TABLES

6.0 SUMMARY, CONCLUSIONS AND NEXT STEPS

6.1 SUMMARY AND CONCLUSIONS

The *Clean Water Act, 2006 (CWA)* and regulations aim to protect drinking water supplies in Ontario. The Act requires that we assess risks to all drinking water sources by completing an assessment report. This Assessment Report describes the physical features and water resources within the CVSPA jurisdiction. Using approved provincial methodologies, it delineates vulnerable areas and assesses specific activities on the landscape within these vulnerable areas as potential drinking water threats.

The *Technical Rules* outline the legislated content for assessment reports across Ontario. The *Technical Rules* report was posted on the MOECC's website in December 2008 and further amended in November 2009. The 2017 version of the document can be found at: https://www.ontario.ca/page/2017-technical-rules-under-clean-water-act.

Amendments to the Credit Valley Assessment Report resulting in versions 2.0, 3.0 and 4.0 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.

The various chapters in this Assessment Report have been completed to meet provincial requirements in the determination of any potential risk to drinking water supplies. Based on these discussions, the status and sustainability of drinking water can be determined, as required under the *CWA, 2006*. The vulnerable areas and threats identified in this Assessment Report are the focus of the source protection plan policies.

Municipal drinking water supplies in the CVSPA originate from both Lake Ontario and groundwater aquifers. The *Lake Ontario Collaborative Intakes Protection Zone Studies* (2009), assessed raw water quality data for the two municipal intakes in Lake Ontario that serve as drinking water sources for the lower zone of the CVSPA. Municipal driven wellhead protection area studies (2010 - 2019), assessed raw water quality data for the municipal wells that serve as drinking water sources for the middle and upper zones of the CVSPA. In general, both the Lake Ontario and groundwater sourced water for the CVSPA were assessed as being of high quality and suitable for use as sources of municipal supplies.

The analyses of the Watershed Characterization component of the Assessment Report revealed some interesting trends in the quality of water used as a source for municipal supplies. In general, parameter concentrations remain comfortably below the Ontario Drinking Water Standards, indicating that both surface water and groundwater used as municipal drinking water sources tend to be of high quality. Several supply wells, however, have shown increases in sodium and chloride over time, which are thought to be associated with the application of road salt. Increasing nitrate levels were also observed in several wells, and thought to be linked to septic systems, pesticide and fertilizer application.

Surface water quality in the streams discharging into Lake Ontario show some elevated levels of chlorides, phosphorus, copper and nitrates as compared against ecosystem and aquatic life standards (*Canadian Water Quality Guidelines*). These contaminants are thought to be associated with the impact of urbanization and agricultural activities. With the exception of chlorides which are still below the provincial standards, the other parameters showed decreasing or no trend. The surface water in these streams is not used as a drinking water supply.

The Water Budget analysis in this Assessment Report assessed potential water quantity stress in both surface water (not including Lake Ontario) and groundwater. Tier 2 Water Budget analyses were undertaken for both surface water and groundwater resources. Groundwater sources provide approximately 11% of CVSPA's drinking water and supports vital ecosystem functions. The surface water in streams is important for supporting the ecosystem and is also used for irrigation and other non-drinking water purposes.

With respect to surface water, the vast majority of subwatersheds were found to be experiencing low stresses, with Fletcher's Creek (Subwatershed 15) being the only exception and identified as having a moderate surface water stress level. Given that the stress does not impact municipal drinking water supplies - the focus of the *CWA* additional investigation and management will take place under the conservation authority's watershed protection programs.

With respect to groundwater, the majority of sub-watersheds were also found to be experiencing low stresses, with the exception of Black Creek (subwatershed 10), Silver Creek (subwatershed 11), and Orangeville (subwatershed 19) subwatersheds, which were each identified as having moderate groundwater stress level. Since these subwatersheds support municipal groundwater supplies, they each were required to undergo additional study at the Tier 3 level, per the provisions of the *CWA.* This work was completed, and the findings incorporated in **Chapter 3** of this Assessment Report.

Vulnerability was assessed and scored in the following vulnerable areas in CVSPA – Highly Vulnerable Aquifers (HVAs), Wellhead Protection Areas (WHPAs) and Intake Protection Zones (IPZs) following the *Technical Rules*. The Intake Protection Zones (IPZ-1s and IPZ-2s) were all ranked as having low vulnerability. The resulting HVA and SGRA analyses reflect the presence of many shallow aquifers that are naturally vulnerable. The vulnerability in the WHPAs was found to be highest in close proximity to municipal wellheads, decreasing with distance from the wellheads.

Transport pathway analyses were undertaken within the WHPAs only, and were premised on the occurrence of subsurface utilities, and of quarries and pits that extend below the water table.

Vulnerability is considered together with provincial hazard scores outlined in the Provincial Tables of Circumstances 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 HVAs, WHPAs and IPZs. Significant threats must be addressed in the source protection plan and moderate and low threats may be addressed.

A threat is defined as an activity or condition 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, and includes an activity or condition that is prescribed by the province through the *Technical Rules.* The methodology outlined in the *Technical Rules* directs what types of activities can be considered potential threats. The Provincial Tables of Circumstances assigns the level of drinking water threat to a specific circumstance. The circumstance includes the specific characteristic of the prescribed drinking water threat activity, the type of vulnerable area, and its vulnerability score. There was limited field verification of potential threat activities during the initial threats assessment. Verification of threat activities has taken place during the development and implementation of the source protection plan.

In addition to identifying potential drinking water threat activities, existing water quality problems or increasing trends that suggest a future water quality problem must be evaluated – and may be labeled as "issues". The requirements to identify an issue are set out in *Technical Rules 114 - 117*. According to *Technical Rule 114.1* (a & b), issues may exist only in vulnerable areas associated with a municipal drinking water system.

The analyses identified no significant drinking water conditions, issues or threats related to quality of water in the HVAs or SGRAs.

With respect to the WHPAs, water quality issues relating to sodium (Na) were identified in WHPAs of municipal wells servicing the Town of Orangeville; issues relating to chloride (Cl) were identified in WHPAs of municipal wells servicing the Towns of Orangeville and Georgetown. A water quality issue related to nitrate (NO^3) was identified in WHPAs of the Davidson wellfield of Acton. All threats related to issues were elevated to significant threats in the Issue Contributing Areas with the exception of septic systems governed under the *Building Code Act* only in Issue Contributing Areas for sodium or chloride.

With respect to drinking water supplies sourced from Lake Ontario**,** event based modelling studies undertaken in the vulnerable area surrounding Lake Ontario intakes, resulted in the identification of three unique significant drinking water quality threats to the two intakes located in the CVSPA.

Under the *Technical Rules*, water quantity threats must be assessed through the water budget process. The Great Lakes are exempt and there are no surface water intakes on the Credit River.

For municipal groundwater-based systems, the Tier 3 Water Budget completed for the municipalities of Orangeville, Mono and Amaranth identified 305 significant water quantity threats related to consumptive usage and to recharge reduction. A Tier 3 Water Budget completed for the municipalities of Acton and Georgetown has similarly identified 87 significant water quantity threats related to consumptive usage.

A total of **9,945** significant groundwater quality and quantity threats have been identified around municipal wellheads in the CVSPA. They were located on **7,112** parcels of land as shown in **Table 6.1** below.

Table 6.1: Significant Groundwater Threat (Quality and Quantity) Count in the CVSPA

Municipality	Wells	Significant Drinking Water Threats	Total # of Parcels with Significant Drinking Water Threats
Town of Orangeville	Wells 2A, 5, 5A, 6, 7, 8B, 8C, 9A, 9B, 10, 11 and 12	2,728	2,495
Town of Mono	Cardinal Woods Wells 1, 3 and 4, Island Lake Wells TW1 and PW1, and Coles Wells 1 and 2	66	40
Township of Amaranth	Pullen Well	41	30
Town of Erin	Erin Wells 7 and 8	28	10
	Hillsburgh Wells H2 and H3	39	19
	Bel Erin Wells 1 and 2	223	104
Region of Halton	Acton 4th Line Well, Davidson Wells 1 and 2, and Prospect Park Wells 1 and 2	651	346
	Georgetown Lindsay Court Well 9, Princess Anne Wells 5 and 6, and Cedarvale Wells 1a, 3a, 4 and 4a	6,135	4,046
Region of Peel	Alton Wells 3 and 4A	13	12
	Caledon Village Wells 3 and 4	2	1
	Inglewood Wells 3 and 4	3	3
	Cheltenham Wells 1 and 2	16	6
	Total	**9,945**	**7,112**

The majority of the significant groundwater threats in the CVSPA have been noted in the communities of Acton, Georgetown and Orangeville. These are areas in the middle and upper zones where sizeable populations receive municipal water supplies sourced from the ground.

The *Technical Rules* require only a reference to what circumstances would be moderate and low potential threats. There is no requirement to count or locate where these circumstances exist or are planned. A link to a list of potential moderate and low level threats based on the provincial matrices has been included in this report per the requirements in the Provincial Tables of Threats and associated Circumstances. If and where these activities exist, they may constitute a moderate or low risk to drinking water supplies.

A number of spill scenarios were modelled as part of the Lake Ontario Collaborative 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 waste water treatment plant to evaluate the potential effects to nearby water treatment plants;
- Release of *E. coli* from an industrial processing facility into the Credit River;
- Combined sewer overflow release in the City of Toronto (this did not impact any CVSPA intakes);
- Sanitary Trunk Sewer breaks within Toronto area creeks;
- Spill of gasoline/refined product from large pipelines located under major tributaries to Lake Ontario (e.g., Credit River, Humber River, etc.);
- Release of gasoline from a bulk petroleum fuel storage and handling at facilities in the Oakville area and in the Keele/Finch Area of Toronto; and
- Discharge of tritium from nuclear generating facilities at Pickering and Darlington this did not impact any CVSPA intakes.

There are three categories of IPZs. The IPZ-1 is a one kilometre circle around the intake if it is located in one of the Great Lakes. The IPZ-2 is the area where water can reach the intake in a specified time, two hours was used in the CTC. According to the MOECC *Technical Rules*, there can be no significant threats in an IPZ-1 or IPZ-2 if it is located in one of the Great Lakes, e.g., Lake Ontario. An IPZ-3 is delineated if modelling demonstrates that spills from specific activity that is located outside IPZ-1 and IPZ-2 may be transported to an intake and result in a deterioration of the water quality at an intake. Since the vulnerability scores of IPZ-1 and IPZ-2 are not high enough to identify significant threats; the modelling approach can also be used for activities within IPZ-1 and IPZ-2 to determine if spills from a specific activity within these zones may reach the intake and result in deterioration of the water quality at an intake. If modelling in IPZ-1, IPZ-2 or IPZ-3 demonstrates this deterioration, the modelled threats are deemed to be significant drinking water threats under the provincial rules. The modelling results are also used to delineate event based areas within IPZs where modelled activities are deemed significant.

The selected Lake Ontario Collaborative 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 for each threat activity was delineated by drawing a line from the location of the threat activity on shore where the contaminant is released to the affected intake along the shortest path within the area where concentrations were modelled to exceed the threshold for that contaminant.

The identification of significant threats did not consider any regulated risk management requirements. Current risk management measures and the adequacy of existing regulatory requirements will be

considered in the development of the source protection plan. Source protection plans are required to reduce or eliminate threats to drinking water.

The Lake Ontario modelling identified three locations of significant drinking water quality threats for Lake Ontario intakes within the CVSPA. The source protection plan for CTC Source Protection Region must have policies to address these significant drinking water threats that are located within the source protection area.

In addition, CVSPA has identified significant drinking water threats located outside of the CVSPA. These activities, although not enumerated in this report, affect water treatment plants located in CVSPA, and must be addressed through source protection plan policies developed in adjacent source protection areas. CVSPA staff will bring this information to the attention of the source protection staff of the neighbouring source protection areas to ensure that policies are developed for them.

6.2 DATA GAPS AND UNCERTAINTY

Overall, the information available at the time of writing was sufficient to characterize, delineate, and analyze vulnerability and threats. However, it is recognized that data and knowledge gaps do exist, and should be addressed in order to enhance the value of the available data and the accuracy of conclusions being drawn from them. These gaps have been identified in **Table 6.2**.

In developing policies to address these significant threats, the CTC Source Protection Committee (SPC) and other SPCs in the Lake Ontario Collaborative must take into consideration the dynamic nature of the nearshore water quality in Lake Ontario. As shown in the modelled scenarios, contaminants released in one source protection area can travel to intakes throughout that area and beyond.

Additional work on assessing other spill scenarios and conditions is needed. The analyses done to date, while providing valuable and robust results, do not provide a complete identification of potential threats. What has been achieved is the calibration and validation of a model which can be used to assess nearshore impacts from the Region of Niagara in the west to Prince Edward County in the east. Peer review on the model calibration and validation process could not be completed within the time frame for finalization of this report. The results of the review will be considered when future updates of this Assessment Report are undertaken.

Furthermore, there is the need to be able to do real-time modelling when a spill or other potential threat circumstance arise in order to predict where the contamination may travel and the expected peak concentrations and duration. This will provide municipal water treatment plant operators with the information needed to respond and determine their treatment options, including whether to stop taking water from the intake during the spill.

Further work is required to characterize the potential threats posed by water-borne pathogens other than *E. coli.* Preliminary work to identify the quantity and distribution of pathogens such as *Cryptosporidium* and *Giardia* was not sufficient to characterize the situation and identify where land-based activities are introducing these contaminants into the nearshore. However, based on the results of the *E. coli* scenarios, further work is required to identify the extent and sources of other pathogens to assess whether a threat exists in the source water. There has also not been an adequate analysis of the threats posed by algae such as microsystins or algal mats which can block water intakes.

The analysis undertaken does not address any threats due to cumulative releases of contaminants under non-spill situations to Lake Ontario water quality. The quality of the water at drinking water intakes within the CVSPA is generally very good based on the information provided by municipal plant operators. As discussed in **Chapter 5.8**, water quality in Lake Ontario may be affected by changes in climate. As the

population of the Lake Ontario basin continues to grow, there will likely be more water taken for drinking water along with more discharge of municipal sewage and possibly more industrial use of water and industrial discharges. Lake Ontario is the single most important source of drinking water for the people of Ontario.

The *Technical Rules* require a discussion of uncertainty associated with all technical components of the assessment report. In this Assessment Report the uncertainty level for the watershed characterization is low. For delineation, vulnerability, and scoring of the four vulnerable areas, the uncertainty level ranges from low to high due to limited data available to calibrate the model suites.

For the IPZ-3 studies, pipeline spill scenarios were not completed for each tributary where the oil pipeline crosses. The actual location of travel of a contaminant will depend on the prevailing weather conditions at the time along with the characteristics of the spill and the contaminant which is released. The modelling work done to date does not reflect all of the conditions that might exist nor do the scenarios systematically assess the full array of potential threat activities.

The model assumed that each contaminant did not undergo any transformation during the time period for the model run. This assumption is reasonable in the case of tritium, but will likely overestimate the concentrations of benzene over time which may evaporate or be chemically changed. *E. coli* are living organisms naturally found in the intestines of humans and warm-blooded animals and will die some time after they have been released into the environment. The rate that *E. coli* will die is dependent on time, environmental conditions such as temperature, whether they are shielded by being attached to suspended particles or exposed to disinfecting chemicals. In general terms, *E. coli* survives for about 4-12 weeks in water at a temperature of 15-18°C. Normally waste water treatment plants disinfect the sewage prior to discharge to reduce the concentrations of pathogens, although this is not possible during a disinfection failure event.

Ongoing studies and continuous improvement built in to water management programs serve to improve analyses and reduce uncertainty. Future editions of the Assessment Report will reflect such improvements. Because of the combined uncertainties of delineation, vulnerability, and scoring and the lack of land-use data, the uncertainty level for potential threats in the CVSPA jurisdiction is moderate to high.

Table 6.2: Approved Assessment Report Data and Knowledge Gaps

Identified Data and Knowledge Gaps			
Knowledge Gaps			
Need to develop methodology and tools to provide analysis of spills response, which will involve all pathways, including overland flow, stream travel, and groundwater flow, including the unsaturated zone transport			
Need more detailed consideration of potential transport pathways			
Need more detailed scrutiny of SGRAs as they relate to drinking water systems			
Need more detailed scrutiny of HVAs, specifically shallow aquifer deposits			
Threats, Conditions, and Issues			
Component	**Data Set Name or Source**	**Data Gap Problem**	**Comment**
Threats in WHPAs	Significant threats	Lack of field verification	Additional field verification to further reduce inaccuracy
Knowledge Gaps			
Need updated ecological land classification and MPAC data			
Need for additional work to identify source of the issue at Orangeville Well 10			
Need for additional monioring of Nitrate ($N0_3$) at the Davidson Wellfield			
Additional field verification to confirm land use activities			
Uncertainty regarding the number of animals and types of animals that a farm unit may hold			

6.3 NEXT STEPS

The CTC SPC has used the findings of this Assessment Report, to develop the CTC Source Protection Plan (CTC SPP) which addresses existing and potential future significant drinking water threats identified in CVSPA. In developing the CTC SPP, the CTC Source Protection Committee consulted broadly within the CVSPA and with various sectors as well as neighbouring source protection areas and regions. Policies contained in the CTC SPP address the three significant drinking water quality threats from activities impacting Lake Ontario surface water intakes (located within the CVSPA), in addition to the 9,553 significant drinking water quality threats and 392 signficant drinking water quantity threats identified with the potential to affect municipal groundwater wells.

The CTC SPC also chose to develop policies in the CTC SPP that address moderate and low threats as a result of the application of road salt, as well as the handling and storage of DNAPLs and organic solvents.

Since May 2018, the Credit Valley Source Protection Authority has reported on the progress of implementing the CTC SPP to the Minister of the Environment, Conservation and Parks.

On July 22, 2019, pursuant to Section 36 (1) of the *CWA, 2006* the Minister of the Environment, Conservation and Parks amended the Order established in July 2015 governing the content and timeframes for the review of updates to this Assessment Report and to the CTC SPP. Over the next several years, this Assessment Report will be updated to reflect new or revised data and knowledge.