Chapter 7: Regional Municipality of Peel

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7.1 Introduction

This chapter contains information on one drinking water system for the Regional Municipality of Peel. 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

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 (MECP, 2021)) 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.

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

7.2 Drinking Water Systems

The Region of Peel operates groundwater-based water supplies in six (6) communities and surface water-based supplies in two (2). As shown in Figure 7-1 one (1) of the groundwater supplies is within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR).

The list below also indicates the corresponding lead Source Protection Authority (SPA) for the municipal water supply.

Municipal Groundwater Supply in the Town of Caledon within the Nottawasaga Valley Source Protection Authority (SPA) SGBLS SPR included in this report:

- Palgrave

Municipal Groundwater Supply in the Town of Caledon within the Toronto and Region SPA and Credit Valley, Toronto and Region, and Central Lake Ontario Source Protection Authority (CTC SPR) but not included in this report:

- Caledon East

Municipal Groundwater Supply in the Town of Caledon within the Credit Valley SPA and Credit Valley, Toronto and Region, and Central Lake Ontario Source Protection Authority (CTC SPR) but not included in this report:

- Caledon Village
- Alton
- Inglewood
- Cheltenham-Terra Cotta

Municipal Groundwater Supply in the City of Mississauga within the Credit Valley SPA and Credit Valley, Toronto and Region, and Central Lake Ontario Source Protection Authority (CTC SPR) but not included in this report:

- South Peel (Lakeview) Water Treatment Plant
- South Peel (Lorne Park) Water Treatment Plant

7.3 Palgrave Well Supply

The Region of Peel is a large municipality consisting of the cities of Brampton and Mississauga and the Town of Caledon. The Region falls within the Credit Valley Conservation Authority (CVC), the Toronto Region Conservation Authority (TRCA), and the Nottawasaga Valley Conservation Authority (NVCA) boundaries. The Palgrave system is located in the Town of Caledon, which has a population of 76,581 (Statistics Canada, 2021). One well from the Palgrave system falls within the SGBLS-SPR, while the other two are within the CTC SPR.

The Palgrave Water Supply System is part of the Palgrave-Caledon East Drinking Water System. It consists of three groundwater supply wells (PAL2, PAL3, and PAL4). Well PAL3 is located in the Nottawasaga Valley Source Protection Area whereas PAL 2 and PAL4 are located in the Toronto Region Source Protection Area. Palgrave 2 (PAL2) is located on Mount Hope Road beside a large wetland area. It is screened 39.9 to 47.2 metres below ground surface (mbgs) in the lower Oak Ridges Moraine sands. The 2019 average pumping rate is 209 m^3/day. Palgrave 3 (PAL3) is located beside a baseball field on Mount Hope Road and is screened in the Thorncliffe Formation at 71.3 to 80.5 mbgs with a 2010 average annual pumping rate of 72 m^3/day. Lastly, Palgrave 4 (PAL4) is located on a wooded property east of County Road 50, within the NVCA watershed and is screened into the Thorncliffe Formation at 75.7 to 91.5 mbgas with the 2019 average annual pumping rate of 264 m^3/day. The combined pumping of wells PAL2, PAL3, and PAL4 cannot exceed 11,129 m^3/day.

Information presented for the Palgrave section is based on the original Burnside, 2010g and 2010e reports and have been updated by Aqua Insight (2022).

7.3.1 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 Palgrave water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that

contribute groundwater to the wells were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed using s the Surface to Well Advective Time (SWAT) method. The WHPA and the Vulnerability were considered together as per the Technical Rules (MECP, 2021) to determine a Vulnerability Score for the Palgrave WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Aqua Insight (2022).

7.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Palgrave wells were originally delineated by Earthfx (2007) using a regional groundwater flow model referenced as the West Model. This model is an expansion of the model developed in 2006 by Earthfx for the Oak Ridges Moraine and presented in Earthfx's 2006 report titled Groundwater Modelling of the Oak Ridges Moraine Area. The model was developed to represent three major aquifers in the study area: Oak Ridges Aquifer Complex (ORAC), Thorncliffe Aquifer Complex (TAC), and the Scarborough Aquifer Complex (SAC).

The most current groundwater flow model is the Peel Water Resources Management Model 2021 (PWRMM21) which builds upon earlier work completed for Peel Region in 2019, called the PWRMM19 groundwater flow model which was developed by Earthfx (Earthfx and GeoKamp, 2020). The model was developed for the entire Region of Peel and Credit Valley Conservation watershed area as part of a previous modelling study.

The PWRMM19 model was calibrated at the regional scale and represents the key aquifers and aquitards across Peel Region and the surrounding area. The model was created in MODFLOW using a uniform 90 m grid cell spacing. The 2019 model was parsed for the communities of Palgrave, Caledon East, and Caledon Village and transferred from MODFLOW to FEFLOW in 2021 by Aqua Insight to locally refine the grid (mesh) around the municipal wells, and the hydrogeologic parameters such as the layers, hydraulic conductivity values and boundary conditions that represent lakes, rivers, and wetlands; this revised and updated version of the model is termed herein as PWRMM21. The steady-state version of the PWRMM19 model (Earthfx and GeoKamp, 2020) formed the basis for this study and it was updated locally within five kilometers of the municipal water supply wells in Palgrave, Caledon East, and Caledon Village. The groundwater flow model consists of ten numerical model layers with each numerical model layer representing a specific hydrogeologic unit.

Time of travel and capture zone delineations were done using MODPATH which is the particle tracking module of the MODFLOW package. The delineations were based on analyses of the existing permit to take water (PTTW) for each well, the maximum pumping rate for the well

field allowed under the permit, and the installed system capacity. Earthfx calibrated the model using water wells from the MOE water well database as the main calibration targets. These targets were also supplemented by the inclusion of data from Region of Peel monitoring wells.

Palgrave Well 2 is screened in a shallower unit (Lower Oak Ridges Moraine Sands) than Palgrave Wells 3 and 4 (Thorncliffe Formation), so it has a smaller WHPA that draws water from shallow sources. Most of the water pumped from Palgrave Well 2 is predicted to reach ground surface within 25 years. The Palgrave WHPAs extend north of the Village of Palgrave up to Highway 9. Land uses within the Palgrave WHPAs include natural and open space, agricultural, and residential. Much of the residential areas consist of detached homes on large estate lots. The homes appear to be serviced with natural gas and municipal water and likely have private wastewater disposal systems. A cemetery is located on Pine Road within the WHPAs of Palgrave 3 and 4. A golf course was identified at the most northern tip of the WHPA of Palgrave 3.

The WHPAs delineated by Aqua Insight (2022) have a similar radial extent for the WHPA-B and -C zones, however, the WHPAs delineated in this study are much larger than those delineated previously. The bullet list below outlines the differences in the studies.

- Thorncliffe Formation thickness: the current study interpreted the Thorncliffe Formation to be thinner than previously interpreted. As such, to maintain a reasonable fit to the water level data, an increase in hydraulic conductivity values in the production aquifer were assigned. These interpretations are more conservative, as a thinner and higher hydraulic conductivity aquifer leads to higher groundwater velocities, and particles travelling farther yielding larger WHPAs.
- The current model explicitly represents the Oak Ridges Moraine (ORM) Silts, whereas the groundwater flow model used to delineate the previous WHPAs (Earthfx, 2007, 2008) did not represent this unit. As Palgrave Well 2 pumps from the aquifer that directly underlies this semiconfining unit, the particle pathlines in the current model travel further laterally w the production aquifer (i.e. Lower ORM Sands) before migrating upwards through the ORM Silts. This produces the larger WHPAs for Palgrave Well 2.
- The current model applied a higher hydraulic conductivity value for Palgrave Well 4 than applied previously in Earthfx (2008), which contributed to the larger WHPA.
- The previous WHPA (Earthfx, 2007, 2008) was delineated using a single set of model parameters whereas the current model evaluated sensitivity in the model input parameters, including lower porosity values, using 101 calibrated realizations, and delineated the WHPAs using the composite capture zone. This produces a conservative

set of WHPAs, and greater factor of safety by evaluating the sensitivity of variations in model inputs on the predictions.

7.3.1.2 WHPA-E

None of the wells in this study have shown evidence of hydraulic connection between the well and the surface water bodies near the well. Therefore delineation of a WHPA-E was not required.

7.3.1.3 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the Palgrave municipal wells are shown in Figure 7a-2.

The Groundwater Vulnerability has been determined using the Surface to Well Advective Time (SWAT) analysis by Aqua Insight (2022). It is noted that the groundwater vulnerability was previously determined through the Water Table to Well Advective Time (WWAT) approach by Earthfx (2008.)

Surface to well advective travel time (SWAT) calculations provide a physically based estimate of aquifer vulnerability that estimates the vertical (one-dimensional) travel time through the unsaturated zone from ground surface to the water table, and the threedimensional travel time through the groundwater flow system as per the threedimensional flow model's velocity field. The results are recommended to be viewed as relative measures of vulnerability rather than definitive travel times for contaminants to travel from ground surface to a well. As such, the outputs are generalized rankings of High, Moderate and Low vulnerability. SWAT is the sum of two components: a) Unsaturated zone travel time (UZAT) and b) water table to well advective travel time (WWAT).

The UZAT is an estimate of the vertical travel time from ground surface to the water table. This travel time is a function of the depth to water table (i.e., thickness of the unsaturated zone), the degree of saturation, and the estimated groundwater recharge rate. UZAT calculations were completed within the 25-year time of travel composite WHPA at a grid spacing of 50 m (6,652 locations for Palgrave). Forward particle tracking methods within FEFLOW were used to estimate the WWAT. Particles were released at the computed water table surface over the same grid used for the UZAT calculation. The particles were tracked forward in time, and particles reaching a municipal well were identified.

It should be noted that the travel times are advective travel times and are therefore independent of the nature of the potential contaminants, release mechanisms, and attenuation processes (e.g., diffusion, dispersion, adsorption, and chemical transformation). The following vulnerability scores were applied to the zones of total saturated and unsaturated (SWAT) travel times:

- High vulnerability rating assigned to SWAT travel times that are less than 5 years
- Moderate vulnerability rating assigned to SWAT travel times ranging from 5 to 25 years
- Low vulnerability rating assigned to SWAT travel times greater than 25 years.

The unsaturated and saturated travel times were added and the total advective travel time results were classified into High (less than 5 years), Moderate (5 to 25 years) and Low (greater than 25 years). The Palgrave wells are considered to have predominately low vulnerability with only a few small areas immediately surrounding Palgrave Wells 2 and 3 with moderate vulnerability category ratings.

7.3.1.4 Transport Pathway Increase

The Technical Rules allow for an increase in vulnerability rating of an aquifer due to the presence of transport pathways that may increase the vulnerability of the aquifer by providing a conduit for contaminants to bypass the natural protection of the aquifer. 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.

Transport pathways are developed where man-made (anthropogenic) features in the aquifer provide a path along which contaminants can migrate to the regional aquifer.

Within the Palgrave area, the vulnerability rating categories were increased from Low to Moderate or Moderate to High along the following transport pathways:

- Watermains on Mount Hope Road near Palgrave Well 2. Palgrave Well 2 is considered semi-confined so shallow linear infrastructure was considered to increase the vulnerability within this WHPA. The interpreted depth of watermain (5 m) was found to intercept the water table, so the vulnerability category rating was increased from Low to Moderate.
- Closed private landfill southeast of Palgrave Well 2. A former private landfill is mapped on the southern side of Mount Hope Road and lies within the WHPA for Palgrave Well 2; the vulnerability category rating was increased in this polygon.

- Closed public landfill east of Palgrave Well 2. The former Palgrave Landfill site is located east of Palgrave Well 2 on the northeastern side of Mount Hope Road; the vulnerability was increased within the WHPA of this polygon.

7.3.1.5 Vulnerability Score

The WHPA zones for the Palgrave Water Supply, as shown in Figure 7a-1, the Groundwater Vulnerability, as shown in Figure 7a-2, and the Transport Pathways identified in Section 7.3.1.4 were used to assign a "Vulnerability Score" by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 7a-3 illustrates the Vulnerability Scores for the Palgrave Water Supply. Figure 7a-3 will be used to assess Drinking Water Threats in Section 7.3.3.

Most of the WHPA-C and -D areas have a score of 2, due to the low vulnerability category rating, and the WHPA-B is primarily assigned a score of 6 with some isolate areas that have a score of 8. Scores of 10 are limited to the WHPA-A and a few small areas southeast of Palgrave Well 2.

7.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis (MECP, 2021)).

The Uncertainty Rating associated with the original WHPA delineation was assessed using a qualitative process outlined in Burnside 2010g. A technical peer review consultant was also used to assess the uncertainty of the WHPA delineation.

The Uncertainty Assessment methodology used by Burnside, 2010g, 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 of the original Vulnerability Assessment (WWAT and Transport Pathways) was determined to be High.

An uncertainty assessment was completed by Aqua Insight (2022) for the updated WHPAs that included modifying model input parameters such as hydraulic conductivity and porosity values to evaluate the impact of changes on these values on the shape, orientation, and extent of the delineated WHPAs. Over 50 sensitivity realizations were developed in each area as part of this analysis and composite capture zones were created. These capture zones incorporate the range

of potential areas that the WHPAs may cover and as such, the uncertainties associated with all of the WHPA-A to -D delineations are considered Low.

7.3.2 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)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

As part of the Issues Evaluation, Burnside 2010e assessed whether any contaminants are impacting or have the potential to impact or interfere with Palgrave's drinking water source by a review of available water quality data from municipal drinking water wells and monitoring wells.

Some general water quality trends were identified within the Region.

Results indicate that the groundwater in the area, in general, is very hard and often exceeds the Operational Guideline (OG) range of 80-100 mg/L listed in the Technical Support Document for Ontario Drinking Water Quality Standards (ODWQS), Objectives and Guidelines, 2006 (ODWQS). This guideline is an operational guideline set to aid in water source selection when a choice exists and it is typical for aquifers in Ontario to exceed the guidelines. Hardness in samples collected in 2006 ranged from 176 mg/L to 715 mg/L. Hardness is not a health-related parameter and therefore does not present a significant issue to the use of the groundwater for municipal water supply.

The groundwater in the study area has naturally high concentrations of iron. The guideline for iron is considered an aesthetic objective (AO), which means that it may impair the taste, smell, or color of the water or interfere with good water quality control practices. Iron concentrations exceeded the ODWQS aesthetic objective of 0.3 mg/L in Palgrave 2 and 3. Green sand filters have been installed in many of the wells with high iron concentrations. These filters provide adequate filtration of iron reducing potential impacts on the aesthetics and treatment of the groundwater.

Manganese levels are naturally high in most wells in the Region. Manganese can be elevated as a result of reducing conditions and mineral deposits in the bedrock aquifer. Manganese is not a health-related parameter. High levels may result in the staining of laundry and fixtures and may impair tastes in beverages.

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

Microbiological testing of water indicates that all *E. coli* and total coliform samples taken between 2003 and 2007 were negative. A review of 2008 and 2009 water quality results indicated that no *E. coli* or fecal coliforms were identified (Region of Peel, 2009f).

Sampling of supply wells from 2002 to 2009 show that sodium levels in the wells are at natural aquifer levels ranging between 3 mg/L and 5 mg/L. Nitrate levels were below detection limits. The lack of nitrate in the water samples suggests that no anthropogenic impacts are evident in the deep municipal aquifer.

Water quality results collected from monitoring wells within the Palgrave WHPAs generally met the ODWQS and there is no evidence that the municipal aquifer has been impacted by local land uses (Beatty & Associates, 2009e). Chloride and sodium levels ranged from 2 mg/L to 10 mg/L indicating that road salt has not impacted the aquifer. Impacts from pesticide use or hydrocarbon or organic compound indicators were not identified.

7.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Palgrave 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 Palgrave water supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the 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
- an enumeration of Drinking Water Threats

7.3.3.1 List of Drinking Water Threats – Activities

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

7.3.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Palgrave Well Supply:

- Ecolog Environmental Risk Information Services Ltd Search. Databases used include:
    - Federal Government Source Database
    - Provincial Government Source Database
    - Private Sources Databases
- Municipal Parcel Assessment Codes

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

7.3.3.3 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 Threats circumstances~~Technical Rules can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances ~~tables~~ can be found at https://threats.swpip.ca/. ~~https://swpip.ca/.~~

7.3.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules can be used in conjunction with the Vulnerability Scores to identify the areas where Activities associated with pathogen threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Palgrave Well Supply (Figure 7a-4)~~.~~. 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.

7.3.3.3.2 Chemical Parameters

The ~~MECP table of Drinking Water Threats~~Technical Rules~~-~~ can be used in conjunction with the Vulnerability Scores to identify the areas where Activities associated with chemical threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Palgrave Well Supply (Figure 7a-5). 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.

7.3.3.3.3 DNAPL Chemical Parameters

Figure 7a-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Palgrave Well Supply. ~~The MECP table of Drinking Water Threats~~Technical Rules can be used to can be used to identify the circumstances in which these Activities would be Significant or Moderate Drinking Water Threats.

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

Further to Section 7.3.3.2, no Conditions have been identified within the WHPA for the Palgrave 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 7a-3 illustrates the Vulnerability Score maps for Palgrave well supply that can be used to determine where a Condition is or would be a Significant, Moderate, or Low Threat to Drinking Water.

7.3.3.5 Enumerating Drinking Water Threats

~~7.3.3.5~~

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7.3.3.5.1 Enumerating Significant Drinking Water Threats – Methods

This section describes the identification and enumeration of Significant Drinking Water Threat Activities. Identification of Activities requires determining where they are located in terms of vulnerable areas and their associated Risk Score based on the type of Activity. Detailed methodology can be found in the Toronto and Region Source Protection Area Assessment Report (based on Burnside, 2010e).

In order to classify activities in the study area the various databases and sources outlined in Section 7.3.3.2 were reviewed and information on site activities was compiled. The circumstances under which Activities are considered Threats and the classification of those Threats are contained in the Technical Rules. ~~(December 2021)~~

Two unique 'polygon' Threats were assigned to each WHPA with a Vulnerability Score of 10 in accordance with the common methodology developed by SGBLS (SGBLS, 2010). For the Threat 'sewage system or sewage works – sanitary sewers and related pipes', where present, one Threat was assigned to each WHPA to account for the potential Threat that could exist related to the sanitary network. One Threat was assigned to represent the entire network since detailed information regarding distribution and conveyance capacities was not readily available within some study areas. The second polygon Threat assigned was related to domestic fuel storage (i.e. Fuel Storage) which may be on a property as a primary source of heating fuel. One

fuel storage Threat was assigned to each WHPA where there was a high probability that natural gas was not available in the area.

Some Threats such as the Application of Agricultural Source Material to Land have Circumstances based on datasets that are on a scale larger than individual properties. These Circumstances included percent Managed Lands, Livestock Density, and Impervious Surfaces. Therefore, additional calculations were required to determine these Circumstances for each WHPA. The percent Managed Lands and Livestock Density calculations were completed for this project using a methodology developed in consultation with the SGBLS Source Protection Region and was based on the MOE Technical Bulletin for Managed Land and Livestock Density Calculations (MOE, November 2009). Managed Lands, Livestock Density, and Impervious Surfaces are discussed in more detail below.

7.3.3.5.1.1 Managed Lands

Managed Land is land to which nutrients (Agriculture Source Material (ASM), commercial fertilizer, Non-Agricultural Source Material (NASM)) are applied. Managed Lands is broken into two subsets; agricultural Managed Lands and Non-Agricultural Managed Lands. Agricultural Managed Lands include areas of crop land, fallow, and pasture land that may receive nutrients. Non-agricultural Managed Lands include golf courses, sports fields, and residential lawns and other built up grassed areas that may receive nutrients (primarily commercial fertilizers).

Technical Rule 16(9) ~~(MECP, 2021)~~ 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 (e.g. the vulnerability score less than 6) in the -Technical Rules ~~(December 2021).~~. The percent Managed Lands was determined for the Palgrave WHPA by Aqua Insight (2022). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 7.3.3.5.2).

Figure 7a-7 illustrates the distribution of Managed Lands within the delineated WHPA zones for the Palgrave Supply.

7.3.3.5.1.2 Livestock Density

Livestock Density is calculated to provide a measure of the potential for generating, storing, and land applying ASM as a source of nutrients within a defined area. The Livestock Density is expressed as Nutrient Units per Acre. It is determined by dividing the Nutrient Units generated

in each area by the number of acres of agricultural Managed Land in the area where agricultural source material is applied.

Technical Rule 16(10) ~~(MECP, 2021)~~ 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 (e.g. the vulnerability score less than 6) in the -Technical Rules ~~(December 2021)~~. The Livestock Density was determined for the Palgrave WHPAs by Aqua Insight (2022). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 7.3.3.5.2). Figure 7a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Palgrave Supply.

7.3.3.5.1.3 Impervious Surfaces

Impervious Surfaces are defined in the Technical Rules as areas that receive road salt application and include roads and parking lots. The areas were determined using road mapping from the National Road Network (Natural Resources Canada) and satellite air photography to identify large parking lots and paved areas. The percentage of impervious area within a one-kilometre grid centred on the municipal wells was estimated using the project GIS. As outlined in the Technical Rules (MECP, 2021), the percent impervious area was calculated within each grid cell within a WHPA-A to -D polygon.

The percentage of impervious cover across most of the Palgrave WHPAs lies within the 1 to 8% category, with a few small areas that have less than 1%, which is appropriate considering the rural residential land uses in this area.

Technical Rule 16(11) (MECP, 2021) 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 Technical Rules (December 2021).

Figure 7a-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Palgrave Supply.

7.3.3.5.2 Enumerating Significant Drinking Water Threats – Results

There are no Significant Threats associated with Drinking Water Issues or Conditions.

Table 7-1 documents the enumeration of existing activities that are considered to be Significant Drinking Water Threats within the WHPA for the Palgrave Water Supply. Palgrave Well 3have

four Activities that are considered to be potential Significant Drinking Water Threats identified in association with three land parcels. Potential Significant Threats are associated with sewage systems (3) and the handling and storage of fuel (1).

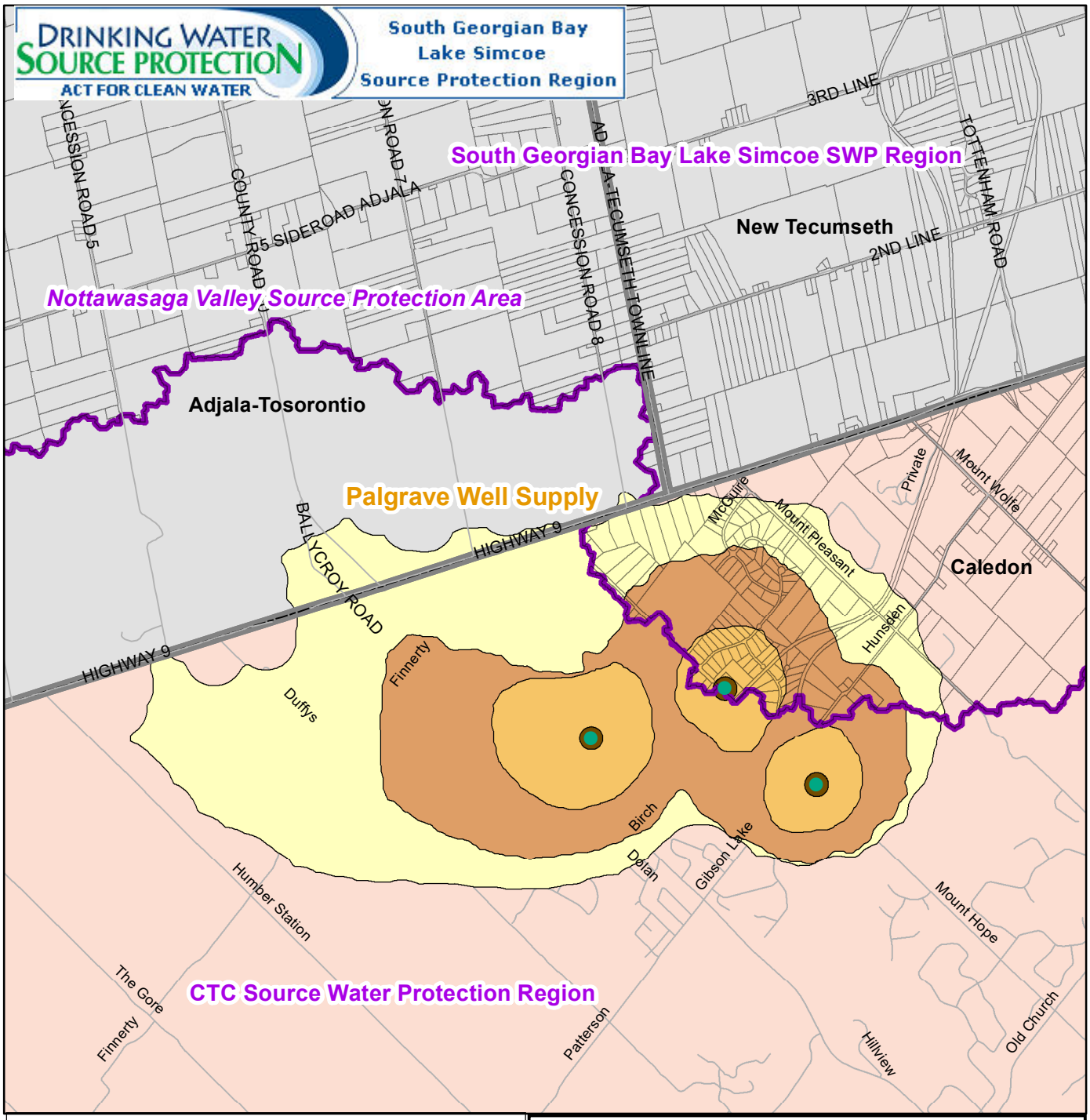
Table 7-1: Number of Significant Drinking Water Threats for the Palgrave Well Supply, Enumeration of Significant Threats (Wellhead Protected Area)

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	3
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

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	0
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
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard	0
22	The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.	0
-	**Total Number**	**4** significant threats (in **3** properties)

Notes for the table above:

1. The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C1 (10 years time of travel)
- WHPA-D (25 years time of travel)
- SWP Watershed Area
- Municipal Boundary

N, W, E, S

600 300 0 600 Meters

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Drinking Water System Vulnerable Areas in Regional Municipality of Peel

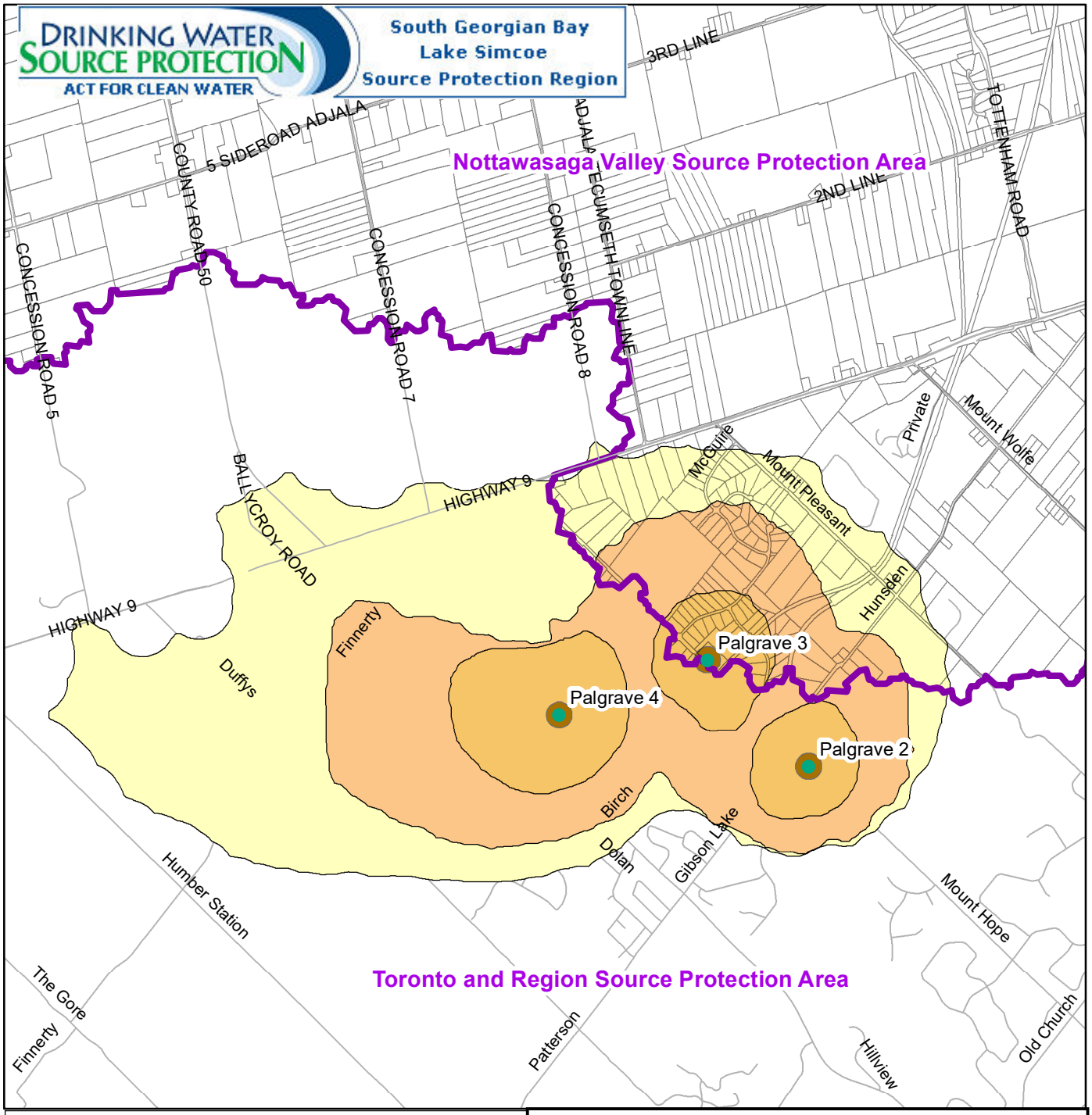
Created by: NVCA
Date: 2022-08

Scale: 1:50,000

UTM Zone 17N, NAD83

Ontario

Figure 7-1



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area
- WHPA-A (100 M RADIUS)
- WHPA-B (2-YEAR TIME-OF-TRAVEL)
- WHPA-C1 (10-YEAR TIME-OF-TRAVEL)
- WHPA-D (25-YEAR TIME-OF-TRAVEL)

800 400 0 800 Meters

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WELLHEAD PROTECTION AREAS-
PALGRAVE, REGION OF PEEL

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

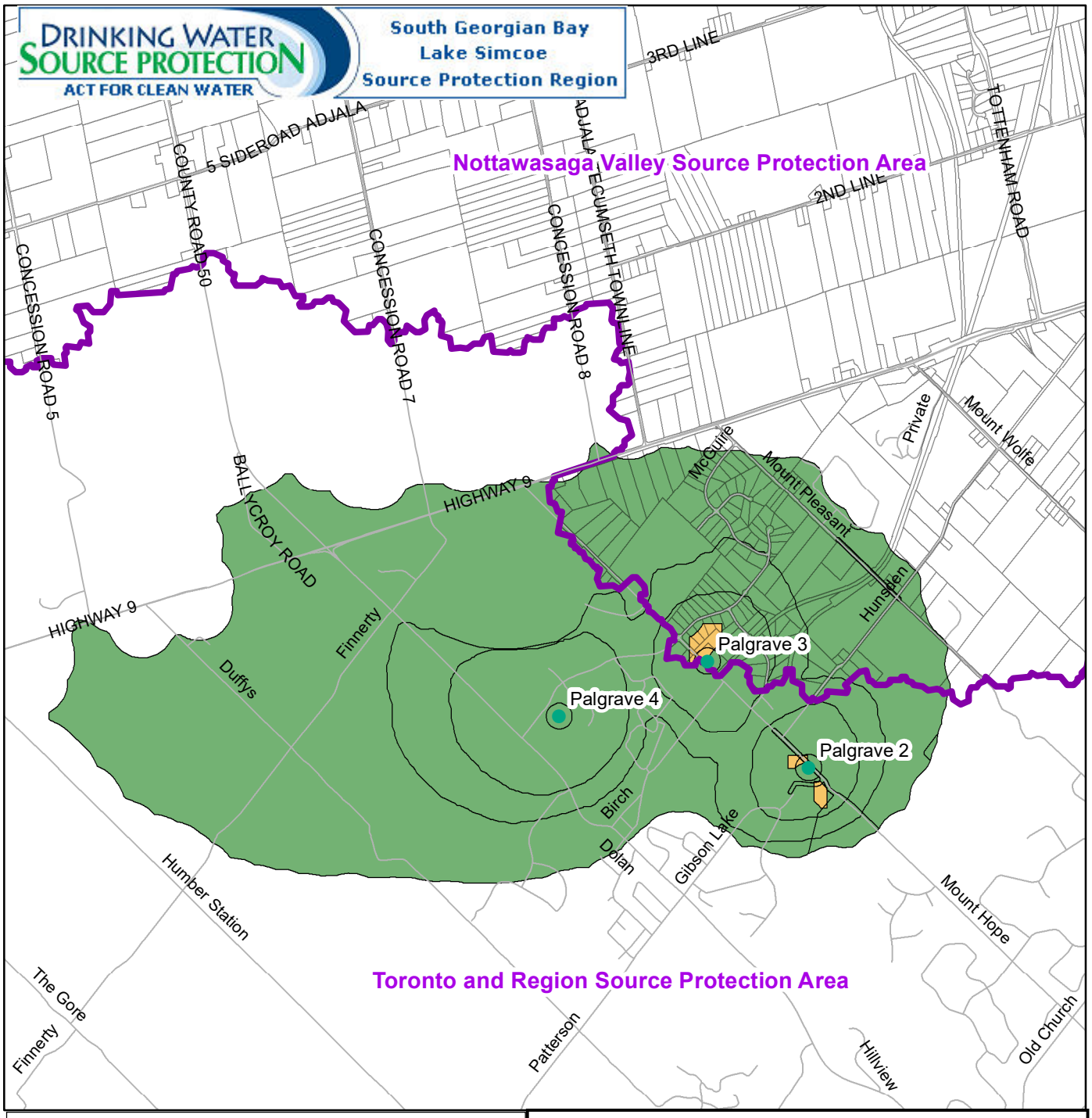
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-1



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area

Aquifer Vulnerability

- High
- Medium
- Low

800 400 0 800 Meters

N W E S

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GROUNDWATER VULNERABILITY- PALGRAVE

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

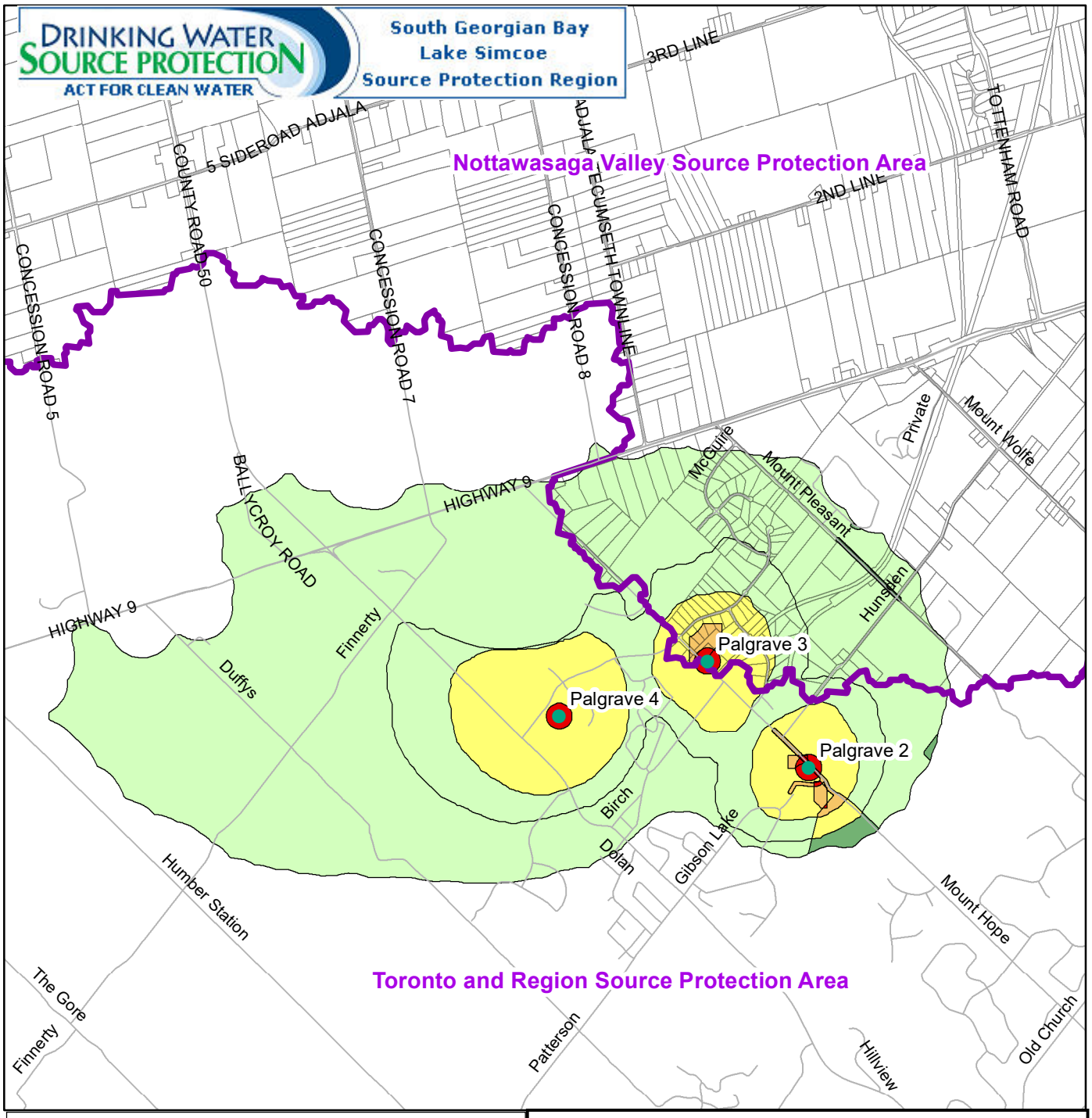
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-2



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area

Vulnerability Score

- 10
- 8
- 6
- 4
- 2

N W E S

800 400 0 800 Meters

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VULNERABILITY SCORES- PALGRAVE

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

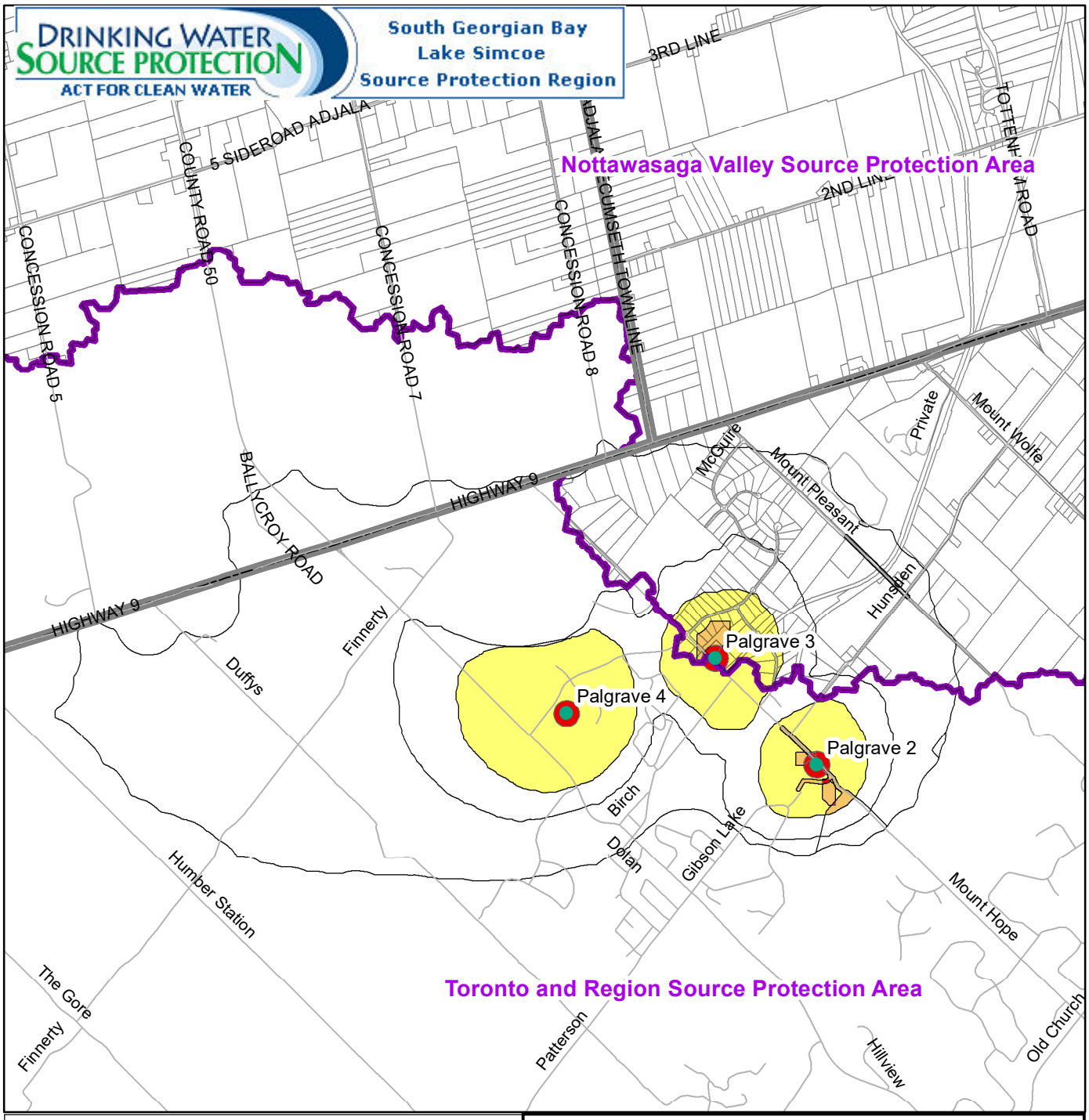
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-3



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area

Vulnerability Score

- 10
- 8
- 6

N W E S

800 400 0 800 Meters

This figure is to be used to identify the area where a landuse activity is or would be a drinking water threat based on the Technical Rules.

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

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

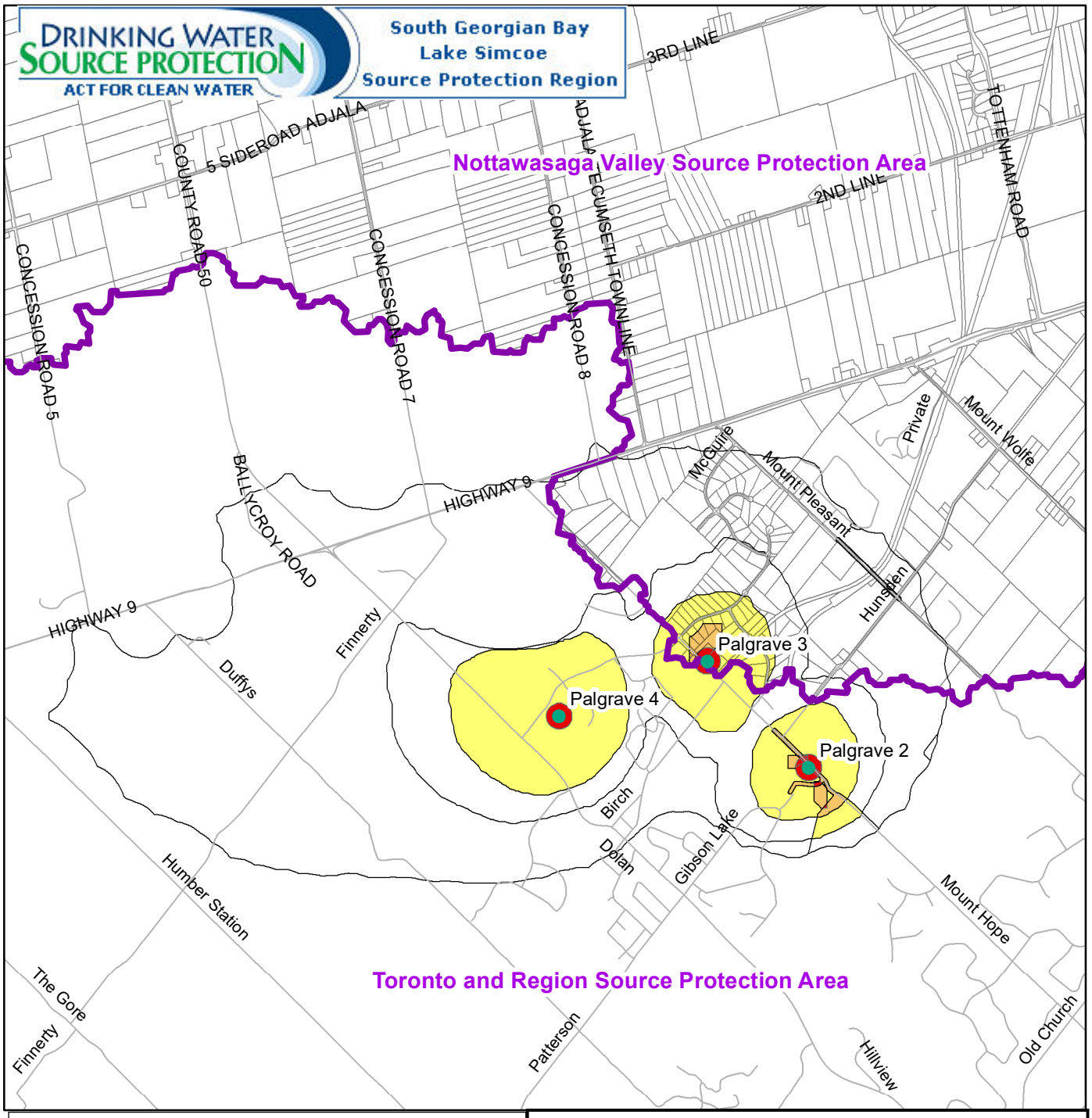
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-4



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area

Vulnerability Score

- 10
- 8
- 6

N W E S

800 400 0 800 Meters

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.

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

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

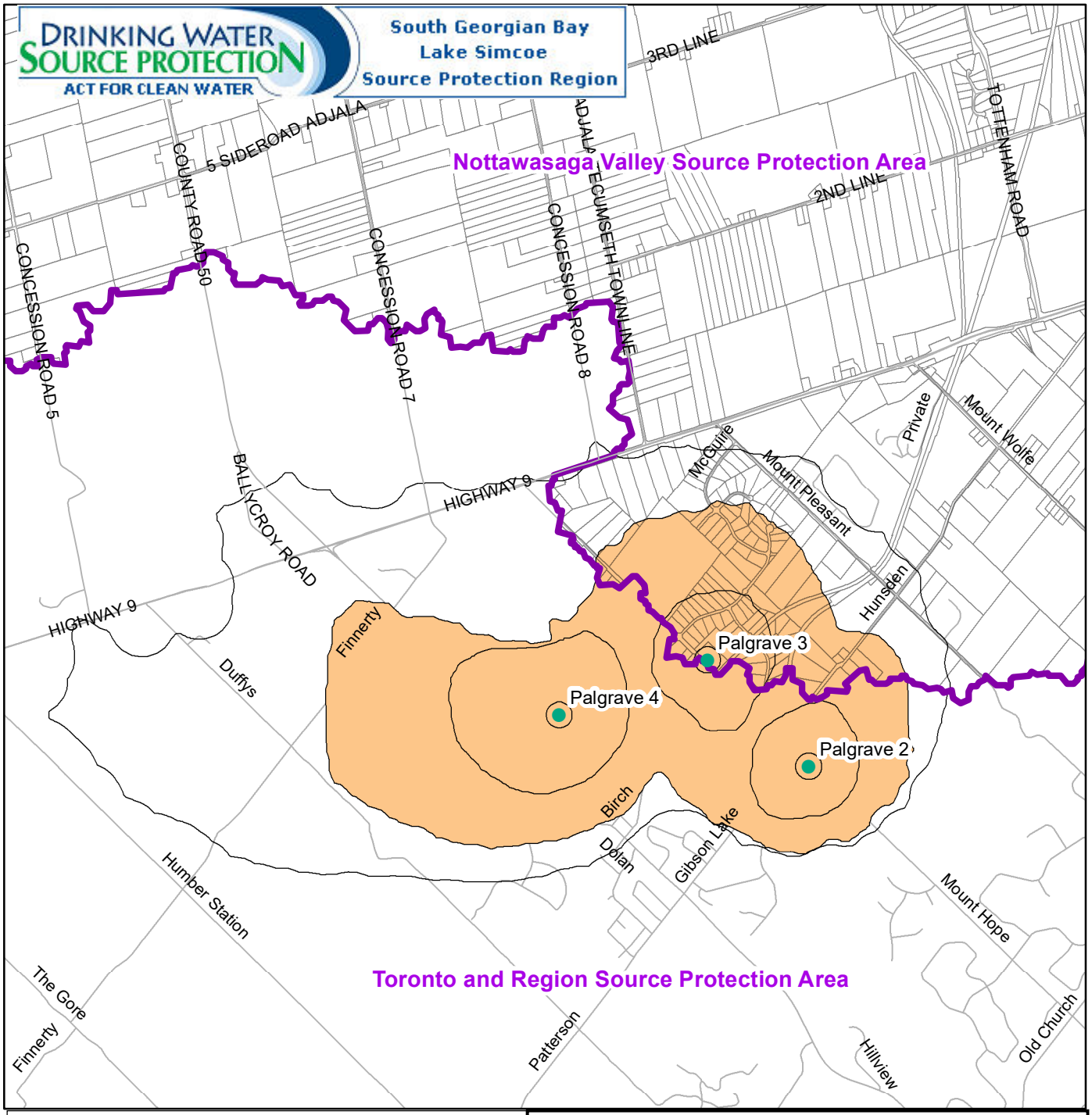
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-5



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area
- WHPA-C1 (10-YEAR TIME-OF-TRAVEL)

N W E S

800 400 0 800 Meters

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

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

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.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

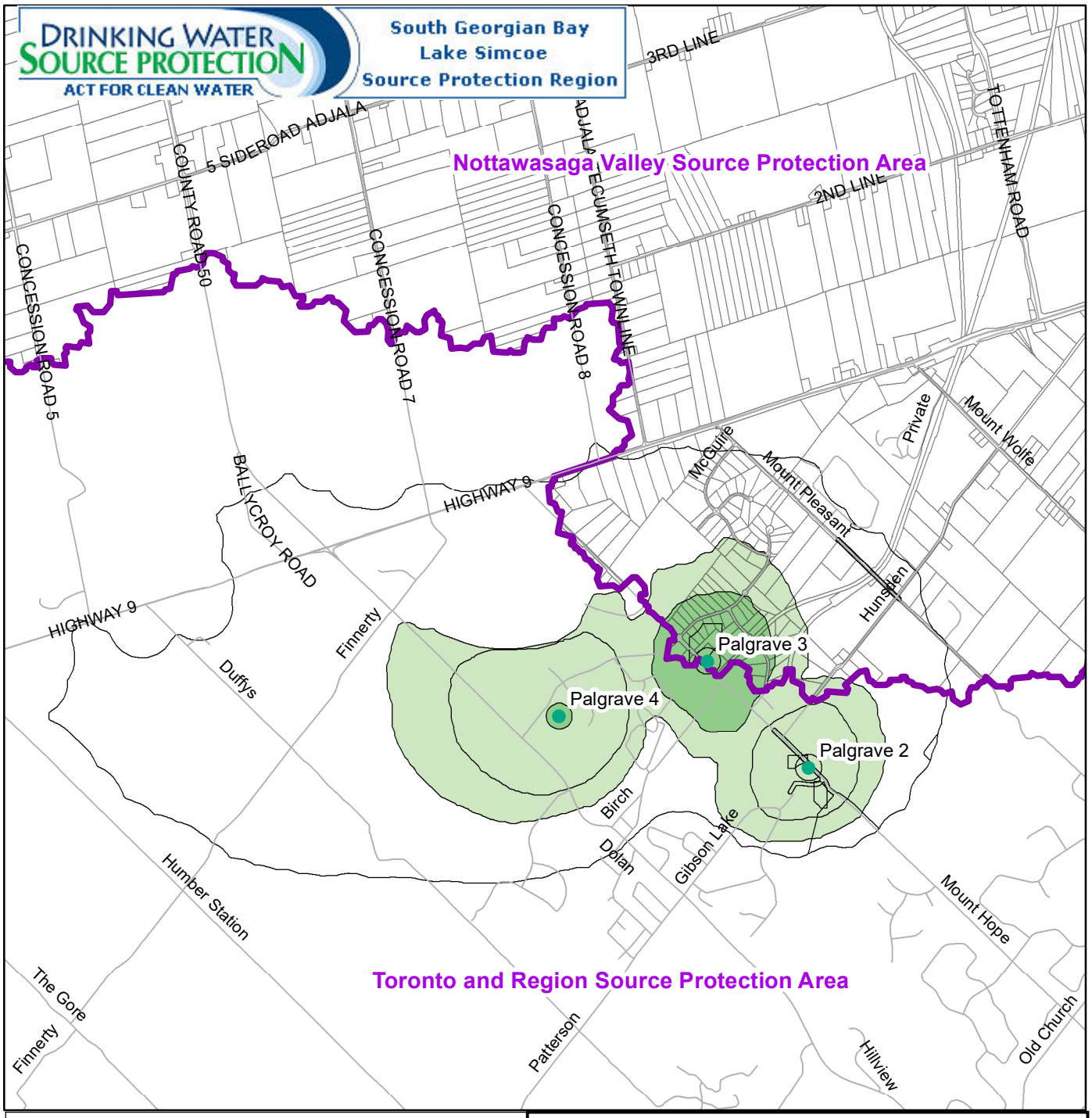
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-6



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

800 400 0 800 Meters

The Managed Lands proportion is illustrated where the vulnerability score is greater than 6.

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MANAGED LANDS- PALGRAVE

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

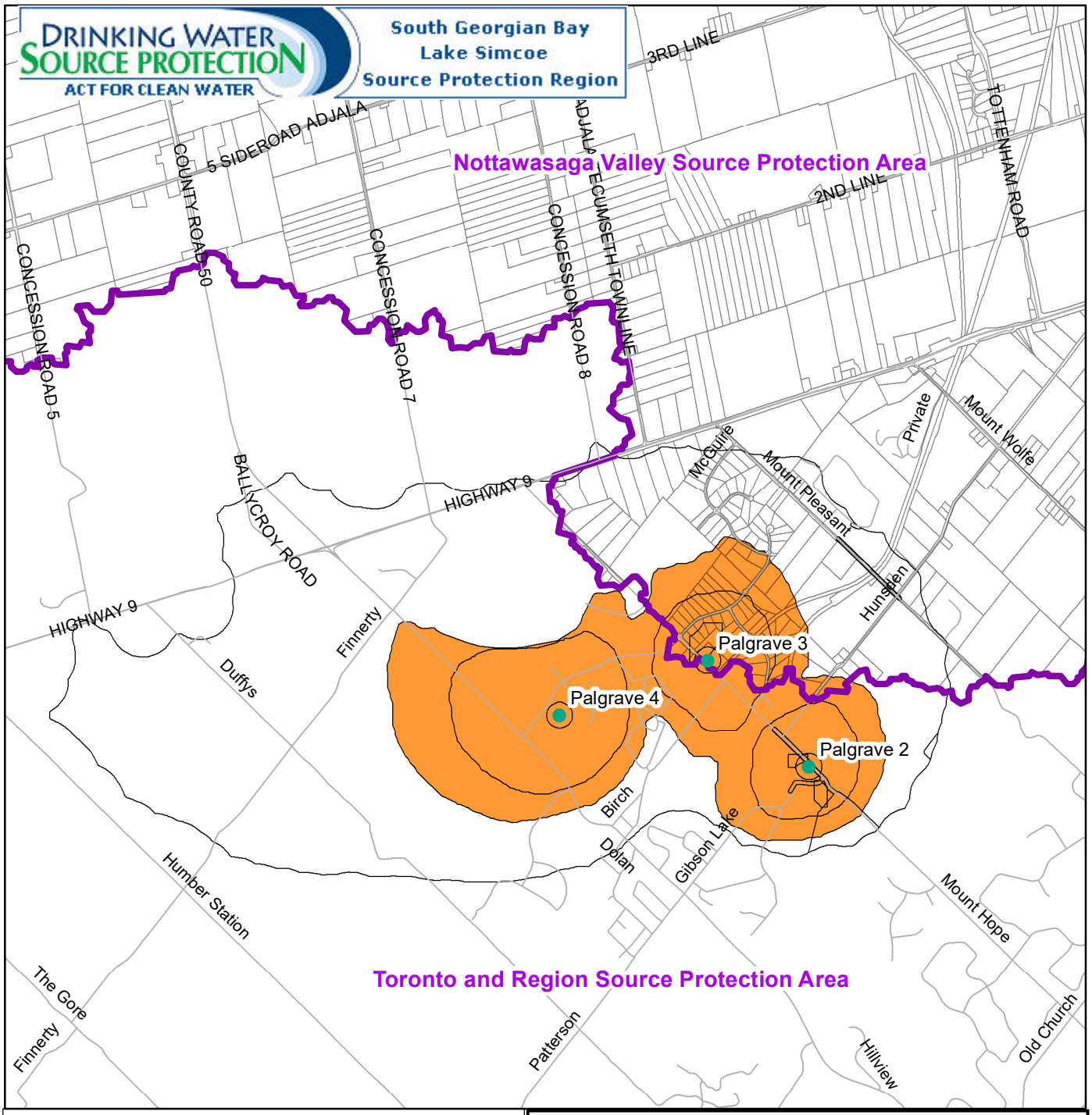
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-7



Legend

- MUNICIPAL WELL LOCATION
- SWP Watershed Area
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

800 400 0 800 Meters

The Livestock Density proportion is illustrated where the vulnerability score is greater than 6.

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LIVESTOCK DENSITY-PALGRAVE

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

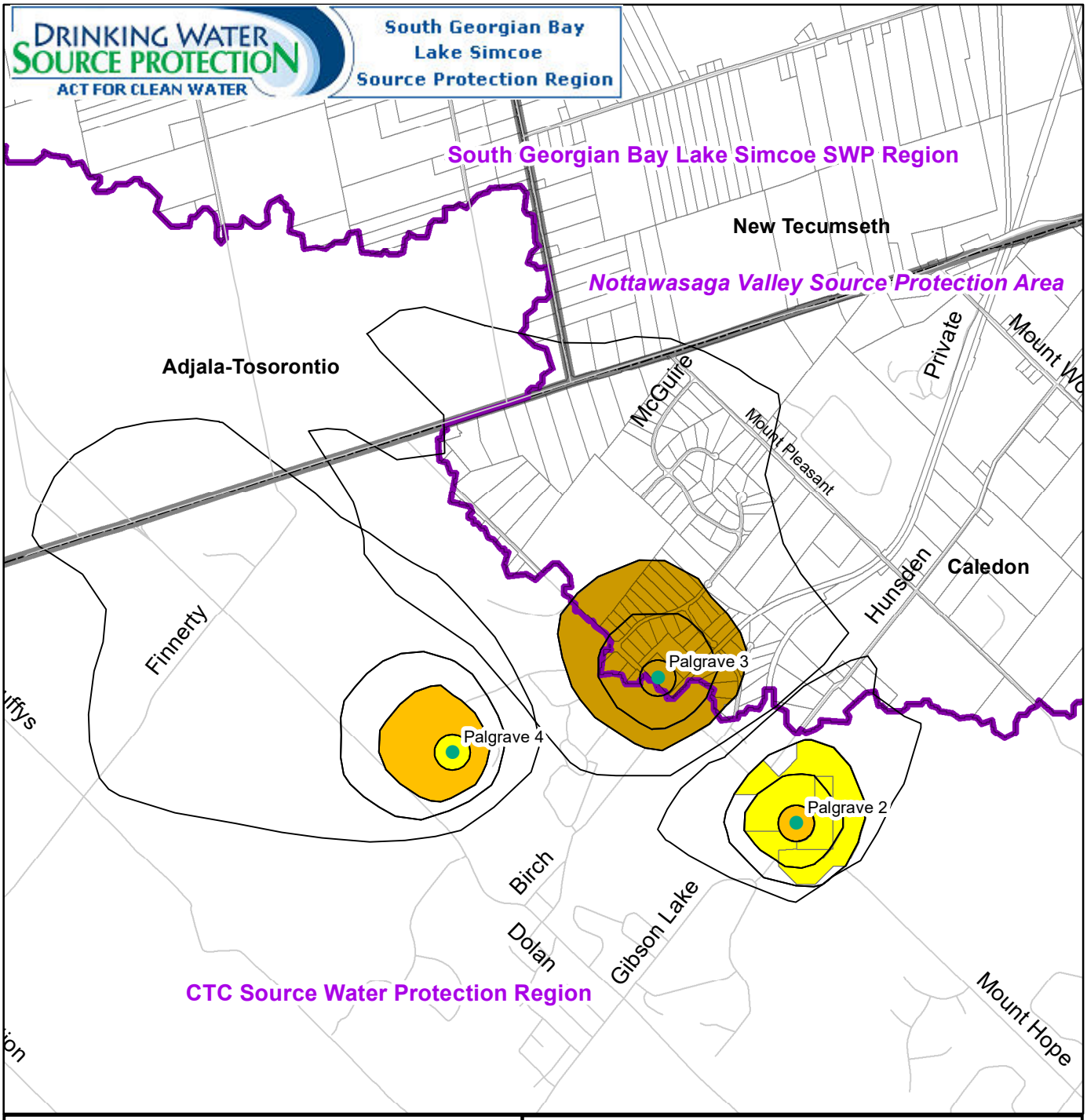
Created by: NVCA
Date: 2022-08

Scale: 1:45,000

UTM Zone 17N, NAD83

Ontario

Figure 7a-8



Legend

- MUNICIPAL WELL LOCATION
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%
- SWP Watershed Area
- Municipal Boundary

N W E S

390 195 0 390 Meters

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IMPERVIOUS SURFACES - PALGRAVE, REGIONAL MUNICIPALITY OF PEEL

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

Created by: NVCA
Date: 2025-09

Scale: 1:32,893

UTM Zone 17N, NAD83

Ontario

Figure 7a-9