DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

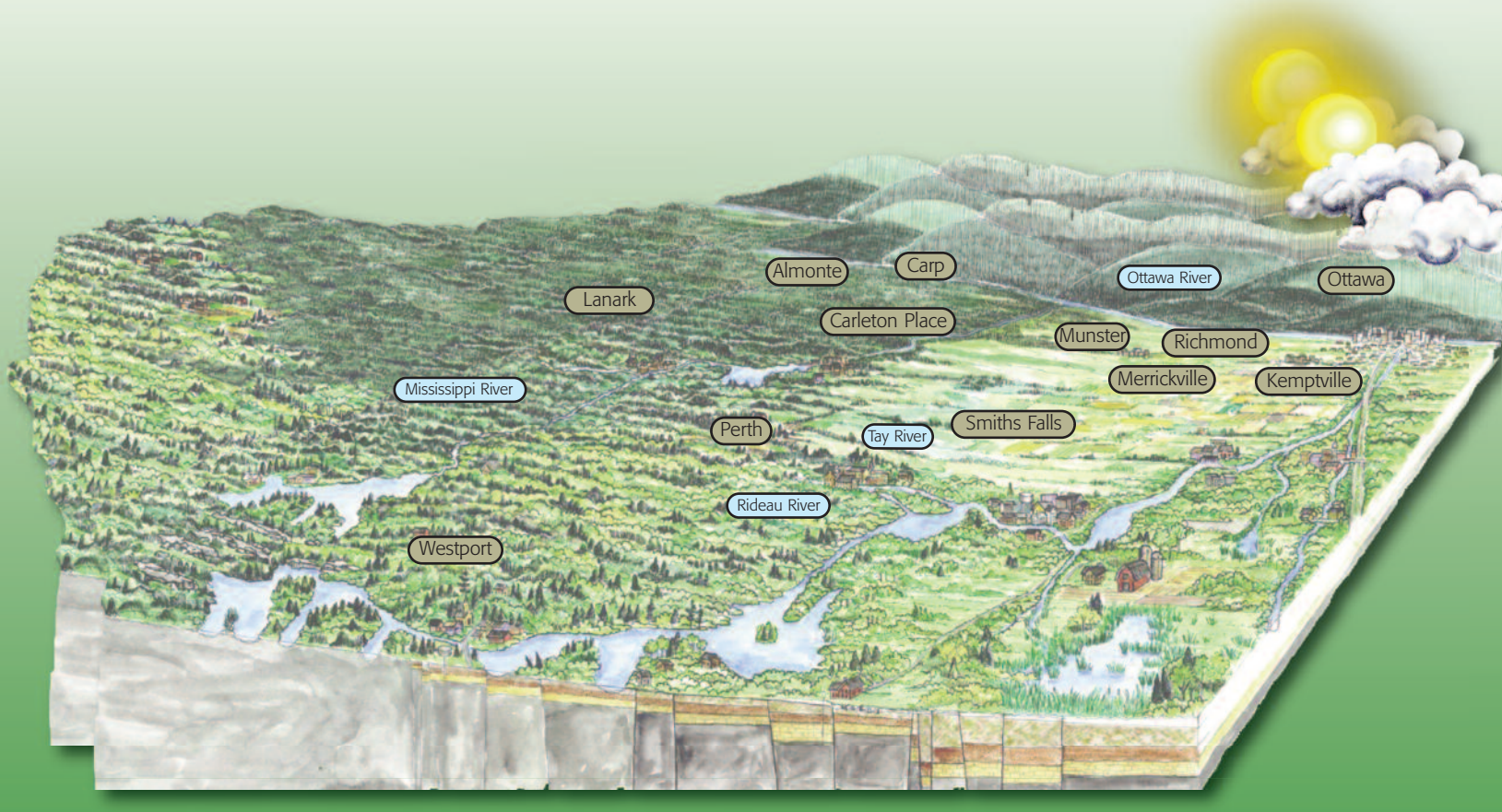
Mississippi-Rideau Source Protection Region

Draft Amendment #1

Assessment Report

Rideau Valley Source Protection Area

November 14, 2018
Submission for Approval



Mississippi Valley Conservation Authority

RIDEAU VALLEY CONSERVATION AUTHORITY

Ontario

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Preamble

The Assessment Report for the Rideau Valley Source Protection Area (RVSPA) was approved by the Ministry of the Environment, Conservation and Parks (MECP) on December 19, 2011. Chapter 5 of the RVSPA Assessment Report is entitled 'Groundwater Sources' and it provides information on groundwater within the Mississippi-Rideau Source Protection Region (MRSPR), including specific information about each of the groundwater-based municipal drinking water systems in the RVSPA. The 5 groundwater-based municipal drinking water systems in the RVSPA are located in Kemptville, Merrickville, Munster, Richmond (King's Park) and Westport.

The purpose of this Amendment is to provide key information about the new groundwater-based municipal drinking water system for the Western Development Lands (also referred to as Richmond West) located in the Village of Richmond, Ontario (located in the City of Ottawa). This new drinking water system now has a new wellhead protection area (WHPA) for Richmond West and has changed the existing WHPAs for Munster and King's Park in Richmond.

The information provided in this Amendment replaces all existing information from the approved RVSPA Assessment Report related to:

- **Section 5.7 Munster Water Supply**; and
- **Section 5.8 Richmond – King's Park Water Supply**
- All tables (Tables 5-8 through 5-11) and figures associated with the Munster Water Supply (Figures 5-7a through 5-7p) and the Richmond – King's Park Water Supply (Figures 5-8a through 5-8p).

The information provided in this Amendment is presented as '**Section 5.7 Munster and Richmond Water Supplies**' and contains groundwater information for three groundwater-based municipal drinking water systems, namely Munster, King's Park-Richmond and Richmond West.

None of the other chapters have been updated at this time, however, the following summary figures have been updated and are included in this amendment:

- All wellhead protection areas within the MRSPR (Figure 5-10)
- All wellhead protection areas within the MRSPR with a vulnerability score of 8-10, including DNAPL zone (Figure 5-11)
- All wellhead protection areas and Intake Protection Zones within the MRSPR (Figure 5-12)

5.7 Munster and Richmond Water Supplies

Munster

Munster Hamlet obtains its drinking water from two municipal wells as shown in Figure 5-7-1a. The Munster water supply system currently serves the entire Hamlet and obtains its water supply from two bedrock aquifer wells: Munster Well No. 1 (MW1) and Munster Well No. 2 (MW2). MW1 and MW2 are completed to a depth of 116 m and 122 m, respectively. Both wells are completed in the Nepean Formation sandstone. The groundwater system supplies approximately 1,300 people.

The local geology in the Munster area consists of limited overburden material (less than five metres) made up of sandy till. The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying Munster (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The source water has a moderately high level of hardness (270 mg/L). The groundwater contains a small amount of free ammonia (0.11 mg/L), and fluoride is present at a concentration of approximately 0.60 mg/L. In addition, there is a measurable concentration of bromide (0.22 mg/L) that occurs naturally in the geology. The presence of bromide results in a higher proportion of brominated compounds in the disinfection by-products for this system. The source water also contains iron at a concentration ranging from 0.15 – 0.65 mg/L, which at times is above the aesthetic guideline of 0.3 mg/L. Iron can be oxidized during chlorination and can at times result in rust or iron deposits in the water distribution system. Most importantly, routine bacteriological testing over many years have demonstrated that both Well No.1 and No.2 are clear from the presence of Total coliform or *E. coli* bacteria.

Private wells in the Munster area generally obtain water from a bedrock aquifer within the Oxford and March Formations.

Richmond

There are two communities in the Village of Richmond who are supplied with municipal drinking water. These are referred to as King's Park and the Western Development Lands. Each community obtains their drinking water from two municipal wells (four wells in total) as shown in Figures 5-7-2a and 5-7-3a. Details about each of the well systems is provided below.

The local geology in the Richmond area consists of limited overburden material (less than five metres) made up of clay material. The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying Richmond (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

Private wells in the Richmond area generally obtain water from a bedrock aquifer within the Oxford and March Formations.

King's Park

The King's Park Water Supply System consists of two bedrock wells, Well No. 1 (RW1) and Well No. 2 (RW2), which are both approximately 45 years old. RW1 and RW2 are completed to a depth of 66 and 61 m, respectively. The wells penetrate the Oxford and March formations and are completed as open holes in the underlying Nepean Formation sandstone. Two monitoring wells are also present and their locations are shown on Figure 5-7-2a. The groundwater system supplies approximately 450 people.

The source water has a moderately high level of hardness (340 mg/L). The groundwater contains a slight amount of ammonia (0.08 mg/L), and fluoride is present at a concentration of approximately 0.45 mg/L. In addition, there is a substantial concentration of bromide (0.43 mg/L) that occurs naturally in the geology. The presence of bromide results in a higher proportion of brominated compounds in the disinfection by-products for this system. The source water also contains iron at a concentration of 0.4 mg/L, which is above the aesthetic guideline of 0.3 mg/L. Iron can be oxidized during chlorination and can at times result in rust or iron deposits in the water distribution system. Most importantly, routine bacteriological testing over many years have demonstrated that both Well No.1 and No.2 are clear from the presence of Total coliform or *E. coli* bacteria.

Western Development Lands

The Western Development Lands Water Supply System, also referred to as 'Richmond West Water Supply System', consists of two bedrock wells, Well No. 1 (PW08-1) and Well No. 2 (PW09-1), which were both drilled in 2009. PW08-1 and PW09-1 are completed to a depth of 137 m and 70 m, respectively. The wells penetrate the Oxford and March formations and are completed as open holes in the underlying Nepean Formation sandstone. The groundwater system will supply approximately 5,800 people.

Based on sampling done to assess treatability, prior to construction of the new well system, the source water was found to have a moderately high level of hardness (310 mg/L). The source water also contains iron at a concentration of 0.23 mg/L, which is slightly below the aesthetic guideline of 0.3 mg/L. No Total Coliform or *E. coli* indicator bacteria were detected in any of the samples taken.

5.7.1 Delineation of Munster and Richmond Wellhead Protection Areas

The basic methodology for delineating each WHPA is provided in Section 5.3.2 of the approved RVSPA Assessment Report. In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Munster and Richmond areas. Also, geologic and hydrologic data was obtained from provincial and federal studies. These data were used to create the conceptual hydrogeological model for Munster and Richmond.

A cross-section for the conceptual model is shown in Figure 5-7-1b. The wells descend through surface layers of clay and glacial till, then through the upper aquifer (the Oxford/March formations), before arriving at the deep Nepean aquifer. Precambrian bedrock lies below the Nepean aquifer. Groundwater from the Oxford/March formation and the Nepean Formation enters the Munster and King's Park wells. Therefore, WHPA analyses were carried out for shallow (Oxford/March) and deep (Nepean) groundwater systems. A deeper well casing was installed in the Richmond West wells to prevent Oxford/March formation groundwater from entering the wells. As such, there is only one set of WHPAs for the Richmond West wells.

An independent third-party peer review was carried out for each modeling study to ensure the approach used was accepted by other groundwater experts.

Regionally, groundwater flow in the deep Nepean aquifer is from the northwest. Locally, groundwater flow in the overlying Oxford and March Formations is from the northwest.

The WHPAs were delineated using the following flow rates:

Munster - A combined flow rate for the two wells of 443 m^3/day.

King's Park –A forecasted combined flow rate for the two wells of 210 m^3/day.

Richmond West – A forecasted combined flow rate for the two wells of 1,630 m^3/day which is the anticipated average water demand for the development at full build out.

The numerical model was used to calculate WHPA A through D for each of the Munster and Richmond water supplies, including both the shallow and deep aquifer systems for Munster and King's Park. The Munster (shallow/deep) WHPA zones are shown in Figures 5-7-1c & 5-7-1d; the King's Park WHPA zones are shown in Figures 5-7-2b & 5-7-2c; and the Richmond West WHPA zones are shown in Figure 5-7-3b.

As previously discussed in the approved Assessment Report, the Technical Rules require that levels of uncertainty associated with 1) the delineation of new WHPAs, and 2) their assigned vulnerability scores. The approach applied is described in Section 5.3.2 of the approved RVSPA Assessment Report and includes:

> *The sensitivity analysis for the numerical model made reasonable adjustments to the aquifer parameters and model assumptions to determine what the WHPAs would look like if the model parameters were slightly different. The results of each*

of the additional computer simulations were plotted on a map. The area where the results from these additional computer simulations overlapped for the 2 years, 5 years, and 25 years ToT was used to delineate the final WHPA-B, WHPA-C, and WHPA-D respectively. The final (composite) WHPAs are considered to provide a greater degree of protection around the supply wells than would be achieved by using the results from a single model simulation.

The uncertainty method applied by the Consultant for the Western Development Lands, Munster and Kings Park systems determined that the areas of low uncertainty coincide with the two-year time of travel (TOT). The remaining areas within the WHPAs were mapped as high uncertainty. This was a decision made using professional judgement, as per Appendix 6C in the guidance document.

The decision to assign the areas of low uncertainty to that contained within the two-year TOT capture zone was based on the following, as described in the Peer Review Correspondence (Appendix A) of the Groundwater Vulnerability Study (November 2018):

- High quality data in the form of pumping test information was available near the wells. The data included monitoring well response in both the upper and lower aquifers. This information provided relatively high confidence that the conceptual model correctly represented the aquifer flow systems in the area, as the model was calibrated to the data;
- Considering the relatively low quality and density of data beyond the two-year time of travel (WHPA-B) as compared to that near the wells, the WHPA-C and WHPA-D zones were assigned high uncertainty.

The Munster (shallow/deep) zones of high and low uncertainty are shown in Figures 5-7-1e & 5-7-1f; the Richmond-King's Park zones of high and low uncertainty are shown in Figures 5-7-2d & 5-7-2e; and the Richmond West zones of high and low uncertainty are shown in Figure 5-7-3c.

5.7.2 Aquifer Vulnerability - Munster and Richmond Wellhead Protection Areas

Once the WHPAs are delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI protocol without the modification, as discussed in Section 5.1.2 of the approved RVSPA Assessment Report. Briefly, the ISI looks at the thickness and types of soil and rock layers above the aquifer, and how easily water can pass through these layers to the production aquifer. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPAs.

Figures 5-7-1g and 5-7-1h show the results of the aquifer vulnerability study for the Munster (shallow/deep) WHPA Zones. For the shallow aquifer, the aquifer vulnerability is medium and high. The medium vulnerability is a result of overburden deposits of sand and gravel, glacial till and organic deposits. The high vulnerability is a result of bedrock outcrop areas.

For the deep aquifer, the aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford/March Formation aquifers.

Figures 5-7-2f and 5-7-2g show the results of the aquifer vulnerability study for the King's Park (shallow/deep) WHPA Zones. For the shallow aquifer, the aquifer is characterized by mostly medium vulnerability, with some high vulnerability. The area is underlain by clay deposits ranging from about 4 to 8 metres in thickness above the bedrock, with the upper three metres assumed to be weathered clay. The high vulnerability areas are found where the clay thickness is not greater than 4 metres. For the deep aquifer, the aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford/March Formation aquifers.

Figure 5-7-3d shows the results of the aquifer vulnerability study for the Richmond West. The aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford/March Formation aquifers.

As set out in the Technical Rules, the presence of transport pathways within a WHPA can increase the intrinsic vulnerability. An area with low vulnerability can increase to medium, and an area with medium vulnerability can increase to high. Areas that are already high cannot be increased. As per the Dillon Consulting Limited 'Drinking Water Threats & Issues Inventory', dated May 2010, the presence, extent and characteristics of water wells, pits and quarries, mines, construction activities, sewer services, septic systems and stormwater infiltration was examined in the WHPA to determine whether adjustments to the vulnerability scoring were justified. The transport pathway adjustments discussed below are based on Dillon's report recommendations.

As shown on Figure 5-7-1g, two areas were identified where transport pathways increase the risk to the Munster shallow aquifer. One area, located in the centre of Munster, was raised from medium to high vulnerability because the cumulative impacts of the elevated well density, commercial land use, and the presence of sewer services. In another area, just west of the centre, the vulnerability was increased from medium to high because of the presence of surface water ponds. The till overburden in the pond area is estimated to have a thickness of less than 5 m; thus, these ponds may be resulting in a significant reduction in the overburden thickness. As shown on Figure 5-7-1h, five areas were identified for the Munster deep aquifer. Vulnerabilities were increased from low to medium because of the presence of bedrock quarries because they reduce the amount of overlying material to filter and/or attenuate contaminants.

As shown on Figure 5-7-2g, one area where transport pathways increase the risk to the Richmond King's Park deep aquifer was identified. The vulnerability was raised in this area from low to medium because of a bedrock quarry which reduces the amount of overlying material to filter and/or attenuate contaminants. For the Richmond King's Park shallow aquifer, no transport pathways that warranted an increase in intrinsic vulnerability were identified.

As shown on Figure 5-7-3d, ten areas were identified for the Richmond West aquifer. Vulnerabilities were increased from low to medium because of the presence of bedrock quarries because they reduce the amount of overlying material to filter and/or attenuate contaminants.

5.7.3 Vulnerability Scoring - Munster and Richmond Wellhead Protection Areas

The Technical Rules set out a process for scoring vulnerability within a WHPA. It is based on the combination of aquifer vulnerability and overlapping WHPAs. The more vulnerable the aquifer and the closer you are to the well, the higher the vulnerability score. The table shown below has the scoring system laid out as per the Technical Rules. Possible vulnerability scores are 2, 4, 6, 8, and 10. A score of 10 is highest, indicating an area where drinking water is most vulnerable to contamination.

Vulnerability Category (ISI)	WHPA-A	WHPA-B	WHPA-C	WHPA-D
High	10	10	8	6
Medium	10	8	6	4
Low	10	6	4	2

The categories in the table above were used to assign vulnerability scores to the areas within the Munster and Richmond WHPAs.

Figures 5-7-1i and 5-7-1j show the vulnerability scoring for the Munster (shallow/deep) WHPA Zones. Figure 5-7-1k shows the combined vulnerability score for the Munster shallow and deep WHPA zones (highest vulnerability score).

Figures 5-7-2h and 5-7-2i show the vulnerability scoring for the King's Park (shallow/deep) WHPA Zones. Figures 5-7-2j and 5-7-2k show the combined vulnerability score for the King's Park shallow and deep WHPA zones (highest vulnerability score).

Figures 5-7-3e and 5-7-3f show the vulnerability scoring for the Richmond West WHPA Zones.

The final vulnerability scoring for the combined Munster Richmond WHPA is based on the highest of the combined vulnerability scores and is shown in Figure 5-7-4a.

5.7.4 Managed Lands and Livestock Density – Munster and Richmond Wellhead Protection Areas

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.3.3 of the approved RVSPA Assessment Report.

Figures 5-7-1m and 5-7-1n and Table 5-7-1 show the managed lands and the livestock density for the Munster (shallow/deep) WHPA Zones. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

Figures 5-7-2l and 5-7-2m and Table 5-7-3 show the managed lands and the livestock density for the King's Park (shallow/deep) WHPA Zones. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

Figure 5-7-3g and Table 5-7-5 show the managed lands and the livestock density for the Richmond West WHPA Zones. Also shown in the table is the risk threshold for the over application of nutrients to land and the risk threshold for the over application of ASM to land.

Based on the managed lands and livestock density results for Munster, King's Park and Richmond West, it is concluded that there can be significant threats for the application of agricultural source material to land, the application of commercial fertilizer to land, or the application of non-agricultural source material to land.

The data for the managed lands evaluation was based on property assessment data and refined using satellite imagery. Site activity, including the level of nutrient application, was not known.

5.7.5 Impervious Surfaces – Munster and Richmond Wellhead Protection Areas

Impervious surfaces are primarily constructed surfaces such as roads and parking lots that are covered by impenetrable materials such as asphalt, concrete and stone. These materials are a barrier to groundwater infiltration. Impervious surfaces also generate more runoff during melt or storm events.

Road salt applied to roads and walkways for winter maintenance may enter surface and groundwater systems. Impervious surface area calculations are required to determine if road salt application in vulnerable areas could be a drinking water threat.

For information on methodology for determining percentage of impervious surfaces please see section 5.1.4 of the approved RVSPA Assessment Report.

The percent impervious surfaces results for each grid within the Munster Richmond WHPA zones is shown on Figure 5-7-4b. Within the village boundaries of Munster and Richmond,

the percent impervious surface is either 1 to 8 or 8 to 80. There are no impervious areas greater than 80%.

5.7.6 Water Quality Threat Assessment - Munster and Richmond Wellhead Protection Areas

Water quality threats are existing conditions (i.e., contaminated sediment, soil or groundwater) or existing or future land use activities that could contaminate a drinking water supply.

It should be noted that a single land use activity could fall into multiple threat categories. For example, a crop farm could be storing fuel, applying commercial fertilizer to land, and applying agricultural source material to land. Each of these activities is a separate threat category in the provincial table, and so each is therefore a separate threat.

Land use activities and associated threats that occur where the vulnerability score is high may result in determining it to be a significant threat. In many cases, the specific circumstances that apply to a threat category are unknown. Using the same example, a crop farm may store fuel, but the volume of fuel stored is unknown. Unless additional information was available, it was assumed that enough material was stored for that activity to be a significant threat.

Results of Munster and Richmond Wellhead Protection Area Water Quality Threat Assessment

A total of 64 potentially significant drinking water threats were identified in the Munster and Richmond WHPAs, of which 42 are related to sanitary sewer line segments. For WHPAs, this is where the vulnerability score is 8 or 10, or if the activity pertains to dense non-aqueous phase liquids (DNAPLs), anywhere within the 5-year WHPA C. The potentially significant drinking water threats are shown in Tables 5-7-2, 5-7-4 and 5-7-6. Figures 5-7-4c shows the areas containing potentially significant threats in red if the vulnerability score is 10 and orange for a vulnerability score of 8. See Section 4.4.3 of the approved RVSPA Assessment Report for information on the full list of significant, moderate, and low threats. The significant threat counts were determined based on the threats assessment study carried out by Golder Associates Ltd. for this study as well as on-going threats assessment work being carried out by the staff from the Rideau Valley Source Protection Authority.

Table 5-7-7, demonstrates where the 22 prescribed activities are a significant threat. Moreover, the Threats Tool, which is a searchable database can be used to identify which of the prescribed threat activities would be a significant threat in the applicable vulnerability scores shown in Figure 5-7-4c. It is publicly accessible and can be found at the following link http://swpip.ca/. Information from the Threats Tool can be exported into a spreadsheet that can then be sorted either by threat status or vulnerability score. This tool could be used, along with the maps of vulnerability scores, to understand where the 22 prescribed activities are a significant drinking water threat.

5.7.7 Issues and Conditions – Munster and Richmond Wellhead Protection Areas

As discussed in Chapter 4 of the approved RVSPA Assessment Report, issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. No issues were identified in the Munster and Richmond WHPA zones.

A condition is a situation where past activities resulted in a drinking water threat. Based on the criteria, there are no confirmed conditions in the Munster and Richmond WHPA zones.

5.7.8 Mississippi-Rideau Wellhead Protection Area Summary

Figure 5-10 shows all WHPAs within the MRSPR. Figure 5-11 shows all WHPAs within the MRSPR with a vulnerabilty scores of 8 to 10. For further information on the WHPAs within the Mississippi Valley Source Protection Area (MVSPA), shown in Figure 5-10, see the approved MVSPA Assessment Report.

5.7.9 Mississippi-Rideau Intake Protection Zone & Wellhead Protection Area Summary

Figure 5-12 shows all intake protection zones (IPZs) and WHPAs within the MRSPR.

References

Study	Consultant
King's Park, Richmond and Munster Hamlet Managed Lands and Livestock Density Calculations, Final Report, July 18, 2018	Dillon Consulting
Threats Assessment – Richmond Village, King's Park (Richmond) and Munster Well Systems, Ottawa, Ontario, July 17, 2018	Golder Associates Ltd.
Consolidated Groundwater Vulnerability Study, Richmond Village Well System, Richmond, Ontario, November 2018	Golder Associates Ltd.
Assessment Report, Rideau Valley Source Protection Area, December 19, 2011	N/A
Water quality summary descriptions, I.Douglas, City of Ottawa (April, 2018)	N/A

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Table 5-7-1

Risk to Munster WHPAs Based on Managed Lands and Livestock Density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density (NU/acre)	Risk for Over Application of ASM
Shallow WHPA				
Zone A #1 (10)	39.90%	LOW	0.0	LOW
Zone A #2 (10)	35.40%	LOW	0.0	LOW
Zone B (8)	73.40%	MODERATE	0.0	LOW
Zone B (10)	46.20%	MODERATE	0.0	LOW
Zone C (6)	82.70%	HIGH	0.0	LOW
Zone C (8)	63.90%	MODERATE	0.0	LOW
Zone D (6)	73.60%	MODERATE	0.0	LOW
Deep WHPA				
Zone A #1 (10)	39.90%	LOW	0.0	LOW
Zone A #2 (10)	35.40%	LOW	0.0	LOW
Zone B (6)	66.00%	MODERATE	0.2	LOW
Zone B (8)	20.50%	LOW	0.0	LOW
Zone C (4)	24.00%	LOW	0.0	LOW
Zone C (6)	21.90%	LOW	0.0	LOW
Zone D (2)	17.80%	LOW	0.0	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

Table 5-7-2
Summary of Potentially Significant Threats to Munster Source Water
Mississippi - Rideau Source Protection Region

City of Ottawa

Prescribed Drinking Water Threat	Threat Subcategory / Land Use Activity	Residential Fuel / Hydrcarbon Storage	Sewage Treatment Facilities	Sewer Mainlines and Connections	Total
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage System Or Sewage Works - Sanitary Sewers and related pipes			28	**28**
	Sewage System Or Sewage Works - Storage Of Sewage (E.G. Treatment Plant Tanks)		1		**1**
The handling and storage of fuel.	Storage Of Fuel	10			**10**
	Total	**10**	**1**	**28**	**39**

Table 5-7-3

Risk to King's Park WHPAs Based on Managed Lands and Livestock Density

Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density (NU/acre)	Risk for Over Application of ASM
Shallow WHPA				
Zone A #1 (10)	66.90%	MODERATE	0.0	LOW
Zone A #2 (10)	53.70%	MODERATE	0.0	LOW
Zone B (8)	55.30%	MODERATE	0.0	LOW
Zone B (10)	51.30%	MODERATE	0.0	LOW
Zone C (6)	57.90%	MODERATE	0.0	LOW
Zone D (6)	41.40%	MODERATE	0.0	LOW
Deep WHPA				
Zone A #1 (10)	66.90%	MODERATE	0.0	LOW
Zone A #2 (10)	53.70%	MODERATE	0.0	LOW
Zone B (6)	70.60%	MODERATE	0.2	LOW
Zone C (4)	64.60%	MODERATE	N/A	N/A
Zone D (4)	0.00%	LOW	N/A	N\A
Zone D (2)	29.90%	LOW	N/A	N/A

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

Table 5-7-4

Summary of Potentially Significant Threats to Richmond - King's Park Source Water

Mississippi - Rideau Source Protection Region

City of Ottawa

Prescribed Drinking Water Threat	Threat Subcategory / Land Use Activity	Residential Fuel / Hydrcarbon Storage	Sewer Mainlines and Connections	Automotive Servicing	Total
The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage System Or Sewage Works - Sanitary Sewers and related pipes		14		**14**
The handling and storage of a dense non-aqueous phase liquid.	Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)			4	**4**
	Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)			4	**4**
The handling and storage of fuel.	Storage Of Fuel	1			**1**
	Total	**1**	**14**	**8**	**23**

Table 5-7-5

Risk to Richmond West WHPAs Based on Managed Lands and Livestock Density
Mississippi - Rideau Source Protection Region

WHPA Zone and Vul. Score	Percent Total Managed Lands	Risk for Over Application of Nutrients	Livestock Density (NU/acre)	Risk for Over Application of ASM
Zone A (10)	91.30%	HIGH	0.0	LOW
Zone B (6)	46.90%	MODERATE	0.1	LOW
Zone C (6)	0.00%	LOW	0.0	LOW
Zone C (4)	44.50%	MODERATE	0.4	LOW
Zone D (4)	6.50%	LOW	0.0	LOW
Zone D (2)	47.00%	MODERATE	0.3	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

Table 5-7-6
Summary of Potentially Significant Threats to Richmond West Source Water
Mississippi - Rideau Source Protection Region

City of Ottawa

Prescribed Drinking Water Threat	Threat Subcategory / Land Use Activity	Automotive Servicing	Total
The handling and storage of a dense non-aqueous phase liquid.	Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	1	**1**
	Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	1	**1**
	Total	**2**	**2**

Table 5-7-7
Drinking Water Threats
Mississippi - Rideau Source Protection Region

Prescribed Drinking Water Threats Ontario Regulation 287/07 s.1.1 (1)		Land Use/Activity	Wellhead Protection Area (WHPA) Vulnerability Scoring									
			Chemical					Pathogen				
			10	8	6	4	2	10	8	6	4	2
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* .	Landfills - active & closed; Hazardous Waste Disposal; Liquid Industrial Waste	✓	✓				✓				
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	Sewage Infrastructure; Septic Systems, etc.	✓	✓				✓				
3	The application of agricultural source material to land.	e.g. manure, whey, etc.	✓					✓				
4	The storage of agricultural source material.	e.g. manure, whey, etc.	✓					✓				
5	The management of agricultural source material.	aquaculture										
6	The application of non-agricultural source material to land.	Organic Soil Conditioning; Biosolids	✓					✓				
7	The handling and storage of non-agricultural source material.	Organic Soil Conditioning; Biosolids	✓					✓				
8	The application of commercial fertilizer to land.	Agriculture fertilizer	✓									
9	The handling and storage of commercial fertilizer.	General Fertilizer Storage	✓									
10	The application of pesticide to land.	Pesticides	✓									
11	The handling and storage of pesticide.	General Pesticide Storage	✓									
12	The application of road salt.	Road Salt Application	✓									
13	The handling and storage of road salt.	Road Salt Storage	✓									
14	The storage of snow.	Snow Dumps	✓									
15	The handling and storage of fuel.	Petroleum Hydrocarbons	✓									
16	The handling and storage of a dense non-aqueous phase liquid (DNAPLs)*.	DNAPLs	Anywhere in 5 year time of travel									
17	The handling and storage of an organic solvent.	Organic Solvents	✓									
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	De-Icing	✓									
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.**	Private Water Taking										
20	An activity that reduces the recharge of an aquifer.**	Impervious Surfaces										
21	The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.	Agriculture Operations	✓					✓				
22	The establishment and operation of a liquid hydrocarbon pipeline.	Liquid Hydrocarbon Pipeline	✓									

*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

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