



CTC Source Protection Region

DRINKING WATER
SOURCE PROTECTION
Our Actions Matter

CTC Source
Protection
Region

Approved Assessment Report: Central Lake Ontario Source Protection Area

Prepared by: CTC Source Protection Committee

Approved Date: July 24, 2015

Effective Date: December 31, 2015

Version 2.0

Approved Assessment Report: Central Lake Ontario Source Protection Area



This project has received funding support from the Government of Ontario.

Preface

Source Protection Committee Commitment

The CTC Source Protection Committee (SPC) is a multi-stakeholder committee selected to represent municipal, economic, and public interests. The SPC has legislated responsibilities to protect drinking water sources across the CTC Source Protection Region.

The SPC has developed a Source Protection Plan that is currently being implemented by responsible parties, including municipalities, in order to eliminate, reduce, or manage threats to drinking water sources, both now and in the future.

About This Document

The *Approved Updated Assessment Report: Central Lake Ontario Source Protection Area* (Assessment Report) contains new (updated) information about municipal drinking water threats and minor revisions for clarification requested by the Ministry of the Environment and Climate Change (MOECC). The *Amended Assessment Report: Central Lake Ontario Source Protection Area* was submitted and approved by the Ministry of the Environment in 2012, after revisions and public consultation. More recent studies completed by authorities outside of the Central Lake Ontario Source Protection Area, that resulted in additional threats to local drinking water systems prompted the need for this update. It should be noted that the studies supporting the updates presented in this report were peer-reviewed and underwent public consultation.

This Assessment Report identifies the location and nature of threats to sources of municipal drinking water supplies. These threats include activities that are impacting or could adversely impact drinking water quality or quantity from groundwater and/or surface water sources. New information is included in identifying threats to surface water quality and the Lake Ontario drinking water intakes located in the Central Lake Ontario Source Protection Area's jurisdiction as well as water quantity threats identified through a Tier 3 Water Budget study in the Region of York and a portion of Region of Durham. The Tier 3 Water Budget study extends over a small area in the northwest part of the Central Lake Ontario Source Protection Area's jurisdiction. This updated report contains supporting documentation for these studies.

The Central Lake Ontario Source Protection Authority submitted the original *Proposed Assessment Report* to the Minister of the Environment for approval in December 2010. At that time, additional research was being carried out, which necessitated updates to the *Proposed Assessment Report*. The *Amended Proposed Assessment Report* was submitted to the Ministry of the Environment on July 29, 2011, and it was subsequently approved on January 18, 2012. This current Assessment Report, which contains a number of updates was submitted for approval in December 2014 and approved in July 2015. The completion of an assessment report is a requirement of the *Clean Water Act, 2006 (CWA)* and Ontario Regulation (O. Reg.) 287/07, both of which came into effect on July 3, 2007. It has been developed in accordance with these regulations, the Director's *Technical Rules*, and the *Terms of Reference: CLOSPA* (2009) as approved by the Minister of the Environment. Amendments to the CLOSPA Assessment Report resulting in version 2 were made using the 2017 Director's Technical Rules and Tables of Drinking Water Threats. Sections of the Assessment Report that were not updated as part of those amendments refer to the 2009 edition of the Director's Technical Rules and Tables of Drinking Water Threats.

Public comments on this Assessment Report were sought in May 2014 for the Tier 3 Water Budget study on the municipal water systems in York Region coinciding with consultation on newly proposed water quantity policies. The public was invited to review the *Updated Approved Assessment Report* online at www.ctcswp.ca and a public drop-in session was held in collaboration with the South Georgian Bay Lake Simcoe Source Protection Region in the Town of Whitchurch-Stouffville on May 7, 2014 for those wanting more information. Notice of this comment period was posted online and sent to individuals on the CTC SPC's electronic mailing list. Residents impacted by the Tier 3 Water Budget and quantity policies were also informed by newspaper advertisements in local weekly newspapers of their opportunity to comment. The comments and input received during the public consultation periods were considered by the CTC SPC in finalizing this Assessment Report.

Note: The Ministry of Environment, Conservation and Parks has undergone several name changes throughout the years. It was called the Ministry of Environment (MOE) in the early 2000's. In June 2014, the name was changed to the Ministry of the Environment and Climate Change (MOECC). In June 2018, the name was changed yet again, to the Ministry of the Environment, Conservation and Parks (MECP), as it is currently known.

In June 2014, the Ministry of Natural Resources (MNR) changed its name to the Ministry of Natural Resources and Forestry (MNRF). In 2021, the Ministry of Natural Resources and Forestry changed its name to the Ministry of Northern Development, Mines, Natural Resources and Forestry.

The recent and past names of both Ministries are used within this document.

Version Control

Version Number	Approval Date	Effective Date	Summary of Amendments
1.0	July 24, 2015	December 31, 2015	Approved Assessment Report
			Amendments to this document, made under Ontario Regulation 287/07, Section 51 to correct clerical, grammatical or typographical errors; to make changes referencing a name, title, location, or address that has changed. Date amendment posted: June 5, 2018
2.0	n/a	n/a	Amendments to this document, made under Ontario Regulation 287/07, Section 51 to correct clerical, grammatical or typographical errors; to make changes referencing a name, title, location, or address that has changed; to incorporate Phase 1 Director Technical Rule 2017 amendments. Date amendment posted: May 20, 2022

Acknowledgements

The preparation of this Assessment Report has been a collaborative exercise with support from staff with the Regional Municipality of Durham, City of Toronto, Region of Peel, Oak Ridges Moraine Groundwater Program, and the Central Lake Ontario Conservation Authority. Work in this report has been directed through the Central Lake Ontario Conservation Authority and the CTC Source Protection Committee. Funding to complete the technical studies on which this Assessment Report is based has been provided by the Province of Ontario. The Province of Ontario also funds the conservation authority staff and Source Protection Committee members for their work on drinking water source protection. Technical experts, including consultants working for municipalities and conservation authorities, have prepared background technical reports, peer reviews and provided advice and direction in completing this Assessment Report. Members of the CTC Source Protection Committee and Working Groups have reviewed the technical studies and the text of this Assessment Report.

EXECUTIVE SUMMARY

Why should you read this document?

The *Approved Updated Assessment Report: Central Lake Ontario Source Protection Area* (Assessment Report) has been prepared under the direction of the CTC Source Protection Committee (SPC), one of 19 such committees across Ontario (**Figure ES: 1**). It is a requirement of the *Clean Water Act, 2006 (CWA)* and Ontario Regulation (O. Reg.) 287/07 as amended by O. Reg. 59/10, and has been developed in accordance with the regulations, the *Technical Rules: Assessment Report* and the *Terms of Reference: Central Lake Ontario Source Protection Area*, as approved by the Minister of the Environment.

Amendments to the Central Lake Ontario Source Protection Area Assessment Report resulting in version 2 were made using the 2017 Director's Technical Rules and Tables of Drinking Water Threats. Sections of the Assessment Report that were not updated as part of those amendments refer to the 2009 edition of the Director's Technical Rules and Tables of Drinking Water Threats.

This Assessment Report identifies the location and nature of threats to sources of municipal drinking water supplies. These threats include activities that are impacting, or could adversely impact, drinking water quality or quantity from groundwater and/or surface water sources. New information includes a new vulnerable area, significant water quantity threats based on the recently completed York Tier 3 Water Budget work, additional threats to surface water quality in Lake Ontario, and updated maps.

This Assessment Report identifies the location and nature of potential threats to sources of municipal drinking water. These threats include activities that are adversely impacting, or could impact, drinking water quality or quantity from groundwater and/or surface water sources.

Source protection committees determine risks to drinking water sources by delineating and applying vulnerability scores to four types of vulnerable areas, where they exist, within each source protection area, as discussed in the legislation. These areas are:

- Intake protection zones (IPZs);
- Highly vulnerable aquifers (HVAs);
- Significant groundwater recharge areas (SGRAs);
- Wellhead protection areas (WHPAs) (note: there are no municipal groundwater supplies located in Central Lake Ontario Source Protection Area (CLOSPA). A Well Head Protection Area for a well located in another source protection area may extend into an adjacent source protection area. This is the case with the York Tier 3 Water Budget where the Well Head Protection Area for quantity threats extends into a small portion of the CLOSPA);
- Issue contributing areas (ICAs) – none within the CLOSPA; and
- Water quantity vulnerable areas (WHPA-Q1/Q2).

Detailed information about how these vulnerable areas were delineated and scored can be found in **Chapter 4** (regarding vulnerability) and **Chapter 5** (regarding Intake Protection Zone-3). This Assessment Report identifies and describes, per the *Technical Rules (2009)*, the four types of vulnerable areas within CLOSPA. Because CLOSPA does not have municipal drinking water wells, there are no Well Head Protection Areas related to water quality to be delineated. A Well Head Protection Area related to quantity does, however, extend into the CLOSPA. The information on this latter new vulnerable area is included in this Assessment Report and discussed at length in **Chapter 3**. Below are six maps showing the vulnerable areas for the CLOSPA. Descriptions, scoring, and documentation on the analyses

performed to arrive at these delineations are all contained in the body of this Assessment Report or in the referenced technical appendices.

The Tier 3 Water Budget WHPA-Q1/Q2 map shows (**Figure ES: 2**) the water quantity vulnerable area that extends into CLOSPA. The IPZ-1 and IPZ-2 map (**Figure ES:3**) indicates areas near a drinking water intake where a contaminant spill could reach the intake before a plant operator is able to respond. In CLOSPA, all municipal residential drinking water system intakes are in Lake Ontario.

The IPZ-1 is based on drawing a one km radius around the intake. IPZ-2 is based on the estimation of the distance a contaminant might move in a two-hour time of travel to the intake and is made up of two parts – the in-lake portion, and the landward extent. The delineation of the in-lake portion is based on hydrodynamic modelling, while the delineation of the landward extent is based on the extent of storm sewer drained areas, and on the *two-year storm* velocities in contributory watercourses. The upland component considers various setbacks, and transport pathways, such as tile drainage, with the residual time of travel onto the land as a limiting factor. Details on this work can be found in **Chapter 4** of this Assessment Report.

Two-year storm: The maximum estimated wind likely to occur at least once every two years (two-year return frequency).

The IPZ-3 map (**Figure ES: 4**) shows the IPZ-3 delineations, which are associated with a number of spill scenarios that were modelled as part of the Lake Ontario Collaborative to determine if certain land-based sources activities could pose a potential drinking water threat to these intakes. Any scenario that identifies conditions under which a contaminant could exceed a threshold in the raw water is identified as a significant drinking water threat. Once a contaminant is modelled to reach an intake, an IPZ-3 was delineated using the required setbacks from the point of its release in the tributary to a point representing the maximum landward extent of the IPZ-2. A dashed line is also drawn from the point of entry at the lake to the affected intake. This line is termed the “spill collector” and represents the shortest transport path between the shoreline and the affected intakes. An IPZ-3 that falls in the lake such as a spill at a wastewater treatment plant (WWTP) is represented by a spill collector dashed line only. **Figure ES: 5** presents an integrated intake map of all IPZ zones for the CLOSPA. More details about this work can be found in **Chapter 5** of this Assessment Report. Note that the IPZ-3 outside of the CLOSPA jurisdiction has not been clipped to the IPZ-2 boundaries as required by the Technical Rules. The clipping has been completed only where the source is located within CLOSPA.

Details on this IPZ-3 work can be found in **Chapter 5** of this Assessment Report, along with detailed maps for each of the Lake Ontario systems. The maps show the shortest path that a modelled spill that has been identified as a significant drinking water threat could take to reach the intakes within the Toronto and Region Source Protection Area, or that could be affected by activities within the TRSPA.

Figure 5.13: Ajax Intake

Figure 5.16: Bowmanville Intake

Figure 5.14: Whitby Intake

Figure 5.17: Newcastle Intake

Figure 5.15: Oshawa Intake

The SGRA map (**Figure ES: 6**) indicates areas where a high percentage of rain or snow seeps down into the ground and flows to an aquifer that is used for drinking water (including both municipal and other users). These areas are delineated according to the methodology provided in **Chapter 4** using the recharge results from the water budget process described in **Chapter 3** of this Assessment Report. Under the *Clean Water Act, 2006* the CTC SPC may choose to develop policies to protect SGRAs within CLOSPA.

The HVA map (**Figure ES: 7**) indicates areas where one or more aquifers have been determined to be highly vulnerable to surface contaminants moving from elsewhere into the aquifer, e.g., contaminants on the surface move downwards into the groundwater. Extra caution should be taken when

constructing wells in vulnerable aquifers. Water well construction standards are set out in O.Reg. 903 under the *Ontario Water Resources Act*. Under the *Clean Water Act, 2006*, the CTC SPC may choose to develop policies to protect HVAs within CLOSPA.

Where Tier 3 Water Budget studies are undertaken, water quantity vulnerable areas are delineated around wells or groups of wells where they interact with one another, called WHPA-Q1 and Q2. **Chapter 3** of this Assessment Report describes how these areas are delineated. The York and portion of Durham Tier 3 water budget study, completed for the wells in Whitchurch-Stouffville and Uxville, identified a WHPA-Q1/Q2 area that extends into part of CLOSPA.

The Source Protection Plan (SPP) identifies actions required to reduce, manage, or eliminate current threats to municipal drinking water sources, as well as to prevent future potential threats. The SPP will also set out requirements for regular monitoring and reporting on the implementation of the SPP. The public consultation was an important part of developing the SPP, which started in 2011. The SPP was submitted to the Minister of the Environment for approval in October 2012, and again in December 2014 as an amended plan. The source protection plan was approved by the Minister of the Environment and Climate Change on July 28, 2015, and became effective on December 31, 2015.

This Assessment Report describes the physical features and water resources within the Central Lake Ontario Source Protection Area (CLOSPA). Using approved provincial methodologies, it delineates vulnerable areas and assesses specific activities on the landscape within these vulnerable areas as potential drinking water threats. It should be noted that all municipal drinking water supplies for the CLOSPA's jurisdiction come from Lake Ontario. In general, the Lake Ontario source water for the CLOSPA water treatment plants was of high quality. The operators reported the source as excellent, relatively predictable, and easy to work with. The operators reported that raw water quality fluctuations were the result of seasonal, weather-driven events.

The analyses of the Watershed Characterization component in **Chapter 2** of this Assessment Report revealed some increasing trends in levels of contaminants in shallow groundwater supplies that support private wells in the study area. Levels are compared to the Ontario Drinking Water Standards as private well owners use groundwater as a source of drinking water. Shallow wells are naturally vulnerable to impact from land-use activities; for example, increases in sodium and chloride were observed and are thought to be associated with the application of road salt. Water well construction guidelines under *Ontario Regulation 903 (Water Wells)* should be strictly adhered to. Surface water quality in the streams discharging into Lake Ontario shows some elevated levels of chlorides, phosphorus, and nitrates as compared against the ecosystem and aquatic life standards (Canadian Water Quality Guidelines).

The Tier 1 Water Budget analysis in **Chapter 3** of this Assessment Report assessed potential water quantity stress in both surface water (not including Lake Ontario) and groundwater. Groundwater supplies in CLOSPA are used as a source of drinking water for private wells (5% of the population in the study area) and to support ecosystem functions. The surface water in streams in the study area is important for supporting the ecosystem and is also used for irrigation and other non-drinking water purposes.

Lynde and Darlington Creek watersheds were found to have moderate groundwater stress levels, and the Lynde, Goodman, Oshawa, Darlington, and Soper Creek watersheds have significant surface water stress levels during summer months. All other catchments in the study area have low-stress levels for both groundwater and surface water. Given that these stresses are not associated with municipal drinking water supplies, which are the focus of the *Clean Water Act, 2006* additional investigation and management should be conducted under the conservation authority watershed protection programs.

The previous water budget analyses were concluded at a Tier 1 level as part of the 2012 Central Lake Ontario Source Protection Area Assessment Report submission with no municipal groundwater systems located within the jurisdiction. Tier 3 Water Budget work was completed in 2014 for the areas around the Whitchurch-Stouffville and Uxville wells as part of a larger York Region and a portion of Durham Region Tier 3 Water Budget Risk Assessment study. The risk assessment indicates that the York Tier 3 WHPA-Q1/Q2 extends into a small part of CLOSPA. The WHPA-Q1/Q2 is classified at a moderate risk level because increases in pumping to meet allocated demand are predicted to create a greater than one metre incremental drawdown in the aquifer serving other permitted wells and under provincially significant wetlands. Therefore, the existing consumptive water uses and recharge reduction activities within the WHPA-Q1/Q2 are considered moderate drinking water quantity threats, while future activities are considered to be significant drinking water quantity threats. Since the *Technical Rules, 2009* exclude consideration of Great Lakes in water budget “stress” assessments, Lake Ontario was not included in the water budget studies. The Tier 3 discussion is presented in **Chapter 3** of this Assessment Report as part of updates to the Central Lake Ontario Source Protection Area Assessment Report and is consistent with the Tier 3 discussion in the Toronto Region Source Protection Area Assessment Report where the Tier 3 study is centered in the CTC Source Protection Region.

Chapter 4 assesses and scores vulnerability and scored in all vulnerable areas in CLOSPA (WHPAs, IPZs, HVAs, and SGRAs). The IPZs for the study area (IPZ-1s and IPZ-2s) were all ranked as having low vulnerability. The results of the CLOSPA HVA and SGRA vulnerability analyses reflect the presence of many shallow aquifers that are naturally vulnerable. The SGRA mapping and SGRA vulnerability scoring were updated to include the SGRA delineation revisions resulting from the York Region Tier 3 water budget study. No changes were made to the HVA mapping for CLOSPA as the Tier 3 area was already scored as highly vulnerable.

In **Chapter 5**, vulnerability is considered together with provincial hazard scores outlined in the Table of Drinking Water Threats and Circumstances (*Technical Rules*) for the various activities and their associated chemicals and pathogens to determine a risk score. Using both the natural vulnerability and hazard scores, potential drinking water threats are ranked as significant, moderate, or low in the vulnerable areas (WHPAs, IPZs and HVAs). In certain vulnerable areas (ICA, and WHAP-Q1/Q2 determined to have a significant risk level for water quantity threats) all the relevant activities are deemed to be significant drinking water threats. In the case of the IPZ-3s for intakes in Lake Ontario, the determination of whether a threat is significant was determined through event-based spill scenario modelling to assess the impact of a particular spill scenario on individual intakes.

Significant threats must be identified and located in the Assessment Report and addressed in the Source Protection Plan. In the absence of field verification, the Source Protection Committee took a conservative approach in identifying threats, assuming that a threat activity could exist based on current land use and other available information. However, source protection plan policies will only apply to activities that actually exist or are planned. If the activity does not exist or ceases to exist on a property where it could pose a drinking water threat, any policies directed at the activity would not apply.

If the activity is categorized as a moderate or low-level threat, the Province requires only the identification of all of the circumstances that could pose a threat to drinking water by reference to the Provincial Tables of Circumstances.

It should be noted that these moderate and low threats may not actually exist within the vulnerable area discussed. Low and moderate threats do not require mandatory action.

There are eleven (11) moderate drinking water quantity threats related to municipal drinking water supplies and no significant drinking water quality threats, conditions, or issues related to groundwater sources identified in this Assessment Report.

A number of spill scenarios were modelled as part of the Lake Ontario Collaborative (LOC) project to determine if certain land-based activities could pose a potential drinking water threat to these intakes. Any scenario that identifies conditions under which a contaminant could exceed a threshold in the raw water is identified as a significant drinking water threat. The scenarios considered included:

- Disinfection failure at each Lake Ontario WWTP to evaluate the potential effects to nearby water treatment plants (WTP);
- Release of *E. coli* from an industrial processing facility into the Credit River (this does not impact any CLOSPA intake);
- Combined sewer overflow (CSO) release in the City of Toronto to evaluate the potential effects to the Toronto WTPs, (this does not impact any CLOSPA intake);
- Sanitary trunk sewer (STS) break within certain Toronto tributaries;
- Spill of gasoline or refined products from large pipelines located under major tributaries to Lake Ontario (e.g. Credit River, Humber River, etc.);
- Release of gasoline or refined products containing benzene from a bulk petroleum fuel storage facility in the Keele/Finch area of Toronto (this does not impact any CLOSPA intake) and in the Mississauga – Oakville area (this does not impact any CLOSPA intake); and
- Discharge of tritium from nuclear-generating plants at Pickering or Darlington.

The Technical Rules require an IPZ-3 to be delineated if modelling demonstrates that contaminants may be transported to an intake and result in deterioration of the raw water quality of a drinking water supply above a specific threshold, based on the Ontario Drinking Water Standards.

The selected LOC spill scenarios were based on “real” events that have occurred in the past and were not based on extreme weather condition events at the time of the spill. The IPZ-3 was delineated for activities in the tributary using the required setbacks from the contaminant point of release to a point representing the maximum landward extent of the IPZ-2. A dashed line is also drawn from the point of entry at the lake to the affected intake. This line is termed the “spill collector” and represents the shortest transport path between the shoreline and the affected intakes. An IPZ-3 that falls in the lake such as a spill at a WWTP is represented by a spill collector dashed line only. The spill collector line represents the shortest path to the intake within the area where concentrations were modelled to exceed the threshold for the contaminant. Once a contaminant is modelled to reach an intake at a level that is identified as a significant drinking water threat, an Event-Based Area (EBA) within the IPZ-1, 2 or 3 was delineated using the required setbacks, from the point of its release in the tributary to a point representing the maximum landward extent of the IPZ-2. The EBA is the spatial component of the IPZ-1, 2 or 3 required for database and policy application purposes.

The Lake Ontario modelling identified eight locations of significant drinking water quality threats related to Lake Ontario intakes within CLOSPA. The Source Protection Plan for the CTC SPR must have policies to address these significant drinking water threats that are located within the source protection area.

In addition, the CLOSPA has identified significant drinking water threats related to municipal intakes in Lake Ontario located outside of the jurisdiction. These activities, although not enumerated in this Assessment Report, affect water treatment plants located in the CLOSPA, and must be addressed through source protection plan policies developed in adjacent source protection areas. CLOSPA staff has brought this information to the attention of the source water protection staff of the neighbouring source protection areas to ensure that policies are developed for them.

All municipal drinking water supplies in the CLOSPA come from Lake Ontario. Significant drinking water threats must be addressed in the Source Protection Plan per the *CWA, 2006* and the associated *Technical Rules*.

You may request more information by writing to:

ctcswp@cvc.ca

or by regular mail to:

Chair, CTC Source Protection Committee
c/o Credit Valley Conservation
1255 Old Derry Road, Mississauga, ON L5N 6R4

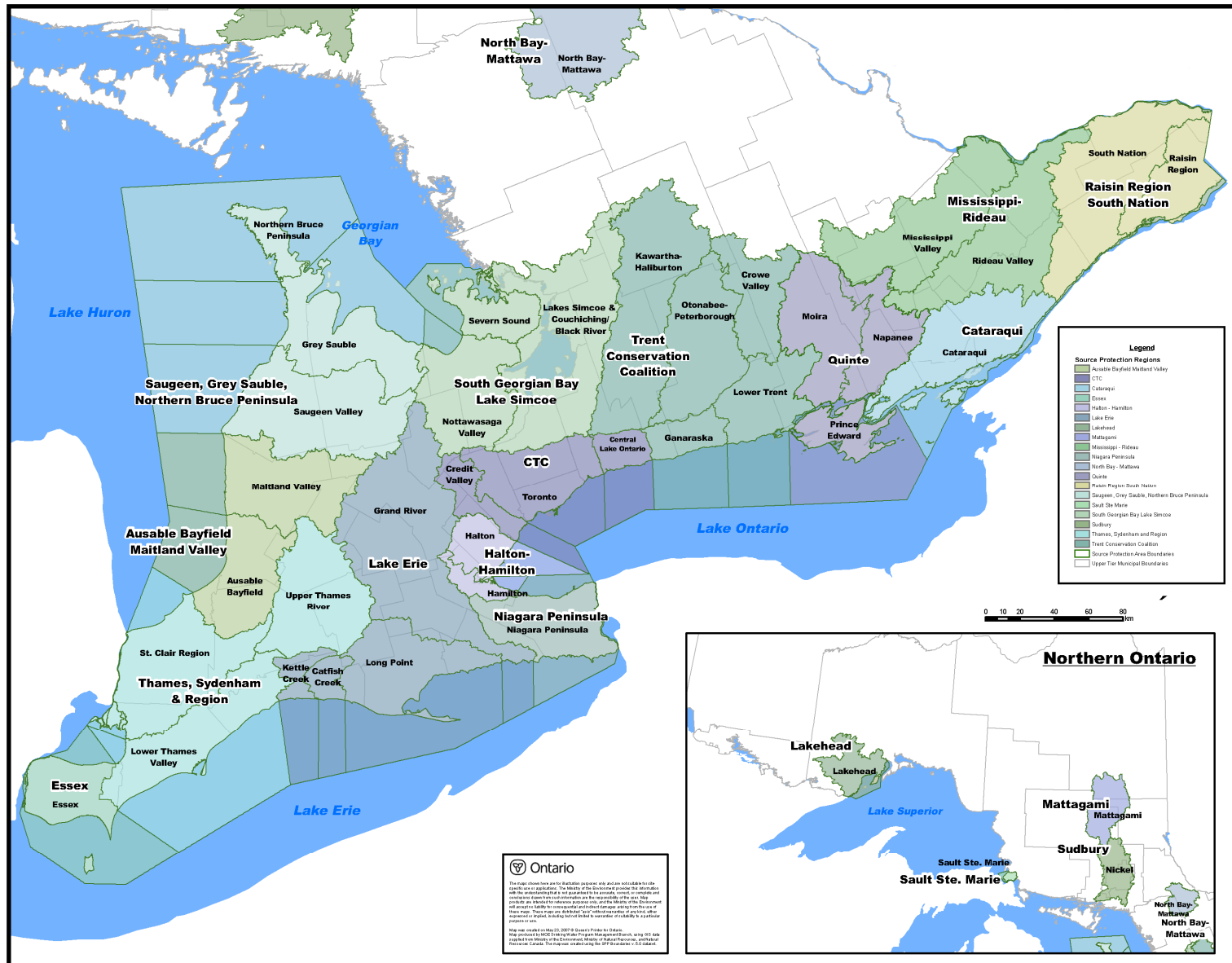


Figure ES: 1: Source Protection Regions and Source Protection Areas in Ontario

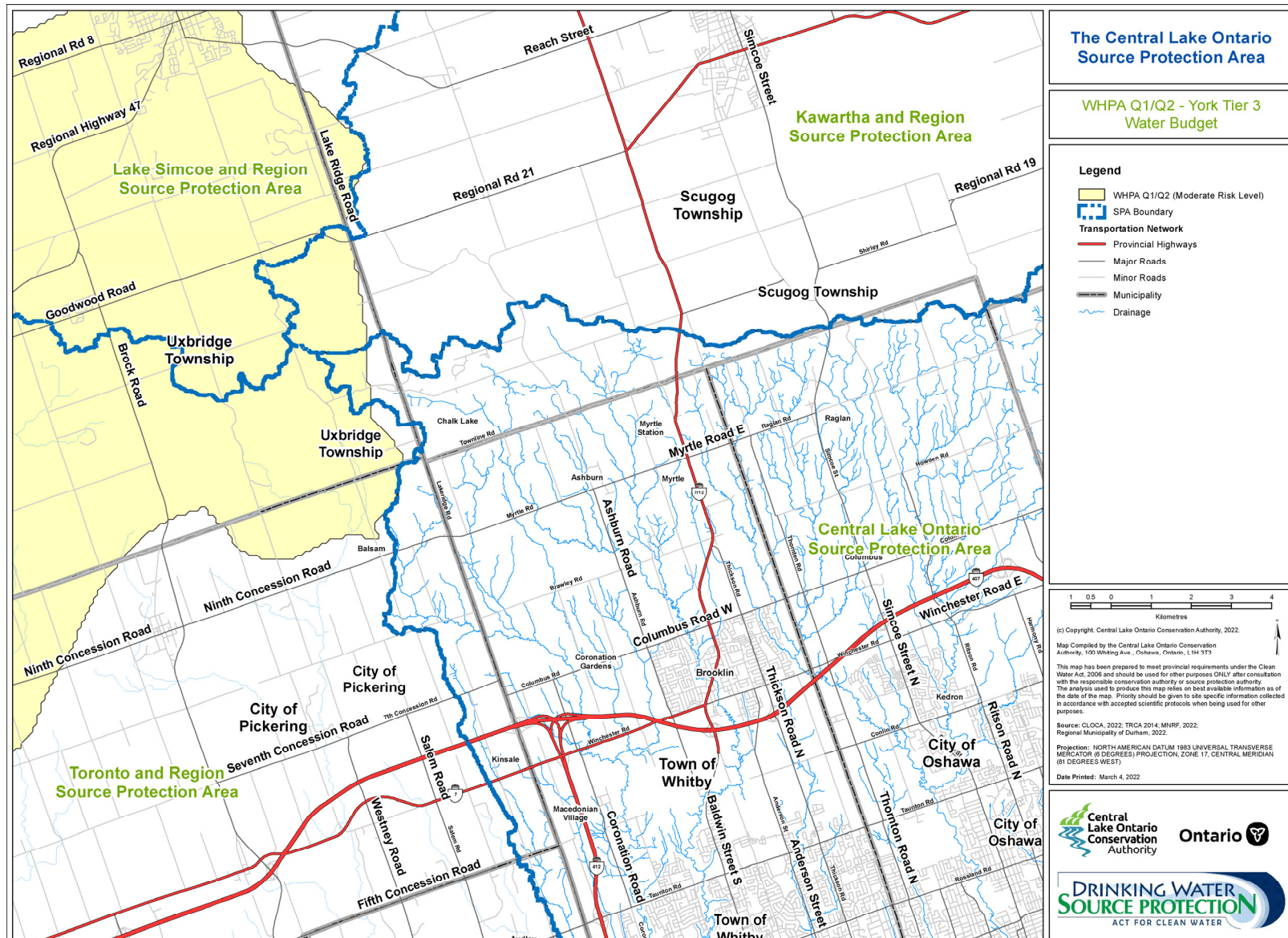


Figure ES: 2: WHPA-Q1/Q2 York Region Tier 3 Water Budget in CLOSPA

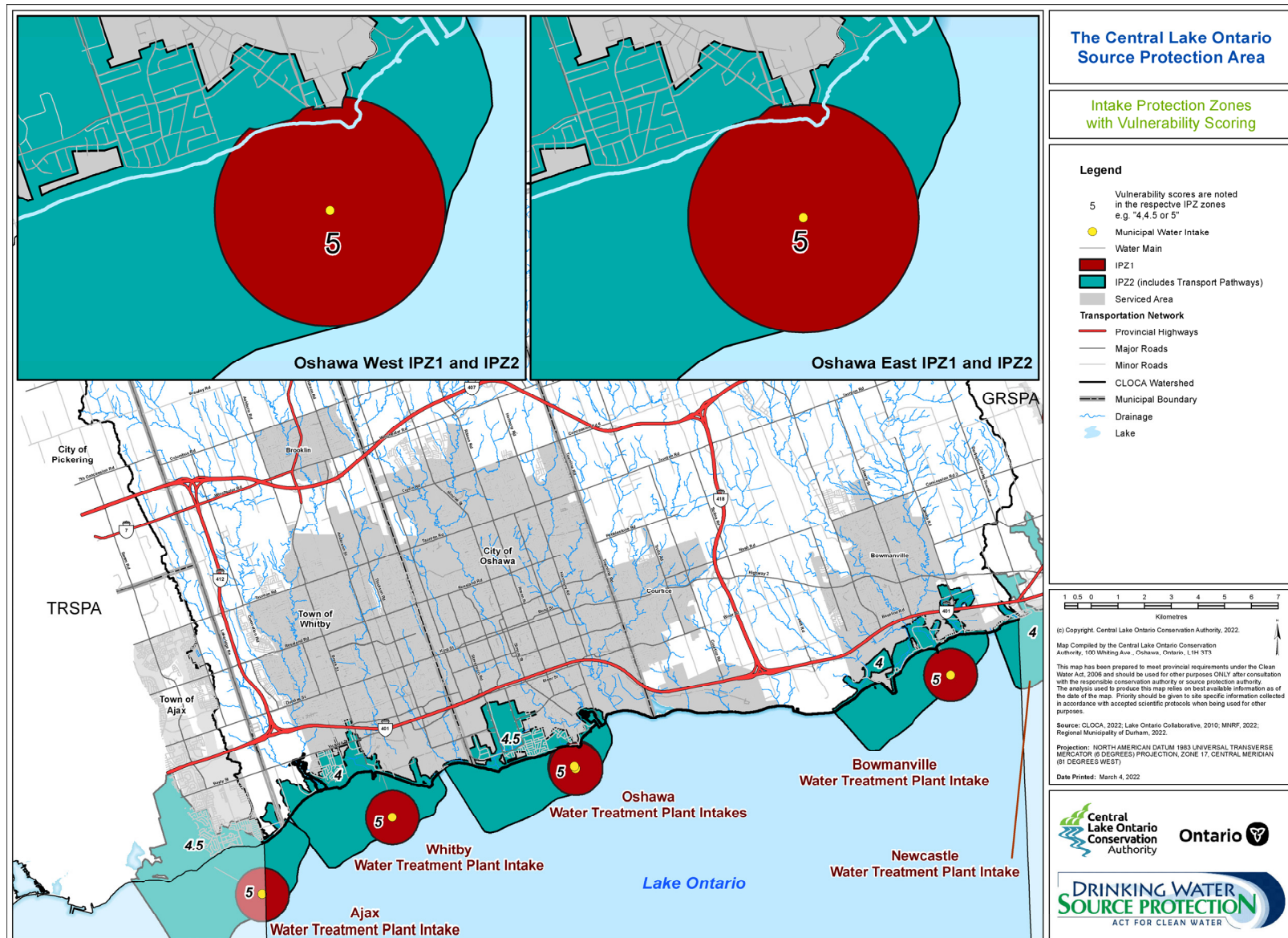


Figure ES: 3: Intake Protection Zones Delineation 1 and 2 with Vulnerability Scoring for the Ajax, Whitby, Oshawa, and Bowmanville Water Treatment Plants

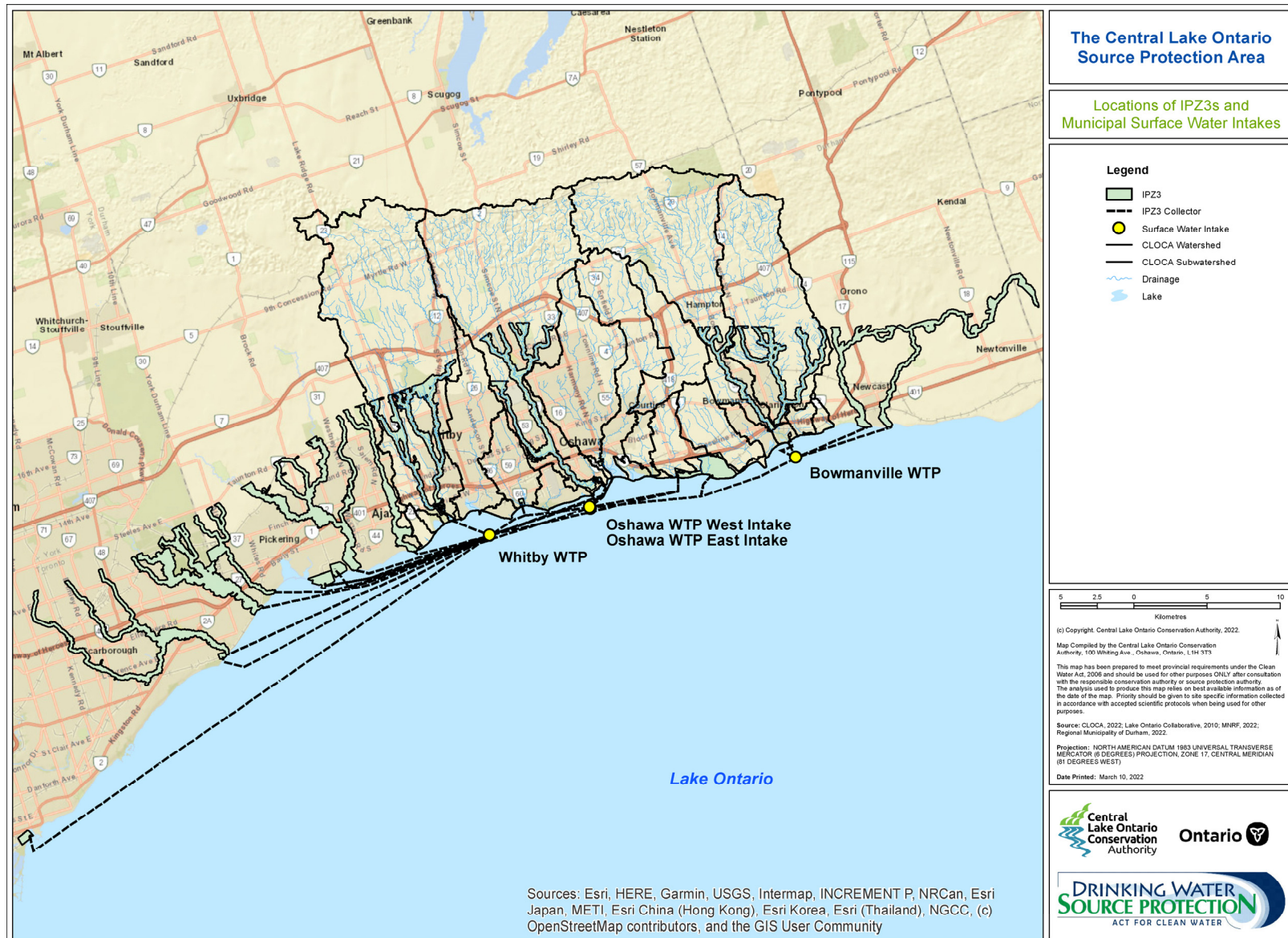


Figure ES: 4: Locations of IPZ-3s and Municipal Surface Water Intakes

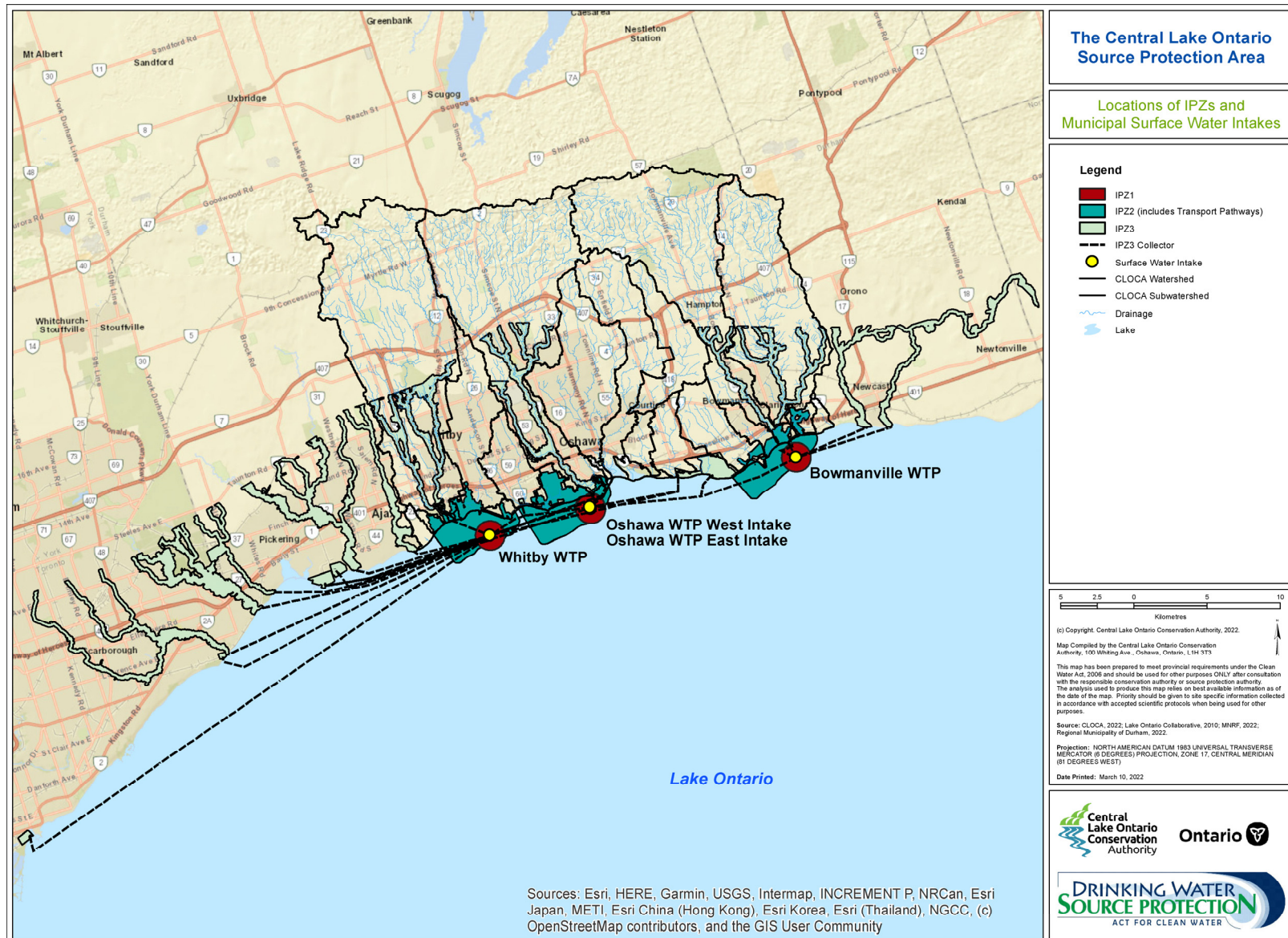


Figure ES: 5: Location of IPZs and Municipal Surface Water Intakes

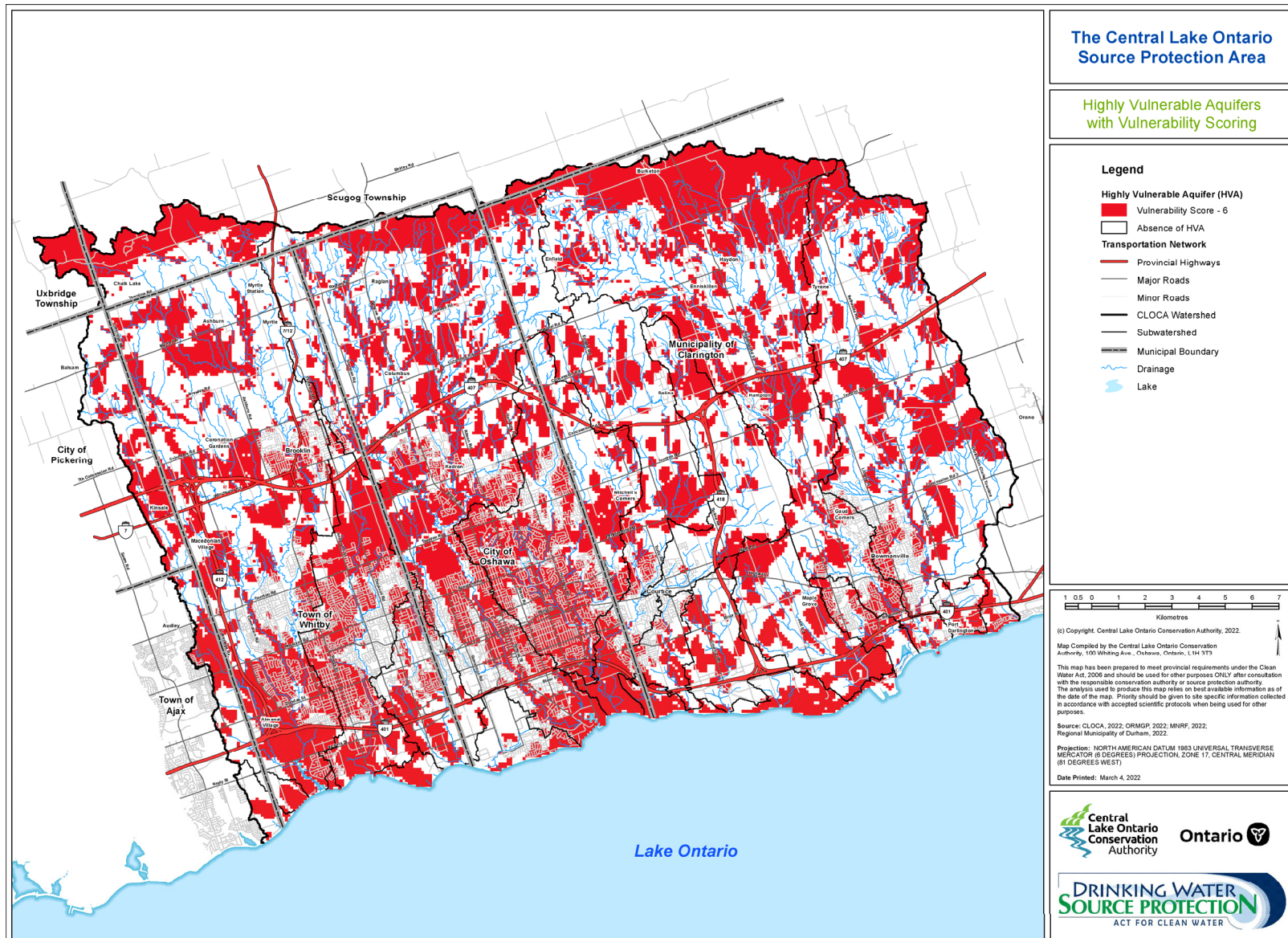


Figure ES: 6: Highly Vulnerable Aquifers (HVAs) with Vulnerability Scoring

Glossary

Below are some terms, both scientific and non-scientific, related to Drinking Water Source Protection. Note that some of these terms are derived from draft documents, and as such may be subject to change. They are provided here for information purposes, not as official legal definitions.

Abandoned Well: A well that is deserted because it is dry, contains non-potable water, was discontinued before completion, is not being properly maintained, was constructed poorly, or for which it has been determined that natural gas may pose a hazard.

Abiotic: Not relating to living things.

Activity: One or a series of related processes, natural or anthropogenic that occur within a geographical area and may be related to a particular land use.

Aggregate Risks: Multiple risks in a municipal water supply protection area that are considered together relative to the overall risk to drinking water sources.

Agro-ecosystem: Any agricultural system, which incorporates a natural community of plants and animals within a particular physical environment, on land where domestic animals are raised, or crops grown.

Ambient water: Natural concentration of water quality constituents prior to mixing of either point or non-point source load of contaminants.

Aquatic: Growing or living in water.

Aquiclude: A saturated geologic unit that is incapable of transmitting significant quantities of water under ordinary conditions.

Aquifer: An underground area of porous, permeable soil or rock that contains a sufficient amount of water to support a domestic well. Shallow aquifers exist in the overburden, the sedimentary rock and soil above bedrock, whereas bedrock aquifers are found in the bedrock itself, beneath whatever overburden is present.

Aquifer Vulnerability Index (AVI): A numerical indicator of an aquifer's intrinsic or inherent vulnerability susceptibility to contamination expressed as a function of the thickness and permeability of overlying layers.

Aquitard: The layer of geological material that prevents or inhibits the transmission of water in a confined aquifer.

Attenuation (Flow): Flow that is lessened or weakened, or the severity reduced.

Average Maximum Water Velocity: The average highest speed of a surface water body.

Bank Stability: The ability of a stream bank to resist change.

Baseflow: The water that flows into a stream through the subsurface.

Bedrock: The solid rock underlying unconsolidated surface material.

Bedrock Geology: The study of the solid rock underlying unconsolidated surface material. Also refers to description of bedrock types.

Benthic: Occurring at the base of bodies of water: lakes, oceans and seas.

Benthic Invertebrates: Small aquatic organisms that live in stream sediments and are a good indicator of water quality and stream health.

Biochemical Oxygen Demand (BOD): A measurement used to assess the rate at which water is deoxygenated. High BOD generally corresponds to water containing high amounts of organic pollution.

Bioengineering: The application of biological science to engineering principles. The use of living or organic plant material to achieve engineering solutions.

Biogeochemistry: The study of the cycles of chemical elements, such as carbon and nitrogen, and their interactions with and incorporation into living things.

Biological Diversity: The variability among organisms and the ecological complexes of which they are a part.

Biomass: The amount of living matter, usually measured per unit area or volume of habitat.

Biotic: Relating to, produced by, or caused by living organisms.

Bog: A wetland ecosystem characterized by high acidity, low nutrient levels, and accumulation of peat and mosses, chiefly *Sphagnum*. The water table is at or near the surface in spring, and slightly below during the remainder of the year. The bog surface is often raised; if flat or level with the surrounding wetlands, it is virtually isolated from mineral soil waters. Peat is usually formed in situ under closed drainage and oxygen saturation is very low.

Broader Landscape: The watershed or drinking water source protection study area. Applies to regional rather than local aquifer vulnerability assessments usually using an indices method of vulnerability assessment.

Campylobacter Bacteria: Bacteria commonly found in the intestines of humans and animals. Some types of *Campylobacter* can cause serious illness in humans.

Carbon Sequestration: Process by which carbon is removed from the environment and held within, for example, a wetland.

Catchment: The groundwater and surface water drainage area from which a woodland, wetland, or watercourse derives its water.

Chemical: A substance used in conjunction with, or associated with, a land use activity or a particular entity, and with the potential to adversely affect water quality.

Climate: The average weather conditions of a place or region throughout the seasons.

Cold water: Water with a temperature of approximately 14°C. This thermal habitat is typically considered ideal for brook and brown trout.

Conceptual Water Budget: A written description of the overall flow system dynamics for each watershed in the Source Protection Area taking into consideration surface water and groundwater features, land cover (e.g., the proportion of urban vs. rural uses), human-made structures (e.g., dams, channel diversions, water crossings), and water takings.

Conductivity: The quality or power of conducting or transmitting.

Confined Aquifers: An aquifer that is bounded above and perhaps below by layers of geological material that do not transmit water readily.

Conservation: The protection of natural or man-made resources and landscapes for later use.

Consumptive Use: Water use that diminishes the source and is not available for other and future uses.

Contaminant: Chemicals and pathogens.

Contaminant of Concern: A chemical or pathogen that is or may become a drinking water threat.

Contamination: The mixing of harmful elements, compounds or microorganisms with surface or groundwater. Contamination can occur naturally (e.g., an aquifer flowing through mineral deposits that contain heavy metals) or through human activity (e.g., sewer water flowing into a river). Nutrients, such as nitrogen and phosphorus, can also cause water contamination when they are present in excessive amounts.

Contiguous: Having contact with, or touching along a boundary or point.

Cumulative (water quality) Effects: The consequence of multiple threats' sources, in space and time, which affect the quality of drinking water sources.

Cumulative (water quantity) Effects: The consequence of multiple threats sources, in space and time, which affect the quantity of drinking water sources.

Data Gaps: The lack of raw information for a specific geological area and/or specific type of information.

Decommissioned Wells: Capped, plugged and sealed in compliance with regulatory requirements (O. Reg. 903) established by the Ministry of the Environment and Climate Change.

Dense Non-Aqueous Phase Liquids (DNAPLs): a group of chemicals that are insoluble and denser than water.

Designated System: A drinking water system that is included in the terms of reference, pursuant to resolution passed by a municipal council under subsection 8(3) of the proposed *Clean Water Act*, 2005.

Developed / Developable: Reference to the useable portion of a parcel of land that meets the regulatory zoning provisions, particularly those pertaining to defining the area of occupation for buildings, structures, facilities and infrastructure.

Discharge Area: An area where water leaves the saturated zone across the water table surface.

Drainage Density: Length of watercourse per unit drainage area.

Drainage System (under the Drainage Act): A drain constructed by any means, including works necessary to regulate the water table or water level. This broad definition allows for features to be included in drainage systems to restore wetlands while still protecting the agricultural interests of the private landowners.

Drained: A condition in which the level or volume of groundwater or surface water has been reduced or eliminated from an area by artificial means.

Drinking Water Concern: A purported drinking water issue that has not been substantiated by monitoring, or other verification methods. Drinking water concerns will be identified through consultations with the public, stakeholder groups, and technical experts (e.g., water treatment plant operators).

Drinking Water Threat: An existing activity, possible future activity, or an existing condition that results from past activity, (a) that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, or (b) that results in or has the potential to result in the raw water supply of an existing or planned drinking-water system failing to meet any standards prescribed by the regulations respecting the quality or quantity of water, and includes an activity or condition that is prescribed by the regulations as a drinking water threat.

Drinking Water Issue: A substantiated condition relating to the quality of quantity of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipal residential system or designated system.

Ecological: Relating to the totality or pattern relations between organisms and their environment.

Ecosystem: A natural community of plants and animals within a particular physical environment, which is linked by a flow of materials throughout the non-living (abiotic) as well as the living (biotic) section of the system.

Elevation: The height of a portion of the Earth's surface in relation to its surroundings.

Empirical: Information gained by means of observation, experience, or experiment.

Enhancement: To add to, or to make greater; for example, to add additional water to a wetland, in order to make greater its environmental functionality.

Entity: One or a series of related objects, natural or anthropogenic, that may be related to a specific process. Examples: Storage Tank, Bird Colony, Abandoned Well, Mine Tailing, Natural Radiation Source.

Entrain: To draw in and transport through water.

Episodic: Made up of separate loosely connected episodes.

Erosion: The wearing away of the land by the action of water, wind or glacial ice.

***Escherichia coli (E. coli)*:** A type of coliform bacteria found in human and animal waste. Their presence in water indicates fecal contamination.

Event: Occurrence of an incident (isolated or frequent) with the potential to promote the introduction of a threat into the environment. An event can be intentional, as in the case of licensed discharge or accidental, as in the case of a spill.

Existing Drinking Water Source: The aquifer or surface water body from which municipal residential systems or other designated systems currently obtain their drinking water. This includes the aquifer or surface water body from which back-up wells or intakes for municipal residential systems or other designated systems obtain their drinking water when their current source is unavailable or an emergency occurs.

Exposure: The extent to which a contaminant or pathogen reaches a water resource. Exposure, like a drinking water threat, can be quantified based on the intensity, frequency, duration and scale. The degree of exposure will differ from that of a drinking water threat dependent on the nature of the pathway or barrier between the source (threat) and the target (receptor) and is largely dependent on the vulnerability of the resource.

Extirpated: A species that still exists somewhere in the world, but is no longer found in the study area.

Fen: Fens are peatlands characterized by surface layers of poorly to moderately decomposed peat, often with well-decomposed peat near the base. The waters and peat in fens are less acidic than in bogs, and often are relatively nutrient-rich and minerotrophic since they receive water through groundwater discharge from adjacent uplands. Fens usually develop in situations of restricted drainage where oxygen saturation is relatively low and mineral supply is restricted. Usually, very slow internal drainage occurs through seepage down very low gradient slopes, although sheet surface flow may occur during spring melt or periods of heavy precipitation or if a major local or regional aquifer discharges into the wetland. Some fen wetlands develop directly on limestone rock where minerotrophic waters are emerging through constant groundwater discharge.

Flood Pulse: The peak flow during a flooding event.

Floodplain: A plain bordering a river, which has been formed from deposits of sediment carried down the river. When a river rises and overflows its banks, the water spreads over the floodplain.

Flow Regime: The pattern of how water levels change in a stream.

Flow Stability: Determined by measuring the ratio of surface discharge to groundwater discharge on an annual basis.

Fluvial: Relating to a stream or river.

Forest Cover: The percentage of the watershed that is forested.

Forest Interior: The portion of a woodlot which remains when a 100 metre buffer is removed from the perimeter of the forest (e.g., 100 metres in from the outside edge).

Function: An ecological role for human benefit.

Future Municipal Water Supply Areas: An area corresponding to a wellhead protection area or a surface water intake protection zone, or an aquifer or groundwater area identified for future municipal water supply infrastructure (either a well or a surface water intake pipe).

Geology: The science of the composition, structure and history of the Earth. It thus includes the study of the material of which the Earth is made, the forces which act upon these materials and the resulting structures.

Geomorphology: The scientific study of the origin of land, including riverine and ocean features on the Earth's surface.

Glaciation: The covering of an area or the action on that area, by an ice sheet or by glaciers.

Goals: High level achievements to aim for with respect to source protection (e.g., to protect drinking water sources). Provide an opportunity to add value statements. Not measurable through numeric means.

Gradient: The rate or regular graded ascent or descent.

Granular: Having a texture composed of small particles.

Great Lakes: The five interconnected freshwater lakes located along the border of Canada and the United States: Lake Ontario, Lake Superior, Lake Huron, Lake Erie, and Lake Michigan.

Great Lakes Connecting Channels: The rivers that connect the Great Lakes (e.g., St. Clair River, St. Lawrence River).

Groundwater: Subsurface water that occurs beneath the water table in soils and geological formations that are fully saturated.

Groundwater Discharge: The function of a wetland to accept subsurface water and hold it for release over long periods of time.

Groundwater Recharge Area: The area where an aquifer is replenished from (a) natural processes, such as the infiltration of rainfall and snowmelt and the seepage of surface water from lakes, streams and wetlands, (b) from human interventions, such as the use of storm water management systems, and (c) whose recharge rate exceeds a specified threshold.

Groundwater Table: The meeting point between the groundwater and the unsaturated layer above it.

Groundwater Under the Direct Influence of Surface Water (GUDI): Groundwater supply sources that have a direct hydrological connection to surface water sources (rivers, streams, ponds, etc.), and are therefore vulnerable to contamination from the surface.

Habitat: The environment of an organism; the place where it is usually found.

Hazard: A contaminant and/or pathogen threat.

Hazard Rating: The numeric value which represents the relative potential for a contaminant of concern to impact drinking water sources at concentrations significant enough to cause human illness.

High-Water Mark: The usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. Under the director's technical rules, this term is consistent with the definition of 'ordinary high-water mark' as defined by Fisheries and Ocean Canada as described in DFOs Fish Habitat Fact Sheet #T-6.

Highly Vulnerable Aquifer (HVA): An aquifer that can be easily changed or affected by contamination from both human activities and natural processes as a result of (a) its intrinsic susceptibility, as a function of the thickness and permeability of overlaying layers, or (b) by preferential pathways to the aquifer.

Hydraulic Gradient: A measure of the change in groundwater head over a given distance. Maximum flow will normally be in the direction of the maximum fall in head per unit of vertical distance.

Hydric Soil: A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favour the growth and regeneration of hydrophytic vegetation.

Hydrogeology: Hydrogeology is the study of the movement and interactions of groundwater in geological materials.

Hydrologic Cycle: The continuous movement of water on, above, and below the surface of the earth.

Hydrologic Function: The functions of the hydrological cycle that include the occurrence, circulation, distribution, and chemical and physical properties of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere, and water's interaction with the environment including its relation to living things.

Hydrology: The study of the Earth's water, particularly of water on and under the ground before it reaches the ocean or before it evaporates into the air.

Hydro-period: The seasonal pattern of the water level of a wetland that is a hydrologic signature of each wetland type. It defines the rise and fall of a wetland surface and subsurface water.

Hydrophytic Plants: Vegetation adapted to growing in water or in hydric soils.

Imminent Threat to Health: A contaminant of concern that can affect human health in a short period of time.

Index of Biotic Integrity (IBI): Indicator of overall stream health.

Infiltration: The movement of water into soil pores from the ground surface.

Inland Lake: An inland body of standing water, usually fresh water, larger than a pool or pond or a body of water filling a depression in the earth surface.

Inland Rivers: A creek, stream, brook and any similar watercourse inland from the Great Lakes that is not a connecting channel between two Great Lakes

Intermittent: Stopping and beginning again, pausing at intervals. An intermittent stream is a watercourse that does not flow permanently year-round.

Intrinsic Vulnerability: The potential for the movement of a contaminant(s) through the subsurface based on the properties of natural geological materials.

Invertebrates: Animals lacking a spinal column.

Impact: Often considered the consequence or effect, the impact should be measurable and based on an agreed set of indicators. In the case of drinking water source protection, the parameters may be an acceptable list of standards which identify maximum raw water levels of contaminants and pathogens of concern. In the case of water quantity, the levels may relate to a minimum annual flow, piezometric head or lake level.

Knowledge Gaps: Lack of referenced materials or expertise to assess certain characteristics of the specific watershed that can be adequately described without tabular or spatial data.

Landform: Defines the physical shape of the landscape and the materials based on how the geologic material was deposited by glaciers.

Land Use: A particular use of space at or near the earth surface with associated activities, substances and events related to the particular land use designation.

Liaising: Business act to refine logistics around gathering data and information.

Local Discharge: Discharge to a watercourse that originates nearby. The water moves through the upper layers of the groundwater system.

Low flow: The flows that exist in a stream channel in dry conditions.

Macroinvertebrates: Animals lacking a spinal column that are visible with the unaided eye.

Marsh: Wetlands frequently or continually inundated with water, characterized by emergent soft-stemmed vegetation adapted to saturated soil conditions (e.g., cattails).

Meandering: Bends in the course of a river which continually curves from side to side.

Meltwater Channel: The path of drainage and leftover sedimentary deposits usually from the ice margin of an alpine or continental glacier.

Model: An assembly of concepts in the form of mathematical equations or statistical terms that portrays the behaviour of an object, process or natural phenomenon.

Model Calibration: The process for generating information over the life cycle of the project that helps to determine whether a model and its analytical results are of a quality sufficient to serve as the basis of a decision.

Model Evaluation: A comparison of model results with numerical data independently derived from experiments or observations of the environment.

Model Validation: A test of a model with known input and output information that is used to adjust or estimate factors for which data are not available.

Model Verification: The examination (normally performed by the model developers) of the numerical technique in the computer code to ascertain that it truly represents the conceptual model and that there are no inherent numerical problems with obtaining a solution.

Monitoring: Periodic evaluation of a site to determine success in achieving goals.

Moraine: The debris or rock fragments brought down with the movement of a glacier.

Municipal Residential System: All municipal drinking-water systems that serve or are planned to serve a major residential development (i.e., six or more private residencies).

Naturalize: To make a part of the physical environment natural, free from conventional characteristics.

Natural Heritage: The legacy of natural objects and attributes encompassing the countryside and natural environment, including plants and animals.

Naturally Occurring Processes: Processes that occur in nature and that are not the result of human activity. For example, erosion along a stream that provides a source of drinking water or the leaching of naturally occurring metals found in bedrock into groundwater.

Non-Aqueous Phase Liquid (NAPL): A group of chemicals that are insoluble in water, including light and dense NAPLs.

Non-consumptive Water Use: Water use that does not diminish the source or impair future water use.

Non-Point Source: A source of pollutants from a wide geographic area, such as manure runoff, stream bank erosion, and storm water runoff, which threatens the quality of surface and groundwater sources of drinking water.

Non-Renewable Resources: A resource that is not capable of being replaced by natural ecological cycles or sound management practices within the timeframe of a human life.

Nutrient: Something that nourishes and promotes growth. It is possible to have too many nutrients in an ecosystem, which can result in an unhealthy imbalance or overgrowth of certain species.

Ontario Drinking Water Standards (ODWS): means Ontario Regulation 169/03 (Ontario Drinking Water Quality Standards) made under the Safe Drinking Water Act, 2002.

Organic Matter: Of, relating to, or derived from living organisms.

Overburden: Unconsolidated geologic material above the bedrock.

Parcel Level: A parcel is a conveyable property, in accordance with the provisions of the Land Titles Act. The parcel is the smallest geographic scale at which risk assessment and risk management are conducted.

Pathogen: A disease-causing organism.

Percolation: The downward movement of water in the ground through porous soil and cracked or loosely-packed rock.

Permeability: The quality of having pores or openings that allows liquids to pass through.

Phosphorus: A non-toxic pollutant that is an essential nutrient. In excessive amounts it leads to eutrophication of a water system. Phosphorus accumulates along the entire length of a river from a variety of point and non-point sources.

Physiography: The study or description of landforms.

Planned Drinking Water Source: The drinking water source (i.e., aquifer or surface water body) from which planned municipal residential systems or other planned designated systems are projected to obtain their drinking water from in the future and for which specific wellhead protection areas and surface water intake protection zones have been identified.

Point Source: A source of pollutants from a municipal treatment plant or an industrial facility, often by way of a pipe.

Poorly Drained: Soils that are saturated at or near the surface during a sufficient part of the year such that field crops cannot be grown without drainage.

Precipitation: The deposits of water in either liquid or solid form which reach the Earth from the atmosphere. It includes rain, sleet, snow and hail.

Preferential Pathways: Any structure of land alteration or condition resulting from a naturally occurring process or human activity which would increase the probability of a contaminant reaching a drinking water source.

Productivity: Rate of production, especially of food or solar energy by producer organisms.

Raw Water: Water that is in a drinking-water system or in plumbing that has not been treated in accordance with, (a) the prescribed standards and requirements that apply to the system, or (b) such additional treatment requirements that are imposed by the license or approval for the system.

Raw Water Supply: Water outside a drinking-water system that is a source of water for the system.

Recharge Area: An area where water enters a saturated zone at the water table surface.

Regional Discharge: Water that has traveled deep beneath the ground through the saturated zone and resurfaces at the water table.

Regulated Areas: Those areas for which Conservation Authorities delineate and restrict land uses by making regulations under subsection 28(1) of the Conservation Authority Act. This subsection applies to watercourses, streams, lakes, valleys, flood plains, and wetlands in Ontario. Provincially approved standards and methodologies for delineating Regulated Areas are outlined in draft guidance documents prepared by Conservation Ontario in cooperation with the Ontario Ministry of the Natural Resources (MNR).

Renewable Resources: Resources capable of being replaced through ecological processes or sound management practices.

Reserve Amounts: Minimum flows in streams that are required for the maintenance of the ecology of the ecosystem.

Restoration: Changing existing function and structure of wetland habitat so that it is similar to historical conditions.

Return Period: The frequency in which a flow event in a stream is likely to repeat itself.

Receptor: The exposed target in danger of incurring a potential impact. An example would be any aquifer or surface water body used for drinking water consumption.

Response Factor: Typical factors affecting the response include dilution, rate of discharge, absorption, and degradation of the contaminant or pathogen in question. Because of the nature of the water resource, certain contaminants and pathogens may not have an impact (see definition), great enough to warrant concern or responsive action. The level of impact may not effectively degrade the water resource and therefore would not require a mitigative action.

Riffle/Pool System: A riverine system that alternates cycles of shallow broken water (riffle) and deeper still water (pool).

Riparian Areas: Vegetated areas close to or within a water body that directly or indirectly contribute to fish habitat by providing a variety of functions such as shade, cover, and food production areas.

Risk: The likelihood of a drinking water threat (a) rendering an existing or planned drinking water source impaired, unusable or unsustainable, or (b) compromising the effectiveness of a drinking water treatment process, resulting in the potential for adverse human health effects.

Riverine: Relating to or resembling a river.

Runoff: Water that moves over land rather than being absorbed into the ground. Runoff is greatest after heavy rains or snowmelts, and can pick up and transport contaminants from landfills, farms, sewers, industry and other sources.

Saturated Soil: Soil that is full of moisture.

Scale: A graduated series or scheme of rank or order.

Security of well or intake infrastructure: An evaluation of structures/measures that are in place or are needed to protect a municipal groundwater supply well or surface water intake from potential contamination from external sources.

Sediment: Material deposited by water, wind or glaciers.

Sedimentary Bedrock: Rock formed of mechanical, chemical or organic sediment such as rock formed from sediment transported from elsewhere, by chemical precipitation from solution or from inorganic remains of living organisms.

Semi-Quantitative: Describes an approach or methodology that uses measurable or ranked data, derived from both quantitative and qualitative assessments, to produce numerical values to articulate results.

Sensitivity Analysis: Sensitivity analysis evaluates the effect of changes in input values or assumptions on a model results.

Severity: The degree to which an impact is measured compared to an idealized value of some indicator of concern. In the case of water quality, the severity may relate to degree of measurable exceedance of some contaminant or pathogen. In the case of water quantity, deviation from some measurable indicator (e.g., minimum annual flow, piezometric head or lake level) must also be established.

Significant Hydrologic Features: (a) A permanent or intermittent stream, (b) wetlands, (c) kettle lakes and their surface catchment areas, (d) seepage areas and springs, and (e) aquifers and recharge areas that have been identified as significant by the Ministry of Natural Resources, using evaluation procedures established by that Ministry, as amended from time to time.

Sinkhole: Any depression in the surface of the ground, with or without collapse of the surrounding soil or rock, which provides a means through which surface water can enter the ground and therefore come in contact with groundwater. Sinkholes often allow this contact to occur quite rapidly and do little to filter any contaminants the surface water may contain.

Site-level: The most refined scale at which technical assessment of hydrological and hydrogeological conditions can be conducted. These assessments may contribute to water budgets, vulnerability assessments, and issues evaluation.

Slope: Ground that forms a natural or artificial incline.

Source Protection (Drinking Water Source Protection): Protecting surface water sources such as lakes, rivers and streams, and groundwater sources from contamination or overuse, particularly through the planning process under the *Clean Water Act, 2006*. It is the first step in the multi-barrier approach to protecting drinking water. Other barriers include water testing and monitoring, reliable water treatment and distribution systems and training of water managers and staff. At this time, the emphasis of the

project is to identify and address existing or potential threats to municipal water supplies by concentrating on zones immediately surrounding municipal wellheads and surface water intake zones in Lake Huron. See the About Source Protection tab for more details.

Source Protection Planning: The creation of local, watershed-based plans for the protection of the quality and quantity of drinking water sources, now and in the future. Plans will be created by local stakeholders on Source Protection Committees (SPCs); this process will be facilitated by conservation authorities, who will ensure that SPCs have the technical knowledge to ensure that plans are science-based. See the About Source Water Protection and Our Project tabs for more details.

Spawn: To produce or prevent eggs in the reproductive process (particularly in aquatic animals).

Spillway: The valley that results when glacial meltwater cuts into the landscape. Spillways are often composed of sand and gravel.

Stratigraphy: Geology that deals with the origin, composition, distribution and succession of layers of the Earth.

Stream: A body of running water flowing on the surface of the Earth.

Substrate: The base on which an organism lives.

Subwatershed: An area that is drained by an individual tributary into the main watercourse of a watershed.

Successional Areas: Ecosystems undergoing the gradual process of change that results from one community gradually replacing another.

Surface Water: Water occurring in lakes, rivers, and streams that may be used as a source of drinking water. As water moves in a cycle (hydrologic cycle), groundwater and surface water interact; this may cause contaminants to move between groundwater and surface water systems.

Surface to Aquifer Advection Time (SAAT): The average time required by a water particle to travel from a point at the surface to the aquifer of concern. The SAAT is approximated by using the vertical component of the advective velocity integrated over the vertical distance and the average porosity.

Surface to Well Advection Time (SWAT): The average time required by a water particle to travel from a point at the ground surface to the well, including both vertical and horizontal movement.

Surface Water Intake Protection Zone (IPZ): The contiguous area of land and water immediately surrounding a surface water intake, which includes:

- 1) The distance from the intake.
- 2) The minimum travel time of the water associated with the intake of a municipal residential system or other designated system, based on the minimum response time for the water treatment plant operator to respond to adverse conditions or an emergency. And
- 3) The remaining watershed area upstream of the minimum travel time area (also referred to as the Total Water Contributing Area) is applicable to inland water courses and inland lakes only.

Surficial Geology: Deals with the study and description of the forms on the outer layer of the Earth.

Swamp: Any wetland dominated by woody plants such as trees and shrubs. This is generally considered as 25% or more cover of trees or tall shrubs. Standing to gently flowing waters occurs seasonally or persist for long periods on the surface. Many swamps are characteristically flooded in spring, with dry relict pools apparent later in the season.

Targets: In the context of technical guidance documents, these are detailed goals that are often expressed as numeric goals (e.g., to reduce contaminant X in this aquifer by 10 per cent by 2009).

Ten-year storm wind conditions: The maximum sustained wind speed coming from a single direction likely to occur once every ten years.

Terrestrial: Living on or growing on land.

Thermal Regime: The characteristic behaviour and pattern of temperature.

Till: Tough unstratified clay loaded with stones originating from finely ground rock particles that were deposited by glacial activity.

Time of Travel (TOT): An estimate of the time required for a particle of water to move in the saturated zone from a specific point in an aquifer into the well intake.

Tolerance of a Water Supply System: A measure of the ability to sustain required pumping levels even during exposure events.

Topography: A detailed description or representation of the features, both natural and artificial, or an area. Also the physical and natural features of an area, and their structural relationships.

Transport Pathway: A man-made or natural feature on the landscape that may promote quicker travel of contaminants to the water bearing rock material, than would otherwise occur in the surrounding landscape. Where transport pathways occur the vulnerability score maybe increased.

Uncertainty Analysis: Uncertainty analysis investigates the effects of lack of knowledge and other potential sources of error in the model.

Uncertainty Score: Uncertainty addresses known gaps in data/information about, or deficiencies in methods of assessment for, threats and/or vulnerability. It reflects the degree of confidence in the semi-quantitative data used to calculate risk.

Unconfined Aquifer: An aquifer whose upper boundary is the water table.

Unsaturated Zone Advection Time (UZAT): Estimated time for water to flow vertically from ground surface through to the water table.

Valley: A long, narrow depression on the Earth surface, usually with a fairly regular downward slope. A river or stream usually flows through it.

Valuation of the Supply: An evaluation of the importance of a particular municipal well or intake to the whole municipal drinking water supply. For example, where there are multiple supplies, value may be smaller, versus a single supply where value may be greater.

Vernal Pools: Temporary pools of water that are usually devoid of fish, and thus allow the safe development of natal amphibian and insect species.

Water Treatment Plant (WTP): A facility that provides municipal drinking water.

Waste Water Treatment Plant (WWTP): A facility that treats to sanitary sewage.

Water Well Information System (WWIS): A database of water wells from across Ontario that includes a summary of the characteristics of the well and soil for each well.

Water Balance: Use of a water budget to mitigate changes to the hydrological cycle following urbanization, typically by increasing infiltration and evaporation and decreasing runoff.

Water Budget: The movement of water within the hydrologic cycle can be described through a water budget or water balance. It is a tool that when used properly allows the user to determine the source and quantity of water flowing through a system. From a groundwater perspective the key components of a water budget are: infiltration, contribution to baseflow, deeper groundwater flow outside the study area and groundwater taking.

Water Control Structure: An engineered structure designed to hold back water and mimic a natural water regime that promotes wetland restoration, without affecting adjacent agricultural practices.

Watercourse: An identifiable depression in the ground in which a flow of water regularly or continuously occurs (*Conservation Authorities Act*, Section 28(1), Regulations by the Minister of Natural Resources, May 2006).

Water Cycle: The continuous movement of water from the oceans to the atmosphere (by evaporation), from the atmosphere to the land by condensation and precipitation, and from the land back to the sea (via stream flow).

Watershed: An area where many sources of surface water drain into the same place.

Water Quality Indicator: An entity that provides information on the condition and quality of water through its life cycle patterns. Water quality can also be determined through non-living sources, like chemical sampling.

Water Table: The surface below which the soil is saturated with water.

Water Wells: A hole in the Earth surface used to obtain water from an aquifer. For a bored well, an earth auger is used to bore a hole to carry earth to the surface. The casing is usually steel, concrete or plastic pipe. Modern dug wells are dug by power equipment and typically are lined with concrete tile. Dug and bored wells have a large diameter and expose a large area to the aquifer. These wells are able to obtain water from less-permeable materials such as very fine sand, silt, or clay. Drilled wells are constructed by either percussion or rotary-drilling machines. Drilled wells that penetrate unconsolidated material require the installation of casing and a screen to prevent inflow of sediment and collapse. A flowing, or Artesian, well is completed in a confined aquifer that has a water level higher than the ground surface at the location of the well. This causes water to flow out of the well.

Weathering: The disintegration of the Earth's crust by exposure to the atmosphere, most importantly, rain.

Well Capture Zone: The area in the aquifer that will contribute water to a well in a certain time period, often measured in days and years. Area at the ground surface is also included if the time period chosen is longer than the travel time for water in the aquifer and the groundwater recharge area is incorporated.

Wellhead Protection Area (WHPA): The surface and underground area surrounding a water well or well field that supplies a municipal residential system or other designated system through which contaminants are reasonably likely to move so as to eventually reach the water well or wells.

Wetland: Land that is seasonally or permanently covered by shallow water, as well as land where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs, and fens. Periodically soaked or wet lands being used for agricultural purposes, which no longer exhibit wetland characteristics, are not considered to be wetlands for the purposes of this definition (*Provincial Policy Statement*, 2005).

Wetland Values: Wetland processes or attributes which are beneficial to society.

Woodland: A treed area that provides environmental and economic benefits to both the private landowner and the public, such as erosion prevention, hydrological and nutrient cycling, clean air and long-term storage of carbon, wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots, or forested areas and vary in their level of significance at local, regional, and provincial levels (*Provincial Policy Statement*, 2005).