7. DECEW FALLS, ST. CATHARINES-THOROLD WATER TREATMENT PLANT

The DeCew Falls Water Treatment Plant (WTP) is located in St. Catharines, Ontario and provides treated drinking water to the Cities of St. Catharines, Thorold and a portion of the Towns of Niagara-on-the Lake and Lincoln. With a total capacity of 227 million litres per day, the plant services a population of approximately 167,000.

The DeCew Falls WTP has three associated intakes. The main intake is connected directly to the WTP and is located at the end of a series of three reservoirs (upper, middle and lower). The upper reservoir receives Welland Canal water through a supply canal operated by Ontario Power Generation (OPG) and Niagara Region.

The second intake is a control structure on the OPG Power Canal located at Highway 406. This intake represents the entry point to the DeCew Falls drinking water system as all three reservoirs (upper, middle and lower) provide pretreatment (sedimentation) and are defined as part of the system in Drinking Water Works Permit 007-202 issued under the Safe Drinking Water Act (Ministry of the Environment, 2009f). Furthermore, this intake represents the last control structure that Niagara Region can operate to prevent any potentially contaminated source water from entering the upper reservoir.

The third intake is an alternate supply intake in Lake Gibson. This intake may provide an alternate water supply to the upper reservoir in the event that maintenance is required on the OPG Power Canal or the integrity of the OPG Power canal or its water supply is compromised.

All three intakes are defined as part of DeCew Falls' drinking water system and are included in the Drinking Water Works Permit (Ministry of the Environment, 2009f). A map showing the local setting of the DeCew Falls WTP, its water sources, and three intakes is shown in Figure 7.1.

A surface water vulnerable area and water quality threats assessment has been completed for the DeCew Falls WTP intakes. The methodology used for this assessment is described in Chapter 5 and specific results are outlined in Sections 7.1 through 7.7. Data sources used for each task are listed in Appendix B.

7.1 Classification of Intake

The MOE has classified the DeCew intake as a **Type B – Connecting Channel** intake under Assessment Report Technical Rule 55.1 (I. Smith, 2010c). Although the DeCew intake could be interpreted also as a Type D the MOE has indicated that a Type B classification is more appropriate. For example, although there is a Lake Gibson intake, Lake Gibson does not function as a traditional lake and is man-made. Its high flows from the Welland Canal (a Great Lakes Connecting Channel) are in one direction.

TR 55, TR 1(1)

7.2 Delineation of Surface Water Intake Protection Zones

The following sections describe the delineation of the primary (IPZ-1) and secondary (IPZ-2) Intake Protection Zones.

7.2.1 Primary Zone (IPZ-1) Delineation - Main Intake

The IPZ-1 (Figure 7.2) for the DeCew Falls WTP main intake was delineated in accordance with the TR. The resulting IPZ-1 was delineated using a 1,000 m semi circle upstream, centred on the intake structure. The prescribed 1,000 m radius reaches the middle of the upper reservoir. The IPZ-1 south of the reservoirs was truncated at 120 m from the shoreline in order to adhere to an MOE directive. This change in the IPZ-1 delineation was required because the Diversion Channel and its tributaries only impact the reservoirs under adverse spring conditions when flooding may overwhelm the berm separating the reservoirs from the Diversion Channel. The Diversion Chanel still lies within the 120 m setback of the IPZ-1.

TR 61-64

7.2.2 Primary Zone (IPZ-1) Delineation – Highway 406 Control Structure

The IPZ-1 (Figure 7.3) for the intake located at the Highway 406 Control Structure is a 1,000 m semi-circle centered on the control structure. It extends to the east approximately 1,000 m east of Beaverdams Road. The areas to the north and south of the supply canal were truncated using a combination of 120 m and height of land, i.e. drainage divides. The IPZ-1 has been revised based on new information received in 2010 concerning drainage divides in this area.

7.2.3 Primary Zone (IPZ-1) Delineation – Lake Gibson Alternate Supply

The IPZ-1 (Figure 7.4) for the Lake Gibson Alternate Supply Intake is based on a 1,000 m radius semi-circle centred on the supply structure and extending upstream. The IPZ-1 extends towards the east through Lake Gibson to both north and south shores and the supply canal at Highway 406. Along the north shore of Lake Gibson, the IPZ-1 inland boundary follows DeCew Road from just west of the Lake Moodie channel toward Highway 406 through identification of the height of land. The southern extent of the IPZ-1 is delineated using height of land between the supply canal and Lake Gibson and data detailing the land that is drained south of the supply canal through raised and buried culverts. Delineation of this IPZ-1 was reviewd after changes were made to other IPZs.

7.2.4 Secondary Zone (IPZ-2) Delineation

The IPZ-2s for the DeCew Falls' intakes were delineated in three components: in-water, upland, and up-tributary. The development of each of these components is described in further detail below.

TR 65-66

7.2.4.1 In-water – Main Intake

As described above, the main intake at the DeCew Falls WTP is located at the end of a series of three reservoirs (upper, middle and lower). The upper reservoir receives Welland Canal water through a supply canal operated by Ontario Power Generation (OPG) and Niagara Region. A second intake is associated with a control structure in the supply canal at Highway 406. This intake represents the entry point to the DeCew Falls drinking water system as all three reservoirs that follow (upper, middle, lower) provide pretreatment and are defined as part of the system in Drinking Water Works Permit 007-202, issued under the Safe Drinking Water Act. Furthermore, this intake represents the last control structure that Niagara Region can operate to prevent any potentially contaminated water from entering the reservoirs and ultimately, the WTP.

In accordance with Technical Rule 65(1), a time of travel (TOT) must be specified for delineation of IPZ-2. The TOT represents the time that is sufficient to allow an Operator to respond to a spill or other event that may impair the quality of the water at the intake. In general, a two hour TOT has been adopted for Niagara Region's intakes in accordance with the minimum response time defined in Technical Rule 66. However, the situation at DeCew Falls' main intake is unique.

As described above, once water has passed the control structure at Highway 406, it has entered the drinking water system and will proceed through the reservoirs to the main intake. In order for an Operator to respond to a spill or other event that could impair the quality of water at the main intake, the TOT must be sufficient for the Operator to have the control structure at Highway 406 closed. Therefore, the TOT must include the retention time of all three reservoirs and the short stretch of the OPG Power Canal to the Highway 406 control structure. Depending on the flow rate at the WTP, this can range from 2.5 to 5.6 days, design capacity to average day, respectively. Therefore, the conservative TOT of 5.6 days has been adopted for the DeCew Falls main intake, matching recent average day demands observed (2003-2009).

The IPZ-2 for the DeCew Main Intake was based on this assessment noted above. The IPZ-2 for the DeCew Main Intake is shown in Figure 7.2.

7.2.4.2 In-water – Highway 406 Control Structure

The IPZ-2 for the Highway 406 Control Structure was established using two hydraulic flow models: HEC-RAS™ for the supply canal and ECOMSED™ for the Welland Canal section. An estimate of the effects of transient ship-induced currents was also included. Calculations were based on flows and stages in the canals and a 2-hour TOT factor.

The results of the in-water modelling for the Highway 406 Control Structure are shown in Figure 7.5. As can be observed from Figure 7.5, with a 2-hour TOT, the in-water component of IPZ-2 extends from the Highway 406 control structure through the supply canal and into the Welland Canal. The IPZ-2 for the Highway 406 Control Structure is shown in Figure 7.3.

7.2.4.3 In-water – Lake Gibson

The IPZ-2 for the Lake Gibson Alternate Supply Intake was established using the hydraulic flow model HEC-RAS™ based on flows and stages in the lake, wind conditions and a 2-hour TOT factor.

The results of the in-water modelling for the Lake Gibson intake are shown in Figure 7.6. As can be observed from Figure 7.6, with a 2-hour TOT, the in-water component of IPZ-2 encompasses all of Lake Gibson and a portion of the Welland Canal.

The IPZ-2 for the Lake Gibson intake is shown in Figure 7.4.

7.2.4.4 Upland – Transport Pathways

Where the IPZ-2 delineations touch land and are not impacted by outfalls, drains, and/or watercourses, they were extended inland to the height of land (to a maximum of 120 m) or the area of the Conservation Authority Regulation Limit. Where the in-water IPZ-2 was impacted by outfalls, drains and/or watercourses, appropriate upland delineations were applied, as described below.

As required by the TR, any storm sewershed that could contribute water to the intake within the modelled TOT (2-hours), must be included as part of IPZ-2. Therefore, the upland portion of the Lake Gibson IPZ-2 includes the four outfalls of Confederation Heights storm sewer catchment areas.

Allanburg has been included in the IPZ-2s for the Highway 406 Control Structure and the Lake Gibson intake. This was determined using the elevation of land as Allanburg stormwater is drained by open ditches.

The majority of the OPG Power Canal (Main Intake IPZ-1, Highway 406 Control Structure IPZ-1 and IPZ-2) is protected from northern flowing runoff through drains/culverts that discharge to Lake Gibson.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) tile drained area data (OMAFRA, 2009a) were reviewed and it was determined that one tile drained area exists partly within the IPZ-1 for the Main Intake. Detailed information on this tile drainage system was not available. It is assumed the tile drainage system follows the natural drainage of the land in this area. Therefore, the IPZ-1 for the DeCew Main Intake was not altered because of the tile drained area. No other tile drained areas were identified for inclusion in the IPZ-2 upland delineations.

Figure 7.7 illustrates the storm sewer network, the corresponding outfalls and the culverts described above.

TR 65(2)

7.2.4.5 Up-Tributary

Four un-named watercourses flow into the supply canal south of the OPG Diversion Structure (Figure 7.7). Ten un-named watercourses flow into Lake Gibson via culverts including Highway 406 drainage (Figure 7.7).

Cross sections were surveyed for the watercourses within the study area (Chambers and Associates, 2009). Using velocity and residual TOTs, the up-tributary distances for the watercourses were calculated. Where the calculated up-tributary extent of the watercourses exceeded the actual length of the tributary, the delineations were terminated at the headwaters of the watercourse with a circular cap radius of 120 m. Appropriate setback distances of 120 m or the Conservation Authority Regulation Limit were also applied around each watercourse. Where the topography indicated overland flow traveled away from a watercourse, the 120 m or the area of the Conservation Authority Regulation limit was truncated.

TR 72-75

Figures 7.2, 7.3 and 7.4 show the resulting IPZ-2 delineations (including in-water, upland and up-tributary components) for the Main Intake, Highway 406 Control Structure, and Lake Gibson Alternate Supply Intake, respectively.

7.2.5 Tertiary Zone (IPZ-3) Delineation

An IPZ-3 was delineated between Clarence Street in Port Colborne and the DeCew Falls Highway 406 Control Structure IPZ-2 according to Technical Rule 68, incorporating appropriate set-backs (Stantec Consulting Limited, 2012, and NPCA, 2013). The delineation is shown on Figure 7.8. Significant threat policies addressing diesel fuel storage, handling and transportation in the IPZ-3 also apply downstream in the IPZ-2 and IPZ-1 (where modelled) as attenuation of contaminants would be less. Significant threat policies also apply where modelled in the Lake Gibson Alternate Intake IPZ-2 and IPZ-1 as shown in Figure 7.9.

These delineations were based upon a combination of ten modelled scenarios of diesel spills from either Clarence Street (Port Colborne), Regional Road 3 (Port Colborne) or Highway 20 (Allanburg) exceeding the ODWQS for benzene at the Highway 406 or the Lake Gibson intakes. The scenarios included both summer and winter conditions, and spills of 1,000 and 10,000 litres. The most severe impacts to the intakes would be a winter 10,000 litre spill at Highway 20 (Allanburg). Modelled scenarios resulting in significant drinking water threat (SDWT) identification (i.e. benzene concentration that exceeded 5 µg/L at the intake) are summarized in Table 7.1.

Table 7.1: Summary of DeCew Falls SDWT Event-based Modelling			
Welland Canal Spill Location	**Spill Size (litres)**	**Season**	**Highway 406 Intake Concentration (µg/L)**
Clarence Street, Port Colborne	10,000	Winter	6-7
		Summer	5-6
Regional Road #3, Port Colborne	10,000	Winter	6-11
		Summer	5-10
Allanburg, Thorold	10,000*	Winter	230 (13-15 Lake Gibson Intake)
		Summer	200 (11-13 Lake Gibson Intake)
	1,000*	Winter	24
		Summer	20

Note: * - concentrations are sufficiently high for these scenarios as to also be applicable to a spill of gasoline (NPCA, 2013)

TR 68-70, 72-75, 130

7.3 Assignment of Vulnerability Scores

As described in Section 5.3, a vulnerability score must be determined for each IPZ to represent the susceptibility of the intake to contaminants. The vulnerability score is calculated using the area and source vulnerability factors using the methodology described in Section 5.3.

TR 8(2), 9(1)(c)(iv), 86-96

7.3.1 Area Vulnerability Factor

The TR prescribe an area vulnerability factor of 10 for the IPZ-1 of all intake types. Therefore, the IPZ-1 vulnerability factor for all three intakes is 10.

In the case of IPZ-2, the TR require that the area vulnerability factor be not less than 7 and not more than 9 (refer to Table 5.3).

TR 88-89

The establishment of area vulnerability factors for the IPZ-2 of each of the three DeCew intakes is summarized below.

An area vulnerability factor of 8 was determined for the Main Intake IPZ-2, as summarized in Table 7.2

An area vulnerability factor of 7 was determined for the Highway 406 Control Structure IPZ-2, as summarized in Table 7.3

Table 7.2: Main Intake IPZ-2 Area Vulnerability Factor		
Factor	**Description**	**Supports an Area Vulnerability Factor of :**
Percent Land	• 84% of the IPZ-2 is land	Moderate
Land Characteristics	• Low relief with slow infiltration rates • Majority of land cover is forest, agriculture, parks, mixed vegetation • Approximately 1% impervious	Low
Transport Pathways	• Three watercourses • Limited amount of overland flow	High
Overall Area Vulnerability Factor		**Moderate (=8)**

Table 7.3: Highway 406 Control Structure IPZ-2 Area Vulnerability Factor		
Factor	**Description**	**Supports an Area Vulnerability Factor of :**
Percent Land	• 90% of the IPZ-2 is land	High
Land Characteristics	• Slow drainage mitigated by bypass channels, drains and berms diverting runoff from source water • Approximately 11% impervious	Low
Transport Pathways	• Three watercourses • Limited amount of overland flow	Low
Overall Area Vulnerability Factor		**Low (=7)**

DeCew Lower Reservoir (looking west towards intake)

An area vulnerability factor of 8 was determined for the Lake Gibson IPZ-2 as summarized in Table 7.4 (below).

Table 7.4: Lake Gibson Alternate Supply IPZ-2 Area Vulnerability Factor		
Factor	**Description**	**Supports an Area Vulnerability Factor of :**
Percent Land	• 79% of the IPZ-2 is land	High
Land Characteristics	• Low relief with slow infiltration rates • Majority of land cover is agriculture, mixed vegetation or moderately developed • Approximately 8.5% impervious	Low to Moderate
Transport Pathways	• Four storm sewer outfalls • 30% of area is storm catchments • Eight water courses, numerous unnamed watercourses • Several ditches • Four culverts	High
Overall Area Vulnerability Factor		**Moderate (=8)**

7.3.2 Source Vulnerability Factor

The source vulnerability factor is based on intake properties. The TR require that the source vulnerability factor be between 0.7 to 0.9 for Type B intakes (refer to Table 5.3).

TR 95

The establishment of source vulnerability factors for the Main Intake, Highway 406 Control Structure and Lake Gibson Alternate Supply intake is summarized in Tables 7.5 to 7.7, respectively.

Table 7.5: DeCew WTP Main Intake Source Vulnerability Factor		
Factor	**Description**	**Supports a Source Vulnerability Factor of :**
Depth of intake	2.2 m below high water levels	High
Distance of intake from land	The Main Intake raw water reservoirs are protected from any local discharges in the area.	Low
Historical raw water quality concerns	Excellent historical raw water quality recorded at the intake.	Low
Overall Source Vulnerability Factor		**Moderate (=0.8)**

Table 7.6: Highway 406 Control Structure Source Vulnerability Factor		
Factor	**Description**	**Supports a Source Vulnerability Factor of :**
Depth of intake	The control structure is a weir gate on the west side of Highway 406. Based on the design of the structure there is a depth of zero.	High
Distance of intake from land	This is a diversion structure and length is not a feasible factor to consider.	N/A
Historical raw water quality concerns	Excellent historical raw water quality recorded at the Main Intake and inferred for this location.	Low
Overall Source Vulnerability Factor		**Moderate (=0.8)**

Table 7.7: Lake Gibson Alternate Supply Intake Source Vulnerability Factor		
Factor	**Description**	**Supports a Source Vulnerability Factor of :**
Depth of intake	4.9 m	Low
Distance of intake from land	Located through the berm separating Lake Gibson and the upper reservoir. There are no recorded shoreline influences within the area of the intake, however there are the influences resulting from the discharge of culverts along the south shore of Lake Gibson.	Moderate
Historical raw water quality concerns	Historical contamination of Lake Gibson.	Moderate
Overall Source Vulnerability Factor		**Moderate (=0.8)**

7.3.3 Overall Vulnerability Scores

The calculated vulnerability scores for each intake are summarized in Table 7.8.

Table 7.8: DeCew Falls WTP Vulnerability Score Summary					
Intake Type	**Area Vulnerability Factor (Vf_a)**		**Source Vulnerability Factor (Vf_s)**	**Vulnerability Score (V)**	
	IPZ-1	**IPZ-2**		**IPZ-1**	**IPZ-2**
Type B: **Main Intake**	10	8	0.8	10 x 0.8 = **8.0**	8 x 0.8 = **6.4**
Type B: **Highway 406 Control Structure**	10	7	0.8	10 x 0.8 = **8.0**	7 x 0.8 = **5.6**
Type B: **Lake Gibson**	10	8	0.8	10 x 0.8 = **8.0**	8 x 0.8 = **6.4**

7.4 Identification of Threats

Surface water quality threats are defined as activities or conditions that pose a potential risk to source water quality. Threats may be identified by an activity or condition. An activity is a land use; for example the storage, application or discharge of a substance including chemicals and pathogens. A condition is an existing situation as a result of a past activity; for example, contaminated sediment.

The TR require consideration of the following activities and conditions:

- Activities that are prescribed as drinking water threats in O.Reg. 287/07,
- Non-prescribed, locally based activities, and
- Conditions resulting from past land use activities.

The TR also allow for the identification of significant threats by way of the event-based modelling approach (which may result in mapping IPZ-3s).

Each of the above were evaluated and described in detail in Sections 7.4.1 through 7.4.3, respectively.

7.4.1 Prescribed Activities

Section 5.4.1 lists the activities that are prescribed as drinking water threats for a vulnerable area in paragraphs 1 through 18 and paragraph 21 of subsection 1.1(1) of O.Reg. 287/07.

TR 7(3), 118

To determine the number of activities that constitute significant, moderate or low drinking water threats (if they were to occur) within the DeCew Falls IPZs, the Tables of Drinking Water Threats (TDWT) were truncated by vulnerability score, as described in Section 5.4.1. Table 7.9 provides Appendix reference numbers for the Provincial Tables of Circumstances corresponding with significant, moderate and low threats for each IPZ (both chemical and pathogen).

Lake Gibson (looking northwest)

Table 7.9: DeCew Falls WTP References for Provincial Tables of Circumstances							
IPZ	**Vulnerability Score**	**Provincial Table Reference - Chemical Threats**			**Provincial Table Reference - Pathogen Threats**		
		Sig.	**Mod.**	**Low**	**Sig.**	**Mod.**	**Low**
Main, Highway 406 and Lake Gibson							
1	8.0	Appendix C.3	Appendix C.6	Appendix C.11	Appendix C.17	Appendix C.20	Appendix C.25
Main							
2	6.4	--	Appendix C.8	Appendix C.13	--	Appendix C.22	Appendix C.27
Highway 406							
2	5.6	--	--	Appendix C.14	--	--	Appendix C.28
Lake Gibson							
2	6.4	--	Appendix C.8	Appendix C.13	--	Appendix C.22	Appendix C.27

There are no potential significant threats in the IPZ-2s because of their low vulnerability scores.

TR 118.1

Figure 7.8 illustrates areas where activities are or would be significant, moderate or low drinking water quality threats. This figure should be viewed in conjunction with the appendices referenced in Table 7.9 to determine specific activities within an IPZ that would be significant, moderate or low drinking water quality threats. For example, if one wants to determine activities that would be moderate threats within Lake Gibson's IPZ-2, one should reference Appendices C.8 and C.22.

TR 8(4), 9(1)(c)(ix), 127-129, 132-137

7.4.2 Non-Prescribed Activities

The NPSPC has included additional (locally based) activities other than those already identified as prescribed threats (Section 5.4.2).

Moderate transportation threats were enumerated by cross-referencing the intake vulnerability scores with Table 1 (Appendix E, MOE letter May, 2011) and then

identifying roads, railways and marine transport pathways within the IPZ where these transport corridors could be significant or moderate threats (Stantec Consulting Limited, 2010).

Table 7.10: DeCew Falls WTP Reference for Non-Prescribed (Transportation) Activities

IPZ	Vulnerability Score	Appendix E - Chemical Threats			Appendix E - Pathogen Threats		
		Sig.	Mod.	Low	Sig.	Mod.	Low
1	8.0	--	Table 1		--	Table 1	
Main, Highway 406 and Lake Gibson							
2	6.4,5.6,6.4	--	--	Table 1	--	--	Table 1

TR 7(3), 119-122, 125

7.4.3 Conditions

The TR state that conditions may exist in a vulnerable area if the presence of a single mass of more than 100 litres of dense non-aqueous phase liquids occurs in the surface water of an IPZ and/or if there is the presence of a contaminant in the surface soil or sediment.

TR 126

A sediment quality analysis was undertaken by OPG (BOS Engineering and Environmental Services, 2001) and included sediment sampling locations within the Lake Gibson Alternate Intake IPZ-1, IPZ-2, and the Highway 406 Control Structure IPZ-2. The available sediment data were compared with the Table 4 Soil Standards (MOE, 2008b). MOE approved the comparison to Soil Standards instead of sediment criteria because the soil standards are based on human health considerations whereas the sediment criteria are based on ecological considerations. (The MOE letter is provided in Appendix E.)

Within the Lake Gibson Alternate Supply IPZ-2, sediment parameters were present at concentrations above the MOE soil standards for petroleum hydrocarbons and beryllium and are therefore conditions. These conditions are assigned a hazard rating of 6. This is because (i) there is no evidence of off-site contamination and (ii) the conditions are not located at the intake parcel.

The above listed conditions occur within the Lake Gibson Alternate Intake IPZ-2 vulnerable area. Therefore, using a hazard rating of 6 and vulnerability score of 6.4, the sediment conditions have risk scores of 38.4, and are not considered threats.

As described in Section 5.4.3, a condition is determined to represent a significant threat if it has a risk score greater than 80, a moderate threat for scores between 60 and 80 and a low threat for scores between 40 and 60. A condition is also considered significant if it is associated with a drinking water quality issue or if there is evidence that it may be causing off-site contamination.

The following contaminated sites registries were also reviewed to assist with further identification of conditions within the WTP vulnerable area:

- Provincial Brownfield Sites Registry (MOE, 2009c);
- Federal Contaminated Sites Inventory (TBCS, 2009);
- MOE IPZ-1 Threats Database for Niagara Region (MOE, 2009d);
- MOE Spills Database for Niagara Region (WHI, 2005);
- Brownfield site GIS layer (NPCA, 2009c); and
- Closed landfill GIS layer (WHI, 2005).

After reviewing the available data sources listed above, no additional conditions were identified that result from past activities.

As no sediment sampling data was available for the reservoirs and only limited sampling results were available in the vulnerable areas, additional soil and sediment data are noted as a future consideration in Section 5.9.

TR 7(4), 9(3)(c), 126, 139

7.4.4 Significant Threats Identified by Event-based Modelling

Significant threats were enumerated during the Event-Based Modelling process when contaminant concentrations (i.e. benzene) that were modelled exceeding the Maximum Acceptable Criteria (MAC) drinking water criteria at either the Highway 406 or Lake Gibson intakes (Section 7.2.1). However significant diesel fuel threats were not identified for the DeCew Falls Main Intake primarily because of the pre-treatment effect of the three DeCew Falls Reservoirs.

TR 68-70, 72-75, 130

7.5 Enumeration/Listing of Existing Threats

The TR require the enumeration/listing of locations at which:

- A person is engaging in an activity that is or would be a <u>significant</u> threat; and
- A condition resulting from a past activity is a <u>significant</u> drinking water threat.

TR 9(1)(e) and (f)

Existing moderate drinking water threats have also been enumerated as these may be addressed in the Source Protection Plan. Enumeration of each of these threat types is described in further detail in Sections 7.5.1 and 7.5.2.

7.5.1 Activities

As described in Section 5.5, land use information and other data were obtained from various sources and compared with threat circumstances from the TDWT to determine existing threats within each IPZ (refer to Appendix C).

For this analysis, existing threats are defined as activities that could occur because infrastructure is in place. For example if there are two livestock enterprises in operation and a third has an empty barn with no livestock, then three livestock enterprises are counted because the third barn could have livestock brought in the next day.

Based on this analysis, three significant threats were found to exist within the Main Intake IPZ-1, three significant threats within the Lake Gibson IPZ-1, and two significant threats within the Highway 406 Control Structure IPZ-1. The enumeration of activities that are or would be significant threats is summarized in Table 7.11.

Table 7.11: Enumeration of Locations At Which A Person is Engaging in An Activity That is Or Would Be A Significant Threat

Main Intake IPZ-1	Highway 406 Control Structure IPZ-1	Lake Gibson IPZ-1
3	2	3
3. Application of agricultural source material to land (TDWT Circumstance 1944) 4. Storage of agricultural source material (TDWT Circumstance 1962/1964) 21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm animal yard (TDWT Circumstance 1945/1946)		

The five (5) circumstances listed in Table 7.11 (1944, 1962, 1964, 1945 and 1946) apply to each parcel and refer to the potential presence of pathogens in surface water from threat categories 3, 4 or 21. For additional explanations of individual circumstances please refer to the appropriate Provincial Table of Circumstances (refer to Table 7.8).

Twenty-three (23) moderate threat locations/parcels were identified in the Main Intake IPZ-1, twenty-two (22) in the Lake Gibson Alternate Intake IPZ-1, thirteen (13) in the Highway 406 Control Structure IPZ-1, six (6) in the Main Intake IPZ-2 and one hundred and twenty-nine (129) in the Lake Gibson Alternate Intake IPZ-2, as shown in Table 7.12.

Table 7.12: Enumeration of Locations At Which A Person is Engaging in An Activity That is Or Would Be A Moderate Threat		
Activities	TDWT Circumstances	Number - Count
		Main Intake IPZ-1
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	1956, 1957	1
4. Storage of agricultural source material	1201, 1202	3
9. Handling and storage of commercial fertilizer	1287, 1288	3
10. Application of pesticide to land	66-76	2
	77-87	1
11. Handling and storage of pesticide	1190-1200	3
12. Application of road salt	92, 93	3
15. Handling and storage of fuel	177-181	4
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	200, 201	3
		Lake Gibson Alternate Intake IPZ-1
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	1956, 1957	1
4. Storage of agricultural source material	1201, 1202	3
9. Handling and storage of commercial fertilizer	1287, 1288	3
10. Application of pesticide to land	77-87	3
11. Handling and storage of pesticide	1190-1200	3
12. Application of road salt	90, 91	1
	92, 93	2
15. Handling and storage of fuel	177-181	3
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	200, 201	3
		Hwy 406 Control Structure IPZ-1
4. Storage of agricultural source material	1201, 1202	2
9. Handling and storage of commercial fertilizer	1287, 1288	2
10. Application of pesticide to land	77-87	2
11. Handling and storage of pesticide	1190-1200	2
12. Application of road salt	92, 93	1
15. Handling and storage of fuel	177-181	2
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	200, 201	2
		Lake Gibson Alternate Intake IPZ-2
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	570-629	1
	1948, 771-782	2
3. Application of agricultural source material to land	1944	37
4. Storage of agricultural source material	1962, 1964	37
10. Application of pesticide to land	82, 84	15
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	1945, 1946	37
		Main Intake IPZ-2
3. Application of agricultural source material to land	1944	2
4. Storage of agricultural source material	1962, 1964	2
21. Use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard	1945,1946	2

7.5.2 Conditions

As described in Section 7.4.3, two parameters were identified as conditions resulting from past activities in the Lake Gibson Alternate Intake IPZ-2. However, their risk scores are below 40 and they are not considered threats. Therefore, no conditions represent a significant drinking water threat.

7.5.3 Non-Prescribed Activities

Moderate chemical and pathogen roadway transportation threats were enumerated for the DeCew Falls Main, Highway 406 and Lake Gibson IPZ-1s corridor threats as shown on Figures 7.11, 7.12 and 7.13 (Note: the DeCew Falls IPZ-2s cannot have significant or moderate local transportation threats as their vulnerability scores are less than 7). Marine and rail transport corridors are not present in the DeCew Falls IPZ-1s. The transportation threat type counts per category, per individual IPZ-1, are presented below (Table 7.13). This analysis is similar to the TDWTs analysis, as threats were identified (based upon the vulnerability score) and where a roadway exists which could allow these materials to be transported.

Table 7.13 Moderate DeCew Falls Main, Highway 406 and Lake Gibson IPZ-1 Transportation Threats	
Chemical Threats	
Organic Solvents	3
DNAPLS	4
Fuels	2
Pesticides/Herbicides	9
Other Chemicals	15
Agricultural Source Material	2
Non-Agricultural Source Material – Sewage Biosolids	2
Non-Agricultural Source Material – Pulp and Paper Waste	2
Pathogen Threats	
Agricultural Source Material	1
Non-Agricultural Source Material – Sewage Biosolids	1
Non-Agricultural Source Material – Pulp and Paper Waste	0

7.5.4 Significant Threats Identified by Event-Based Modelling (EBM)

Diesel handling, storage and transportation of 10,000 L or greater are enumerated as significant drinking water threats (SDWTs) along the Welland Canal from the Clarence Street Refueling Station (Port Colborne) to the Decew Falls Highway 406 intake (Figure 7.8). Diesel fuel along these waterways was identified as a SDWT from three locations. From upstream to downstream these are (i) Clarence Street, Port Colborne, (ii) Highway 3, Port Colborne and (iii) Highway 20 in Allanburg, Thorold (see Section 7.2.5 for more detail). Spills from these locations have been modelled (Stantec

Consulting Limited, 2012 and NPCA, 2013) and the activities at these locations deemed to be SDWT. The area that is subject to source protection policies has been extended beyond the IPZ-3 (Figure 7.8). This is because a spill within the IPZ-2 or IPZ-1 would result in similar or greater benzene concentration than in Table 7.1 due to the flow characteristics and behaviour of a one direction water system. These activities are significant threats in the IPZ-3 and downstream in the IPZ-2 and IPZ-1 (where contaminant attenuation would be less). Diesel/gasoline handling, storage and transportation of 1,000 L or greater is also a SDWT from Highway 20 (Allanburg) for the Highway 406 intake.

Diesel/gasoline handling, storage and transportation of 10,000 L or greater are also SDWTs for modelled portions of the Lake Gibson Alternate intake IPZ-2 and IPZ-1 (Figure 7.9). Spills from the Allanburg/Highway 20 Welland Canal area have been modelled (Stantec Consulting Limited, 2012 and NPCA, 2013) and the activities at this location deemed to be SDWT. The area that is subject to source protection policies only includes portions of the IPZ-2 and IPZ-1. This is because a spill within the hatched areas would result in similar or greater benzene concentrations than in Table 7.1 due to the flow characteristics and behaviour of a one direction water system. Two flow regimes of the IPZ-2 area are not yet included in the event-based modelled area; (i) drainage from south of the water supply canal through slue drains to Lake Gibson and (ii) the northeastern portion of Lake Gibson. However these may be included in a future update.

Diesel/gasoline handling, storage and transportation activities are elevated from moderate or low threat status (based on either the TDWT or Table 1 – Appendix E) to significant as EBM identified the activity as having a potential to degrade the water quality at the intake (Stantec Consulting Limited, 2012 and NPCA, 2013).

7.6 Evaluation of Drinking Water Quality Issues

To determine if any drinking water issues exist, the methodology described in Section 5.6 was applied for the DeCew Falls WTP raw water quality data.

1. **Collect raw water quality data**
   Drinking Water Information System (DWIS) data for the years 2003-2008 and Drinking Water Surveillance Program (DWSP) data for the years 1990-2007 was collected from the MOE for the DeCew Falls WTP main intake. Data was unavailable for the Highway 406 Control Structure or the Lake Gibson Alternate Supply intake. These have been listed as a future consideration in Section 5.9. Although the raw water at the Highway 406 Control Structure may be similar to the Main Intake, in order to describe a drinking water issue at an intake, the Technical Rules require the raw water sampling to occur at the specific intake. Based on this information any preliminary issues identified will be restricted to the area of the Main Intake.

2. **Establish issues benchmarks**
   Issues benchmarks established by the NPSPC are listed in Table 5.7.

3. **Identify "parameters of interest"**
   As described in Section 5.6, parameters of interest are those that consistently measure above 10% of their regulatory criteria and often above 25%. The following parameters of interest were identified were identified for the DeCew Falls WTP intake:
   - Aluminum;
   - Colour;
   - Hardness;
   - Iron;
   - Organic Nitrogen;
   - Temperature; and
   - Turbidity.

4. **Identify "potential water quality issues"**
   Parameters of interest were plotted and analyzed to determine if they were regularly present at their benchmark values and/or trending upwards toward their benchmarks. Based on an analysis of the above parameters of interest, only six non health related potential water quality issues were identified for the DeCew Falls WTP vulnerable area. Colour was identified based upon several values above the benchmark and an increasing trend. Aluminum, temperature and turbidity were identified as potential water quality issues based on several concentrations above the benchmark. Finally, hardness and organic nitrogen were identified due to consistent concentrations above the benchmark.

5. **Identify "issues"**
   The potential water quality issues were further evaluated to determine if they are directly related to human health considerations and/or can be attributed to artificial source(s). It was found that none of the potential water quality issues are directly related to human health considerations. Furthermore, aluminum, colour, hardness, temperature and turbidity have been attributed to naturally occurring processes and characteristics. For these reasons, these parameters are not considered drinking water quality issues.

   In the case of organic nitrogen, the information available does not clearly indicate an absolute source(s) and therefore further investigation should be undertaken. Information related to the source(s) of organic nitrogen is identified as an item for future consideration in Section 5.9.

In summary, no water quality issues were identified for the DeCew Falls WTP main intake. The high quality of raw water received at the DeCew Falls WTP combined with its diligent operation ensures a safe supply of treated drinking water.

TR 6, 9(1)(c)(xii), 114-115, 131, 134.1

7.7 Evaluation of Uncertainty

The TR require a description of every uncertainty analysis conducted as part of the surface water quality assessment.

TR 9(2)(f), 13-14

Descriptions of the sources of uncertainty considered for each major task are outlined in Table 7.14. As indicated the overall level of uncertainty for the DeCew Falls WTP surface water vulnerability assessment is low.

Table 7.14: Evaluation of Sources of Uncertainty for DeCew Falls WTP

Task	Description of Uncertainty	Uncertainty
Section 7.1: Classification of Intake		
Intake classification	TR prescribe the Welland Canal to be a Connecting Channel	Low
Section 7.2: Delineation of IPZs		
IPZ-1 Delineation	Dimensions for the IPZ-1 delineation are prescribed by the TR. Abutted shore setbacks were determined using the topographic surface and area of the Conservation Authority Regulation Limit, both of which were provided by the NPCA and have low uncertainty associated with their accuracy.	Low
IPZ-2 Delineation	Data acquired for modelling was of sufficient quality to conceptualize the in-water IPZ-2. Maps of storm sewer catchments, networks, outfalls, and the topographic surface were also considered to be of sufficient quality.	Low
IPZ-3 Delineation	While there was reliable flow and water level data for the steady-state systems, information on Lake Gibson bathymetry was limited and wind effects were not modelled for these evaluations.	High
Section 7.3: Assignment of Vulnerability Scores		
Vulnerability Scores	Data contributing to the area and source vulnerability factors are from reliable provincial and federal monitoring programs, Niagara Region Water Operations staff, and City of Thorold staff.	Low
Section 7.4: Identification of Threats		
EBM Significant Threats	Uncertainty of the results may exceed +/- 50% if uncertainties are combined. Although some scenarios identified impacts over 40x the ODWQS (giving high confidence) many others were fairly close to the MAC.	High
Section 7.5: Enumeration/Listing of Existing Threats		
Identification of Land Use	The data used to find specific parcels were provided by government resources and were of a sufficient quality.	Low

Table 7.14: Evaluation of Sources of Uncertainty for DeCew Falls WTP		
Task	Description of Uncertainty	Uncertainty
Activities	Multiple resources were used to identify the land use activities present on parcels within the vulnerable areas. The quality and quantity of these resources was also sufficient.	
Section 7.6: Evaluation of Issues		
Issues Evaluation	The issues evaluation was based upon raw water quality data provided by the MOE. The data spanned 17 years; however, the frequency of sampling for each parameter varied. The methodology was tailored to suit the quality and quantity of available data and was appropriate for the issues evaluation.	Low