DRINKING WATER SOURCE PROTECTION

ACT FOR CLEAN WATER

Thames-Sydenham and Region Source Protection Committee

Lower Thames Valley Source Protection Area

Amended Proposed

Assessment Report

November 12, 2010

7.0 Threats and Risk Assessment – Water Quality

APPROVED

Made possible through the support of the Government of Ontario

Thames – Sydenham and Region
c/o Upper Thames River Conservation Authority
1424 Clarke Road, London, ON, N5V 5B9

November 12, 2010

Dear reader

Re: **Lower Thames Valley Amended Proposed Assessment Report posted for comments**

The Thames-Sydenham and Region Source Protection Committee (SPC) has posted the enclosed Lower Thames Valley Amended Proposed Assessment Report for review and comment by stakeholders. Comments received through the first posting (Draft Proposed Assessment Report) were considered by the SPC and that report was revised. Comments received in response to the second posting (Proposed Assessment Report) were forwarded to the Ministry of the Environment (MOE) with the submission of the Proposed Assessment Report. Based on directions received from MOE, the Proposed Assessment Report has now been amended to result in this Amended Proposed Assessment Report for the Lower Thames Valley Source Protection Area. Following consultation on this report it will be forwarded to the MOE, along with any comments, for approval.

The recent amendments to the report have helped fill some of the data gaps identified in the Proposed Assessment Report. These include the delineation of an intake protection zone (IPZ) for the West Elgin emergency intake, and an update of the IPZ for the West Elgin primary intake with better drainage information. Also additional threats and risk assessment work has resulted in the identification of a few more potential significant drinking water threat activities in the Ridgetown and Highgate Wellhead Protection Areas (WHPA). New mapping products have been added to the report to show managed lands, livestock density and impervious surfaces in Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRA). The changes included in this report are summarized in Appendix 4. Local consultation will be conducted with those affected by the amendments to the Proposed Assessment Report.

The Amended Proposed Assessment Report for the Lower Thames Valley Source Protection Area represents the next significant milestone in the SPC's progress in the completion of the first Source Protection Plans for the Thames-Sydenham and Region. The SPC realizes that this report is a "living document" which will need to be updated and amended as more information becomes available.

Yours truly,
THAMES-SYDENHAM and REGION

Robert Bedggood, Chair
Source Protection Committee

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7.0 Threats and Risk Assessment – Water Quality

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 Section 3 - Water Budget and Water Quantity Stress Assessment 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 to be *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, 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 two 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 led 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 one 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 three 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. LTVCA staff created mapping products needed in threats analysis, and analysed certain types of threats.

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	1. 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 2. Potential Threats Analysis and Issues Evaluation for the West Elgin Water Treatment Plant Emergency Intake. Municipality of West Elgin Source Protection Planning Technical Study Phase 2 – Potential Threats Analysis TM. Final Report. Stantec Consulting Ltd. June 2010
Ridgetown and Highgate	1. 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.January 29, 2010 2. Updated Significant Threats Tables. Highgate and

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

Drinking Water Systems	Technical Study on Threats and Risk Assessment
	Ridgetown Systems. Dillon Consulting Limited. Technical memo dated October 7, 2010 3. Technical Memo regarding the Assessment of Chemical Threats from the Use of Land as Livestock Grazing, Pasturing Land, and Outdoor Confinement Area or a Farm-Animal Yard. Thames-Sydenham and Region. Jason Wintermute. September 29, 2010.
Wheatley, Chatham and South Chatham-Kent, West Elgin, Ridgetown and Highgate	Technical Memo regarding Creation of Impervious, Managed Land and Livestock Density Maps. Thames-Sydenham and Region. Jason Wintermute. February 2, 2010.

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 Quality 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 Zone (IPZ), Wellhead Protection Area (WHPA), Highly Vulnerable Aquifers (HVA)* and *Significant Groundwater Recharge Areas (SGRA)*. *IPZ* are comprised of *IPZ-1, IPZ-2* and *IPZ-3*, while *WHPA* are comprised of *WHPA-A, WHPA-B, WHPA-C, WHPA-D, WHPA-E* (related to *GUDI* systems) and *WHPA-F* (related to *GUDI* systems). The vulnerability assessment (including delineation and assignment of vulnerability scores) of these *vulnerable areas* is described in Section 4 - Vulnerability Assessment of this Assessment Report. Work related to *IPZ-3* is yet to be completed. Highgate is currently classified as a *GUDI* (*groundwater under the direct influence of surface water*) system. As described in section 4.3.4, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3). 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 *IPZ* around the municipal intakes, and the *WHPA* around municipal wellheads. Map 4-7 shows the delineated *HVA*, while Map 4-8 shows the delineated *SGRA* in the Lower Thames Valley Source Protection Area.

The drinking water quality *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.

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.

Table 7-2 Activities Prescribed as Drinking Water Threats

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 Section 3 - Water Budget and Water Quantity Stress Assessment 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
- 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 pose a *risk* to drinking water quality based on the following factors which are described further in this section:

- the *vulnerable area* where the *activity* is located;
- the vulnerability score assigned to that area;
- the *circumstances* related to the *activity*; and

- the *hazard score* resulting from the *activity* under the *circumstances* related to the *activity*.

An *activity* is deemed to be a significant, moderate or low *threat* depending on the calculated *risk* score. The *risk* score is calculated by multiplying the vulnerability score assigned to a *vulnerable area* with the hazard score of the *activity*.

Risk = Vulnerability X Hazard

Table 7-3 shows the relationship between the *risk* score calculated and the resulting *threat* level. The highest possible *risk* score is 100. 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 *WHPA-A* (100 m radius), *WHPA-B* (2 year capture zone excluding A), and *WHPA-C* (2 to 5 year capture zone) regardless of the vulnerability score. In *WHPA-D* (5 to 25 year capture zone), *WHPA-E* and *WHPA-F*, *dense non-aqueous phase liquids* (*DNAPLs*) are considered under chemical *threats*. *Pathogens* are not viewed as *threats* at all, outside of *WHPA-A, WHPA-B, WHPA-E* and *IPZ-1* and *IPZ-2*. *WHPA-E* and *WHPA-F* are delineated for drinking water systems designated to be *groundwater under the direct influence of surface water* (*GUDI*). Work related to *IPZ-3* is yet to be completed. As described in Section 4.3.4 and 7.1, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3).

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
40 or less than 40	No threat

As mentioned earlier, the *vulnerable areas* are *IPZ, WHPA, HVA* and *SGRA*. According to the *Technical Rules: Assessment Report*, vulnerability scores for Great Lakes *IPZ* range from 3.5 to 7.0 (depending on whether it is for *IPZ-1* or *IPZ-2*), and for *WHPA*, range from 2 to 10 (depending on whether it is for *WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*). 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* (dependent on the *circumstances* associated with *activity*). The highest vulnerability score possible for a Great Lakes *IPZ* is 7, while *WHPA-A*, *WHPA-B* and *WHPA-C* can have vulnerability scores of 8 or greater. Through vulnerability scoring of the Great Lakes *IPZ*s, it is not expected to identify *significant threats*. However, through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. It is also possible to have *significant threats* in *WHPA-A, WHPA-B* and *WHPA-C*, dependent upon the assigned vulnerability score. *HVA* are assigned a vulnerability score of 6 while *SGRA* are assessed a vulnerability score of 6 or less, as described in Section 4 – 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.

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*. The *MOE tables of drinking water threats* include the results of the *risk* score

calculation and identify the *threat* level associated with an *activity* based on the vulnerability score of the area in which the *activity* is being undertaken. The *MOE tables of drinking water threats* 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. The hazard score ranges between 4.1 to 10 for chemical *threats*, 5 to 10 for *pathogens*, and 8.3 to 10 for *DNAPLs*.

There are two separate tables in the *tables of drinking water threats* 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 source material 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 *WHPA-A, WHPA-B* and *WHPA-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 *activities* or products containing *DNAPLs* include: dry cleaning, pesticides, brake cleaners, glues, varnishes, automotive coolant and nail polish. Pathogens are disease-causing microorganisms and in the *tables of drinking water threats*, 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 source material and non-agricultural source material* to land, livestock grazing, and sewage discharge.

The Clean Water Act requires the enumeration of locations at which a *significant threat* is thought to occur. Also, a list of *activities* which are or 'would be' *threats* is 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 *significant threats* must also be identified in the Assessment Reports.

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 *technical 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 *tables of drinking water threats*. The calculations made to map the impervious area, managed lands and livestock density are described briefly below.

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 kilometre 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 *WHPA* and *IPZ* have been calculated; however *HVA* and *SGRA* have yet to be calculated.

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 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 score 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 two 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 include 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.

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.

For the assessment of chemical threats related to the land application of nutrients, the "specified area" mentioned above refers to the vulnerable area being examined (only if a threat can exist there), while the agricultural managed land refers to all agricultural managed land including cropland and pastureland.

For the assessment of chemical threats related to the use of land for livestock grazing, pasturing or outdoor confinement area or animal yard, the "specified area" mentioned above refers to the whole of the farm itself being examined, while the agricultural managed land refers to only that agricultural managed land being assessed, i.e. grazing land, pasture land, outdoor confinement area or animal yard.

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 the maps for both percentage of managed lands and livestock density be considered when evaluating the *circumstances* with regard to each of the thresholds for land application of nutrients. Table 7-4 summarizes the chemical hazard scores 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 of 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 Significant in areas of Vulnerability Score 10**	**9.2 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 pasture 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 *tables of drinking water threats* 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 hectare of the area annually for groundwater and at a rate of more than 120 NUs per hectare 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 hectare 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 *tables of drinking water threats* 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 *tables of drinking water threats* 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 parcel 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 parcel. Under the Table of Drinking Water *Threats* this is determined by the NU stored on farm parcel divided by the size of farm parcel. 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*, upon approval of the Director. These are called *other activities* (Rule 119). The Source Protection Committee can also identify additional *circumstances* (not already in the *tables of drinking water threats*) under which they consider the *activity* to be 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, and if the hazard score (calculated based on certain criteria set out in the *technical rules*) is 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 *WHPA*, *HVA* and *SGRA*
- a single mass of more than 100 litres of *dense non-aqueous phase liquids* in surface water in an *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 as per Technical Rule 126, and provided in Section 6 - Conditions Assessment of the Assessment Report, along with what the *MOE* 'criteria' are 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*) are identified, the hazard score is either 6 or10 depending on certain factors (Rule 139). A *condition* is a *significant threat*, if the risk score is at or above 80 (as per Rule 140), or if it is related to a drinking water quality *issue* (as per Rule

141) or using an extreme event based approach, it is demonstrated that a condition results in a deterioration to intake drinking water quality in an *IPZ-3* (as per Rules 68 and 140.1). For more information, refer to Section 6 – Conditions Assessment of this Assessment Report.

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 Source Protection Area are summarized in the Section 5 - Issues Evaluation of the Assessment Report. They are identified as per Rule 115.1. The sources of some of the issues is yet to be determined.

Should an *issue* be identified as per Technical Rule 114, the *issue* contributing area must be delineated as per Rule 115. Also as per rule 115, activities that contribute to the *issue* within the *issue* contributing area must be identified and are deemed to be a *significant risk* to the source of drinking water for those systems included in the Terms of Reference for an *SPA*. These *activities* may be *prescribed* or *other threats* or *conditions* as per Rule 115 (4). *Significant risks* must be mitigated through the *source protection plan*.

As per Technical Rules 68, 130 and 131, a third intake protection zone (*IPZ-3*) for surface water intakes may be delineated, based on an extreme event, to include the activity and area known to contribute to the drinking water quality *issue*. These tasks are yet to be completed and will be part of an amended Assessment Report.

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 *IPZ* 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 *IPZ*. The vulnerability scores and *vulnerable areas* were considered 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 *WHPAs*, 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 activities* are considered potential rather than confirmed. In summary, evaluation followed a multi-step process including:

- assigning land use *activity*
- assigning vulnerability scores
- relating land use *activity* to *threat* category
- relating land use *activity* to *prescribed* drinking water *threat* and
- determining applicable *circumstances*.

Determining the applicable *circumstances* 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 are considered. In many cases, selection of the relevant *circumstance* is based largely on professional opinion as to the likelihood of a *circumstance* being applicable, as site inspections have not been conducted to date.

A tier 2, or site-specific, *risk* assessment is planned for 2010 to confirm the number of locations at which *significant threats* occur.

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 *tables of drinking water threats*) 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 and 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 cannot 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 – Conditions Assessment.

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 Section 5 - Issues Evaluation 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 Calculation and 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. These are Maps 7-1a-c, 7-2a-d, 7-3a-d of Appendix 1. The identification of the *threats* related to these mapped areas is completed. The *threats* related to these mapping products are the application of *agricultural source material and non-agricultural source material* to land, the application of commercial fertilizer to land, and the application of road salt. Livestock density and agricultural managed land are also used in the farm-level risk assessment related to the *threat* 'use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard'.

Significant threats related to some of the activities described above were identified within the *WHPAs* of the Ridgetown and Highgate systems, as described in Section 7.2.4 and 7.2.5. Due to the vulnerability scoring of the *IPZ* for Great Lakes intakes, and for *HVA* and *SGRA*, the analysis did not result in the identification of any *significant threats* in these *vulnerable areas*.

For activities related to the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard, no chemical or pathogen *threats* were identified in *IPZ*s with vulnerability scores at or greater than 4.5 (chemical) and 4.2 (pathogen) due to current land use (scores lower than these do not result in these activities being identified as *threats* in *IPZ*s).

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 threats* within the *IPZ*, the *HVA* and *SGRA*. This is due to the range of vulnerability scores allowed for Great Lakes intakes, *HVA* and *SGRA* as discussed in Section 7.1.1. There are

however locations where *significant threats* 'are or would' occur in the *WHPA-A*, *WHPA-B* and *WHPA-C*.

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

System and Vulnerable Area	Vulnerability Score	Number of Locations of Significant Threats
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	25
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	5.6	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
HVAand SGRA		
HVA	6.0	0
SGRA	6.0, 4.0 and 2.0	0

7.2.3. Threats in Chatham/South Kent IPZs

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 *IPZ* 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-4 in Appendix 1 identifies the areas in the Chatham/South Kent *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-6 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-4, refer to the Tables A10-1-I1-5 and A10-1-I2-4 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-6 Levels of Threats Related to Pathogens and Chemicals in the Chatham/South Kent IPZs

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 Wellhead Protection Areas

Table 7-7 indicates the number of locations where *significant threats* could occur in the Highgate *WHPAs*, based on current land use. Land use in *WHPA-A* is mainly residential; *WHPA-B* is residential and agricultural, while in *WHPA-C* and *WHPA-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).

The Map 7-5 in Appendix 1 identifies the areas in the Highgate *WHPAs* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-7 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. In *WHPA-A, WHPA-B* and *WHPA-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 below indicates the activities that are *significant threats* in the Highgate *WHPAs* and whether they are chemical, *DNAPL* or pathogen *threats*.

To see a list of the activities which 'are or would be' low, moderate or *significant threats* in this vulnerable area shown on Map 7-5, refer to the Tables A10-1-WA-10, A10-1-WB-6, A10-1-WC-4 and A10-1-WD-2 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at

http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

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	24	24	1
WHPA-B	6	0	0	2
WHPA-C	4	0	0	0
WHPA-D	2	0	0	0

Table 7-8 Significant Threats in the Highgate WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	Chemical, Pathogen	A
The application of agricultural source material to land	Pathogen	A
The application of non-agricultural source material to land	Pathogen	A
The handling and storage of dense non aqueous phase liquids	DNAPL	A, B
The handling and storage of fuel	Chemical	A
Total number of locations of significant prescribed drinking water threats		26*

*some parcels may have more than one activity occurring

7.2.5. Threats in Ridgetown Wellhead Protection Areas

Table 7-9 indicates the number of locations where *significant threats* could occur in the Ridgetown *WHPAs*, 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 Source

Protection Study. Municipality of Chatham-Kent PUC. Dillon Consulting Limited. October 19, 2009).

The Map 7-6 in Appendix 1 identifies the areas in the Ridgetown *WHPAs* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-9 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. In *WHPA-A, WHPA-B* and *WHPA-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 7-10 below indicates the activities that are *significant threats* in the Ridgetown *WHPAs*, and whether they are chemical, *DNAPL* or pathogen *threats*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-6, refer to the Tables A10-1-WA-10, A10-1-WB-6, A10-1-WC-2 and A10-1-WD-2 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-9 Number of Locations of Significant Threats in the Ridgetown WHPAs

Vulnerable Area	Vulnerability Score	Significant Threats Related To		
		Pathogens	Chemicals	DNAPLs
Erie Well Field				
WHPA-A	10	10	24	2
WHPA-B	6	0	0	2
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0
Scane Well Field				
WHPA-A	10	1	2	0
WHPA-B	6	0	0	0
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0

Table 7-10 Significant Threats in the Ridgetown WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
Erie Street System		
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	Chemical, Pathogen	A
The application of agricultural source material to land	Pathogen	A
The storage of agricultural source material	Chemical, Pathogen	A
The application of non-agricultural source material to land	Chemical, Pathogen	A
The handling and storage of commercial fertilizer	Chemical	A
The handling and storage of pesticide	Chemical	A
The handling and storage of dense non aqueous phase liquids	DNAPL	A, B
The handling and storage of fuel	Chemical	A
The application of fertilizer	Chemical	A
The handling and storage of organic solvents	Chemical	A
The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	Pathogen	A
Scane Road System		
The handling and storage of fuel	Chemical	A

Table 7-10 Significant Threats in the Ridgetown WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
The application of pesticide	Chemical	A
The application of agricultural source material to land	Pathogen	A
The application of non-agricultural source material to land	Pathogen	A
Total number of locations of significant prescribed drinking water threats		30*

*some parcels may have more than one activity occurring

7.2.6. Threats in West Elgin IPZs

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* for both the primary and emergency intakes is primarily cropland 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-7 in Appendix 1 identifies the areas in the West Elgin *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-11 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-7, refer to the Tables A10-1-I1-6, A10-1-I1-7, A10-1-I2-4.2 and A10-1-I2-5.6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at

http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-11 Levels of Threats Related to Pathogens and Chemicals in the West Elgin IPZs

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	5.6	No	Yes	Yes	No	Yes	Yes

7.2.7. Threats in Wheatley IPZs

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 *IPZ* 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-8 in Appendix 1 identifies the areas in the Wheatley *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-12 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is

dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-8, refer to the Tables A10-1-I1-6, A10-1-I1-7, A10-1-I2-4.8 and A10-1-I2-5.6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-12 Levels of Threats Related to Pathogens and Chemicals in the Wheatley IPZs

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 HVA and SGRA

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. Due to the low to moderate vulnerability scoring of the *HVA* and *SGRA*, it is not possible to have *significant threats* in these *vulnerable areas*. Map 4-7 and 4-8 show the *HVA* and *SGRA* delineations respectively in the Lower Thames Valley Source Protection Area. Map 4-9 shows the vulnerability scores of the delineated *SGRA*.

Table 7-13 shows the levels of *threats* that could occur in these *vulnerable areas*. The level of *threat* is dependent upon the *vulnerable area* (*HVA* or *SGRA*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. As can be seen from Table 7-13, there are no *significant threats*, and no pathogen related *threats* in *HVA* and *SGRA* 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*.

Table 7-13 Levels of Threats Related to Pathogens, Chemicals and DNAPLs in HVAs and SGRAs

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 DNAPLs		
		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

To see a list of the activities which are or would be low, moderate or *significant threats* in these vulnerable areas, refer to the Tables A10-1-HV-6, A10-1-SG-2, A10-1-SG-4 and A10-1-SG-6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

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 landowners. The outcome of the tier 2 *risk* assessment will be part of an amended Assessment Report.

7.4 Data Gaps

The delineation and vulnerability assessment of *IPZ-3* is 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. Highgate is currently classified as a *GUDI* (*groundwater under the direct influence of surface water*) system. As described in Section 4.3.4 and 7.1, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3).

A preliminary investigation has been completed 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.

Thames – Sydenham and Region
c/o Upper Thames River Conservation Authority
1424 Clarke Road, London, ON, N5V 5B9

November 12, 2010

Dear reader

Re: **Lower Thames Valley Amended Proposed Assessment Report posted for comments**

The Thames-Sydenham and Region Source Protection Committee (SPC) has posted the enclosed Lower Thames Valley Amended Proposed Assessment Report for review and comment by stakeholders. Comments received through the first posting (Draft Proposed Assessment Report) were considered by the SPC and that report was revised. Comments received in response to the second posting (Proposed Assessment Report) were forwarded to the Ministry of the Environment (MOE) with the submission of the Proposed Assessment Report. Based on directions received from MOE, the Proposed Assessment Report has now been amended to result in this Amended Proposed Assessment Report for the Lower Thames Valley Source Protection Area. Following consultation on this report it will be forwarded to the MOE, along with any comments, for approval.

The recent amendments to the report have helped fill some of the data gaps identified in the Proposed Assessment Report. These include the delineation of an intake protection zone (IPZ) for the West Elgin emergency intake, and an update of the IPZ for the West Elgin primary intake with better drainage information. Also additional threats and risk assessment work has resulted in the identification of a few more potential significant drinking water threat activities in the Ridgetown and Highgate Wellhead Protection Areas (WHPA). New mapping products have been added to the report to show managed lands, livestock density and impervious surfaces in Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRA). The changes included in this report are summarized in Appendix 4. Local consultation will be conducted with those affected by the amendments to the Proposed Assessment Report.

The Amended Proposed Assessment Report for the Lower Thames Valley Source Protection Area represents the next significant milestone in the SPC's progress in the completion of the first Source Protection Plans for the Thames-Sydenham and Region. The SPC realizes that this report is a "living document" which will need to be updated and amended as more information becomes available.

Yours truly,
THAMES-SYDENHAM and REGION

Robert Bedggood, Chair
Source Protection Committee

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7.0 Threats and Risk Assessment – Water Quality

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 Section 3 - Water Budget and Water Quantity Stress Assessment 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 to be *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, 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 two 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 led 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 one 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 three 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. LTVCA staff created mapping products needed in threats analysis, and analysed certain types of threats.

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	1. 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 2. Potential Threats Analysis and Issues Evaluation for the West Elgin Water Treatment Plant Emergency Intake. Municipality of West Elgin Source Protection Planning Technical Study Phase 2 – Potential Threats Analysis TM. Final Report. Stantec Consulting Ltd. June 2010
Ridgetown and Highgate	1. 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.January 29, 2010 2. Updated Significant Threats Tables. Highgate and

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

Drinking Water Systems	Technical Study on Threats and Risk Assessment
	Ridgetown Systems. Dillon Consulting Limited. Technical memo dated October 7, 2010 3. Technical Memo regarding the Assessment of Chemical Threats from the Use of Land as Livestock Grazing, Pasturing Land, and Outdoor Confinement Area or a Farm-Animal Yard. Thames-Sydenham and Region. Jason Wintermute. September 29, 2010.
Wheatley, Chatham and South Chatham-Kent, West Elgin, Ridgetown and Highgate	Technical Memo regarding Creation of Impervious, Managed Land and Livestock Density Maps. Thames-Sydenham and Region. Jason Wintermute. February 2, 2010.

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 Quality 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 Zone (IPZ), Wellhead Protection Area (WHPA), Highly Vulnerable Aquifers (HVA)* and *Significant Groundwater Recharge Areas (SGRA)*. *IPZ* are comprised of *IPZ-1, IPZ-2* and *IPZ-3*, while *WHPA* are comprised of *WHPA-A, WHPA-B, WHPA-C, WHPA-D, WHPA-E* (related to *GUDI* systems) and *WHPA-F* (related to *GUDI* systems). The vulnerability assessment (including delineation and assignment of vulnerability scores) of these *vulnerable areas* is described in Section 4 - Vulnerability Assessment of this Assessment Report. Work related to *IPZ-3* is yet to be completed. Highgate is currently classified as a *GUDI* (*groundwater under the direct influence of surface water*) system. As described in section 4.3.4, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3). 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 *IPZ* around the municipal intakes, and the *WHPA* around municipal wellheads. Map 4-7 shows the delineated *HVA*, while Map 4-8 shows the delineated *SGRA* in the Lower Thames Valley Source Protection Area.

The drinking water quality *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.

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.

Table 7-2 Activities Prescribed as Drinking Water Threats

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 Section 3 - Water Budget and Water Quantity Stress Assessment 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
- 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 pose a *risk* to drinking water quality based on the following factors which are described further in this section:

- the *vulnerable area* where the *activity* is located;
- the vulnerability score assigned to that area;
- the *circumstances* related to the *activity*; and

- the *hazard score* resulting from the *activity* under the *circumstances* related to the *activity*.

An *activity* is deemed to be a significant, moderate or low *threat* depending on the calculated *risk* score. The *risk* score is calculated by multiplying the vulnerability score assigned to a *vulnerable area* with the hazard score of the *activity*.

Risk = Vulnerability X Hazard

Table 7-3 shows the relationship between the *risk* score calculated and the resulting *threat* level. The highest possible *risk* score is 100. 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 *WHPA-A* (100 m radius), *WHPA-B* (2 year capture zone excluding A), and *WHPA-C* (2 to 5 year capture zone) regardless of the vulnerability score. In *WHPA-D* (5 to 25 year capture zone), *WHPA-E* and *WHPA-F*, *dense non-aqueous phase liquids* (*DNAPLs*) are considered under chemical *threats*. *Pathogens* are not viewed as *threats* at all, outside of *WHPA-A, WHPA-B, WHPA-E* and *IPZ-1* and *IPZ-2*. *WHPA-E* and *WHPA-F* are delineated for drinking water systems designated to be *groundwater under the direct influence of surface water* (*GUDI*). Work related to *IPZ-3* is yet to be completed. As described in Section 4.3.4 and 7.1, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3).

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
40 or less than 40	No threat

As mentioned earlier, the *vulnerable areas* are *IPZ, WHPA, HVA* and *SGRA*. According to the *Technical Rules: Assessment Report*, vulnerability scores for Great Lakes *IPZ* range from 3.5 to 7.0 (depending on whether it is for *IPZ-1* or *IPZ-2*), and for *WHPA*, range from 2 to 10 (depending on whether it is for *WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*). 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* (dependent on the *circumstances* associated with *activity*). The highest vulnerability score possible for a Great Lakes *IPZ* is 7, while *WHPA-A*, *WHPA-B* and *WHPA-C* can have vulnerability scores of 8 or greater. Through vulnerability scoring of the Great Lakes *IPZ*s, it is not expected to identify *significant threats*. However, through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. It is also possible to have *significant threats* in *WHPA-A, WHPA-B* and *WHPA-C*, dependent upon the assigned vulnerability score. *HVA* are assigned a vulnerability score of 6 while *SGRA* are assessed a vulnerability score of 6 or less, as described in Section 4 – 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.

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*. The *MOE tables of drinking water threats* include the results of the *risk* score

calculation and identify the *threat* level associated with an *activity* based on the vulnerability score of the area in which the *activity* is being undertaken. The *MOE tables of drinking water threats* 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. The hazard score ranges between 4.1 to 10 for chemical *threats*, 5 to 10 for *pathogens*, and 8.3 to 10 for *DNAPLs*.

There are two separate tables in the *tables of drinking water threats* 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 source material 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 *WHPA-A, WHPA-B* and *WHPA-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 *activities* or products containing *DNAPLs* include: dry cleaning, pesticides, brake cleaners, glues, varnishes, automotive coolant and nail polish. Pathogens are disease-causing microorganisms and in the *tables of drinking water threats*, 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 source material and non-agricultural source material* to land, livestock grazing, and sewage discharge.

The Clean Water Act requires the enumeration of locations at which a *significant threat* is thought to occur. Also, a list of *activities* which are or 'would be' *threats* is 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 *significant threats* must also be identified in the Assessment Reports.

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 *technical 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 *tables of drinking water threats*. The calculations made to map the impervious area, managed lands and livestock density are described briefly below.

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 kilometre 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 *WHPA* and *IPZ* have been calculated; however *HVA* and *SGRA* have yet to be calculated.

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 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 score 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 two 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 include 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.

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.

For the assessment of chemical threats related to the land application of nutrients, the "specified area" mentioned above refers to the vulnerable area being examined (only if a threat can exist there), while the agricultural managed land refers to all agricultural managed land including cropland and pastureland.

For the assessment of chemical threats related to the use of land for livestock grazing, pasturing or outdoor confinement area or animal yard, the "specified area" mentioned above refers to the whole of the farm itself being examined, while the agricultural managed land refers to only that agricultural managed land being assessed, i.e. grazing land, pasture land, outdoor confinement area or animal yard.

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 the maps for both percentage of managed lands and livestock density be considered when evaluating the *circumstances* with regard to each of the thresholds for land application of nutrients. Table 7-4 summarizes the chemical hazard scores 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 of 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 Significant in areas of Vulnerability Score 10**	**9.2 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 pasture 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 *tables of drinking water threats* 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 hectare of the area annually for groundwater and at a rate of more than 120 NUs per hectare 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 hectare 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 *tables of drinking water threats* 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 *tables of drinking water threats* 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 parcel 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 parcel. Under the Table of Drinking Water *Threats* this is determined by the NU stored on farm parcel divided by the size of farm parcel. 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*, upon approval of the Director. These are called *other activities* (Rule 119). The Source Protection Committee can also identify additional *circumstances* (not already in the *tables of drinking water threats*) under which they consider the *activity* to be 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, and if the hazard score (calculated based on certain criteria set out in the *technical rules*) is 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 *WHPA*, *HVA* and *SGRA*
- a single mass of more than 100 litres of *dense non-aqueous phase liquids* in surface water in an *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 as per Technical Rule 126, and provided in Section 6 - Conditions Assessment of the Assessment Report, along with what the *MOE* 'criteria' are 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*) are identified, the hazard score is either 6 or10 depending on certain factors (Rule 139). A *condition* is a *significant threat*, if the risk score is at or above 80 (as per Rule 140), or if it is related to a drinking water quality *issue* (as per Rule

141) or using an extreme event based approach, it is demonstrated that a condition results in a deterioration to intake drinking water quality in an *IPZ-3* (as per Rules 68 and 140.1). For more information, refer to Section 6 – Conditions Assessment of this Assessment Report.

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 Source Protection Area are summarized in the Section 5 - Issues Evaluation of the Assessment Report. They are identified as per Rule 115.1. The sources of some of the issues is yet to be determined.

Should an *issue* be identified as per Technical Rule 114, the *issue* contributing area must be delineated as per Rule 115. Also as per rule 115, activities that contribute to the *issue* within the *issue* contributing area must be identified and are deemed to be a *significant risk* to the source of drinking water for those systems included in the Terms of Reference for an *SPA*. These *activities* may be *prescribed* or *other threats* or *conditions* as per Rule 115 (4). *Significant risks* must be mitigated through the *source protection plan*.

As per Technical Rules 68, 130 and 131, a third intake protection zone (*IPZ-3*) for surface water intakes may be delineated, based on an extreme event, to include the activity and area known to contribute to the drinking water quality *issue*. These tasks are yet to be completed and will be part of an amended Assessment Report.

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 *IPZ* 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 *IPZ*. The vulnerability scores and *vulnerable areas* were considered 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 *WHPAs*, 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 activities* are considered potential rather than confirmed. In summary, evaluation followed a multi-step process including:

- assigning land use *activity*
- assigning vulnerability scores
- relating land use *activity* to *threat* category
- relating land use *activity* to *prescribed* drinking water *threat* and
- determining applicable *circumstances*.

Determining the applicable *circumstances* 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 are considered. In many cases, selection of the relevant *circumstance* is based largely on professional opinion as to the likelihood of a *circumstance* being applicable, as site inspections have not been conducted to date.

A tier 2, or site-specific, *risk* assessment is planned for 2010 to confirm the number of locations at which *significant threats* occur.

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 *tables of drinking water threats*) 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 and 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 cannot 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 – Conditions Assessment.

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 Section 5 - Issues Evaluation 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 Calculation and 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. These are Maps 7-1a-c, 7-2a-d, 7-3a-d of Appendix 1. The identification of the *threats* related to these mapped areas is completed. The *threats* related to these mapping products are the application of *agricultural source material and non-agricultural source material* to land, the application of commercial fertilizer to land, and the application of road salt. Livestock density and agricultural managed land are also used in the farm-level risk assessment related to the *threat* 'use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard'.

Significant threats related to some of the activities described above were identified within the *WHPAs* of the Ridgetown and Highgate systems, as described in Section 7.2.4 and 7.2.5. Due to the vulnerability scoring of the *IPZ* for Great Lakes intakes, and for *HVA* and *SGRA*, the analysis did not result in the identification of any *significant threats* in these *vulnerable areas*.

For activities related to the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard, no chemical or pathogen *threats* were identified in *IPZ*s with vulnerability scores at or greater than 4.5 (chemical) and 4.2 (pathogen) due to current land use (scores lower than these do not result in these activities being identified as *threats* in *IPZ*s).

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 threats* within the *IPZ*, the *HVA* and *SGRA*. This is due to the range of vulnerability scores allowed for Great Lakes intakes, *HVA* and *SGRA* as discussed in Section 7.1.1. There are

however locations where *significant threats* 'are or would' occur in the *WHPA-A*, *WHPA-B* and *WHPA-C*.

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

System and Vulnerable Area	Vulnerability Score	Number of Locations of Significant Threats
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	25
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	5.6	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
HVAand SGRA		
HVA	6.0	0
SGRA	6.0, 4.0 and 2.0	0

7.2.3. Threats in Chatham/South Kent IPZs

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 *IPZ* 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-4 in Appendix 1 identifies the areas in the Chatham/South Kent *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-6 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-4, refer to the Tables A10-1-I1-5 and A10-1-I2-4 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-6 Levels of Threats Related to Pathogens and Chemicals in the Chatham/South Kent IPZs

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 Wellhead Protection Areas

Table 7-7 indicates the number of locations where *significant threats* could occur in the Highgate *WHPAs*, based on current land use. Land use in *WHPA-A* is mainly residential; *WHPA-B* is residential and agricultural, while in *WHPA-C* and *WHPA-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).

The Map 7-5 in Appendix 1 identifies the areas in the Highgate *WHPAs* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-7 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. In *WHPA-A, WHPA-B* and *WHPA-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 below indicates the activities that are *significant threats* in the Highgate *WHPAs* and whether they are chemical, *DNAPL* or pathogen *threats*.

To see a list of the activities which 'are or would be' low, moderate or *significant threats* in this vulnerable area shown on Map 7-5, refer to the Tables A10-1-WA-10, A10-1-WB-6, A10-1-WC-4 and A10-1-WD-2 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at

http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

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	24	24	1
WHPA-B	6	0	0	2
WHPA-C	4	0	0	0
WHPA-D	2	0	0	0

Table 7-8 Significant Threats in the Highgate WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	Chemical, Pathogen	A
The application of agricultural source material to land	Pathogen	A
The application of non-agricultural source material to land	Pathogen	A
The handling and storage of dense non aqueous phase liquids	DNAPL	A, B
The handling and storage of fuel	Chemical	A
Total number of locations of significant prescribed drinking water threats		26*

*some parcels may have more than one activity occurring

7.2.5. Threats in Ridgetown Wellhead Protection Areas

Table 7-9 indicates the number of locations where *significant threats* could occur in the Ridgetown *WHPAs*, 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 Source

Protection Study. Municipality of Chatham-Kent PUC. Dillon Consulting Limited. October 19, 2009).

The Map 7-6 in Appendix 1 identifies the areas in the Ridgetown *WHPAs* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-9 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*WHPA-A, WHPA-B, WHPA-C* or *WHPA-D*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. In *WHPA-A, WHPA-B* and *WHPA-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 7-10 below indicates the activities that are *significant threats* in the Ridgetown *WHPAs*, and whether they are chemical, *DNAPL* or pathogen *threats*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-6, refer to the Tables A10-1-WA-10, A10-1-WB-6, A10-1-WC-2 and A10-1-WD-2 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-9 Number of Locations of Significant Threats in the Ridgetown WHPAs

Vulnerable Area	Vulnerability Score	Significant Threats Related To		
		Pathogens	Chemicals	DNAPLs
Erie Well Field				
WHPA-A	10	10	24	2
WHPA-B	6	0	0	2
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0
Scane Well Field				
WHPA-A	10	1	2	0
WHPA-B	6	0	0	0
WHPA-C	2	0	0	0
WHPA-D	2	0	0	0

Table 7-10 Significant Threats in the Ridgetown WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
Erie Street System		
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	Chemical, Pathogen	A
The application of agricultural source material to land	Pathogen	A
The storage of agricultural source material	Chemical, Pathogen	A
The application of non-agricultural source material to land	Chemical, Pathogen	A
The handling and storage of commercial fertilizer	Chemical	A
The handling and storage of pesticide	Chemical	A
The handling and storage of dense non aqueous phase liquids	DNAPL	A, B
The handling and storage of fuel	Chemical	A
The application of fertilizer	Chemical	A
The handling and storage of organic solvents	Chemical	A
The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	Pathogen	A
Scane Road System		
The handling and storage of fuel	Chemical	A

Table 7-10 Significant Threats in the Ridgetown WHPA

Prescribed Drinking Water Threat	Type (Chemical, Pathogen or DNAPL)	WHPA
The application of pesticide	Chemical	A
The application of agricultural source material to land	Pathogen	A
The application of non-agricultural source material to land	Pathogen	A
Total number of locations of significant prescribed drinking water threats		30*

*some parcels may have more than one activity occurring

7.2.6. Threats in West Elgin IPZs

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* for both the primary and emergency intakes is primarily cropland 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-7 in Appendix 1 identifies the areas in the West Elgin *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-11 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-7, refer to the Tables A10-1-I1-6, A10-1-I1-7, A10-1-I2-4.2 and A10-1-I2-5.6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at

http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-11 Levels of Threats Related to Pathogens and Chemicals in the West Elgin IPZs

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	5.6	No	Yes	Yes	No	Yes	Yes

7.2.7. Threats in Wheatley IPZs

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 *IPZ* 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).

Through vulnerability scoring of these areas, there are no *significant threats* in either *IPZ-1 or 2*. Through issues and event based threats and risk assessment (see Sections 7.1.3 and 7.1.4), it may be possible to identify *significant threats*. The Map 7-8 in Appendix 1 identifies the areas in the Wheatley *IPZ* where activities 'are or would be' low, moderate or *significant threats*. The table on the map and the Table 7-12 below indicate the vulnerability score and vulnerable area in which the activities 'are or would' be low, moderate or *significant threats*. The level of *threat* is

dependent upon the *vulnerable area* (*IPZ-1 or 2*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*.

To see a list of the activities which are or would be low, moderate or *significant threats* in this vulnerable area shown on Map 7-8, refer to the Tables A10-1-I1-6, A10-1-I1-7, A10-1-I2-4.8 and A10-1-I2-5.6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

Table 7-12 Levels of Threats Related to Pathogens and Chemicals in the Wheatley IPZs

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 HVA and SGRA

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. Due to the low to moderate vulnerability scoring of the *HVA* and *SGRA*, it is not possible to have *significant threats* in these *vulnerable areas*. Map 4-7 and 4-8 show the *HVA* and *SGRA* delineations respectively in the Lower Thames Valley Source Protection Area. Map 4-9 shows the vulnerability scores of the delineated *SGRA*.

Table 7-13 shows the levels of *threats* that could occur in these *vulnerable areas*. The level of *threat* is dependent upon the *vulnerable area* (*HVA* or *SGRA*) where the *activity* is occurring, the vulnerability score and the *circumstances* associated with the *activity*. As can be seen from Table 7-13, there are no *significant threats*, and no pathogen related *threats* in *HVA* and *SGRA* 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*.

Table 7-13 Levels of Threats Related to Pathogens, Chemicals and DNAPLs in HVAs and SGRAs

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 DNAPLs		
		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

To see a list of the activities which are or would be low, moderate or *significant threats* in these vulnerable areas, refer to the Tables A10-1-HV-6, A10-1-SG-2, A10-1-SG-4 and A10-1-SG-6 in Appendix 10 Threats and Circumstances Tables. To see the *circumstances* which would result in the activity being a low, moderate or *significant threat*, refer to the Provincial tables of circumstances at http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php. To see drinking water threats and *circumstances* for all vulnerable areas and scores, refer to the Province's tables of drinking water threats at http://www.ene.gov.on.ca/en/water/cleanwater/cwa-technical-rules.php.

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 landowners. The outcome of the tier 2 *risk* assessment will be part of an amended Assessment Report.

7.4 Data Gaps

The delineation and vulnerability assessment of *IPZ-3* is 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. Highgate is currently classified as a *GUDI* (*groundwater under the direct influence of surface water*) system. As described in Section 4.3.4 and 7.1, the MOE directed that the workplans for *WHPA-E* and *WHPA-F* for the Highgate system not be included in the Assessment Report as information available at this time indicates that the system does not meet the test in Rule 49 (3).

A preliminary investigation has been completed 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.