8. PORT COLBORNE WATER TREATMENT PLANT

The Port Colborne Water Treatment Plant (WTP) is located in Port Colborne, Ontario and obtains raw water from Lake Erie via the Welland Canal. With a total capacity of 36 million litres per day, the plant services a population of approximately 15,000 in the City of Port Colborne. A map showing the local setting of the Port Colborne WTP and its intake is shown in Figure 8.1.

A surface water vulnerable area and water quality threats assessment has been completed for the Port Colborne WTP intake. The methodology used for this assessment is described in Chapter 5 and specific results are outlined in Sections 8.1 through 8.7. Data sources used for each task are listed in Appendix B.

8.1 Classification of Intake

According the Ministry of Environment (MOE) Assessment Report Technical Rules (TR), the Welland Canal is defined as a Great Lakes Connecting Channel. Therefore, the Port Colborne WTP intake is classified as **Type B – Connecting Channel**.

TR 55 TR 1(1)

8.2 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.

8.2.1 Primary Zone (IPZ-1) Delineation

The IPZ-1 (Figure 8.2) for the Port Colborne WTP was delineated in accordance with the TR. The resulting IPZ-1 extends 100 m downstream (north), 1,000 m upstream (south) and includes the width of the canal and appropriate setbacks.

The setbacks were identified using topography to indicate that the slope of the land increases near the banks of the Welland Canal. This was considered the limit of the area that may contribute overland flow directly to the Welland Canal and therefore the IPZ-1 upland extent terminates along this height of land along either side of the Welland Canal within the setback requirements.

TR 61-64

8.2.2 Secondary Zone (IPZ-2) Delineation

The IPZ-2 (Figure 8.2) for the Port Colborne WTP was delineated in three components: in-water, upland, and up-tributary. The development of each of these components is described in further detail below.

8.2.2.1 In-water

The in-water component of IPZ-2 was established using two moderately conservative analyses to determine the 2-hour Time Of Travel (TOT). The two analyses were conducted with the hydraulic flow models HEC-RAS™ and ECOMSED™. The conservative modelled flow conditions were of low stage combined with 10-year peak flow.

The results of the in-water modelling are shown in Figure 8.3. As can be observed from Figure 8.3, with a 2-hour time of travel, the in-water component of IPZ-2 extends approximately 2,060 m southward (upstream to Lake Erie) and 120 m northward (downstream) from the intake. An allowance was made in the modelling for ship induced currents.

TR 65-66

8.2.2.2 Upland – Transport Pathways

The Conservation Authority Regulation Limit does not apply to the federally-administered Welland Canal (refer to Figure 2.12). Consequently, the upland IPZ-2 along the Welland Canal defaults to the required setback distance of 120 m off each bank. In addition to these setbacks, the upland extent is also affected by transport pathways such as storm sewersheds.

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 IPZ-2 includes the following seven Port Colborne storm sewer catchment areas:

Princess Street	Victoria Street	Charlotte Street	Kent Street
Elm Street	Nickel Street	Rodney Street	

These catchment areas are drained by six storm sewer outfalls which discharge into the IPZ-1 upstream of the intake, as illustrated in Figure 8.4. The catchment extents were identified in concert with City of Port Colborne staff from a consideration of land elevation and the storm sewer network.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) tile drained area data (OMAFRA, 2009a) were reviewed and it was determined that no tile drains exist along the extents of watercourses delineated in the up-tributary analysis, or along the shoreline. Therefore tile drained areas were not included in the upland delineation.

TR 65(2)

8.2.2.3 Up-Tributary

No natural watercourses discharge to the Welland Canal within the Port Colborne WTP IPZ-2. Therefore, no further transport pathways were included in the IPZ-2 delineation.

TR 72-75

8.2.3 Tertiary Zone (IPZ-3) Delineation

An IPZ-3 was delineated for the Port Colborne intake according to Technical Rule 68, incorporating appropriate set-backs (Stantec Consulting Limited, 2012, and NPCA, 2013). The contaminant was modelled from the spill location at the Clarence Street fueling station inside the IPZ-1 to the intake. An IPZ-3 was delineated (Figure 8.5) where the event-based modelling showed the contaminant would travel outside the IPZ-1 on its way to the intake (TR 68(1) and 75). Significant threat policies addressing diesel fuel storage, handling and transportation in the IPZ-3 also apply upstream in the IPZ-1 (where modelled).

This delineation was based upon a series of modelled scenarios of diesel spills from the Clarence Street Fueling Station. The analysis was conducted with the hydraulic flow model ECOMSED. This included replicating the June 2010 actual spill when benzene was not detected at the intake. The modelling demonstrated that the water quality would exceed the ODWQS for benzene at the Port Colborne intake under certain specific scenarios (i.e. winter 10,000 Litre diesel spills). The modelled scenarios included both summer and winter conditions, wind effects and spills of 1,000 and 10,000 Litres. Modelled scenarios resulting in significant drinking water threat (SDWT) identification (i.e. benzene concentration exceeded 5 µg/L at the intake) are summarized in Table 8.1.

Table 8.1: Summary of Port Colborne SDWT Event-based Modelling

Welland Canal Spill Location	Spill Size (litres)	Flow (m^3/s)	Season	Wind (m/s, direction)	Intake Concentration (µg/L)
Clarence Street, Port Colborne	10,000*	281	Winter	14 E	8
		125-150 becoming 0 from canal shutdown		4 N	6
				4.5 NNE	7
				5.5 E	12

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

TR 68-70, 72-75, 130

8.3 Assignment of Vulnerability Scores

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

8.3.1 Area Vulnerability Factor

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

An area vulnerability factor of 9 was determined for the Port Colborne IPZ-2 as summarized in Table 8.1.

Table 8.2: Port Colborne WTP IPZ-2 Area Vulnerability Factor

Factor	Description	Supports an Area Vulnerability Factor of :
Percent Land	• 82% of the IPZ-2 is land	High
Land Characteristics	• Poor drainage • Approximately 79% impervious	High
Transport Pathways	• Six storm sewer outfalls • Three sanitary sewage pumping stations • City streets, bridges, and Welland Canal	High
Overall Area Vulnerability Factor		**High (=9)**

8.3.2 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

A source vulnerability factor of 0.9 was determined for the Port Colborne intake as summarized in Table 8.3.

Table 8.3: Port Colborne WTP Source Vulnerability Factor

Factor	Description	Supports a Source Vulnerability Factor of :
Depth of intake	2.0 m average intake depth	High
Distance of intake from land	The intake does not extend to the Welland canal and cannot be extended due to shipping lanes	High
Historical raw water quality concerns	Historical data suggests occasional elevated microbial concentrations	Moderate to High
Overall Source Vulnerability Factor		**High (=0.9)**

8.3.3 Overall Vulnerability Scores

The calculated vulnerability score was determined to be 9.0 for IPZ-1 and 8.1 for IPZ-2. These results are summarized in Table 8.4.

Table 8.4: Port Colborne 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	10	9	0.9	10 x 0.9 = **9.0**	9 x 0.9 = **8.1**

8.4 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 process (which may result in mapping IPZ-3s).

Each of the above were evaluated and described in detail in Sections 8.4.1 through 8.4.3, respectively.

8.4.1 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 Port Colborne IPZs, the Tables of Drinking Water Threats (TDWT) were truncated by vulnerability score, as described in Section 5.4.1. Table 8.5 provides Appendix reference numbers for the Provincial Tables of Circumstances corresponding with significant, moderate and low threats for each IPZ (both chemical and pathogen.

Table 8.5: Port Colborne 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**
1	9.0	Appendix C.1	Appendix C.4	Appendix C.9	Appendix C.15	Appendix C.18	Appendix C.23
2	8.1	Appendix C.2	Appendix C.5	Appendix C.10	Appendix C.16	Appendix C.19	Appendix C.24

TR 118.1

Figure 8.5 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 8.5 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 Port Colborne's IPZ-1, one should reference Appendices C.4 and C.18.

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

8.4.2 Non-Prescribed Activities

The NPSPC has included additional (locally based) activities other than those already identified as prescribed threats (Section 5.4.2). Significant and moderate transportation threats were enumerated by cross-referencing the intake zone vulnerability scores with Table 1 (Appendix E, MOE letter May, 2011) and then identifying roads, railways and marine transport pathways within the IPZs where these transport corridors could be significant or moderate threats (Stantec Consulting Limited, 2010).

Table 8.6: Port Colborne 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	9.0	--	Table 1		Table 1		
2	8.1	--					

TR 7(3), 119-122, 125

8.4.3 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

The following contaminated sites registries and reports were reviewed to assist the 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);
- Closed landfill GIS layer (WHI, 2005);
- Soil Investigation and Human Health Risk Assessment for the Rodney Street Community, Port Colborne (MOE, 2002); and
- INCO 2004 Social Responsibility Report (INCO, 2004).

After reviewing the available data sources listed above, no conditions were identified that result from past activities. For example, the Soil Investigation and Human Health Risk Assessment (MOE, 2002) for the Rodney Street Community did identify properties with elevated nickel levels. However, all properties were remediated by 2005 (INCO, 2004). Therefore these sites are not identified as conditions. For this report, if contaminated sediments were identified in an IPZ, they were compared to MOE Soil Standards instead of sediment criteria because Soil Standards are based on human health considerations whereas the sediment criteria is based on ecological considerations. (See MOE letter dated June 21, 2010 in Appendix E).

The collection of additional soil and sediment data is noted as a future consideration in Section 5.9.

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

8.4.4 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 the Port Colborne intake (Section 8.2.1).

TR 68-70, 72-75, 130

8.5 Enumeration/Listing of Existing Threats

The TR require the enumeration of locations at which:

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

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

Existing moderate 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 8.5.1 and 8.5.2.

8.5.1 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.

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, no significant threats were found to exist within Port Colborne's IPZ-1 and IPZ-2. Thirty-seven (37) moderate threat locations/parcels were identified in the IPZ-1 and twenty-seven (27) locations/parcels in the IPZ-2, as shown below in Table 8.7.

The number count per TDWT circumstance indicates the number of parcels within the individual IPZ for which the activity or activities and/or its potential existence has been identified. For example, one parcel has been identified within the IPZ-1 for two TDWT circumstances related to threat category 2: 506 and 1951. Circumstance 506 refers to the potential discharge of aluminum from a National Pollutant Release Inventory (NPRI) reporting facility that collects, transmits or treats industrial sewage. While circumstance 1951 refers to the potential discharge of pathogens to surface water from that same facility. For additional explanations of individual circumstances please refer to the appropriate Provincial Table of Circumstances in Appendix C (refer to Table 8.4).

Table 8.7: Enumeration of Locations At Which A Person is Engaging in An Activity That is Or Would Be A Moderate Threat		
Threat Category	TDWT Circumstances	Number - Count
		Port Colborne IPZ-1
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	506, 1951	1
	505-567	3
	315-333	6
	1958	1
8. Application of commercial fertilizer to land	19, 20	6
12. Application of road salt	92, 93	10
13. Handling and storage of road salt	1439, 1440	1
15. Handling and storage of fuel	157-161	1
	177-181	6
16. Handling and storage of dense non-aqueous phase liquid	107-111	2
		Port Colborne IPZ-2
2. The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage	507	2
	505-567	1
12. Application of road salt	92, 93	1
13. Handling and storage of road salt	1441, 1442	1
15. Handling and storage of fuel	177-181	9
16. Handling and storage of dense non-aqueous phase liquid	107-111	12
17. Handling and storage of an organic solvent	1261-1264	1

8.5.2 Conditions

As described in Section 8.4.3, no conditions were identified that result from past activities. Therefore, no conditions represent a significant drinking water threat.

8.5.3 Non-Prescribed Activities

Significant and moderate chemical and pathogen roadway, rail and marine transportation threats were enumerated for the Port Colborne IPZ-1 and IPZ-2 corridor threats as shown on Figure 8.7.

Two transportation threats were enumerated as possible significant pathogen threats in the Port Colborne IPZ-1 as listed in Table 8.8. The transportation corridors where these activities could occur are shown in Figure 8.7

Table 8.8 Significant Port Colborne IPZ-1 Transportation Threats	
	IPZ-1
Pathogen Threats	
Agricultural Source Material	1
Non-Agricultural Source Material – Sewage Biosolids	1

Table 8.9 lists the moderate transportation threat type counts per category, per IPZ-1. This analysis is similar to the TDWTs analysis, as threats were identified (based upon the vulnerability score) and where a transportation corridor (road, rail, marine) exists which could allow these materials to be transported.

Table 8.9 Moderate Port Colborne IPZ-1/IPZ-2 Transportation Threats		
	IPZ-1	**IPZ-2**
Chemical Threats		
Organic Solvents	5	4
DNAPLS	9	6
Fuels	7	4
Pesticides/Herbicides	21	12
Other Chemicals	28	18
Agricultural Source Material	4	2
Non-Agricultural Source Material – Sewage Biosolids	4	2
Non-Agricultural Source Material – Pulp and Paper Waste	4	2
Pathogen Threats		
Agricultural Source Material	*	1
Non-Agricultural Source Material – Sewage Biosolids	*	1
Non-Agricultural Source Material – Pulp and Paper Waste	-	-

* - These are IPZ-1 significant pathogen threats as noted above

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

Diesel/gasoline handling, storage and transportation of 10,000 L or greater are enumerated as significant threats along the Welland Canal from Clarence Street (Port Colborne) to the WTP intake (Figure 8.5) both in the IPZ-3 and in the upstream portions of the IPZ-1 where modelled.

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).

8.6 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 Port Colborne 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 Port Colborne WTP 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 value and often above 25%. The following parameters of interest were identified were identified for the Port Colborne WTP intake:
   - Colour;
   - Temperature;
   - Turbidity
   - Aluminum;
   - Hardness;
   - pH; and
   - Organic nitrogen.

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 three non health related potential water quality issues were identified for the Port Colborne WTP vulnerable area. Turbidity was identified due to several samples recorded above the issues benchmark (Table 5.7). Hardness and organic nitrogen were also identified as potential water quality issues because of 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, turbidity and hardness have been attributed to naturally occurring processes and characteristics. For these reasons, turbidity and hardness 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 Port Colborne WTP IPZs. The high quality of raw water received at the Port Colborne 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

8.7 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 8.10. As indicated in Table 8.10, the overall level of uncertainty for the Port Colborne WTP surface water vulnerability assessment is low.

Table 8.10: Evaluation of Sources of Uncertainty for Port Colborne WTP

Task	Description of Uncertainty	Uncertainty
Section 8.1: Classification of Intake		
Intake classification	TR prescribe the Welland Canal to be a Connecting Channel	Low
Section 8.2: 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 provided by the NPCA and have low uncertainty associated with the accuracy of the information.	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 topography were also considered to be of sufficient quality.	Low
IPZ-3 Delineation	Data included reliable flow and water level data for the steady-state system and an actual spill event to verify modelling information including wind effects.	Low
Section 8.3: 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 Port Colborne staff.	Low

Table 8.10: Evaluation of Sources of Uncertainty for Port Colborne WTP		
Task	Description of Uncertainty	Uncertainty
Section 8.4: Identification of Threats		
EBM Significant Threats	Uncertainty of results estimated as +/- 50%, however even a 50% reduction in modelled results exceed the MAC at the intake making the uncertainty of diesel fuel being a significant threat low.	Low
Section 8.5: Enumeration/Listing of Existing Threats		
Identification of Land Use Activities	The data used to find specific parcels were provided by government resources and were of a sufficient quality. 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.	Low
Section 8.6: 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

Welland Canal in Port Colborne (looking upstream / to the south)