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North Bay-Mattawa Conservation Authority

Surface Water Vulnerability Study for the Village of South River Drinking Water Intake

Prepared by:

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Project Number:

113616

Date:

January 6, 2010

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January 6, 2010 Project Number: 113616

Sue Miller
Manager, Source Protection
North Bay - Mattawa Conservation Authority
15 Janey Avenue
North Bay, ON P1C 1N1

Dear Ms. Miller:

Re: Surface Water Vulnerability Study for the Village of South River Drinking Water Intake

I am pleased to submit this final report that provides technical input for Drinking Water Source Protection for the Village of South River municipal drinking water intake under the *Clean Water Act, 2006*. This report has been revised from its draft version (dated October 28, 2009) to address comments received from the Technical Advisory Committee and recent changes to the MOE's Technical Rules: Assessment Report (November 20, 2008) as amended November 16, 2009 (EBR Posting Number EBRO10-7573) and including updates to the MOE's drinking water threats tables (Microsoft Access database, Threats_LUT_v7.1.2).

This report provides the necessary technical information for the completion of an Assessment Report for the following components of Drinking Water Source Protection Planning:

- Part VI – Delineation of Vulnerable Areas: Surface Water Intake Protection Zones
- Part VIII - Vulnerability: Surface Water Intake Protection Zones
- Part XI – Drinking Water Threats: Water Quality
- Part I.4 – Uncertainty Analysis – Water Quality

It has been a pleasure assisting the North Bay-Mattawa Conservation Authority with this study and I wish the CA the best of luck with upcoming phases of Source Protection Planning for the Village of South River drinking water intake.

Please do not hesitate to contact me if you have any questions or concerns.

Sincerely,
AECOM Canada Ltd.

Tammy Karst-Riddoch, Ph.D.
Tammy.Karst@aecom.com

TKR :tkr
Encl.

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	TKR	6-Jan-10	Address comments from the Technical Advisory Committee, public consultation, and Mr. G. Thornborrow (OCWA); updates following amendments to the Technical Rules of November 16, 2009 and changes to the threats database (version 7.1.2)

Signature Page

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1. Introduction

As part of its strategy to protect Ontario's drinking water from source to tap, the Ontario government has released legislation under the *Clean Water Act* (2006) requiring the creation of source protection plans for all municipal drinking water sources. These plans identify potential risks to drinking water quality and supply, and provide strategies to reduce or eliminate these risks.

A key part of the source protection planning process is the development of an Assessment Report. The purpose of the Assessment Report is to identify and assess risks to the quality and quantity of municipal drinking water sources using a science-based watershed approach. Technical requirements for the Assessment Report are set out in the Assessment Report: Technical Rules (November 20th, 2008; amended December 12th, 2008 and November 16th, 2009) under section 107 of the *Clean Water Act* (2006) (herein called the 'Rules').

This report provides technical information for the surface water vulnerability assessment components of the Assessment Report for the Village of South River drinking water intake in the South River Reservoir.

2. Water Treatment Plant and Intake Characteristics

The South River water treatment plant (WTP) (Certificate of Approval – Amended # 7257-6TRPD4, October 25, 2006) is located at 28 Howard Street in the Village of South River. It is owned by the village and operated by the Ontario Clean Water Agency (OCWA). The plant came online in 2000 and services approximately 99% of the population of the village. The population of South River was 1,069 in 2006, a 2.8% increase from the 2001 population of 1,040 (Statistics Canada, 2007).

Water treatment is by chemically assisted coagulation with 2x Napier Ried filtration (1 anthracite filter and 1 granular activated carbon filter) and disinfection by sodium hypochlorite. Standby emergency power is provided by a 135 kw cooled diesel generator. There is no water storage reservoir for the village and so the distribution system is pressurized.

Upon notification of a spill or other event that may impair the quality of water at the intake, the time to shut down the WTP is less than 1 hour (David Walters, Operations Manager, OCWA, pers. comm., September 15, 2009).

The WTP has a rated capacity of 1,680 m^3/day. Presently, the plant operates well below its capacity with an average water taking of 590 m^3/day and a maximum taking of 854 m^3/day in 2008. The total water taking in 2008 was 215,539 m^3.

The intake is located in the South River Reservoir[1], an impoundment of the South River, between two earthen berms that presently serve as causeways (Chemical Road and Brennan Road causeways) for the crossing of vehicles (Figure 1). The intake pipe has a diameter of 300 mm and extends 232 m from the shoreline to the intake crib, which lies at a depth of 4.5 m from the surface.

3. Source Water Characterization

The South River is approximately 89.7 km long extending from its headwaters in the rocky uplands of the west end of Algonquin Provincial Park to its outlet in Lake Nipissing. The total drainage area of the river is 829.4 km^2. There are 6 hydro generating stations along the length of the South River and water levels are regulated on 8 lakes in the upper watershed including the South River Reservoir. A detailed review of the hydrology of the South River is provided in the South River Water Management Plan (OPGI, draft report 2005).

Water levels in the South River Reservoir are regulated by MNR's Forest Lake Dam[2] located at the outlet of the reservoir (Figure 1). A privately-owned generating station that operated at the Forest Lake Dam provided electricity to the residents of South River until the mid 1960s when Ontario Hydro connected the village to the provincial grid. The generating station is presently being redeveloped to produce 650 kW of power and will be a run-of-the-river facility that is, the facility will operate based on the amount of water flow entering Forest Lake within the existing water level restrictions established in the South River Water Management Plan (SRWMP) (OPG, 2005). The new generating station is scheduled for completion in late fall of 2009 (Pers. comm., Steve Taylor, Ministry of Natural Resources).

As per the SRWMP, water levels in the South River Reservoir are drawn down by 0.15 m per month beginning October 1st to achieve a flood control target of 349 m a.s.l. by March 15th. Water levels are maintained within a 40 cm band of 349.5 m a.s.l. to 349.9 m a.s.l. for navigation and recreation from July 1st to October 1st. The mean annual flow at the dam is 5.78 m^3, with maximum flows in April during the spring freshet and minimum flows in September. Bankfull flow ($Q_{1.7}$) is 28.1 m^3/s and the average 7-day low flow in a 20-year return period (7Q20) is 0.37 m^3/s.

[1] *The area impounded upstream of the Forest Lake Dam has often been referred to as 'Forest Lake' and/or the 'South River Reservoir'. In this report, the South River Reservoir includes the basin between the Forest Lake Dam and the causeway at Brennan Road. Forest Lake is considered as the basin upstream of the Brennan Road causeway.*

[2] *Forest Lake Dam is commonly known as Kootchie Dam and has often been referred to as the South River Dam. For consistency, the dam is referred to as the Forest Lake Dam in this report.*

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FIGURE 1.
Impoundment Features / Study Area
South River Intake

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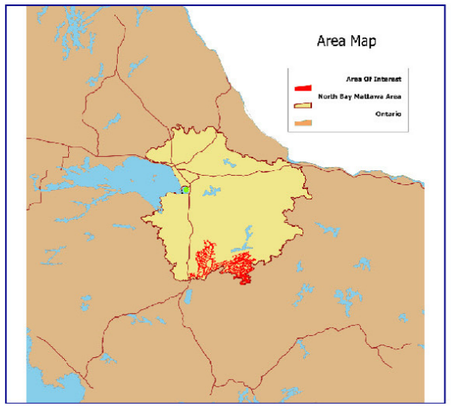

Waterbody
Wetland Area
Streams/creeks

Downstream Vectors
Basin

C Causeway
F Fake Gull Head
Intake
L Log Downstream

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The South River Reservoir has a surface area of 2.5 km^2 and drainage area of 327.6 km^2, which represents the upper 39% of the South River watershed (Figure 2). The reservoir is bound by the Brennan Road causeway to the east and the Forest Lake Dam to the west that serves as the outlet of the reservoir to the South River. A 20-m wide opening in the Brennan Road Causeway serves as the inlet to the reservoir from Forest Lake. The reservoir is divided into two hydrologically distinct basins by the Chemical Road Causeway located downstream of the intake. Flow between the basins is restricted to a 20-m wide opening in the causeway. Due to strong downstream flows through the opening in the Chemical Road Causeway, backflow of water through the causeway toward the South River intake is unlikely.

The South River Reservoir is shallow with a mean depth of approximately 1.2 m and volume of approximately 3.9 x 10^6 m^3 (TSH, 1998). There are isolated deep spots located along the east/west axis of the reservoir in the former riverbed reaching a maximum depth of approximately 9 m. Because of the shallow depth of the reservoir, the water column does not thermally stratify and water is able to mix to the bottom by wind.

There are no known water quality monitoring data from the South River Reservoir beyond raw water quality data collected at the intake for the drinking water plant (see Section 6.1). Historic data (1973-1991) are available from a Provincial Water Quality Monitoring Network Station (PWQMN) that was located in the South River downstream of the Forest Lake Dam near Highway 11. Monitoring at the station was reinstated in 2007 and a summary comparing the 1973-1991 and 2007-2009 data is presented in Table 1. The water quality measured at this location is generally typical of rivers on the Precambrian Shield. There is a range in values for most parameters that is associated with either variations in discharge in the river or differences between clear water and turbid conditions. These are moderated somewhat by proximity to the reservoir outflow.

At the South River PWQMN, Provincial Water Quality Objectives (PWQOs) have been exceeded by several parameters that are typically correlated to water contact time with soils e.g., aluminum, iron, copper, cadmium and phosphorus, and these parameters often increase naturally under turbid water conditions (Table 1). Two parameters that are typically related to human sources, lead and phenolics, have exceeded the PWQOs. Phenolics exceeded the PWQO of 1 μg/L on a single occasion in May, 1991. Lead exceeded the PWQO of 5 μg/L on 2 occasions in 2009 (May 26 and June 29). Between 2007 and 2009, lead concentration was reported as a negative value on 14 of 20 sampling occasions. Analytical qualifiers (detection limits, trace values, etc.) were not provided to AECOM and so interpretation of these negative values is not possible, but these likely represent concentrations at or below detection limits. While there are natural sources of lead in the environment (weathering, volcanic activity), these rarely result in elevated concentrations in the natural environment. The primary human source of lead is typically from industrial emissions, but historic uses of lead in paint and gasoline can also still contribute to lead concentrations above natural levels in the environment. There are no known concentration data for lead or phenolics in raw water from the South River Reservoir, but there have been no reported detections of these parameters in treated water at the South River WTP (Section 6.1) and it is plausible that inputs of these parameters to the river occurred downstream of the reservoir (and the drinking water intake).

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FIGURE 2.
South River Watershed
Elevation and features

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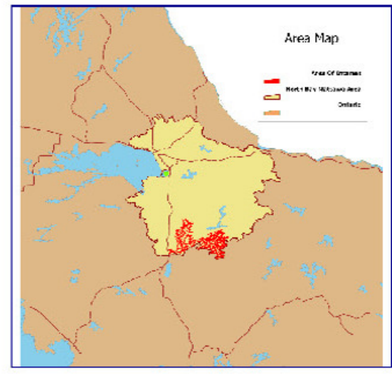

Contours
Waterbody Segment
Wetland Area, Permanent
Streams/creeks

Roads

Elevation Surface

Heights (m)

455
434
413
391
370
349

Ever Lake
FOREST LAKE
EAST TWIN LAKE
Nokomis Lake
Ericsyea Creek

0 2500 m

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For most parameters monitored at the South River PWQMN, levels are similar or lower during the 2007-2009 sampling period than those observed between 1973 and 1991, and there is no indication that there is an increasing trend in any of the parameters. Direct comparison using statistical techniques is precluded, however, due to changes in analytical methods and detection limits over the period of the monitoring record.

Table 1. Water Quality in South River (Provincial Water Quality Monitoring Network Station 03013302302, 1973-1991; 2007-2009)

Parameter[a]	1973-1991				2007-2009				Provincial Water Quality Objective (PWQO)[b]
	n	Maximum	Mean	Standard Deviation	n	Maximum	Mean	Standard Deviation	
Acidity, total	3	3.00	2.67	0.58					
Alkalinity, total	17	22.8	10.5	4.5	21		9.2	2.4	
Aluminium, unfiltered total (µg/L)	3[c]	93	70.3	20.2	21	117	62.4	25.0	75
Ammonium, total filtered reactive	102	0.25	0.04	0.04	20	0.048	0.022	0.013	
Arsenic, unfiltered total (µg/L)	14	0.03	0.00	0.01					5
Biological oxygen demand (BOD), 5 day	66	3.20	0.89	0.61					
Cadmium, unfiltered total (µg/L)	1	0.01	0.01		21	1	0.5	0.3	0.1
Calcium, unfiltered reactive	8	3.8	3.5	0.3	21	3.66	2.97	0.62	
Chloride, unfiltered reactive	101	29.0	2.3	2.9	21	2.9	1.7	0.4	
Colour, apparent (HCU)	3	40.0	33.3	5.8					
Conductivity (µohms/cm)	102	161	50	14	20	45	34.8	5.3	
Copper, unfiltered total (µg/L)	4[c]	5.50	1.85	2.4	20	1.32	0.45	0.38	1
Dissolved oxygen (mg/L)	76	13.00	8.70	2.02	20	9.6	6.3	1.3	
Hardness, total	11	20	14	3	20	14.2	10.4	2.6	
Iron, unfiltered total (µg/L)	4[c]	1000	525	351	20	717	402	151	300
Lead, unfiltered total (µg/L)[d]	4[c]	2.50	2.0	0.69	6	11.1	5.9	2.9	5
Magnesium, filtered reactive	8	1.35	1.03	0.21	20	1.24	0.99	0.23	
Manganese, unfiltered total	1	0.02	0.02		20	0.0817	0.0347	0.0188	
Nickel, unfiltered total (µg/L)	4[c]	2.50	1.3	0.50	20	1.95	0.61	0.50	25
Nitrate, filtered reactive	87	0.41	0.11	0.09	20	0.101	0.035	0.030	
Nitrates total, filtered reactive	1	0.12	0.12						
Nitrogen, total,Kjeldahl, unfiltered reactive	97	0.99	0.42	0.17	20	0.51	0.33	0.09	
pH (unit)	19	7.60	6.98	0.36	20	7.38	7.09	0.21	6.5-8.5
Phenolics, unfiltered reactive (µg/L)	13	2.80	1.15	0.60					1
Phosphate, filtered reactive	101	0.65	0.01	0.07	18	0.0055	0.0013	0.0012	
Phosphorus, unfiltered total	102	0.95	0.04	0.12	20	0.031	0.012	0.006	0.30
Sulphate, unfiltered reactive	1	6.1	6.1						
Temperature, water (°C)	100	26.0	10.6	8.8	4	20.1	13.2	4.8	
Turbidity (FTU)	98	9.00	1.82	1.27					
Zinc, unfiltered total (µg/L)	4[c]	7.8	2.7	1.9	20	3.81	2.87	0.974	20

[a]units are in mg/L unless otherwise noted; [b]shaded cells indicate that the parameter has exceeded the PWQO; [c]data for 1991 only; [d]significant changes in analytical detection limits occurred beginning in 1991, data pre-1991 exist but are not included in the assessment

4. Delineation of Vulnerable Areas

4.1 Intake Classification (Part VI.I, Rule 55)

Surface water intakes are classified according to the type of water body in which they are located. A surface water intake is classified as Type A if it is located in a Great Lake, Type B if it is located in a connecting channel, Type C if it is located in a river where neither the direction nor velocity of the flow of water at the intake is affected by a water impoundment structure, or Type D for all other locations.

The South River intake draws water from the South River Reservoir, a reservoir created by the impoundment of the South River at its outlet, and is therefore best classified as a Type D intake.

4.2 Delineation of Vulnerable Areas (Intake Protection Zones)

A vulnerable area includes areas of land and/or water that contribute water to the drinking water intake and where the release of a contaminant could cause a deterioration of water quality at the intake for use as a drinking water source. The vulnerable area for the South River drinking water intake is comprised of three zones, called intake protection zones (IPZs) as defined in the following sections for a type D intake in accordance with Parts VI.2 to VI.6 of the Rules. Note that a fourth zone, IPZ-Q is not applicable for the South River intake because the subwatershed in which the intake is located is not considered to have a surface water stress level of moderate or high as defined in Part III.4 of the Rules.

4.2.1 Intake Protection Zone 1 (IPZ-1) (Part VI.4, Rules 61-64)

Intake Protection Zone 1 (IPZ-1) is the most vulnerable of the vulnerable area for an intake. If a spill or other event that may impair water quality at the intake occurs in this zone, the drinking water plant operators would have little to no time to respond. IPZ-1 for the South River intake includes the surface area of east basin of the South River Reservoir within 1 km of the intake crib and abutting lands that drain to this area to a maximum setback of 120 m from the high water mark (Figure 3). As described in Section 3, the east basin of the reservoir in which the intake is located is hydrologically separated from the downstream west basin by the Chemical Road Causeway. The opening under the causeway effectively serves as the outlet of the east basin.

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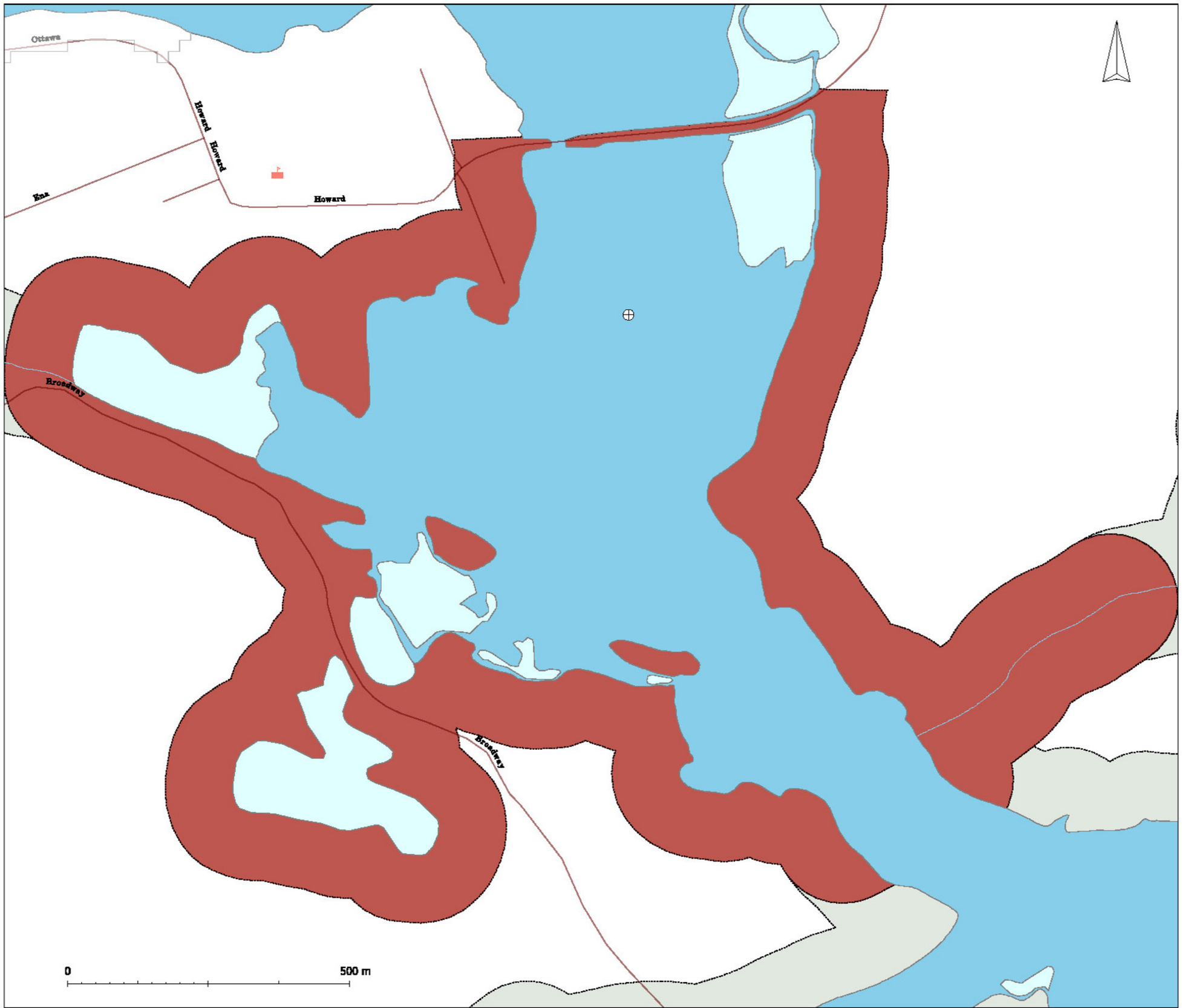

FIGURE 3.
IPZ 1
South River Intake

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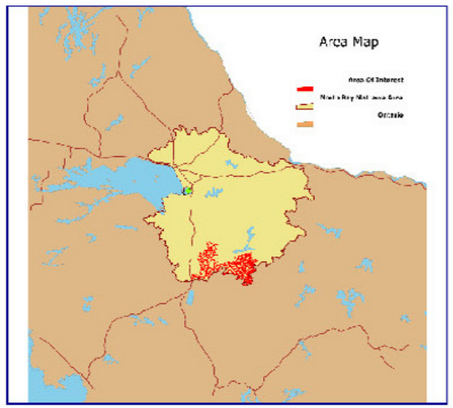

IPZ1
IPZ3
Roads
South River Treatment (approx)
Intake
Waterbody
Wetland Area
Streams/creeks

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4.2.2 Intake Protection Zone 2 (IPZ-2) (Part VI.5, Rules 65-66; Part VI.6, Rules 72-74)

Intake Protection Zone 2 (IPZ-2) is the secondary protection zone. If a spill or other event that may impair water quality at the intake occurs in the IPZ-2, the plant operator would have sufficient time to respond. The IPZ-2 therefore includes the area of surface water bodies that contributes water to the intake where the time of travel to the intake is equal to or less than the time that is sufficient for the drinking water plant operator to respond to a spill or other event that may impair water quality at the intake. If the response time of the plant operator is less than two hours, then the IPZ-2 should extend to include the area representing a two hour time of travel to the intake. Where this area abuts land, the IPZ-2 is extended to include land area draining to the water body to a maximum setback of 120 m from the high water mark. IPZ-2 is also extended to include areas draining to stormwater management works that contribute water to the intake where the time of travel to the intake is equal to or less than two hours. The IPZ-2 does not include any areas defined as IPZ-1.

The South River drinking water plant operator can respond to a spill or other event in less than one hour (David Walters, Operations Manager, OCWA, pers. comm., September 15, 2009), therefore, the delineation of the IPZ-2 is based on a two hour time of travel to the intake.

In 2009, WESA used a HEC-RAS model to simulate river generated water flow velocities in the South River Reservoir. At bankfull flows estimated at the Forest Lake Dam (27.1 m^3/s), the model estimated velocities of 0.01 to 0.02 m/s near the intake. These river generated flow speeds within the reservoir are slow because of the shallow and broad nature of the basin near and upstream of the intake. In this type of setting, wind-driven surface current velocities would exceed river generated flow velocities. This was observed during a site visit on August 19th, 2009, when measured surface water velocities ranged from 0.01 to 0.10 m/s in the reservoir upstream of the intake under wind speeds ranging from 15 to 24 km/hr (North Bay A Station 6085700) (Table 2).

In the absence of a hydrodynamic model or measured surface water currents during high wind conditions, maximum surface water current velocity in the South River Reservoir was estimated using major limnological principals guiding wind-driven surface water current speeds. The velocity of wind-driven currents is about 2% of the speed of the wind generating them up to a critical wind speed of approximately 6 m/s (21.6 km/h) beyond which surface water velocity decreases in a non-linear fashion (Wetzel, 2001). There is no weather station in South River, but maximum wind speeds often exceed 21.6 km/h in the region. The maximum wind speed from the 1971-2000 climate normals recorded at the Muskoka (Station 6115525) and the North Bay A (Station 6085700) weather stations is 66 km/h (recorded February 19, 1972) and 72 km/h (recorded March 8, 1956), respectively.

At the critical wind speed, the maximum surface water velocity is 0.12 m/s and the distance from the intake to encompass a minimum 2-hour time of travel at the critical wind speed is 864 m. This distance is less than the 1,000 m minimum distance required for the IPZ-1 delineation. The two hour time of travel in the South River Reservoir is therefore encompassed by the IPZ-1.

Table 2. Measured Surface water velocities in the South River Reservoir, August 19, 2009.

Site #	Location		Easting	Northing	Distance (m)	Time (s)	Velocity (m/s)	Direction of Flow
1	Log Downstream		627715	5077964			0.01	Northeast
2	Fake Gull Head		627868	5077359			0.02	Northeast
3	Causeway (Chemical Rd.)		627738	5077779			0.10	northward toward outlet
4	Causeway (Brennan Rd.)						0.04	northward to South River Reservoir
Transect 1	Main Basin	T0	627684	5077351		0.0		
		T1	627712	5077356	28.44	5.7	0.08	
		T2	627730	5077360	18.44	10.2	0.07	
		T3	627749	5077358	19.10	14.5	0.07	
		T4	627780	5077366	32.02	22.0	0.07	
		End	627807	5077375	28.46	28.0	0.08	
	Mean						0.08	northeast
Transect 2	North Basin	T0	627665	5077887		0.0		
		T1	627692	5077939	58.59	705.0	0.08	
		End	627727	5077949	36.40	1260.0	0.07	
	Mean						0.08	northeast

There is one tributary that enters the east basin of the South River Reservoir within the two hour time of travel distance to the intake. Flows in the tributary are intermittent and there was no visible flow at the Broadway Street culvert during either of two site visits on August 19th and September 14th, 2009. The inlet of this tributary is located 700 m from the intake on the west shore of the reservoir. Travel time from the inlet to the intake is approximately 1.6 hours based on maximum surface water current speed of 0.432 km/hr. The IPZ-1 extends 325 m upstream of the tributary. Assuming the same wind-driven surface current speed, this distance represents a 0.75 hour time of travel in the tributary. This time of travel is considered a conservative estimate given the intermittent nature of flow in the tributary and the attenuation of flows in the tributary as it passes through extensive wetland area before reaching the reservoir (Figure 4). The total time of travel for water to reach the intake from where the IPZ-1 boundary crosses the tributary is 2.35 hours, which is greater than the two hour time of travel necessitated for the IPZ-2. There are no land areas outside of the IPZ-1 that drain water to stormwater management works and contribute water to the intake where the time of travel to the intake would be two hours or less.

Based on this evaluation, the IPZ-1 encompasses all areas that contribute water to the intake within a 2-hour time of travel including drainage to stormwater management works such that there is no IPZ-2 for the South River drinking water intake.

Figure 4. West Tributary at Broadway Street Crossing

4.2.3 Intake Protection Zone 3 (IPZ-3) (Part VI.5, Rule 70, Part VI.6, Rules 72-73, 75)

Intake Protection Zone 3 (IPZ-3) is the third vulnerable area, which is meant to protect the intake from long-term chronic or cumulative impacts. It includes the area of all surface water bodies contributing water to the intake including areas that contribute water via a transport pathway, and adjacent lands (setback area) where overland flow drains to the surface water bodies to a maximum setback of 120 m. The IPZ-3 for the South River intake is illustrated in Figure 5.

5. Vulnerability: Surface Water Intake Protection Zones (Part VIII)

5.1 Area Vulnerability Factors

The IPZ-1 is assigned a set vulnerability factor of 10 (Rule 88). Different area vulnerability factors are assigned for five areas within the IPZ-3 (Figure 6), which include:

IPZ-3 A (west tributary) - the tributary (and setback area) that crosses Broadway Street and outlets to the South River Reservoir at the west shore;

IPZ-3 B (east tributary) - the tributary (and setback area) that outlets to the South River Reservoir at the east shore;

IPZ-3 C - area downstream of the Brennan Road Causeway; and

IPZ-3 D – Forest Lake (upstream of the Brennan Road Causeway) and tributaries draining to Forest Lake within 5 km of the intake, and

IPZ-3 E – area upstream of IPZ-3 D

Area vulnerability factors assigned to areas within an IPZ-3 can range from 1 to 9, where a higher factor corresponds to a higher vulnerability and must be assigned with consideration of:

1. percentage of the area that is composed of land;
2. land cover, soil type, permeability of the land and the slope of setbacks;
3. hydrological and hydrogeological conditions in the area that contributes water to the area through transport pathways; and
4. the proximity of the area to the intake.

The Rules do not provide specific guidance for the consideration of the above factors when assigning area vulnerability scores. For the South River intake, each of the required factors for consideration was weighted equally in the scoring with a total possible score of 2 assigned for each factor (Table 3). The area vulnerability was calculated as 1 plus the total scores for individual factors rounded up to the nearest unit.

North Bay - Mattawa

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

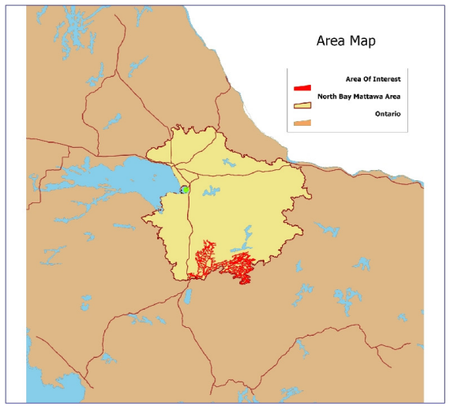
FIGURE 5
IPZ 1 and 3
South River Intake

AECOM

NORTH BAY-MATTAWA CONSERVATION AUTHORITY

HINSBURGER LAKE
SMYTH LAKE
LOXTON LAKE
HAWE LAKE
LAMBS LAKE
TIMPANO LAKE
TOWER LAKE
BEAUTIFUL LAKE
WENDIGO LAKE
TWENTY SEVEN LAKE
FOREST LAKE
Forest Lake
LAURAL LAKE
Ewayea Creek
Pishnecka Creek
Bobeep Creek
Charr Lake
Pishnecka Creek
Bobeep Creek
Nokomis Lake
Craig Creek
Nokomis Creek
Craig Creek
Bobeep Creek
Basil Lake
Nahma Lake
Axton Lake
Craig Creek
STRINGER LAKE
Wabanah Lake
Pemican Lake
Sanwa Lake
Winifred Lake
Togo Lake

0 >500 m



IPZ1
IPZ3
Roads
South River Treatment (approx)
Intake
Waterbody
Wetland Area
Streams/creeks

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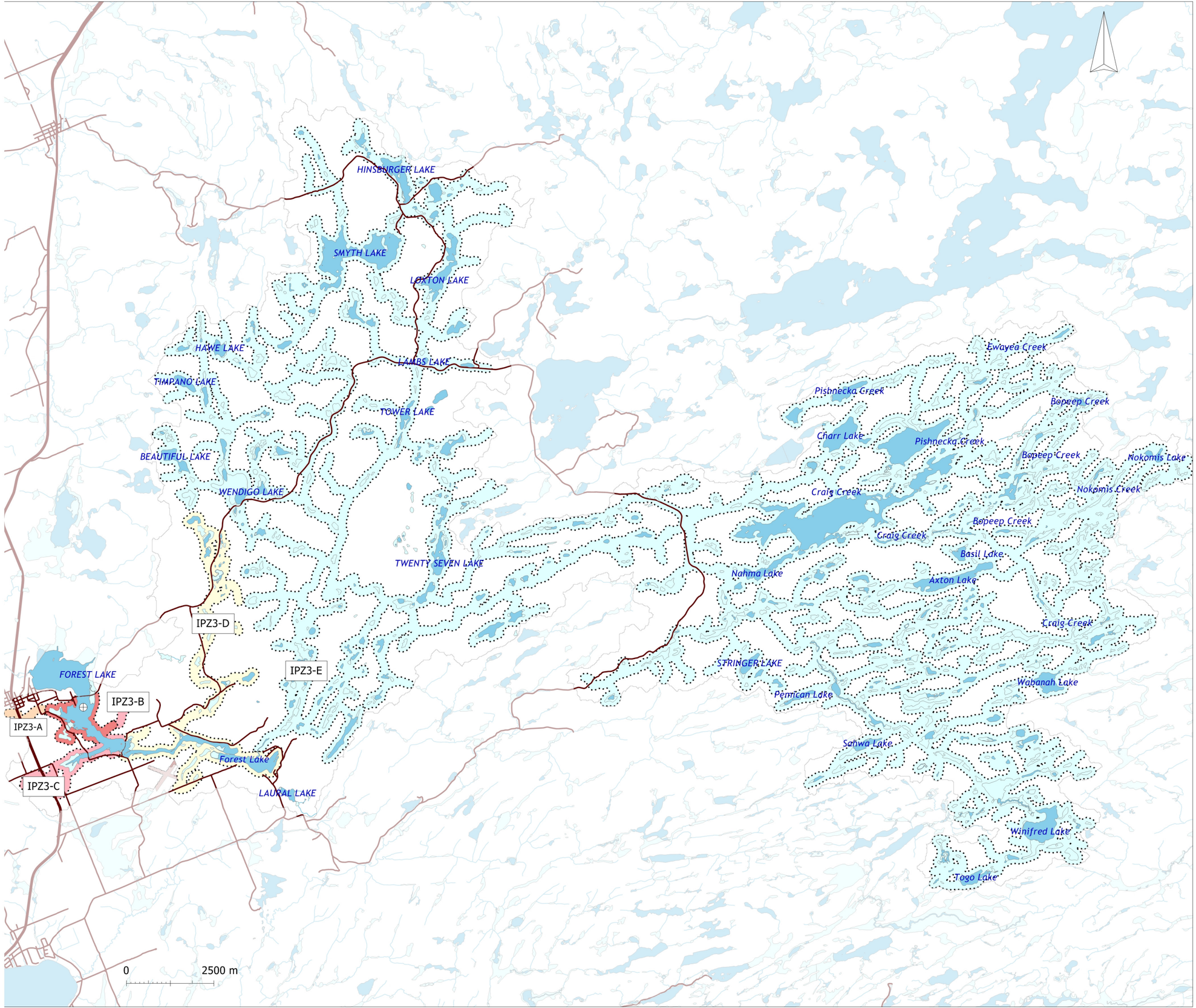
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

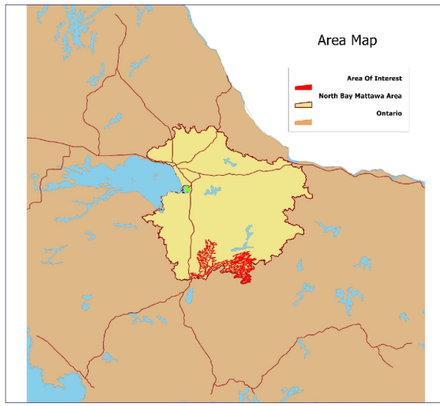
FIGURE 6. Vulnerability Zones

AECOM

NORTH BAY-MATTAWA CONSERVATION AUTHORITY



Area Map



Waterbody
Wetland Area
Streams/creeks

Intake

Roads

Airport

Vulnerability

Vulnerability Scores

2.7
3.6
4.5
6.3
9.0

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Based on this analysis, IPZ-3A has an area vulnerability of 7. IPZ-3B and IPZ-3C have an area vulnerability of 5, which is the mid value of the possible range of area vulnerability scores (1-9). The area vulnerability for IPZ-3D and IPZ-3E is 4 and 3, respectively.

Table 3. Area Vulnerability Scoring for Vulnerable Areas in the IPZ-3 for the South River Intake

Factor Affecting Area Vulnerability and Scoring	IPZ-3 Subzone and Scoring[a]				
	A West tributary	B East tributary	C Downstream of Brennan Rd. Causeway	D Forest Lake & tributaries within 5 km of the intake	E Area upstream of IPZ-3 D
% area composed of land Scoring: <25% = 2 25-75% = 1 >75% = 0	9% (2)	51% (1)	25% (1)	50% (1)	50% (1)
Land cover, soil type, permeability, slope of setbacks Scoring: <85% forested = 0.5 variable soils = 0.5 >25% impervious area = 0.5 Setback slopes >20% = 0.5	69% forested (0.5) Variable Soils (0.5) 31% impervious surface (0.5) Very low setback slopes (<20%) (0)	100% forested (0) Variable soils (0.5) 0% impervious surface (0) Variable setback slopes (>20%) (0.5)	32% forested (0.5) Variable soils (0.5) 2% impervious surface (0) Variable setback slopes (>20%) (0.5)	86% forested (0) Variable soils (0.5) 0% impervious surface (0) Variable setback slopes (>20%) (0.5)	85% forested (0) Variable soils (0.5) 0% impervious surface (0) Variable setback slopes (>20%) (0.5)
Transport Pathways Scoring: All subzones were given a score of 0 as there are no known constructed pathways.	none known (0)	none known (0)	none known (0)	none known (0)	none known (0)
Proximity to the intake Scoring: <2 km = 2 2 to 5 km = 1 >5 km = 0	Within ~2 km of the intake (2)	Within ~2 km of the intake (2)	Within ~2.5 km of the intake (2)	Within ~5 km of the intake (1)	greater than 5 km from the intake (0)
Area Vulnerability Factor Scoring: 1 + sum of individual factor scores	7	5	5	4	3

[a]*scores for individual factors affecting vulnerability are provided in brackets*

5.2 Source Vulnerability Factor

The source vulnerability factor can range from 0.8 to 1.0 for a type D intake and the following must be considered in assigning the score:

1. depth of the intake from the surface
2. distance of the intake from land, and
3. history of water quality concerns at the intake.

The South River intake is located at a shallow depth of only 4.5 m from the surface and is relatively close to land (232 m). Both of these factors contribute to higher source vulnerability for the South River intake because they increase the risk of a contaminant reaching the intake. There have been no known documented concerns with water quality at the intake, and so this lowers the source vulnerability. If each consideration is weighted equally, the source vulnerability factor is 0.9 (calculated as 0.8 + 0.2*2/3 = 0.9).

5.3 Vulnerability Scores

Vulnerability scores are calculated as the product of the area and source vulnerability factors. Vulnerability scores for each vulnerable area of the South River drinking water intake are provided in Table 4. The final vulnerability score for IPZ-1 is 9 from a possible range of 8 to 10. Vulnerability scores for the IPZ-3 range from 6.3 for subzone IPZ-3A to 2.7 for IPZ-3E. These scores are used to assess the risk of contamination of the drinking water source at the intake from threats (Section 6.2.1).

Table 4. Vulnerability Scores for Vulnerable Areas of the South River Intake

Vulnerable Area	Area Vulnerability Factor	Source Vulnerability Factor	Vulnerability Score
IPZ-1	10	0.9	9.0
IPZ-3 A	7		6.3
IPZ-3 B	5		4.5
IPZ-3 C	5		4.5
IPZ-3 D	4		3.6
IPZ-3 E	3		2.7

6. Drinking Water Threats: Water Quality (Part XI)

6.1 Drinking Water Issues (Part XI.1)

Drinking water issues relate to the presence of a 'listed parameter'[3] in water at the intake if:

1. the parameter is present at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water, or
2. there is an increasing trend of the parameter that would result in the deterioration of water quality for use as drinking water.

Drinking water issues can also relate to a pathogen in water at a surface water intake that is not one of the 'listed parameters', but requires that a microbial risk assessment be conducted with respect to that pathogen. For the South River intake, no microbial risk assessment was undertaken for any pathogens. The only pathogens considered in this issues evaluation are total coliforms and *E. coli*, which are listed parameters.

The Rules do not specifically define 'deterioration of the quality of water for use as a source of drinking water'. We therefore assessed water quality parameters as issues using the following approach:

1. All listed parameters in raw and treated water were compared to the applicable Ontario Drinking Water Quality Standard (ODWQS), Aesthetic Objective (AO), or Operational Guideline (OG).
2. Any parameter in treated water that has exceeded the applicable benchmark (ODWQS, AO, OG) is considered a drinking water issue.
3. Any parameter in raw water that has exceeded the applicable benchmark or that has come within 25% of the benchmark is identified and is further evaluated as a drinking water issue based on the ability of the water treatment plant to treat the parameter. It is noted that insufficient data exist to identify trends in raw and treated water quality parameters for the South River intake. If sufficient data existed, these would be assessed for trends. A parameter would be considered a drinking water issue if an increasing trend occurred, and a continuation of that trend would result in the inability of the water treatment plant to treat that parameter.

6.1.1 Data Sources

The following sources of data were assessed to identify potential drinking water quality issues for the South River intake:

1. Drinking Water Information System (DWIS) Monitoring Data

[3] *Parameters listed in Schedule 1, 2 or 3 of the Ontario Drinking Water Quality Standards or Table 4 of the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines.*

Drinking Water Systems Regulation (O. Reg. 170/03) parameters analyzed in treated and raw water at the South River Water Treatment Plant from 2003 to 2006 were available at the time of report production. For raw water, only bacteria (*E. coli* and total coliform) data are included in the DWIS database. There are chemical and bacteriological data for treated water however most of the chemical parameters were only sampled on one occasion in 2004. If additional DWIS data exist for 2007 to present, these should be assessed for drinking water issues.

2. O. Reg. 170/11 Annual Report – 2009 (for the period of Jan. 1 to Dec. 31, 2008)

This report was reviewed at the Village of South River Town Office (September 14th, 2009). Previous annual reports, if available, should be provided to confirm AECOM's assessment of drinking water quality issues.

Overall, there are minimal data available for raw water from the South River intake to evaluate drinking water issues. It is recommended that the drinking water issues be reassessed as new data become available.

6.1.2 Chemicals

Based on the available DWIS data, all measured chemical parameters in treated water at the point of entry to the distribution system of the South River Drinking Water Plant have been below detection limits with the exception of nitrogen (nitrate and nitrite), sodium and chromium (Table 5). Of these, only chromium exceeded the applicable ODWQS, aesthetic objectives and operational guidelines. A concentration of 1.3 mg/L was reported for chromium on March 1st, 2004, which greatly exceeds the ODWQS of 0.05 mg/L. Based on discussions with the WTP operator and the Technical Advisory Committee, there is no apparent source of chromium to the South River Reservoir and it is suspected that the 2004 reported value for chromium is anomalous. Chromium is therefore not considered a drinking water issue as defined by the Rules.

No chemical parameters were reported to exceed applicable ODWQS, aesthetic objectives or operational guidelines in 2008 in the O. Reg. 170/11 Annual Report – 2009 for the South River WTP.

The drinking water plant operator (Mr. Glenn Thornborrow, OCWA) investigated the source of elevated apparent colour at the point of entry of the WTP in the summer of 2009. In an email to T. Karst-Riddoch dated November 9th, 2009, Mr. Thornborrow noted that beginning on June 25th, apparent colour increased from the normal 50-70 range to a maximum of 97 on June 26th, and then returned to normal levels by July 2nd. Using a manganese reagent set, Mr. Thornborrow measured a manganese concentration of 0.105 mg/L on July 2nd and 0.09 mg/L on July 3rd at the point of entry, which exceed the aesthetic objective of 0.05 mg/L for manganese. Given that iron concentrations at that time were low (0.01 mg/L), manganese was considered to be the source of discolouration of the water at that time. The timing of the colour increase was coincident with the removal of a beaver dam on June 23rd, upstream from the intake where Broadway/Sandhill Road crosses a tributary arm of the reservoir. It is suspected that the release of manganese-rich waters from upstream of the beaver dam resulted in the elevated manganese and colour observed at the intake.

AECOM agrees that the removal of the beaver dam is the most likely cause of the elevated manganese concentrations observed at the intake in the summer of 2009. Manganese is naturally occurring in sediments and can be released into overlying waters during periods of anoxia (lack of oxygen) in the water column. The occurrence of anoxia is common in still waters where there is an abundance of aquatic vegetation. At night, oxygen is depleted in the water due to the respiration of aquatic plants. Anoxic conditions can also occur due to the decomposition of aquatic vegetation. Oxygen levels can be replenished with oxygen from the atmosphere when the water column mixes. It is therefore most likely that the source of manganese at the intake was natural, released from sediments upstream of the beaver dam.

Given that measured manganese concentrations exceeded the ODWQSOG, manganese is considered as a drinking water issue for the South River intake under Rule 114. There are no other chemical parameters that are confirmed drinking water issues for the South River intake.

Table 5. Chemical Parameter Concentrations in Treated Water at the Point of Entry to the South River Drinking Water Distribution System (DWIS data, 2003-2006)

O. Reg170 Parameter Name	Maximum (mg/L)	n
1,2,4-triazin-5(4h)-one, 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-	<5	1
2,4,5-trichlorophenoxyacetic acid	<1	1
2,7:3,6-dimethanonaphth[2,3-b] oxirene,3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,(1a-alpha, 2-beta, 2a-alpha, 3-beta, 6- beta,6a-alpha, 7-beta, 7a-alpha)-	<0.006	1
4,7-methanoindan, 1,4,5,6,7,8,8-heptachloro-2,3- epoxy-3a,4,7,7a-tetrahydro-	<0.006	1
4,7-methanoindene, 1,4,5,6,7,8,8-heptachloro-3a, 4,7,7,7a-tetrahydro-	<0.006	1
Acetic acid (2,4-dichlorophenoxy)-	<1	1
a-Chlordane	<0.006	1
Alachlor	<0.5	1
Aldicarb	<5	1
Aldrin	<0.006	1
Aldrin+dieldrin	<0.012	1
Aroclor 1260	<0.05	1
Arsenic	<0.7	1
Atrazine	<0.5	2
Atrazine+n-dealkylated metabolites	<1	2
Barium	<17	1
Benzene	<0.5	1
Benzene, 1, 2-dichloro-	<0.5	1
Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-	<0.024	1
Benzene, 1,4-dichloro-	<0.5	1
Benzo[a]pyrene	<0.01	2
Benzonitrile, 3,5-dibromo-4-hydroxy-	<0.5	1
Boron	<12	1
Butanedioic acid, [(dimethoxyphosphinothioyl)thio]-, diethyl ester	<5	1
Cadmium nitrate cd(no3)2 (10325-94-7)	<0.5	1
Carbamic acid, methyl-, 2,3-(dimethylmethylenedioxy)phenyl ester	<2	1
Carbamic acid, methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester	<5	1
Carbaryl	<5	1
Chlordane	<0.012	1
Chlorethene	<0.2	1
Chlorobenzene	<0.5	1
Chlorpyrifos	<1	1
Chromium cr (7440-47-3)	1.3	1
Cyanazine	<1	1
De-ethylated atrazine	<0.5	1
Dicamba	<1	1
Dipyrido[1,2-a:2',1'-c]pyrazinediium, 6,7-dihydro-, dibromide	<7	1
Ethane, 1,2-dichloro-	<0.5	1
Ethene, 1,1-dichloro-	<0.5	1
Ethene, trichloro-	<0.5	1
Ethene,tetrachloro-	<0.5	1

O. Reg170 Parameter Name	Maximum (mg/L)	n
Fluoride	<0.1	1
G-chlordane	<0.006	1
Glyphosate	<10	1
Heptachlor + heptachlor epoxide	<0.012	1
Lindane	<0.006	1
Mercury	<0.1	1
Methane, tetrachloro-	<0.5	1
Methylene chloride	<1	1
Metolachlor	<0.5	1
Nitrate (as nitrogen)	0.2	3
Nitrate + Nitrite (as nitrogen)	0.3	3
Nitrates	0.2	4
Nitrite	0.1	5
Nitrite (as nitrogen)	0.3	3
op-DDT	<0.006	1
Oxychlordane	<0.006	1
Paraquat	<1	1
Parathion	<1	1
Pentachlorophenol	<0.5	1
Phenol, 2,3,4,6-tetrachloro-	<0.5	1
Phenol, 2,4,6-trichloro -	<0.5	1
Phenol, 2,4-dichloro-	<0.5	1
Phenol,2-(1-methylpropyl)-4,6-dinitro	<1	1
Phorate	<0.5	1
Phosphorodithioic acid, o,o-diethyl-s-(((1,1-dimethylethyl) thio)methyl)-ester	<0.7	1
Phosphorodithioic acid, o,o-dimethyl ester, s-ester with 3-(mercaptomethyl)- 1,2,3-benzotriazin-4(3h)-one	<2	1
Phosphorodithioic acid, o,o-dimethyl s-[2-(methylamino)-2-oxoethyl]ester	<2.5	1
Phosphorothioate,o,o-diethyl-o-(2-isopropyl-6-methyl-4- pyrimidioyl)	<1	1
Picloram	<5	1
pp-DDD	<0.006	1
pp-DDE	<0.006	1
pp-DDT	<0.006	1
Prometryne	<0.25	1
Propanoic acid, 2-[4-(2,4-dichlorophenoxy)phenoxy]-, methyl ester	<0.9	1
Selenium	<0.8	1
Simazine	<1	1
Sodium	11	1
Technical ddt	<0.024	1
Temephos	<10	1
Triallate	<1	1
Trifluralin	<1	1
Uranium	<0.8	1
Urea, n'-(3,4-dichlorophenyl)-n,n-dimethyl-	<10	1

6.1.3 Pathogens

E. coli and total coliforms should not be detectable in drinking water as per Table 1 of the ODWQS, and for heterotrophic plate counts (HPC), increases in concentrations above baseline conditions are considered undesirable according to the Operational Guideline (OG) (MOE, 2006).

Total coliforms and *E. coli* are naturally occurring bacteria in surface water and are typically detected in raw water samples at the South River intake, therefore exceeding the ODWQS. *E. coli* and total coliform were detected at >10 cfu/100 mL in 43% and 96% of the raw water samples analyzed between 2003 and 2006, respectively (Table 6). In 2008, *E. coli* ranged from 1-140 cfu/100 mL and total coliform ranged from 10 to 510 cfu/100 mL in raw water. The observed of these bacteria are expected in the South River Reservoir because of its shallow nature which allows mixing of surface waters containing these bacteria and their transport to the intake. Moreover, large littoral and wetland areas provide abundant habitat for wildlife, a primary source of *E. coli* and other coliform bacteria to surface water. Despite naturally occurring levels, *E. coli* and total coliform have not been detected in treated water from the South River Water Treatment Plant in 2003-2006 (Table 6) or in 2008.

Statistical analysis of trends in *E. coli* and total coliform was precluded due to the large number of values below analytical detection (detection limit was 10 cfu/100 mL for the DWIS data) and the limited data availability (only 2 full years of data were available at the time of report production). If additional data become available, AECOM will assess these for trends.

Based on this evaluation of available pathogen data, *E. coli* and total coliform are not considered to be drinking water issues for the South River intake.

Table 6. *E. coli* and Total Coliform in Raw and Treated Water from the South River Water Treatment Plant (2003-2006).

Parameter		Raw Water	Treated Water
E. coli	Maximum (cfu)	60	0
	Minimum (cfu)	4	0
	n	92	93
	n > detection of 10 cfu	36	0
Total coliform	Maximum (cfu)	2000	0
	Minimum (cfu)	10	0
	n	91	93
	n > detection of 10 cfu	87	0

6.2 Drinking Water Threats

The threats evaluation for Source Protection Planning involves the identification of threats that can cause contamination of drinking water by a chemical or pathogen. Threats can include ‘activities’ or ‘conditions’ that occur within vulnerable areas of the intake. There are 21 activities that can be considered as threats

with respect to drinking water as prescribed in the Clean Water Act (2006) O. Reg. 287/07 (General) subsection 1.1(1) (Table 7). Only nineteen of the activities are applicable to water quality; activities 19 and 20 relate to water quantity and are not applicable to the South River intake. Conditions, as defined by Rule 126, result from past activities and can include the presence of:

1. a non-aqueous phase liquid in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or wellhead protection area,
2. a single mass of more than 100 L of one or more dense non-aqueous phase liquids (DNAPLs) in surface water in a surface water IPZ,
3. a contaminant in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or wellhead protection area, if the contaminant is listed in, and its concentration exceeds the potable groundwater standard in, Table 2 of the Soil, Ground Water and Sediment Standards,
4. a contaminant is surface soil in a surface water IPZ if the contaminant is listed in, and its concentration exceeds the standard for industrial/commercial/community property in, Table 4 of the Soil, Ground Water and Sediment Standards, or
5. a contaminant in sediment if the contaminant is listed in, and its concentration exceeds the standard in, Table 1 of the Soil, Ground Water and Sediment Standards.

There are two major components to addressing drinking water threats to comply with the Rules with respect to threats assessment. These involve:

1. The LISTING of activities that ***are or would*** be significant, moderate or low threats if they were conducted within the vulnerable areas (Section 6.2.1) and,
2. The ENUMERATION of significant threats (activities or conditions) that ***presently exist*** in the vulnerable areas (Section 6.2.2).

Table 7. Activities Prescribed to be Drinking Water Threats in O. Reg. 287/07 (General) of the *Clean Water Act* (2006)

O. Reg. 287/07 par.	Activity
1	**The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act*.**
2	**The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.**
3	**The application of agricultural source material to land.**
4	**The storage of agricultural source material.**
5	**The management of agricultural source material.**
6	**The application of non-agricultural source material to land.**
7	**The handling and storage of non-agricultural source material.**
8	**The application of commercial fertilizer to land.**
9	**The handling and storage of commercial fertilizer.**
10	**The application of pesticide to land.**
11	**The handling and storage of pesticide.**
12	**The application of road salt.**
13	**The handling and storage of road salt.**
14	**The storage of snow.**
15	**The handling and storage of fuel.**
16	**The handling and storage of a dense non-aqueous phase liquid.**
17	**The handling and storage of an organic solvent.**
18	**The management of runoff that contains chemicals used in the de-icing of aircraft.**
19	**An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body.**
20	**An activity that reduces the recharge of an aquifer.**
21	**The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard**

Note: "agricultural source material", "application", "commercial fertilizer", "livestock", "non-agricultural source material" and "outdoor confinement area" have the same meanings as in Ontario Regulation 267/03 (General) made under the Nutrient Management Act*, 2002; "management" means, with respect to agricultural source material, the collection, handling, treatment, transportation or disposal of agricultural source material; "pesticide" has the same meaning as in the* Pesticides Act*; "sewage" has the same meaning as in the* Ontario Water Resources Act*, O. Reg. 385/08, s. 3.*

6.2.1 Listing Significant, Moderate and Low Drinking Water Threats (Part XI.2)

Rule 9 (ix) requires that areas within vulnerable areas where activities that are or would be a significant, moderate or low drinking water threats be listed in the Assessment Report, that is, regardless of whether or not the activities presently exist in the vulnerable area.

An activity is deemed a significant, moderate or low threat dependent upon 1) specific circumstances related to that activity that influence the hazard presented by a chemical or pathogen associated with that activity, 2) the vulnerable area in which the activity is or would be located, and 3) the vulnerability score of that area. The MOE provides reference tables of significant, moderate and low drinking water threats related to activities. Table 1 and Table 2 of the Tables of Drinking Water Threats provided by the MOE lists drinking water threats related to chemicals and pathogens, respectively. Despite the above, an activity is deemed to be a significant or moderate threat if it contributes to a drinking water issue as per Rules 131 and 134.1.

Table 8 below provides an example showing the layout of the MOE Tables of Drinking Water Threats for pathogens. In this example, the drinking water threat in Column 1 would be considered to be significant if it were located in an area of the IPZ-1 with a vulnerability score of 9 under the circumstances set out in Column 2. The same threat would be considered to be low in an area of an IPZ-2 with a vulnerability score of 5.1.

Table 8. Example from Table 2 of the Tables of Drinking Water Threats to Identify Significant, Moderate and Low Threats Related to Pathogens

DRINKING WATER THREAT:	Reference number	Under the following CIRCUMSTANCES:	Area within Vulnerable Area	Threat is Significant in Areas with a Vulnerability Score of:	Threat is Moderate in Areas with a Vulnerability Score of:	Threat is Low in Areas with a Vulnerability Score of:
Column 1	Column 2		Column 3	Column 4	Column 5	Column 6
The application of agricultural source material to land	1	1. Agricultural source material is applied to land in any quantity. 2. The application may result in the presence of one or more pathogens in groundwater or surface water.	**IPZ-1, IPZ-2, IPZ-3 & WHPA-E**	8 - 10	6 - 7.2	4.2 - 5.6
			WHPA-A & WHPA-B	10	8	6

Lists of significant, moderate and low drinking water threats related to chemicals and pathogens were compiled for each of the vulnerable areas of the South River drinking water intake using the Ministry of the Environment's Microsoft Access database (Threats_LUT_v7.1.2) that allows the user to query threats based on a range in risk scores for each vulnerable area. Lists of significant, moderate and low threats for each vulnerable area are provided in digital format in Appendix A due to the large data files. The numbers of significant, moderate and low threats in vulnerable areas of the South River intake are summarized in Table 9.

Only the IPZ-1 for the South River intake has drinking water threats related to activities that would be significant due to contamination by chemicals or pathogens, and is further considered for enumeration of existing significant threats (Section 6.2.2).

Table 9. Number of Significant, Moderate and Low Drinking Water Threats for Vulnerable Areas of the South River Intake

Vulnerable Area	Vulnerability Score	# of Chemical Threats			# of Pathogen Threats		
		Significant	Moderate	Low	Significant	Moderate	Low
IPZ-1	9	239	967	646	41	27	4
IPZ-3 A	6.3	0	40	1,282	0	40	28
IPZ-3 B and C	4.5	0	0	239	0	0	41
IPZ-3 D	3.6	0	0	0	0	0	0
IPZ-3 E	2.7	0	0	0	0	0	0

6.2.2 Enumerating Significant Drinking Water Threats

The Rules require that the number of locations within vulnerable areas be enumerated at which 1) an activity that is a significant drinking water threat is being engaged in, and 2) any conditions resulting from a past activities that are a significant drinking water threat.

There are 239 chemical threats and 41 pathogen threats that would be significant if they occurred in the IPZ-1 of the South River intake. A breakdown of the activities prescribed to be drinking water threats and the number of circumstances under which those activities would be significant is provided in Table 10.

Manganese is the only confirmed drinking water issue (in accordance with Rule 114 (1)) for the South River intake. Manganese was considered to be naturally occurring and therefore, Rule 131 does not apply for the determination of significant threats associated with drinking water issues.

Based on a desktop search, field investigations conducted August 19th and September 14th, 2009 by AECOM staff, and information contained in previous threats assessments for the area (WESA, 2009), ***there are no known significant drinking water threats*** that presently exist in the vulnerable areas of the South River drinking water intake.

Based on a desktop search, ***there are no known conditions*** that exist in the vulnerable areas of the South River drinking water intake.

Table 10. Activities Prescribed to be Significant Drinking Water Threats in the IPZ-1 of the South River Intake

Activities Prescribed to be Drinking Water Threats	# of Significant Threats	
	Chemical	Pathogen
The application of agricultural source material to land.	6	5
The application of commercial fertilizer to land.	6	
The application of non-agricultural source material to land.	6	5
The application of pesticide to land.	10	
The application of road salt.	2	
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	159	5
The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	20	1
The handling and storage of non-agricultural source material.	6	1
The handling and storage of pesticide.	2	
The handling and storage of road salt.	2	
The management of runoff that contains chemicals used in the de-icing of aircraft.	2	
The storage of agricultural source material.	6	14
The storage of snow.	8	
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.	4	10
Grand Total	239	41

7. References

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Drinking Water Source Protection Studies for the Village of South River: Surface Water Vulnerability Study, Threats Inventory and Issues Evaluation, Water Quality Risk Assessment. Draft final report prepared for the North Bay-Mattawa Conservation Authority, Project No. SB5904, March 2009).