8.0 South River

8.1 Introduction and Summary of Findings

This section includes analyses of vulnerability with respect to both water quantity and water quality for the surface water intake for the Village of South River. General methodology for water quality vulnerability assessments for surface water systems is provided in Section 3.1 of this report.

Technical work supporting this section was completed during two studies, which are available online at www.nbmca.on.ca under the Drinking Water Source Protection tab or www.actforcleanwater.ca or directly from the North Bay-Mattawa Conservation Authority:

- WESA, 2009: 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); and
- AECOM, 2010b: Surface Water Vulnerability Study for the Village of South River Drinking Water Intake, Final report prepared for the North Bay-Mattawa Conservation Authority, Project No. 113616, January 6, 2010.

and includes the following:

- intake characterization (including water treatment plant and raw water quality)
- intake protection zone (IPZ) delineations;
- uncertainty analysis of IPZ delineations and vulnerability scores;
- drinking water issues evaluation;
- threat identification and assessment; and
- gap analysis and recommendations.

A technical advisory committee oversaw the technical aspects of the report and local knowledge was solicited from the community at large at two public meetings. Study findings were presented to the public and comments received. Peer review was conducted during the first study by WESA, and it was determined that additional flow data was required to verify the designation of the intake type. This work was subsequently undertaken by AECOM and a summary report was provided to meet all requirements for technical information for completion of the Assessment Report.

The intake for the Village of South River draws water from an impounded section of the South River. An analysis of flow conditions comparing the influence of the river current to wind effects at the surface confirmed that the most appropriate designation for the intake was Type D as an impoundment rather than a river.

Figure 8-1. South River Intake

A large portion of the watershed, upstream of the Village of South River, is in the Algonquin Highlands; the Village marks the uppermost area of settlement in the watershed. There are no significant or moderate stresses to the quantity of water.

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. The fact that there have been no documented concerns with water quality at the intake reduces the scoring of the source vulnerability from what it would be otherwise. The water treatment plant has full treatment (chemical assisted coagulation, flocculation and filtration).

Manganese concentrations have exceeded provincial drinking water standards, so manganese, which can cause excessive colour in water, was investigated as a drinking water issue for the

South River intake. The source of manganese was determined to be natural, likely released from sediments when a beaver dam was removed, but manganese remains a drinking water issue under Rule 114. There are no other chemical parameters that are confirmed drinking water issues for the South River intake.

There are no known significant drinking water threats that presently exist in the vulnerable areas of the South River drinking water intake.

Ontario Regulation 287/07 Section 1.1 (1) under the *Clean Water Act (2006)* lists 19 activities that may result in threats to drinking water quality. (Two additional prescribed activities pose threats to quantity.) (Section 3, Table 3-5). Conditions, as defined by Part XI.3 of the Technical Rules, refer to past activities that have produced contaminants that may result in significant drinking water threats.

Related to the nineteen prescribed activities, there are 239 circumstances that could be identified as chemical threats and 41 circumstances that could be identified as producing pathogen threats that would be significant if they occurred in the most vulnerable area – Intake Protection Zone -1 (IPZ-1).

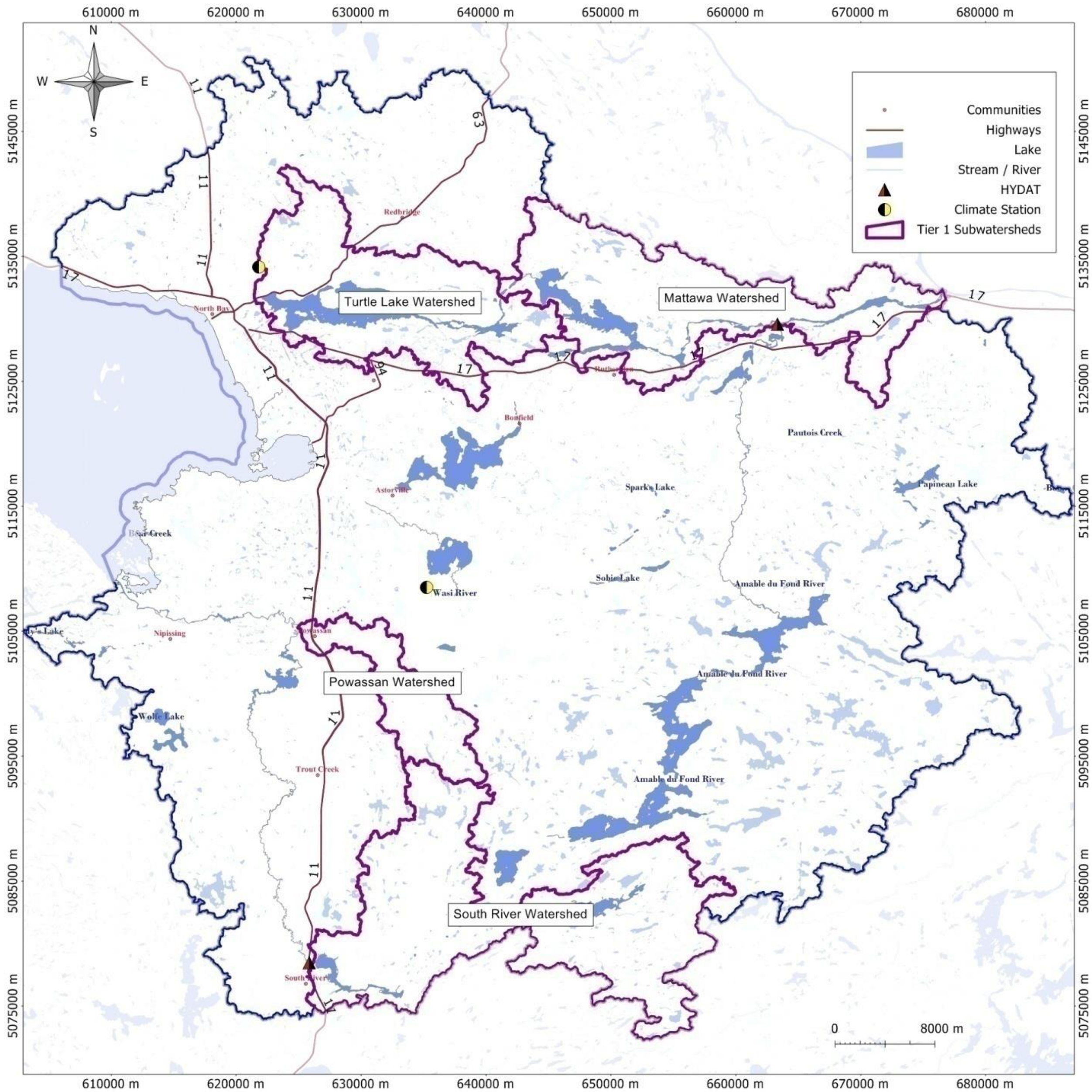
8.2 Water Budget and Water Quantity Stress Assessment

A water budget and water quantity stress assessment for each subwatershed is required by the *Clean Water Act (2006)* to determine whether the subwatershed will be able to meet current and future demands of all users. General principles were explained earlier in Section 2.5 Conceptual Water Budget.

The methodology specified in the Technical Rules Part III describes a tiered approach whereby all subwatersheds are subjected to a Tier One assessment and if stress is low during all months of the year, no further assessment is required. If stress levels are shown to be either moderate or significant, a more robust Tier Two assessment is completed and, similarly, if that reveals moderate or significant stress, a Tier Three Local Risk Assessment must be undertaken. The information for this section is based primarily on the Tier One Water Budget and Stress Assessment for the South River, Powassan and Mattawa Municipal Water Supplies (WESA, 2010). A Tier One assessment for the remainder of the subwatersheds in the SP Area is presented in Section 2.6.

The subwatershed containing the Village of South River surface water supply is comprised of the South River watershed upstream of the South River Dam (Figure 8-2). Municipal drinking water for the Village of South River is currently serviced by a surface water intake that draws water from the South River reservoir. The Village of South River experienced an increase in population of 2.8%, between 2001 and 2006 (Statistics Canada, 2007), but had previously experienced a decline of 5.3% between 1996 and 2001, resulting in a net decline of 2.6% over the 10-year period. As a result, the Tier One Water Budget has been conducted using current population estimates.

Figure 8-2. Tier One Water Budget Subwatershed



Water budget elements, including precipitation, actual Evapotranspiration (AET), surplus, recharge, and runoff were estimated using the methodology described in Section 2-5. Table 8-1 summarizes these parameters.

Total annual surplus should theoretically equal stream flow (Gartner Lee Ltd., 2007a). Analysis of continuous stream flow data collected at Environment Canada/Water Survey of Canada gauge 02DD009 (South River at South River) yields a total annual surplus of 435 mm. The total surplus predicted by the Thornthwaite-Mather soil moisture budget conducted by WESA on the South River subwatershed yielded a total annual surplus of 482 mm; a difference of approximately 11% compared to EC/WSC stream flow data. The primary cause for the difference is likely that the precipitation predicted by the WESA GIS model was greater than that predicted by Gartner Lee Ltd. (2007a), as was the case with the Powassan subwatershed.

There is still a high level of confidence in the water balance despite the difference between surplus predicted by WESA and Gartner Lee Ltd. (2007a).

Total surplus was partitioned into recharge and runoff using the average partitioning coefficient for the NBMCA Source Protection Area (0.478; Gartner Lee Ltd., 2007a). This resulted in annual recharge and runoff of 227 and 250 mm, respectively. It should be noted that the sum of the recharge and runoff total 477 mm, while the total annual surplus is 482 mm. This discrepancy is due to rounding errors in the spreadsheet model during the calculation of monthly recharge and runoff.

Table 8-1. Estimated Water Budget Elements (South River)

Month	Precipitation (mm)	AET (mm)	Surplus (mm)	Recharge (mm)	Runoff (mm)
January	74.1	0.0	74.1	1.4	1.6
February	54.7	0.0	54.7	0.7	0.8
March	64.5	0.0	64.5	0.4	0.4
April	67.2	20.7	46.5	28.4	31.2
May	83.5	76.2	7.3	84.4	92.9
June	88.2	106.4	0.0	42.2	46.4
July	95.7	117.2	0.0	21.1	23.2
August	92.6	99.1	0.0	10.5	11.6
September	113.1	67.0	0.0	5.3	5.8
October	98.5	29.9	68.5	18.9	20.9
November	93.4	0.0	93.4	9.5	10.4
December	72.8	0.0	72.8	4.1	4.6
Total	**998.3**	**516.4**	**481.9**	**226.9**	**249.8**

The surface water supply is the water available for a subwatershed’s surface water users. The South River water supply was estimated using Environment Canada/Water Survey of Canada (EC/WSC) HYDAT stream gauge data from gauge 02DD009 (South River at South River). The dataset spans from 1962 through 1991. Parametric statistics (median and Q_{P50}) were calculated for these data. Table 8-2 presents these results.

Table 8-2. Surface Water Flow Statistics for HYDAT Station 02DD009

Month	Flow (m^3/s)		
	Median	Supply (Q_{P50})	Reserve (Q_{P90})
Jan	4.1	4.0	3.0
Feb	4.0	3.9	3.1
Mar	4.6	4.7	3.3
Apr	10.9	10.5	5.6
May	6.3	6.5	3.7
Jun	3.6	3.5	2.0
Jul	2.4	2.3	1.4
Aug	2.3	2.3	1.3
Sep	2.4	2.3	1.3
Oct	3.6	3.6	1.7
Nov	4.9	4.8	2.0
Dec	4.9	5.1	2.8

The 50th percentile flow (Q_{P50}) ranges from a minimum of 2.3 m^3/s (July through September) to a maximum of 10.5 m^3/s (April). The average total annual water supply based on the streamflow gauge is 435 mm. This is in close agreement with the total surplus predicted using the soil moisture budget spreadsheet (482 mm).

As described in Section 2.6, surface water reserve was estimated as the Q_{P90} (10$_{th}$ percentile) of the gauged stream flow (MOE, 2007). Average annual water reserve based on continuous streamflow data from EC/WSC gauge 02DD009 is 25.3 mm and monthly water reserve is 2.10 mm, or 2.58 m^3/s (based on a subwatershed area of 322,598,800 m^2). Table 8-2 presents monthly reserve (Q_{P90}) based on median monthly flows.

Water use was estimated from the relevant datasets available for the study area and the results, compiled on monthly and annual scales.

Municipal and communal use was determined using the 2004 Environment Canada Municipal Water and Wastewater Survey (Environment Canada, 2004b) as well as the PTTW database (MOE, 2009a). Municipal and communal water takings include the municipal surface water intake (for which actual water use data are available) and other permitted communal takings contained in the PTTW database, such as campgrounds. There were no permitted takings for communal use in the South River municipal supply subwatershed.

Water takings and returns were divided between deep groundwater, shallow groundwater, and surface water. The following assumptions were made:

- 2004 actual municipal water use values used in order to be consistent with other values in the Municipal Water and Wastewater Survey;
- municipal water consumed includes water from populations with sewage haulage; and
- municipal system losses are returned to shallow groundwater through infiltration.

Gross takings for municipal/communal use are approximately 207,316 m^3/yr. Of the gross municipal/communal takings, approximately 37,275 m^3/s (14%) is consumed. Municipal and communal water takings make up approximately 31% of the total gross water takings in the subwatershed and 10% of the water consumed.

Municipal and communal water takings are comprised of:

- surface water takings from the municipal intake in the South River Reservoir that reach serviced residents (186,377 m^3/yr); and
- water that is lost to the system (20,939 m^3/yr).

Table 8-3 summarizes these results. 100% of municipal and communal takings (207,316 m^3/yr) are from surface water. All of the municipal water not consumed is returned to shallow groundwater as 100% of the serviced population uses septic systems for water treatment (Environment Canada, 2004b).

Table 8-3. Municipal and Communal Takings (South River)

General Use	Specific Source/Use	Gross Takings (m^3/yr)	Consumed (m^3/yr)	% Consumed
Municipal / Communal	Municipal surface water to serviced residents	186,377	37,275	18.0
Municipal	System Losses	20,939	0	0.0
Total		207,316	37,275	18

Water use results for the industrial and commercial sectors were estimated from the 2004 Environment Canada Municipal Water and Wastewater Survey (Environment Canada, 2004b) and through review of the PTTW database.

The PTTW database yielded one result for the commercial sector (golf course irrigation; permit number 00-P-5002; MOE, 2009a). The gross water taking for this permit was 396,097 m^3/yr; 354,315 097 m^3 from surface water and 41,782 m^3 from groundwater. It is assumed that the groundwater takings are from shallow groundwater as the permit information states that water is withdrawn from a dug well. The surface water taking is allowed for 260 days per year (assumed to extend between March 1 through November 15), while the groundwater taking is allowed year-round. The maximum allowable taking for this permit accounts for 60% of the gross water takings, 63% of gross surface water takings, and 100% of the gross takings from shallow groundwater.

A consumptive factor of 0.70 was used to determine consumption (MOE, 2007), which resulted in annual consumption of 248,021 m^3 and 29,247 m^3 from the surface water and groundwater takings, respectively. This accounts for 87% of the consumption from surface water and 100% of the consumption from shallow groundwater. The total consumption of 277,268 m^3 accounts for 74% of total consumption. Commercial water use results in consumption of 42% of gross water takings in the subwatershed. It was assumed that water returns (118,829 m^3 /yr) are to shallow groundwater via septic systems and infiltration of irrigation water.
There are no additional permits for the Village of South River municipal water supply subwatershed in the PTTW database.

Statistics Canada data indicates the population of the Village of South River was 1,069 in 2006. Of this population, 1 % of residents are supplied by private wells, with a total gross water taking of 683 m^3/yr. It is assumed that domestic use from outside the Village of South River is negligible.

Using a consumptive factor of 0.2, it was estimated that 137 m^3/yr is consumed. It is assumed that the remaining water is returned via septic systems to the shallow groundwater.

The following assumptions were made during the analysis of agricultural water use:

- water use for livestock consumption is constant throughout the year, while water taken for crop irrigation is isolated to July and August (MOE, 2007);
- 100% of the water taken for livestock consumption is consumed, while 80% of water used for crop irrigation is consumed (MOE, 2007);
- water taking is from deep groundwater (to be consistent with private domestic wells); and
- water not consumed is assumed to return to shallow groundwater through infiltration.

Gross water takings for agricultural purposes are used entirely for livestock irrigation (as crop data was suppressed to meet confidentiality requirements of the Statistics Act and are therefore assumed negligible) and are estimated at 61,778 m^3/yr. Total agricultural demand comprises approximately 9% of the total water takings and 16% of total consumption.

The water use results developed for each of the sectors and presented above were amalgamated to estimate the cumulative water use for each of the systems (surface water, shallow groundwater, and deep groundwater). Results from South River are summarized on an annual scale in Tables 8-4a, b, and c, and graphically on Figure 8-3.

Of the gross annual water takings within the study area, 84% are from surface water, 6% from shallow groundwater and 9% from deep groundwater.

Of the gross water takings, 57% are consumed, where 76% of water consumed comes from surface water, 8% from shallow groundwater and 16% from deep groundwater. All water that is not consumed is assumed to be returned to shallow groundwater through infiltration and septic systems. Since 100% of serviced residents use septic systems for treatment (Environment Canada, 2004b), it is assumed that returns from other users are also treated via septic systems. It is assumed that water lost to the system is lost through leakage and returns to the shallow groundwater through infiltration).

Table 8-5 summarizes the net water takings for South River. Positive values indicate that returns exceed takings. This is the case for shallow groundwater where an excess of 247,634 m^3 are returned annually. Both the surface water and deep groundwater systems have more water taken than returned; 561,631 and 62,461 m^3/yr, respectively. The net water takings exceed returns by 376,458 m^3/yr.

Table 8-4a. Annual Water Use Results - Gross Takings (South River)

	Gross Annual Takings (m³)					
Reservoir	Permitted Takings			Non-Permitted		TOTAL
	Municipal and Communal[a]	Industrial and Commercial[b]	Other Permitted	Private Domestic	Agricultural[c]	
Surface Water	207,316	354,315				561,631
Shallow Groundwater		41,782				41,782
Deep Groundwater				683	61,778	62,461
TOTAL	207,316	396,097	0	683	61,778	665,874

Table 8-4b. Annual Water Use Results - Consumption (South River)

	Annual Consumed (m³)					
Reservoir	Permitted Takings			Non-Permitted		TOTAL
	Municipal and Communal	Industrial and Commercial	Other Permitted	Private Domestic	Agricultural	
Surface Water	37,275	248,021				285,296
Shallow Groundwater		29,247				29,247
Deep Groundwater				137	61,778	61,915
TOTAL	37,275	277,268	0	137	61,778	376,458

Table 8-4c. Annual Water Use Results - Returns (South River)

	Annual Returned (m³)					
Reservoir	Permitted Takings			Non-Permitted		TOTAL
	Municipal and Communal[d]	Industrial and Commercial[b]	Other Permitted	Private Domestic[e]	Agricultural	
Surface Water						0
Shallow Groundwater	170,040	118,829		546		289,416
Deep Groundwater						0
TOTAL	170,040	118,829	0	546	0	289,416

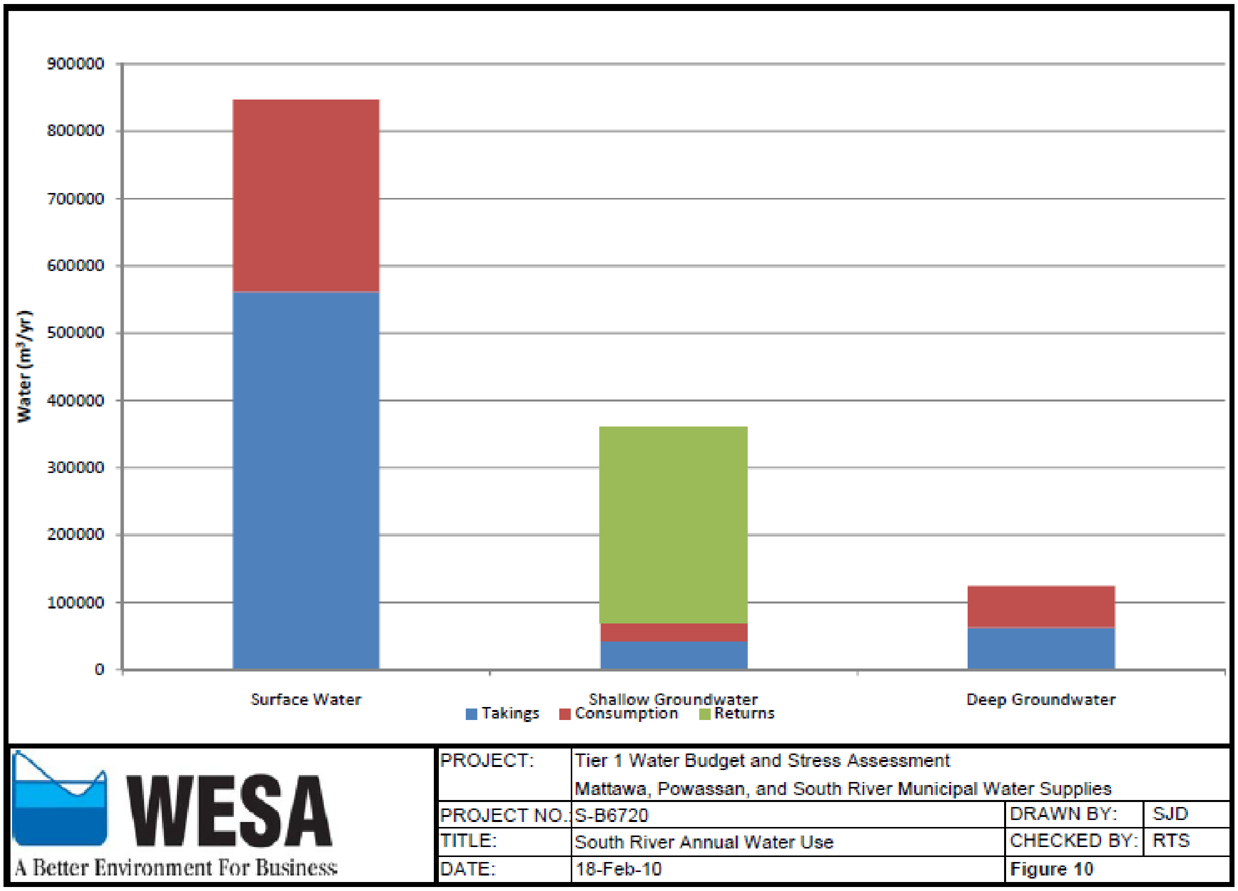
Notes:
a Includes system losses, which are assumed to return to surface water
b Assume industrial and commercial water comes from shallow groundwater and returns to SW through sewer service
c Assume agricultural water comes from deep groundwater, since assuming source is same as private wells, and most private domestic wells are in deep bedrock
d Assume remaining 0.2% returns to surface water (99% on sewer and 0.8% on septic)
e Assume returns from private domestic wells discharges through septic systems to shallow groundwater

Table 8-5. Net Water Takings (South River)

Reservoir	Net Water Takings (m3)
Surface Water	-561,631
Shallow Groundwater	247,634
Deep Groundwater	-62,461
TOTAL	-376,458

Note:
Positive values indicate that returns exceed takings

Figure 8-3. Annual Water Use (South River)



Monthly takings from surface water range from 15,904 to 59,853 m^3. The large range is due to the seasonal water takings used for golf course irrigation, which occur between March 1 and November 15. Takings from shallow groundwater range between 3,205 and 3,549 m^3, while takings from deep groundwater range from 4,792 to 5,305 m^3. Tables 8-6a, b and c present monthly water use results, including gross, consumed, and returned water.

Table 8-6a. Monthly Water Use Results - Gross Takings (South River)

Reservoir	Monthly Gross Water Takings (m³)												Annual Gross Water Takings (m³/yr)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Surface Water	17,608	15,904	59,853	57,922	59,853	59,853	57,922	59,853	57,922	59,853	37,481	17,608	561,631
Shallow Groundwater	3,549	3,205	3,549	3,434	3,549	3,434	3,549	3,549	3,434	3,549	3,434	3,549	41,782
Deep Groundwater	5,305	4,792	5,305	5,134	5,305	5,136	5,303	5,305	5,134	5,305	5,134	5,305	62,461

Table 8-6b. Monthly Water Use Results - Consumption (South River)

Reservoir	Monthly Consumptive Water Takings (m³)												Annual Consumptive Water Takings (m³/yr)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Surface Water	3,166	2,859	32,738	31,681	32,738	32,738	31,681	32,738	31,681	32,738	17,373	3,166	285,296
Shallow Groundwater	2,484	2,244	2,484	2,404	2,484	2,404	2,484	2,484	2,404	2,484	2,404	2,484	29,247
Deep Groundwater	5,259	4,750	5,259	5,089	5,259	5,089	5,258	5,259	5,089	5,259	5,089	5,259	61,915

Table 8-6c. Monthly Water Use Results - Returns (South River)

Reservoir	Monthly Water Returns (m³)												Annual Water Returns (m³/yr)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Surface Water	0	0	0	0	0	0	0	0	0	0	0	0	0
Shallow Groundwater	15,553	14,048	28,226	27,316	28,226	28,192	27,350	28,226	27,316	28,226	21,183	15,553	289,416
Deep Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0

8.2.1 Surface Water Stress Assessment

Surface water stress is determined by examining the ratio of water demand (water takings) to water supply, while considering in the reserve required to maintain ecosystem function (MOE, 2007). The percent water demand is compared to a stress threshold (Table 8-7) to determine the stress level.

Table 8-7. Surface Water Stress Thresholds Based on Maximum Monthly % Water Demand

Groundwater Quantity Stress Level Assignment	Maximum Monthly (%) Water Demand
Significant	≥ 50%
Moderate	> 20% and < 50%
Low	≤ 20%

The maximum monthly percent surface water demand for the Village of South River municipal supply subwatershed is 1.2 %. Table 8-8 presents the demand, supply, and reserve values used to calculate the percent demand. A subwatershed is considered low stress if the maximum monthly percent demand is less than 20%. As a result, the Village of South River municipal supply subwatershed is considered low stress and does not require a Tier Two Assessment.

Table 8-8. Percent Water Demand (South River)

Month	Consumption	Supply	Reserve	%Demand
January	0.010	33.2	24.91	0.118
February	0.009	29.2	23.25	0.148
March	0.101	39.0	27.40	0.873
April	0.098	84.4	44.99	0.249
May	0.101	54.0	30.72	0.437
June	0.101	28.1	16.07	0.842
July	0.098	19.1	11.62	1.314
August	***0.101***	***19.1***	***10.79***	***1.222***
September	***0.098***	***18.5***	***10.45***	***1.222***
October	0.101	29.9	14.11	0.643
November	0.054	38.6	16.07	0.239
December	0.02	42.3	23.25	0.126
Annual	**0.90**	**435**	**253.6**	**0.494**

Note:
Bold italics *indicate months with maximum monthly percent demand.*

8.2.2 Uncertainty

The limitations inherent to each dataset individually, combined with the discrepancies between datasets, all introduce various levels of uncertainty which are ultimately compounded into the results.

Because this study is conducted at the regional scale, results must be interpreted in their context and would require confirmation and refinement through further investigation at the local scale. Also, the various datasets used in the analysis are a ‘snapshot in time’, as population census is as of 2006, while municipal water use data is current as of 2004. Obtaining contemporary, more up to date data would reduce the error associated with the combination of datasets from varying dates;

The greatest source of uncertainty in estimating water use comes from the Provincial Permits to Take Water (PTTW) database. Permit validity determined from information contained in the database (expiry date, whether a permit has been revoked, etc) is challenging, and would require review of individual permits to increase confidence in the data. Only water takings greater than 50,000 L/d are included in the PTTW database, while water use from smaller users is unknown.

The PTTW database only contains information on maximum allowable withdrawals, while actual takings are unknown with the exception of a municipal water supply. However the uncertainty associated from this limitation was reduced in part by applying the monthly and consumptive use factors specified in the provincial guidance document (MOE, 2007) and AquaResource (2005).

Other sources of uncertainty include how very little information is available for some sectors; for instance, there may be a number of smaller industrial and commercial users that are not accounted for. Water taking for livestock is exempt from the permitting requirements, regardless of the volume taken. Similarly, no information is available for recreational or ecological users.

Considering the significant sources of uncertainty, the uncertainty associated with the Tier One Water Budget and Stress Assessment is considered high. However, the percent demand for this system is well below the defined thresholds, and as such no additional work is likely required to address the uncertainty.

8.3 Intake Characterization

Source Water

The intake is located in the South River Reservoir[8], 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 (Fig. 8-1). 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.

The South River is approximately 90 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 830 km^2. There are six hydro generating stations along the length of the South River and water levels are regulated on eight lakes in the upper watershed including the South River Reservoir according to the South River Water Management Plan (OPGI, draft report 2005). The Plan includes a detailed review of the hydrology of the South River.

Water levels in the South River Reservoir are regulated by MNR's Forest Lake Dam[9] located at the outlet of the reservoir. A privately-owned generating station that operated at the 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 was redeveloped in 2010 to produce 650 kW of power as a run-of-the-river facility.

Water quality data for the period 1973-1991 are available from a Provincial Water Quality Monitoring Network Station (PWQMN) 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 8-9. The water quality measured at this location is generally typical of rivers on the Precambrian Shield. Values for most parameters tend to vary with flow rates and turbidity, but these are moderated somewhat by the influence of the dam and reservoir.

[8] *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.*

[9] *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.*

Table 8-9. 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 1991only; [d]significant changes in analytical detection limits occurred beginning in 1991, data pre-1991 exist but are not included in the assessment

Several parameters that are typically correlated to water contact time with soils e.g., aluminum, iron, copper, cadmium and phosphorus exceeded the Provincial Water Qualtity Objectives (PWQO) on several occasions. These parameters often increase naturally with turbidity.

Two parameters that are typically associated with anthropogenic (human) sources, lead and phenolics, have exceeded the PWQOs. Lead exceeded the objective of 5 µg/L twice in 2009 (May 26 and June 29) but was reported below detection limits on 14 of 20 sampling occasions between 2007 and 2009. 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. Phenolics exceeded the PWQO of 1 µg/L on a single occasion in May, 1991. No exceedances of either lead or phenolics have been reported in raw water or treated water at the South River water treatment plant. It is possible that inputs of these parameters to the river occurred downstream of the water intake; therefore, no additional action was recommended.

For most parameters monitored at the South River PWQMN, levels in 2007 to 2009 were similar to 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.

Hydrology

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. The reservoir is bound upstream by the Brennan Road causeway and downstream by the Forest Lake Dam 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 and flow between the basins is restricted to a 20-m wide opening in the causeway. Due to a strong current through that opening, back-flow of water from the downstream basin toward the intake is unlikely.

The South River Reservoir is shallow with a mean depth of approximately 1.2 m and volume of approximately 3.9×10^6 m^3 (Tottten Sims Hubricki Associates, 1998). There are isolated deep spots located 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.

System Details

The South River water treatment plant 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 99% of the population of the village (Environment Canada, 2001). The population of South River was 1,069 in 2006, a 2.8% increase from the 2001 population of 1,040 (Statistics Canada, 2009).

Water treatment is by chemically assisted coagulation with 2x Napier Ried filtration (one anthracite filter and one 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 plant is less than 1 hour.

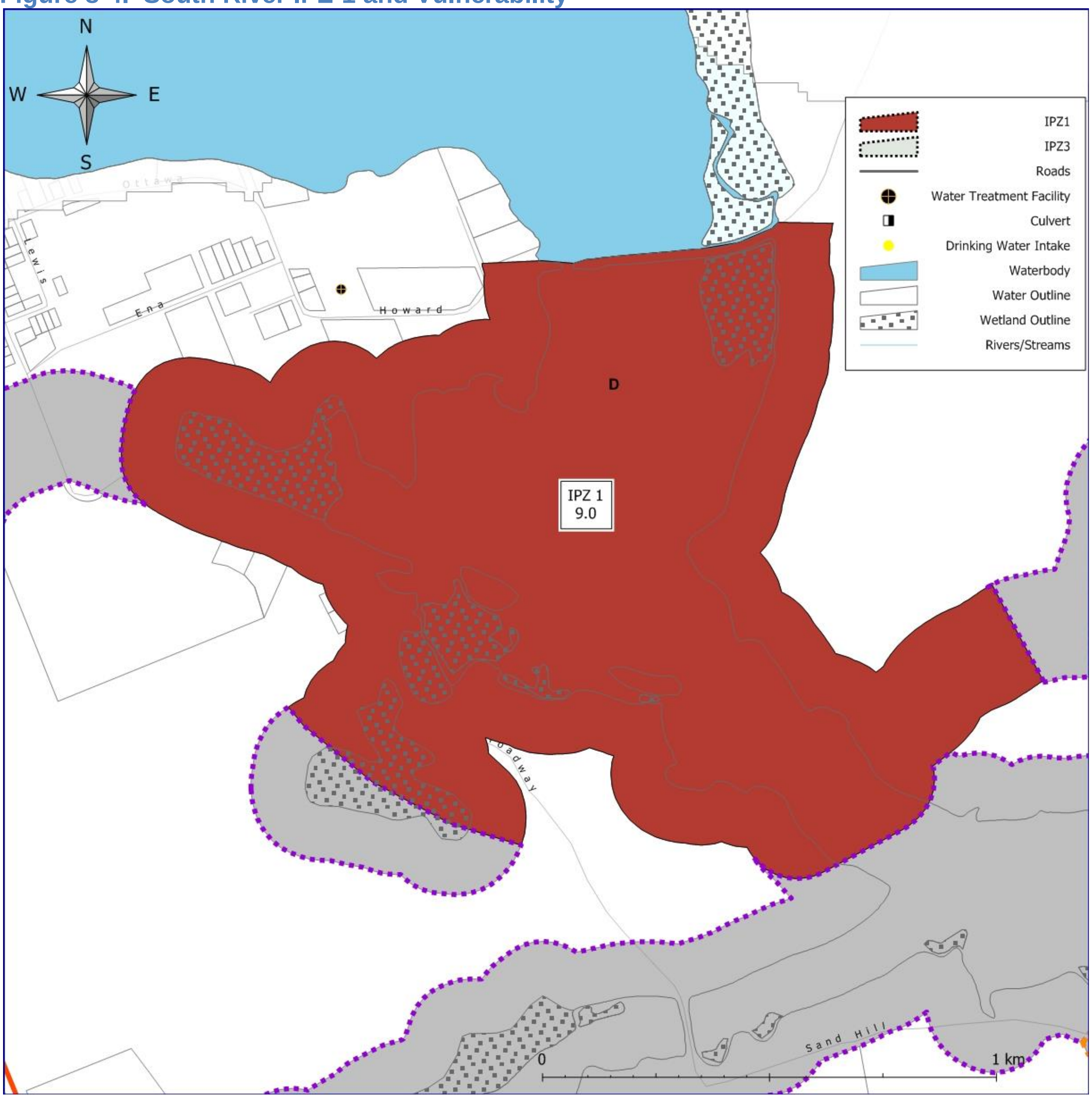
The plant has a rated capacity of 1,680 m^3/day. Presently, the plant operates well below its capacity with an average water taking of 590 m^3/day and a maximum taking of 854 m^3/day in 2008. The total water taking in 2008 was 215,539 m^3.

8.4 Delineation and Scoring of Vulnerable Areas

8.4.1 Defining the Vulnerable Areas

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 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). Delineation of these was completed in accordance with Parts VI.2 to VI.6 of the Technical Rules for a Type D intake. In some cases, a zone may lie entirely within another zone, and in those cases only the most vulnerable zone will be indicated.

Figure 8-4. South River IPZ-1 and Vulnerability



Intake Protection Zone 1 (IPZ-1) is the most vulnerable of the vulnerable area for an intake and the procedure for delineation is specified by Technical Rules 61-64. If contaminants were released in this area the drinking water plant operators would have little time to respond. IPZ-1 for the South River intake includes the surface area of the east basin of the South River Reservoir within 1 km of the drinking water intake and abutting lands that drain to this area to a maximum setback of 120 m from the high water mark (Figure 8-5). As described in Section 8.3, the basin of the reservoir in which the intake is located is hydrologically separated from the downstream basin by the Chemical Road Causeway. The opening under the causeway effectively serves as the outlet of the basin in which the intake is located. The decision to include some wetland areas in the IPZ-1 was based on an assessment of local site conditions made during field investigations.

Intake Protection Zone 2 (IPZ-2) is the secondary protection zone, delineated according to Technical Rules 72-74. If a spill or other event that may impair water quality at the intake were to occur in the IPZ-2, the plant operator would have sufficient time to respond. Although response time for operators of the South River water treatment plant is estimated at less than one hour, a minimum two hour response time must be provided. IPZ-2 therefore includes the area where a contaminant could reach the intake within two hours, but does not include any areas already in the IPZ1. IPZ-2 is also extended to include applicable areas draining to stormwater management works. Establishing the time it takes for water borne contaminants to reach the intake is a key step in the process. The following paragraphs describe the process undertaken which concluded that the IPZ-2 would lie entirely within the IPZ-1.

In 2009, WESA used a HEC-RAS model to simulate flow velocities in the reservoir, and predicted velocities of only 0.01 to 0.02 m/s near the intake at bank-full conditions. These appear quite reasonable considering 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 by AECOM 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.

In the absence of a hydrodynamic model or measured surface water currents during high wind conditions, maximum surface water current velocity in the reservoir was estimated using major limnological principals guiding wind-driven surface water current speeds. 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 Airport (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 two-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. Therefore the two hour time of travel area in the South River Reservoir is already included in the IPZ-1.

There is one tributary that enters the intake basin within the two hour time of travel distance. 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 a 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. 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.

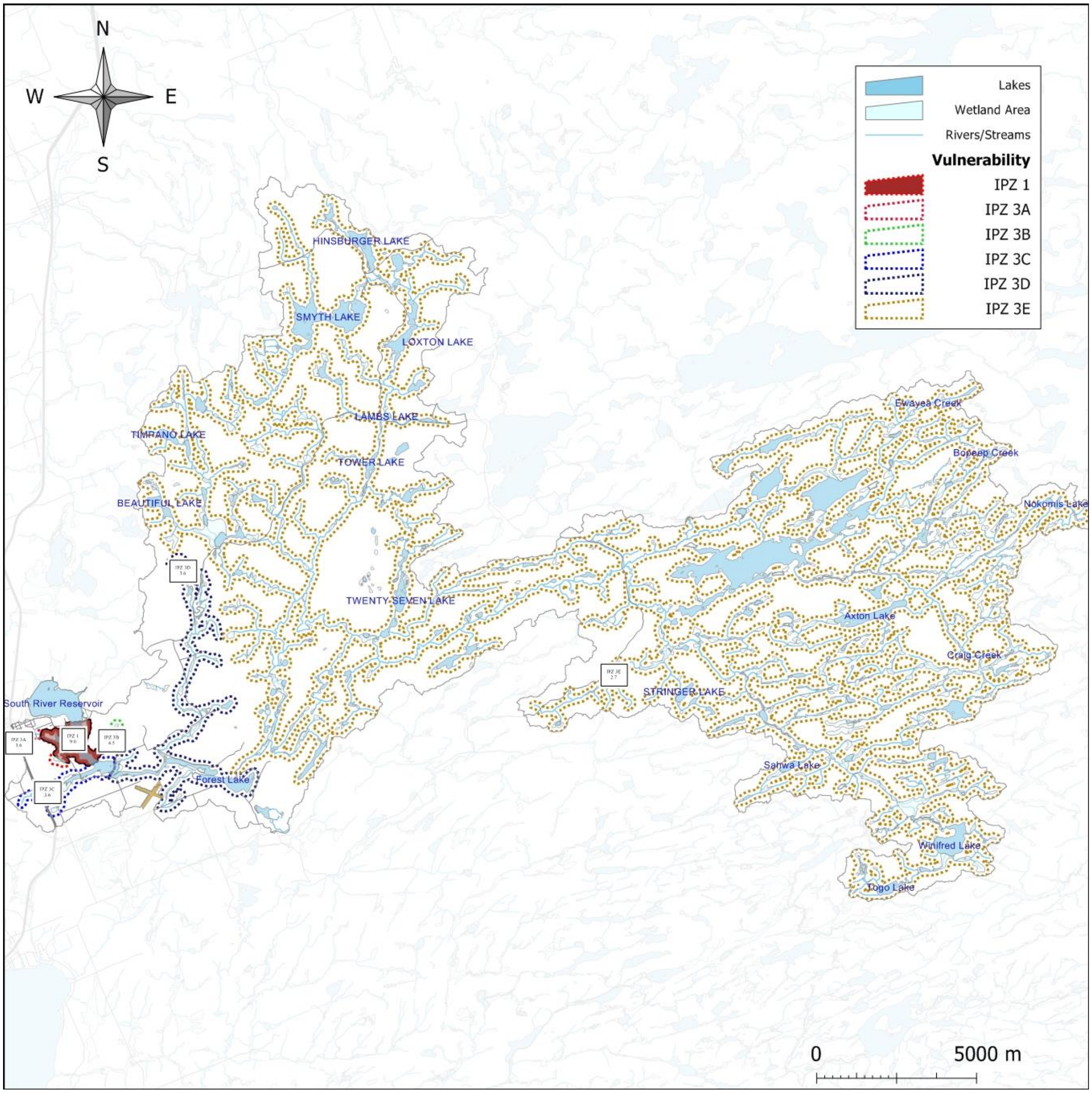
There are no land areas outside of the IPZ-1 that drain water to stormwater management works and contribute water to the intake where the time of travel to the intake would be two hours or less. The property along the east shore near the IPZ-1 is not developed and has no stormwater management.

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

Intake Protection Zone 3 (IPZ-3) is the third vulnerable area and Technical Rules 72, 73 and 75 direct how it is to be delineated. IPZ-3 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 and the corresponding Vulnerability Scores is illustrated in Figure 8-6 and further discussed below.

Figure 8-5. IPZ-3 Subzones and Vulnerability

Note: larger 11" x 17" version is available in Appendix A.



8.4.2 Vulnerability Scoring of the IPZs

Vulnerability scores are calculated as the Area Vulnerability Factor multiplied by the Source Vulnerability Factor. Guidance for calculating these vulnerability factors is provided in Part VIII.2 and Part VIII.3 of the technical rules.The IPZ-1 is assigned a set area vulnerability factor of 10 (Rule 88). The vulnerable area for South River's municipal intake did not contain an IPZ-2.

Area Vulnerability Factors assigned to areas within the IPZ-3 can range from 1 to 9, where a higher vulnerability factor results in greater vulnerability. Area Vulnerability Factors for an IPZ-3 were based on the following aspects:

- Percentage of the area that is composed of land;

1. <25% = 0
2. 25–75% = 1
3. >75% = 2

- Land cover, soil type, permeability of the land and the slope of setbacks (each factor was given a score of 0.5 if the criteria below was met, then added to a maximum score of 2);

1. <85% forested = 0.5
2. Variable soils = 0.5
3. >25% impervious area = 0.5
4. Setback slopes >20% = 0.5

- Hydrological and hydrogeological conditions in the area that contributes water to the area through transport pathways;

1. Many transport pathways = 2
2. Few transport pathways = 1
3. No transport pathways = 0

- The proximity of the area to the intake.

1. <2km = 2
2. 2-5km = 1
3. >5km = 0

The specific methodology for assigning Area Vulnerability Factors for each of the surface water intakes is provided in Section 3.1. For each subzones, the Area Vulnerability Factor was calculated as the sum of individual scores (0, 1 or 2) assigned for each of the four aspects listed above. This procedure weighted all facotrs equally. The maximum aspect score that could be generated is 8 for the IPZ-3 subzones (four aspects times maximum score of 2). The aspect score was then pro-rated to determine the Area Vulnerability Factor for each zone.

Different Area Vulnerability Factors were assigned for five areas within the IPZ-3 (Figure 8-6) based on differences in physical characteristics of each area, including distance to the intake. The areas include:

- IPZ-3a (west tributary) - the tributary (and setback area) that crosses Broadway Street and outlets to the South River Reservoir at the west shore;
- IPZ-3b (east tributary) - the tributary (and setback area) that outlets to the South River Reservoir at the east shore;
- IPZ-3c - area downstream of the Brennan Road Causeway;
- IPZ-3d - Forest Lake (upstream of the Brennan Road Causeway) and tributaries draining to Forest Lake within 5 km of the intake, and
- IPZ-3e - area upstream of Forest Lake & its tributaries mentioned above (ie. >5km from the intake)

Based on this analysis, IPZ-3A, IPZ-3C and IPZ-3D have an area vulnerability of 4. IPZ-3B has an area vulnerability of 5, which is the mid value of the possible range of area vulnerability scores (1-9), and IPZ-3E has an area vulnerability of 3. Area vulnerability scoring is summarized in Table 8-10.

Table 8-10. 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				
	3a	3b	3c	3d	3e
	West tributary	East tributary	Downstream of Brennan Rd. Causeway	Forest Lake & tributaries within 5 km of the intake	Area upstream of Forest Lake & tributaries (ie. >5km from the intake)
% area composed of land Scoring: <25% = 0 25-75% = 1 >75% = 2	9% (0)	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	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 (1)	Within ~5 km of the intake (1)	greater than 5 km from the intake (0)
Total Aspect Score	3.5/9 = 39%	4/9 = 44%	3.5/9 = 39%	3/9 = 33%	2/9 = 22%
Possible AVF range	1-9	1-9	1-9	1-9	1-9
Area Vulnerability Factor Scoring: 1 + sum of individual factor scores	4 (39%x8+1)	5 (44%x8+1)	4 (39%x8+1)	4 (33%x8+1)	3 (22%x8+1)

Note:
Scores for component factors affecting vulnerability are provided in brackets

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:

- depth of the intake from the surface;
- distance of the intake from land; and

- 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).

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 8-11. 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 4.5 for subzone IPZ-3b 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.

Table 8-11. 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-3a	4		3.6
IPZ-3b	5		4.5
IPZ-3c	4		3.6
IPZ-3d	4		3.6
IPZ-3e	3		2.7

8.4.3 Uncertainty Analysis

Part I.4 of the Rules requires than an uncertainty rating of “high” or “low” be made with respect to the delineation of intake protection zones (IPZs) and vulnerability scores based on:

1. The distribution, variability, quality and relevance of data used in the preparation of the assessment report.
2. The ability of the methods and models used to accurately reflect the flow processes in the hydrological system.
3. The quality assurance and quality control procedures applied.
4. The extent and level of calibration and validation achieved for models used or calculations or general assessments completed.
5. The accuracy to which the area vulnerability factor and the source vulnerability factor effectively assesses the relative vulnerability of the hydrological features.

In consideration of the above factors, a “low” uncertainty is assigned to the delineation of the IPZ-1 and IPZ-3 and the associated vulnerability scores.

The IPZs were delineated in accordance with the Technical Rules, which are highly prescribed such that uncertainty of the delineations is greatly reduced. Watershed delineations and the identification of water bodies and setbacks were completed by a qualified GIS specialist using geographical information available from the Ministry of Natural Resources, providing a high degree of certainty in the final IPZ delineations. There is some uncertainty with respect to the delineation of the IPZ-1 as the exact position of the intake was not field-verified. The intake location was determined from engineering design documents and is believed to be accurate to within a few meters.

The area and source vulnerability factors were assigned using a semi-quantitative approach to provide a consistent means of assessing relative vulnerability of the IPZs. Quantitative GIS data including land cover, slope characteristics, permeability, etc. were considered in the scoring. This approach was also used for the surface water intakes in Callander and North Bay providing a consistent means of vulnerability scoring across the North Bay-Mattawa Source Protection Area. Uncertainty was reduced by field reconnaissance investigations of the setback areas around the South River reservoir.

8.5 Issues Identification and Assessment

The issues identification process reviews records of pathogens and chemicals in the source water that may indicate a cause for concern. Drinking water issues relate to the presence of a 'listed parameter' in water at the intake if:

- 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
- 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 Technical Rules do not specifically define 'deterioration of the quality of water for use as a source of drinking water'. Therefore AECOM assessed water quality parameters as issues using the following approach:

- 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);
- any parameter in treated water that has exceeded the applicable benchmark (ODWQS, AO, OG) is considered a drinking water issue;
- 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.

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

Drinking Water Information System (DWIS) Monitoring Data

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 production of the vulnerability report. 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.

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.

8.5.1 Issues Related to 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 8.9). 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 water treatment plant operator and the Technical Advisory Committee for the study, 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 Technical 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 investigated the source of elevated apparent colour at the point of entry of the WTP in the summer of 2009. 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, the manganese concentration of 0.105 mg/L was measured 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.

8.5.2 Issues Related to 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). However, 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. 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 levels 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 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 two full years of data were available at the time of report production). (Table 8-12) If additional data become available, trends will be assessed.

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 8-12. *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

8.6 Threats Identification and Assessment

Threats are defined as those activities or conditions that could cause contamination of drinking water by a chemical or pathogen within one of the three Intake Protection Zones (IPZs). Activities must be assessed and reported whether or not they currently occur within the vulnerable areas. Ontario Regulation 287/07 section 1.1 (1) under the *Clean Water Act (2006)* lists 19 activities that may result in threats to drinking water quality. (Two additional prescribed activities pose threats to quantity.)

The threats evaluation involves the identification of activities or conditions within vulnerable areas that could cause contamination of drinking water by a chemical or pathogen. Conditions, as defined by Rule 126, result from past activities and can include the presence of:

- a non-aqueous phase liquid in groundwater in a highly vulnerable aquifer, significant groundwater recharge area or wellhead protection area;
- 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;
- 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;
- 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
- 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 Technical Rules with respect to threats assessment. These involve:

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

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.

8.6.1 Threats

Part XI.4 of the Technical Rules describe the methods for identifying significant, moderate and low drinking water threats related to activities in the vulnerable area of a drinking water intake.

A threat is deemed significant, moderate or low depending on:

6. the vulnerable area in which the activity occurs or would occur;
7. the vulnerability score of the vulnerable area;
8. a set of prescribed activities and corresponding circumstances that constitute a threat.

The Technical Rules require activities that would be a significant, moderate or low drinking water threat within the vulnerable areas to be listed in the Assessment Report, *regardless of whether or not the activities presently exist in the vulnerable area.* For an activity to pose even a low threat, the vulnerability score of the area in which it occurs must be greater than or equal to 4.2 for a surface system.

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 based on the MOE Tables of Drinking Water Threats. Existing activities were compared to the MOE Tables of Drinking Water Threats, where the prescribed activities that pose a threat were classified as significant, moderate or low based on their circumstances.

Threats Approach - Potential Activities & Circumstances

Based on the resulting vulnerability scores, the possible threat levels were identified for each of the vulnerable areas. (Table 8-13). 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 8.6.2) Refer to Figure 8-6 above for further support of the vulnerable areas where activities are or would be significant, moderate or low drinking water threats.

Table 8-13. Areas Within South River Intake Protection Zone Where Activities Are or Would be Significant, Moderate and Low Drinking Water Threats

Threat Type	Vulnerable Area	Vulnerability Score	Threat Level Possible		
			Significant	Moderate	Low
Chemicals	IPZ-1	9	✓	✓	✓
	IPZ-3a	3.6			
	IPZ-3b	4.5			✓
	IPZ-3c	3.6			
	IPZ-3d	3.6			
	IPZ-3e	2.7			
Pathogens	IPZ-1	9	✓	✓	✓
	IPZ-3a	3.6			
	IPZ-3b	4.5			✓
	IPZ-3c	3.6			
	IPZ-3d	3.6			
	IPZ-3e	2.7			

The circumstances under which these threats may be considered as significant, moderate or low are referenced in the MOE Provincial Table of Circumstances. These tables can be used to help the public determine where activities are or would be significant, moderate and low drinking water threats. A summary of the list of Provincial Tables relevent to each vulnerable area in Mattawa is provided in Table 7-11.

The Provincial Table headings listed within Table 8-14 (i.e. CIPZWE9S) represent one of 76 tables and are titled using a combination of acronyms explained in the chart below. The MOE Provincial Tables of Circumstances can be found at:
http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/STDPROD_081301.html

Acronym	Definition
C	Chemical
P	Pathogen
W	Wellhead protection area
IPZ	Intake protection zone
IPZWE	IPZ and WHPA-E
(number)	Vulnerability score

Acronym	Definition
S	Significant
M	Moderate
L	Low

For example: CW9S is a table of:
C - **C**hemical Threats in a
IPZWE- **I**ntake **P**rotection **Z**one or **W**ellhead Protection Area **E**, with vulnerability score of
9 - **9,** categorized as a
S - **S**ignificant threat

Table 8-14. Potential Circumstances for South River IPZ based on Provincial Tables

Vulnerability Score	Significant	Moderate	Low
9	CIPZWE9S PIPZWE9S	CIPZWE9M PIPZWE9M	CIPZWE9L PIPZWE9L
4.5	NA NA	NA NA	CIPZWE4.5L PIPZWE4.5L
3.6	NA	NA	NA
2.7	NA	NA	NA

The Technical Rules require that the number of locations within vulnerable areas be enumerated at which

- an activity that is a significant drinking water threat is being engaged in, and
- any conditions resulting from a past activities that are a significant drinking water threat.

There are 14 prescribed activities that would be significant drinking water threats if they occurred in the IPZ-1 of the South River intake. A breakdown of the prescribed activities and the number of circumstances under which those activities would be significant is provided in Table 8-15.

Table 8-15. Enumeration of Circumstances in which Prescribed Activities would be SignificantThreats to the South River Drinking Water Intake

Activities Prescribed to be Drinking Water Threats	# of Significant Threats	
	Chemical	Pathogen
The application of agricultural source material to land.	6	1
The application of commercial fertilizer to land.	6	
The application of non-agricultural source material to land.	6	1
The application of pesticide to land.	10	
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	

Activities Prescribed to be Drinking Water Threats	# of Significant Threats	
	Chemical	Pathogen
The storage of agricultural source material.	6	2
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	2
Grand Total	239	13

**Table summarizes CIPZWE9S and PIPZWE9S Provincial Tables of Circumstances within IPZ-1 - See Appendix X*

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.

8.6.2 Issues

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.

8.6.3 Conditions

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

8.6.4 Local Threat Considerations

The North Bay-Mattawa Source Protection Committee is concerned about the threat posed by the transportation of hazardous substances along a number of transportation corridors within the South River Intake Protection Zone which creates the potential for a spill to occur in the vulnerable area.

Although there is no prescribed threat activity related to the transportation of hazardous substances under the Clean Water Act, Technical Rule 119 allows Source Protection Committees to request that an activity be listed as a drinking water threat if:

1. The activity has been identified by the Source Protection Committee as an activity that may be a drinking water threat; and
2. The Director indicates that the chemical or pathogen hazard rating for the activity is greater than 4.

The Source Protection Committee submitted a formal request to the Ministry of Environment for the addition of transportation of hazardous substances as a non-prescribed (local) drinking water threat in the SP Area. This request was approved by the Director on February 8, 2011 (Appendix G). Included in the approval are the circumstances and hazard ratings for the activities considered.

Table 8.15 shows where significant, moderate and low threats relating to the transportation of hazardous substances are located in the South River IPZs. There is one circumstance in which the threat is significant for the South River intake. This occurs in IPZ-1 (Figure 8-4) and relates to a pathogen threat from the transportation of septage, for which a spill of any quantity may result in the presence of pathogens in surface water. No significant chemical threats relating to transportation exist for this intake.

Table 8-16. Areas within the South River Intake Protection Zone where Transportation of Hazardous Substances is Considered a Significant, Moderate or Low Drinking Water Threat

Threat Type	Vulnerable Area	Vulnerability Score	Threat Level Possible		
			Significant	Moderate	Low
Chemicals	IPZ-1	9		✓	✓
Pathogens	IPZ-1	9	✓		
	IPZ-3b	4.5			✓

8.7 Gap Analysis and Recommendations

This study uses Drinking Water Systems Regulation (O. Reg. 170/03) parameters analyzed from 2003 to 2006 at the South River Water Treatment Plant. For raw water, only bacteria data are include in the DWIS database. In treated water, chemical and bacteriological data exists, but most of the chemicals were only sampled on one occasion in 2004. Overall, there is minimal data available for raw water from the South River intake to evaluate drinking water issues. It is recommended that the drinking water issues evaluation be reassessed as new data becomes available.

Statistical analysis of trends in *E. coli* and total coliform was precluded due to the large number of values below analytical detection limits, as well as the limited data availability consisting of only two full years of data. Additional data would serve as beneficial towards analyzing for trends in pathogens.