

7. Threats and Risk Assessment

In order to protect drinking water sources, it is necessary to identify the activities within vulnerable areas that pose a threat to drinking water sources. It is also necessary to assess the risks due to the identified threats. This section describes the Threats and Risk Assessment work pertaining to Water Quality, conducted in the Lower Thames Valley Source Protection Area. The risk associated with Water Quantity Threats is considered in the Water Budget and Water Quantity Stress Assessment section of the Assessment Report.

A drinking water threat is 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 source of drinking water” (Clean Water Act, 2006). Risk Assessment is the process of assessing the threats to determine their relative risk to the drinking water source. It considers the vulnerability of the area that the activity is being undertaken in. It also considers the hazard associated with the activity.

Following the completion of the Assessment Report, a Source Protection Plan must be developed by the Source Protection Committee. The focus of the Source Protection Plan is to reduce risks to drinking water sources by managing the threats causing those risks. The Source Protection Plan will contain policies focused on activities which are identified as threats within the vulnerable areas. Hence the identification of the threats and the assessment of risks due to the threats are key to the development of the Source Protection Plan. Further, the Source Protection Plan must mitigate those risks to drinking water sources that are deemed significant. The policies related to significant threats are mandatory and must be implemented. Source protection policies may include incentive programs, education and outreach, new or amended provincial instruments, and risk management plans.

The Threats and Risk Assessment studies involved the operating authorities of the drinking water systems and were undertaken through partnerships involving the Conservation Authorities in the region. As described in Section 4.0, a project led by the Essex Region Conservation Authority (ERCA) was initiated through a partnership between ERCA and the Conservation Authorities in the Thames-Sydenham and Region and the plant operators. This project included

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2 drinking water systems in the Lower Thames Valley Source Protection Area that draw water from Lake Erie. The Chatham-Kent Public Utilities Commission (PUC) was an active partner in this project and participated in the technical steering of the project. Another project was lead by the Municipality of West Elgin with the Ontario Clean Water Agency (OCWA) providing technical and project management services for the municipality. This project included 1 drinking water system in the Lower Thames Valley Source Protection Area that draws water from Lake Erie. Stantec Consulting Ltd. was the primary consultant for the projects led by ERCA and the Municipality of West Elgin, and completed the threats risk assessment technical studies for these 3 surface water systems. The Municipality of Chatham-Kent PUC led technical studies on the two groundwater systems in the Lower Thames Valley Source Protection Area. Dillon Consulting Ltd. was the primary consultant who completed the threats and risk assessment work for these groundwater systems.

The technical reports for the above described studies are listed in Table 7-1 below:

Table 7-1 Technical Studies on Drinking Water Threats and Risk Assessment

Drinking Water Systems	Technical Study on Threats and Risk Assessment
Wheatley, Chatham and South Chatham-Kent	Potential Threats Analysis for the Thames Sydenham Region Water Treatment Plants. Essex Chatham – Kent Source Protection Planning Technical Study Potential Threats Analysis Technical Memorandum. Final Report. Stantec Consulting Ltd. November 2009
West Elgin	Potential Threats Analysis for the West Elgin Water Treatment Plant. Municipality of West Elgin Source Protection Planning Technical Study Phase 2 – Potential Threats Analysis TM. Final Report. Stantec Consulting Ltd. November 2009
Ridgetown and Highgate	Water Quality Threats and Risk Assessment Draft Report. Ridgetown and Highgate Municipal Drinking Water System Source Protection Study. Municipality of Chatham – Kent PUC. Dillon Consulting Limited. October 19, 2009

From these technical studies, information is compiled and provided in this section of the Assessment Report. This section is organized into discussions on the types of activities that may be considered as drinking water quality threats, the methodology used to identify threats and assess risks, the lists of threats in vulnerable areas with maps showing these, and lastly the next steps and data gaps.

7.1. Drinking Water Threat Identification and Risk Assessment Methodology

Drinking water quality threats in vulnerable areas must be identified and assessed as to their risk to the drinking water source. The vulnerable areas are Intake Protection Zones (IPZs), Well Head Protection Areas (WHPAs), Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRAs). The delineation and assessment of these vulnerable areas is described in the Section 4.0 - Vulnerability Assessment of this Assessment Report. In the Lower Thames Valley Source Protection Area, three drinking water systems draw their source water from Lake Erie and two systems draw from groundwater aquifers. **Map 4-1** shows the location of the Intake Protection Zones around the municipal intakes, and the Wellhead Protection Areas around municipal wellheads.

The drinking water threats that may be considered in the identified vulnerable areas are those due to: 'prescribed activities', 'other activities', 'conditions' (past activities) and activities contributing to identified 'drinking water quality issues'. The Technical Rules: Assessment Report Part XI describes the listing of drinking water quality threats. In the Thames-Sydenham and Region, a local guidance document was developed to provide clarification and local interpretation of the relevant sections in the Clean Water Act, its regulations and the associated technical rules pertaining to the threats and risk assessment. The methodology is included in Appendix 10.

The sections below summarize the types of threats and the methodology followed in the region to identify threats and assess risks.

7.1.1. Prescribed Drinking Water Threats

Through the Clean Water Act and General Regulation 287/07, a list of 21 prescribed drinking water threats is provided. That list is reproduced in Table **7-2**.

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Table 7-2 Activities Prescribed as Drinking Water Threats

1. The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
3. The application of agricultural source material to land.
4. The storage of agricultural source material.
5. The management of agricultural source material.
6. The application of non-agricultural source material to land.
7. The handling and storage of non-agricultural source material.
8. The application of commercial fertilizer to land.
9. The handling and storage of commercial fertilizer.
10. The application of pesticide to land.
11. The handling and storage of pesticide.
12. The application of road salt.
13. The handling and storage of road salt.
14. The storage of snow.
15. The handling and storage of fuel.
16. The handling and storage of a dense non-aqueous phase liquid.
17. The handling and storage of an organic solvent.
18. The management of runoff that contains chemicals used in the de-icing of aircraft.
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.
20. An activity that reduces the recharge of an aquifer.
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard. O. Reg. 385/08, s. 3.

The risk associated with activities prescribed as water quantity related threats (numbers 19 and 20 in the above table) are considered in the Water Budget and Water Quantity Stress Assessment section of this Assessment Report. The activities 1 to 18 and 21 are prescribed drinking threats related to drinking water quality and are discussed in this section. They may be summarized into:

- Application, handling and storage of agricultural source material (manure), non-agricultural source material (bio-solids), commercial fertilizer, pesticide or road salt

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- Handling and storage of fuel, dense non-aqueous phase liquids, or organic solvents
- Management of runoff that contains aircraft de-icing chemicals
- Livestock grazing or pasturing land, outdoor confinement areas or farm-animal yards
- Snow storage
- Systems that collect, store, transmit, treat or dispose of sewage
- Waste disposal sites

An activity may be determined to be a drinking water threat based on:

- the vulnerable area it occurs in;
- the vulnerability score assigned to that area;
- the circumstances related to the activity; and
- the hazard rating resulting from the activity under the circumstances related to the activity.

An activity can only be identified as a threat if it is occurring in a vulnerable area and the vulnerability score of the area is greater than 4. In an area where the vulnerability score is 8 or greater, the threat may be significant (dependant on the circumstances associated with activity). According to the 'Technical Rules: Assessment Report' the highest vulnerability score possible for a Great Lakes Intake Protection Zone (IPZ) is 7. Wellhead Protection Area-A (WHPA-A), B and C can have vulnerability scores of 8 or greater. As a result, it is not expected that there will be any significant threats of the Great Lakes intake protection zones. It is, however, possible to have significant threats in WHPA-A, B and C, dependant upon the assigned vulnerability score. Highly Vulnerable Aquifers (HVA) are assigned a vulnerability score of 6 while Significant Groundwater Recharge Areas (SGRA) are assessed a vulnerability score of 6 or less, as described in Section 4.0 – Vulnerability Assessment. Hence there can be no significant threats in these vulnerable areas. Further, in SGRA with vulnerability scores of 4 and 2, no threats can be identified, as discussed above.

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In order to assess the risks due to the prescribed drinking water quality threats, the Ministry of Environment (MOE) has developed "Tables of Drinking Water Threats" based on the 21 prescribed threats. These MOE threats tables, as they are commonly referred to, provide the circumstances under which an activity may be categorized as a low, moderate or significant threat. Hence the circumstances of the activity are considered to determine the level of risk associated with a water threat. The circumstances to be considered include the type of material, the quantity of material and whether it might be released to surface water or groundwater. Each combination of circumstances for an activity is assigned a hazard score.

There are two separate tables in the MOE threats tables for activities related to chemicals and for activities related to pathogens. Chemicals include, but are not limited to, nitrogen and phosphorus (related to the application of commercial fertilizers, and agricultural and non-agricultural source material to land), atrazine, dicamba, glyphosate (related to the application of pesticide on land), trichloroethylene, vinyl chloride (related to the handling and storage of dense non-aqueous phase liquids), BTEX, certain petroleum hydrocarbons (related to the handling and storage of fuel), chloroform (related to the handling and storage of organic solvent), sodium and copper (related to the storage of snow). Dense non-aqueous phase liquids (DNAPLs) are considered under chemical related activities except in Well Head Protection Area-A, B and C where they are considered separately, as explained in the risk determination discussion below. DNAPLs are heavier than water and do not mix with water. They are of concern in groundwater since they sink into the ground, settle at the bottom of and contaminate an aquifer. Examples of where DNAPLs are used include: dry cleaning, pesticides, brake cleaners, glues, varnishes, automotive coolant and nail polish. Pathogens are disease causing microorganisms and in the MOE threats tables, they are not limited to a specific list of types of pathogens. Activities that may cause the presence of pathogens include but are not limited to the application of agricultural and non-agricultural source material to land, livestock grazing, and sewage discharge.

The risk score is calculated by multiplying the vulnerability score assigned to a vulnerable area with the hazard score of the activity thought to be a threat.

$$\text{Risk} = \text{Vulnerability} \times \text{Hazard}$$

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An activity is then deemed to be a significant, moderate or low threat depending on the calculated risk score. The MOE threats tables include the results of this calculation and identify the risk level associated with an activity based on the vulnerability score of the area in which the activity is being undertaken.

Table 7-3 shows the relationship between the risk score calculated and the resulting threat level. A risk score of 80 or greater results in a significant threat level. Some exceptions include issue-based threats which are deemed significant regardless of the vulnerability area and score, and activities related to Dense Non-Aqueous Phase Liquids (DNAPLs) which are significant threats in well head protection areas A (100 m radius), B (2 year capture zone excluding A), and C (2 to 5 year capture zone). In Well Head Protection Area-D, E and F, dense non-aqueous phase liquids (DNAPLs) are considered under chemical threats. Pathogens are not viewed as threats at all, outside of Well Head Protection Areas-A, B, E and Intake Protection Zones 1 and 2.

Table 7-3 Threat Level Determination

Risk Score	Threat Level
80 or more	Significant
60 or greater, but less than 80	Moderate
Greater than 40, but less than 60	Low

Under the Clean Water Act, it is required to determine the number of locations at which a significant threat is thought to occur. Also, a list of activities which are or "would be" threats are to be included. Generally this is addressed by including all activities listed in the prescribed lists even if they are not currently occurring in an area. Activities not currently occurring in the vulnerable areas, "would be" threats if the activity was to occur in the future. The circumstances which result in them being significant threats must also be included in the Assessment Reports.

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As part of the identification of certain prescribed chemical drinking water threats, an intermediate step involving the creation of maps showing impervious area, managed lands and livestock density is necessary. A determination of the percentage of impervious area is needed to determine the level of threat associated with the application of road salt. Also, the percentage of managed lands is required, as this is related to the level of threat for the application of agricultural source material (ASM), commercial fertilizer or non-agricultural source material (NASM). The Director's Rules also require that the livestock density for an area, expressed in terms of nutrient units/acre, be determined as a means of estimating the potential for the generation, storage and application of agricultural source materials (ASM) in an area.

Any pathogen threats associated with these activities (application of road salt, agricultural source material, commercial fertilizer or non-agricultural source material) are assessed separately using the pathogen table of the MOE threats tables. The calculations made to map the impervious area, managed lands and livestock density are described briefly below.

7.1.1.1. Impervious Area

For determining the risk level associated with the application of road salt, the percentage of impervious area must be determined. Impervious areas related to application of road salt include roads, parking areas and sidewalks. The percentage of impervious surface areas must be calculated within each square kilometre of vulnerable areas (Rule 16). The percentage impervious is calculated for each square kilometer as determined by overlaying a 1 kilometre by 1 kilometre grid over the vulnerable area with a node of the grid located at the centroid of the Source Protection Area. Geographic Information System (GIS) tools were used to undertake this calculation for each grid which touched a vulnerable area. The Percent of Impervious areas within the grids touching Wellhead Protection Areas and Intake Protection Zones have been calculated; however Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas have yet to be calculated.

7.1.1.2. Managed Lands

In determining the percentage of managed lands source protection committees must determine the areas where there may be application of agricultural source material (ASM), commercial

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fertilizer, or non-agricultural source material (NASM). These areas are expressed as percentages of the total area being evaluated. Mapping the percentage of managed lands is not required where the vulnerability scores for an area is less than the vulnerability score necessary for the activity to be considered a threat in the Table of Drinking Water Threats. Managed lands can be broken into 2 types: agricultural managed land and non-agricultural managed land. Agricultural managed land includes areas of cropland, fallow and improved pasture that may receive nutrients. Non-agricultural managed lands includes golf courses (turf), sports fields, lawns (turf) and other built-up grassed areas that may receive nutrients (primarily commercial fertilizer). Both managed land and agricultural managed lands are to be delineated within each of the vulnerable areas (individually for each WHPA-A, B, C, D, E, F, IPZ-1, 2, and 3 as well as for HVA and SGRA).

The percentage of managed land area within a vulnerable area is the sum of agricultural managed land and non-agricultural managed land, divided by the total area of *all land* within a vulnerable area, multiplied by 100. This was undertaken for each part of the WHPA and IPZ which have been delineated. Where a parcel of managed land is partially within a vulnerable area, only the portion of the parcel within the vulnerable area is used in the calculations.

7.1.1.3. Livestock Density

Livestock density is used as a surrogate measure of the potential for generating, storing, and land applying Agricultural Source Material (ASM) as a source of nutrients within a defined area. The livestock density is expressed in nutrient units per acre. The calculation of livestock density in a specified area requires the following steps:

1. Estimate the number of each category of animals present within the specified area,
2. Convert the number of each category of poultry and livestock present into nutrient units (NU), to enable all livestock to be compared on an equivalent unit of measure in terms of the nutrients produced by each type,
3. Sum the total NU of all categories of poultry and livestock within the specified area and then divide this NU value by the area of agricultural managed land within the same specified area.

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7.1.1.4. Risk Assessment using Managed Lands and Livestock Density

The percentage of managed land and the livestock density of an area are used together as a surrogate for representing the quantity of nutrients present as a result of nutrient generation, storage, and land application within an area. The risk assessment using managed lands and livestock density calculations is described below.

Chemical Threats Related to the Land Application of Nutrients

Table 1 of the Tables of Drinking Water Threats requires that you consider the maps for both percentage of managed lands and livestock density when evaluating the circumstances with regard to each of the thresholds for land application of nutrients. **Table 7-4** summarizes the chemical hazard scorings for various combinations of percentage of managed lands and livestock densities. These are the consolidated hazard scores, incorporating the quantity, toxicity and fate scores. The highlighted combinations of percentage of managed land and NU/Acre give a hazard rating for land application of nutrients that, when combined with the area vulnerability scores of 9 or 10, would result in significant risk to source waters. To calculate risk, the hazard score is multiplied by the vulnerability score for the area.

Table 7-4 Chemical Hazard Scorings for Various Combinations of Percentage of Managed Lands and Livestock Densities

Percentage Managed Land to Total Land	Nutrient Units (NU) per Acre of Cropland		
	< 0.5 NU/acre	0.5 to 1.0 NU/acre	> 1.0 NU/acre
GROUNDWATER			
> 80%	8 Significant in areas of Vulnerability Score 10	8.4 Significant in areas of Vulnerability Score 10	8.4 Significant in Areas of Vulnerability Score 10
40 to 80%	6.8	7.6	8.4 Significant in areas of Vulnerability Score 10
< 40%	6	6.8	8 Significant in areas of Vulnerability Score 10
SURFACE WATER			
> 80%	8.8 Significant in areas of Vulnerability Score 10	9.2 Significant in areas of Vulnerability Score 10 or 9	9.2 Significant in areas of Vulnerability Score 10 or 9
40 to 80%	7.6	8.4	9.2

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		Significant in areas of Vulnerability Score 10	Significant in areas of Vulnerability Score 10 or 9
< 40%	6.8	7.6	8.8 Significant in areas of Vulnerability Score 10

Chemical Threats Related to the Use of Land for Livestock Grazing, Pasturing or Outdoor Confinement Area or Farm-Animal Yard

In general, the use of land as livestock grazing or pasturing land will be a significant chemical threat in:

- Vulnerable Areas scoring 9 if the livestock density is sufficient to generate nutrients at an annual rate that is more than 1.0 Nutrient Units per acre (NU/acre); or
- Vulnerable Areas scoring 10 if the livestock density is sufficient to generate nutrients at an annual rate that is at least 0.5 NU/acre for surface water (in an IPZ) or more than 1.0 NU /acre for groundwater; and
- if the land use may result in the presence of Nitrogen or Phosphorus in surface water or Nitrogen in groundwater. The MOE threats tables refer to Phosphorus in groundwater, but do not identify any threats associated with it in a WHPA.

The use of land as livestock outdoor confinement area or a farm-animal yard will be a significant chemical threat in:

- Vulnerable Areas scoring 10 if the number of animals confined in the area at any time is sufficient to generate nutrients at a rate of more than 300 nutrient units (NU) per hectares of the area annually for groundwater and at a rate of more than 120 NUs per hectares of the area annually for surface water (IPZ); or
- Vulnerable Areas scoring 9 if the number of animals confined in the area at any time is sufficient to generate nutrients at a rate of more than 120 NUs per hectares of the area annually for surface water (in an IPZ); and

- the land use may result in the presence of Nitrogen or Phosphorus in surface water or Nitrogen in groundwater. The MOE threats tables refer to Phosphorus in groundwater, but do not identify any threats associated with it in a WHPA.

Chemical Threats Related to Agricultural Source Material Storage

The technical rules and associated MOE threats tables state that the use of land to store Agricultural Source Material (ASM) would be a significant chemical threat in Vulnerable Areas scoring 9 or 10 if the weight or volume of manure stored annually on a Farm Unit is sufficient to annually land apply nutrients at a rate that is more than 1.0 Nutrient Units per Acre (NU/Acre) of the farm unit. The nutrients stored and applied at an annual rate for the circumstances under the Table of Drinking Water Threats of the technical rules for ASM storage is determined by the NU stored on farm divided by the size of farm unit. Furthermore, another circumstance for ASM storage is that a spill of the material or runoff from the area where the material is stored (i.e. a point source release) may result in the presence of Nitrogen or Phosphorus in groundwater (WHPA) or surface water (IPZ).

7.1.2. Other Activities

The Clean Water Act also allows the Source Protection Committee to include activities that they consider being drinking water threats but are not prescribed drinking water threats. These are called 'other activities' (Rule 119). The Source Protection Committee can also identify additional circumstances (not already in the MOE threats tables) under which they consider the activity a prescribed drinking water threat. The Source Protection Committee is considering a few such 'other activities', as discussed in Section 7.3. These include geothermal systems (harnessing underground temperature), transportation corridors (shipping or road transport of materials) and rifle ranges (shooting practice areas).

Other activities may be listed as threats only if the Source Protection Committee identifies them as drinking water threats, and similar to the prescribed threats, if the hazard score is greater than 4 and the risk score calculated is greater than 40. The hazard score must be calculated

based on certain criteria including toxicity and which vulnerable area the activity is located, and further must be agreed upon by the Director (MOE).

7.1.3. Threats Arising from Conditions

Conditions are a result of past activities. In general, conditions are the presence of:

- non-aqueous phase liquids in Well Head Protection Areas (WHPAs), Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRAs)
- a single mass of more than 100 litres of dense non-aqueous phase liquids in surface water in an Intake Protection Zone (IPZ)
- a contaminant in the groundwater of an HVA, SGRA or WHPA, in surface soil of an IPZ, or in sediments in a vulnerable area, that exceeds a certain MOE 'criteria' for different land uses

The list above is only a summary of the types of situations that can be considered conditions. The actual list of situations are in Section 6.0 - Conditions Assessment of the Assessment Report, along with what the MOE 'criteria' is from MOE published tables of standards for soil, groundwater and sediments for land uses such as commercial, residential and industrial.

If Conditions (resulting from past activities) were identified, the hazard score is always 10 (Rule 139). Hence the level of threat due to a condition will be determined by the vulnerability score of the vulnerable area it occurs in. Similar to the prescribed threats, the risk score is calculated by the product of the vulnerability and hazard scores. However, if the condition results in a drinking water quality issue, that condition is deemed a significant threat (Rule 141).

7.1.4. Threats Arising from Issues

A drinking water issue is a parameter (a substance) or pathogen (a disease causing microorganism) which is shown to deteriorate, or trends towards a deterioration of raw (untreated) water quality for the purposes of drinking. The issues identified in the Lower Thames Valley SPA are summarized in the Issues Evaluation Section of the Assessment Report. According to Rule 131, activities in vulnerable areas that contribute to drinking water quality issues are deemed significant drinking water threats regardless of assigned vulnerability scores.

These activities may be 'prescribed' or 'other' threats (according to Rule 115(3), or they may be 'conditions' (Rule 141). If an issue is identified, the activities that contribute to the identified issue and the areas they occur in must also be identified. Since the activities contributing to issues are deemed significant risks, the threats they pose must be reduced through the source protection plan.

7.1.5. Local Guidance and Technical Studies

In the Thames-Sydenham and Region, the threat and risk assessment work was done according to the Threats and Risk Assessment Local Guidance Version 1.2 (September 9, 2009). This guidance document provides clarification and local interpretation of the relevant sections in the Clean Water Act, its regulations and the associated technical rules pertaining to the threats and risk assessment. It is provided in Appendix 10.

The threats analysis for Intake Protection Zones of the West Elgin, Wheatley and Chatham/South-Kent intakes on Lake Erie was based on reviewing the Ministry of Environment Tables of Drinking Water Threats and the vulnerability scores of these Intake Protection Zones. The input of vulnerability scores were used to generate the listing of land use activities that are or would be drinking water threats in each vulnerable area. The listing details land use activities that, given the vulnerability score for each specific vulnerable area, would present low, moderate, or significant drinking water threats.

For the threats analysis in the Ridgetown and Highgate Well Head Protection Areas, an inventory of land use activities that may be associated with prescribed drinking water threat was conducted. The inventory was based on a review of multiple data sources including public records, data provided through questionnaires completed by municipal officials, previous contaminant/historical land use information, and data collected during windshield surveys. No site specific information was collected; therefore, all prescribed drinking water threat are considered potential rather than confirmed. In summary, evaluation followed a multi-step process including: Assign Land Use Activity, Assign Vulnerability Scores, Relate Land Use Activity to Threat Category, Relate Land Use Activity to Prescribed Drinking Water Threat, and

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Determine Applicable Circumstances. Determining the applicable circumstance is based on a combination of site-specific knowledge of activities on the property, available information on local/regional characteristics, and on professional opinion. Where possible, site specific data from information provided through available public records and interviews is considered. In many cases, selection of the relevant circumstance is based largely on professional opinion on the likelihood of a circumstance being applicable, as site inspections have not been conducted.

7.2. Drinking Water Quality Threats and Risk Assessment

From the prescribed list of activities, the drinking water threats and their circumstances are identified in vulnerable areas of each drinking water system. They are described further in this section.

The Source Protection Committee has not identified any 'other' (not prescribed) activities or circumstances (not in the MOE threats tables) at this point. However, the Source Protection Committee has expressed a concern to the MOE, over the risks associated with the transportation of materials through pipelines or other corridors. The Source Protection Committee has also expressed a concern over the potential risk that geothermal systems pose to groundwater sources of drinking water. The Source Protection Committee is also considering rifle ranges in vulnerable areas as a potential threat. The Source Protection Committee will give further consideration to these activities and may include them in an amended Assessment Report if they are not able to be adequately addressed through other means.

The investigation to determine if there are any conditions (threats resulting from past activities) is yet to be completed, at the time of drafting this Assessment Report. However a couple of potential conditions in the Lower Thames Valley Source Protection Area are being considered for further work. More studies will be undertaken on identifying and assessing conditions and the Assessment Report will be amended if necessary. These are discussed in Section 6.0 – Conditions Assessment.

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Activities that contribute to issues are deemed a significant risk by the Clean Water Act. The area and activities contributing to a drinking water quality issue must both be identified. This work has yet to be completed and will be part of an amended Assessment Report. A work plan to conduct this work is included in the Issues Evaluation Section of the Assessment Report.

The following subsections describe the findings of the threats identification, and results of the risk assessment for each drinking water system. This includes the identification of significant threats, number of locations at which significant threats are or would occur, and areas within vulnerable areas where low, moderate or significant threats could occur.

7.2.1. Threats Identified through Mapping of Impervious Surfaces, Managed Lands and Livestock Density

The maps indicating impervious surfaces, managed lands and livestock density in the region were updated based on MOE guidance received during the drafting of this Assessment Report. The identification of the threats related to these mapped areas is yet to be completed. The threats related to these mapping products are the application of agricultural and non-agricultural source material to land, the application of commercial fertilizer to land and the application of road salt. The threats and risk assessment work will be updated in the amended Assessment Report to include threats due to these activities. Due to the vulnerability scoring of the intake protection zones for Great Lake intakes, and for Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas, the analysis will not result in the addition of any significant threats. Some changes in the number of locations of significant threats may be anticipated within the wellhead protection areas (WHPA-A) of the Ridgetown and Highgate systems, depending on whether the location has already been identified related to other activities at that location.

7.2.2. Number of Locations of Significant Threats

Table 7-5 provides the number of locations where significant threats are thought to occur, based on current land use, within the vulnerable areas of the Lower Thames Valley Source Protection Area. These numbers include threats due to chemical and pathogen-related activities. As can be seen from Table 7-5, there are no locations of activities that 'are or would be' significant

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threats within the Intake Protection Zones, the Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRA). This is due to the range of vulnerability scores allowed for Great Lakes intakes, HVA and SGRA as discussed in [Section 7.2.1](#). There are however locations where significant threats 'are or would' occur in the WHPA-A, B and C.

Table 7-5 : Number of Locations of Significant Drinking Water Threats

System and Vulnerable Area	Vulnerability Score	Significant Threat Locations
Chatham/South Kent Water Treatment Plant		
IPZ-1	5.0	0
IPZ-2	4.0	0
Highgate Well Supply System		
WHPA - A	10	24
WHPA - B	6	2
WHPA - C	4	0
WHPA - D	2	0
Ridgetown Well Supply System - Erie Street wells		
WHPA - A	10	26
WHPA - B	6	2
WHPA - C	2	0
WHPA - D	2	0
Ridgetown Well Supply System - Scane Road wells		
WHPA - A	10	3
WHPA - B	6	0
WHPA - C	2	0
WHPA - D	2	0
West Elgin Water Treatment Plant – Primary Intake		
IPZ-1	6.0	0
IPZ-2	4.2	0
West Elgin Water Treatment Plant – Emergency Intake		
IPZ-1	7.0	0
IPZ-2	To be determined	0
Wheatley Water Treatment Plant – Primary Intake		
IPZ-1	6.0	0
IPZ-2	4.8	0
Wheatley Water Treatment Plant – Emergency Intake		
IPZ-1	7.0	0
IPZ-2	5.6	0
Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas		
HVA	6.0	0
SGRA	6.0, 4.0 and 2.0	0

7.2.3. Threats in Chatham/South Kent Intake Protection Zones

Table 7-5 indicates the number of locations where significant threats could occur in the vulnerable areas of the Lower Thames Valley Source Protection Area based on current land use. The land use activities within the upland area of the Chatham/South Kent Intake Protection Zones consist mostly of agricultural lands with minimal residential development along the shoreline (Potential Threats Analysis for the Thames Sydenham Region Water Treatment Plants. Essex Chatham – Kent Source Protection Planning Technical Study Potential Threats Analysis Technical Memorandum. Final Report. Stantec Consulting Ltd., November 2009). Due to the low vulnerability of these areas there are no significant threats in either IPZ-1 or 2. **Map 7-4** shows areas in the Chatham/South Kent Intake Protection Zones where activities “are or would be” low, moderate or significant threats. The level of threat is dependant upon the vulnerable area (Intake Protection Zone-1 or 2) where the activity is occurring, the vulnerability score and the circumstances associated with the activity. **Table 7-6** shows the levels of threats that could occur in this vulnerable area. **Refer to Appendix 11** for detailed lists of significant, moderate or low threat level activities and the circumstances under which they occur.

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals		
		Significant	Moderate	Low	Significant	Moderate	Low
IPZ-1	5.0	No	No	Yes	No	No	No
IPZ-2	4.0	No	No	No	No	No	No

7.2.4. Threats in Highgate Well Head Protection Areas

Table 7-7 indicates the number of locations where significant threats could occur in the Highgate Well Head Protection Areas, based on current land use. Land use in WHPA-A is mainly residential, in WHPA-B is residential and agricultural, while in WHPA-C and D, land use is primarily agricultural. (Water Quality Threats and Risk Assessment Draft Report. Ridgetown and Highgate Municipal Drinking Water System Source Protection Study. Municipality of Chatham – Kent PUC. Dillon Consulting Limited. October 19, 2009). **Map 7-5** show areas in the Highgate Well Head Protection Areas where activities “are or would be” low, moderate or

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significant threats. The level of threat is dependant upon the vulnerable area (WHPA-A, B, C or D) where the activity is occurring, the vulnerability score and the circumstances associated with the activity. In Well Head Protection Area-A, B and C, activities related to dense non-aqueous phase liquids (DNAPLs) are considered separately from those related to chemical threats, and are deemed significant threats in these areas. **Table 7-8** shows the levels of threats that could occur in this vulnerable area. **Refer to Appendix 11** for detailed lists of significant, moderate or low threat level activities and the circumstances under which they occur.

Table 7-7 Number of Locations of Significant Threats in the Highgate WHPAs

Vulnerable Area	Vulnerability Score	Significant Threats Related To		
		Pathogens	Chemicals	DNAPLs
WHPA-A	10	23	24	1
WHPA-B	6	0	0	2
WHPA-C	4	0	0	0
WHPA-D	2	0	0	0

Table 7-8 Levels of Threats Related to Pathogens, Chemicals and DNAPLs in the Highgate WHPAs

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals			Level of Threat for Activities Related to DNAPL		
		Significant	Moderate	Low	Significant	Moderate	Low	Significant	Moderate	Low
WHPA-A	10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
WHPA-B	6	No	No	Yes	No	Yes	Yes	Yes	No	No
WHPA-C	4	No	No	No	No	No	No	Yes	No	No
WHPA-D	2	No	No	No	No	No	No	No	No	No

7.2.5. Threats in Ridgetown Well Head Protection Areas

Table 7-9 indicates the number of locations where significant threats could occur in the Ridgetown Well Head Protection Areas, based on current land use. The WHPA-A land use is a mix of mainly light commercial and residential. The WHPA-B land use is mainly residential and portions of the sewage treatment lagoons. Land use in the WHPA-C and WHPA-D is mainly rural, with the exception of a part of the Ridgetown campus in WHPA-D (Water Quality Threats and Risk Assessment Draft Report. Ridgetown and Highgate Municipal Drinking Water System

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Source Protection Study. Municipality of Chatham – Kent PUC. Dillon Consulting Limited. October 19, 2009). **Map 7-6** show areas in the Ridgetown Well Head Protection Areas where activities “are or would be” low, moderate or significant threats. The level of threat is dependant upon the vulnerable area (WHPA-A, B, C or D) where the activity is occurring, the vulnerability score and the circumstances associated with the activity. **Table 7-10** shows the levels of threats that could occur in this vulnerable area. **Refer to Appendix 11** for detailed lists of significant, moderate or low threat level activities and the circumstances under which they occur.

Vulnerable Area	Vulnerability Score	Significant Threats Related		
		Pathogens	Chemicals	DNAPLs
Erie Well Field				
WHPA-A	10	6	24	0
WHPA-B	6	0	0	2
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0
Scane Well Field				
WHPA-A	10	0	3	0
WHPA-B	6	0	0	0
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals			Level of Threat for Activities Related to DNAPL		
		Significant	Moderate	Low	Significant	Moderate	Low	Significant	Moderate	Low
Erie Well Field										
WHPA-A	10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
WHPA-B	6	No	No	Yes	No	Yes	Yes	Yes	No	No
WHPA-C	2	No	No	No	No	No	No	Yes	No	No
WHPA-D	2	No	No	No	No	No	No	No	No	No
Scane Well Field										
WHPA-A	10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
WHPA-B	6	No	No	Yes	No	Yes	Yes	Yes	No	No

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WHPA-C	2	No	No	No	No	No	No	Yes	No	No
WHPA-D	2	No	No	No	No	No	No	No	No	No

7.2.6. Threats in West Elgin Intake Protection Zones

Table 7-5 indicates the number of locations where significant threats could occur in the vulnerable areas of the Lower Thames Valley Source Protection Area based on current land use. Land use within the West Elgin upland IPZ-2 is primarily crop land agriculture (Potential Threats Analysis for the West Elgin Water Treatment Plant. Municipality of West Elgin Source Protection Planning Technical Study Phase 2 – Potential Threats Analysis TM. Final Report, Stantec Consulting Ltd., November 2009). Due to the low to moderate vulnerability of these areas there are no significant threats in either IPZ-1 or 2. **Map 7-7** show areas in the West Elgin Intake Protection Zones where activities “are or would be” low, moderate or significant threats. The level of threat is dependant upon the vulnerable area (Intake Protection Zone-1 or 2) where the activity is occurring, the vulnerability score and the circumstances associated with the activity. **Table 7-11** shows the levels of threats that could occur in this vulnerable area. **Refer to Appendix 11** for detailed lists of moderate or low threat level activities and the circumstances under which they occur.

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals		
		Significant	Moderate	Low	Significant	Moderate	Low
West Elgin Primary Intake							
IPZ-1	6.0	No	Yes	Yes	No	Yes	Yes
IPZ-2	4.2	No	No	Yes	No	No	Yes
West Elgin Emergency Intake							
IPZ-1	7.0	No	Yes	Yes	No	Yes	Yes
IPZ-2	To be determined (TBD)	TBD	TBD	TBD	TBD	TBD	TBD

7.2.7. Threats in Wheatley Intake Protection Zones

Table 7-5 indicates the number of locations where significant threats could occur in the vulnerable areas of the Lower Thames Valley Source Protection Area based on current land use. The land use activities within the upland area of the Wheatley Intake Protection Zones consist of agriculture lands with minimal residential development along the shoreline and commercial development within close proximity of Wheatley Harbour (Potential Threats Analysis for the Thames Sydenham Region Water Treatment Plants. Essex Chatham – Kent Source Protection Planning Technical Study Potential Threats Analysis Technical Memorandum. Final Report. Stantec Consulting Ltd. November 2009).. Due to the low to moderate vulnerability of these areas there are no significant threats in either IPZ-1 or 2. Map 7-8 show areas in the Wheatley Intake Protection Zones, where activities “are or would be” low, moderate or significant threats. The level of threat is dependant upon the vulnerable area (Intake Protection Zone-1 or 2) where the activity is occurring, the vulnerability score and the circumstances associated with the activity. Table 7-12 shows the levels of threats that could occur in this vulnerable area. Refer to Appendix 11 for detailed lists of moderate or low threat level activities and the circumstances under which they occur.

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals		
		Significant	Moderate	Low	Significant	Moderate	Low
Wheatley Primary Intake							
IPZ-1	6.0	No	Yes	Yes	No	Yes	Yes
IPZ-2	4.8	No	No	Yes	No	No	Yes
Wheatley Emergency Intake							
IPZ-1	7.0	No	Yes	Yes	No	Yes	Yes
IPZ-2	5.6	No	No	Yes	No	No	Yes

7.2.8. Threats in Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas

Table 7-5 indicates the number of locations where significant threats could occur in the vulnerable areas of the Lower Thames Valley Source Protection Area based on current land

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use. Due to the low to moderate vulnerability scoring of the Highly Vulnerable Aquifers (HVAs) and Significant Groundwater Recharge Areas (SGRAs), it is not possible to have significant threats in these vulnerable areas. [Map 4-7 and 4-8](#) respectively show the HVAs and SGRAs delineations in the Lower Thames Valley Source Protection Area. [Table 7-13](#) shows the levels of threats that could occur in these vulnerable areas. [Refer to Appendix 11](#) for detailed lists of moderate or low threat level activities and the circumstances under which they occur.

Vulnerable Area	Vulnerability Score	Level of Threat for Activities Related to Pathogens			Level of Threat for Activities Related to Chemicals			Level of Threat for Activities Related to DNAPL		
		Significant	Moderate	Low	Significant	Moderate	Low	Significant	Moderate	Low
HVA	6	No	No	No	No	Yes	Yes	No	Yes	Yes
SGRA	6	No	No	No	No	Yes	Yes	No	Yes	Yes
SGRA	4	No	No	No	No	No	No	No	No	No
SGRA	2	No	No	No	No	No	No	No	No	No

As can be seen from [Table 7-13](#), there are no significant threats, and no pathogen related threats in HVAs and SGRAs in the Lower Thames Valley Source Protection Area. It is possible however to have low and moderate levels of chemical threats, including dense non aqueous phase liquids (DNAPLs), for a vulnerability score of 6 in HVA and SGRA.

7.3. Tier 2 Risk Assessment

A tier 2, or site-specific, risk assessment is planned for 2010 to confirm the number of locations at which significant threats occur. As part of the consultation on this assessment report, those who are believed to be engaging in a significant threat will be notified. This will allow their participation in the tier 2 risk assessment. The tier 2 work involves the examination of land use activities and the circumstances under which they are undertaken, through site visits and discussions with the land owners. The outcome of the tier 2 risk assessment will be part of an amended assessment report.

7.4. Data Gaps

The maps indicating impervious surfaces, managed lands and livestock density in the region were updated based on MOE guidance received during the drafting of this Assessment

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Report. The identification of the threats related to these mapped areas is yet to be completed. The threats related to these mapping products are the application of agricultural and non-agricultural source material to land, the application of commercial fertilizer to land and the application of road salt. The threats and risk assessment work in the delineated vulnerable areas will be updated in the amended Assessment Report to include threats due to these activities. The delineated vulnerable areas are: Wellhead Protection Areas-A, B, C and D, Intake Protection Zones-1 and 2, Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas.

The delineation and vulnerability assessment of the third intake protection zone (IPZ-3) as well as the WHPA-E and F for GUDI (groundwater under the direct influence of surface water) drinking water systems are yet to be complete. It is estimated to complete this work in fall 2010. Thereafter, the impervious, managed lands and livestock density calculations and associated threats identification and risk assessment will be completed for these vulnerable areas in 2011, to be a part of an amended assessment report.

At the time of drafting of this Assessment Report, the SPC has not completed an extensive investigation to determine if there are any conditions. A couple of potential conditions in the Lower Thames Valley Source Protection Area are being considered. More work will be undertaken on identifying and assessing conditions for potential threats, and the Assessment Report will be amended if necessary.

Work to identify the area and the activity contributing to a drinking water quality issue has yet to be completed and will be part of an amended Assessment Report. A work plan to conduct this work is included in the Issues Evaluation section of the Assessment Report.