outlined in Technical Memorandum A-4, WSP, 2021 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.3.3.5). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

~~Figure 6a-8~~Figure 6a-10 illustrates the location and proportion of managed lands within the delineated WHPA zones for the Cannington Drinking Water Supply where vulnerability scores were greater than 6 for WHPA-A to WHPA-D.

6.3.3.5.2 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~~Technical Rules.

The Livestock Density was determined for the Cannington WHPA as outlined in Technical Memorandum A4, WSP 2021 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.3.3.5). The Livestock Density is used in the identification of threat activities associated with the storage of Agricultural Source Material, and the grazing and/or outdoor confinement of livestock.

~~Figure 6a-9~~Figure 6a-11 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Cannington Drinking Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figures reflect the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A4, WSP 2021 (Appendix D).

6.3.3.5.3 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

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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 Technical Rules](#).

The proportion of impervious surfaces within the Cannington WHPA was determined in accordance with the methodology in Technical Memorandum A4, WSP, 2021 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.3.3.5). The impervious surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

[Figure 6a-10](#) [Figure 6a-12](#) illustrates the distribution of impervious surfaces within the delineated WHPA zones for the Cannington Drinking Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

[6.3.3.5.4 TCE Drinking Water Issue](#)

[TCE was identified as a Drinking Water Issue. As per the Technical Rules, land use activities that can release parameters that are identified as a Drinking Water Issue within the identified WHPA-ICA are to be considered as Significant Drinking Water Threats. Table 6-3 provides a list of the land uses that can potentially release TCE to the environment within the identified Issues Contributing Area \(Figure 6a-4\).](#)

[Figure 6a-4 illustrates the WHPA-ICA where activities and circumstances listed in Table 6-3 are considered to be a Significant Drinking Water Threat for the Cannington drinking water system.](#)

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6.4 Sunderland Well Supply

The Community of Sunderland is located approximately 13 kilometres northwest of Lake Scugog, 15 kilometres southeast of Lake Simcoe and 45 kilometres north of Ajax, at the intersection of Highway 7/12 and Concession Road 6, in the Township of Brock. Approximately 1,573 residents in the Community of Sunderland are serviced by municipal water and sewers. Sunderland's water system, identified as DWIS# 2200004910 includes three active wells, [one decommissioned well \(MW3\)](#), one above ground reservoir (standpipe) and approximately 9 km of water main. The standpipe is used for pressure equalization and storage.

The Sunderland municipal drinking water supply is sourced from three groundwater wells – designated MW1, MW2, and [MW3](#) – located in two wellfields. The original wells (MW1 and MW2) are located to the east of the community, on the opposing bank of the Beaver River. [MW3](#) is located off Jane Street near the north end of the community, west of the main stem of the Beaver River. The locations of the municipal wells are presented in [Figure 6b-1](#).

The two original drilled wells that provide water to Sunderland are located approximately 100 m from the Beaver River. Sunderland well MW1 has been in service since 1957. This well was constructed with a 250 mm diameter steel casing and a 3.05 m long 250 mm diameter stainless steel screen extending between depths of 5.91 and 8.96 m below ground surface. MW2 was constructed about 30 metres north of MW1 in 1972. This well was constructed with a 250 mm diameter steel casing and a 3.05 m long 250 mm diameter stainless steel screen extending between depths of 8.53 and 11.58 m below ground surface. Wells MW1 and MW2 are screened in coarse-grained sand and gravels of the Channel Aquifer deposits, at the base of the Beaver River incised valley. In May 2017, MW2 was taken offline due to the degradation of raw water quality that inhibited the effectiveness of the existing water treatment system. Despite attempts to rehabilitate the well and restore the water quality, the ultraviolet transmittance (UVT) remained below the acceptable limit required to ensure adequate levels of disinfection.

To compensate for the water supply issues at MW2, the Region of Durham initiated an exploration program, which resulted in the construction and incorporation of TW17-3 (now MW3) into the municipal water supply system. MW3 was constructed in 2017 and was installed approximately 10 m northwest of the standpipe belonging to the Sunderland water distribution system. This well was constructed with 150 mm diameter casing installed to 27.90 m below ground surface followed by a 132 mm diameter 5.9 m long screen, set between 27.90 and 33.80 m below ground surface. MW3 is screened across a deposit of medium-grained sand corresponding to the Thorncliffe Formation. The operation of the Sunderland municipal wellfields is authorized under PTTW number [4812-BJ4M7K8370-CVFRGR](#), secured on [November 21, 2019](#) [October 27, 2023](#), and expiring May 31, 2033. The PTTW allows for the concurrent

continuous pumping from MW1, MW2 and MW3 for 24 hours per day for a total maximum daily taking of 2,745,000 L/day (2,745 m³/day).

Groundwater flowing to Sunderland municipal well MW1 located within the Beaver River incised valley primarily originate within 500 m of the wellfield, in areas of thicker eskerine or Channel Aquifer deposits to the east and west of the Beaver River. Groundwater flowing to well MW3 is directed from northwest to southeast creating a relatively broad and symmetrical shaped WHPA, owing to the confined nature of the Thorncliffe aquifer in this area.

Information presented for the Sunderland section of this Chapter is based on the GeoProcess, 2021a report and builds upon previous studies done on behalf of Durham Region by GENIVAR, 2010b and Jagger Hims Limited in 2003 and 2007.

6.4.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, of which current (or future) Threats 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 man-made (anthropogenic) structures, 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 Threat could affect the drinking water supply. 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 Sunderland drinking water supply has been updated by GeoProcess (2021a) following the process recommended in the Technical Rules. The areas determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The groundwater vulnerability within the WHPA was assessed and included consideration of the effects of man-made (anthropogenic) structures that may increase the vulnerability. The WHPA and the intrinsic vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Community of Sunderland. Details of the methods for the vulnerability analysis are provided GeoProcess (2021a). Updates to the vulnerability assessment by WSP (2022) are outlined in Technical Memorandum A1 – Vulnerability Increase – Transport Pathways – Methods and in in Technical Memorandum B1 – Vulnerability Increase for Transport Pathways – Sunderland MW3 (Appendix D).

6.4.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Sunderland Municipal Water Supply wells as delineated by GeoProcess (2021a) are shown in Figure 6b-1. WHPA-A has been added to include the 100 m radius from each municipal well. The WHPAs were delineated using a 3-dimensional numerical groundwater flow model. Further details can be found in GeoProcess (2021a) (Appendix D).

The WHPA for Sunderland wells MW1 and MW2 reflects a groundwater flow pattern from east to west toward the Beaver River. The WHPA for Well MW3 reflects a groundwater flow pattern from northwest to southeast, also towards the Beaver River.

6.4.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the three municipal wells in Sunderland is shown in Figure 6b-2. The Groundwater Vulnerability has been determined by GeoProcess (2021a) using the surface to well advection time (SWAT) approach. Both of the Sunderland WHPAs (east and west of the Beaver River), demonstrate a variation in vulnerability scores that closely follow the progression of the WHPAs, with areas within the WHPA-A assigned the highest vulnerability scores of 10 and areas within the WHPA-Ds assigned the lowest scores. The lower vulnerability scores noted for WHPA-C and WHPA-D associated with well MW3 is due to the effective confinement of the Thorncliffe Aquifer by the overlying Newmarket Till, which results in long surface-to-well travel times and therefore a uniformly low vulnerability level assigned across the capture zone. The Groundwater Vulnerability has been assessed as High beneath the entire WHPA associated with wells MW1 and MW2.

6.4.1.3 Transport Pathway Increase

WSP (2022) documents the consideration of Transport Pathways as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial transport pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, or that are no longer used and/or that have not been sealed, present the greatest potential for increasing the rated vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was reviewed to identify wells that penetrate to the water supply aquifers and have potential to increase the vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells. A vulnerability increase is

reasonable for areas within the WHPA where wells are known to intersect the water supply aquifers.

In general, the delineated WHPAs are not in areas where there are building foundations and municipal services. The areas closest to the wellheads are typically assigned a high vulnerability therefore, a Transport Pathway increase is not recommended for the Sunderland Drinking Water Supply aquifers to deal with building foundations and buried infrastructure.

The Groundwater Vulnerability for the 30 m radius around each well identified as a potential pathway has been increased by one step from “Medium” to “High” or from “Low” to “Medium”. Mapping of the transport pathways and increased vulnerability were presented in the technical study completed by WSP (2022). Ultimately the locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 6.4.1.4)

6.4.1.4 Vulnerability Score

The WHPA zones for the Sunderland Drinking Water Supply, as shown in Figure 6b-1, the Groundwater Vulnerability, as shown in Figure 6b-2, and vulnerability increases due to Transport Pathways were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 6b-3 illustrates the Vulnerability Scores for the Sunderland Drinking Water Supply. Figure 6b-3 will be used to assess Drinking Water Threats in Section 6.4.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

6.4.1.5 WHPA-E /~~WHPA-F~~

Municipal wells MW1 and MW2 in the Sunderland Drinking Water Supply are considered to be Groundwater Under Direct Influence of Surface Water (GUDI) with effective in-situ filtration and therefore a WHPA-E is required. Technical Memorandum C-2 (Appendix D) provides details of work to delineate a WHPA-E for the Sunderland Drinking Water Supply. Sunderland well MW3 is not designated as GUDI and therefore additional assessment to delineate a WHPA-E or WHPA-F was not required. This was confirmed by the numerical modelling (GeoProcess, 2021a) and hydraulic testing performed by R.J. Burnside (2018).

Previous assessments and monitoring data have demonstrated that the Beaver River does not contribute to the GUDI condition. Wetland areas that are identified adjacent to the Beaver River and in the area of the Municipal Wells are considered to have the potential to contribute surface water to the aquifer. A WHPA-E has been delineated for a 120 m distance around the delineated wetland adjacent to the municipal wells (Figure 6b-4). There are no known Transport Pathways that can contribute surface water into the WHPA-E area. The Vulnerability

Score for the WHPA-E has been determined in accordance with the Technical Rules and is based on ratings for an Area Vulnerability Factor and a Source Vulnerability Factor that reflect the land cover, soil type, permeability, hydrological and hydrogeological conditions and the depth of the well intake. The Vulnerability Score within WHPA-E for Sunderland is shown on Figure 6b-4.

The Vulnerability Score for WHPA-E will be used independently in the Threat Assessment to identify areas that are or would be Drinking Water Threats. The WHPA-E is shown on a separate map from the WHPA-A to WHPA-D, as the WHPA-E area, and the corresponding Vulnerability Score, reflects the potential for land use activities to affect surface water that passes close to the well. The Vulnerability Score of 6.3 out of a possible 10 is assigned to WHPA-E for Sunderland.

6.4.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MECPCP, 2017)). The uncertainty associated with the WHPA delineation and the groundwater vulnerability scoring was assessed by GeoProcess (2021a).

The Uncertainty Rating assigned for the delineation of the Sunderland WHPAs is High. The Uncertainty Rating for the Sunderland groundwater vulnerability scoring is also High. The full results of the uncertainty assessment are available in GeoProcess (2021a). The High Uncertainty Rating reflects uncertainties in understanding the groundwater flow system and representing this system in the numerical model. A High Uncertainty Rating does not correspond to a relatively low degree of confidence that the vulnerability assessment for the water supply wells reflects the conditions that dictate the vulnerability of the municipal wells to contamination from activities at surface.

6.4.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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 (1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring, or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Sunderland municipal water supplies has been reviewed to identify Drinking Water Issues that are considered likely to deteriorate the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Sunderland are provided in Technical Memorandum C3 – Evaluation of Drinking Water Issues – Sunderland (Appendix D).

No Drinking Water Issues were identified for the Sunderland Water Supply.

6.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Sunderland Water Supply was completed in accordance with the methodology presented in Technical Memorandum – A3, WSP 2022 (Appendix D). 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 Sunderland Water Supply 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.

6.4.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Sunderland Drinking Water Supply 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.

6.4.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Sunderland Water Supply system:

- Files provided by the Ministry of the Environment, [Conservation and Parks](#) local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment, [Conservation and Parks](#) website containing registry of Brownfield Sites.
- Records from previous contaminant source inventories that identified situations that may qualify as Conditions.
- Interviews of Durham Region staff to identify potential Conditions within the identified WHPA for the drinking water supply.

Durham Region staff were consulted in 2021 to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Community of Sunderland Drinking Water Supply. No potential Conditions have been identified for consideration at this time.

6.4.3.3 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~~ [Technical Rules](#) threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The ~~circumstance~~ [tables](#) can be found at: <https://threats.swpip.ca/>, <https://swpip.ca/>

6.4.3.3.1 Pathogen Parameters

The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6b-3](#) to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Sunderland Water Supply ([Figure 6b-5](#)). Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the 2-Year time-of-travel zone (WHPA-B) where the Vulnerability Score is 10. Pathogens can only be a significant, moderate or low threat within WHPA-A and WHPA-B.

6.4.3.3.2 Chemical Parameters

The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6b-3](#) to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Sunderland Water Supply ([Figure 6b-6](#)). Activities that are or would be Significant Drinking Water Threats for chemical parameters can be observed within the 2-Year time-of-travel zone (WHPA-B) where the Vulnerability Score is equal to or greater than 8.

6.4.3.3.3 DNAPL Chemical Parameters

[Figure 6b-7](#) 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 Sunderland Water Supply. The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6b-3](#) to identify the circumstances in which these activities associated with DNAPL threats would be Significant or Moderate Drinking Water Threats.

6.4.3.3.4 WHPA-E

[Figure 6b-8](#) illustrates the area of the WHPA-E where Activities are considered to be Moderate or Low Drinking Water Threats for the Sunderland Water Supply. The ~~MECP table of drinking water threats~~ [Technical Rules](#) can be used in conjunction with the Vulnerability Scores on [Figure 6b-8](#) to identify the circumstances in which these activities would be Moderate or Low Threats.

Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 6.4.3.2, no Conditions have been confirmed within the WHPA for the Sunderland Water Supply.

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 A5 (Appendix MO). 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.

Figure 6b-3 illustrates the Vulnerability Score map for Sunderland that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

6.4.3.4 Enumerating Drinking Water Threats

6.4.3.4

The number of Significant Drinking Water Threats for the Sunderland Water Supply has been determined using the methodology outlined in Technical Memorandum A3, WSP 2022 (Appendix D) and refined by Region of Durham staff members.

Table 6-6 documents the refined enumeration of existing Activities that are considered to be Significant Drinking Water Threats within the WHPAs for the Sunderland Drinking Water Supply. Potential Significant Drinking Water Threats were only identified within areas where the Vulnerability Score is 10.

Six (6) activities that are considered to be Significant Threats to Drinking Water were identified in the WHPAs for the Sunderland Wellfield. Four (4) activities relate to private homes with private sewage systems. One (1) activity relates to the potential application of agricultural source material to land, and one (1) activity relates to the potential application of pesticide to land.

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Table 6-66-6: Number of Significant Drinking Water Threats for the Sunderland Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	0
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	4
3	The application of agricultural source material to land.	1
4	The storage of agricultural source material to land.	0
5	The management of agricultural source material.	0
6	The application of non-agricultural source material to land.	0
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	0
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	<u>1</u>
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0
14	The storage of snow.	0
15	The handling and storage of fuel.	0

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Threat Number	Threat	Significant threat counts Number of threats
16	The handling and storage of dense non-aqueous phase liquid.	1
17	The handling and storage of an organic solvent.	0
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
<u>22</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals	6 significant threats (on 5 properties)

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6.4.3.4.1 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~~[Technical Rules](#).

Managed Lands were identified and the managed lands proportions were determined for the Sunderland WHPA as outlined in Technical Memorandum A-3, WSP 2022 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.4.3.4). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 6b-9 illustrates the location and proportion of managed lands within the delineated WHPA zones for the Sunderland Water Supply where vulnerability scores were greater than 6 for WHPA-A to WHPA-D and greater than 4 for WHPA-E.

6.4.3.4.2 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~~[Technical Rules](#).

The Livestock Density was determined in accordance with the methodology in Technical Memorandum A3, WSP, 2022 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.4.3.4). The Livestock Density is used in the identification of threat activities associated with the storage of Agricultural Source Material, and the grazing and/or outdoor confinement of livestock.

Figure 6b-10 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Sunderland Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D and greater than 4 for WHPA-E. The Livestock Density figures reflect the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A3, WSP, 2022 (Appendix D).

6.4.3.4.3 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 Technical Rules](#).

The proportion of impervious surfaces within the Sunderland WHPA was determined in accordance with the methodology in Technical Memorandum A3, WSP, 2022 (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.4.3.4). The impervious surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 6b-11 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Sunderland Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D and greater than 4 for WHPA-E.

6.5 Uxbridge Well Supply

The Uxbridge Urban Area (Uxbridge) is located approximately 25 kilometres (km) south of Lake Simcoe and 32 km north of Lake Ontario in the Township of Uxbridge. The Uxbridge Well Supply serves a population of approximately 10,220 people in the Uxbridge community and consists of three water supply wells: MW5, MW6 and MW7. Raw water is pumped from two (2) municipal wells (MW5 and MW6). A third new well (MW7) is not connected to the system yet, but it is already included in the Drinking Water Permit and the Permit To Take Water (PTTW). Each of the two wells is located inside a well house where sodium hypochloride is added to provide disinfection at each well house. Sodium silicate is also added to the water for iron sequestering.

Treated water is pumped from the well houses to the distribution system. The Quaker Hill Reservoir and Pumping Station provide the storage requirements for the system and boosts pressure for a local area. The underground reservoir has a total capacity of 2,941 cubic metres. The booster station has four high lift in-line centrifugal pumps, a sodium hypochloride disinfection system to boost the residual in the system, and a free chlorine residual analyzer. The distribution system delivers the treated water through approximately 60.2 km of watermains in the two pressure zones.

The Uxbridge Water Supply System (WSS) operates under the following Permits:

- Municipal Drinking Water Licence Number - 003-105
- Drinking Water Works Number – 003 - 205
- Permit To Take Water - PTTW #3588-6TKLAA
- Drinking Water System Number - 22000763

The locations of the municipal wells in Uxbridge are shown in Figure 6c-1.

The municipal wells are screened in the sand and gravel aquifer with the top of the screen set at an elevation 201 metres Above Sea Level (ASL) for wells MW5 and MW7 and 220 m ASL for MW6. Well MW5 is 76.5 m, MW7 is 66.5 m, and MW6 is 58.2 m deep.

The aquifer in Uxbridge is partially connected to the Oak Ridges Moraine (ORM) Aquifer Complex where recharge predominantly occurs in the upland areas of the moraine. Municipal wells MW5 and MW7 obtain their water supply from a deep semi-confined leaky aquifer system referred to as the Thorncliffe Aquifer Complex (TAC). It is interpreted that a tunnel channel breached the Newmarket Till near MW5 and MW7 and this channel appears to connect the TAC with the intermediate and shallow aquifers, as identified through the response to pumping activity at various monitoring well locations.

Municipal well MW6 is also located in the TAC; however, in this location the aquifer is confined by Newmarket Till suggesting that the tunnel channel is not present. The hydraulic vertical gradient near MW6 is upwards and wells in the vicinity of MW6 are flowing.

The regional direction of groundwater movement in the aquifer is to the north, towards Lake Simcoe. In the vicinity of municipal wells MW5 and MW7, groundwater moves in a north-northwest direction. In the vicinity of the well MW6, the direction of groundwater movement is to the north-northeast. The wellhead protection areas (WHPAs) reflect the direction of local groundwater flow towards the municipal supply wells.

Previous municipally funded groundwater studies (2003) delineated WHPAs for MW5 and MW6 using a numerical model and created a Land Use Inventory in accordance with previous Provincial guidance. In this study, the WHPA for the new municipal well MW7 was delineated utilizing the existing 2003 model. Over recent years, a series of monitoring and sentry wells were installed to provide additional hydrogeological data and baseline water quality data for the Uxbridge WSS.

Uxbridge WHPA delineation, supply Vulnerability and Threats Assessment was completed by AECOM Limited, and provided as a series of Technical Memorandums (AECOM, 2009a-e) to the Regional Municipality of Durham. The Regional Municipality of Durham has combined these memorandums into a single technical report (Durham Region, 2010a).

6.5.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats 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 man-made (anthropogenic) structures, 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 Threat could affect the drinking water supply. 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 Uxbridge water supply has been delineated following the process recommended in the Technical Rules. The areas determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-

made structures that may increase Vulnerability. The WHPA and the Vulnerability were considered together, as per the Technical Rules, to determine a Vulnerability Score for the Uxbridge WSS. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 - "Groundwater Vulnerability Assessment Methods" (Appendix MO) and details of the delineation of WHPA for MW7 is provided in AECOM Technical Memorandum (2009a) - "Groundwater Modeling and WHPA Delineation - Uxbridge Water Supply System" (Appendix D).

Work performed to assess the Groundwater Vulnerability for the Uxbridge WSS is provided in AECOM Technical Memorandum (2009b) - "Groundwater Vulnerability Assessment - Township of Uxbridge, Uxbridge Urban Area" (Appendix D).

6.5.1.1 Well Head Protection Area (WHPA) Delineation

The WHPAs for the Uxbridge Municipal Water Supply wells, as delineated by Gartner Lee Limited (presently AECOM) in 2008, are shown in Figure 6c-1 and include the new WHPA delineated for well MW7. WHPA-A has been added to include the 100 m radius from each municipal well.

The WHPAs were delineated using the existing 3-dimensional numerical groundwater flow model developed in 2003 for delineation of wells MW5 and MW6. The permitted pumping rates from PTTW #3588-6TKLAA included the limitation to pump three (3) wells at a rate not exceeding 8,251 cubic metres. The results of WHPA delineation for MW7 is documented in the AECOM Technical Memorandum (2009a) - "WHPA Delineation - Uxbridge Water Supply System" (Appendix D).

The delineated WHPAs for Uxbridge WSS reflect the regional groundwater flow direction from south to north within the Lake Simcoe watershed and the watershed of the Uxbridge Brook and its tributaries.

6.5.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the three municipal wells in Uxbridge is shown in Figure 6c-2. The Groundwater Vulnerability has been determined consistently across Durham based on an analysis of various Aquifer Vulnerability Index (AVI) approaches documented in GENIVAR Technical Memorandum A1 - "Groundwater Vulnerability Assessment Methods" (Appendix MO) and by AECOM for the Uxbridge WSS, as documented in AECOM Technical Memorandum (2009b) - "Groundwater Vulnerability - Uxbridge Urban Area" (Appendix D). Uxbridge Groundwater Vulnerability is typically considered to be Low in the areas near the municipal wells because the municipal wells are relatively deep and the overburden above the aquifer is known to be relatively thick.

6.5.1.3 Transport Pathway Increase

In order to keep a consistent approach to assess Drinking Water Threats, AECOM and GENIVAR have used the same methodology for the consideration of Transport Pathways which is outlined in GENIVAR Technical Memorandum A2 – “Vulnerability Increase – Transport Pathway” (Appendix MO) and AECOM Technical Memorandum (2009b) – “Groundwater Vulnerability” - Uxbridge Water Supply (Appendix D). This method follows the Ministry of Environment, [Conservation and Parks \(MOEMEC\)](#) Technical Rules. The Vulnerability Rating can increase from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed Vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells. A potential Vulnerability increase is reasonable for areas within the WHPA where wells are known to intersect the water supply aquifers.

In this study, AECOM considered Transport Pathways based on [MOEMEC](#) well records within WHPAs for the Uxbridge WSS, including active municipal wells for Uxbridge. These well records were plotted based on coordinates provided from WWIS database and corrected by the Oak Ridges Moraine Conservation Coalition and York Peel Durham Toronto Groundwater Study Team. However, based on local knowledge, Durham staff have reviewed individual [MOEMEC](#) well records within the WHPA and concluded that four (4) of the six (6) identified Transport Pathways within WHPA for MW6 have wrong coordinates, were plotted in the wrong locations, and are actually outside of the WHPA.

In addition, Durham asked to remove any municipal active well, including monitoring or sentry wells because all municipal wells must meet Ontario Regulation 903 under the Ontario Water Resources Act; Durham’s operators are checking the condition of these wells regularly; Durham repairs any deficiencies in any of the wells; and finally they are inspected on a regular basis by [MOEMEC](#) inspectors. For these reasons, the active municipal wells are very unlikely to be a transport pathway.

The Groundwater Vulnerability for the 30 m radius around each well identified as a potential pathway has been increased by one step from “Medium” to “High” (MW5 & MW7 and MW6) or from “Low” to “Medium” (MW6). Mapping of the transport pathways and increased vulnerability were presented in the technical study presented by GENIVAR (2010). Ultimately the locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 6.5.1.5).

6.5.1.4 WHPA-E ~~/WHPA-F~~

None of the wells in this study have been identified as Groundwater Under the Direct Influence (GUDI) of Surface Water, 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.~~

6.5.1.5 Vulnerability Score

The WHPA zones for the Uxbridge WSS, as shown in Figure 6c-1, Groundwater Vulnerability, as shown in Figure 6c-2, and increases due to Transport Pathways were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 6c-3 illustrates the Vulnerability Scores for the Uxbridge WSS. Figure 6c-3 was used to assess Drinking Water Threats in Section 6.5.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPA.

6.5.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both AECOM 2009b and independent peer review. 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 AECOM 2009b.

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 Uxbridge WHPAs is High. The full results of the WHPA delineation Peer Review process for Uxbridge is available in Appendix D and discussed in Chapter 5 (Methods Overview). Based on the rationale provided for the Vulnerability Assessment (see below), AECOM 2009b, 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 uncertainty associated with the Vulnerability Assessment was evaluated using a qualitative process outlined in AECOM, 2009b. The Uncertainty Assessment methodology considers the

type, quantity, and quality of available data, the methods used to determine the Vulnerability Assessment components, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Uxbridge WSS Vulnerability Assessment is Low. In this case, the Uncertainty Rating reflects the amount of information available or the effort undertaken to assess the Groundwater Vulnerability. A Low Uncertainty Rating corresponds to a relatively high degree of confidence that the Vulnerability Assessment for the water supply wells reflects the conditions that dictate the Vulnerability of the municipal wells to contamination from activities at the surface.

6.5.2 Drinking Water Issues

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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 (1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Uxbridge municipal water supplies has been reviewed by AECOM to identify Drinking Water Issues that are considered likely to deteriorate the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Uxbridge WSS are provided in AECOM Technical Memorandum (2009c) – “Evaluation of Drinking Water Issues – Uxbridge Urban Water Supply” (Appendix D).

No Drinking Water Issues were identified for the Uxbridge Water Supply System.

6.5.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Uxbridge WSS was completed as described in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix MO) and in details in Technical Memorandum M5 – “Drinking water Quality Threats Assessment – Uxbridge Urban Area Water Supply” (Appendix MO). 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 Uxbridge Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the following nine steps:

- Step 1: Identify Activities and Conditions
- Step 2: Identify Areas and Circumstances of Significant, Moderate, and Low Drinking Water Quality Threats
- Step 3: Assign Vulnerability Scores to Parcels
- Step 4: Identify Parcels for Analysis
- Step 5: Identify Parcel Land Uses
- Step 6: Assign Potential Drinking Water Quality Threats to Land Uses
- Step 7: Determine Potential Circumstances Present
- Step 8: Assess Potential Drinking Water Quality Threats
- Step 9: Enumerate Locations with Significant Potential Drinking Water Quality Threats

6.5.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Uxbridge Drinking Water Supply 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.

6.5.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Uxbridge WSS:

- Files provided by the [MOEMEC](#) local offices pertaining to licenses and records of spills in the area of the delineated WHPA.
- Records available from the [MOEMEC](#) website containing the Registry of Brownfield Sites.

- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Durham staff to identify potential Conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Uxbridge WSS. No potential Conditions have been identified for consideration at this time.

6.5.3.3 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 Technical Rules](#) threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The [circumstance table](#) can be found at: <https://threats.swpip.ca/>. <https://swpip.ca/>

6.5.3.3.1 Pathogen Parameters

~~The Key Table on~~ Figure 6c-4 can be used in conjunction with the [Technical Rules and 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 Uxbridge WSS. 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 a significant, moderate, or low threat within WHPA-A and WHPA-B only.

6.5.3.3.2 Chemical Parameters

~~The Key Table on~~ Figure 6c-5 can be used in conjunction with the [Technical Rules and 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 Uxbridge WSS. 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.

6.5.3.3.3 DNAPL Chemical Parameters

Figure 6c-6 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 Uxbridge WSS. The ~~Key Table on Figure 6c-6~~ [Technical Rules](#) can be used to identify the circumstances in which these activities associated with DNAPL threats would be Significant or Moderate Threats.

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

Further to Section 6.5.3.2, no Conditions have been confirmed within the WHPA for the Uxbridge WSS.

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 A5 (Appendix MO). 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.

Figure 6c-3 illustrates the Vulnerability Score map for Uxbridge WSS that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

6.5.3.5 Enumerating Drinking Water Threats

6.5.3.5

The number of Significant Drinking Water Threats for the Uxbridge WSS has been determined following the methodology outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D) and described in detail for the Uxbridge WSS in AECOM Technical Memorandum (2009e) – “Uxbridge Urban Area” (Appendix D). The number of Significant Drinking Water Threats has also been refined by Region of Durham municipal staff members.

Table 6-7 and Table 6-8 document the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPAs for the Uxbridge WSS.

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Six (6) land parcels have been identified within the WHPA for MW5 and MW7 as having six (6) activities that are potential Significant Drinking Water Threats. Nine (9) activities that are potential significant threats were identified in association with four (4) land parcels in the WHPA for MW6.

Four (4) parcels within the WHPA for MW5 and MW7 and three (3) parcels within the WHPA for MW6 were identified as having potential for handling and storage of DNAPLs. One (1) of these was also identified as having the potential for the handling and storage of organic solvents. Three parcels were identified with five (5) activities relating to the handling and storage of fuel. Several DNAPL threats associated with single family detached homes were assigned based on questionnaire results completed by the land owners in 2006. As part of the confirmation phase of the Threats Assessment, these parties should be engaged to ensure that they have an understanding of DNAPLs and to determine if they are currently used on the identified properties for purposes other than occasional personal use.

One (1) threat circumstance has been enumerated to address the potential presence of municipal sanitary sewers within the delineated WHPA with a Vulnerability Score of 10 for MW5 and MW7, and for MW6. This circumstance is associated with one property, the municipal road allowance, per WHPA and is included in the count described above.

Table 6-76-7: Number of Significant Drinking Water Threats for the Uxbridge WSS (MW 5&7).

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	29
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	1
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0

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Threat Number	Threat	Significant threat counts Number of threats
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	1
16.	The handling and storage of dense non-aqueous phase liquid.	4
17.	The handling and storage of an organic solvent.	0
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0

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Threat Number	Threat	Significant threat counts Number of threats
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
<u>22.</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals:	96 significant threats (on 9 properties)

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Table 6-86-8: Number of Significant Drinking Water Threats for the Uxbridge WSS (MW6).

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	0
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	1
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0

Threat Number	Threat	Significant threat counts Number of threats
15.	The handling and storage of fuel.	3
16.	The handling and storage of dense non-aqueous phase liquid.	4
17.	The handling and storage of an organic solvent.	1
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
<u>22.</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals:	9 significant threats (on 4 properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

6.5.3.5.1 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](#)[Technical Rules](#).

Managed Lands are used in the identification of Threats and Activities associated with the application of Agriculture Source Material, Non-Agriculture Source Material, and Commercial Fertilizer as outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.5.3.5). This analysis indicates that Managed Lands within the WHPAs for Uxbridge WSS are between 40-80% and do not impact the enumeration of Significant Drinking Water Threats for the Uxbridge WSS.

Figure 6c-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Uxbridge WSS.

6.5.3.5.2 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](#)[Technical Rules](#).

Livestock Density is used to identify Threats and Activities associated with the storage of Agriculture Source Material and the grazing and/or confinement of livestock. A Livestock Density analysis was not completed for Uxbridge WSS WHPAs as there was no evidence indicating the presence of livestock (Figure 6c-8).

6.5.3.5.3 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](#)[Technical Rules](#).

The Total Impervious Surface Area is used to identify threats and activities associated with the application of winter de-icing agents (salt) as outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D). [Methodology in](#)

Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.5.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

~~The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.5.3.5). The results from this analysis indicate that Impervious Surfaces for the Uxbridge WSS vary from less than 1% to 1%-8%. This analysis did not impact the enumeration of Significant Drinking Water Threats for the Uxbridge WSS.~~

Figure 6c-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Uxbridge WSS.

6.6 Beaverton Water Treatment Plant

The Beaverton Water Treatment Plant (WTP), identified as DWIS #220004929, is located on the east shore of Lake Simcoe in the community of Beaverton, in the Township of Brock. The treatment plant has a maximum capacity of 7.3 ML/day and services the community of Beaverton, which has approximately 3,800 residents (Regional Municipality of Durham, 2006).

Construction of the Beaverton Water Treatment Plant and associated intake pipe was completed in 1980. The WTP uses the following unit processes and systems: zebra mussel control, screening, pre-chlorination, low lift pumping, coagulation, flocculation, direct filtration, UV disinfection, post chlorination, and high lift pumping (Regional Municipality of Durham, 2006). The two filters are dual media type with hydraulic scour backwash using Granular Activated Carbon (GAC) for taste and odour control (Regional Municipality of Durham, 2006). The treatment process is monitored with an on-line Supervisory Control And Data Acquisition (SCADA) system.

The intake consists of 986 m of 500 mm diameter polyethylene pipe extending from the shoreline and terminating at the inlet structure. Since the pipe is not aligned perpendicular to the shoreline, but at an angle of approximately 25 degrees counter clockwise from perpendicular, the intake is located approximately 570 m from shore. While there are some minor discrepancies in the reported depth of the intake it was assumed to be in a total water depth of 5.0 m for this study.

Based on the interview with the representative of the Beaverton WTP conducted by personnel from LSRCA on Aug 28, 2006, the WTP can be shut down within 1 hour and 15 minutes upon notification. This estimate includes response travel time.

IPZ delineation and Vulnerability presented in this section is based on Baird (2010a) while the Issues and Threats Assessment is based on Genivar, 2010a report.

6.6.1 Methods and Uncertainties

6.6.1.1 Surface Water Vulnerability

The following section describes the methods used to assess Vulnerability of the Beaverton Water Treatment Plant. Intake Protection Zones and Vulnerability Scores for the Beaverton WTP were delineated by Baird and Associates (Baird, 2010a). The Beaverton intake is classified as a Type-D surface water intake (Rule 55; MOE, 2008a). For Type-D intakes, three zones are to be delineated: the IPZ-1 is based on a fixed radius around the intake crib; the IPZ-2 acts as a secondary protection zone around the IPZ-1; and the IPZ-3 is considered an additional protection zone. For the purposes of delineating the IPZ-3, the Lake Simcoe intakes are also

identified as a special case (Rule 68) and those rules applicable to Type-A and Type-B intakes also apply in this regard.

6.6.1.2 Delineating IPZ-1 and IPZ-2

IPZ-1 was delineated according to the Technical Rules and as outlined in Chapter 5. The IPZ-1 was based on the 1km radius and the 120 m setback from the shoreline and was prepared using GIS.

The IPZ-2 is defined based on the area that may contribute water to the intake where the time of travel to the intake is equal to or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water (Rule 65; MOE, 2008a). The two-hour minimum response time was used for the Beaverton WTP, as the operator response time to shut-down the intake was within 1 hour and 15 minutes of receiving notification.

The IPZ-2 is comprised of four areas:

1. In-lake IPZ-2: the area within each surface water body and an extension up tributaries flowing into the IPZ-2;
2. Up-tributary: IPZ-2 is extended up tributary to the 2-hour time-of-travel limit;
3. Inland setback: Greater of either the 120 m setback inland along the abutted land or the regulation limit;
4. Transport Pathways: an extension to include areas that contribute water to the IPZ-2 through a Transport Pathway.

6.6.1.2.1 In-lake IPZ-2 Delineation

The approach used in this study was to define the in-water IPZ-2 based on the currents predicted by the MIKE3 hydrodynamic model as described in Baird (2010a). The Lake Simcoe model is based on the original model developed for the Assimilative Capacity Studies as described in Baird (2006). This previous work demonstrated that the MIKE3 model could successfully simulate both wind driven currents and thermocline development in Lake Simcoe.

For delineating the IPZ-2, currents were developed for 10 year return period wind events, for eight wind directions, run at 45° intervals (Appendix D – Table 2.2, Baird 2010a). For each wind condition, the model was run with a constant wind applied to the surface of the lake until the currents in the lake were fully developed. Reverse particle tracking was used to track the paths that the currents would have transported neutrally buoyant particles to the intake over a 2 hour period. Although the intakes are located near the lakebed, particles were introduced at

the surface and near the lakebed. The particles released at both depths were considered in delineating the IPZ-2, as this is a more conservative approach. The impact of the water withdrawn by the intake on the local currents was also investigated, with the model indicating that the intake only significantly influences the currents within a 2 m to 5 m radius of the intake.

Currents inshore of the breaker or surf zone are complex and are not well defined by existing numerical models. Comparison of the intake depth with the depth at the estimated lakeward limit of the surf zone suggests that the Beaverton intake is located inside the surf zone, where wave-induced currents and the associated mass transport and mixing are more likely to affect the IPZ-2 delineation. However, it is recognized that there is potential for currents in the surf zone to transport a contaminant in an offshore direction from the shoreline. The significance of this increases for intakes located in high wave energy environments and for intakes located within the surf zone. A preliminary assessment of the location of the surf zone was undertaken by Baird (2010a). The assumption is that mixing processes inside the surf zone could transport a contaminant to the offshore limit of the surf zone. Estimated depth at offshore limit of surf zones is presented in Appendix D – Table 5.1, Baird 2010a.

6.6.1.2.2 Up Tributary

The upstream limit of the IPZ-2 was calculated as (2 hours minus the travel time from the intake to tributary mouth) multiplied by the tributary velocity. Tributary velocity was based on velocity at bank full stage as per the MOE (2006a) recommendation and it was assumed that bank full flow is equivalent to the 2 year return period event.

There are a number of tributaries located within the IPZ-2 for the Beaverton WTP intake with velocities ranging from 0.10 m/s to 1.34 m/s (Appendix D – Baird, 2010a). Tributary velocities provided by the LSRCA were used where available. Alternatively, the velocity was estimated from bank full discharge divided by the approximate area of the cross-section at the mouth of the tributary.

6.6.1.2.3 Inland Setback

Where the IPZ-2 abuts land, it includes the greater of either (1) a setback of not more than 120 m inland along the abutted land measured from the high water mark of the surface water body; or (2) the area of land within the Conservation Authority Regulation Limit along the abutted land (Rule 65; MOE, 2008a). The Regulation Limit for Lake Simcoe was provided by LSRCA, and is the April 24, 2009 Board of Directors approved version.

The shorelines of Lake Simcoe were used in lieu of the high water mark (HWM). The shoreline was developed by digitizing the lake boundary from the 2002 colour 20 cm orthorectified aerial photography.

It must be noted however that the definition of HWM used in this assessment differs to that provided by the MOE. MOE, 2009b, defines the HWM for water bodies where a long term water level record exists as the 80th percentile for the month within which the highest water level occurs, or where a long term record of water levels does not exist as the level at which flood plains are flooded and leave a mark where natural vegetation changes from predominantly aquatic vegetation to terrestrial vegetation. The HWM is defined by LSRCA in terms of fish habitat, as the average annual high water which is 219.15 m above sea level (m ASL). A review of the shoreline used to define the HWM for the IPZ delineation and the HWM provided by LSRCA (219.15 masl) was completed in the Baird (2010d) report which is located in Appendix D. The review found the two shorelines to be comparable.

6.6.1.2.4 Transport Pathways

The IPZ-2s were modified to include potential Transport Pathways based on Rules 72 to 74. A complete description of the methodology, analysis, and Transport Pathway delineation is provided in Baird 2010a.

Data were acquired by LSRCA from field surveys, in-house development, and from participating municipalities. Datasets included (but were not limited to) Storm sewersheds; Storm water pond locations; Sewershed outfall locations, diameters, flows and velocities; Ditch locations and cross-sections; Rural drainage networks; Impervious areas; Subsurface tile drains; Watercourse engineered and modeled cross-sections; Soils and land use data; and Ortho-imagery.

The sewersheds discharging into the IPZ-2 were identified from LSRCA and municipal storm water network datasets. Residence time and the velocity were then used to estimate a maximum within-sewershed travel distance. A summary of travel distance calculations for Beaverton can be found in Baird 2010a. In all sewersheds, the travel distance was greater than the assumed longest flow path in the sewershed, so the entire sewershed was included in the revised IPZ-2.

Near the Beaverton shoreline is a sewage treatment plant (STP) that was considered for possible inclusion in the IPZ-2. From the orthophotos, a storm water pond can be seen adjacent to the building grounds. Through personal communication with an Operations Technician at the Municipality, the technician indicated the storm water pond drains the surface runoff from the paved area of the plant. The building grounds do not need to be included in the IPZ-2, since

areas drained by a storm water pond are considered discontinuous from the watercourse. It was assumed that stormwater ponds are designed to hold approximately the 2-year rain event, and that they would not overflow for the 2-year tributary flow (which is used to delineate the IPZ-2). The sewage lagoons at the STP, however, were considered to be part of the IPZ-2. It is assumed that the treated wastewater is discharged through the gravity sewer infrastructure and outfall as provided by the Municipality. The outfall is located in the lake, within the IPZ-2. Therefore, a potential contaminant residing in the sewage ponds has the capacity to be discharged into the lake within the IPZ-2. Operation procedures at the STP including residence times in the lagoons were not considered.

6.6.1.3 Delineating IPZ-3

The MIKE3 model was used to delineate the area within the surface water body through which contaminants released during an extreme event could be transported to the intake. An extreme event is defined in MOE (2008a) as: a period of heavy precipitation or winds up to a 100 year storm event; a freshet; or a surface water body exceeding its high water mark.

Three events were initially selected for modeling: a 100 year return period wind event with average flows in tributaries; a 10 year return period wind event with 2 year return period non-freshet flows; and a 2 year return period freshet with average winds.

Preliminary test runs with the MIKE3 model showed that the effects of the tributary flows on currents within the lake were very localized (limited to close proximity to the mouth of the tributary). Desktop calculations showed that for the tributaries in the Lake Simcoe watershed, a contaminant could be transported from the headwaters to Lake Simcoe during a freshet or extreme non-freshet flow event. Evaluating the spatial distribution of potential transport within the lake therefore became the focus of the modeling investigations. The details of these investigations can be found in Baird, 2010a.

The modeling demonstrates that a contaminant could reach an intake from anywhere in Lake Simcoe, during extreme events. The size and irregular shape of the lake, with two large bays (Cook's Bay and Kempenfelt Bay) means that movement of the contaminant across the lake, behind islands, and in and out of bays is highly dependent on the directionality of the wind. To complicate matters further, there are eight intakes in Lake Simcoe, and there is substantial overlapping of the IPZ-3s. Based on discussions with LSRCA and MOE, it was agreed that the modeling supports the original direction in MOE (2006a), to extend the IPZ-3 to the watershed limits. Additional site specific contaminant modeling will be undertaken in the next phase. It will consider specific threats to determine whether or not a contaminant could reach the intake

that is of sufficient concentration to compromise the drinking water at the intake (MOE, 2008a; Rule 130).

The IPZ-3 sub-areas, used to define areas with varying Vulnerability Scores, were delineated based on the sub-watershed boundaries. The Lake Simcoe water body was also delineated as one sub-area. Although Lake Simcoe generally flows into Lake Couchiching through Atherley Narrows, data showed that reverse flow does occur, with water flowing from Lake Couchiching into Lake Simcoe. The Lake Couchiching water body and watershed were therefore included as IPZ-3 sub-areas. The IPZ-3 was extended up tributaries from the lake, to the watershed limit. A setback of 120 m was applied on Lake Couchiching (as there is no Regulation Limit) and the Regulation limit was used to define the setback within the Lake Simcoe watershed.

6.6.1.4 IPZ Vulnerability Scores

The Vulnerability Score ranks the relative Vulnerability of the intake to contaminants. The Vulnerability Score is based on the Area Vulnerability Factor and the Source Vulnerability Factor using the formula below:

$$B \times C$$

where,

B = the Area Vulnerability Factor of the area of the IPZ

C = the Source Vulnerability Factor of the surface water of the IPZ

The range of possible Vulnerability Scores can be found in Table 5-5, Section 5.3.2 of Chapter 5: Methods Overview.

6.6.1.4.1 Area Vulnerability Factor

Each of the Intake Protection Zones is assigned an Area Vulnerability Factor (B) with the IPZs closest to the intake having the highest factor.

For IPZ-1s, the Area Vulnerability Factor is assigned a value of 10 due to its close proximity to the intake (Rule 88; MOE, 2008a).

For the IPZ-2, a 'base' Area Vulnerability Factor of 8 (the median factor for an IPZ-2) was initially assigned, and then altered by four modifier scores based factors such as land cover, hydrology, slope and the characteristics of the subwatershed that the IPZ-2 is located in (the four potential modifiers can be found in Baird, 2010a).

The IPZ-2 base Area Vulnerability Factor, modifiers and final Area Vulnerability Factor for the Beaverton WTP intake are listed in Table 6-9. Although the calculated Area Vulnerability Factor

for the IPZ-2 was 6, it was adjusted to a value of 7, which is the minimum allowable value based on MOE (2008a).

Table 6-96-9: Derivation of IPZ-2 Area Vulnerability Factor (B) for Beaverton WTP Intake.

Intake	Sub-watershed Closest to Intake	Base Area Vuln. Factor	IPZ-2 Land % Modifier ¹	Drainage Density Modifier ¹	SCS Curve Number Modifier	Land Use Modifier	Relief/Length Ratio Modifier	IPZ-2 Final Area Vuln. Factor (B)
Beaverton	Beaver River	8	-1	0	-1	0	0	7

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¹ The IPZ-2 Land Modifier and Drainage Density Modifier both reflect the ratio of water to land. The sum of these two modifiers cannot change the Area Vulnerability Factor by more than +/- 1.

SCS – Soil Conservation Service

The Area Vulnerability Factors for the IPZ-3 sub-areas were determined, using the same methodology as IPZ-2, with some minor additions. IPZ-3 sub-areas were defined as the sub-watersheds within the Lake Simcoe watershed and Lake Couchiching subwatershed. The Lake Simcoe and Lake Couchiching water bodies were also defined as IPZ-3 sub-areas. As stated previously, the Area Vulnerability Factors that are assigned to the IPZ-3 sub-areas cannot be greater than the Area Vulnerability Factor assigned to the IPZ-2 (Rule 91; MOE, 2008a). The methodology can be found in Baird, 2010a.

The IPZ-3 sub-area base Area Vulnerability Factors, modifiers and final Area Vulnerability Factors for the Beaverton WTP are listed in Table 6-10.

Table 6-106-10: Derivation of IPZ-3 Area Vulnerability Factors for Beaverton WTP Intake.

IPZ-3 Sub-areas	Base Area Vuln. Factor	Distance Modifier ¹	Drainage Density Modifier ²	SCS Curve Number Modifier ³	Land Use Modifier ⁴	Relief-Length Modifier ⁵	Final Area Vuln. Factor (B) ⁶
Lake Simcoe waterbody (incl. islands)	6	0	-	-	-	-	6
Lake Couchiching waterbody (incl. islands)	6	0	-	-	-	-	6
Beaver River subwatershed	6	0	0	-1	0	0	5

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IPZ-3 Sub-areas	Base Area Vuln. Factor	Distance Modifier ¹	Drainage Density Modifier ²	SCS Curve Number Modifier ³	Land Use Modifier ⁴	Relief-Length Modifier ⁵	Final Area Vuln. Factor (B) ⁶
Whites Creek subwatershed	6	0	0	0	0	0	6
Upper + Lower Talbot River subwatershed	6	-1	0	-1	0	-1	3
Pefferlaw Brook + Uxbridge Brook subwatershed	6	-1	0	0	-1	0	4
Ramara Creeks subwatershed	6	-2	0	0	0	0	4
Black River subwatershed	6	-2	0	0	-1	0	3
Hawkestone Creek subwatershed	6	-2	0	-1	0	1	4
Georgina Creeks subwatershed	6	-2	-1	1	0	0	4
Oro North Creeks subwatershed	6	-3	0	0	1	1	5
Lake Couchiching subwatershed	6	-3	-1	0	0	0	2
Oro South Creeks subwatershed	6	-3	0	0	0	0	3
Innisfil Creeks subwatershed	6	-3	0	0	0	0	3
Hewitts Creek subwatershed	6	-3	0	0	0	0	3
Lovers Creek subwatershed	6	-3	0	0	0	0	3
Maskinonge subwatershed	6	-3	0	1	0	0	4

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IPZ-3 Sub-areas	Base Area Vuln. Factor	Distance Modifier ¹	Drainage Density Modifier ²	SCS Curve Number Modifier ³	Land Use Modifier ⁴	Relief-Length Modifier ⁵	Final Area Vuln. Factor (B) ⁶
West Holland subwatershed	6	-4	1	0	0	0	3
Barrie Creeks subwatershed	6	-4	0	0	1	1	4
East Holland subwatershed	6	-4	1	0	1	0	4

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¹ If waterbody area or nearest subwatershed, Modifier = 0. If further subwatershed, Modifier: Within: <-1 S.D. of mean = -1, >-1 S.D. and mean = -2, mean and <+1 S.D. = -3, >+1 S.D. = -4.

² Drainage density = (Total Length of Streams)/(Subwatershed Area). Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

³ Adjusted SCS Curve Number. Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1. Lake Couchiching CN is average of all other subwatersheds since no data was available.

⁴ Land use: Natural/Forested = -1: Agricultural = 0: Urban/Developed = +1, coarsely interpreted from 1999 LandSat Imagery

⁵ Relief-Length Ratio = (Relief)/(Subwatershed Length). Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

⁶ Final Area Vulnerability Factor plus/minus all modifiers

6.6.1.4.2 Source Vulnerability Factor

A Source Vulnerability Factor is assigned to each surface water intake (Rule 94; MOE, 2008a). Source Vulnerability for intakes within the SGBLS Source Protection Region was based on that developed by the Michigan Department of Environmental Quality (MDEQ). The first three rows in Table 6-11 were taken directly from MDEQ (2004), while the fourth row lists the corresponding Vulnerability Factor assigned for the Beaverton WTP.

Table 6--116-11: Intake Vulnerability Criteria based on Intake Distance from Shore and Depth (adapted from MDEQ, 2004).

Category ¹	Nearshore- Shallow Water	Nearshore- Deep Water	Offshore- Shallow Water	Offshore-Deep Water
Parameters ¹	<350 m offshore <6 m depth	<350 m offshore >6 m depth	>350 m offshore <6 m depth	>350 m offshore >6 m depth
Vulnerability ¹ (MDEQ)	High	High to Moderate	High to Moderate	Moderate
Recommended Source Vulnerability Factor based on Intake Offset and Depth	1.0	0.9	0.9	0.8

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¹Category, parameters and vulnerability based on MDEQ (2004).

None of the water treatment plant operators interviewed by LSRCA for this study reported a plant shut down due to water quality issues. Similarly, the Issues Evaluation (below) did not identify any Issues for this intake. As no Water Quality Issues were identified the Source vulnerability Score was based on the water depth and distance offshore only. The Durham Region - Beaverton WTP intake is located 570 m from shore at a water depth of 5.0 m. A Source Vulnerability Factor (C) of 0.9 was therefore assigned, based on the values presented in Table 6-11 (MDEQ, 2004).

6.6.1.5 Uncertainty Assessment

This section summarizes some of the uncertainty identified by Baird (2010a) when delineating IPZs and the assigning Vulnerability Scores; the entire discussion of uncertainties is presented in Baird 2010a, Appendix D. This assessment was used by Baird (2010a) to assign Uncertainty Ratings of either “High” or “Low” for the IPZ and Vulnerability Scores.

6.6.1.5.1 Data Quality and Gaps:

Data gaps and data quality issues identified during the study included: bathymetry and shoreline delineation data sets that may be out of date or too low resolution; wind data from a single location (Lagoon City Buoy) being applied to the entire lake; tributary flow data being limited to the major tributaries; lower level of confidence in the calibration for the Lake Couchiching model, due to the limited measured current data used in the model calibration;

and the limited availability of raw water quality data. A complete list of data quality and gaps listed in Baird 2010a, Appendix D.

6.6.1.5.2 Model Capabilities and Application

A model is a tool that is used to improve our understanding of the physical processes. It is important to understand the model limitations, as well as the limitations of the application, that is how the model was set up, the data was used as input to the model, the model runs undertaken, and the interpretation of the results. The limitations of the model used in this study include:

- The MIKE3 model does not consider waves and wave induced currents;
- Separate models for Lake Simcoe and Lake Couchiching means that flow through Atherley Narrows may not be accurately modeled since the Narrows are considered as an open boundary;
- Wind direction (45° intervals) and speed (10 year return periods) data that enables consistency between projects was used, but this does not capture actual shifts in wind speed and direction;
- Complex river networks and flow patterns at the north end of Lake Couchiching with limited gauge data and tributary cross-sections in this area;
- Flow velocities were estimated using either measured cross-section data from the mouth of the tributary or approximated cross-sections developed from the bathymetry field sheets for the lake. However, modeling indicated that the effect of tributary flow was localized, and did not significantly impact the in-lake IPZs
- Model application does not consider temperature induced density currents or lake stratification. Where the temperature of a tributary flowing into a lake differs from the lake temperature, there is potential for reduced travel times to the intake, as a result of density driven currents.

A complete list and description of model uncertainties is provided by Baird (2010a), Appendix D.

6.6.1.5.3 Quality Assurance/Quality Control

In completing this project, Baird followed their established *Project Quality Control Program (QCP)*, which includes: Preparation of the Project Control Plan (PCP); Identification of the Project Manager (PM), Project Team (PT), Quality Control Reviewers (QCRs) and Quality Assurance Manager (QAM); Schedule and Budget; Description of tasks, project phases and/or

deliverables to be reviewed; Identification of checklists to be utilized during reviews; Discussion of Quality Assurance procedures to be used during the project life cycle.

6.6.1.5.4 Extent and Level of Model Calibration/Validation

The MIKE3 model was calibrated with measured current data from two locations on Lake Simcoe, and one location in Lake Couchiching. It is important to note that the Acoustic Doppler Current Profiler (ADCP) data sets are of limited duration and spatial coverage. They did not include the extreme events that were modeled for the matrix runs. The level of calibration was based on the available data and in general, the models captured the trends in the surface currents. Based on the calibration undertaken, the model seemed to capture the general trends in current speed and direction.

6.6.1.5.5 Area and Source Vulnerability Factors

The factors considered in assigning the Area Vulnerability values include: the percentage of the area of the IPZ-2 or IPZ-3, as the case may be, that is composed of land; the land cover, soil type, permeability of the land and the slope of any setbacks; the hydrological and hydrogeological conditions in the area that contributes water to the area through Transport Pathways; and in respect of an IPZ-3, the proximity of the area of the IPZ-3 to the intake. The only subwatershed characteristic that is relatively uncertain is the SCS (Soil Conservation Service) Curve, with the uncertainty arising from the fact that the SCS Curve No. is based on many parameters including rainfall, land cover, soil permeability and slope. The parameters considered in assigning the Source Vulnerability Factors were the distance of the intake from shore and the depth of water that it is located in, and the history of water quality concerns. Genivar (2010a) did not report any water quality Issues in their Issues Evaluation report, however limited data were available for the analysis.

6.6.2 Results Beaverton Water Treatment Plant

6.6.2.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Lagoon City WTP are shown in Figure 6d-1. IPZ-1 consists of a 1 km radius centered at the entry point of raw water supply, extending 120 m inland for approximately 1.5 km along the shoreline. The IPZ-2 extends approximately 9 km along the Beaverton community shoreline, and for a short distance along Beaver River and Whites Creek. Transport Pathways, such as drains and ditches extend the IPZ-2 in various locations within the Beaverton community. The IPZ-3 for Beaverton WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 6d-2). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current

flow measurements show that reverse flows (i.e. from Lake Couchiching to Lake Simcoe) do occur.

6.6.2.2 Intake Protection Zone (IPZ) Vulnerability Scores

The Vulnerability Factors and Scores for the IPZ-1, IPZ-2 and IPZ-3 sub-areas are summarized below in Table 6-12 and Figure 6d-1 and Figure 6d-2.

Table 6-12: Summary of Vulnerability Factors and Scores for Beaverton WTP Intake.

IPZ	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	0.9	9
IPZ-2	7	0.9	6.3
IPZ-3 Sub-zones			
Lake Simcoe waterbody	6	0.9	5.4
Lake Couchiching waterbody	6	0.9	5.4
Beaver River subwatershed	5	0.9	4.5
Whites Creek subwatershed	6	0.9	5.4
Talbot River subwatershed	6	0.9	5.4
Pefferlaw Brook + Uxbridge Brook subwatershed	4	0.9	3.6
Ramara Creeks subwatershed	3	0.9	2.7
Black River subwatershed	3	0.9	2.7
Hawkestone Creek subwatershed	4	0.9	3.6
Georgina Creeks subwatershed	4	0.9	3.6
Oro North Creeks subwatershed	4	0.9	3.6
Lake Couchiching subwatershed	2	0.9	1.8
Oro South Creeks subwatershed	3	0.9	2.7
Innisfil Creeks subwatershed	3	0.9	2.7
Hewitts Creek subwatershed	3	0.9	2.7
Lovers Creek subwatershed	3	0.9	2.7
Maskinonge subwatershed	4	0.9	3.6
West Holland subwatershed	3	0.9	2.7
Barrie Creeks subwatershed	4	0.9	3.6

IPZ	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
East Holland subwatershed	4	0.9	3.6

6.6.2.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010a) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as Low and IPZ-2 and IPZ-3 as High. The Uncertainty Rating for the IPZ-1, -2 and -3 Vulnerability Scores are all High (Table 6-13).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 6.6.3), based on the data analyzed, limited data were available for the Issues Analysis, and the operator raised some concerns (Baird, 2010a) A High Uncertainty was therefore assigned to the Vulnerability Score for the IPZ-1.

The IPZ-2 delineation is based on current velocities in the vicinity of the intake. Based on the data, model, model application, and model calibration limitations presented in this section, a “High” rating of uncertainty is recommended. The High levels of Uncertainty are not a reflection of the quality of work, but recognition of the limitations presented. With respect to extension of the IPZ-2 up tributaries, the velocities in small tributaries, in many cases, were assumed, due to lack of data. Similarly, no fieldwork was undertaken to define the characteristics of Transport Pathways and there are significant data gaps. A High level of Uncertainty was therefore assigned to the IPZ-2 delineation. Vulnerability Scores for the IPZ-2 were assigned based on the Area and Source Vulnerability Factors. The Uncertainty Rating for the data used to define the Source Vulnerability Factor (offset from shore, depth and history of water quality concerns) is High as discussed for the IPZ-1. The level of Uncertainty for the Area Vulnerability for the IPZ-2 is also High due to the degree of uncertainty in the methodology used to develop the Area Vulnerability Factor. This in part stems from the fact that the Rules (MOE, 2009a) do not provide specific guidance.

Table 6-136-13: Summary of uncertainty Ratings for the Beaverton WTP Intake IPZs and Vulnerability Scores.

IPZ	Uncertainty for IPZ Delineation	Uncertainty for Vulnerability Scores
IPZ-1	Low	High
IPZ-2	High	High
IPZ-3	High	High

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Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if release of a chemical or pathogen would be transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate, and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

A High level of Uncertainty has also been assigned to the Vulnerability Scoring for the IPZ-3 subareas, for the reasons discussed with respect to the IPZ-1 and IPZ-2.

6.6.3 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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(1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Beaverton WTP has been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Beaverton are provided in Technical Memorandum C1 – Drinking Water Issues Evaluation– Beaverton (Appendix D).

No Drinking Water Issues were identified for the raw water quality supply to the Beaverton Water Treatment Plant

The occasional presence of *E.coli* and coliform bacteria in the surface water is not considered to be a Drinking Water Issue as these parameters are being treated effectively and in accordance with Safe Drinking Water Act regulations. Sodium concentrations are observed to be slightly increasing in Lake Simcoe but are not projected to exceed the ODWQS of 200 mg/L within 50 years. Trihalomethanes are present in treated water in trace concentrations as a by product of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and are not observed to be increasing.

6.6.4 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Community of Beaverton Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). 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 Beaverton Water Supply 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.

6.6.4.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Beaverton Drinking Water Supply 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.

6.6.4.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Beaverton Water Supply system:

- Files provided by the Ministry of the Environment, [Conservation and Parks](#) local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.
- Records available from the Ministry of the Environment, [Conservation and Parks](#) website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as Conditions.
- Interviews of Durham Region staff to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the Community of Beaverton water supply. No potential Conditions have been identified for consideration at this time.

6.6.4.3 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~~ [Technical Rules](#) threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The ~~circumstance~~ [table](https://threats.swpip.ca/) can be found at: <https://threats.swpip.ca/>. ~~https://swpip.ca/~~

6.6.4.3.1 Pathogen Parameters

~~The Key Table on~~ Figure 6d-3 can be used in conjunction with the [Technical Rules and](#) 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 Beaverton Water Supply. Activities that are or would be significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 9.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 6d-4).

6.6.4.3.2 Chemical Parameters

The ~~Key Table on~~ Figure 6d-5 can be used in conjunction with the Technical Rules and 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 Beaverton Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 9.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 6d-6).

6.6.4.4 Identifying areas of Significant/Moderate/Low Threats – Conditions

Further to Section 6.6.4.2, no Conditions have been confirmed within the WHPA for the Beaverton water supply.

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 A5 (Appendix MO). 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.

Figure 6d-1 and Figure 6d-2 illustrates the Vulnerability Score maps for the Beaverton WTP that can be used to determine where a Condition is or would be a Significant, Moderate, or Low Threat to Drinking Water.

6.6.4.5 Enumerating Drinking Water Threats

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The number of Significant Drinking Water Threats for the Beaverton Water Supplies has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no Significant Threats associated with Conditions or Drinking Water Issues.

No land use activities that would result in potential Significant Drinking Water Threats were identified for the Beaverton Water Supply.

6.6.4.6 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 IPZ-1, -2 and -3. 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~~ Technical Rules.

Managed Lands were identified and the Managed Lands proportions were determined for IPZ-1 and IPZ-2 for the water supply to the Beaverton WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.6.4.5). The Managed Lands are used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

Figure 6d-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Beaverton WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 6d-8.

6.6.4.7 Livestock Density

Technical Rule 16(10) (~~August 2009~~) requires the Assessment Report to include maps showing the livestock density within IPZ-1, -2 and -3. 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~~ Technical Rules.

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Beaverton WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.6.4.5). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 6d-9 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Beaverton Surface Water Supply. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 6d-10.

6.6.4.8 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 including IPZ-1, -2 and -3. 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 Technical Rules](#).

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Beaverton WTP was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). [Methodology in Technical Memorandum A5.1 \(Appendix MO\) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules](#). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.6.4.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 6d-11 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the Beaverton Surface Water Supply. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 6d-12.

6.7 Greenbank Drinking Water System

The Greenbank drinking water system is located within the Kawartha-Haliburton Source Protection Area in the Trent Conservation Coalition (TCC) Source Protection Region. The WHPAs of this system extend to the west and a small portion crosses the boundary of the South Georgian Bay-Lake Simcoe SPR. The work performed to assess the drinking water threats for the Greenbank drinking water system showed that there is no potential for drinking water threats within the portion of the WHPA that extends into the Lakes Simcoe and Couchiching-Black River Source Protection Area. This section provides a brief summary of the Vulnerability and Threats Assessment completed for the Greenbank system by Genivar, 2010b for the TCC Source Protection Committee.

The Hamlet of Greenbank is located approximately 6.5 km northwest of Lake Scugog, in the Township of Scugog. Greenbank is serviced by municipal water and individual private septic systems. The existing groundwater-based system consists of five active municipal wells designated as MW1, MW3, MW4, MW5, and MW6. The locations of the active wells in Greenbank are shown in Figure 6e-1. Raw water from each well is pumped into a central underground reservoir and pumphouse at the MW1 site. MW2 produced sand and is now in use as a monitoring well. Greenbank water supplies are operated under Permit To Take Water #1671-6MMNB6 which expires March 31, 2015 and serves approximately 560 residents.

The municipal supply aquifer is a discontinuous overburden aquifer consisting of silty sand to sand and gravel. It is confined by an overlying till aquitard. The confining layer is continuous across the WHPA and is overlain in places by an upper unconfined aquifer. This confining till aquitard is comprised of sandy-silt to silts and till and finer grained fractions of glacial lake deposits. The confining layer provides some protection to the underlying aquifers by minimizing the rate of vertical groundwater movement.

Groundwater within the confined municipal supply aquifer flows from the watershed boundary between the Kawartha Lakes and Lake Simcoe basins in the west toward Lake Scugog in the east. The Wellhead Protection Areas (WHPAs) reflect the direction of local groundwater flow towards the municipal supply wells.

6.7.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats 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 man-made (anthropogenic) structures, 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 Threat could affect the drinking water supply. 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 Community of Greenbank water supply has been delineated following the process recommended in the Technical Rules. The areas that were determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration for the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Community of Greenbank. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO) and details of the work performed to assess the Groundwater Vulnerability in Greenbank are provided in Technical Memorandum F1 – Groundwater Vulnerability Assessment - Greenbank- (Appendix D).

6.7.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Greenbank Municipal Water Supply wells, as delineated by Jagger Hims Limited in 2002, is shown in Figure 6e-1. WHPA-A has been added to include the 100 m radius from each municipal well. The WHPA were delineated using a 3-dimensional numerical groundwater flow model.

The delineated WHPAs for Greenbank reflect the groundwater flow direction from northwest to southeast. A discrete area is delineated for the 25 year TOT zone for the individual municipal wells.

6.7.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPA of the three municipal wells in Greenbank is shown in Figure 6e-2. The Groundwater Vulnerability has been determined from an analysis of various Aquifer Vulnerability Index (AVI) approaches as documented in Technical Memorandum F1 (Appendix D). The Vulnerability beneath the majority of the WHPA areas is designated as Low. A few areas within individual WHPA are designated with Medium Vulnerability. This is consistent with available water quality data for the wells and the shallow aquifer systems.

6.7.1.3 Transport Pathway Increase

Technical Memorandum F1 (Appendix D) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that do not contain seals that will prevent water from moving down around the outside of the well pipe, or those that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

Only one well was identified with the 100 m radius of MW3. In this case, the position of the well within the 100 m radius of the MW3 will not affect the Vulnerability Score.

Review of the local geology and the thickness of the uppermost confining layer indicate that the depth to the bottom of the confining layer that protects the water supply aquifer is below the expected depth of building foundations or municipal services. It is unlikely that building foundations and municipal services installed within the upper 2 to 3 m below grade will create a Transport Pathway that will make the water supply aquifer more susceptible to contamination. A Transport Pathway increase is not recommended for the Greenbank water supply aquifer to deal with building foundations and buried infrastructure.

The Groundwater Vulnerability has been increased by one step from “Medium” to “High” or from “Low” to “Medium”.

6.7.1.4 WHPA-E /~~WHPA-F~~

None of the wells in this study have been identified as Groundwater Under the Direct Influence of Surface Water (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.~~

Vulnerability Score

The WHPA zones for the Greenbank Water Supply, as shown in Figure 6e-1, and the increased Groundwater Vulnerability, were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 6e-3 illustrates the Vulnerability

Scores for the Greenbank Water Supply. Figure 6e-3 will be used to assess Drinking Water Threats in Section 6.7.3.

6.7.1.5 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part 1.4 – Uncertainty Analysis – Water Quality (MOE, 2008a). As the wells for this system are located outside of the SGBLS Region, independent peer review of the WHPA delineation was not undertaken.

The uncertainty associated with the vulnerability assessment was evaluated using a qualitative process outlined in Technical Memorandum A1 (Appendix MO) and described for the Greenbank Water Supply in Technical Memorandum F1 (Appendix D). The uncertainty assessment methodology considers the type, quantity and quality of available data, the methods used to determine the Vulnerability Assessment components, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Greenbank Water Supply is Low. A low Uncertainty Rating corresponds to a relatively high degree of confidence that the Vulnerability Assessment for the water supply wells reflects the conditions that dictate the vulnerability of the municipal wells to contamination from activities at surface. The WHPA for Greenbank has been delineated using decisions and assumptions that would err on the conservative side (larger WHPA and higher Vulnerability Scores). This conservatism was taken into account in the assignment of the Uncertainty Rating.

6.7.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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 (1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Greenbank municipal water supplies has been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues

Evaluation for Greenbank are provided in Technical Memorandum F2 – Evaluation of Drinking Water Issues – Greenbank (Appendix D).

No Drinking Water Issues were identified for the raw water quality supply to the Greenbank municipal wells.

6.7.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Community of Greenbank Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO) . 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 Greenbank Water Supply 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.

6.7.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Greenbank Drinking Water Supply 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.

6.7.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Greenbank Water Supply system:

- Files provided by the Ministry of the Environment, [Conservation and Parks](#) local offices pertaining to licenses, and records of spills in the area of the delineated WHPA.
- Records available from the Ministry of the Environment, [Conservation and Parks](#) website containing registry of Brownfield Sites.
- Records from previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Durham Region staff to identify potential conditions within the identified WHPAs for the drinking water supply

No confirmed Conditions have been identified for the Community of Greenbank Water Supply. No potential Conditions have been identified for consideration at this time.

6.7.3.3 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~~ [Technical Rules](#) threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The ~~tables~~ [circumstances](#) can be found at <https://threats.swpip.ca/>. ~~https://swpip.ca/~~

The areas of Significant, Moderate, or Low Drinking Water Threats are located outside of the Lakes Simcoe and Couchiching SPA.

6.7.3.3.1 Pathogen Parameters

~~The Key Table on~~ Figure 6e-4 can be used in conjunction with the [Technical Rules and](#) 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 Greenbank Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the 100 m radius (WHPA-A) zone where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate, or Low Threat within WHPA-A and WHPA-B only

6.7.3.3.2 Chemical Parameters

~~The Key Table on~~ Figure 6e-5 can be used in conjunction with the Technical Rules and 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 Greenbank Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within the 100 m radius (WHPA-A) zone where the Vulnerability Score is 10.

6.7.3.3.3 DNAPL Chemical Parameters

Figure 6e-6 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 Greenbank Water Supply. ~~The Key Table on Figure 6e-6~~Technical Rules can be used to identify the circumstances in which these Activities would be Significant, or Moderate, or Low Drinking Water Threats.

6.7.3.4 **Identifying Areas of Significant/Moderate/Low Threats – Conditions**

Further to Section 6.7.3.2, no Conditions have been confirmed within the WHPA for the Greenbank Water Supply.

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 A5 (Appendix MO). 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.

Figure 6e-3 illustrates the Vulnerability Score map for Greenbank well supply that can be used to determine where a Condition is or would be a Significant, Moderate, or Low Threat to Drinking Water.

6.7.3.5 Enumerating Drinking Water Threats

6.7.3.5

The number of Significant Drinking Water Threats for the Greenbank Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and refined by Region of Durham municipal staff members. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 6-14 documents the enumeration of existing activities that are considered to be Significant Drinking Water Threats within the WHPAs for the Greenbank Water Supply. Significant Drinking Water Threats were only identified within areas where the Vulnerability Score is 10. The Significant Threats have been documented on one table because the properties intersected by the WHPAs for MW3, MW4, MW5, and MW6 are the same.

Twenty-eight (28) activities that are potential Significant Threats to Drinking Water were identified in association with twenty (20) land parcels in the WHPA for the Greenbank Water Supply. Seventeen (17) of the parcels with identified significant Threats relate to private homes with private sewage systems. The residential land uses are associated with MW1 and MW3. Three (3) parcels were identified for potential application of pesticide to land and three (3) were identified for potential application of fertilizer to land. Three (3) parcels were identified for potential application of agricultural source material to land. One (1) parcel was identified for potential storage of agricultural source material. One (1) parcel was identified as having land use associated with livestock grazing, pasturing land, an outdoor confinement area, or a farm animal yard.

The activities that are identified as potentially Significant Drinking Water Threats are not within the Lakes Simcoe and Couchiching SPA.

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Table 6-146-14: Number of Significant Drinking Water Threats for the Greenbank Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	0
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	17
3.	The application of agricultural source material to land.	3
4.	The storage of agricultural source material to land.	1
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	3
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	3
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0

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Threat Number	Threat	Significant threat counts Number of threats
14.	The storage of snow.	0
15.	The handling and storage of fuel.	1
16.	The handling and storage of dense non-aqueous phase liquid.	3
17.	The handling and storage of an organic solvent.	1
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	1
<u>22.</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals:	28 significant threats (on 20 properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

6.7.3.5.1 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~~ Technical Rules.

Managed Lands were identified and the managed lands proportions were determined for the WHPAs of the Greenbank Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.7.3.5). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

Figure 6e-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Greenbank Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Managed Lands proportion is typically greater than 40% in the rural portions of the WHPA where the Vulnerability Score is greater than 6.

6.7.3.5.2 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~~ Technical Rules.

The Livestock Density was determined for the delineated WHPA zones of the Greenbank Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.7.3.5). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material, and the grazing and/or confinement of livestock.

Figure 6e-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Greenbank Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

6.7.3.5.3 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 Technical Rules](#).

The proportion of impervious surfaces within the delineated WHPA zones for the Greenbank Well Supply was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). [Methodology in Technical Memorandum A5.1 \(Appendix MO\) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules](#). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.7.3.5).

Figure 6e-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Greenbank Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

6.8 Uxville Drinking Water System

The Uxville drinking water system is located within the Credit Valley, Toronto and Region, Central Lake Ontario (CTC) Source Protection Region. The WHPAs of this system extend to the north and a portion crosses the York-Durham regional boundary in Uxbridge into the South Georgian Bay-Lake Simcoe SPR. The work performed to assess the drinking water threats for the Uxville drinking water system showed that there is no potential for drinking water threats within the portion of the WHPA that extends into the South Georgian Bay-Lake Simcoe SPR. This section provides a brief summary of the Vulnerability and Threats Assessment completed for the Uxville system by AECOM Limited (2009f-h) under contract of the Regional Municipality of Durham.

The Uxville Water Supply System (WSS) services the Uxbridge Industrial Park (UIP) and is located approximately 35 kilometres (km) south of Lake Simcoe and 25 km north of Lake Ontario in the Township of Uxbridge.

The Uxville WSS is classified as Small Drinking Water System (Type II Water System) under Ontario Regulation 318/08. In 2008 Durham Regional Council elevated Uxville WSS to include it in the Source Water Protection Planning Initiatives under the Clean Water Act.

The Uxville WSS provides water to UIP from two (2) wells designated as MW1 (main well) and MW2. Raw water from these wells is pumped to the shared pumphouse where it is treated with sodium hypochlorite for disinfection. A 17.4m long chlorine contact tank is located immediately outside the pumphouse. The free chlorine residual and turbidity are monitored continuously by online analyzers.

The distribution system delivers the treated water through approximately 3.8 km of watermains and includes a 1,136 cubic metre standpipe for storage and pressure equalization. The Uxville WSS has an approved combined capacity of 1,898 m³/ day.

The Uxville (WSS) operates under the following Permits:

- Certificate of Approval (C of A) – 7816-5LLKVF
- Permit To Take Water - PTTW #2331-6NJNI6L
- Drinking Water System Number: 7300002312

The locations of the Uxville municipal wells are shown in Figure 6f-1.

The Uxville wells obtain water from sand and gravel of the Oak Ridges Moraine (ORM) Aquifer Complex. The municipal wells are screened in the sand and gravel with the top of screen set at an elevation 295.5 metres Above Sea Level (ASL) for wells MW1 and 291.4 m ASL for MW2. Well MW1 is 61.3 m, MW2 is 58.5 m deep.

The regional direction of groundwater movement in this location is to the south, towards Lake Ontario. The Wellhead Protection Area (WHPA) reflects the direction of local groundwater flow towards the municipal supply wells.

Previous municipally funded groundwater studies (2003) delineated WHPA for MW1 and MW2 using a numerical model and created a Land Use Inventory in accordance with previous Provincial guidance. The numerical model was updated in 2004. Over recent years, a series of monitoring and sentry wells were installed to provide additional hydrogeological data and baseline water quality data for the Uxville WSS.

Uxville WHPA delineation, supply Vulnerability and Threats Assessment was completed by AECOM Limited, and provided as a series of Technical Memorandums (AECOM, 2009f-i) to the Regional Municipality of Durham. The Regional Municipality of Durham has combined these memorandums into a single technical report (Durham Region, 2010b).

6.8.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats 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 man-made (anthropogenic) structures, 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 Threat could affect the drinking water supply. 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 Uxville WSS has been delineated following the process recommended in the Technical Rules. The areas determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The groundwater vulnerability within the WHPA was assessed and included consideration of the effects of man-made structures that may increase Vulnerability. The WHPA and the Vulnerability were considered together, as per the Technical Rules, to determine a Vulnerability Score for the Uxville WSS. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 - “Groundwater Vulnerability Assessment Methods” (Appendix MO) and details of the delineation of WHPA for MW1 and MW2 is provided in AECOM Technical Memorandum (2009f) – “Groundwater Modeling and WHPA Delineation - Uxville Water Supply System” (Appendix D).

Work performed to assess the Groundwater Vulnerability for the Uxville WSS is provided in AECOM Technical Memorandum (2009g) – “Groundwater Vulnerability Assessment –Uxbridge Industrial Park in Uxville (Uxville Water Supply System)” (Appendix D).

6.8.1.1 Well Head Protection Area (WHPA) Delineation

The WHPA for the Uxville WSS wells, as delineated by Gartner Lee Limited (presently AECOM) in 2008, is shown in Figure 6f-1. WHPA-A has been added to include the 100 m radius from each municipal well.

The WHPA was delineated using the 3-dimensional numerical groundwater flow model updated in 2004. As per former PTTW 01-P-3048, the WHPA was delineated based on permitted rates (1,898,000 L/Day). The results of WHPA delineation for MW1 and MW2 is documented in the AECOM Technical Memorandum (2009f) – “WHPA Delineation – Uxville Water Supply System” (Appendix D). The Uxville WSS is presently taking only a fraction of permitted takings, 35,784 L/Day, which is only 2% of permitted rates and therefore the delineated WHPA is very conservative.

The WHPA for Uxville WSS reflects the regional groundwater flow direction from north to south towards Lake Ontario, within the Duffins Creek watershed and its tributaries.

6.8.1.2 Groundwater Vulnerability

In order to keep a consistent approach to assessing Drinking Water Threats, AECOM and GENIVAR have used the same methodology for the Groundwater Vulnerability.

The Groundwater Vulnerability within the WHPA of the two municipal wells in Uxville WSS is shown in Figure 6f-2. The Groundwater Vulnerability has been determined consistently across Durham based on an analysis of various Aquifer Vulnerability Index (AVI) approaches documented in GENIVAR Technical Memorandum A1 – “Groundwater Vulnerability Assessment Methods” (Appendix MO) and by AECOM for the Uxville WSS, as documented in AECOM Technical Memorandum (2009g) – “Groundwater Vulnerability Assessment– Township of Uxbridge – Uxbridge Industrial Park in Uxville (Uxville Water Supply System)” (Appendix D). Uxville Groundwater Vulnerability is considered to be Medium in the areas near the municipal wells because the municipal wells are relatively deep and the overburden above the aquifer is known to be relatively thick.

6.8.1.3 Transport Pathway Increase

In order to keep a consistent approach to assess Drinking Water Threats, AECOM and GENIVAR have used the same methodology for the consideration of Transport Pathways which is outlined in GENIVAR Technical Memorandum A2 – “Vulnerability Increase – Transport

Pathway” (Appendix MO) and AECOM Technical Memorandum (2009g) – “Groundwater Vulnerability Assessment– Township of Uxbridge – Uxbridge Industrial Park in Uxville (Uxville Water Supply System” (Appendix D). This method follows the Ministry of Environment (MOE) Technical Rules. The Vulnerability Rating can increase from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, or wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have the potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells. A potential Vulnerability increase is reasonable for areas within the WHPA where wells are known to intersect the water supply aquifers.

In this study, AECOM considered Transport Pathways based on MOE well records within the WHPA for the Uxville WSS, including active municipal wells for Uxville. These well records were plotted based on coordinates provided from WWIS database and corrected by the Oak Ridges Moraine Conservation Coalition and York Peel Durham Toronto Groundwater Study Team. However, based on local knowledge, Durham staff have reviewed individual MOE well records within the WHPA and concluded that three (3) of the seven (7) identified transport pathways within WHPA for MW1 and MW2 have wrong coordinates, are plotted in the wrong locations, and are outside of the WHPA.

In addition, Durham asked to remove any active municipal well, including monitoring or sentry wells because all municipal wells must meet Ontario Regulation 903 under the Ontario Water Resources Act; Durham’s operators are checking the condition of these wells regularly; Durham repairs any deficiencies in any of the wells; and finally they are inspected on a regular basis by MOE inspectors. For these reasons, the active municipal wells are very unlikely to be a transport pathway.

The Vulnerability increase from the private wells has not been assigned for Uxville WSS.

The areas closest to the wellheads are typically assigned a High Vulnerability and therefore a Transport Pathway increase is not recommended for the Uxbridge WSS aquifer within 100 m buffer to deal with building foundations and buried infrastructure. However, a Vulnerability

increase was recommended within WHPA-B for buried infrastructure (watermains and storm sewers) within re-graded areas (up to six metres of cut and fill) required for development of Uxbridge Industrial Park.

The Groundwater Vulnerability has been increased by one step from “Medium” to “High” to account for the presence of this infrastructure and is shown in Figure 6f-3.

6.8.1.4 WHPA-E/~~WHPA-F~~

None of the wells in this study have been identified as Groundwater Under the Direct Influence of Surface Water (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.~~

6.8.1.5 Vulnerability Score

The WHPA zones for the Uxville WSS, as shown in Figure 6f-1, Groundwater Vulnerability, as shown in Figure 6f-2, and increases due to Transport Pathways were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 6f-3 illustrates the Vulnerability Scores for the Uxville WSS. Figure 6f-3 was used to assess Drinking Water Threats in Section 6.8.3. The Transport Pathways are illustrated as setbacks of 30 m on either side of the roads in WHPA-A and WHPA-B.

6.8.1.6 Uncertainty Rating

As part of the Vulnerability Analysis an Uncertainty Rating of either High or Low is required by the Technical Rules for the Vulnerability Assessment and the WHPA delineation, as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a).

The Uncertainty associated with the WHPA delineation was assessed by AECOM. The Uncertainty Assessment methodology considers the type, quantity and quality of available data, the methods used to determine the vulnerability assessment components, and the nature of the groundwater flow system.

The Uncertainty Rating assigned by AECOM for the Uxville WSS is Low. In this case, the Uncertainty Rating reflects the amount of information available or the effort undertaken to assess the Groundwater Vulnerability. A Low Uncertainty Rating corresponds to a relatively high degree of confidence that the Vulnerability Assessment for the water supply wells reflects the conditions that dictate the Vulnerability of the municipal wells to contamination from activities at surface.

6.8.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals 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. 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 (1,2,3)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality, treated water quality, and water quality monitoring in sentry wells in the area around the Uxville municipal water supplies has been reviewed by AECOM to identify Drinking Water Issues that are considered likely to deteriorate the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for Uxville WSS are provided in AECOM Technical Memorandum (2009h) – “Drinking Evaluation Issues Evaluation – Uxbridge Industrial Park (Uxville Water Supply)” (Appendix D).

No Drinking Water Issues were identified for the Uxville Water Supply System.

6.8.3 Drinking Water Threats Evaluation

An assessment of drinking water threats for the Uxville WSS was completed as described in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix I) and in details in AECOM Technical Memorandum (2009i) – “Drinking Water Quality Threats Assessment – Uxville Water Supply System” (Appendix D). 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 Uxbridge Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the following nine steps:

- Step 1: Identify Activities and Conditions
- Step 2: Identify Areas and Circumstances of Significant, Moderate and Low Drinking Water Quality Threats
- Step 3: Assign Vulnerability Scores to Parcels
- Step 4: Identify Parcels for Analysis
- Step 5: Identify Parcel Land Uses
- Step 6: Assign Potential Drinking Water Quality Threats to Land Uses
- Step 7: Determine Potential Circumstances Present
- Step 8: Assess Potential Drinking Water Quality Threats
- Step 9: Enumerate Locations with Significant Potential Drinking Water Quality Threats

6.8.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Uxville WSS 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.

6.8.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Uxville WSS:

- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions
- Interviews of Durham staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Uxville WSS. No potential Conditions have been identified for consideration at this time.

6.8.3.3 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~~ [Technical Rules](#) threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The ~~tables-circumstances~~ can be found at: <https://threats.swpip.ca/>. ~~https://swpip.ca/~~

The areas of Significant Drinking Water Threats are located outside of the Lakes Simcoe and Couchiching-Black River SPA.

6.8.3.3.1 Pathogen Parameters

~~The Key Table on~~ Figure 6f-4 can be used in conjunction with the [Technical Rules and](#) 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 Uxville WSS. 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 a Significant, Moderate, or Low threat within WHPA-A and WHPA-B only

6.8.3.3.2 Chemical Parameters

~~The Key Table on~~ Figure 6f-5 can be used in conjunction with the [Technical Rules and](#) 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 Uxville WSS. Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 10.

6.8.3.3.3 DNAPL Chemical Parameters

Figure 6f-6 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 Uxville WSS. The ~~Key Table on~~ ~~Figure 6f-6~~ [Technical Rules](#) can be used to identify the circumstances in which these activities associated with DNAPL threats would be Significant or Moderate Drinking Water Threats.

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

Further to Section 6.8.3.2, no Conditions have been confirmed within the WHPA for the Uxville WSS.

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 A5 (Appendix MO). 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.

Figure 6f-3 illustrates the Vulnerability Score map for Uxville WSS well supply that can be used to determine where a Condition is or would be a Significant, Moderate, or Low Threat to Drinking Water.

6.8.3.5 Enumerating Drinking Water Threats

6.8.3.5

The number of Significant Drinking Water Threats for the Uxville WSS has been determined following the methodology outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D) and described in detail for the Uxville WSS in AECOM Technical Memorandum (2009i) – “Uxville Water Supply System” (Appendix D). There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 6-15 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Uxville WSS. Six (6) land parcels have been identified within the WHPA for MW1 and MW2 as having twelve (12) activities that may be Significant Drinking Water Threats.

Five (5) parcels were identified as having potential for operation of a system that disposes of sewage. Three (3) parcels were identified as having potential handling and storage of DNAPLs. One (1) parcel was identified for potential operation and maintenance of a waste disposal site;

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one (1) for storage and handling of fuel; and one (1) for storage and handling of organic solvents.

The activities that are identified as potentially significant drinking water threats are not within the Lakes Simcoe and Couchiching-Black River SPA.

Table 6-156-45: Number of Significant Drinking Water Threats for the Uxville Well Supply.

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	1
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	6
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0

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Threat Number	Threat	Significant threat counts Number of threats
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	1
16.	The handling and storage of dense non-aqueous phase liquid.	3
17.	The handling and storage of an organic solvent.	1
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
<u>22.</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline</u>	<u>0</u>
-	Totals:	12 significant threats (on 6 properties)

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Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

6.8.3.5.1 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~~Technical Rules.

Managed Lands are used in identification of threats and activities associated with the application of Agriculture Source Material, Non-Agriculture Source Material and Commercial Fertilizer as outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D). Managed Lands for Uxville WSS is described in detail for the Uxville WSS in AECOM Technical Memorandum (2009i) – “Uxville Water Supply System” (Appendix D). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.8.3.5). This analysis indicates that managed lands within WHPA for Uxville WSS are less than 40% and do not impact the enumeration of Significant Drinking Water Threats for the Uxville WSS.

Figure 6f-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Uxville WSS where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

6.8.3.5.2 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~~Technical Rules.

Livestock Density is used to identify threats and activities associated with the storage of Agriculture Source Material and the grazing and/or confinement of livestock. The analysis, as described in detail for the Uxville WSS in AECOM Technical Memorandum (2009i) – “Uxville Water Supply System” (Appendix D) indicates that Livestock Density is less than 0.5% and does not impact the enumeration of Significant Drinking Water Threats for the Uxville WSS. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.8.3.5).

Figure 6f-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Uxville WSS.

6.8.3.5.3 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~~ Technical Rules.

The Total Impervious Surface Area is used to identify threats and activities associated with the application of winter de-icing agents (salt) as outlined in AECOM Technical Memorandum (2009d) – “Drinking Water Quality Threats Assessment Methods” (Appendix D). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 6.8.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt). ~~Impervious Surfaces for the Uxville WSS vary from less than 1% to 8% - 80%.~~

Figure 6f-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Uxville WSS.



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

**Drinking Water System
Vulnerable Areas in
Regional Municipality of Durham**

Created by: LSRCA
Date: 2011-04-07



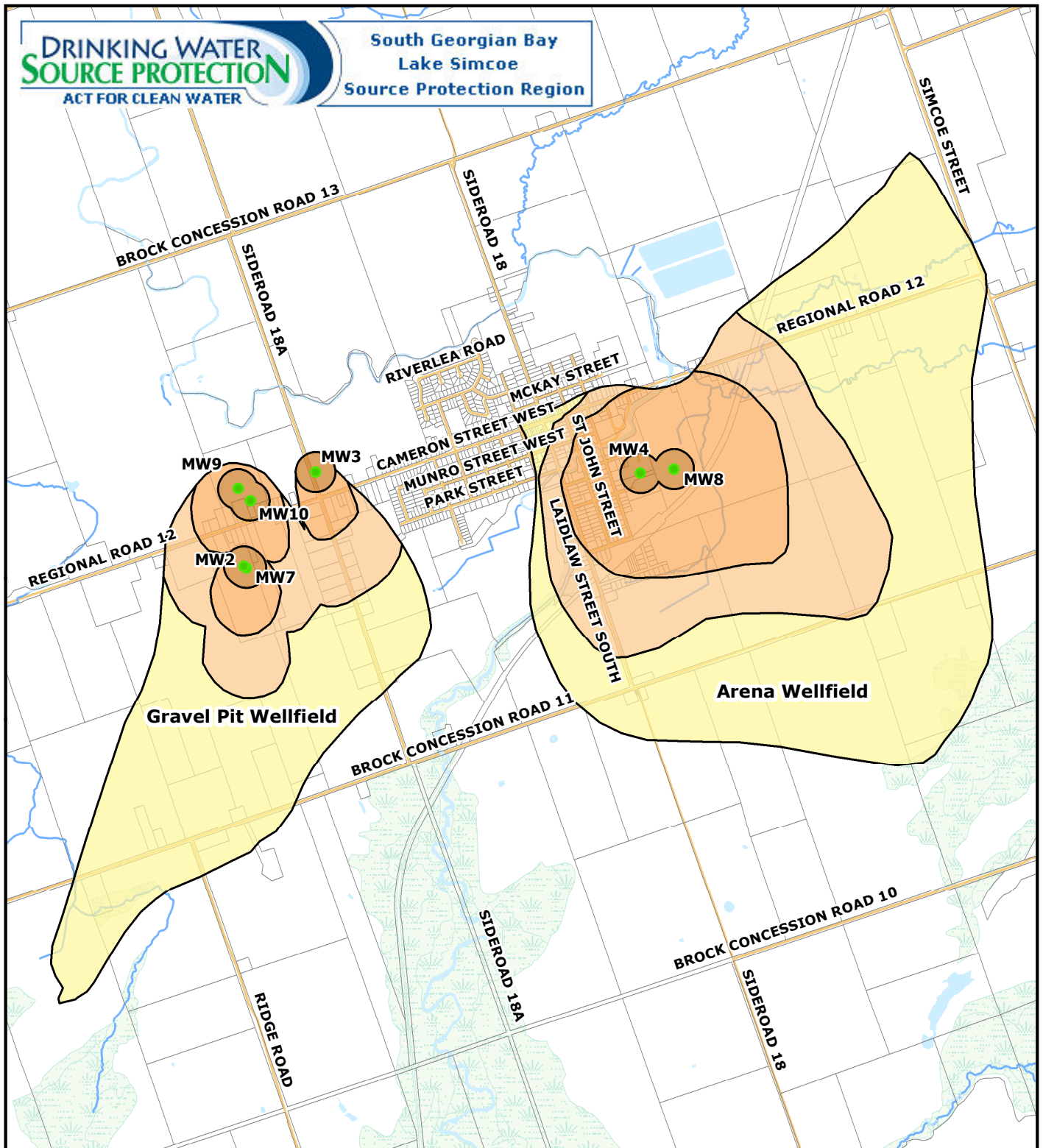
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0 4 8km
UTM Zone 17N, NAD83



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 6-1



● Municipal Supply Wells in Cannington

Wellhead Protection Areas

- WHPA-A (100 radius)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-D (25 years time of travel)

Wellhead Protection Areas - Cannington

Created by: LSRCA, 2021-12-06

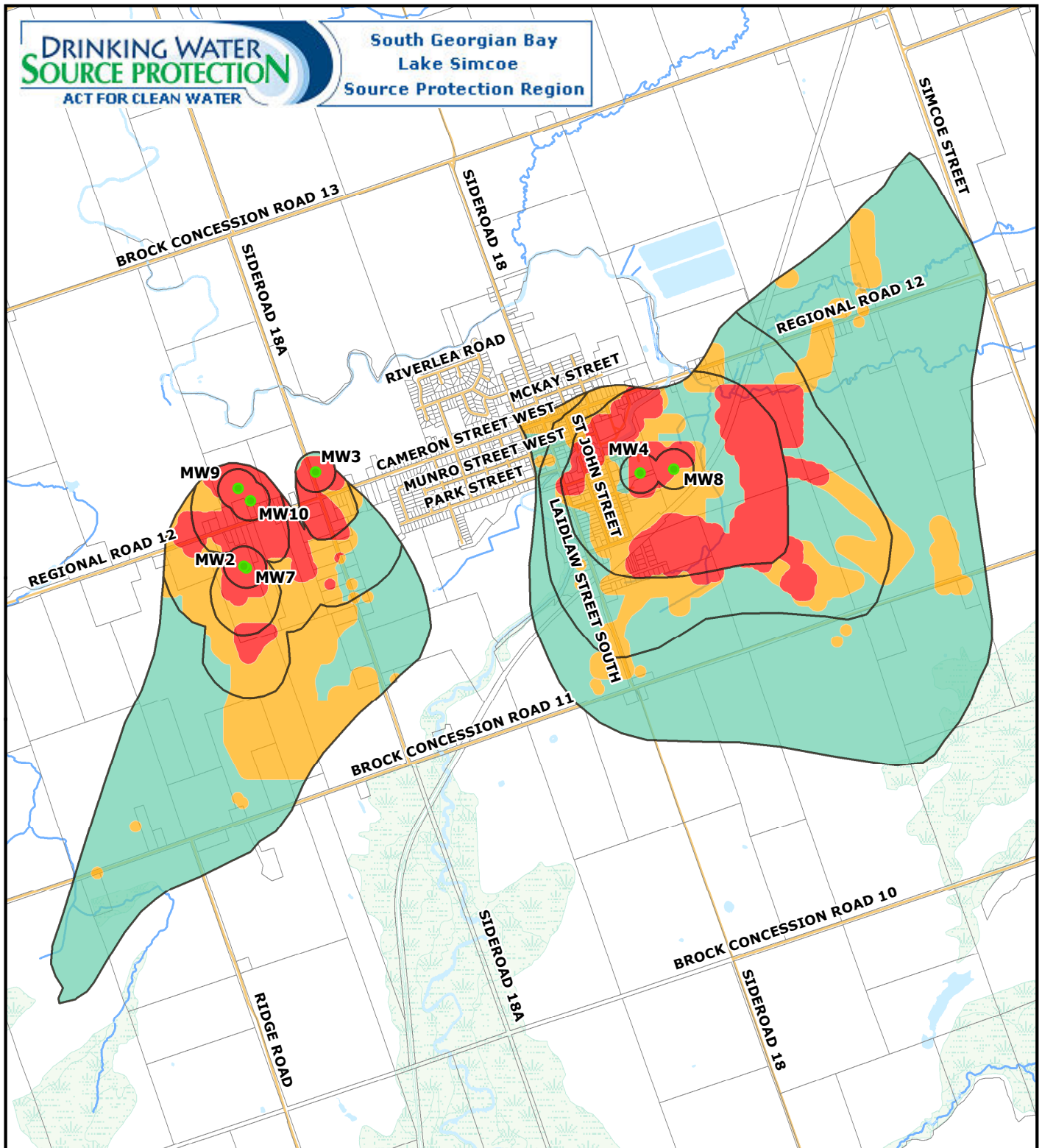
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 UTM Zone 17N, NAD83



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 6a-1



● Municipal Supply Wells in Cannington

Aquifer Vulnerability Index

- HIGH
- MEDIUM
- LOW

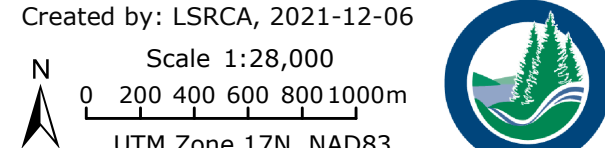
Groundwater Vulnerability - Cannington

Created by: LSRCA, 2021-12-06

Scale 1:28,000

0 200 400 600 800 1000m

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.


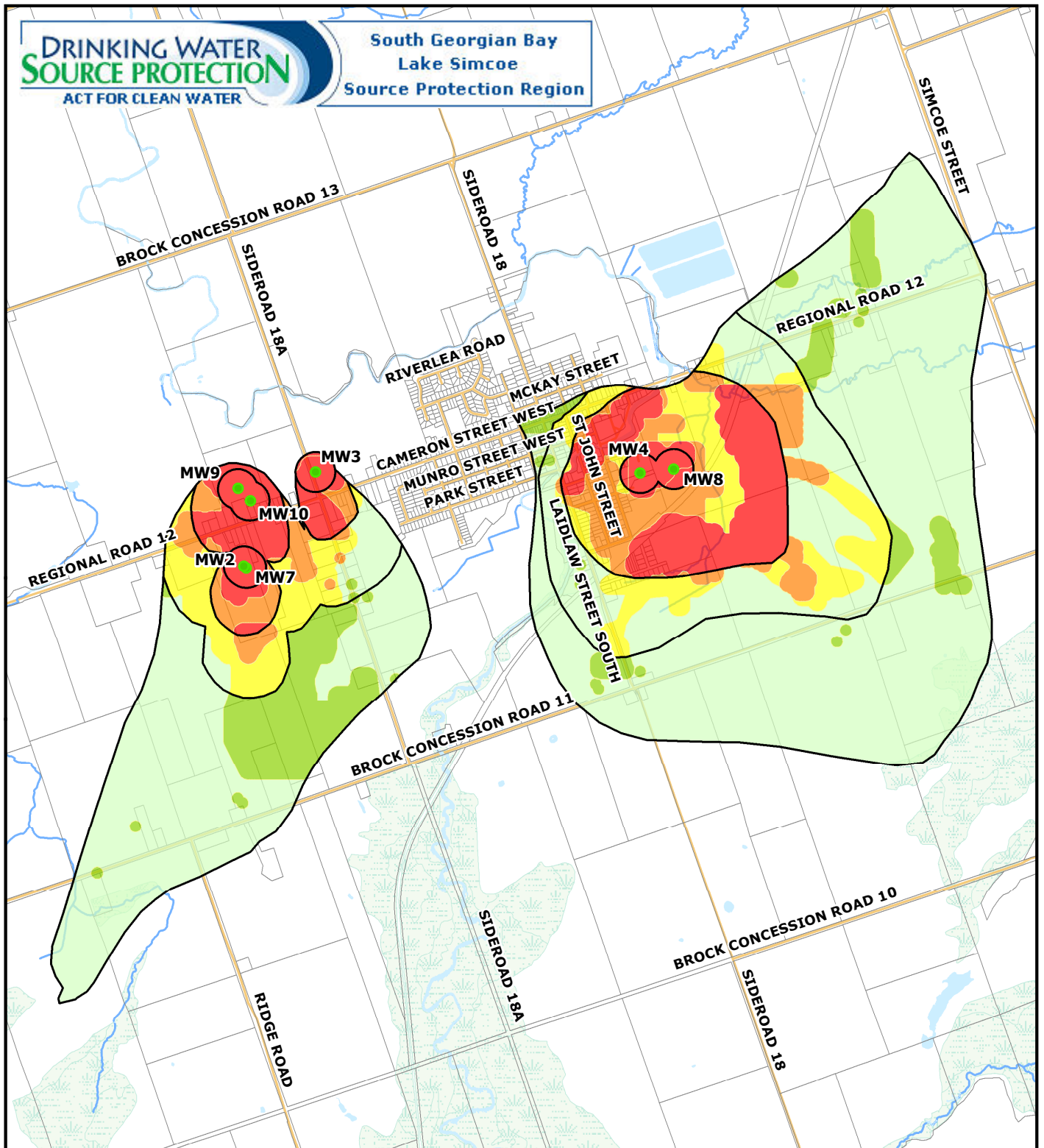
Ontario 

Figure 6a-2



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

● Municipal Supply Wells in Cannington

Vulnerability Scoring

Red	10
Orange	8
Yellow	6
Light Green	4
Very Light Green	2

Vulnerability Score - Cannington

Created by: LSRCA, 2021-12-06

Scale 1:28,000



0 200 400 600 800 1000m

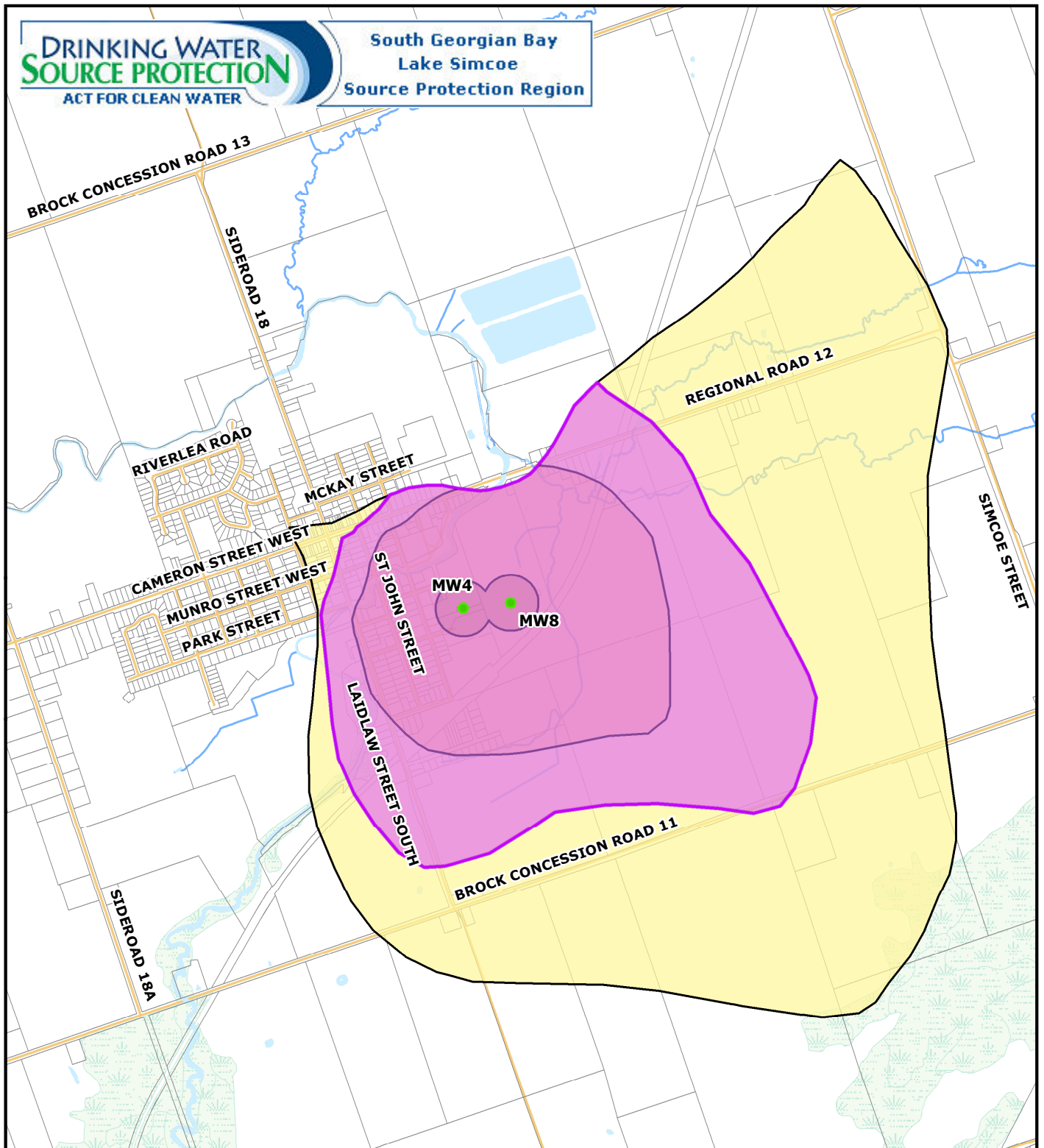
UTM Zone 17N, NAD83



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Figure 6a-3



- Municipal Supply Wells in Cannington
- Issue Contributing Area

Wellhead Protection Areas

- WHPA-A (100 radius)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-D (25 years time of travel)

**Issue Contributing Area -
Arena Wellfield - Cannington**

Created by: LSRCA, 2021-12-06

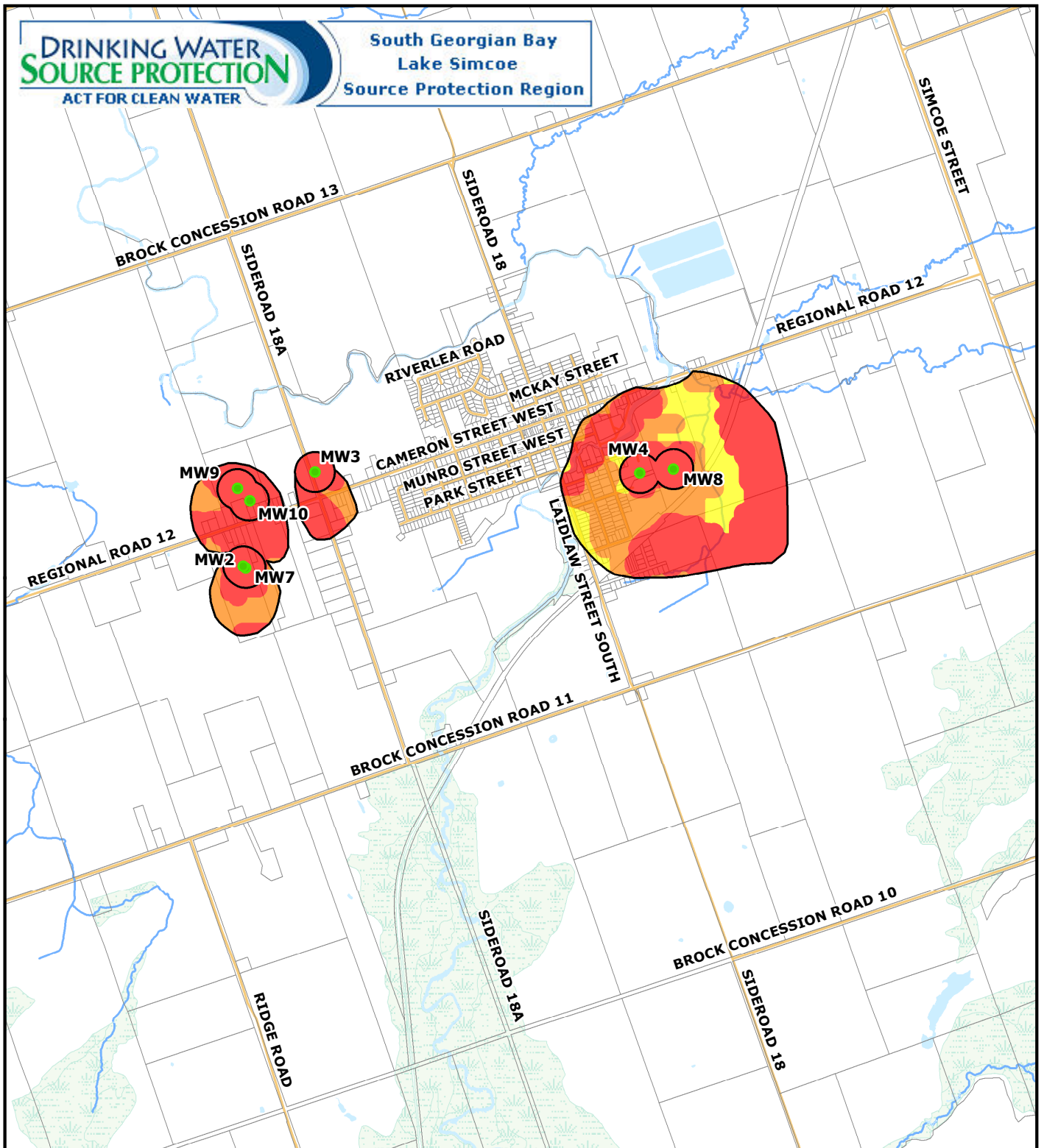
Scale 1:20,000

N

UTM Zone 17N, NAD83

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Figure 6a-4



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

Vulnerability Scoring

- 10
- 8
- 6

Areas Where Pathogens Are or Would Be Significant, Moderate, or Low Threats - Cannington

Created by: LSRCA, 2021-12-06

Scale 1:28,000

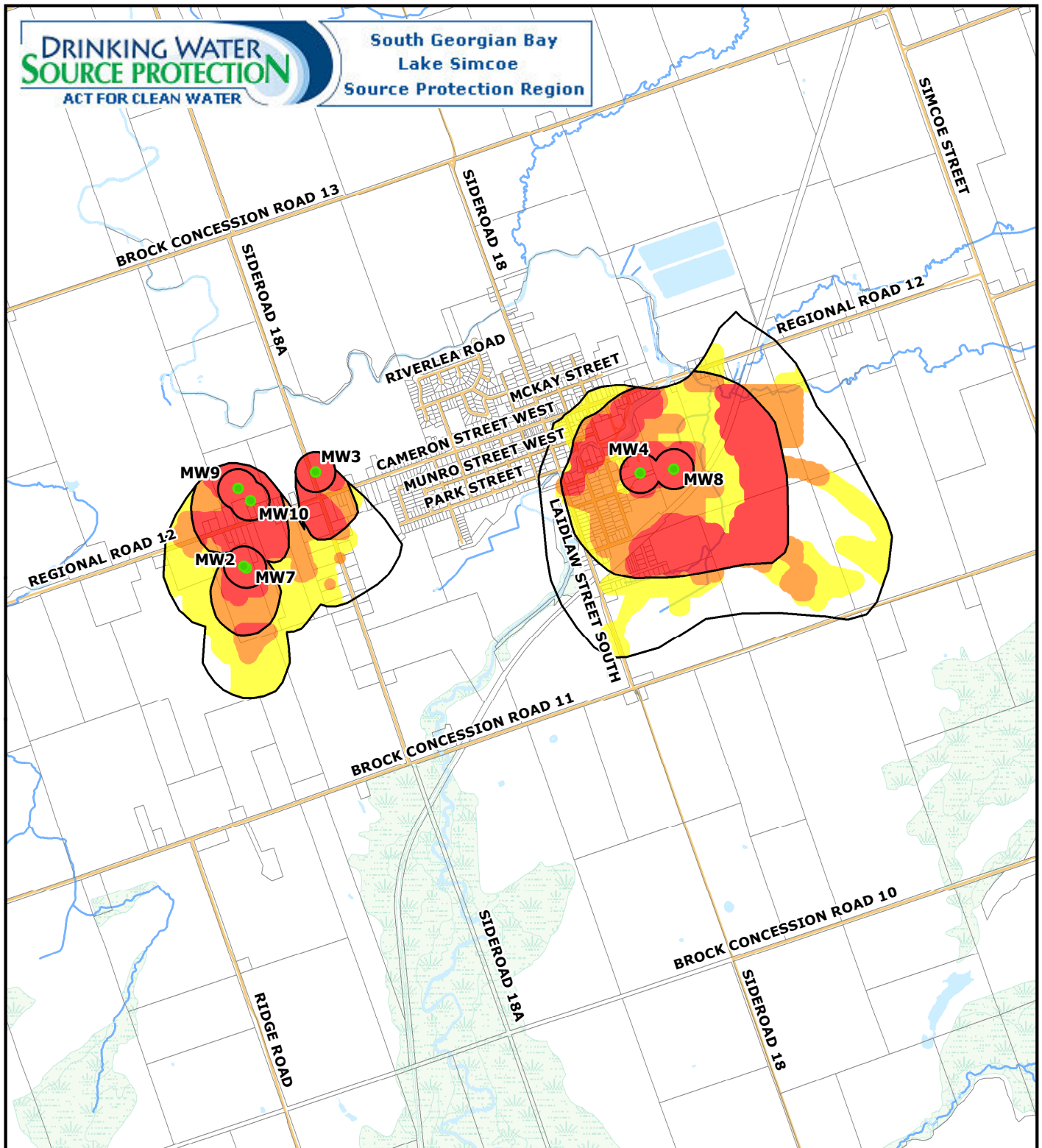
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UTM Zone 17N, NAD83

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 6a-5



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

Vulnerability Scoring

- 10
- 8
- 6

Municipal Supply Wells in Cannington

Areas Where Chemicals Are or Would Be Significant, Moderate, or Low Threats - Cannington

Created by: LSRCA, 2021-12-06

Scale 1:28,000

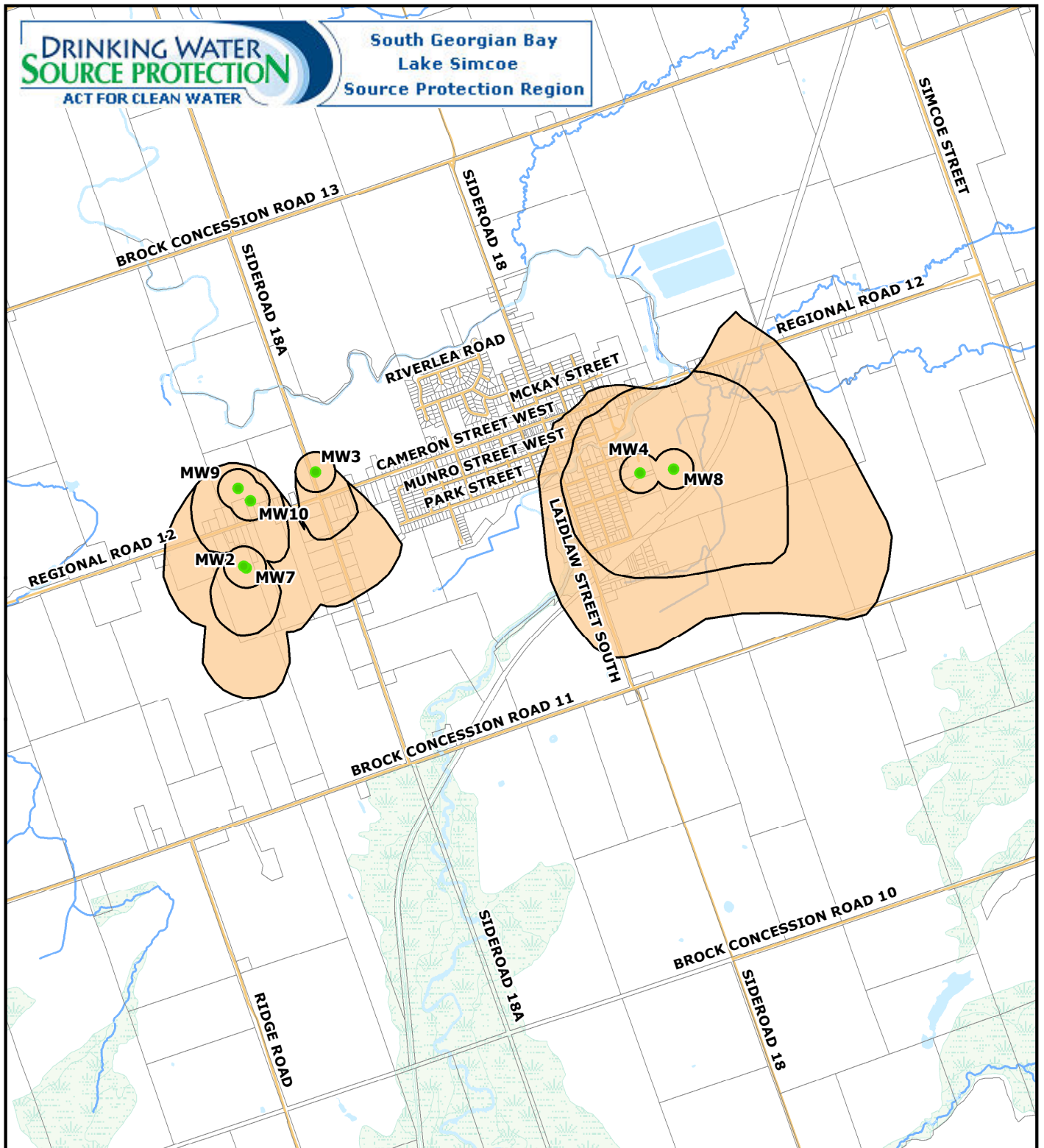
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UTM Zone 17N, NAD83

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 6a-6



● Municipal Supply Wells in Cannington
 WHPA-C (5 years time of travel)

Areas Where DNAPLs Are or Would Be Significant, Moderate, or Low Threats - Cannington

Created by: LSRCA, 2021-12-06

Scale 1:28,000

N

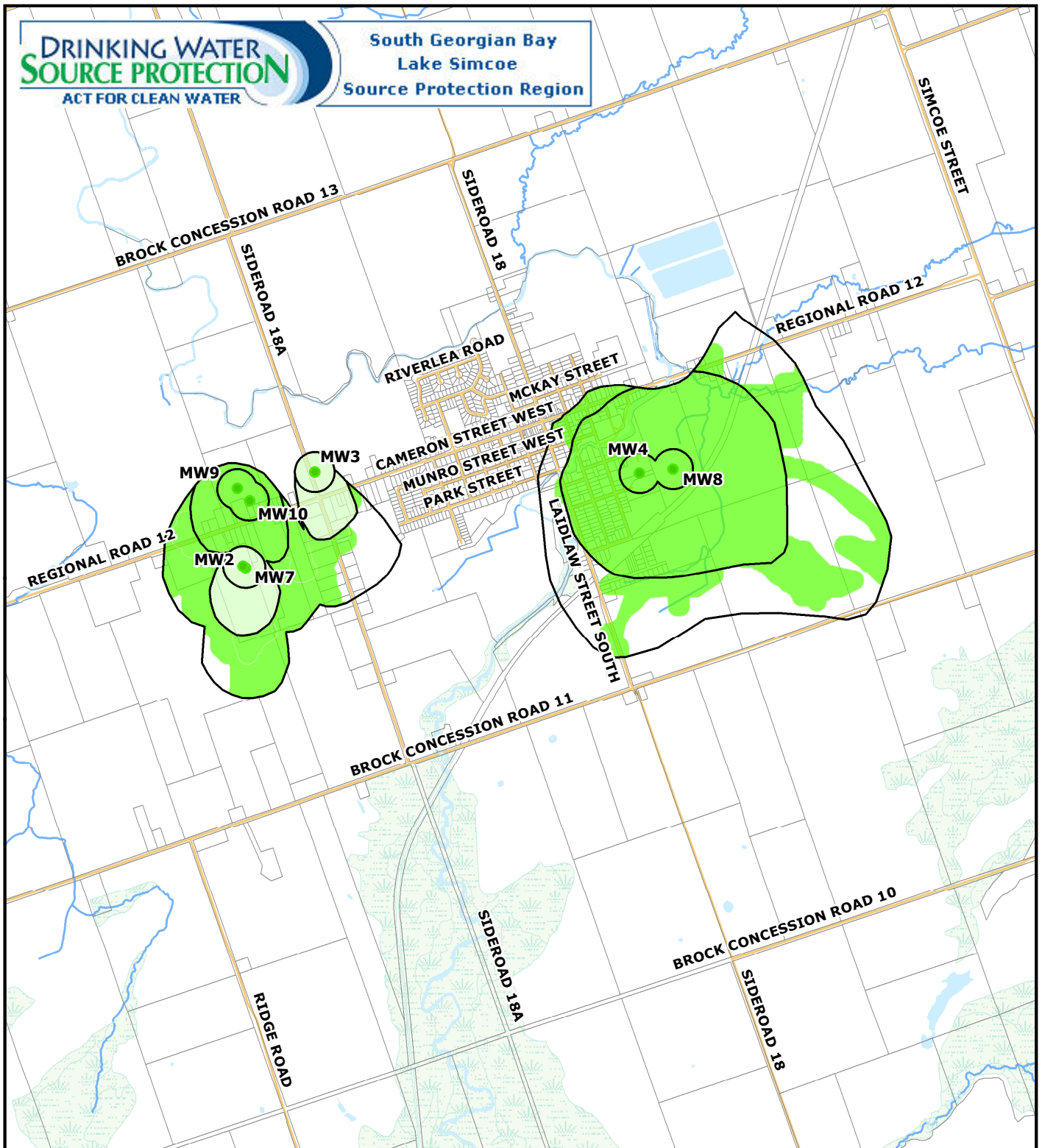
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


UTM Zone 17N, NAD83



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Figure 6a-7



 Municipal Supply Wells in Cannington
MANAGED LANDS
 < 40%
 40% - 80%
 > 80%

Managed Lands - Cannington
 Created by: LSRCA, 2021-12-06
 Scale 1:28,000
 0 200 400 600 800 1000m
 UTM Zone 17N, NAD83


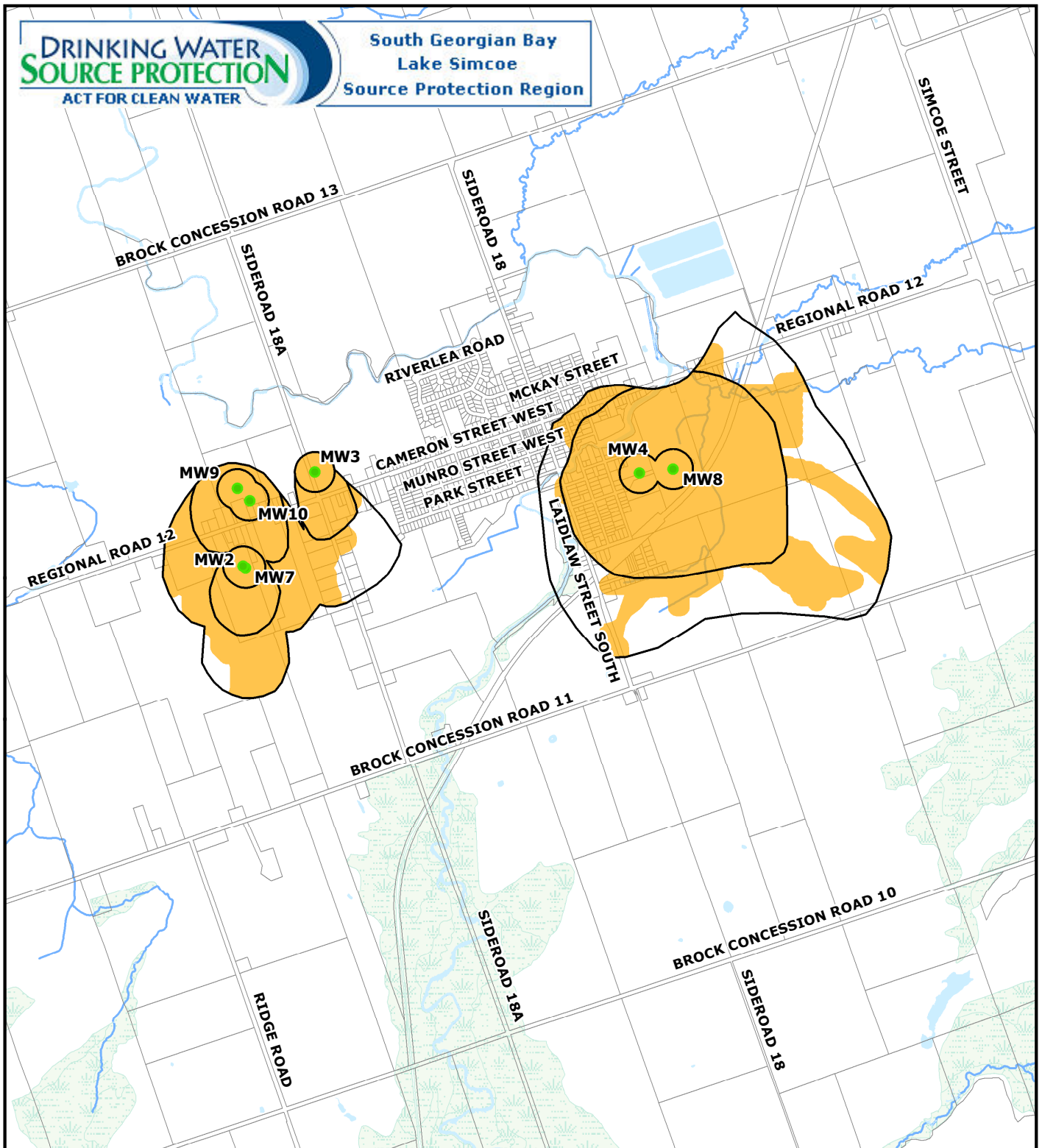
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data,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



Figure 6a-8



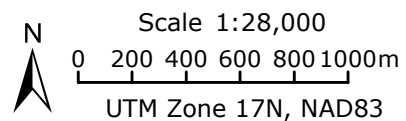
South Georgian Bay
Lake Simcoe
Source Protection Region



- Municipal Supply Wells in Cannington
- Livestock Density**
- <0.5 Nutrient Units
 - 0.5-1.0 Nutrient Units
 - >1.0 Nutrient Units

Livestock Density - Cannington

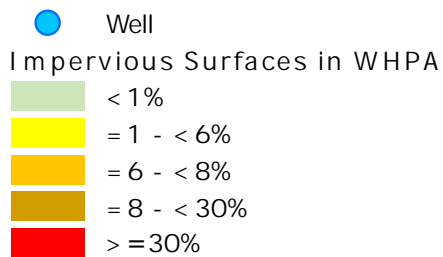
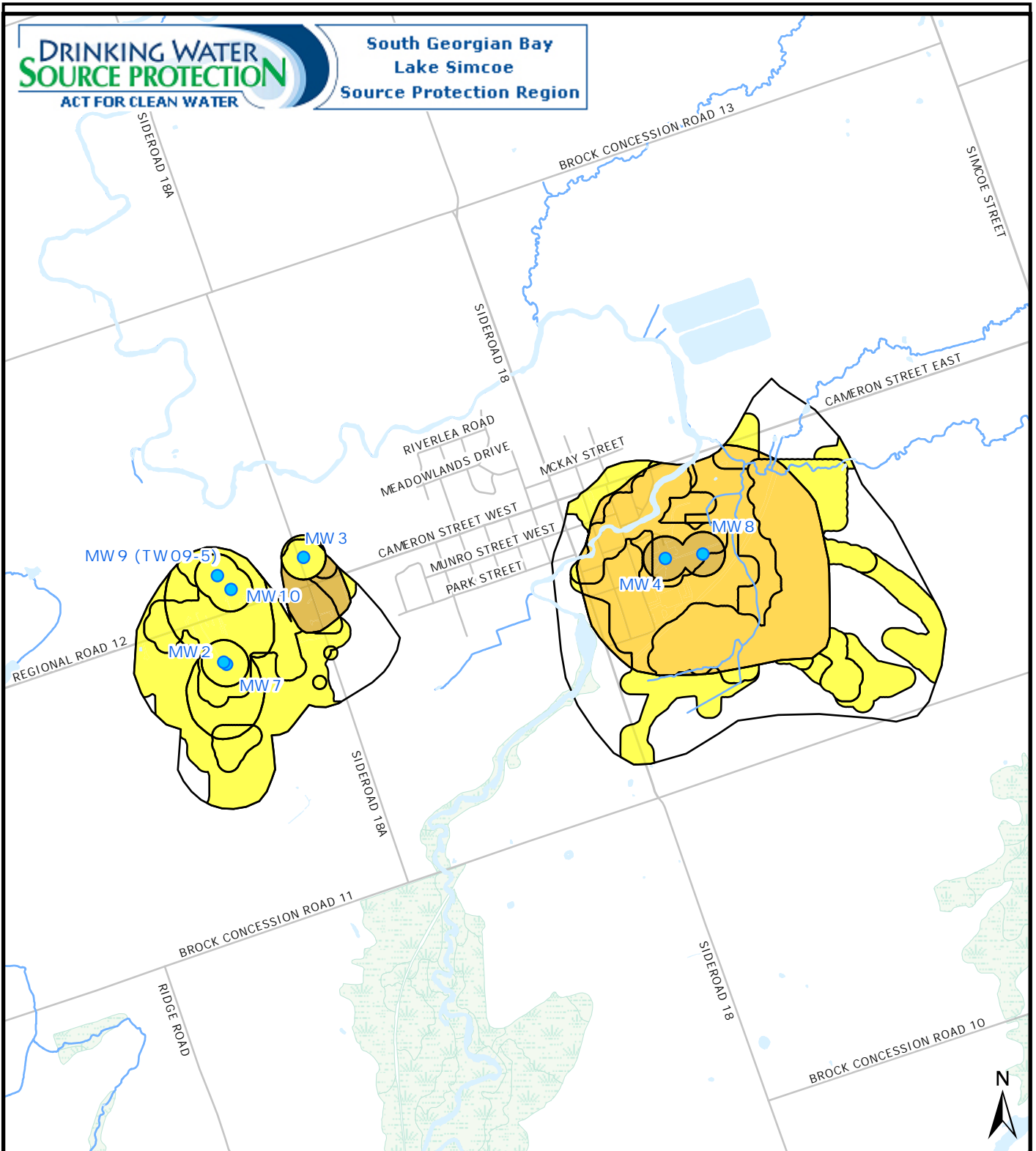
Created by: LSRCA, 2021-12-06



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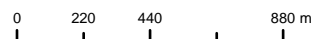
Figure 6a-9



**Impervious Surfaces - Cannington
WHPA**

Created by: LSRCA, 2025-08-05

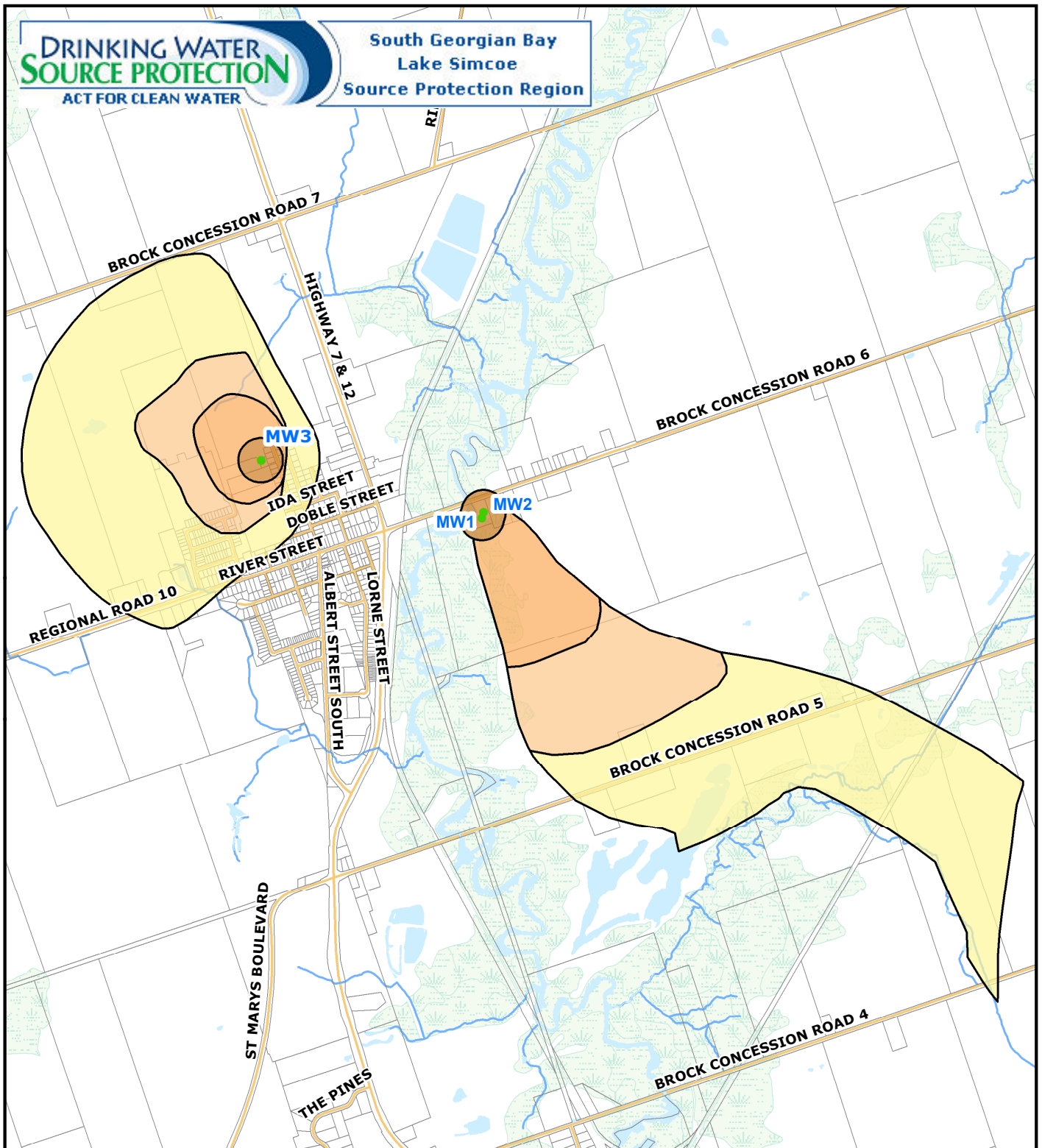
Scale 1: 25,000



UTM Zone 17N, NAD83



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● Municipal Supply Wells in Sunderland
Wellhead Protection Areas
 WHPA-A (100 radius)
 WHPA-B (2 years time of travel)
 WHPA-C (5 years time of travel)
 WHPA-D (25 years time of travel)

Wellhead Protection Areas – Sunderland

Created by: LSRCA, 2021-12-08

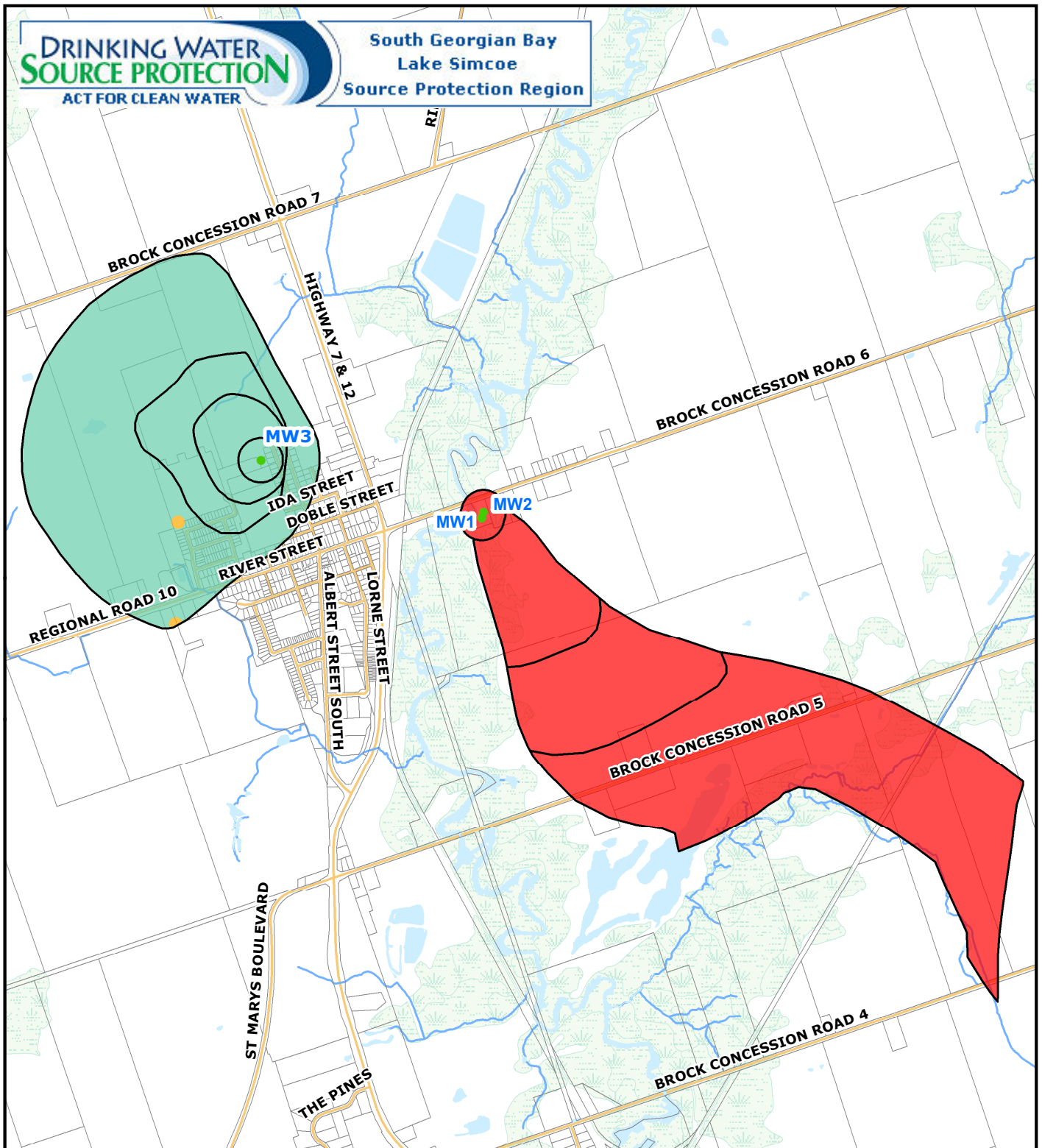
Scale 1:25,000

0 200 400 600 800 1000m

UTM Zone 17N, NAD83

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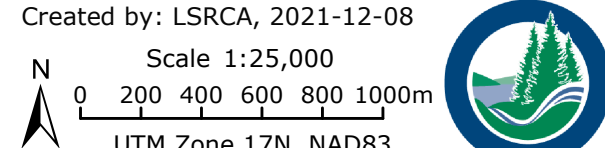
Ontario
Figure 6b-1




● Municipal Supply Wells in Sunderland
 Wellhead Protection Zones
Groundwater Vulnerability
 Aquifer Vulnerability Index
 High
 Medium
 Low

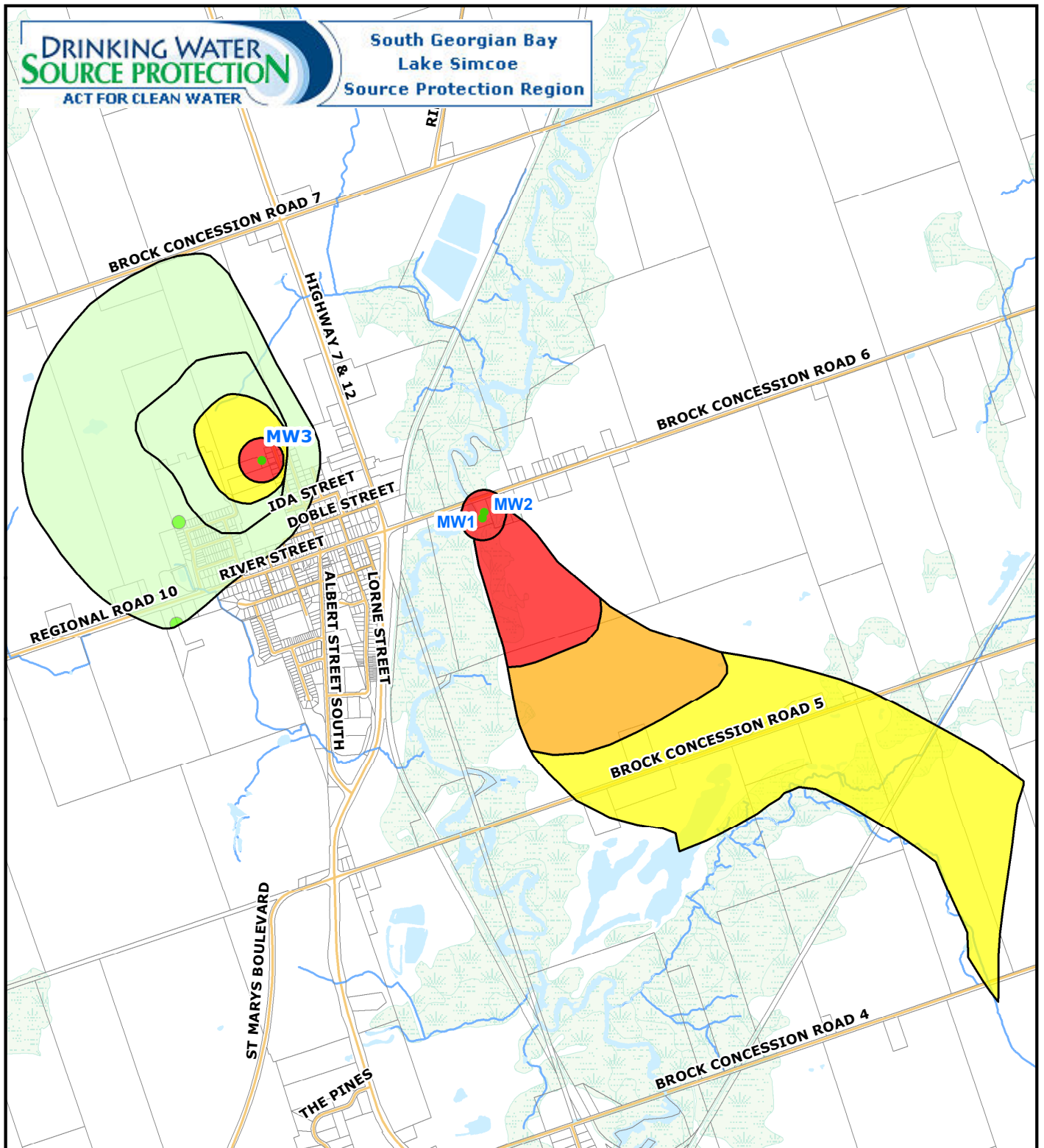
Groundwater Vulnerability – Sunderland

Created by: LSRCA, 2021-12-08
 Scale 1:25,000
 0 200 400 600 800 1000m
 UTM Zone 17N, NAD83



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Figure 6b-2



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

● Municipal Supply Wells in Sunderland

Vulnerability Score

- 10
- 8
- 6
- 4
- 2

Vulnerability Score – Sunderland

Created by: LSRCA, 2021-12-08

Scale 1:25,000

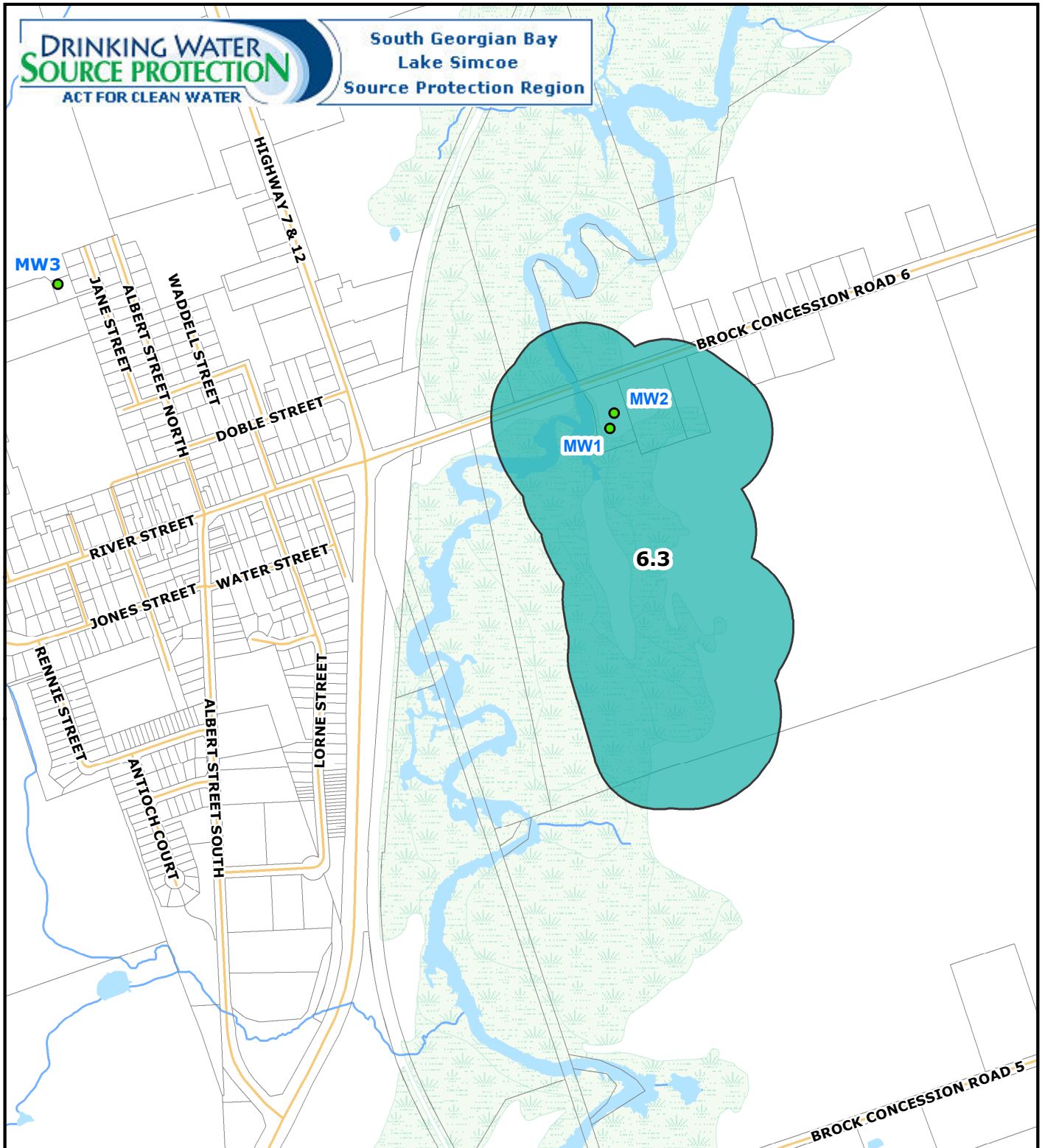
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UTM Zone 17N, NAD83

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Figure 6b-3



- Municipal Supply Wells in Sunderland
- WHPA-E
- Vulnerability Score = 6.3

WHPA-E – Sunderland

Created by: LSRCA, 2021-12-08

Scale 1:10,000

N

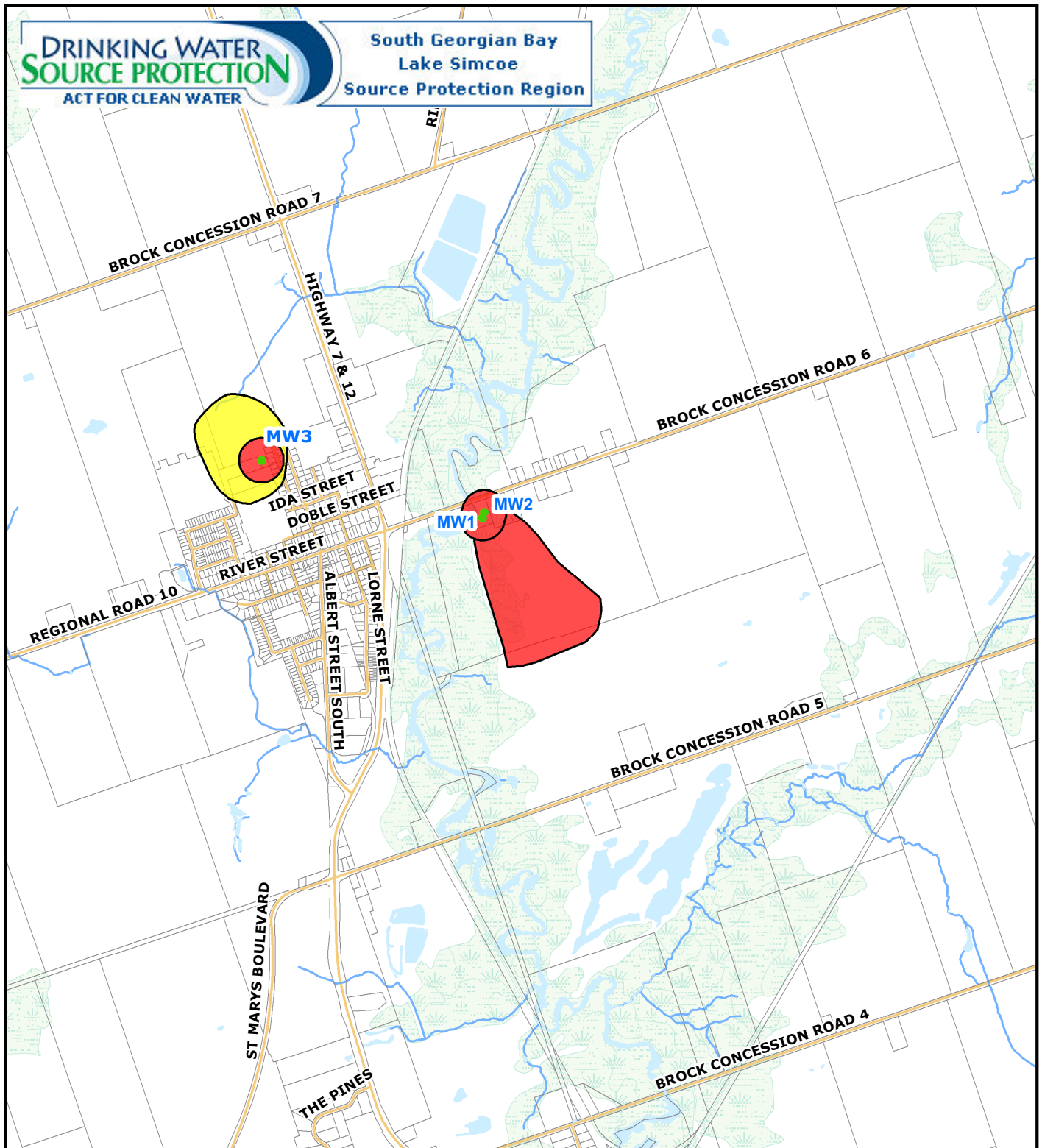
0 100 200 300 400m

UTM Zone 17N, NAD83

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Figure 6b-4



● Municipal Supply Wells in Sunderland

Vulnerability Score

- 10
- 8
- 6

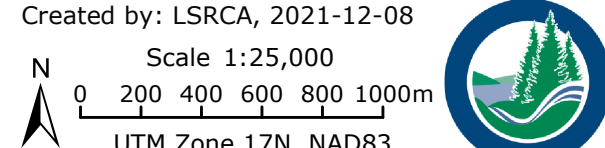
Areas Where Pathogens Are or Would Be Significant, Moderate, or Low Threats - Sunderland

Created by: LSRCA, 2021-12-08

Scale 1:25,000

0 200 400 600 800 1000m

UTM Zone 17N, NAD83



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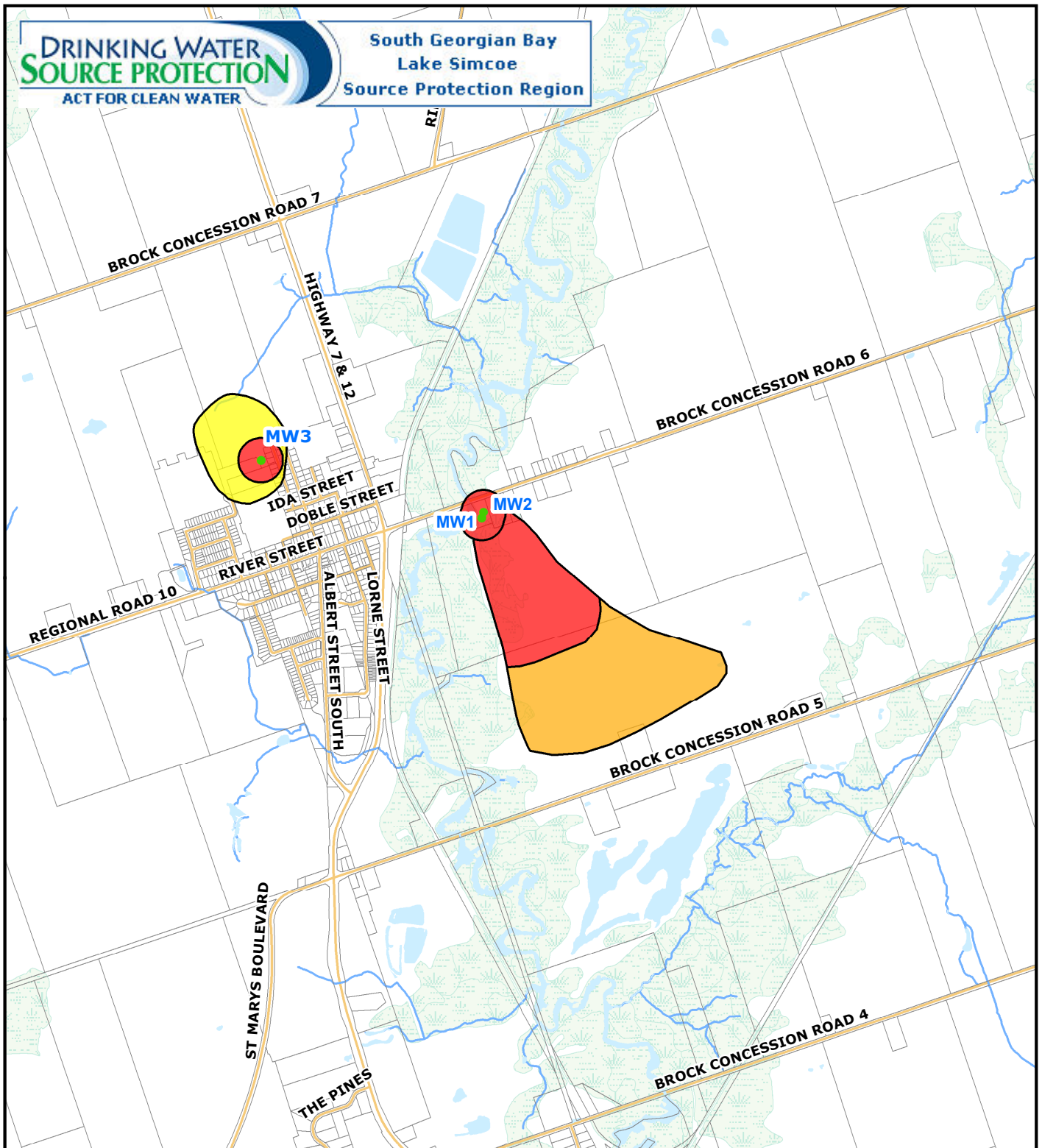
Ontario 

Figure 6b-5



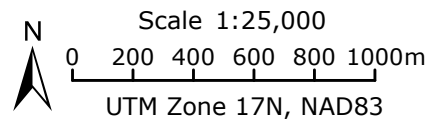
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

- Municipal Supply Wells in Sunderland
- Vulnerability Score**
- 10
 - 8
 - 6

Areas Where Chemicals Are or Would Be Significant, Moderate, or Low Threats - Sunderland

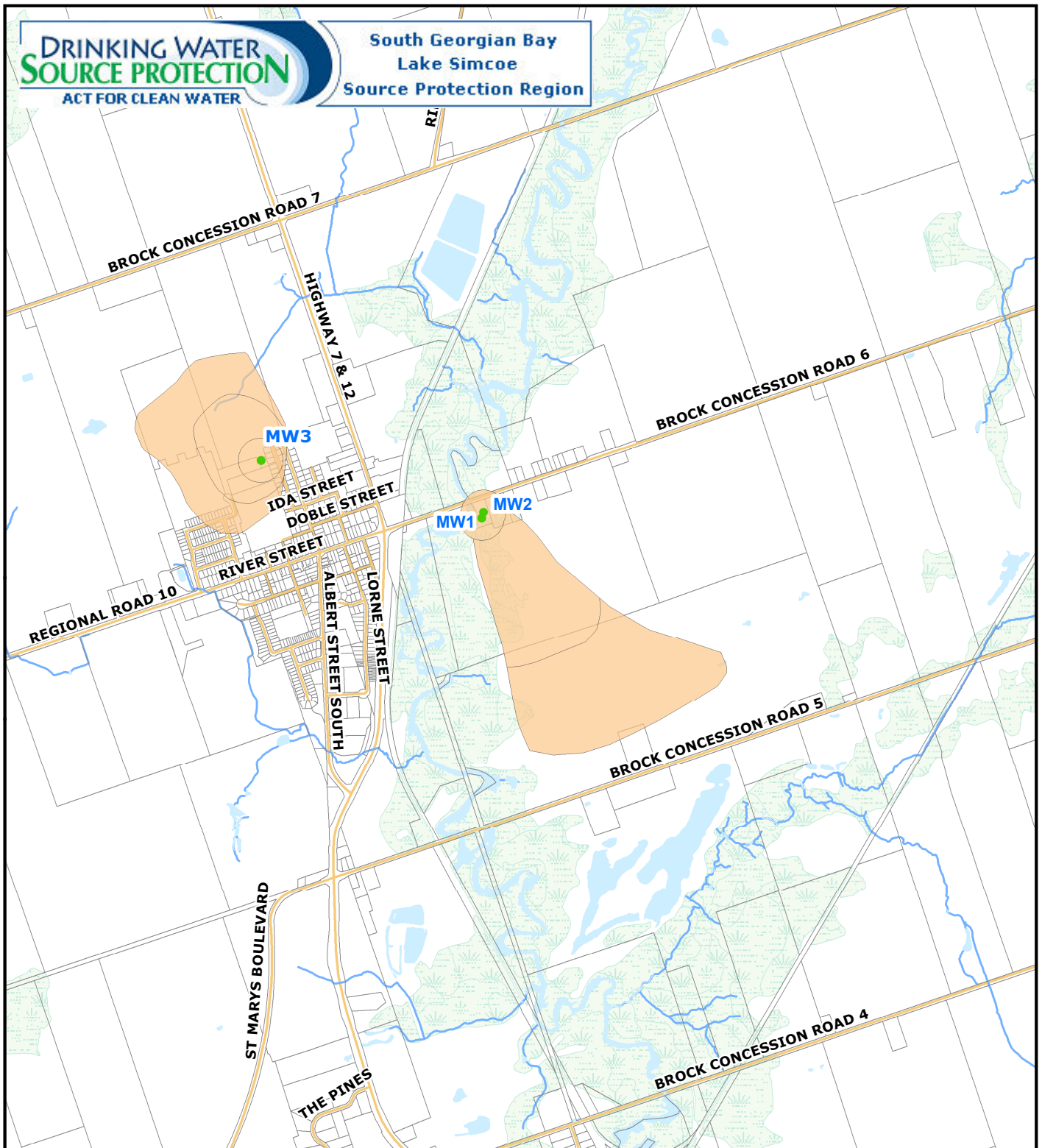
Created by: LSRCA, 2021-12-08



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 6b-6



- Municipal Supply Wells in Sunderland
- WHPA-C (5 years Time-of-Travel)
- Vulnerability Score = 6

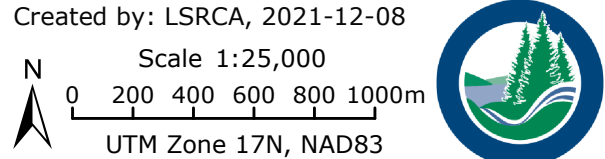
Areas Where DNAPLs Are or Would Be Significant, Moderate, or Low Threats - Sunderland

Created by: LSRCA, 2021-12-08

Scale 1:25,000

0 200 400 600 800 1000m

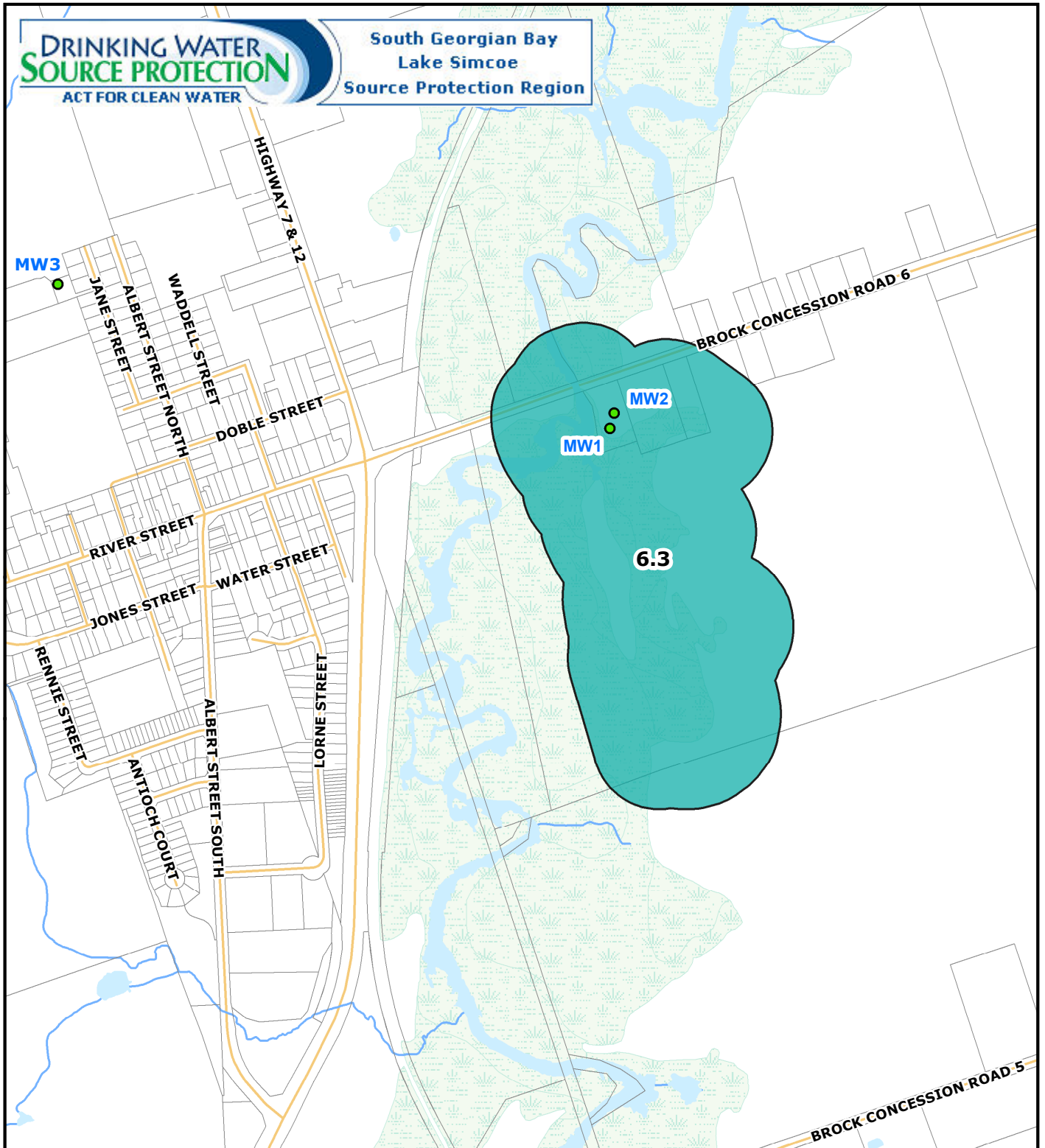
UTM Zone 17N, NAD83



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Ontario 

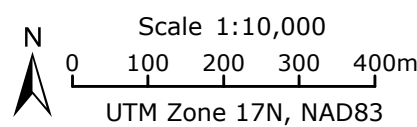
Figure 6b-7



- Municipal Supply Wells in Sunderland
- WHPA-E
- Vulnerability Score = 6.3

Areas of Moderate and Low Threats – Pathogens and Chemicals (WHPA-E) - Sunderland

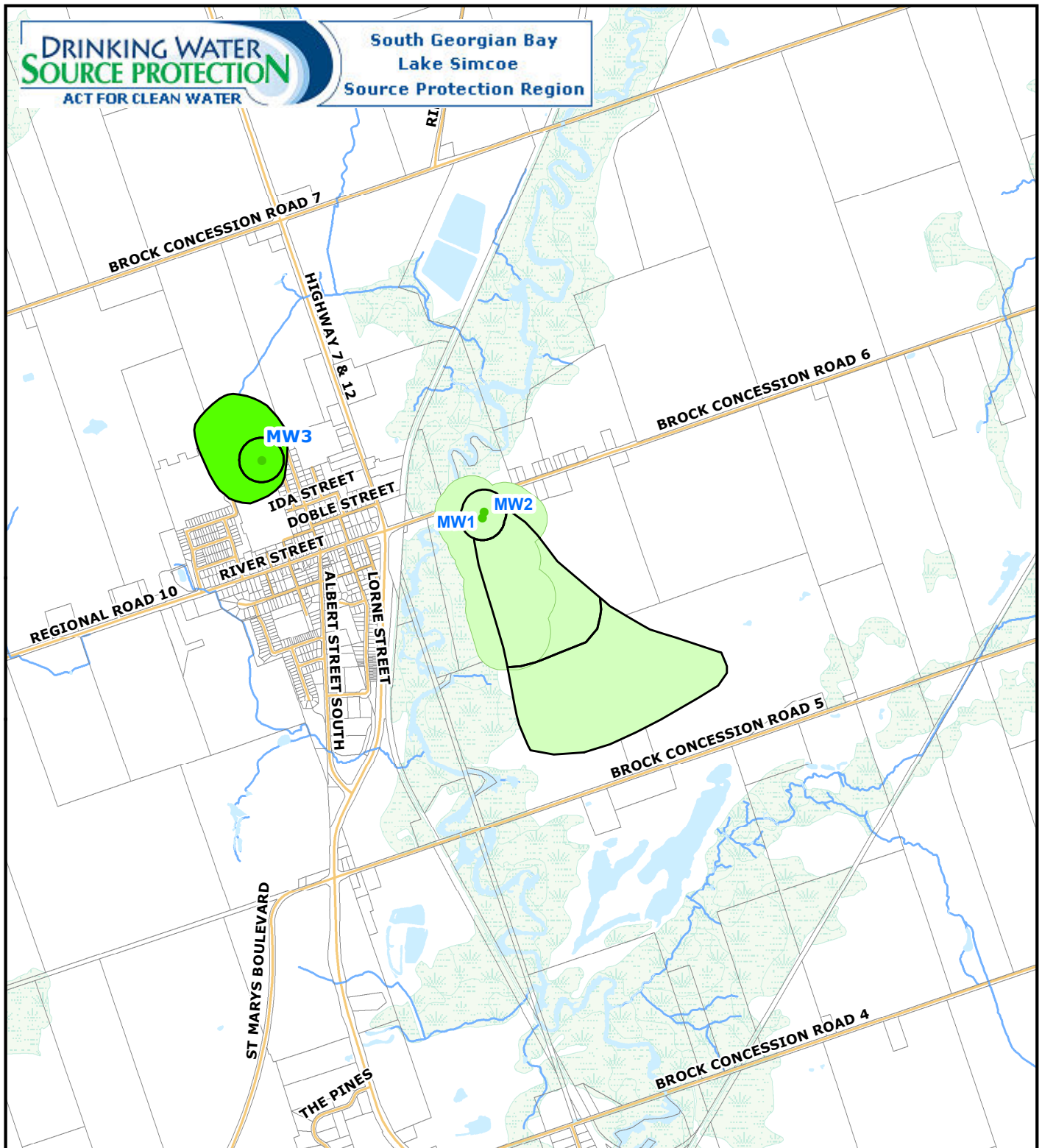
Created by: LSRCA, 2021-12-08



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 6b-8



● Municipal Supply Wells in Sunderland
Managed Lands
 < 40%
 40 - 80%
 > 80%

Managed Lands - Sunderland

Created by: LSRCA, 2021-12-08

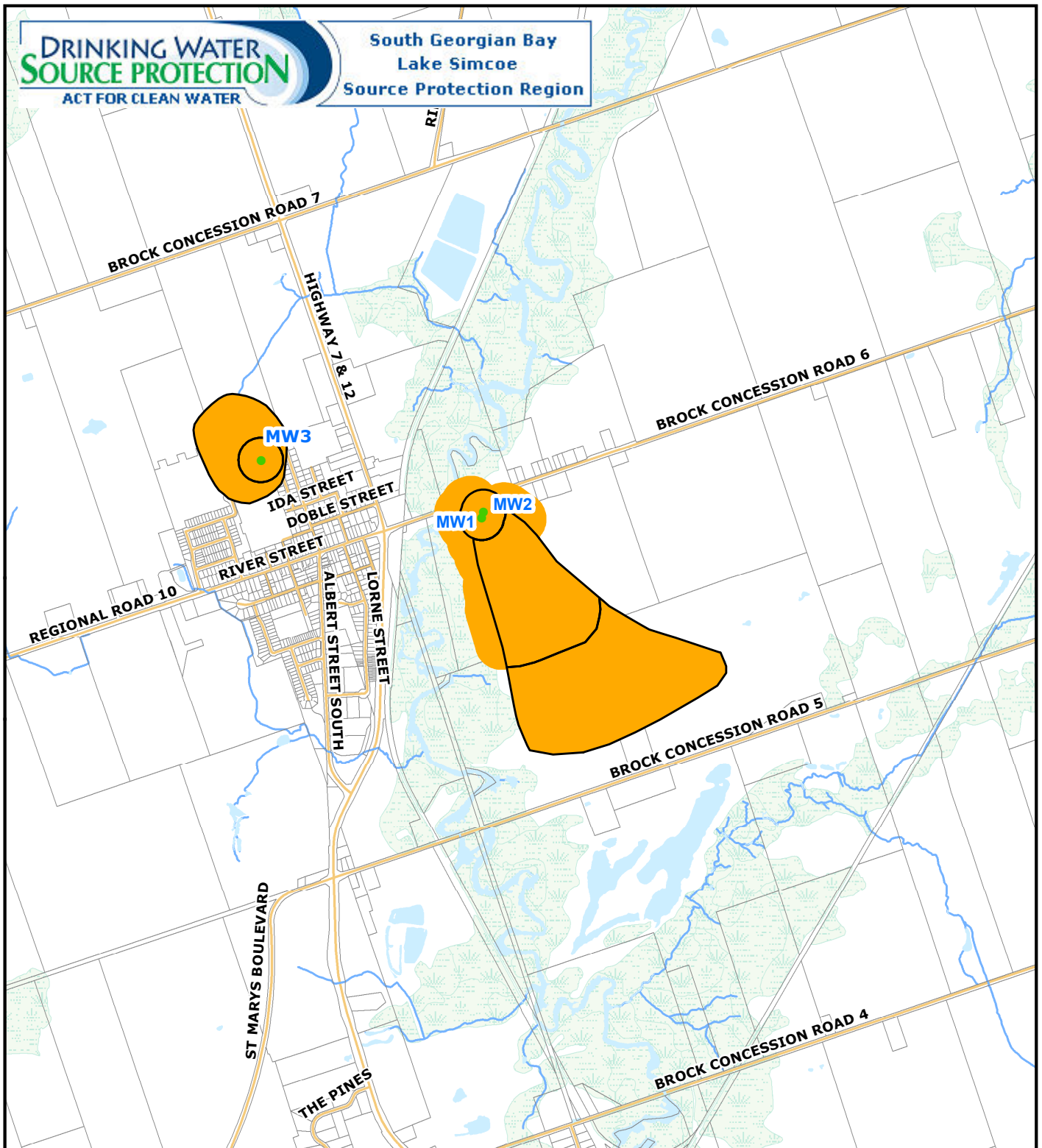
Scale 1:25,000

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0 200 400 600 800 1000m
 UTM Zone 17N, NAD83

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Figure 6b-9



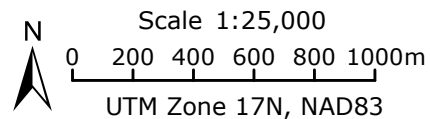
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

- Municipal Supply Wells in Sunderland
- Livestock Density**
- <0.5 Nutrient Units
 - 0.5-1.0 Nutrient Units
 - >1.0 Nutrient Units

Livestock Density - Sunderland

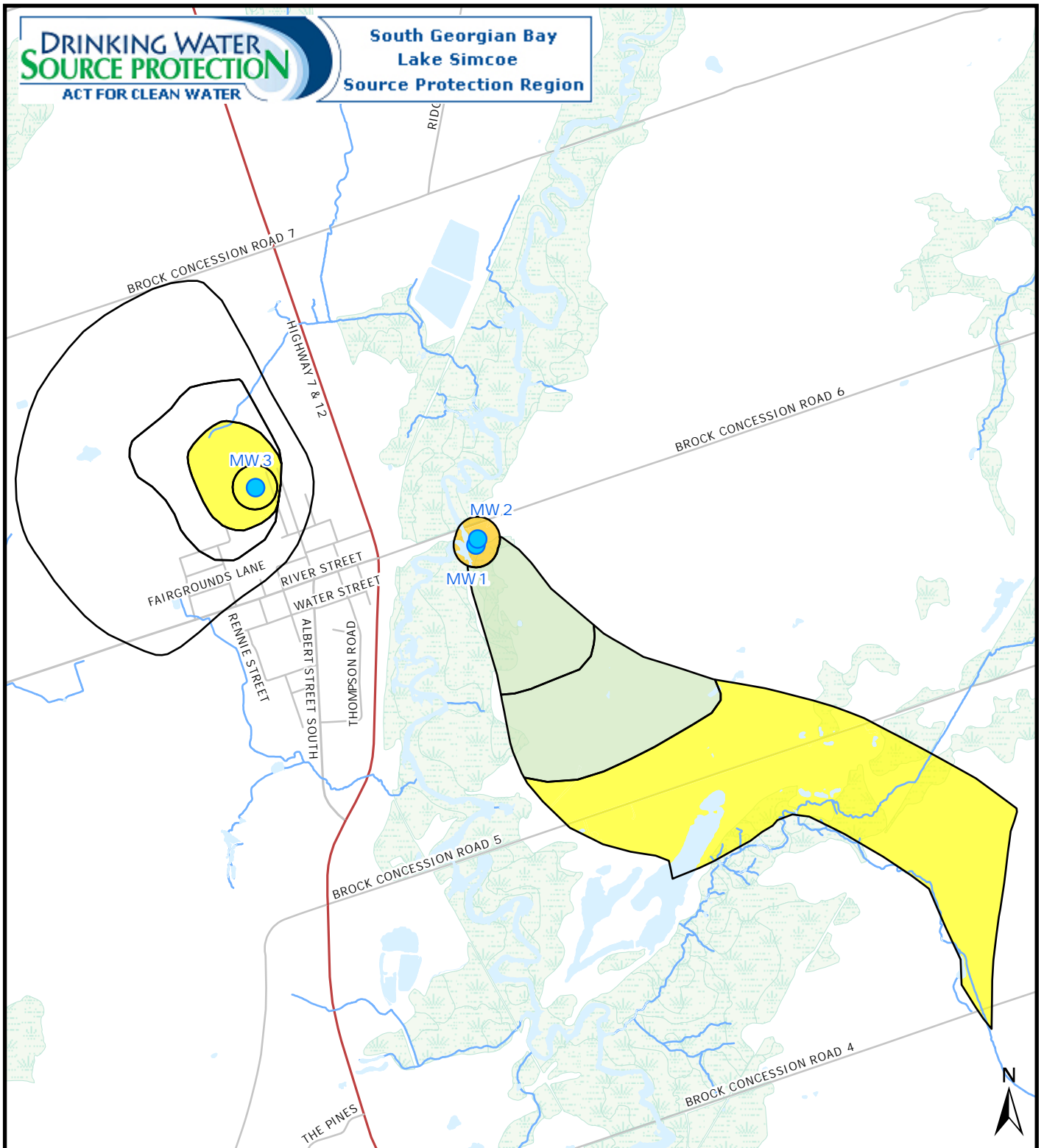
Created by: LSRCA, 2021-12-08



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Figure 6b-10



- Well
- Impervious Surfaces in WHPA**
- < 1%
- = 1 - < 6%
- = 6 - < 8%
- = 8 - < 30%
- > = 30%

**Impervious Surfaces - Sunderland
WHPA**

Created by: LSRCA, 2025-08-05

Scale 1: 25,000

0 220 440 880 m

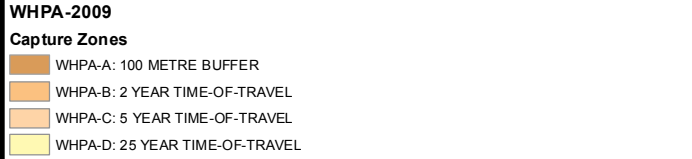
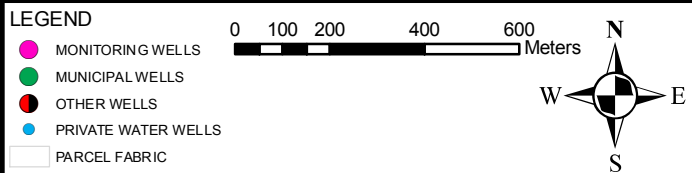
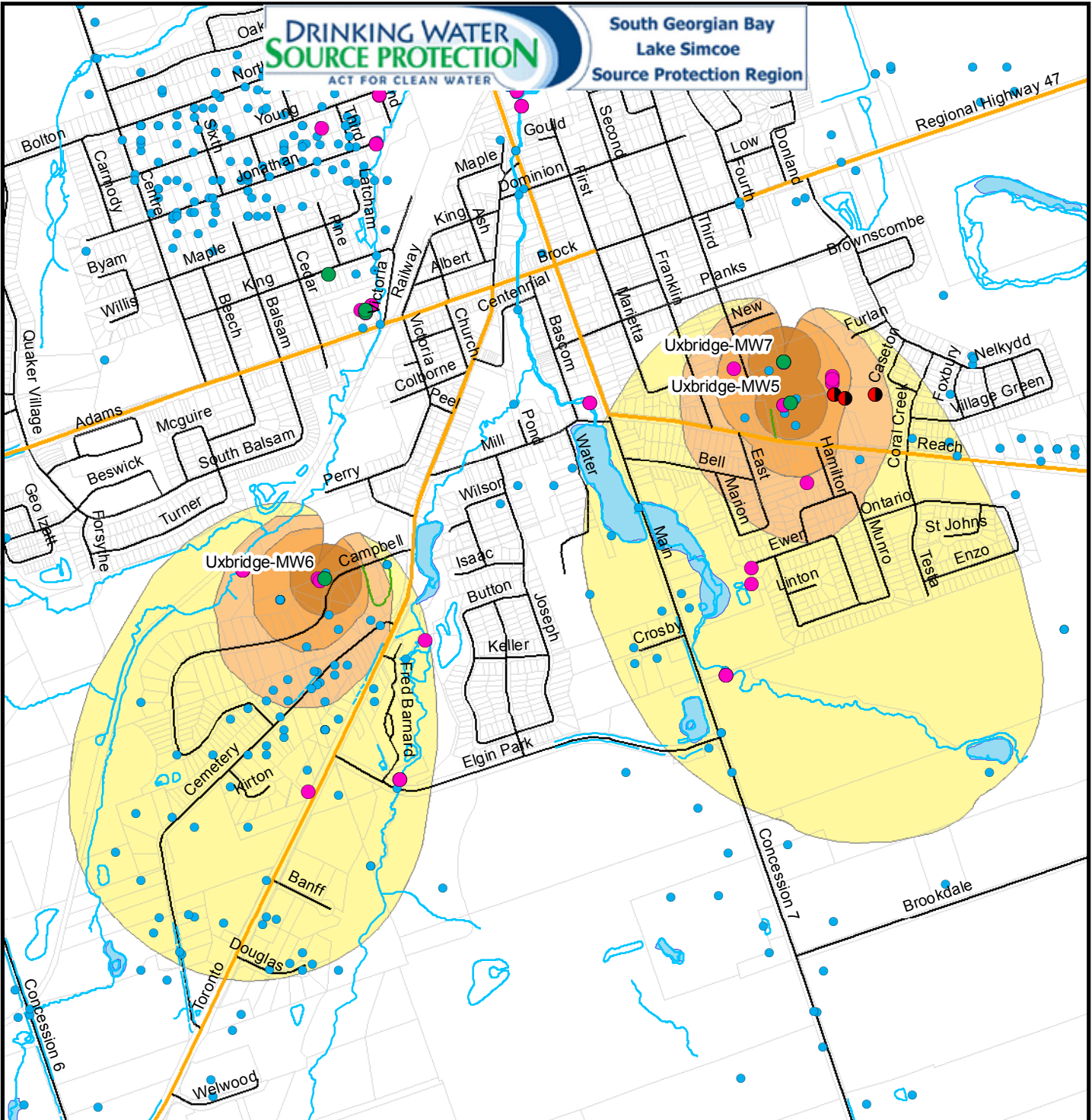
UTM Zone 17N, NAD83



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Figure 6b-11

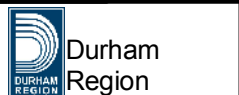


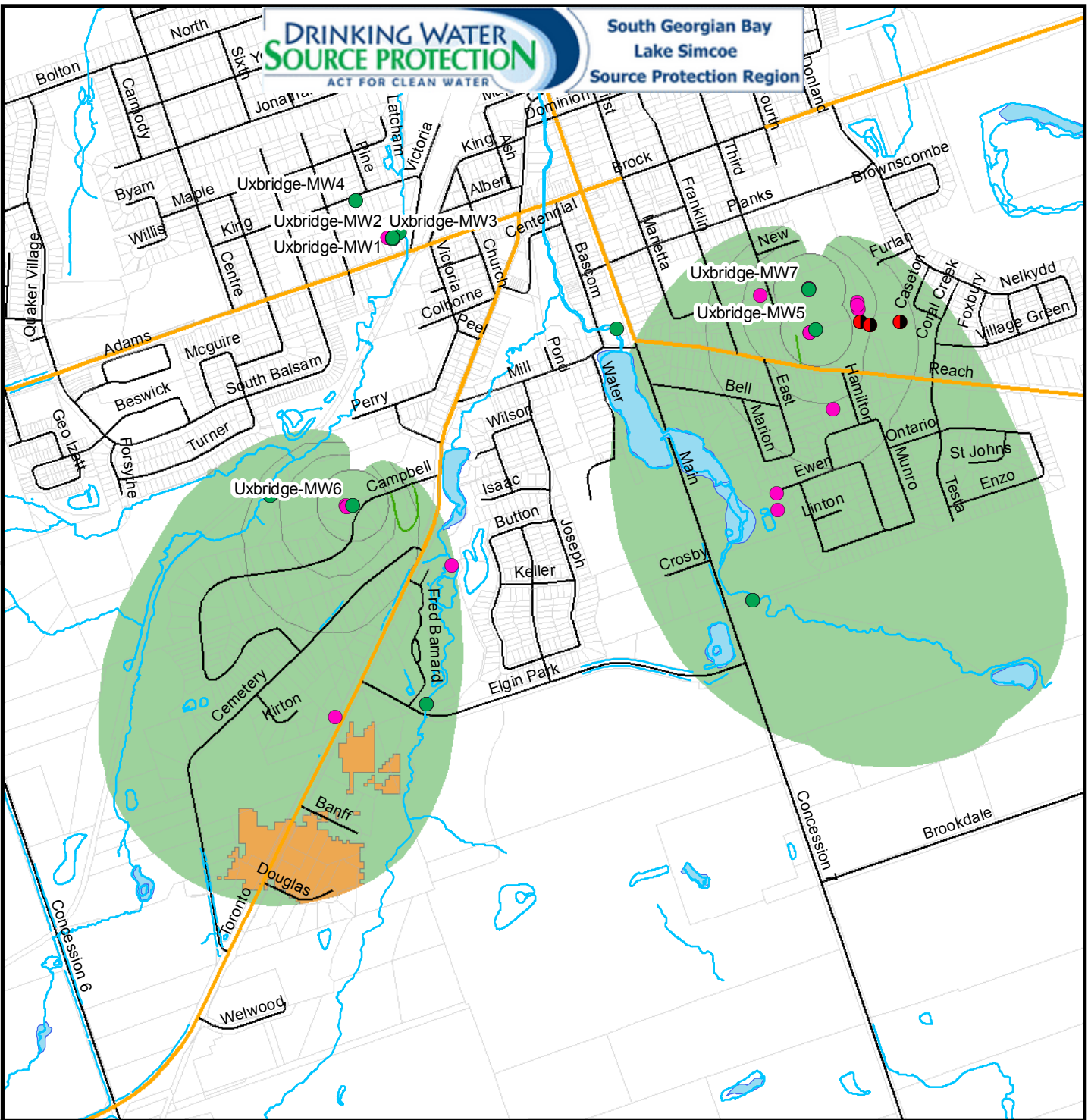
WELLHEAD PROTECTION AREAS - UXBRIDGE

ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
PROJECT: WG-246-07	

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LEGEND

0 100 200 400 600 Meters

- MONITORING WELLS
- MUNICIPAL WELLS
- OTHER WELLS
- PARCEL FABRIC

AQUIFER VULNERABILITY INDEX

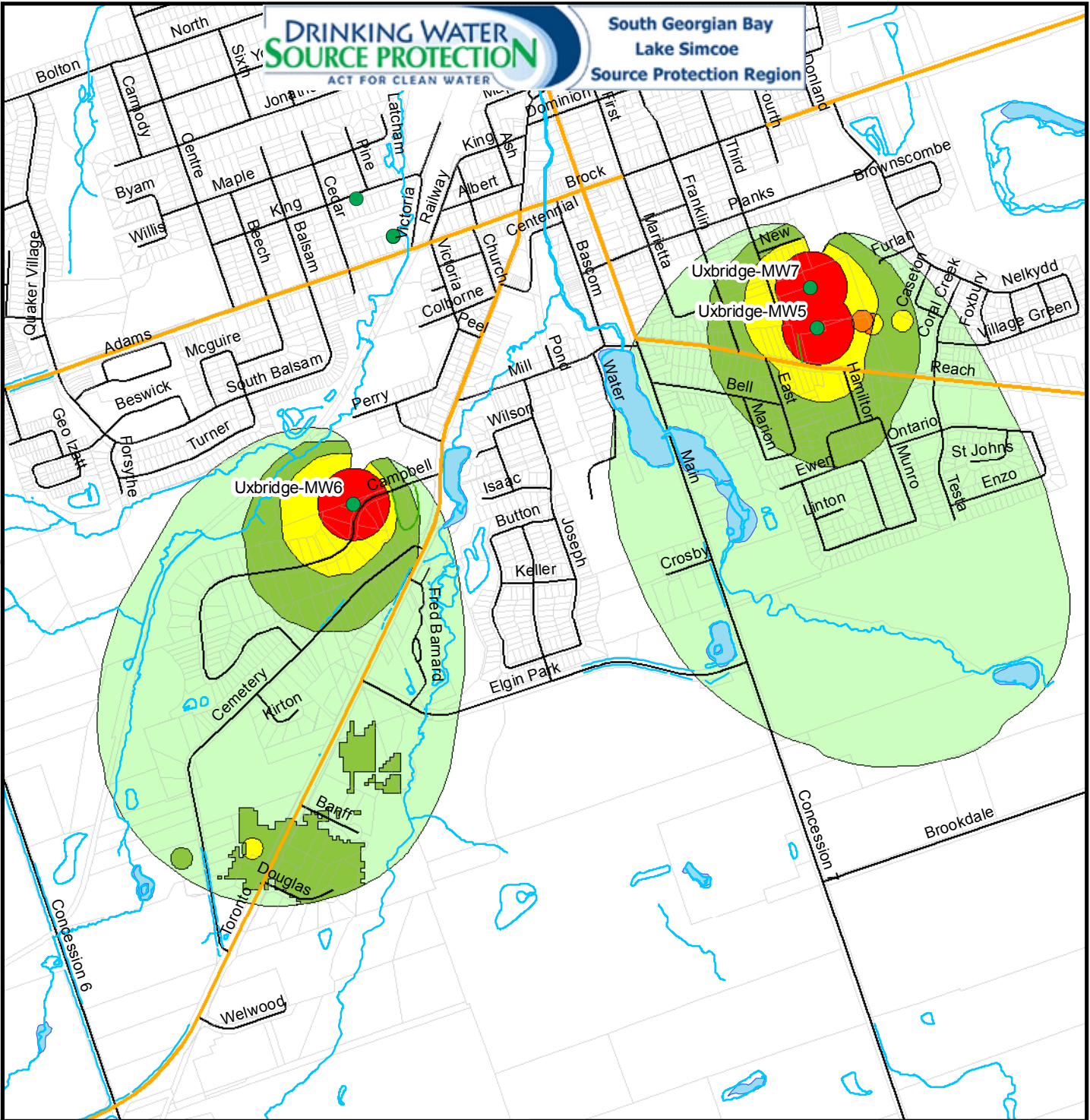
- HIGH
- MEDIUM
- LOW

GROUNDWATER VULNERABILITY - UXBRIDGE

ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
PROJECT: WG-246-07	

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LEGEND

● MUNICIPAL WELLS

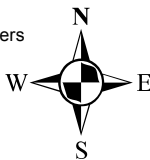
▭ PARCEL FABRIC

Vulnerability Scoring

Final Score

- 10
- 8
- 6
- 4
- 2

0 100 200 400 600 Meters



VULNERABILITY SCORE - UXBRIDGE

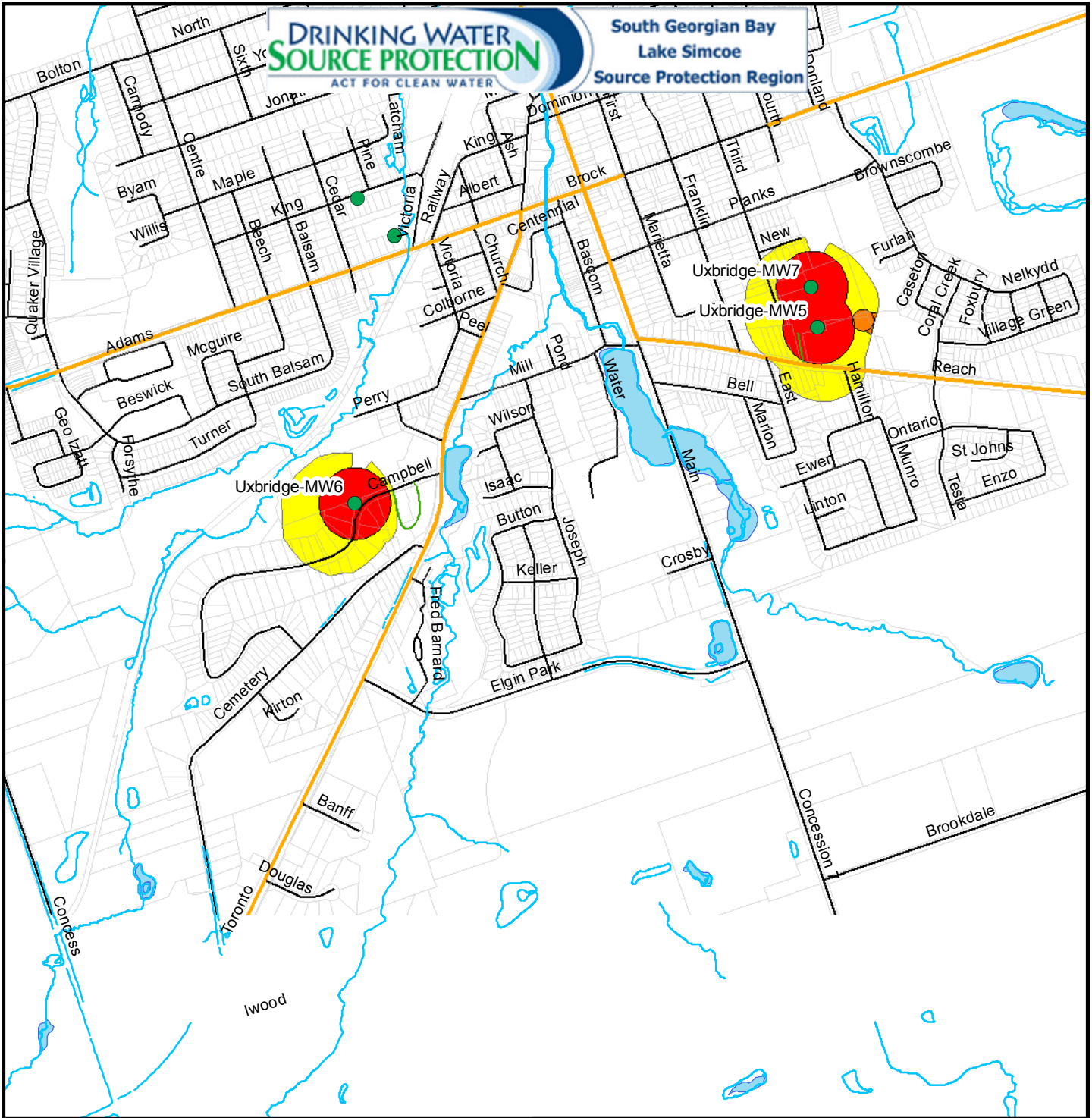
ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010

SCALE: 1:16,000

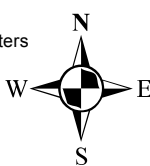
PROJECT: WG-246-07

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LEGEND

0 100 200 400 600 Meters



- MUNICIPAL WELLS
- PARCEL FABRIC

Vulnerability Scoring

- 10
- 8
- 6
- 4
- 2

AREAS OF SIGNIFICANT, MODERATE OR LOW THREAT - PATHOGENS

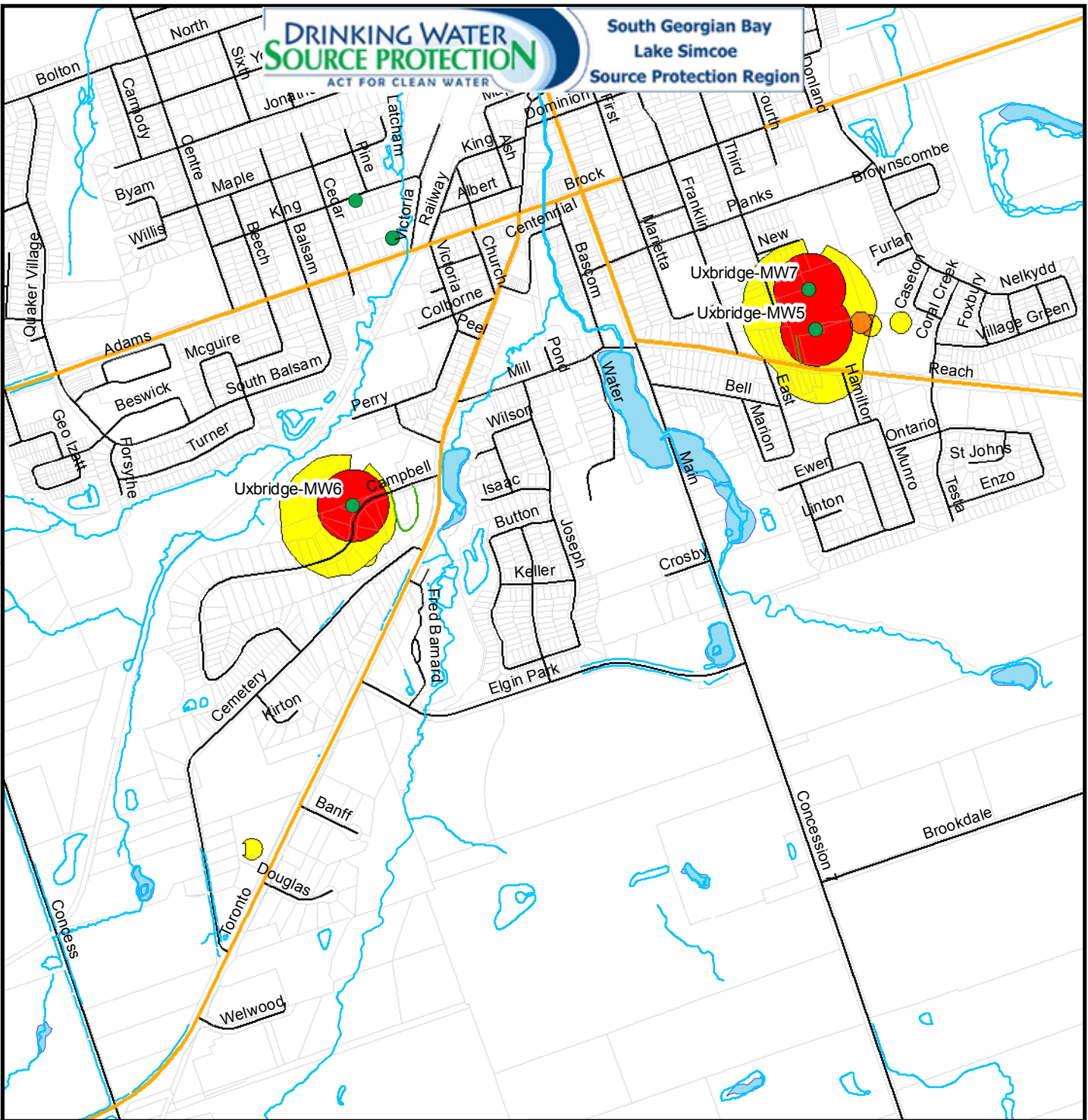
ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010

SCALE: 1:16,000

PROJECT: WG-246-07

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LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC

Vulnerability Scoring

FinalScore

- 10
- 8
- 6
- 4
- 2

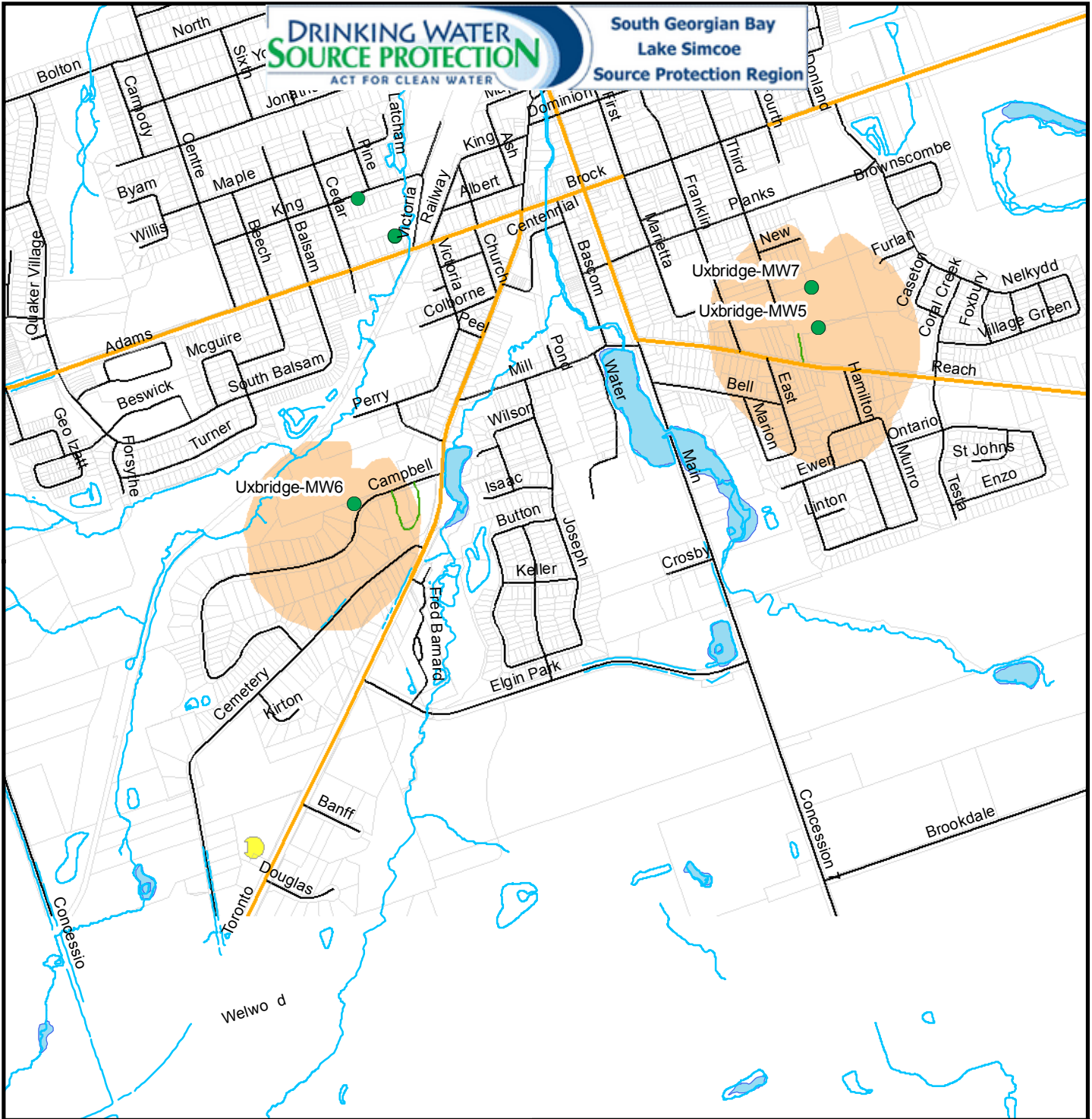
0 100 200 400 600 Meters

AREAS OF SIGNIFICANT, MODERATE OR LOW THREAT - CHEMICALS

ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
PROJECT: WG-246-07	

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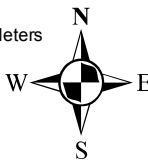
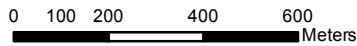


LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC

VULNERABILITY SCORING

- SIGNIFICANT DNAPL THREAT
- MODERATE DNAPL THREAT



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - DNAPLS

ASSESSMENT OF DRINKING WATER THREATS- UXBRIDGE
The Regional Municipality of Durham

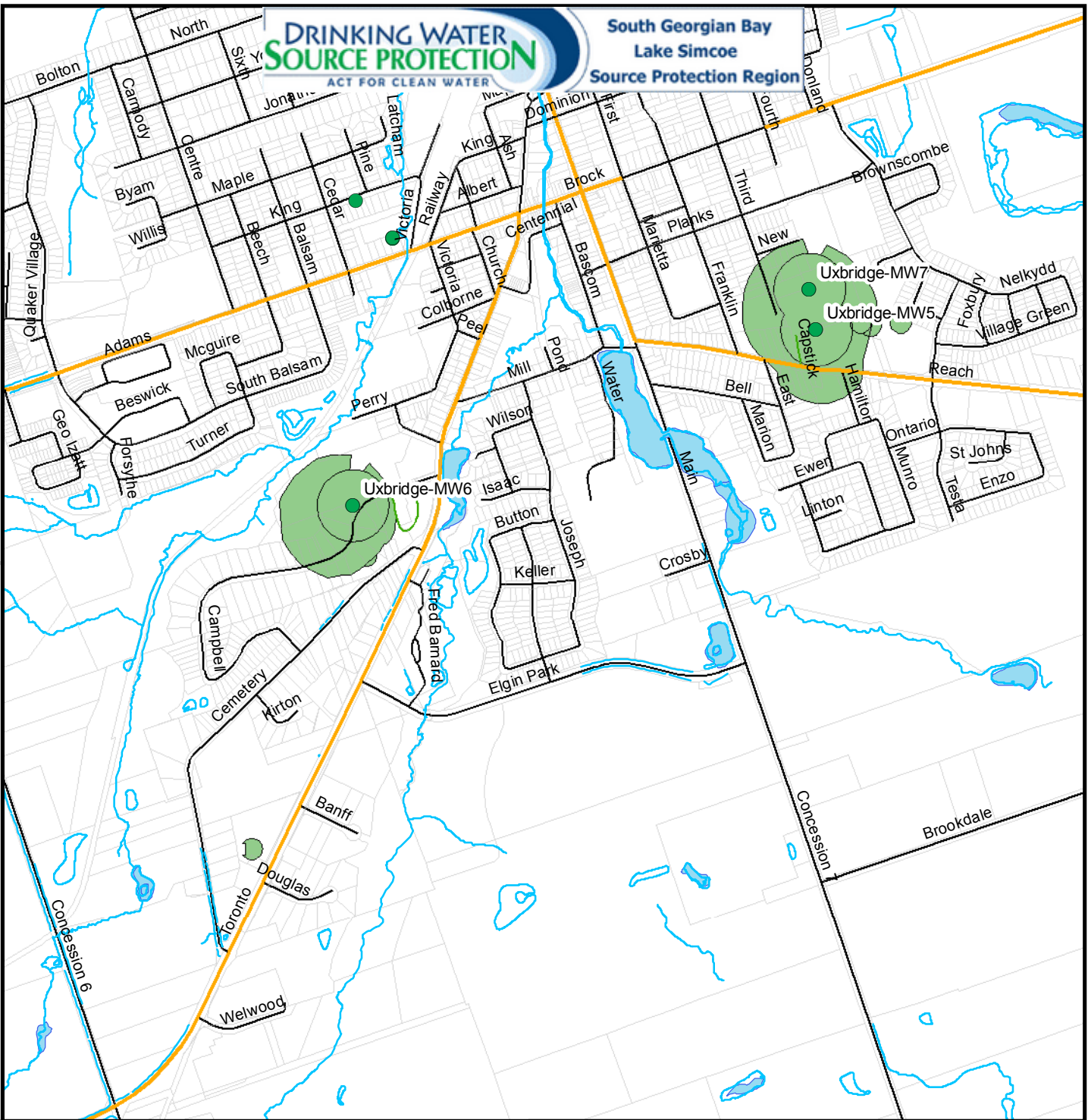
DATE: JUNE 2010

SCALE: 1:16,000

PROJECT: WG-246-07

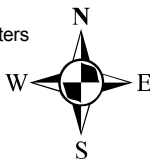
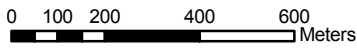
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LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC
- MANAGED LANDS (40-80%)



MANAGED LANDS - UXBRIDGE

ASSESSMENT OF DRINKING WATER
THREATS- UXBRIDGE
The Regional Municipality of Durham

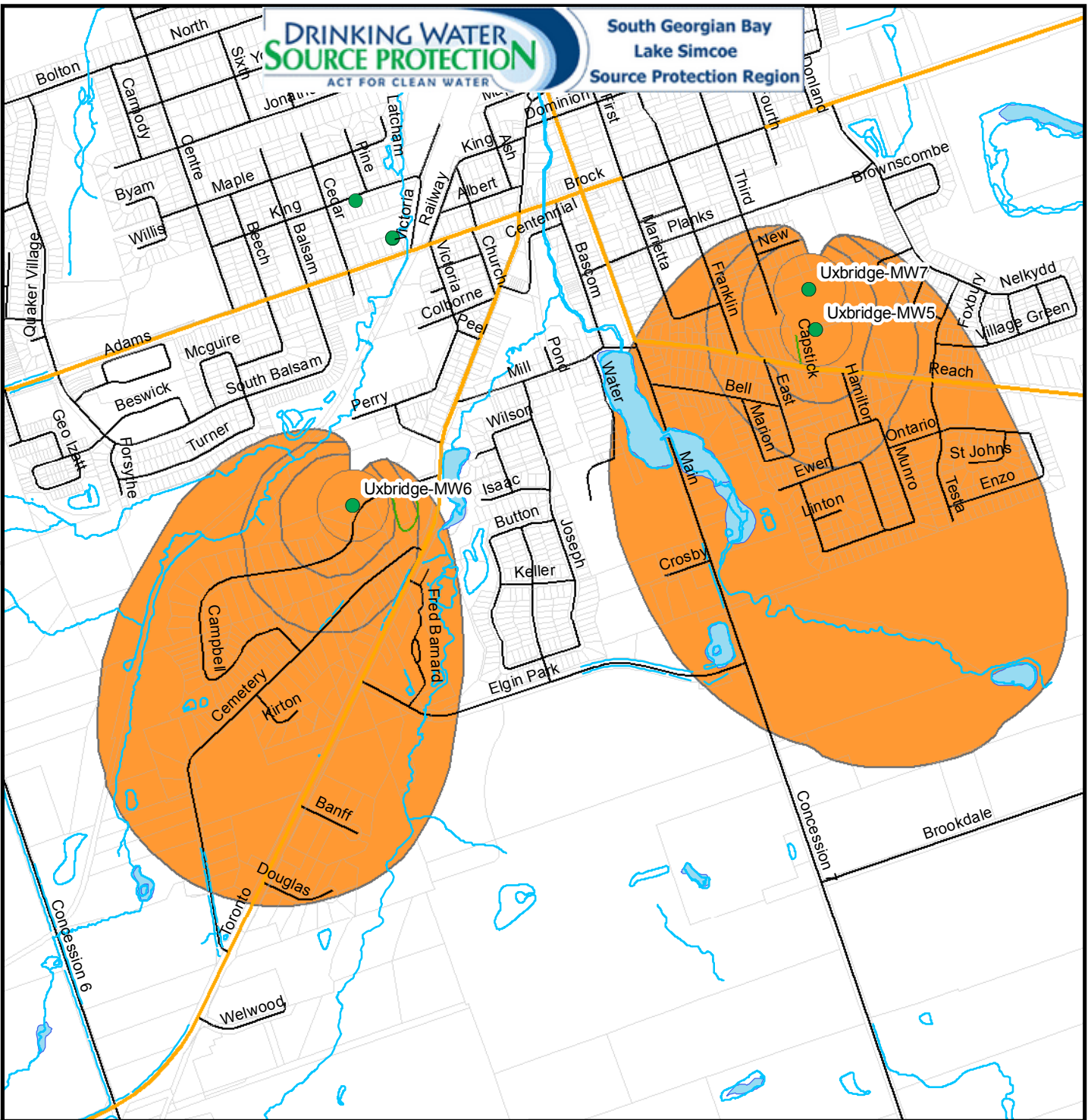
DATE: JUNE 2010

SCALE: 1:16,000

PROJECT: WG-246-07

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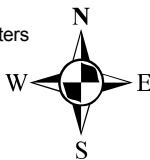




LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC
- < 0.5 NU/ACRE

0 100 200 400 600 Meters



LIVESTOCK DENSITY - UXBRIDGE

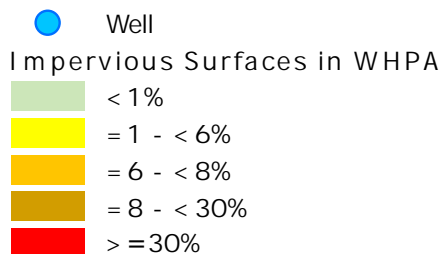
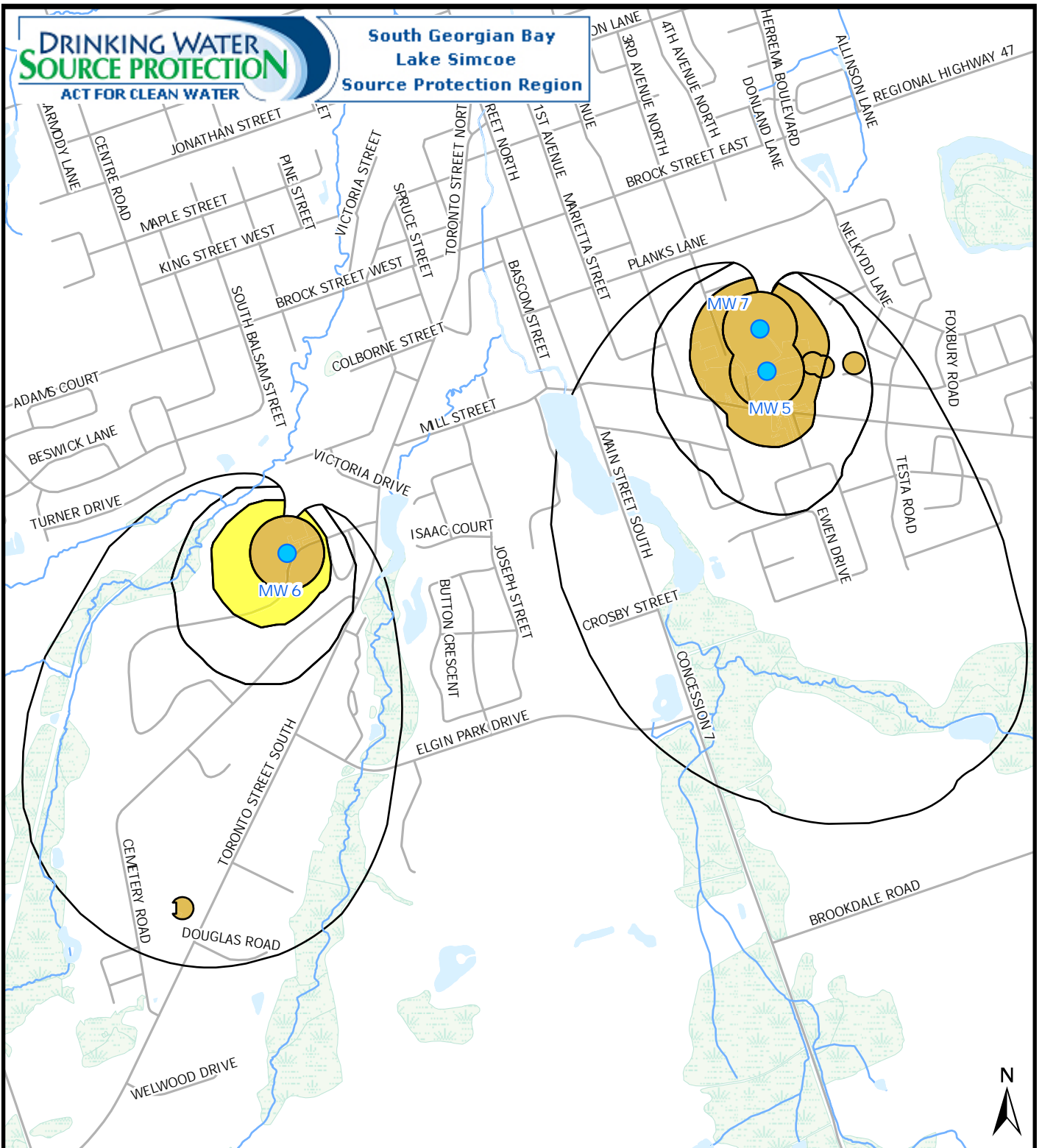
ASSESSMENT OF DRINKING WATER
THREATS- UXBRIDGE
The Regional Municipality of Durham

DATE: JUNE 2010

SCALE: 1:16,000

PROJECT: WG-246-07

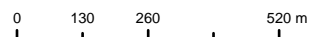
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**Impervious Surfaces - Uxbridge
WHPA**

Created by: LSRCA, 2025-08-05

Scale 1:15,000



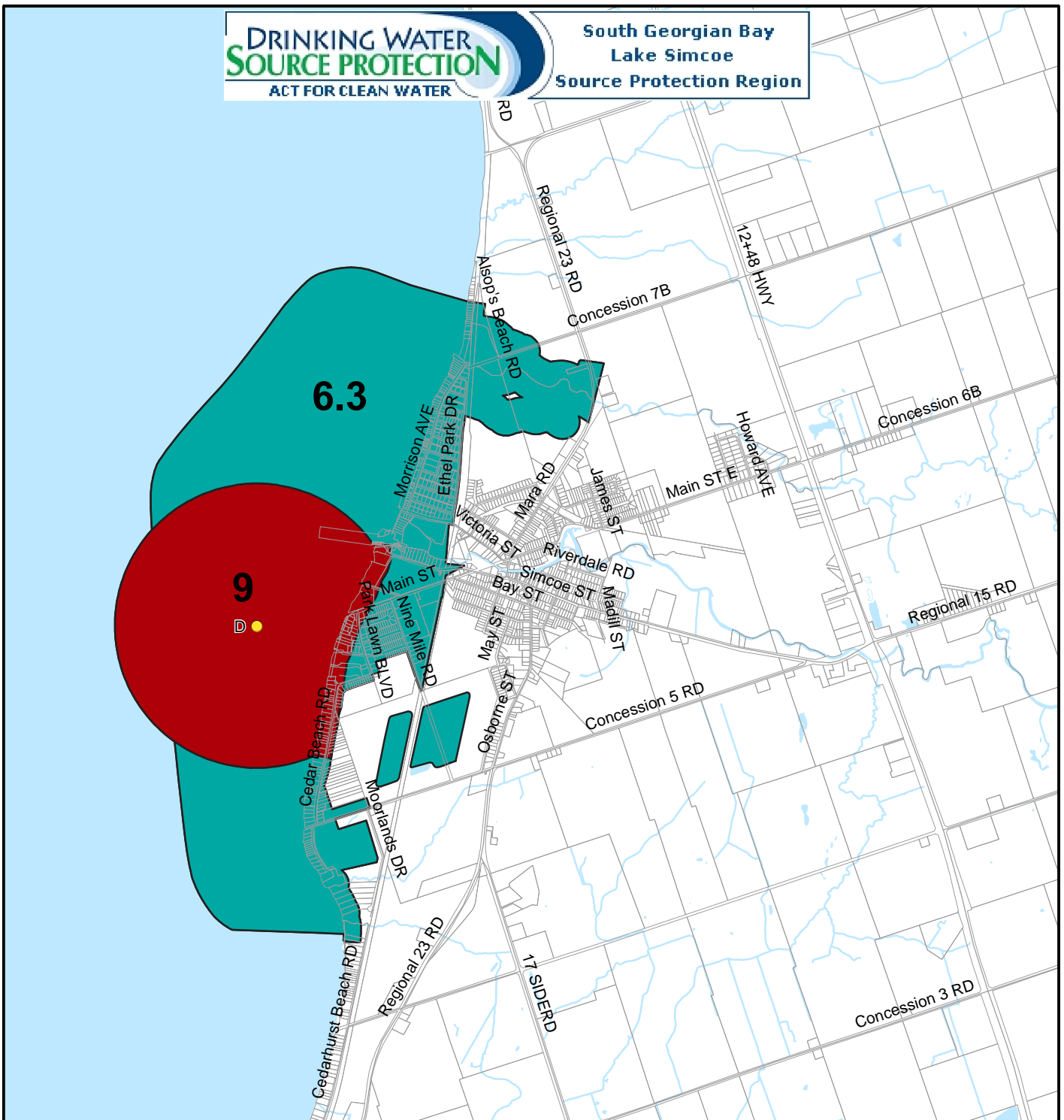
UTM Zone 17N, NAD83



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 6c-9



Legend

- IPZ 1 AND VULNERABILITY SCORE
- IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)



490 245 0 490 Metres

**INTAKE PROTECTION ZONES AND
VULNERABILITY SCORES -
BEAVERTON, DURHAM REGION**

DATE: JUNE 2010

SCALE: 1:40000

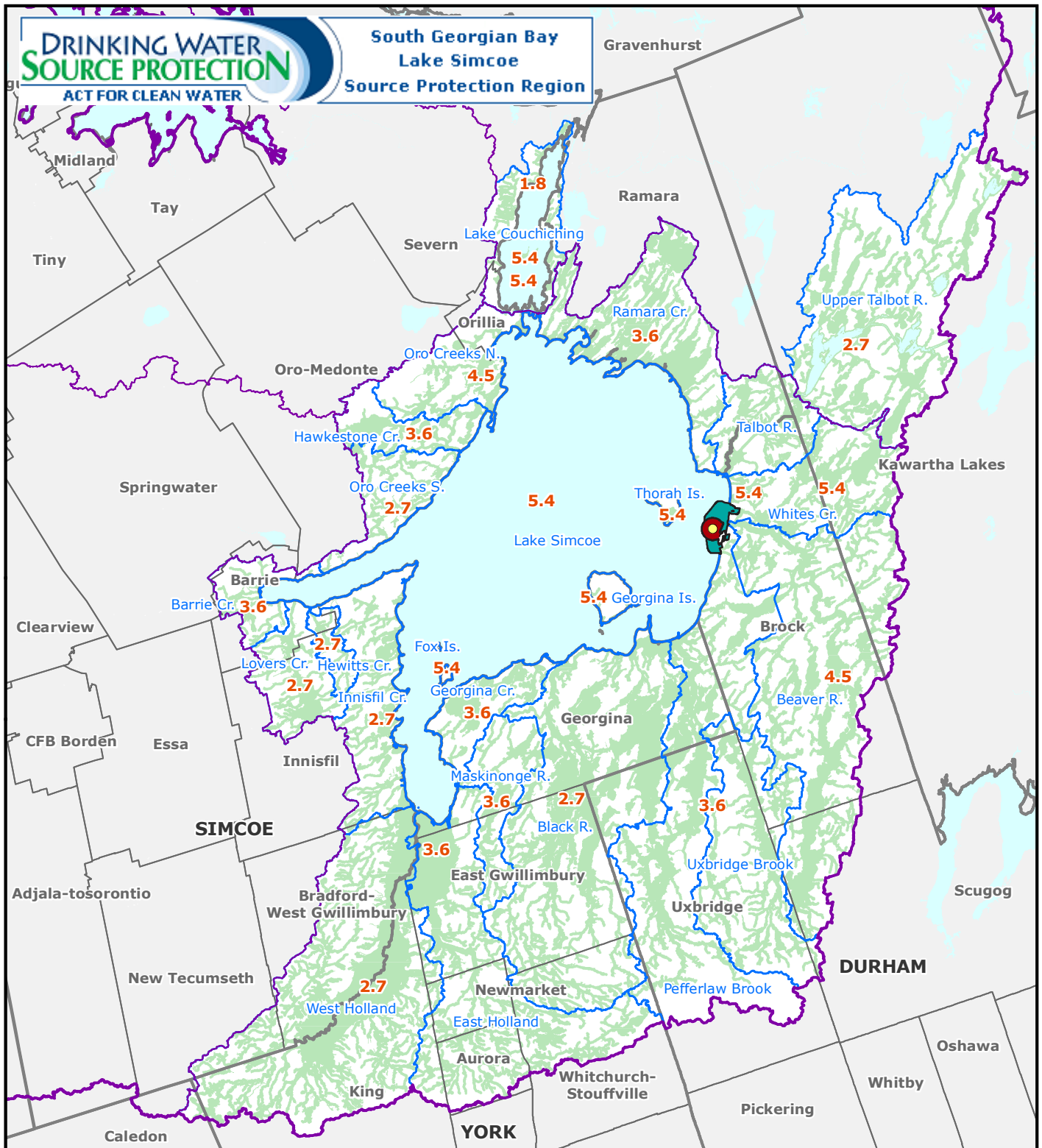
PROJECT: 0-071948.13

FILE. NO.:0-07194813F4-1

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. 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.

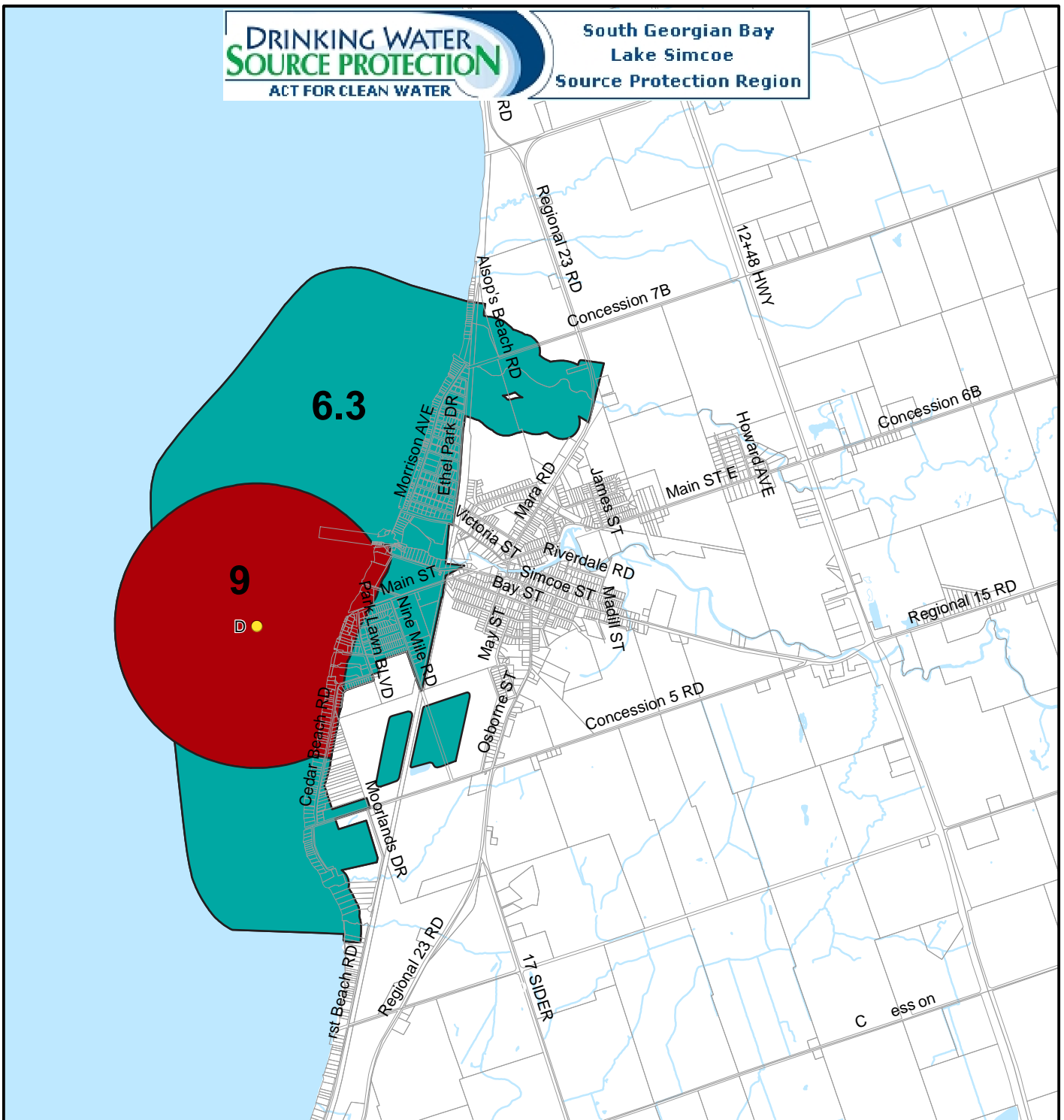


FIGURE
6d-1



<ul style="list-style-type: none"> ● Surface Water Intake ■ IPZ-1 ■ IPZ-2 ■ IPZ-3 and Vulnerability Score ■ SWP Watershed Region ■ SWP Watershed Area ■ Subwatershed Boundary 	<p>Intake Protection Zone 3 and Vulnerability Scores Beaverton, Durham Region</p>
<p>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.</p>	<p>Created by: LSRCA Date: 2010-10-20</p> <p>GENIVAR</p> <p>Scale: 1:500,000 0 2 4 6 8 10km UTM Zone 17N, NAD83</p>

<p>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.</p>		<p>Figure 6d-2</p>
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Legend

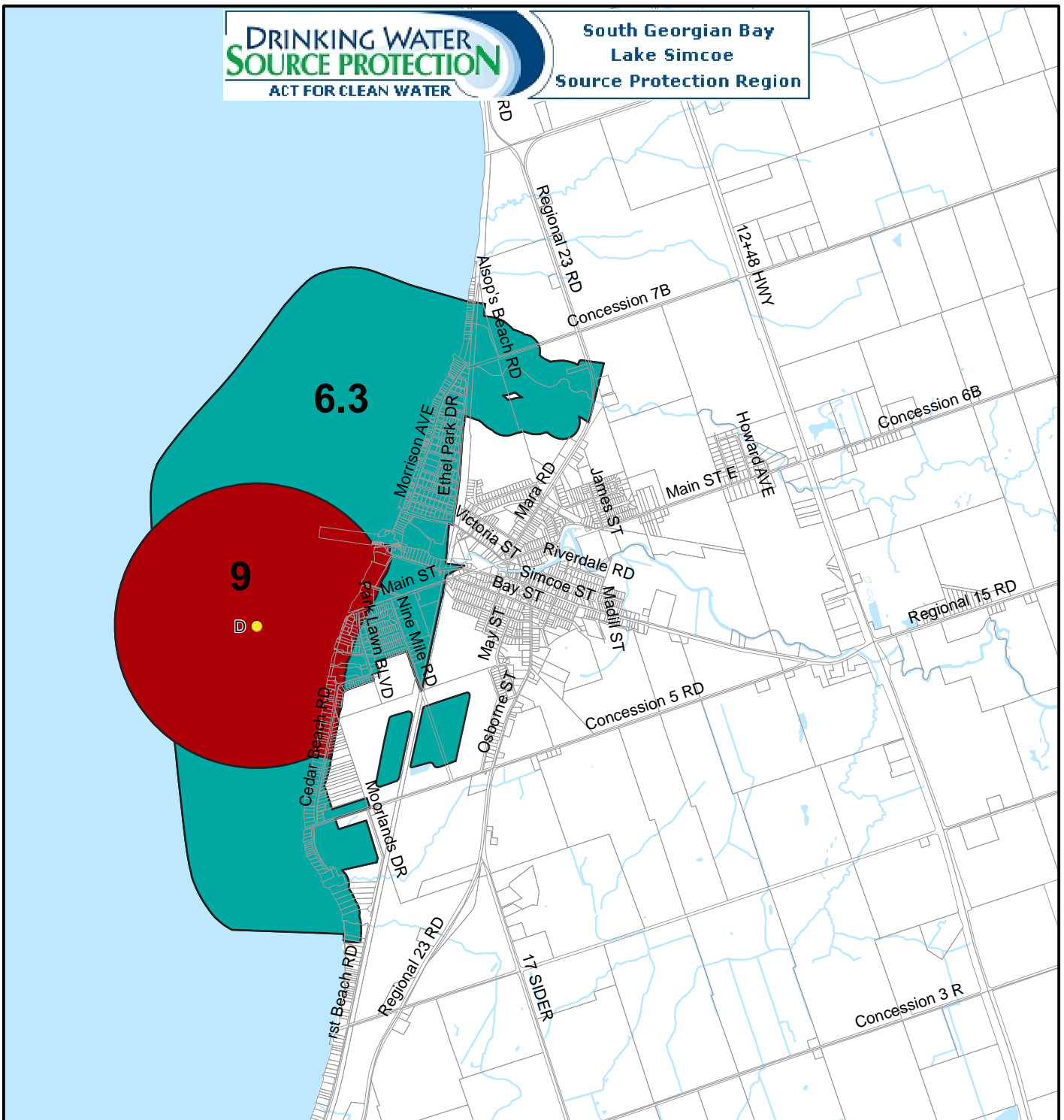
- IPZ 1 AND VULNERABILITY SCORE 10
 - IPZ 2 AND VULNERABILITY SCORE 7
 - SURFACE WATER INTAKE (TYPE D)
- W N E S
-

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BEAVERTON

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010	SCALE: 1:40000
PROJECT: 0-071948.13	FILE. NO.:0-07194813F4-2

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. 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.



Legend

- IPZ 1 AND VULNERABILITY SCORE 10
- IPZ 2 AND VULNERABILITY SCORE 7
- SURFACE WATER INTAKE (TYPE D)



500 250 0 500 Metres

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - BEAVERTON

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: JUNE 2010

SCALE: 1:40000

PROJECT: 0-071948.13

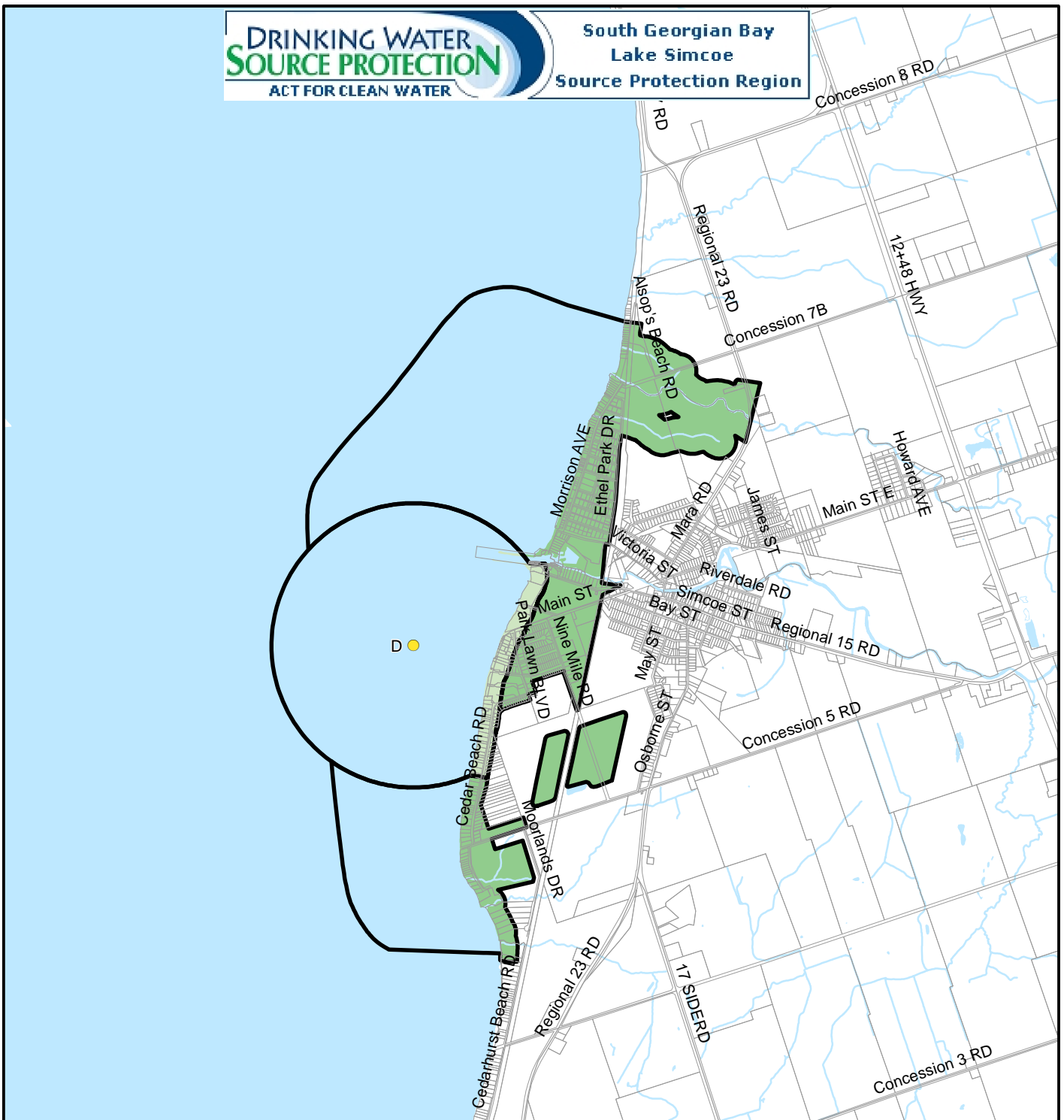
FILE. NO.:0-07194813F4-3

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FIGURE

6d-5



Legend

- MANAGED LANDS (<40%)
 - MANAGED LANDS (40-80%)
 - MANAGED LANDS (>80%)
 - SURFACE WATER INTAKE (TYPE D)
-
-

MANAGED LANDS - BEAVERTON

The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:40000

PROJECT: 0-071948.13

FILE. NO.:0-07194813F4-4

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. 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.



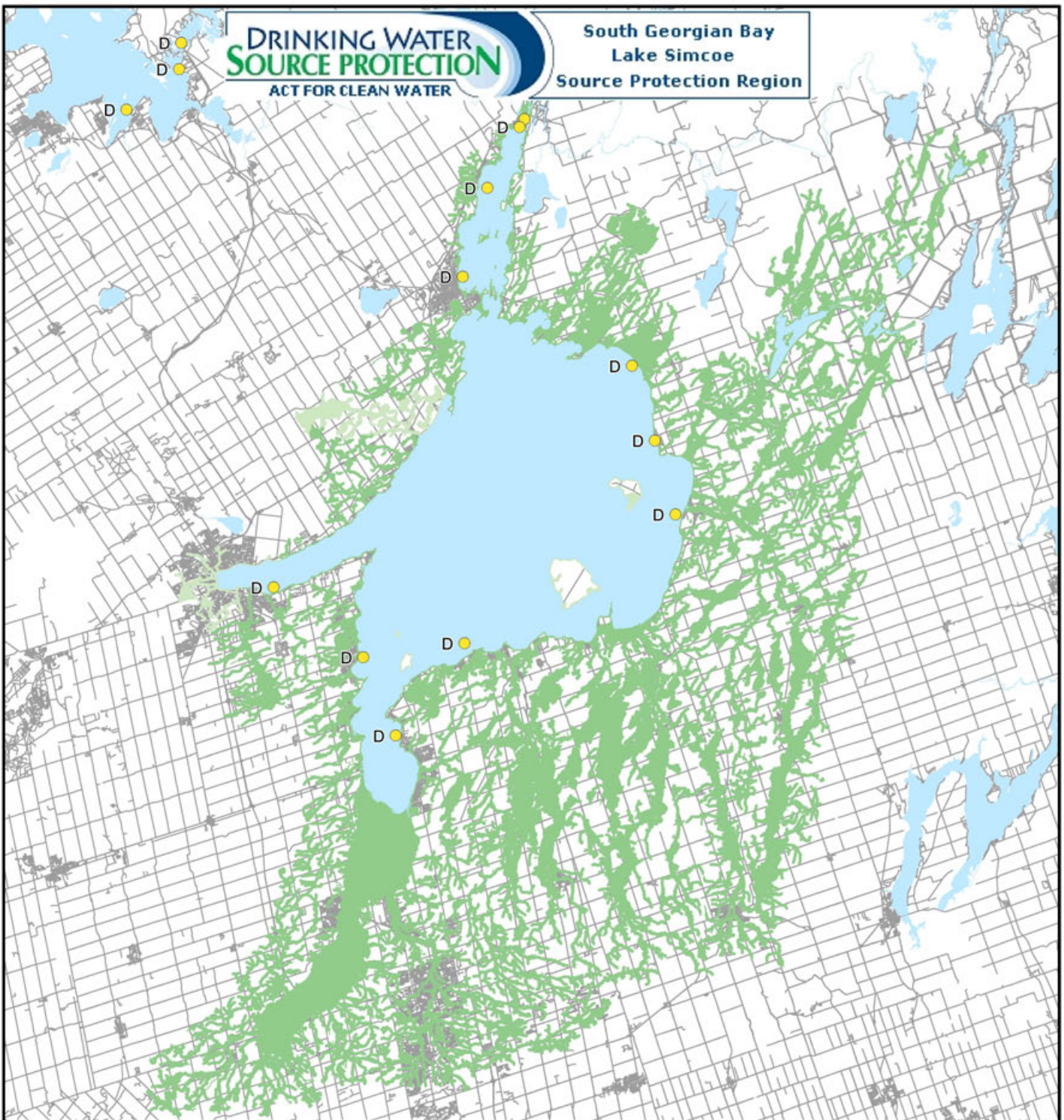
GENIVAR



Ontario

FIGURE

6d-7



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)



5,300 2,650 0 5,300 Metres

**MANAGED LANDS -
INTAKE PROTECTION ZONE 3**

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:505000

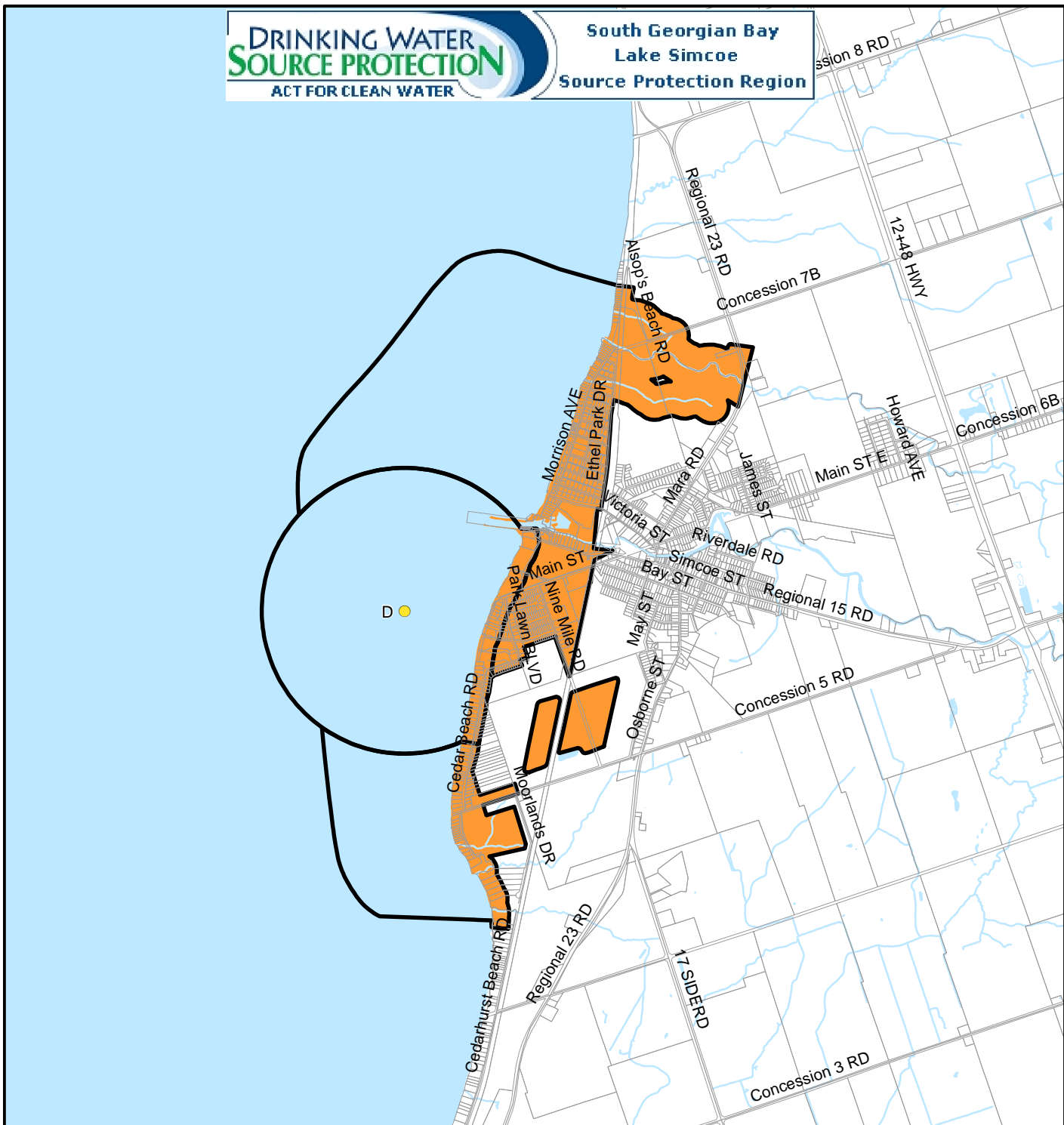
PROJECT: 0-071948.00

FILE. NO.: 0-07194800F3.3-4

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FIGURE
6d-8



Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)



LIVESTOCK DENSITY - BEAVERTON

The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:40000

PROJECT: 0-071948.13

FILE. NO.:0-07194813F4-5

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. 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.



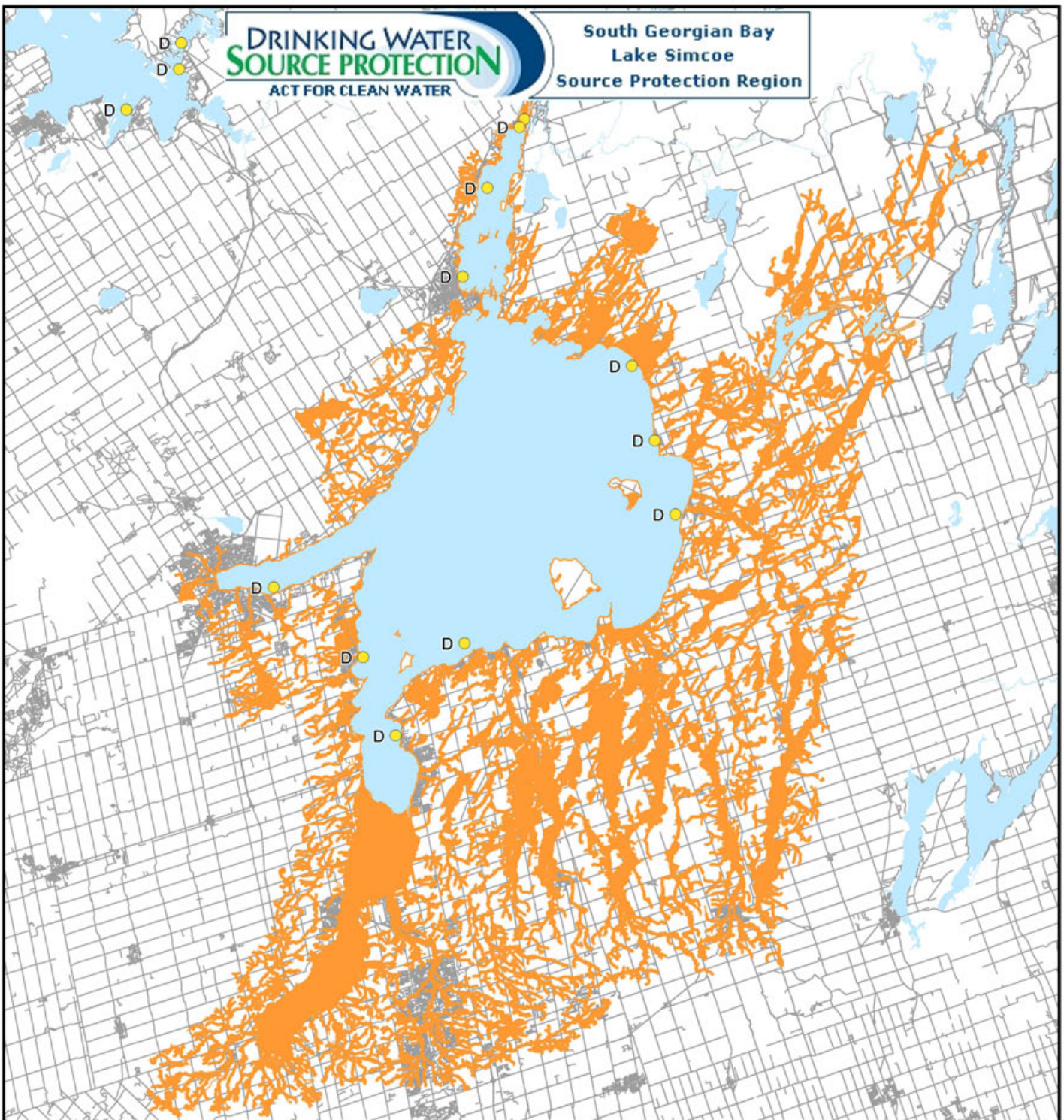
GENIVAR







Ontario

FIGURE

6d-9



Legend

-  LIVESTOCK DENSITY (<math><0.5</math> NUTRIENT UNITS/ACRE)
-  LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
-  LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
-  SURFACE WATER INTAKE (TYPE D)



5,300 2,650 0 5,300 Metres

**LIVESTOCK DENSITY -
INTAKE PROTECTION ZONE 3**

ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010

SCALE: 1:505000

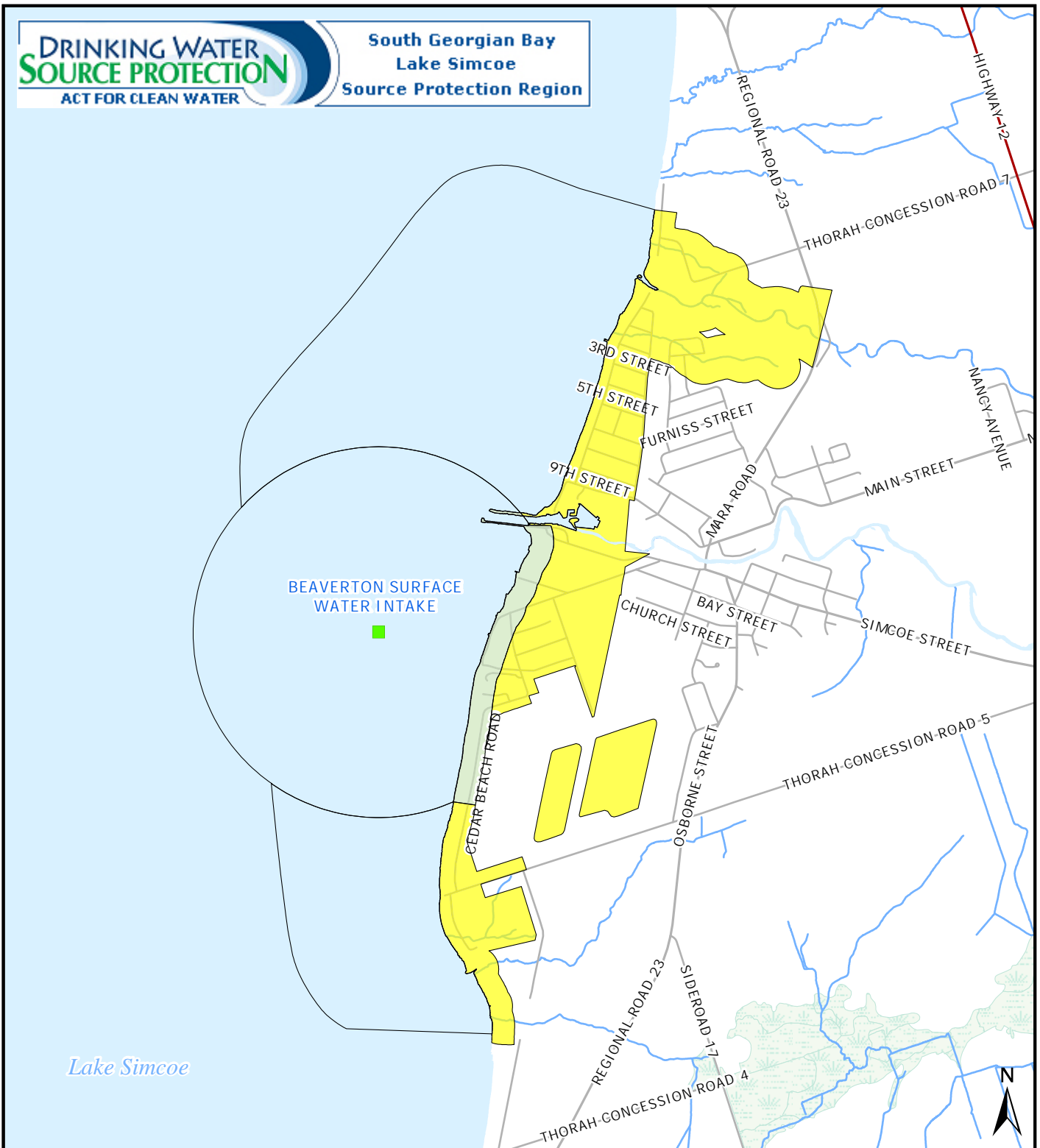
PROJECT: 0-071948.00

FILE. NO.: 0-07194800F3.3-5

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. 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
6d-10

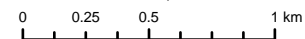


- Surface Water Intake
- Impervious Surfaces in IPZ 1 & 2
- < 1%
- = 1 - < 6%
- = 6 - < 8%
- = 8 - < 30%
- > = 30%

Impervious Surfaces - Beaverton
Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1: 30,000



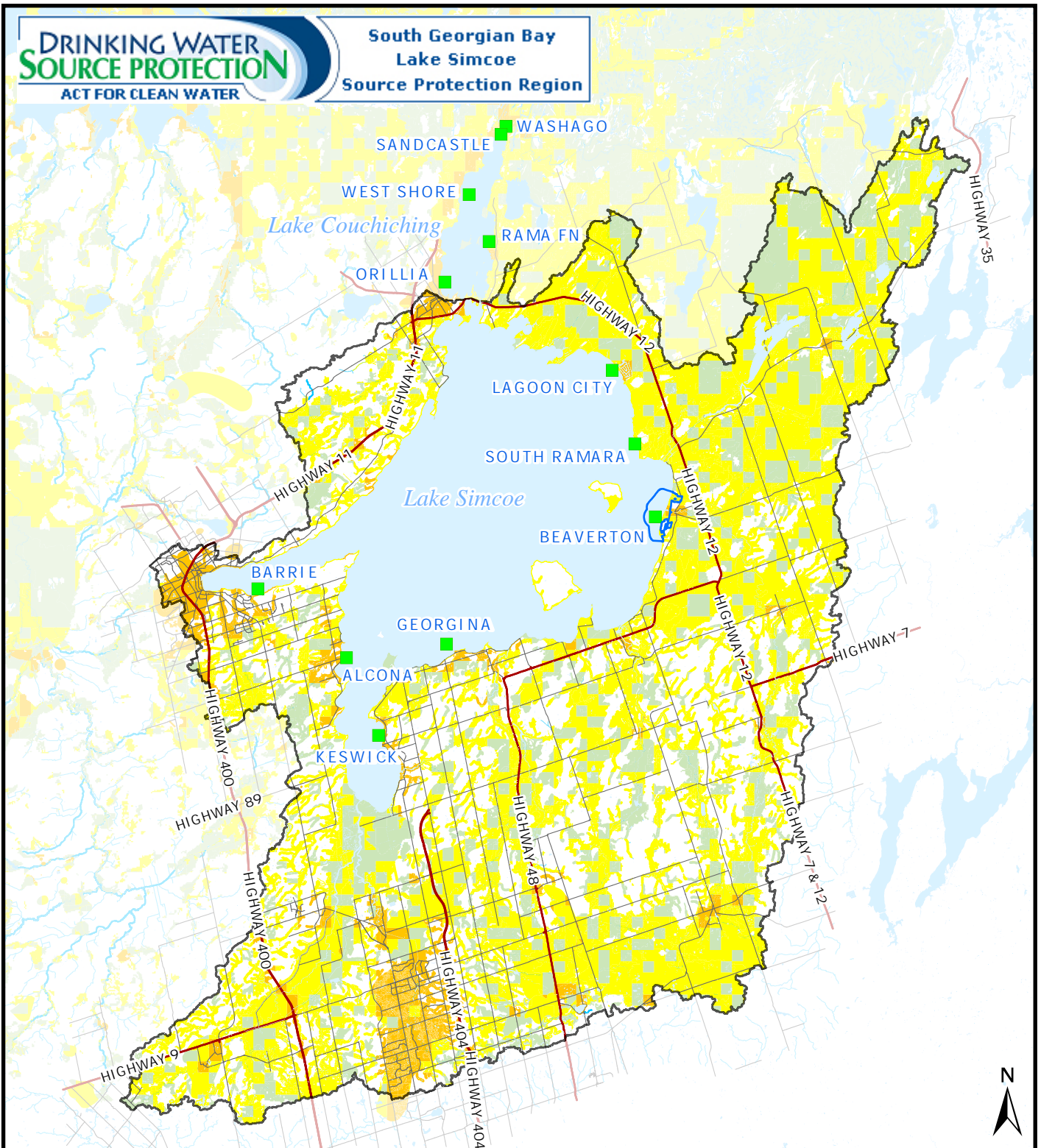
UTM Zone 17N, NAD83



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Figure 6d-11



■ Surface Water Intake
Impervious Surfaces in IPZ 3

- < 1%
- = 1 - < 6%
- = 6 - < 8%
- = 8 - < 30%
- >= 30%

**Impervious Surfaces - Beaverton
Intake Protection Zone 3**

Created by: LSRCA, 2025-08-05

Scale 1: 500,000

0 5 10 15 20km

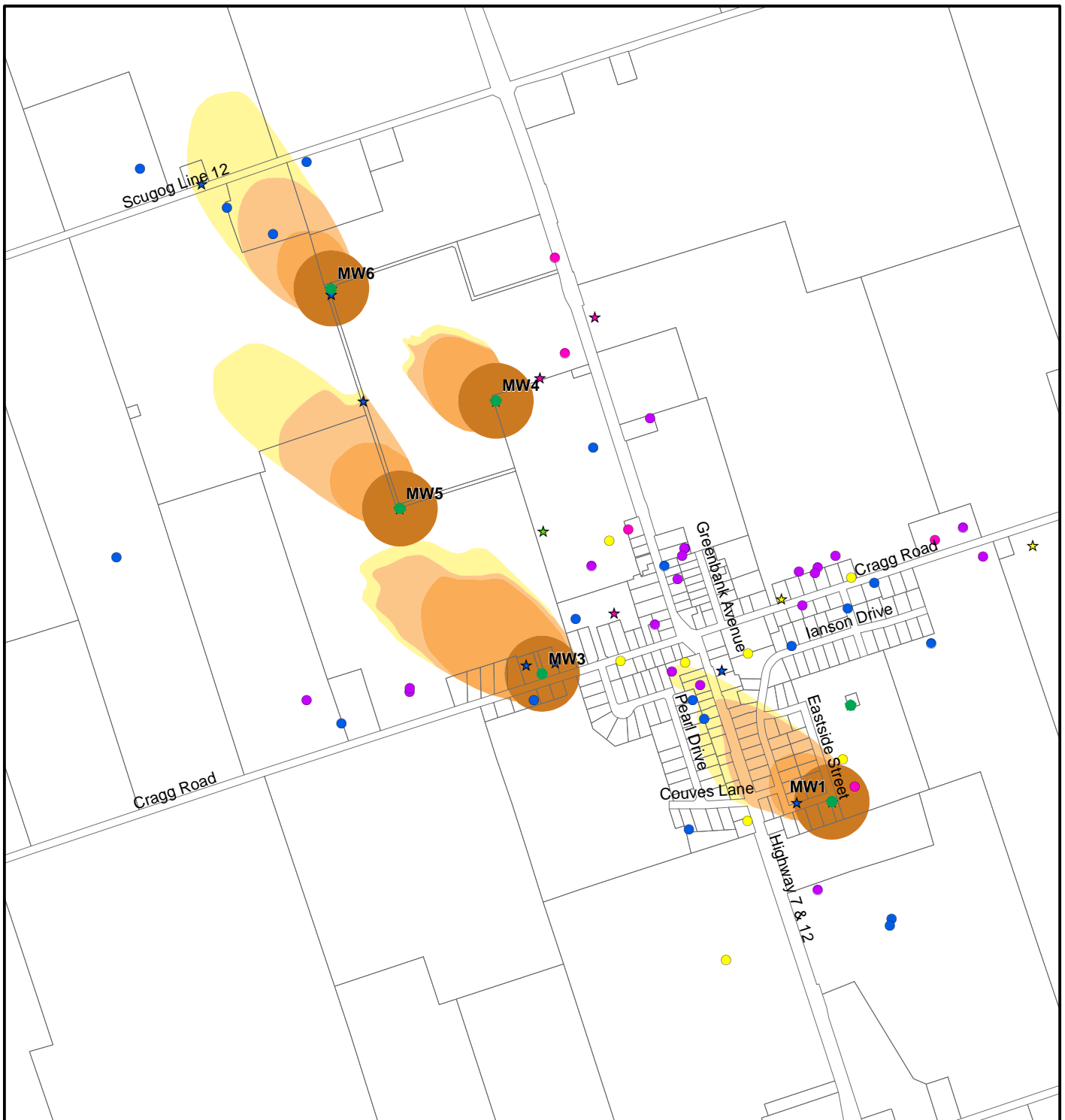
UTM Zone 17N, NAD83



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 6d-12



- LEGEND**
- MUNICIPAL WELLS
 - WELLS ABOVE UPPER AQUIFER
 - WELLS IN UPPER AQUIFER
 - WELLS BETWEEN MUNICIPAL AQUIFERS
 - WELLS IN INTERMEDIATE AQUIFER
 - WELLS BELOW INTERMEDIATE AQUIFER
 - ☆ HIGH QUALITY BOREHOLE INFORMATION
 - BOREHOLE LOCATION (MOE WWIS INFORMATION)

- WELLHEAD PROTECTION AREAS**
- WHPA-A: 100 METRE RADIUS
 - WHPA-B: 2 YEAR TIME-OF-TRAVEL
 - WHPA-C: 5 YEAR TIME-OF-TRAVEL
 - WHPA-D: 25 YEAR TIME-OF-TRAVEL



WELLHEAD PROTECTION AREAS - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK
The Regional Municipality of Durham

DATE: AUGUST 2010

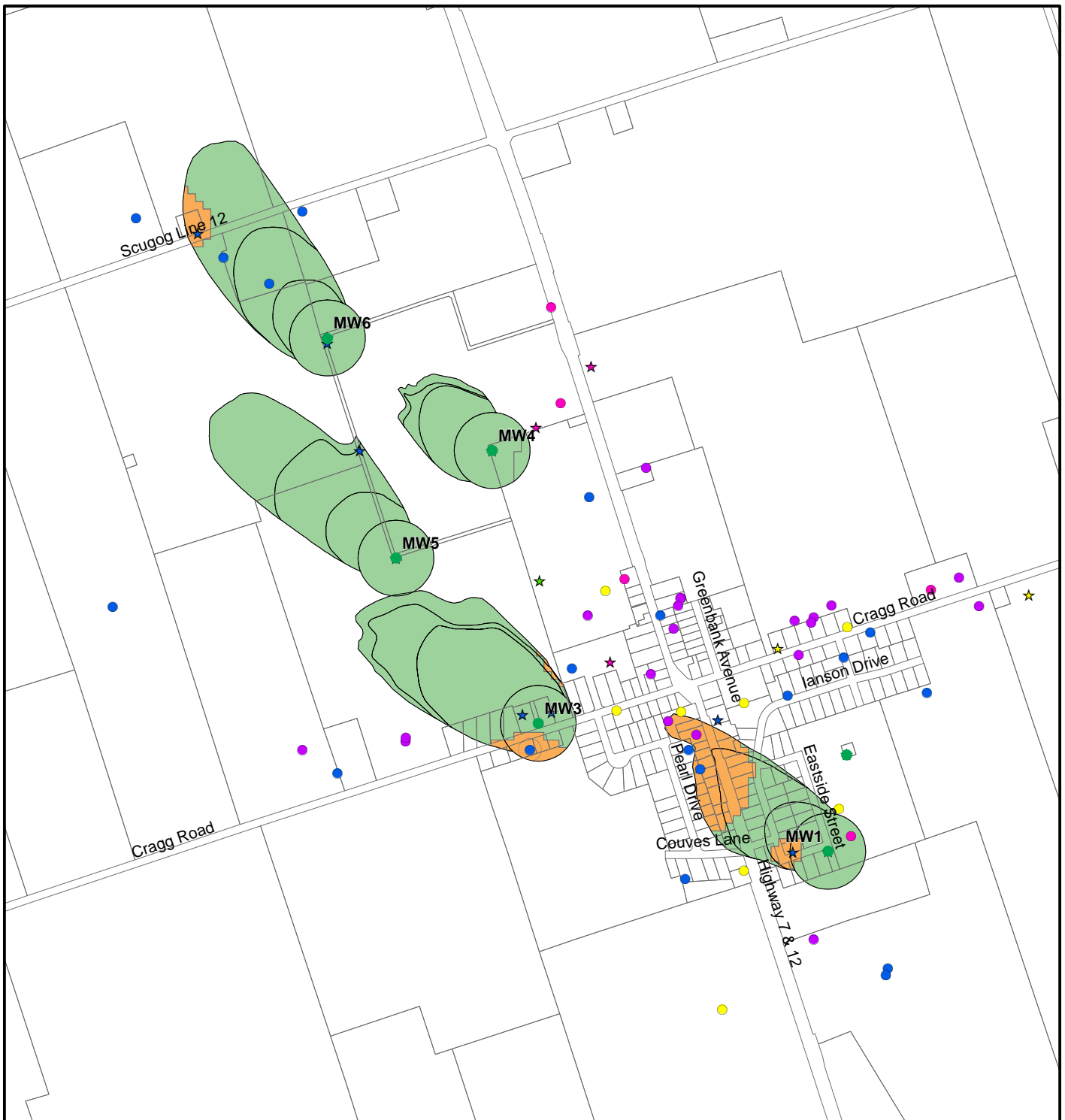
SCALE: 1:15000

PROJECT: 0-021345.02

FILE. NO.:0-02134502F7-1



FIGURE
6e-1



LEGEND

- MUNICIPAL WELLS
- WELLS ABOVE UPPER AQUIFER
- WELLS IN UPPER AQUIFER
- WELLS BETWEEN MUNICIPAL AQUIFERS
- WELLS IN INTERMEDIATE AQUIFER
- WELLS BELOW INTERMEDIATE AQUIFER
- ☆ HIGH QUALITY BOREHOLE INFORMATION
- BOREHOLE LOCATION (MOE WWIS INFORMATION)

AQUIFER VULNERABILITY INDEX

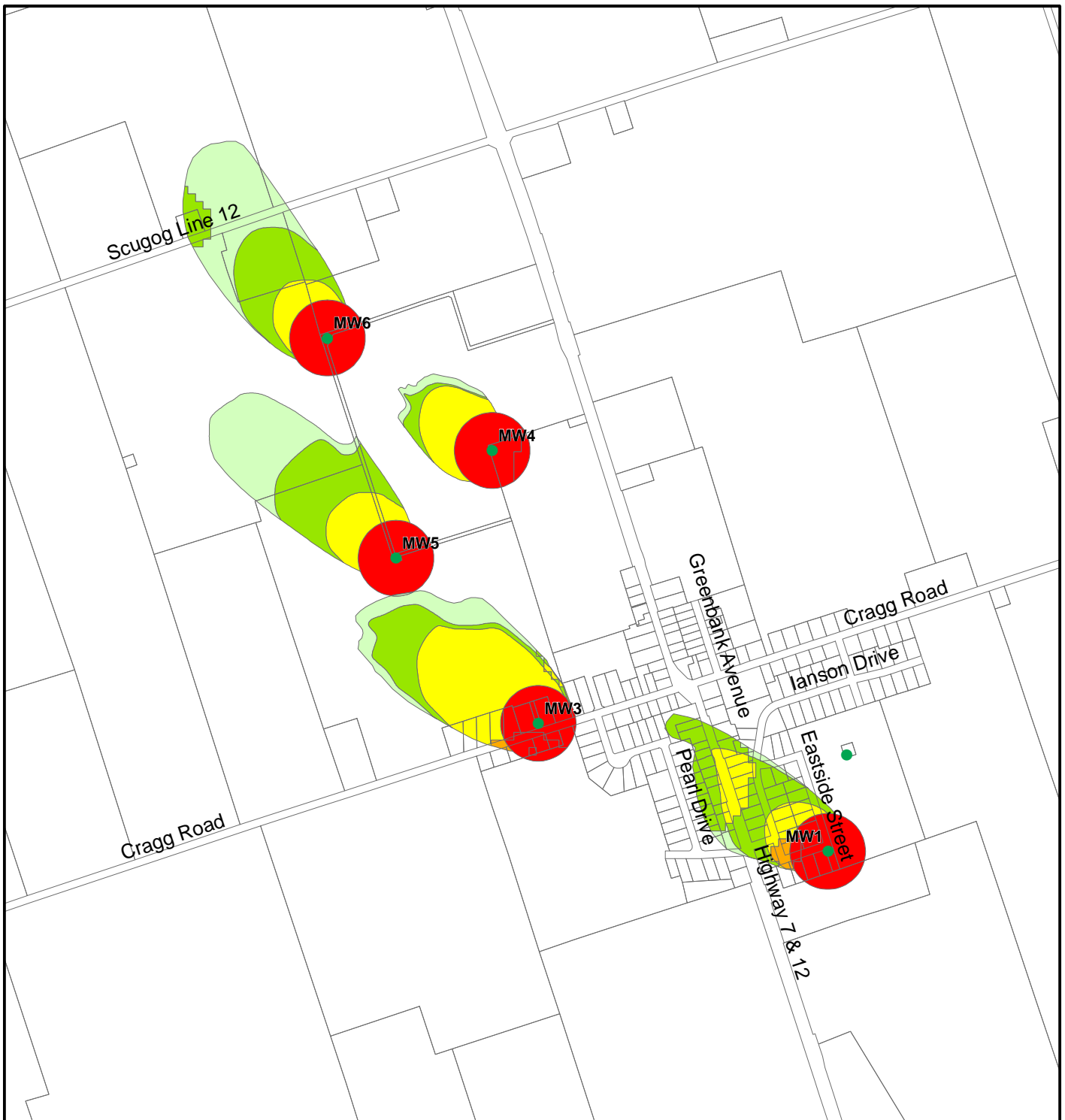
- HIGH
- MEDIUM
- LOW

GROUNDWATER VULNERABILITY - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK
The Regional Municipality of Durham

DATE: AUGUST 2010	SCALE: 1:15000
PROJECT: 0-021345.02	FILE. NO.:0-02134502F7-2

			FIGURE 6e-2
--	--	--	------------------------------



LEGEND

● MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2



VULNERABILITY SCORE - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK

The Regional Municipality of Durham

DATE: AUGUST 2010

SCALE: 1:15000

PROJECT: 0-021345.02

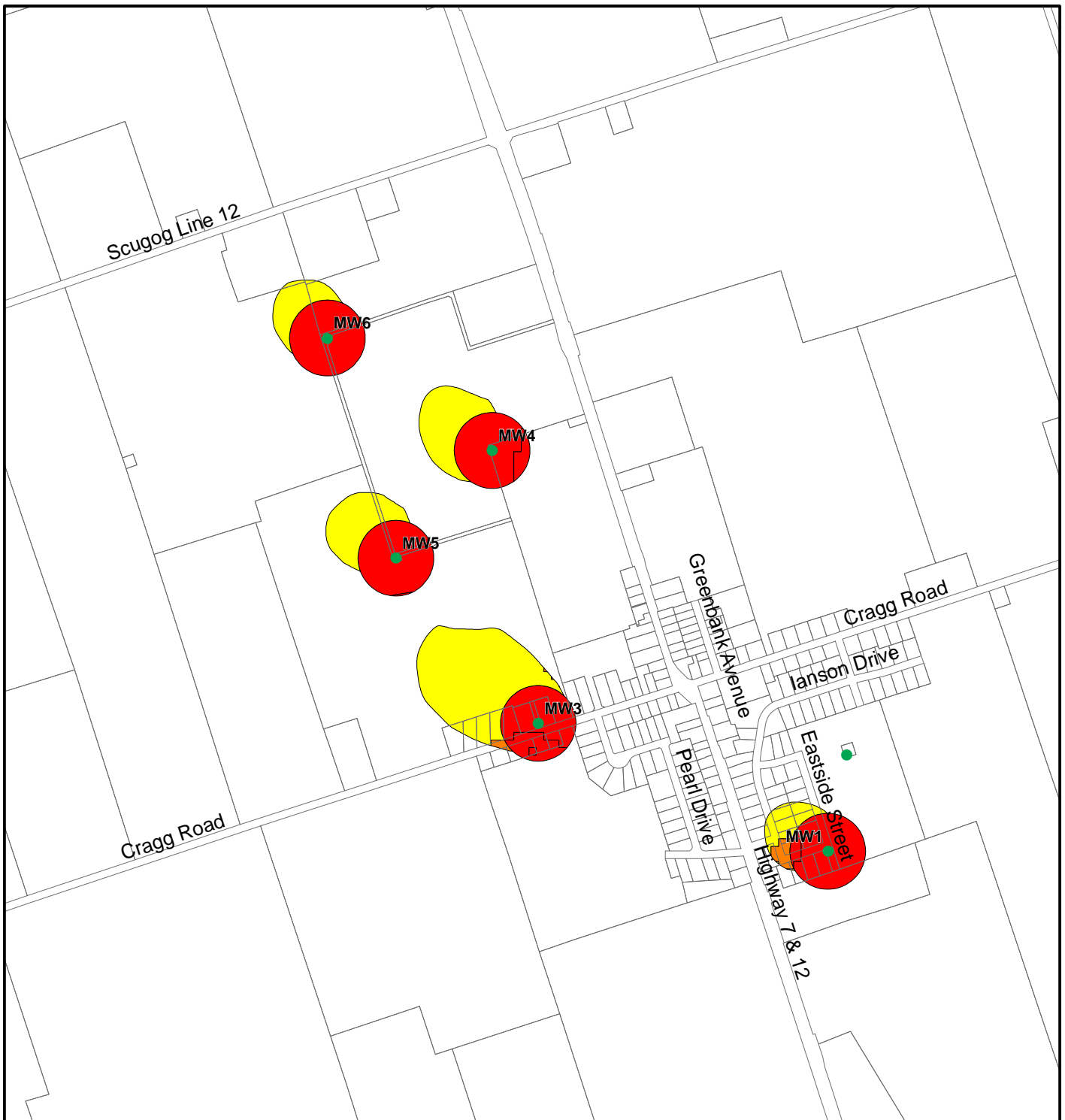
FILE. NO.:0-02134502F7-5

150 75 0 150 Metres



FIGURE

6e-3



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK
 The Regional Municipality of Durham

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: AUGUST 2010
 PROJECT: 0-021345.02

SCALE: 1:15000
 FILE. NO.:0-02134502F7-6

FIGURE
6e-4

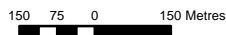


LEGEND

● MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6



AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK

The Regional Municipality of Durham

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: AUGUST 2010

SCALE: 1:15000

PROJECT: 0-021345.02

FILE. NO.:0-02134502F7-7

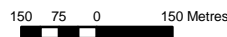


FIGURE
6e-5



LEGEND

- MUNICIPAL WELL LOCATION
- WHPA-C: 5 YEAR TIME-OF-TRAVEL



AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - GREENBANK

ASSESSMENT OF DRINKING WATER THREATS - GREENBANK
The Regional Municipality of Durham

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

DATE: AUGUST 2010

SCALE: 1:15000

PROJECT: 0-021345.02

FILE. NO.:0-02134502F7-8



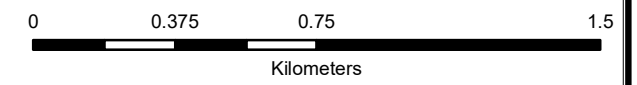
FIGURE
6e-6

Greenbank Municipal Well System
Kawartha-Haliburton Source Protection Area

Managed Land, Livestock Density & Total Impervious Surface Area

Legend

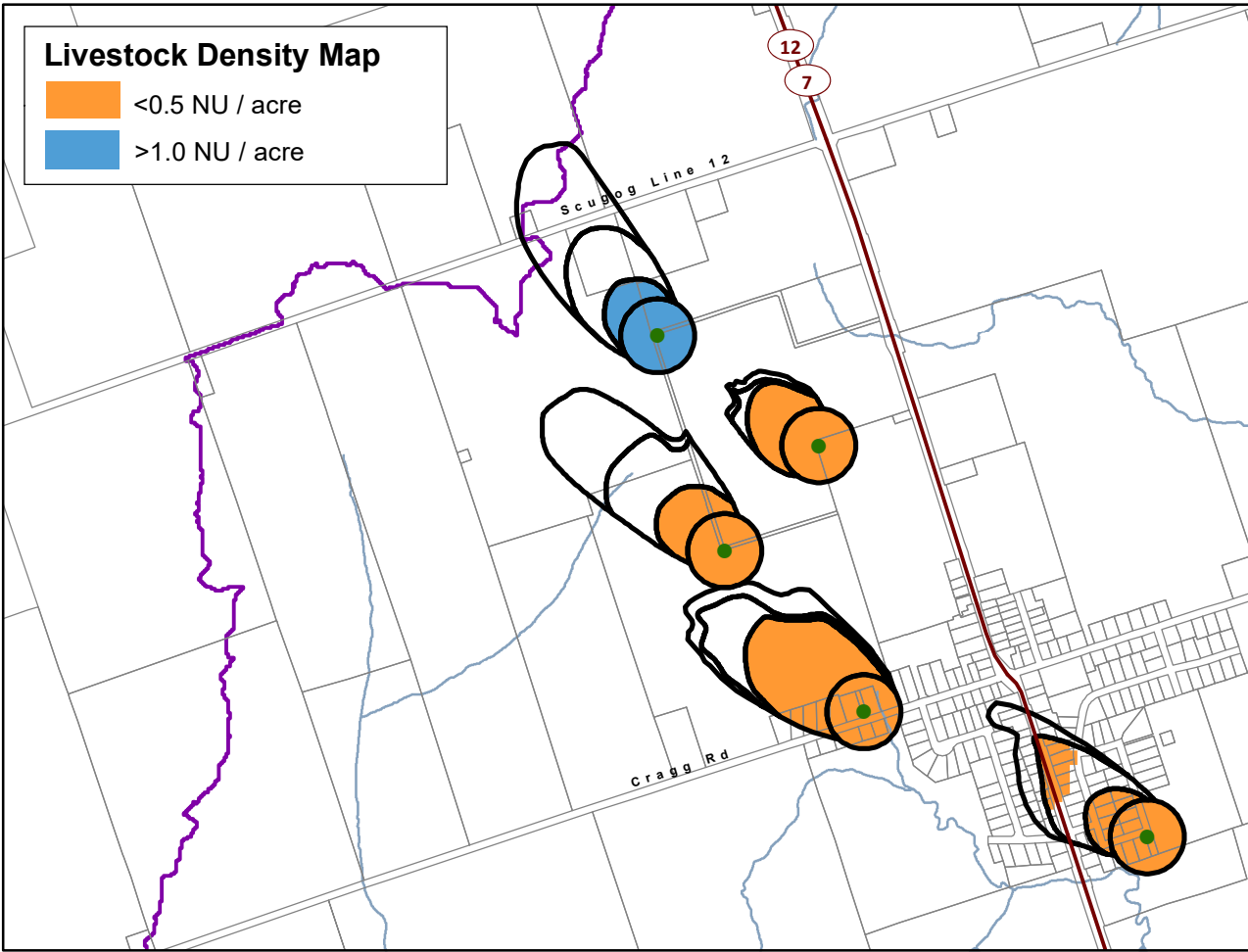
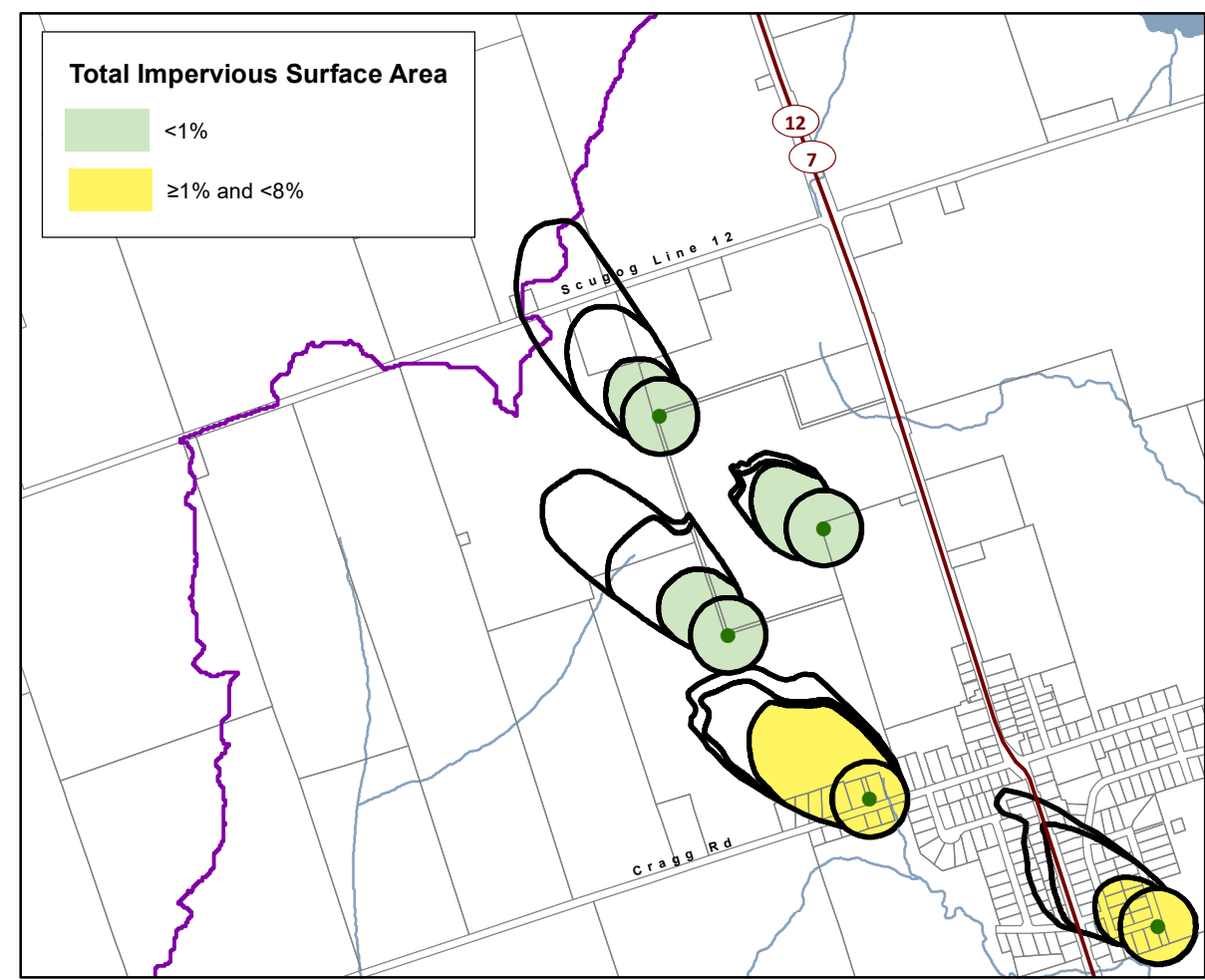
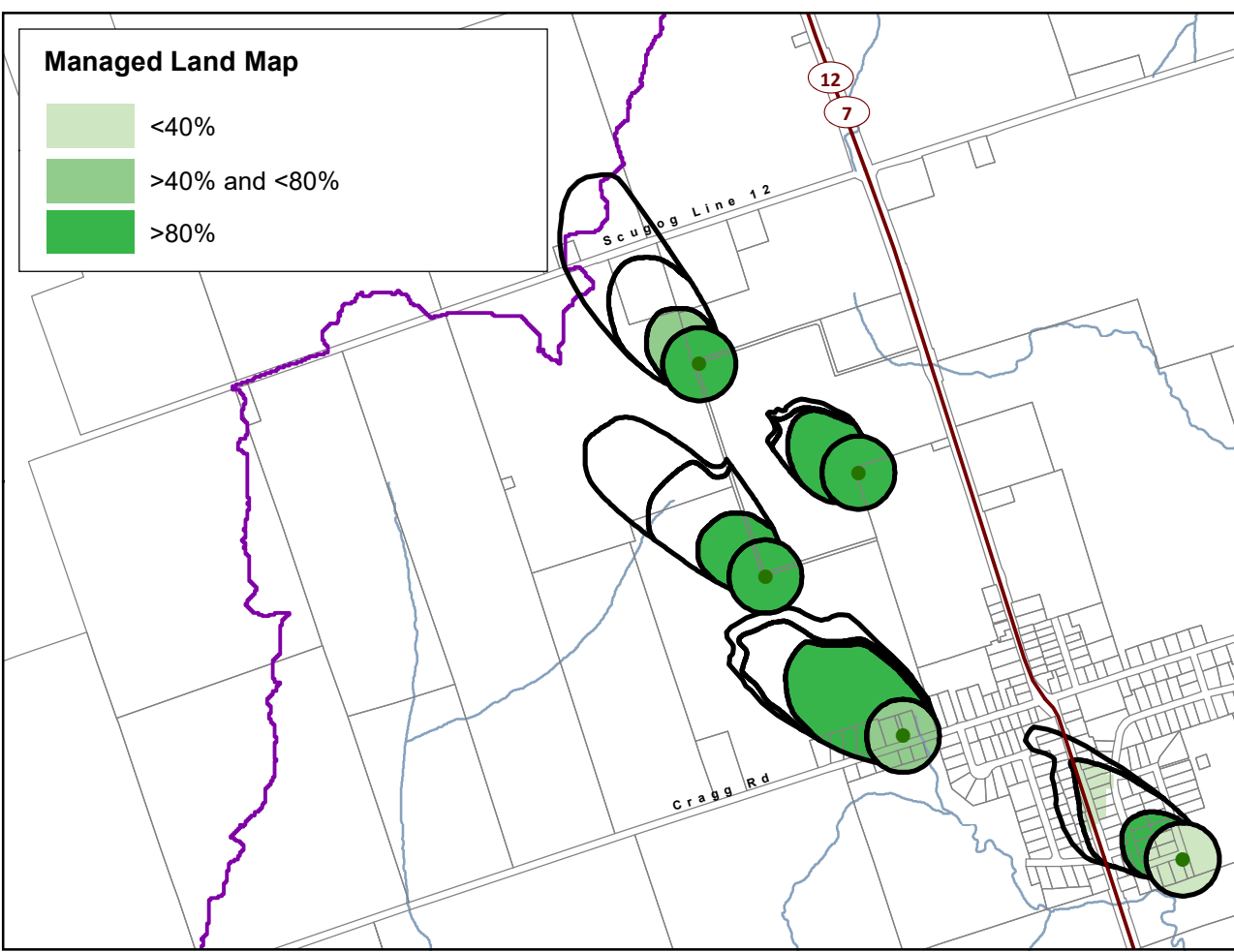
- Municipal Wells
- Railway
- Watercourse
- Main Road
- Highway
- Multi Lane Highway
- Property Boundary
- Source Protection Region
- Source Protection Area
- Lower and Single Tier Municipality
- Upper Tier Municipality
- Wellhead Protection Areas
- Waterbody
- Wetland

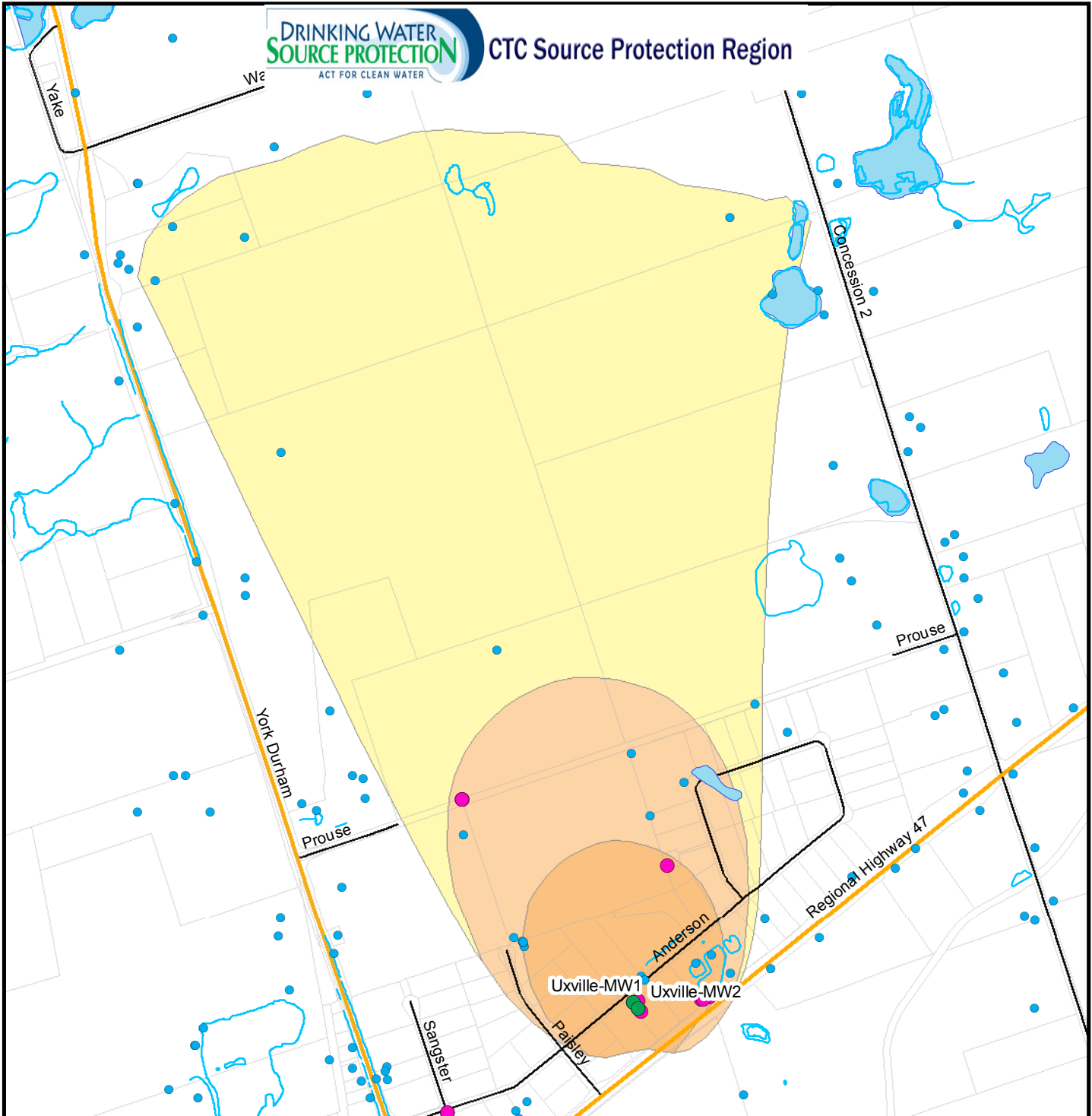


Trent Conservation Coalition
Source Protection Region
www.trentsourceprotection.on.ca

This map has been prepared for the purpose of meeting the provincial requirements under the Clean Water Act, 2006. If it is proposed to use it for another purpose, it would be advisable to first consult with the responsible conservation authority.

PRODUCED BY Lower Trent Conservation on behalf of the Trent Conservation Coalition Source Protection Committee, March 2011 (Updated November 2022), with data supplied under licence by members of the Ontario Geospatial Data Exchange.





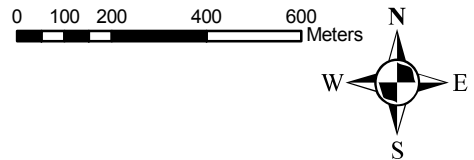
LEGEND

- MONITORING WELLS
- MUNICIPAL WELLS
- PRIVATE WATER WELL
- ▭ PARCEL FABRIC

WHPA-2009

Capture Zones

- WHPA-A: 100 METRE BUFFER
- WHPA-B: 2 YEAR TIME-OF-TRAVEL
- WHPA-C: 5 YEAR TIME-OF-TRAVEL
- WHPA-D: 25 YEAR TIME-OF-TRAVEL



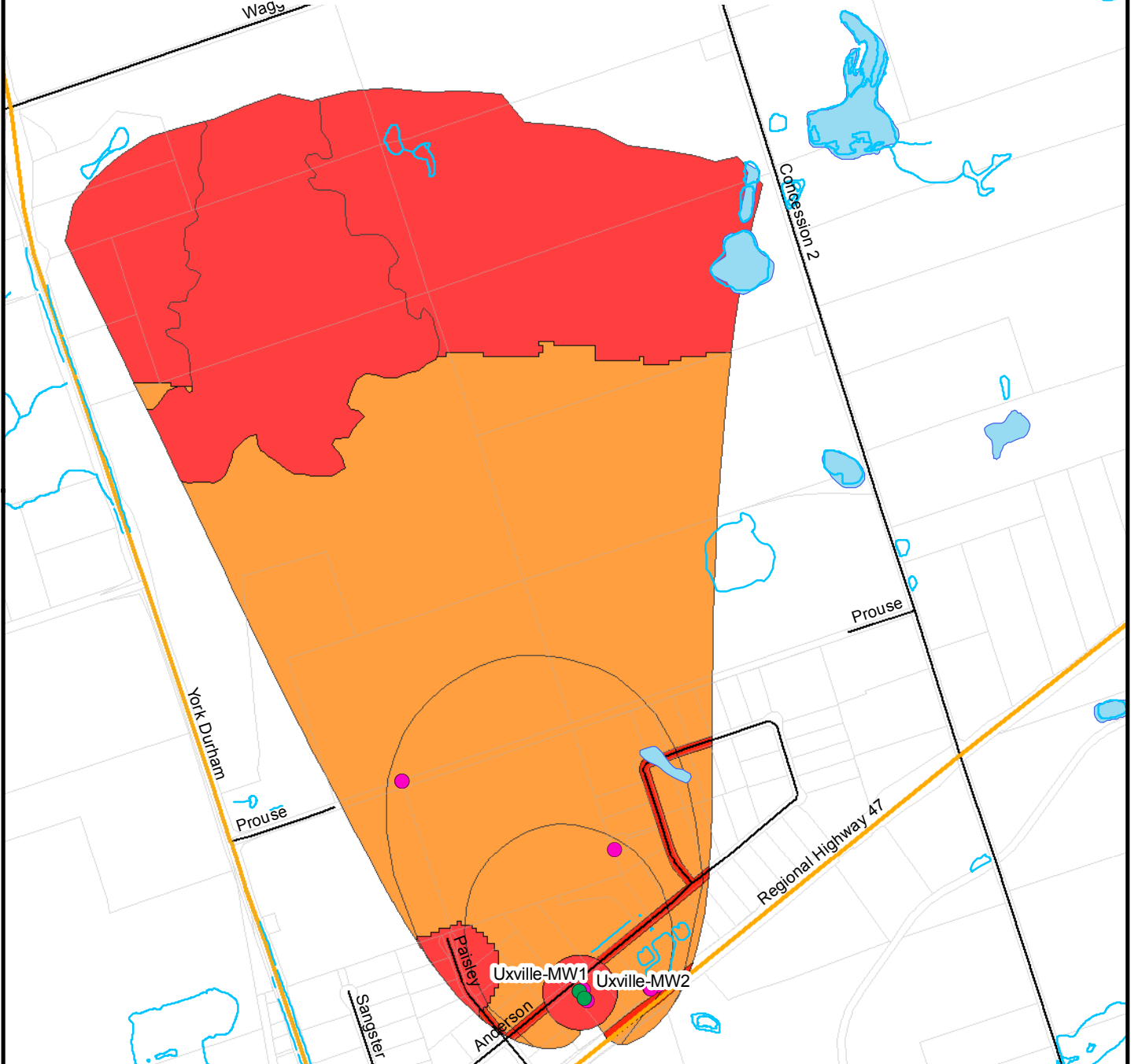
WELLHEAD PROTECTION AREAS - UXVILLE

ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
 The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
PROJECT: WG-246-07	

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LEGEND

- MONITORING WELLS
- MUNICIPAL WELLS
- PARCEL FABRIC

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

GROUNDWATER VULNERABILITY - UXVILLE

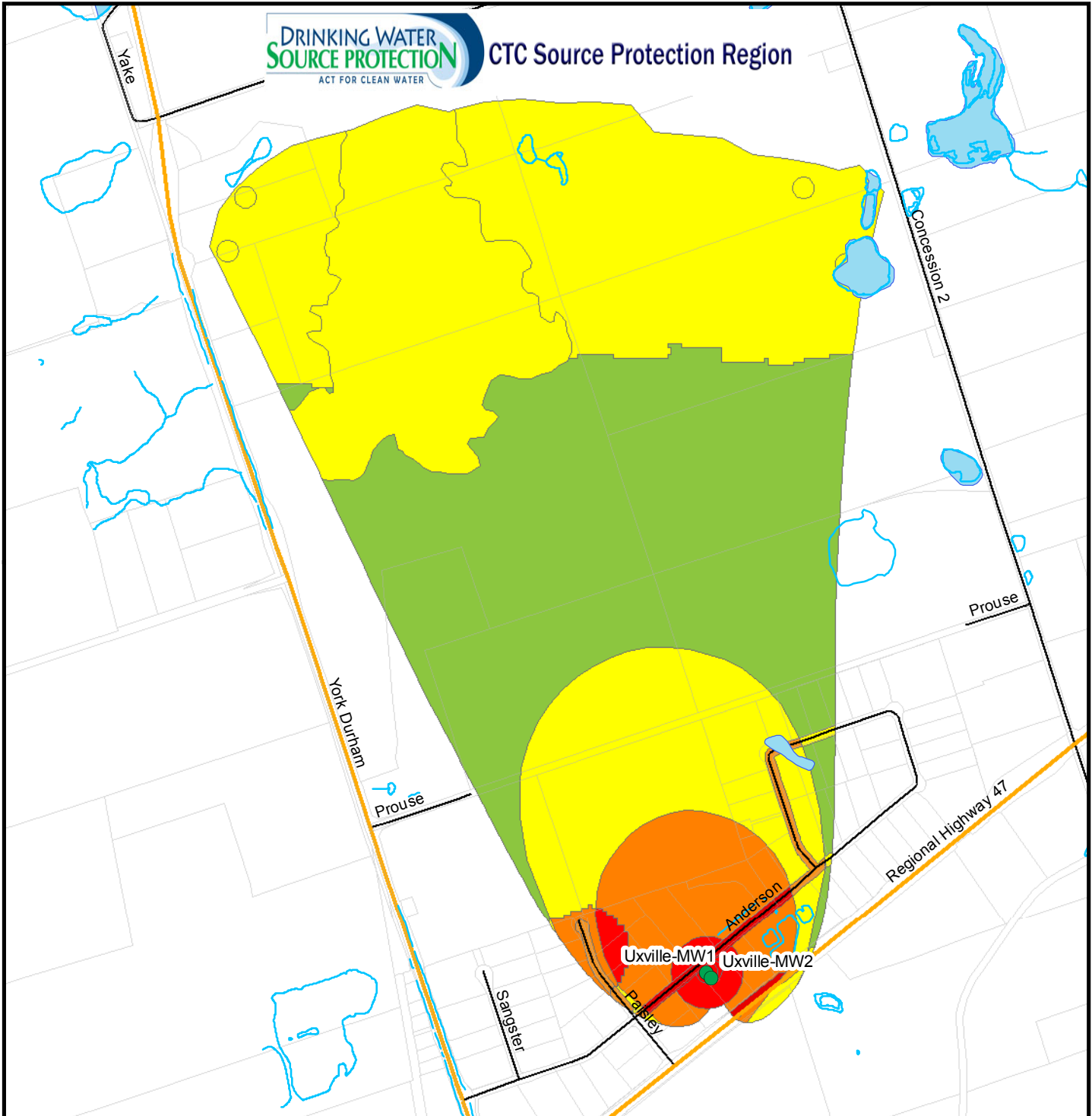
ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
 The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
PROJECT: WG-246-07	

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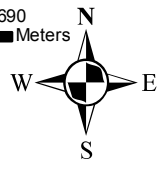


FIGURE **6f-2**



LEGEND 0 115 230 460 690 Meters

- MUNICIPAL WELLS
 - PARCEL FABRIC
- Vulnerability Scoring**
- 10
 - 8
 - 6
 - 4
 - 2



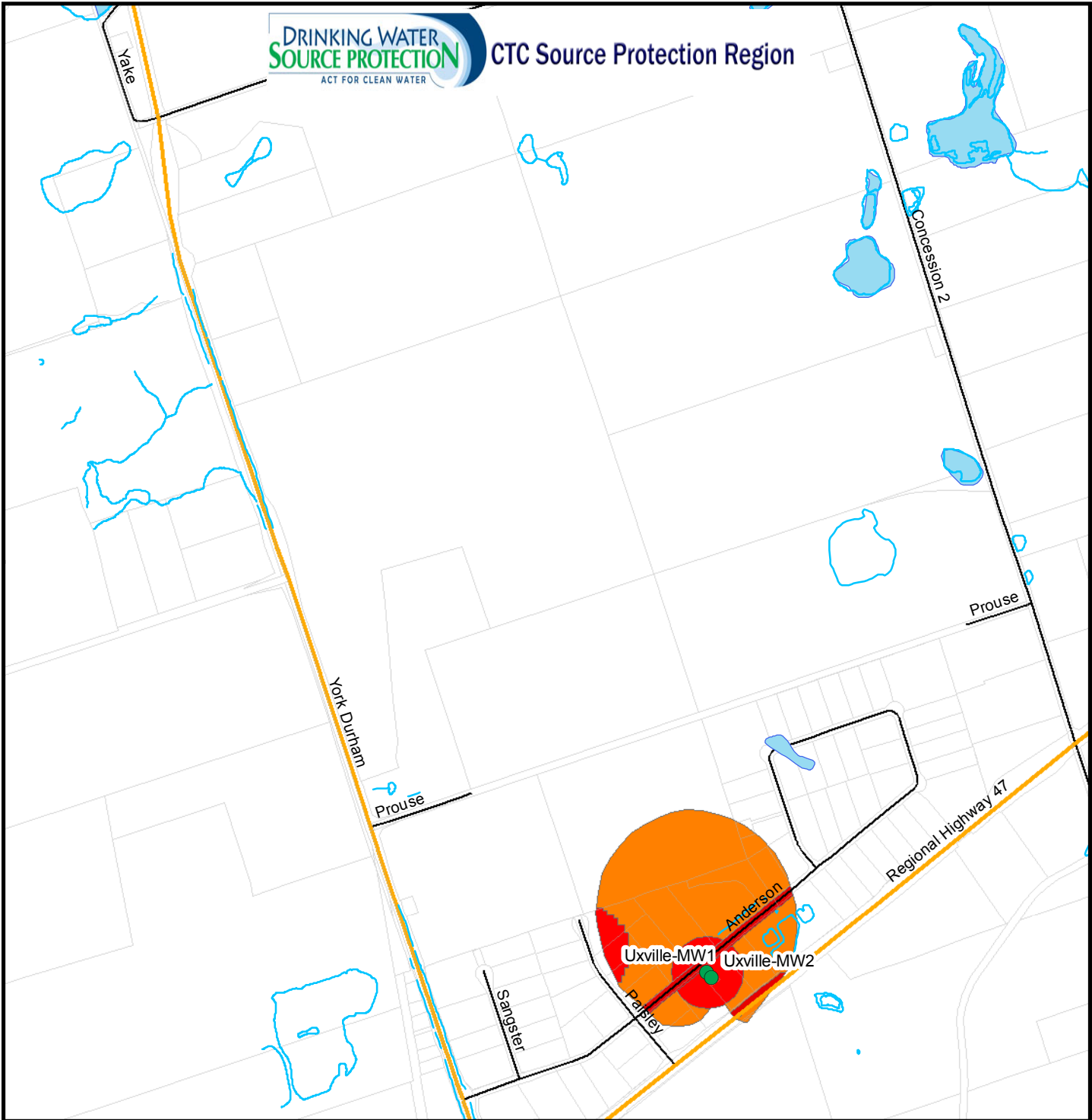
VULNERABILITY SCORE - UXVILLE

ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
The Regional Municipality of Durham

DATE: JUNE 2010	SCALE: 1:16,000
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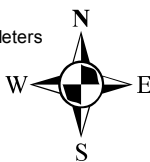
LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC

Vulnerability Scoring

- 10
- 8
- 6
- 4
- 2

0 105 210 420 630 Meters



AREAS OF SIGNIFICANT, MODERATE OR LOW THREAT - PATHOGENS

ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
 The Regional Municipality of Durham

DATE: JUNE 2010

SCALE: 1:16,000

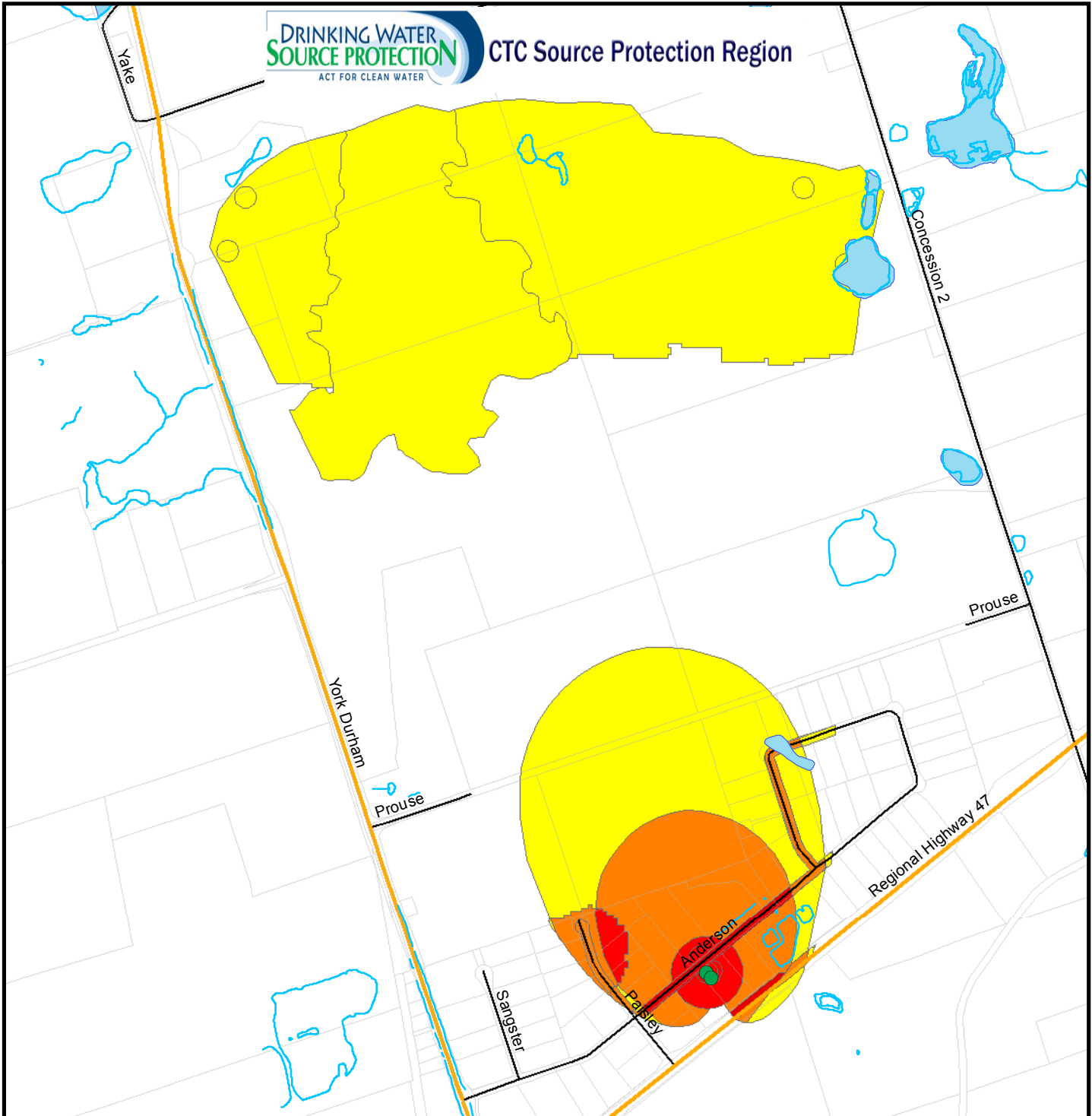
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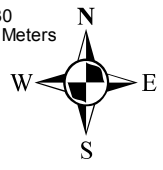
FIGURE

6f-4



0 105 210 420 630 Meters

- LEGEND**
- MUNICIPAL WELLS
 - PARCEL FABRIC
- Vulnerability Scoring**
- FinalScore**
- 10
 - 8
 - 6
 - 4
 - 2



AREAS OF SIGNIFICANT, MODERATE OR LOW THREAT - CHEMICALS

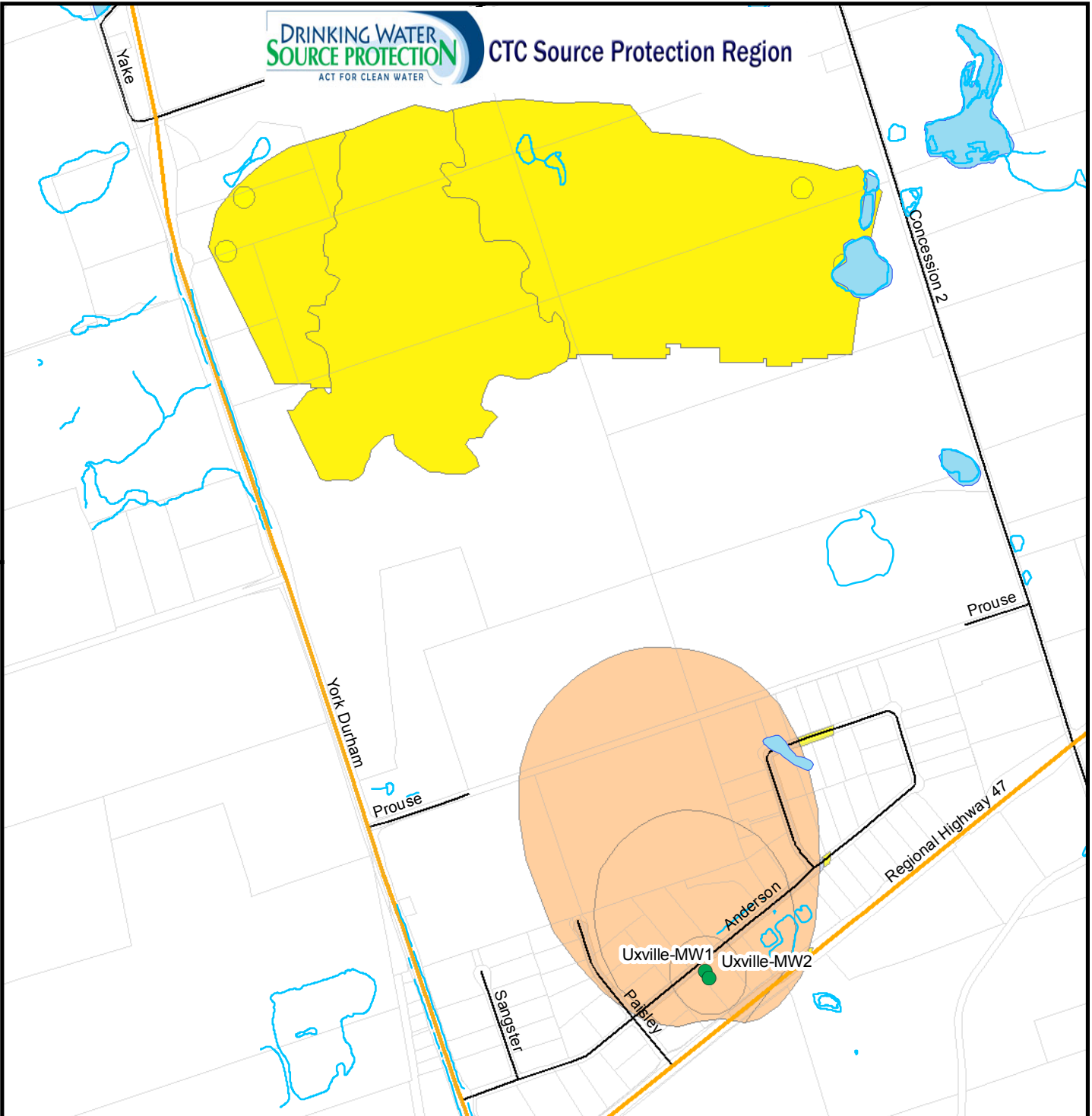
ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
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FIGURE
6f-5

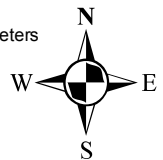
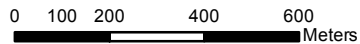


LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC

VULNERABILITY SCORING

- SIGNIFICANT DNAPL THREAT
- MODERATE DNAPL THREAT



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - DNAPLs

ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
The Regional Municipality of Durham

DATE: JUNE 2010

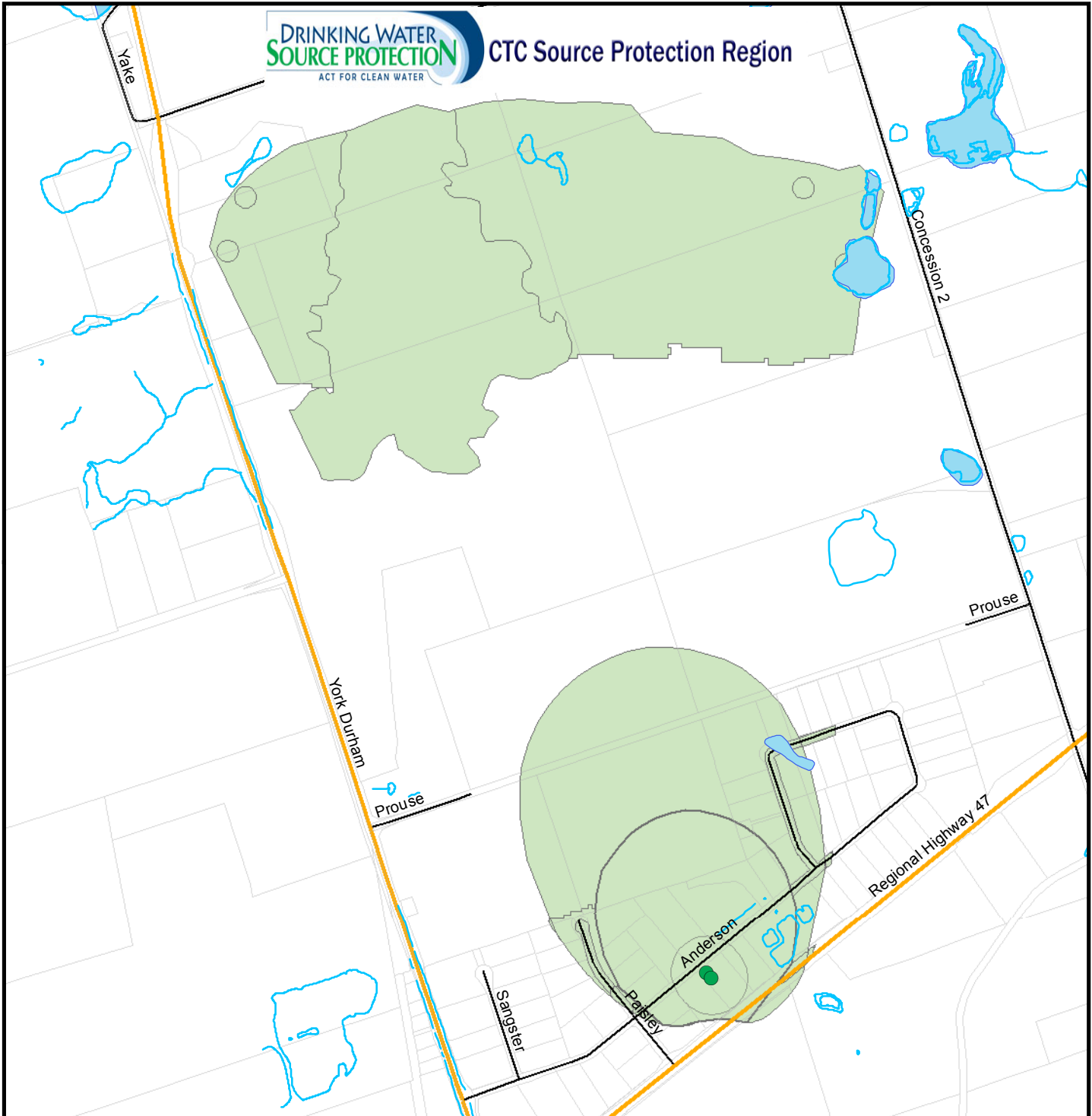
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FIGURE **6f-6**



LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC
- MANAGED LANDS (<40%)

0 100 200 400 600 Meters

MANAGED LANDS - UXVILLE

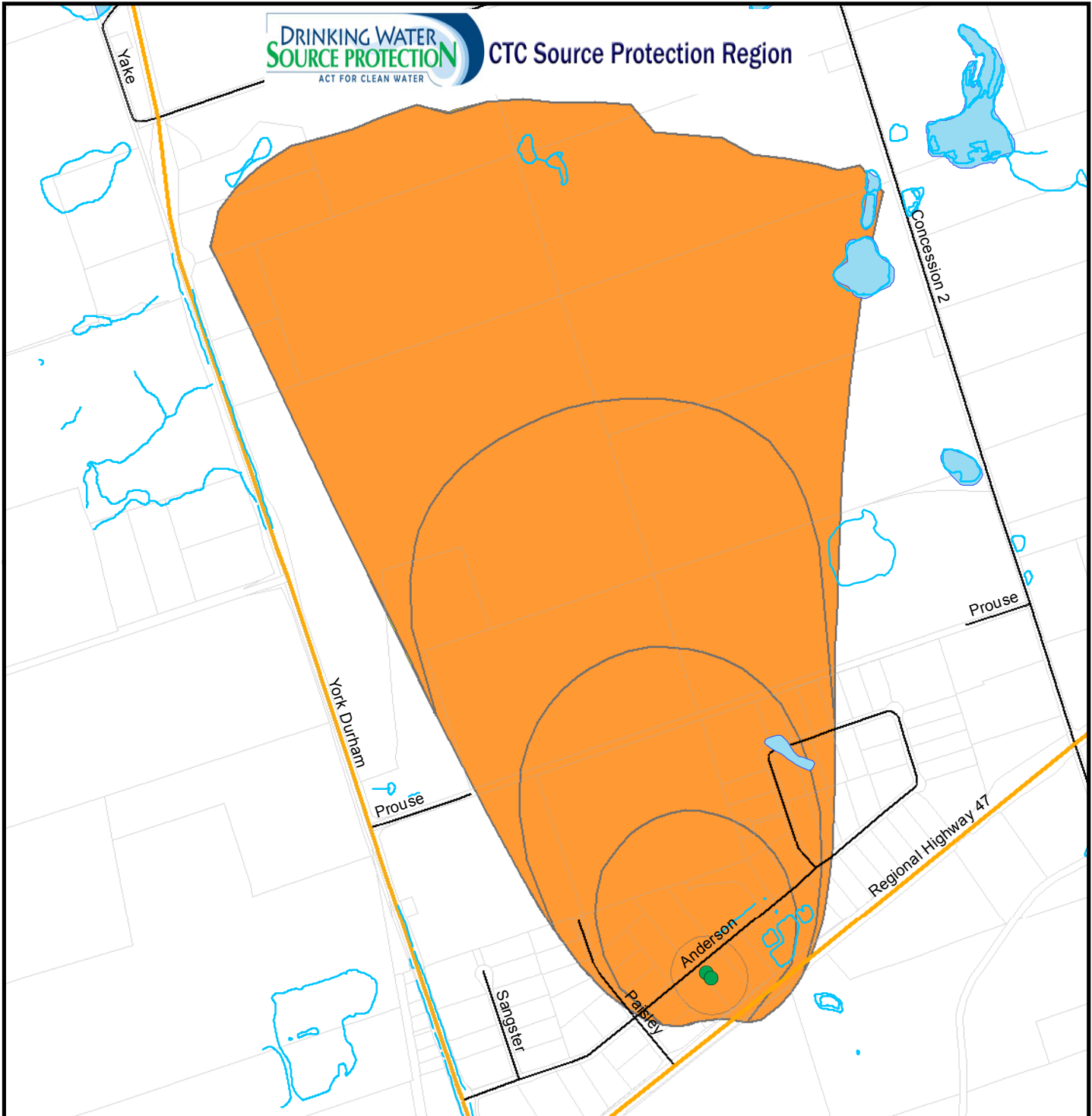
ASSESSMENT OF DRINKING WATER THREATS- UXVILLE

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LEGEND

- MUNICIPAL WELLS
- PARCEL FABRIC
- < 0.5 NU/ACRE

0 105 210 420 630 Meters

LIVESTOCK DENSITY - UXVILLE

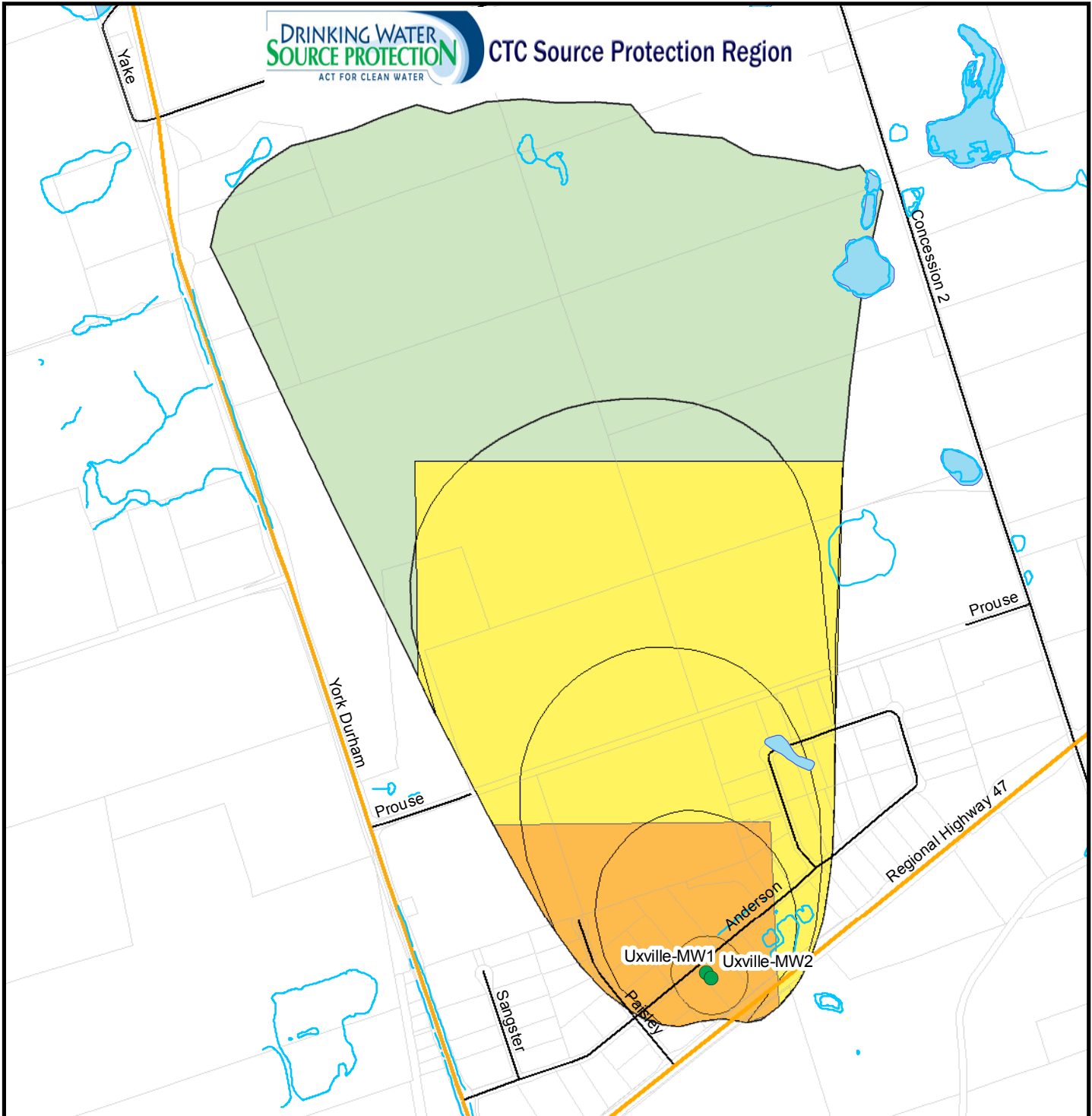
ASSESSMENT OF DRINKING WATER THREATS- UXVILLE

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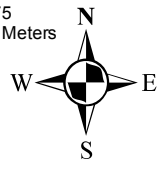


LEGEND 0 112.5 225 450 675 Meters

- MUNICIPAL WELLS
- PARCEL FABRIC

IMPERVIOUS SURFACES

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



IMPERVIOUS SURFACES - UXVILLE

ASSESSMENT OF DRINKING WATER THREATS- UXVILLE
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FIGURE
6f-9