



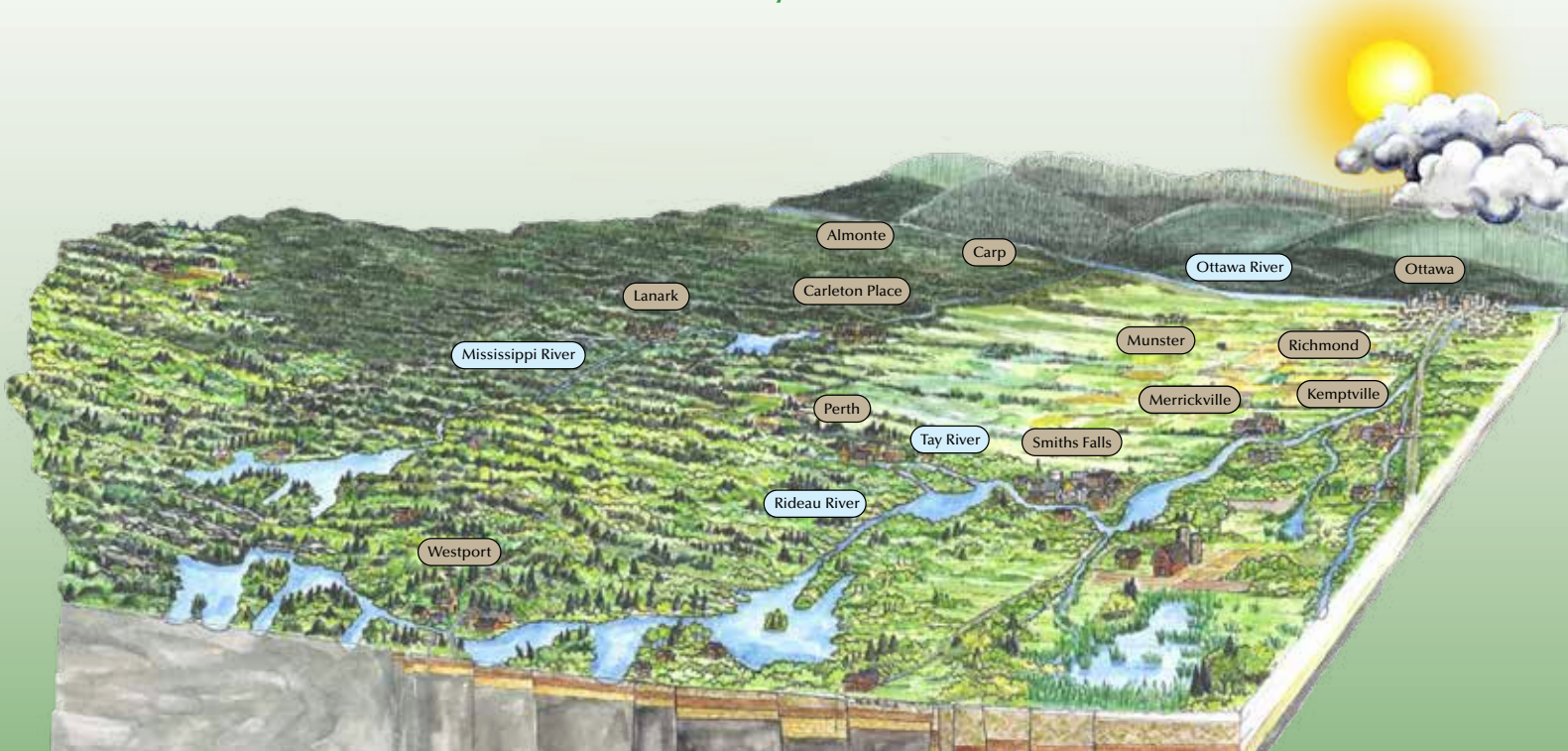
# Mississippi-Rideau Source Protection Region

Draft Amendment 1.2

# Assessment Report

## Rideau Valley Source Protection Area

Submission for Approval  
May 21, 2020



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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. On March 23, 2019, Amendment 1.1 came into effect to add the Richmond West municipal drinking water system to the Assessment Report and Source Protection Plan. 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 6 groundwater-based municipal drinking water systems in the RVSPA are located in Kemptville, Merrickville, Munster, Richmond (2 systems) and Westport.

The purpose of this Amendment is to provide revised key information about the groundwater-based municipal drinking water system for the Municipality of North Grenville because of the new municipal well installed in 2015. The new well installation and updated groundwater vulnerability work in North Grenville has changed the existing WHPA for the Merrickville Municipal Drinking water system. As such the North Grenville and Merrickville municipal drinking water systems now each have revised a WHPA.

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

- **Section 5.5 Kemptville Water Supply**; and
- **Section 5.6 Merrickville Water Supply**
- **All Tables and Figures associated with the Kemptville and Merrickville water supplies. More specifically, Tables 5-4 through 5-7, Figures 5-5a through 5-5p and Figures 5-6a through 5-6p**

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)

## 5.5 Kemptville Water Supply

The Town of Kemptville obtains its drinking water from four municipal wells, shown in Figure 5-5a, which draws water from the Nepean Formation sandstone. The four wells are drilled to depths between 62 and 110 m below ground surface. The wells have casing down to the Oxford Formation (above the Nepean Formation) and are open holes in the Oxford and Nepean Formations. The groundwater system supplies approximately 5,000 people.

The local geology in the Kemptville area consists of a thin overburden layer (less than two metres) in the western half of the area around Kemptville, while in the eastern half, local areas of increased overburden thickness are present (i.e. up to approximately 20 m). The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The Kemptville water system produces high-quality groundwater, the parameters that are tested for have been extremely stable across the testing period. Total coliform bacteria are detected rarely in raw water samples. Any Total Coliform present in the raw water is removed by disinfecting the water via Sodium Hypochlorite and adequate contact time. E.Coli is never detected in the raw or treated water samples.

Hardness and sodium concentrations are typical of the Nepean formation, the average hardness across the four wells is around 310 mg/L. Typical sodium concentrations range between 30 – 40 mg/L at all wells. 20 mg/L is the advisory limit set by the MOE above which the operator must notify the MOE and the Health Department to protect individuals on sodium reduced diets. Sodium does not exceed any other benchmark, nor does it have human health effects except in a small number of cases that are considered in the advisory limit.

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

In December 2010, the Municipality of North Grenville received funding from the Ontario Drinking Water Stewardship Program to extend the well casing of 3 of Kemptville's municipal drinking water wells (with the exception of the East Quadrant well, which was constructed later). The purpose of the well casing extension project is to ensure that the wells do not draw water from the shallow aquifer, and instead rely only on the deep aquifer. Well casing extensions into the deep aquifer provide an immediate and a cost effective action to reduce the wellhead protection area itself, and reduces the number of properties that would constitute significant threats. The work was completed in April 2011.

### 5.5.1 Delineation of Kemptville Wellhead Protection Area

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Kemptville area. Also, geologic

and hydrologic data was obtained from provincial and federal studies. These data were used to create the conceptual hydrogeological model for Kemptville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for Kemptville's conceptual model is shown in Figure 5-5b. 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 Kemptville wells.

Regionally, groundwater flow in the deep Nepean aquifer is from west to east. Locally, in the Town of Kemptville, groundwater flow in the shallow Oxford March Formation differs, flowing from the south, east, and west.

The Kemptville WHPAs were delineated using a forecasted combined flow rate for the four wells of 3,769 m<sup>3</sup>/day. This flow rate is greater than the five year average flow rate of 1639 m<sup>3</sup>/day. The forecasted flow rate was chosen based on water demands obtained from the J.L. Richards and Associates (JLR) 2011 Class EA Report together with 2018 pumping records for the Kemptville drinking water system to determine how much flow to allocated to each well.

The numerical model calculated WHPA A through D for the Kemptville system. Figure 5-5c shows the Kemptville wellhead protection area around the municipal wellheads. It is made up of a circle with a 100 m radius around the wellheads and the 2, 5, and 25 year times of travel. The total area of the Kemptville WHPAs is 630 km<sup>2</sup>. As indicated on Figure 5-5c, a small area of WHPA-D, approximately 3.44 km<sup>2</sup>, is located within the Raisin-South Nation Source Protection Region.

Section 5.3.2 discusses sensitivity analysis in WHPAs. The zones of high and low uncertainty are shown in Figure 5-5d for both WHPA delineation and vulnerability scoring.

## 5.5.2 Aquifer Vulnerability - Kemptville Wellhead Protection Area

Once the WHPA is delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI protocol discussed in Section 5.1.2 without the modification. 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. The Technical Rules outline the process for categorizing the ISI results into aquifer vulnerability (Low, Medium or High) for the areas within the WHPAs. Figures 5-5e show the results of the aquifer vulnerability assignment for Kemptville's WHPA.

The aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford aquifer, except for some small areas near the northern boundary of the WHPA which is medium as the Nepean aquifer gets closer to the ground surface.

Under 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. 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.

As shown on Figure 5-5e, twelve areas were identified where transport pathways increase the risk to the aquifer. The transport pathways are due to the presence of aggregate extraction operations. In each case, the vulnerability was increased from low to medium vulnerability because the aggregate extraction reduces the amount of overlying material to filter and/or attenuate contaminants.

### 5.5.3 Vulnerability Scoring - Kemptville Wellhead Protection Area

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 in Section 5.5.3 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. The categories in the table were used to assign vulnerability scores to the areas within the WHPA (Figure 5-5f and 5-5g).

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

### 5.5.4 Managed Lands and Livestock Density – Kemptville Wellhead Protection Area

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.3.3. Figures 5-5h show the managed lands and the livestock density in the WHPAs. The percent managed lands and average livestock densities for each zone are listed in Table 5-4. 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.

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.

### 5.5.5 Impervious Surfaces – Kemptville Wellhead Protection Area

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 Impervious Surfaces.

The percent impervious surfaces results for each grid within the Kemptville vulnerable aquifer areas is shown on Figure 5-5i. The results range from 0 to 88%.

### **5.5.6 Water Quality Threat Assessment - Kemptville Wellhead Protection Area**

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. A land use inventory of the Kemptville WHPA was completed in 2009.

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.

Table 5-7 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 5-5f. 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.

#### **Results of Kemptville Wellhead Protection Area Water Quality Threat Assessment**

In the Rideau Valley Source Protection Area Assessment Report (2011), a total of 105 potentially significant drinking water threats were identified in the Kemptville WHPA. As of 2019, this number has been further refined to 50 existing and new threats. For the Kemptville WHPA, significant threats are where the vulnerability score is 10 (as there are no 8 scores), 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 summarized in Table 5-5. Figure 5-5j shows the areas containing potentially significant threats in red (the vulnerability score is 10). The area containing potentially significant threats is approximately 0.1 km<sup>2</sup>. The map also outlines the areas containing potential DNAPL threats with a blue dashed line, an area of approximately 75 km<sup>2</sup>. See Section 4.4.3 and Figure 5-5j for information on the full list of significant, moderate, and low threats.

## Transportation Corridors

A number of transportation corridors, including major road arteries, exist within the Kemptville WHPA. These corridors are not considered an activity under Clean Water Act definitions and, therefore, do not fall within the prescribed list of threats (see Section 4.3). However, there is potential for the transportation of dangerous and/or hazardous goods along these corridors and the potential for a spill to occur. Transportation corridors will be considered in the development of the Source Protection Plan to ensure the protection of groundwater sources from potential accidental spills. Transportation corridors can be found on all WHPA maps including the Kemptville WHPA map in Figure 5-5d.

### 5.5.7 Issues and Conditions – Kemptville Wellhead Protection Area

As discussed in Chapter 4, issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. No issues were identified in the Kemptville WHPA.

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 Kemptville WHPAs. However, in the Rideau Valley Source Protection Area Assessment Report (2011), there were six potential conditions noted in the Drinking Water Threats and Issues Technical Report.

## 5.6 Merrickville Water Supply

The Village of Merrickville obtains its drinking water from three municipal wells as shown in Figure 5-6a. Well 1, Well 2 and Well 4 are completed at 35, 49 and 50 m below ground surface, respectively. Well 3 was decommissioned in 2002. All three wells are completed in the Nepean Formation sandstone. The groundwater system supplies water for 1,000 people in Merrickville.

The local geology in the Merrickville area consists of a thin overburden layer (i.e. less than two metres) in the western half of the area around Merrickville, while in the eastern half, local areas of increased overburden thickness are present (i.e. up to approximately 20 m). The overburden material consists primarily of glacial till deposits, offshore marine clay deposits and near shore fine to medium sand deposits.

The overburden material is underlain by sedimentary rocks of Paleozoic age. The sequence of sedimentary rocks underlying the area is (from oldest/deepest to youngest/shallowest) is Nepean Formation (sandstone), March Formation (sandstone/dolostone) and Oxford Formation (limestone/dolostone).

The groundwater has been characterized as having elevated hardness and iron, which do not pose health risks. Elevated turbidity and colour have also been detected in the water, but these are not health risks. The source water has no chemical contaminants. Total coliform bacteria were found periodically between 2003 and 2006. However, *E. coli* has not been detected in the groundwater, and total coliforms are removed during water treatment.

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



In December 2010, the Village of Merrickville-Wolford received funding from the Ontario Drinking Water Stewardship Program to extend the well casing of all 3 of Merrickville's municipal drinking water wells. The purpose of the well casing extension project is to ensure that the wells do not draw water from the shallow aquifer, and instead rely only on the deep aquifer. Well casing extensions into the deep aquifer provide an immediate and a cost effective action to reduce the wellhead protection area itself, and reduces the number of properties that would constitute significant threats. The work was completed in November 2011.

### 5.6.1 Delineation of Merrickville Wellhead Protection Area

In addition to the Water Well Information System, geologic and hydrologic data were also obtained from previous studies carried out in the Merrickville area. Also, geologic and hydrologic data was obtained from provincial and federal studies. These data were used to create the conceptual hydrogeological model for Merrickville. Furthermore, observation wells were drilled as part of a field campaign to improve the understanding of the geology and hydrogeology of the groundwater system.

A cross-section for the conceptual model is shown in Figure 5-6b. 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 Merrickville wells.

Regionally, groundwater flow in the deep Nepean aquifer is from west to east. Locally, in the Town of Merrickville, groundwater flow in the shallow Oxford and March Formations is from the south and west.

The Merrickville WHPAs were delineated using a forecasted combined flow rate for the three wells of 520 m<sup>3</sup>/day. This flow rate is slightly greater than the five year average flow rate of 515 m<sup>3</sup>/day presented in Table 2-17 of Chapter 2.

The numerical model calculated WHPA A through D for the Merrickville system for the aquifer systems. Figure 5-6c shows the Merrickville wellhead protection areas around the municipal wellheads. It is made up of a circle with a 100 m radius around the wellheads and the 2, 5, and 25 year times of travel. The total area of the Merrickville WHPAs is approximately 160 km<sup>2</sup>.

Section 5.3.2 discusses sensitivity analysis in the WHPA. The zones of high and low uncertainty are shown in Figure 5-6d for WHPA delineation and vulnerability scoring.

### 5.6.2 Aquifer Vulnerability - Merrickville Wellhead Protection Area

Once the WHPA is delineated, the aquifer vulnerability is determined using the Intrinsic Susceptibility Index or ISI protocol discussed in Section 5.1.2 without the modification. 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. The Technical Rules outline the process for categorizing aquifer vulnerability (Low, Medium or High) for the areas within the WHPAs. Figures 5-6e show the results of the aquifer vulnerability assignment, for the Merrickville WHPA.

The aquifer vulnerability is generally low because the Nepean aquifer is well protected from the overlying Oxford aquifer, except for some small areas near the northwest

boundary of the WHPA which is medium as the Nepean aquifer gets closer to the ground surface.

Under 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. 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.

As shown on Figure 5-6f, eight areas were identified where transport pathways increase the risk to the aquifer. The transport pathways are due to the presence of aggregate extraction operations. In each case, the vulnerability was increased from low to medium or medium to high vulnerability because the aggregate extraction reduces the amount of overlying material to filter and/or attenuate contaminants.

### **5.6.3 Vulnerability Scoring - Merrickville Wellhead Protection Area**

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 in Section 5.5.3 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. The categories in the table were used to assign vulnerability scores to the areas within the WHPA (Figures 5-6f and 5-6g).

### **5.6.4 Managed Lands and Livestock Density – Merrickville Wellhead Protection Area**

Percent managed land and livestock density calculations were carried out according to the methods outlined in Section 5.3.3. Figure 5-6h show the managed lands and the livestock density in the WHPAs. The percent managed lands and average livestock densities for each zone are listed in Table 5-6. 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.

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.

### **5.6.5 Impervious Surfaces – Merrickville Wellhead Protection Area**

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 Impervious Surfaces. The percent impervious surfaces results for each grid within the Merrickville vulnerable aquifer areas are shown on Figure 5-6i. The results range from 0 to 88%. The higher values found in this area are attributed to the Town of Smiths Falls.

### **5.6.6 Water Quality Threat Assessment - Merrickville Wellhead Protection Area**

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. A land use inventory of the Merrickville WHPA was completed in 2009.

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.

Table 5-7 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 5-6f. 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.

#### **Results of Merrickville Wellhead Protection Area Water Quality Threat Assessment**

In the Rideau Valley Source Protection Area Assessment Report (2011), a total of 24 potentially significant drinking water threats were identified in the Merrickville WHPA. As of 2019, this number has been further refined to 5 existing threats. For the Merrickville WHPA, significant threats are where the vulnerability score is 10 (as there is no 8 scores), 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 summarized in Table 5-7. Figure 5-6j shows the areas containing potentially significant threats in red (the vulnerability score is 10). The area containing potentially significant threats is approximately 0.04 km<sup>2</sup>. The map also outlines the areas containing potential DNAPL threats with a blue dashed line, an area of approximately 57 km<sup>2</sup>. See Section 4.4.3 and Figure 5.6j for information on the full list of significant, moderate, and low threats.

### **Transportation Corridors**

A number of transportation corridors, including major road arteries, exist within the Merrickville WHPA. These corridors are not considered an activity under Clean Water Act definitions and, therefore, do not fall within the prescribed list of threats (see Section 4.3). However, there is potential for the transportation of dangerous and/or hazardous goods along these corridors and the potential for a spill to occur. Transportation corridors will thus be considered in the development of the Source Protection Plan to ensure the protection of groundwater sources from potential accidental spills. Transportation corridors can be found on all WHPA maps including the Merrickville WHPA maps in Figures 5-6c and 5-6d.

### **5.6.7 Issues and Conditions – Merrickville Wellhead Protection Area**

As discussed in Chapter 4 issues are documented cases of water quality contamination approaching or exceeding acceptable provincial levels. A condition is a situation where past activities resulted in a drinking water threat. No issues or conditions were identified in the Merrickville WHPA.

### 5.1.1 References

<b>Study</b>	<b>Consultant</b>
Kemptville Well Field Managed Lands and Livestock Density Calculations, Final Report, September 20, 2019	Dillon Consulting
Merrickville Well Field Managed Lands and Livestock Density Calculations, Final Report, September 4, 2019	Dillon Consulting
Threats Assessment –Kemptville/Merrickville Well Systems, North Grenville/Merrickville-Wolford, Ontario, September 19, 2019	Golder Associates Ltd.
Groundwater Vulnerability Study, Kemptville-Merrickville Well Systems, September 2019	Golder Associates Ltd.
Assessment Report, Rideau Valley Source Protection Area, December 19, 2011	N/A

List of Tables for Amendment (Assesment Report, RVSPA)

Table 5-4	Risk to Kemptville WHPAs Based on Managed Lands and Livestock Density
Table 5-5	Summary of Potentially Significant Threats to Kemptville Source Water
Table 5-6	Risk to Merrickville WHPAs Based on Managed Lands and Livestock Density
Table 5-7	Summary of Potentially Significant Threats to Merrickville's Source Water
Table 5-8	Drinking Water Threats

**Table 5-4****Risk to Kemptville 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)	45.96%	MODERATE	0.0	LOW
Zone B (8)	3.72%	LOW	0.0	LOW
Zone B (6)	42.97%	MODERATE	0.48	MODERATE
Zone C (6)	0.13%	LOW	0.0	LOW
Zone D (6)	3.90%	LOW	0.0	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report

**Table 5-5**  
**Summary of Potentially Significant Threats to Kemptville Source Water**  
**Mississippi - Rideau Source Protection Region**

**North Grenville**

Prescribed Drinking Water Threat	Threat Subcategory	Land Use Activity	Existing/Managed Threats				New Threats		Removed Threats							
			Electronic and Precision Equipment Repair and Maintenance	Residential Fuel / Hydrocarbon Storage	Road Salt Application	Sewer Mainlines and Connections	Total	Electronic and Precision Equipment Repair and Maintenance	Total	Dry Cleaning and Laundry Services	Electric Power Generation, Transmission and Distribution	Other Ambulatory Health Care Services	Residential Fuel / Hydrocarbon Storage	Dry Cleaning and Laundry Services	Other Wood Product Manufacturing	Total
The application of road salt.	Application Of Road Salt			8		8										
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				3	3										
The handling and storage of a dense non-aqueous phase liquid.	Handling Of A Dense Non Aqueous Phase Liquid (DNAPL)	15				15	4	4	2	1			1	1		5
	Storage Of A Dense Non Aqueous Phase Liquid (DNAPL)	15				15	4	4	2	1			1	1		5
The handling and storage of fuel.	Handling Of Fuel					0				1	1					2
	Storage Of Fuel		1			1				1	1	77				79
	<b>Total</b>	<b>30</b>	<b>1</b>	<b>8</b>	<b>3</b>	<b>42</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>77</b>	<b>2</b>	<b>2</b>	<b>91</b>	



**Table 5-6****Risk to Merrickville's 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)	21.60%	LOW	0.0	LOW
Zone B (6)	30.00%	LOW	0.3	LOW
Zone C (6)	0.00%	LOW	0.0	LOW
Zone D (6)	6.60%	LOW	0.0	LOW

Compiled from: Dillon Managed Lands and Livestock Density Technical Report



**Table 5-8**  
**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 <i>Environmental Protection Act</i> .	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	✓												

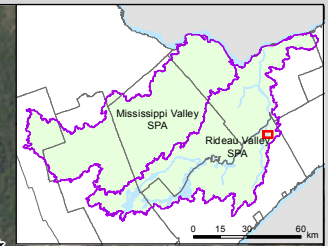
\*DNAPLs are chemicals that are heavy and sink in water (e.g. trichloroethylene)

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Figure 5-10	Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas
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**Mississippi-Rideau  
SOURCE PROTECTION REGION**

**LEGEND**

- Municipal Well
- Road
- Town of Kemptville Boundary
- Source Protection Area

**Location of  
Kemptville Municipal  
Groundwater Supply Wells**

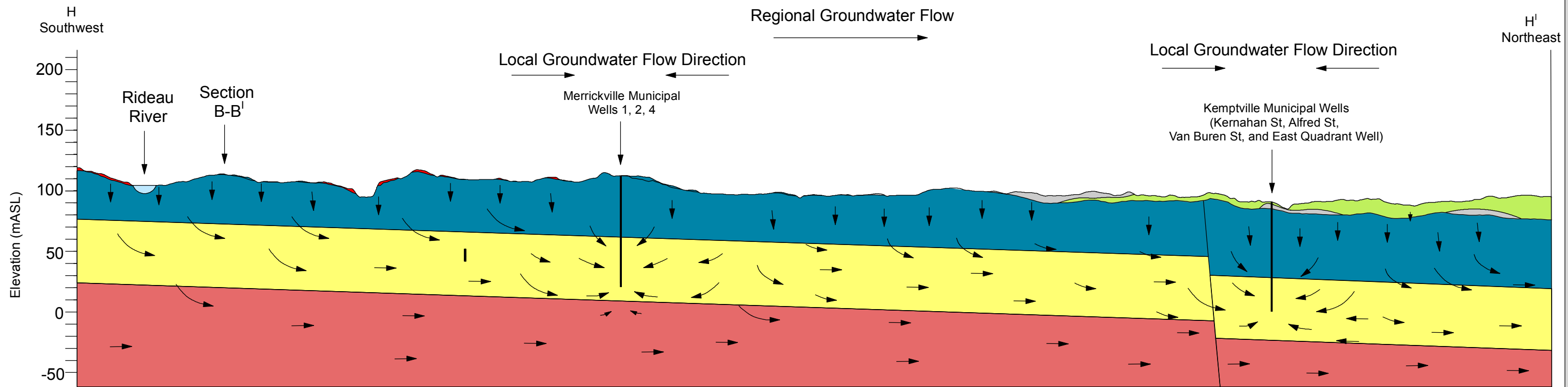
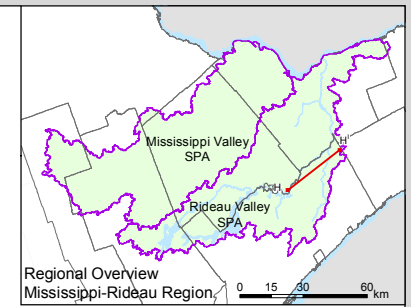
**Figure 5-5a**

0 80 160 320 480  
Meters

Projection: Universal Transverse Mercator, NAD83, Zone 18 North

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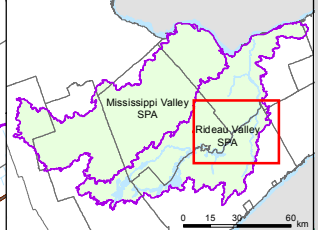
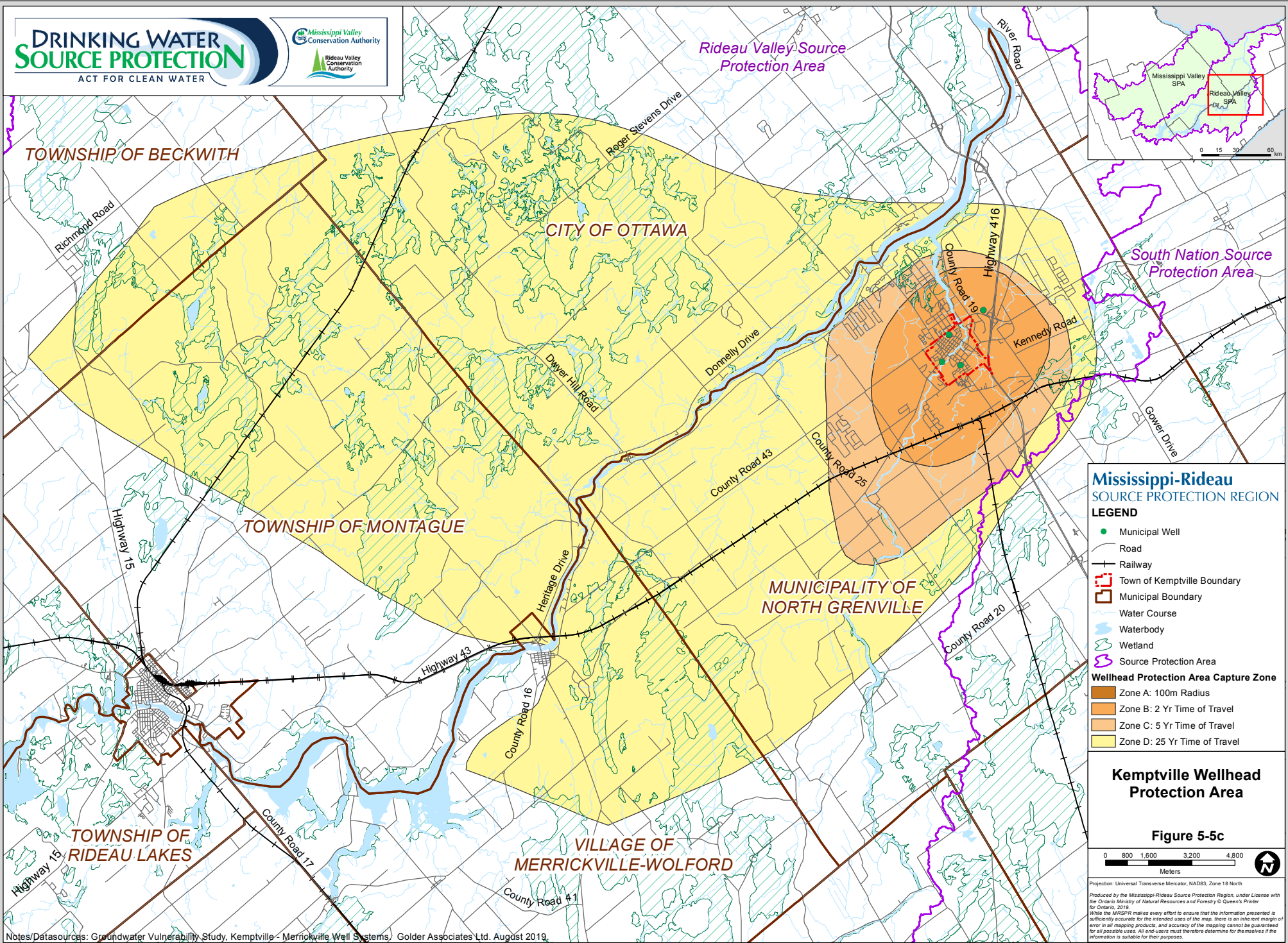


1:25 Vertical Exaggeration

<p><b>LEGEND</b></p> <p><b>Formation</b></p> <p>River/Lake</p> <p>Undifferentiated Overburden</p> <p>(Quaternary Deposits)</p> <p>Clay</p>	<p><b>Mississippi-Rideau SOURCE PROTECTION REGION</b></p> <p>Sand and Gravel</p> <p>Oxford/March Formations (Dolostone/Limestone)</p> <p>Nepean Formation (Sandstone)</p> <p>Precambrian (Granite)</p>	<p><b>Kemptville Conceptual Hydrogeological Cross-Section</b></p> <p><b>Figure 5-5b</b></p> <p>Projection: Universal Transverse Mercator, NAD83, Zone 18 North</p> <p><small>Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019.</small></p> <p><small>While the MRSR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.</small></p>
	<p><b>LEGEND</b></p> <p>River/Lake</p> <p>Undifferentiated Overburden</p> <p>(Quaternary Deposits)</p> <p>Clay</p>	

Notes/Datasources: Modified from Golder 2003a. This information is regional in nature and not intended for site-specific evaluations. The figure should be used only in conjunction with the accompanying report.

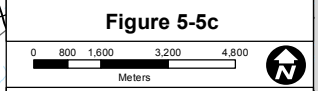
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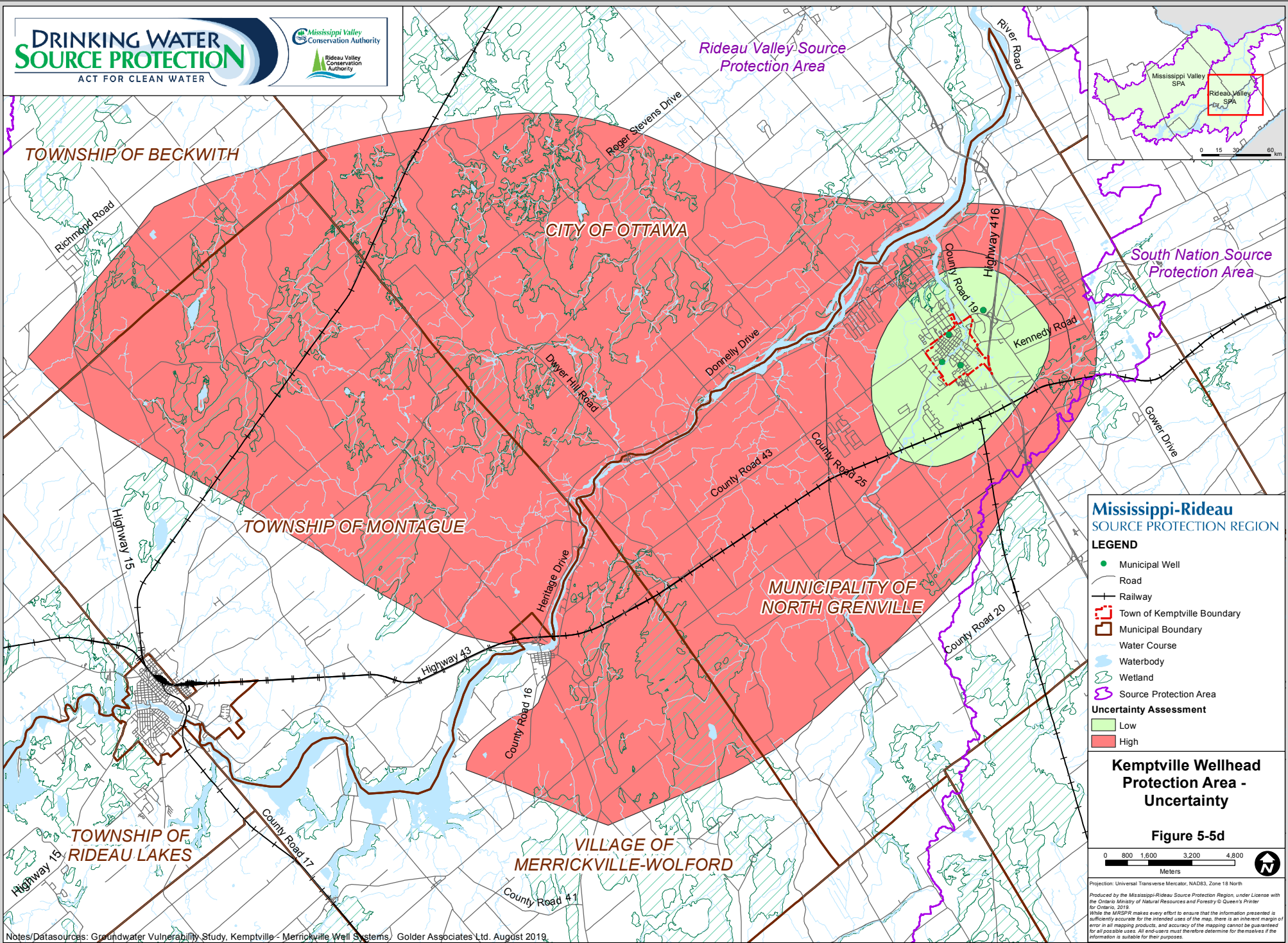
**Mississippi-Rideau SOURCE PROTECTION REGION**  
**LEGEND**

- Municipal Well
- Road
- Railway
- Town of Kemptville Boundary
- Municipal Boundary
- Water Course
- Waterbody
- Wetland
- Source Protection Area
- Wellhead Protection Area Capture Zone**
  - Zone A: 100m Radius
  - Zone B: 2 Yr Time of Travel
  - Zone C: 5 Yr Time of Travel
  - Zone D: 25 Yr Time of Travel

**Kemptville Wellhead Protection Area**







**Mississippi-Rideau SOURCE PROTECTION REGION**

**LEGEND**

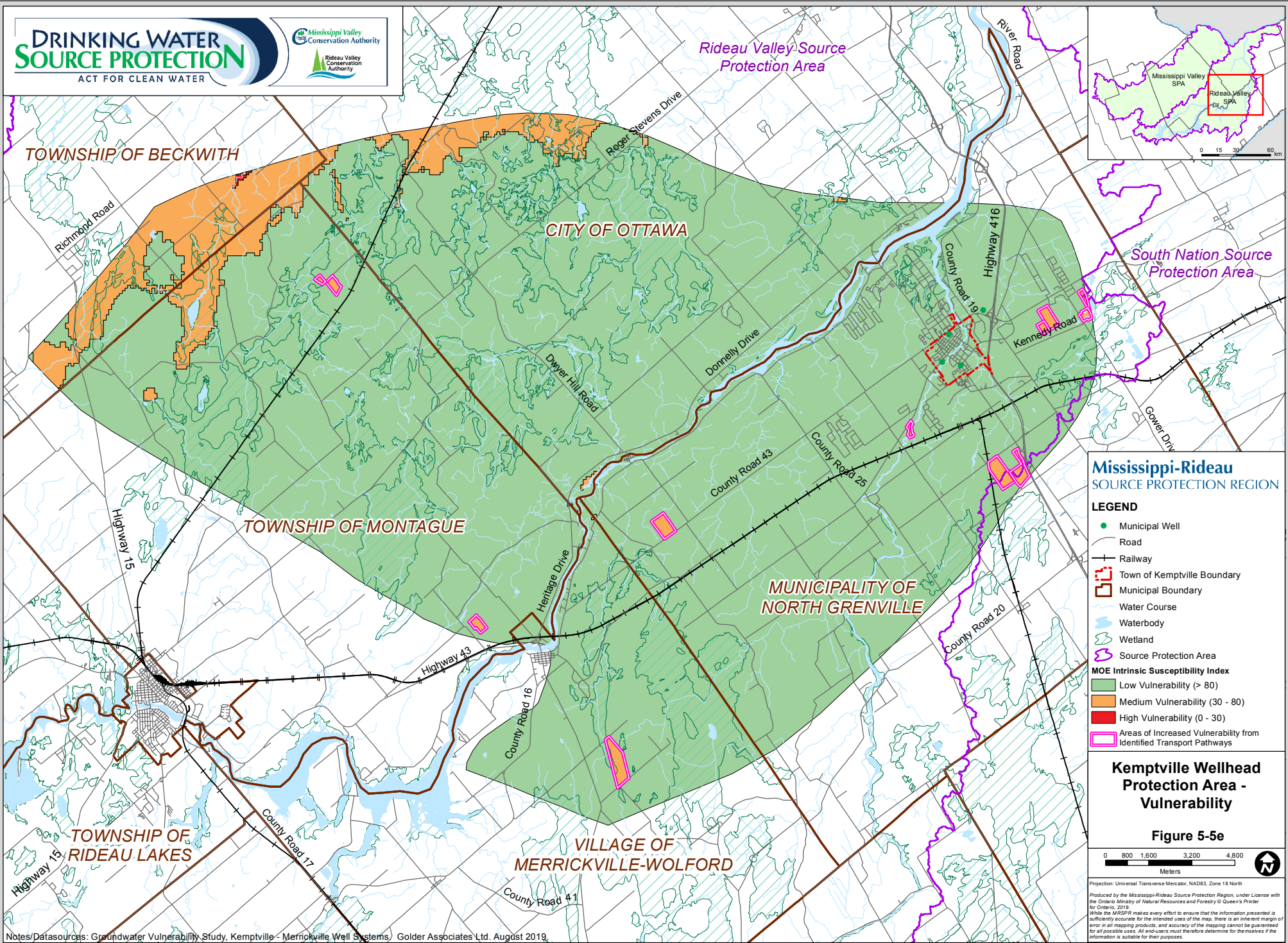
- Municipal Well
- Road
- Railway
- Town of Kemptville Boundary
- Municipal Boundary
- Water Course
- Waterbody
- Wetland
- Source Protection Area
- Uncertainty Assessment**
- Low
- High

**Kemptville Wellhead Protection Area - Uncertainty**

**Figure 5-5d**

0 800 1,600 3,200 4,800  
Meters

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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**Mississippi-Rideau SOURCE PROTECTION REGION**

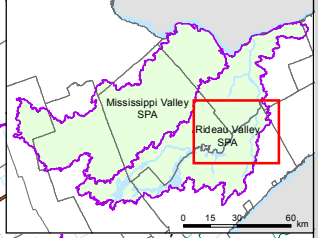
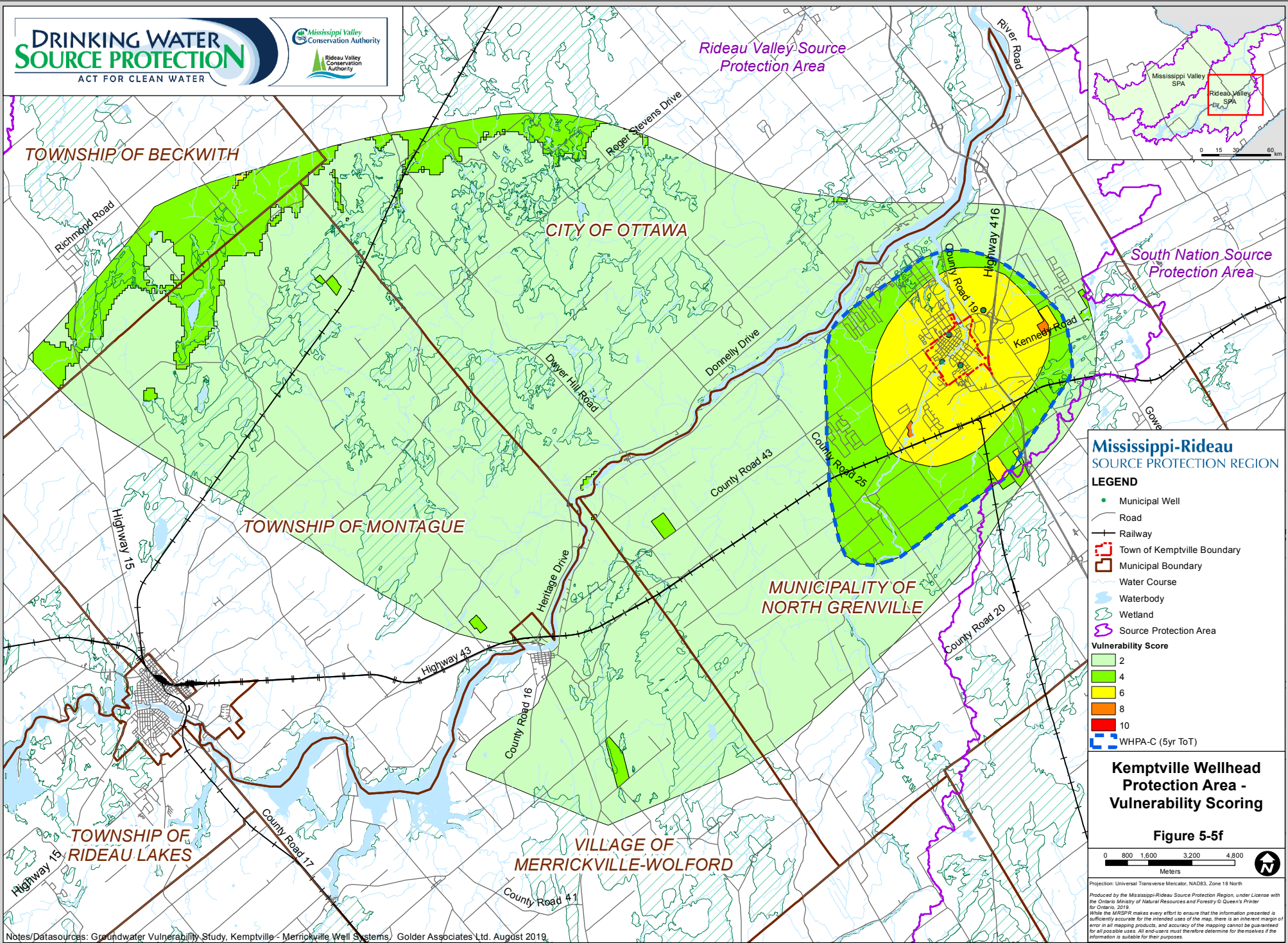
- LEGEND**
- Municipal Well
  - Road
  - +— Railway
  - ▭ Town of Kemptville Boundary
  - ▭ Municipal Boundary
  - ▭ Water Course
  - ▭ Waterbody
  - ▭ Wetland
  - ▭ Source Protection Area
  - ▭ MOE Intrinsic Susceptibility Index
    - ▭ Low Vulnerability (> 80)
    - ▭ Medium Vulnerability (30 - 80)
    - ▭ High Vulnerability (0 - 30)
  - ▭ Areas of Increased Vulnerability from Identified Transport Pathways

**Kemptville Wellhead Protection Area - Vulnerability**

**Figure 5-5e**

0 800 1,600 3,200 4,800  
Meters

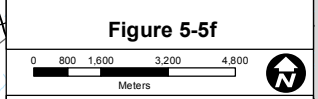
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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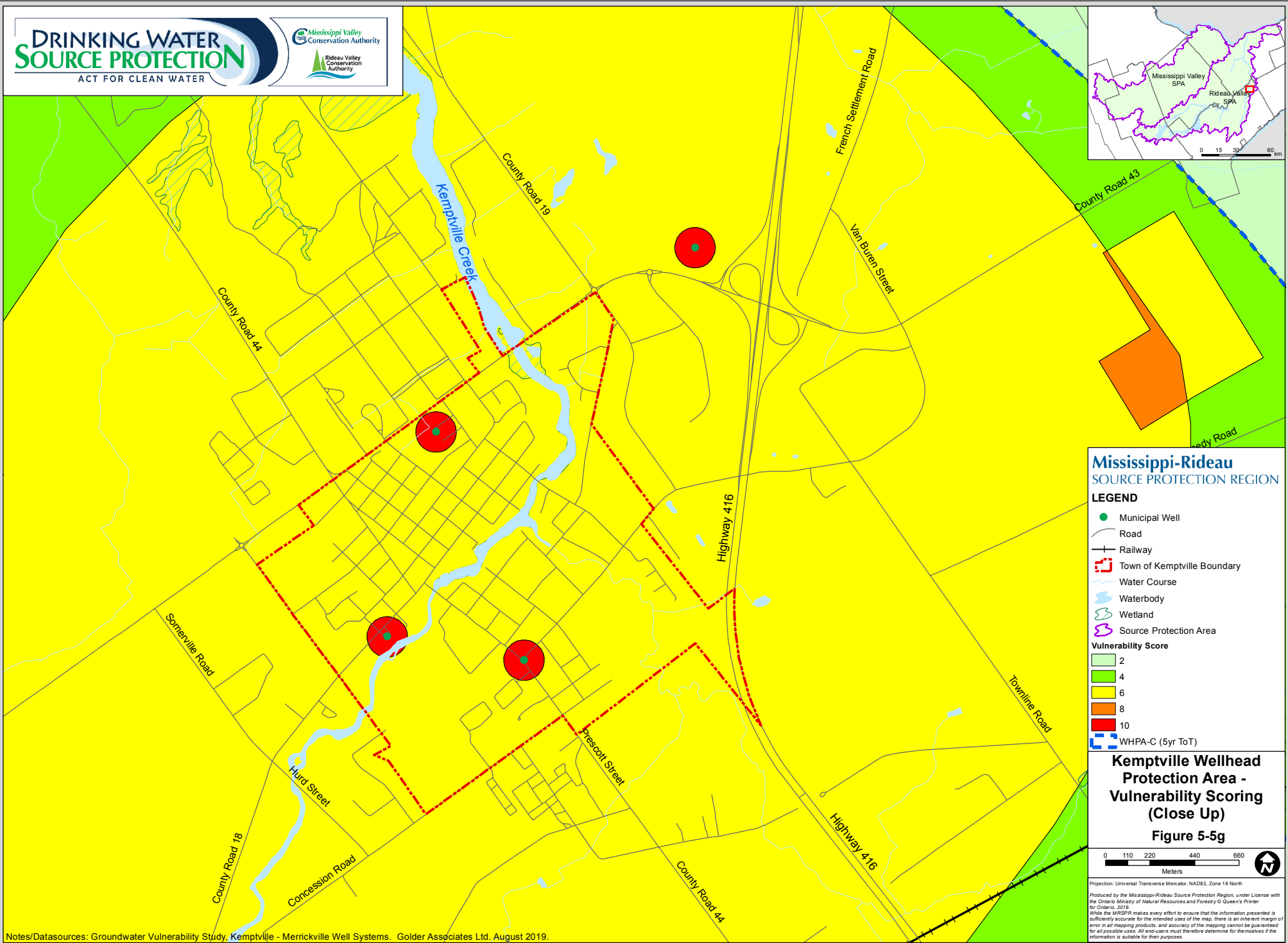
**Mississippi-Rideau SOURCE PROTECTION REGION**

- LEGEND**
- Municipal Well
  - Road
  - Railway
  - ▭ Town of Kemptville Boundary
  - ▭ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Source Protection Area
- Vulnerability Score**
- 2
  - 4
  - 6
  - 8
  - 10
  - WHPA-C (5yr ToT)

**Kemptville Wellhead Protection Area - Vulnerability Scoring**



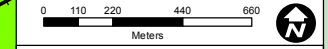
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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While the MRSPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.



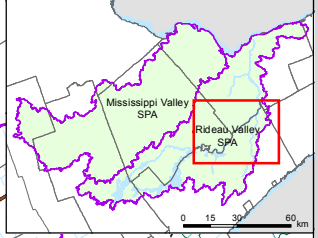
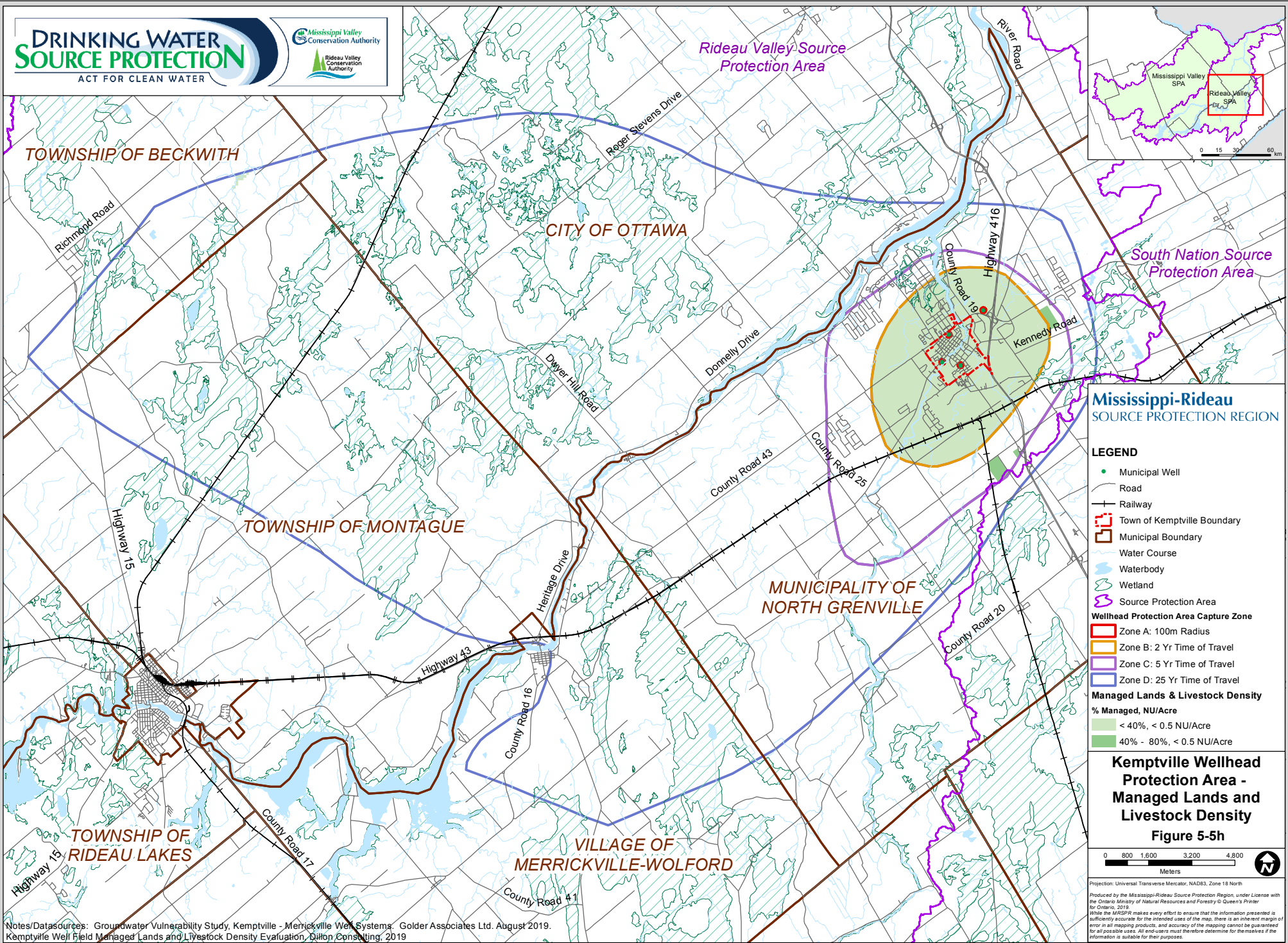
**Mississippi-Rideau  
SOURCE PROTECTION REGION**

- LEGEND**
- Municipal Well
  - Road
  - Railway
  - Town of Kemptville Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Source Protection Area
- Vulnerability Score**
- 2
  - 4
  - 6
  - 8
  - 10
- WHPA-C (5yr ToT)

**Kemptville Wellhead  
Protection Area -  
Vulnerability Scoring  
(Close Up)**  
**Figure 5-5g**



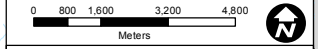
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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While the MRSR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.



**Mississippi-Rideau SOURCE PROTECTION REGION**

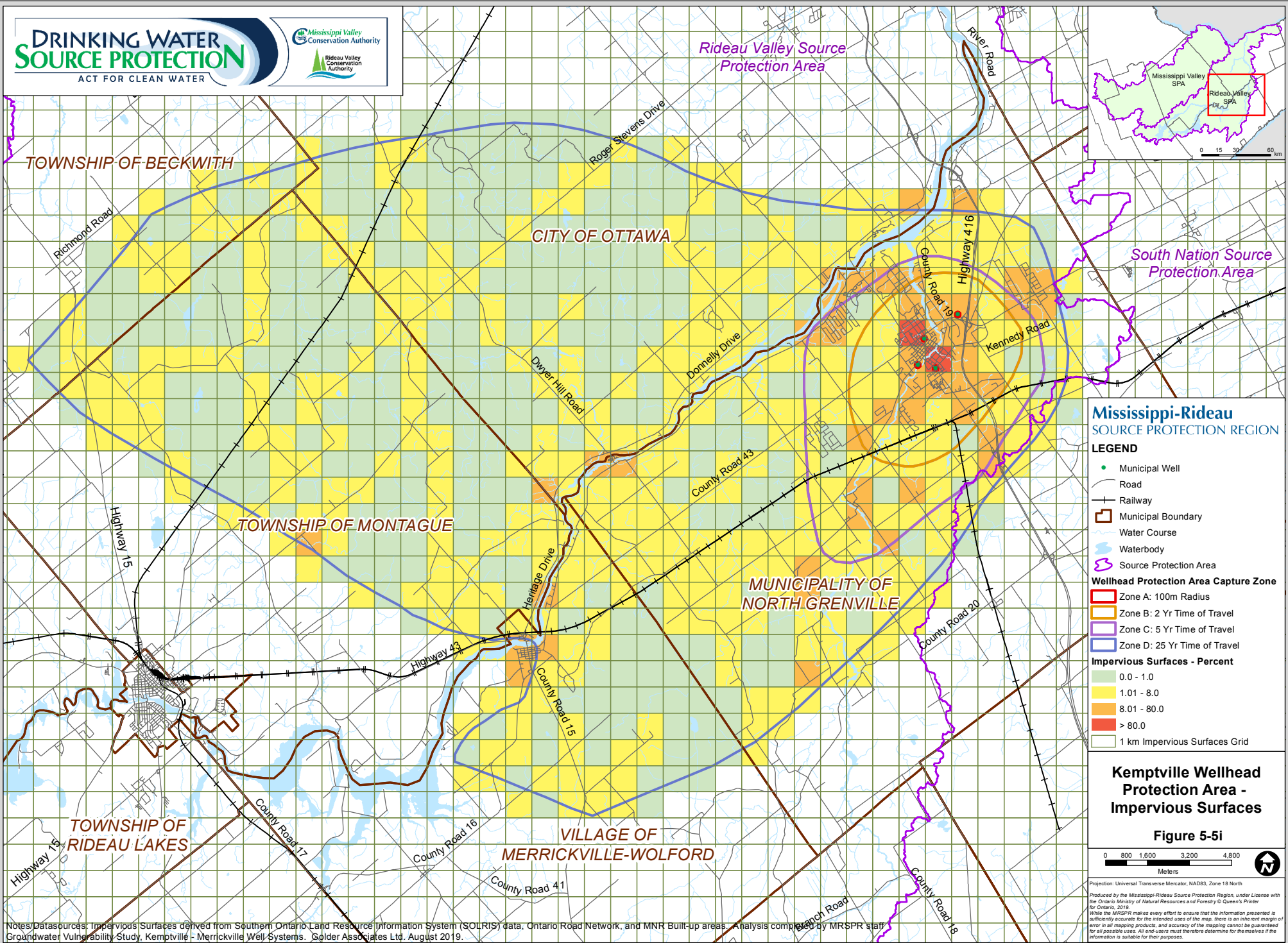
- LEGEND**
- Municipal Well
  - Road
  - Railway
  - ▭ Town of Kemptville Boundary
  - ▭ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Source Protection Area
  - Wellhead Protection Area Capture Zone**
  - ▭ Zone A: 100m Radius
  - ▭ Zone B: 2 Yr Time of Travel
  - ▭ Zone C: 5 Yr Time of Travel
  - ▭ Zone D: 25 Yr Time of Travel
  - Managed Lands & Livestock Density**
  - % Managed, NU/Acre
  - < 40%, < 0.5 NU/Acre
  - 40% - 80%, < 0.5 NU/Acre

**Kemptville Wellhead Protection Area - Managed Lands and Livestock Density**  
**Figure 5-5h**



Notes/Datasources: Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems, Golder Associates Ltd. August 2019. Kemptville Well Field Managed Lands and Livestock Density Evaluation, Dillon Consulting, 2019

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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**Mississippi-Rideau SOURCE PROTECTION REGION**

**LEGEND**

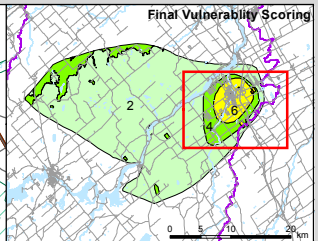
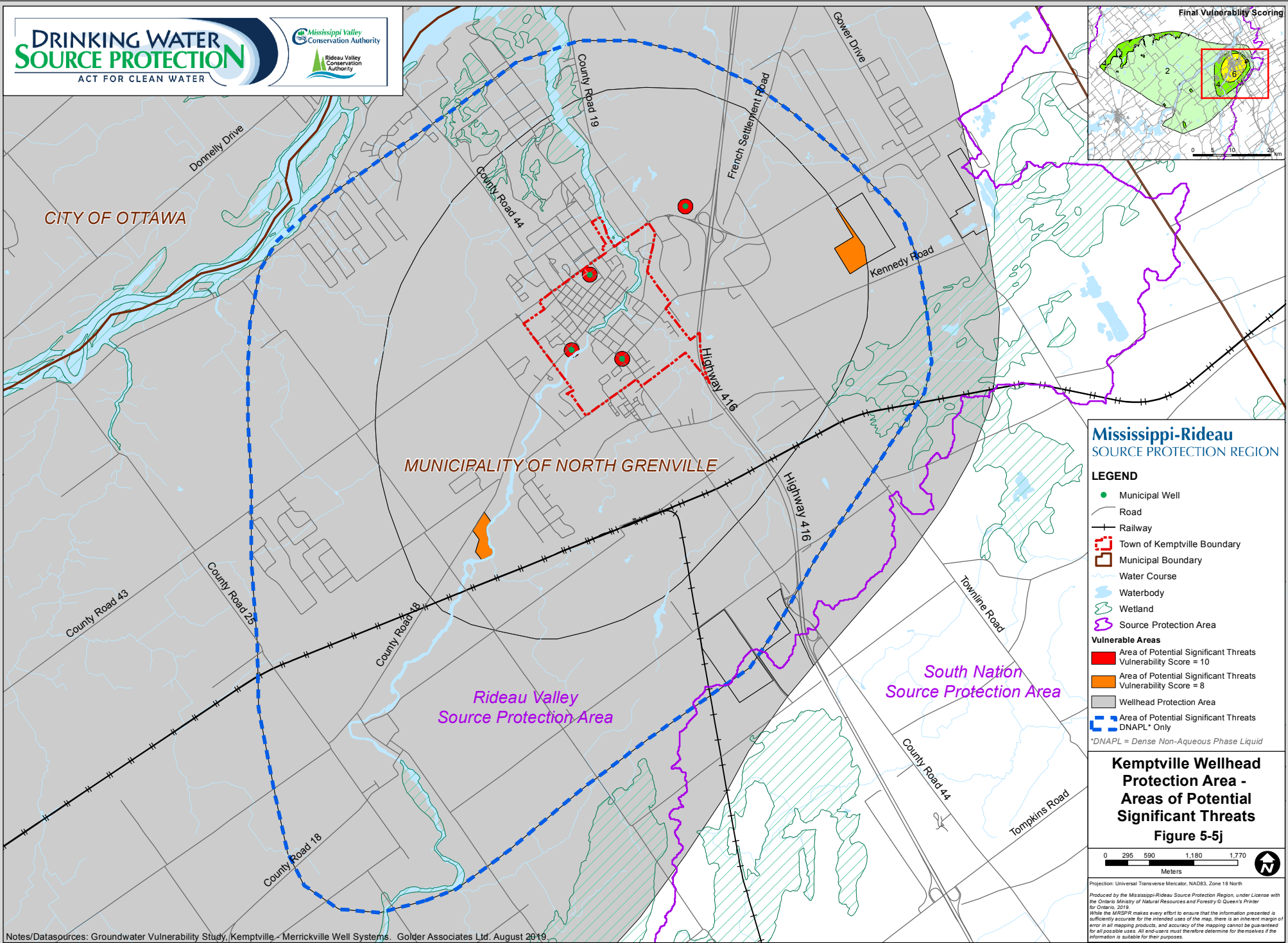
- Municipal Well
- Road
- +— Railway
- ▭ Municipal Boundary
- Water Course
- Waterbody
- Source Protection Area
- Wellhead Protection Area Capture Zone**
- ▭ Zone A: 100m Radius
- ▭ Zone B: 2 Yr Time of Travel
- ▭ Zone C: 5 Yr Time of Travel
- ▭ Zone D: 25 Yr Time of Travel
- Impervious Surfaces - Percent**
- ▭ 0.0 - 1.0
- ▭ 1.01 - 8.0
- ▭ 8.01 - 80.0
- ▭ > 80.0
- ▭ 1 km Impervious Surfaces Grid

**Kemptville Wellhead Protection Area - Impervious Surfaces**

**Figure 5-5i**  
0 800 1600 3200 4800  
Meters

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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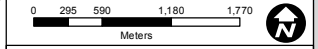
Notes/Datasources: Impervious Surfaces derived from Southern Ontario Land Resource Information System (SOLRIS) data, Ontario Road Network, and MNR Built-up areas. Analysis completed by MRSPR staff Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.



**Mississippi-Rideau  
SOURCE PROTECTION REGION**

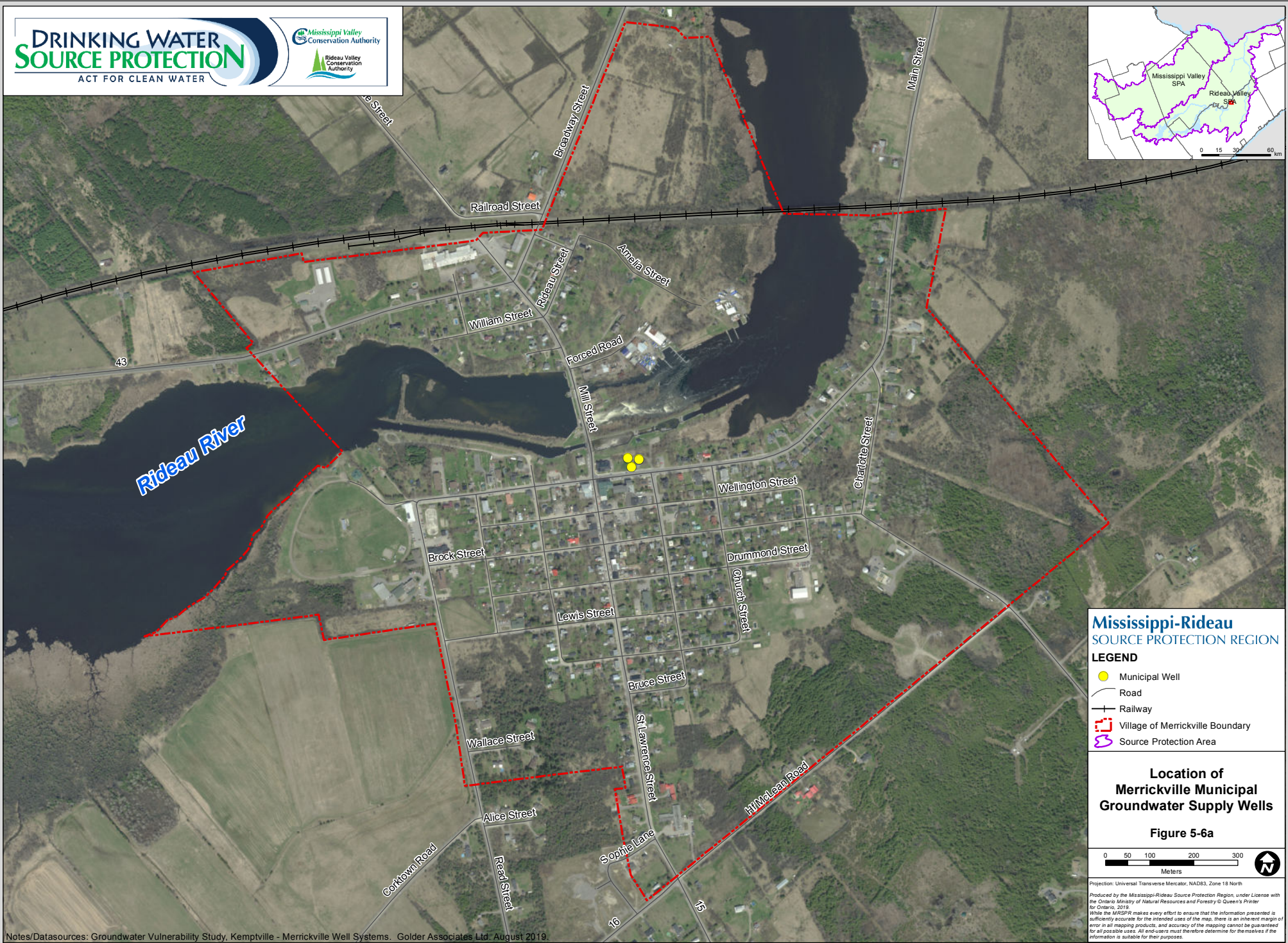
- LEGEND**
- Municipal Well
  - Road
  - +— Railway
  - ⬡ Town of Kemptville Boundary
  - ⬡ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Source Protection Area
- Vulnerable Areas**
- Area of Potential Significant Threats  
Vulnerability Score = 10
  - Area of Potential Significant Threats  
Vulnerability Score = 8
  - Wellhead Protection Area
  - Area of Potential Significant Threats  
DNAPL\* Only
- \*DNAPL = Dense Non-Aqueous Phase Liquid

**Kemptville Wellhead  
Protection Area -  
Areas of Potential  
Significant Threats**  
**Figure 5-5j**



Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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The location, name and other information of the municipalities and counties shown on this map are for information only and do not constitute an endorsement or approval by the Province of Ontario. © 2020 18 18 2019



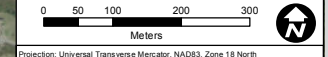
**Mississippi-Rideau**  
SOURCE PROTECTION REGION

**LEGEND**

- Municipal Well
- Road
- Railway
- Village of Merrickville Boundary
- Source Protection Area

**Location of Merrickville Municipal Groundwater Supply Wells**

**Figure 5-6a**

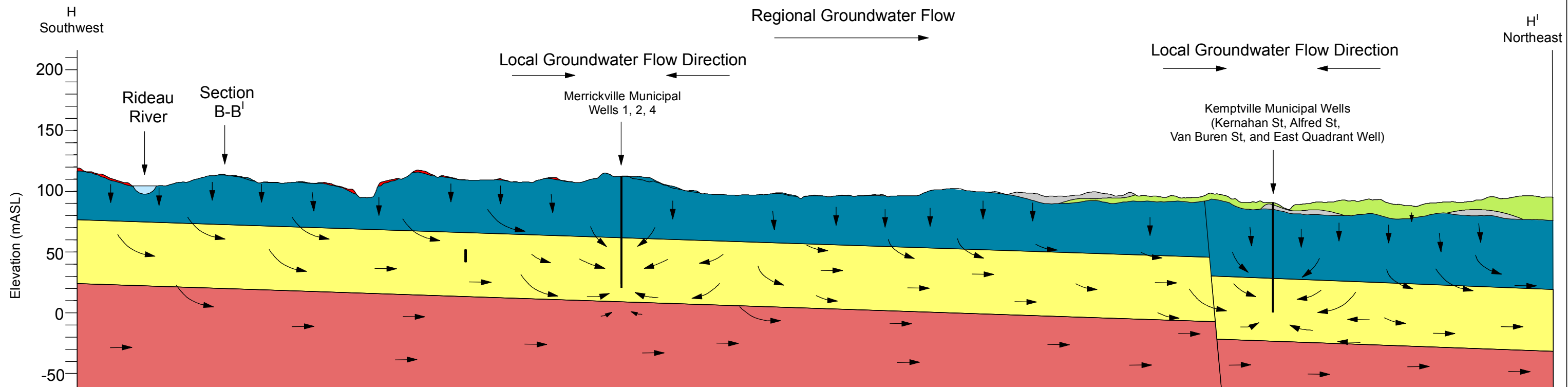
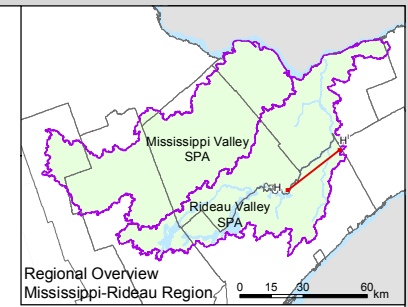


Projection: Universal Transverse Mercator, NAD83, Zone 18 North

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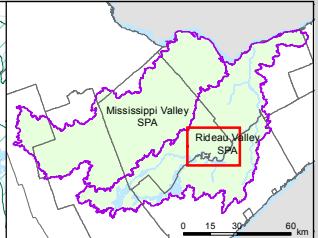
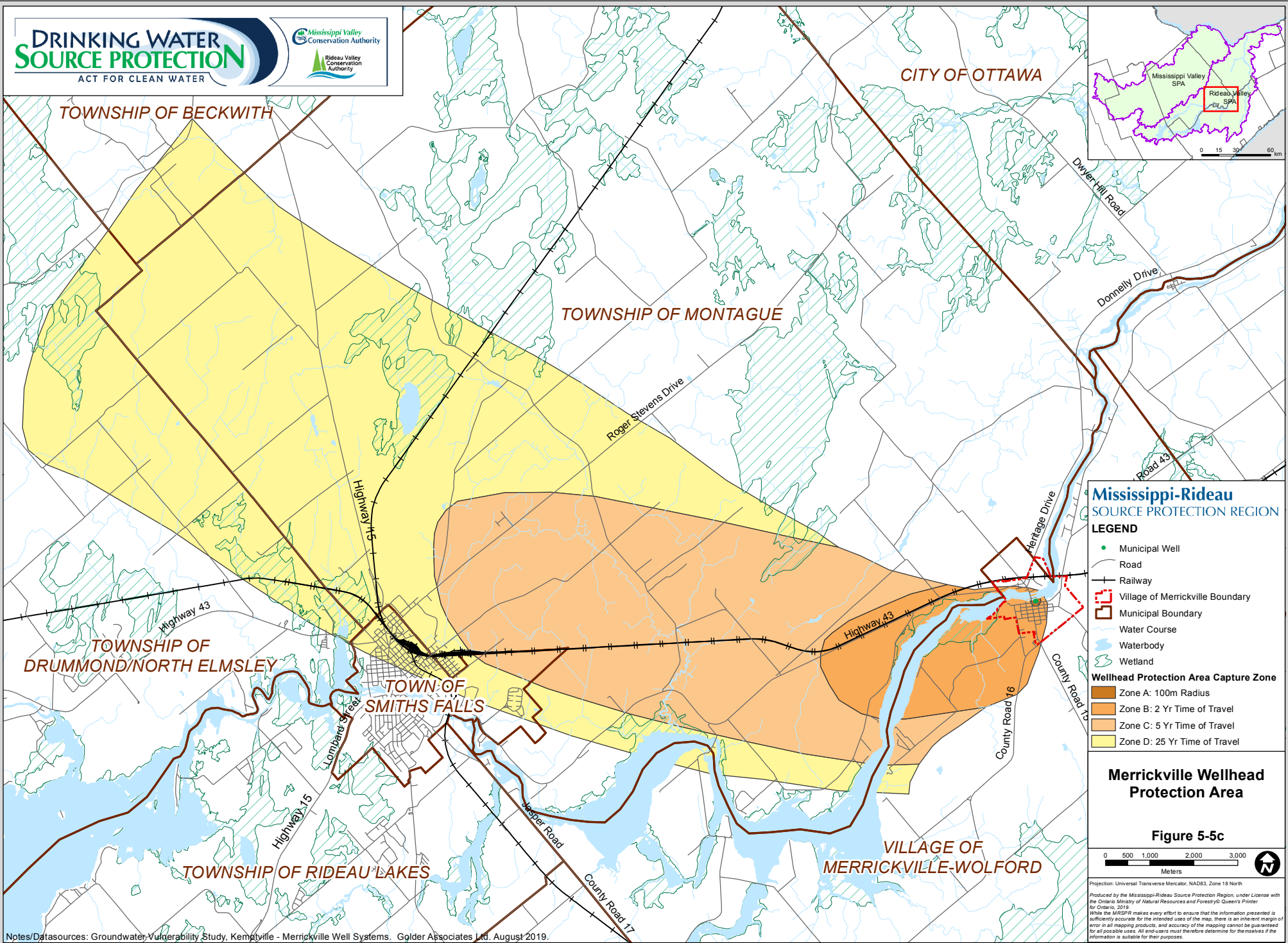
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1:25 Vertical Exaggeration

<b>Mississippi-Rideau SOURCE PROTECTION REGION</b>		<b>Merrickville Conceptual Hydrogeological Cross-Section</b>  <b>Figure 5-6b</b>
<b>LEGEND</b>		
<b>Formation</b>	<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #90EE90; border: 1px solid black; margin-right: 5px;"></span> Sand and Gravel</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #4682B4; border: 1px solid black; margin-right: 5px;"></span> Oxford/March Formations (Dolostone/Limestone)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FFFF00; border: 1px solid black; margin-right: 5px;"></span> Nepean Formation (Sandstone)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #DC143C; border: 1px solid black; margin-right: 5px;"></span> Precambrian (Granite)</li> </ul>	<small>Projection: Universal Transverse Mercator, NAD83, Zone 18 North Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019. While the MRSPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.</small>
<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #ADD8E6; border: 1px solid black; margin-right: 5px;"></span> River/Lake</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #808080; border: 1px solid black; margin-right: 5px;"></span> Undifferentiated Overburden (Quaternary Deposits)</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #808080; border: 1px solid black; margin-right: 5px;"></span> Clay</li> </ul>		
<small>Notes/Datasources: Modified from Golder 2003a. This information is regional in nature and not intended for site-specific evaluations. The figure should be used only in conjunction with the accompanying report.</small>		

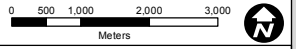


**Mississippi-Rideau SOURCE PROTECTION REGION**

- LEGEND**
- Municipal Well
  - Road
  - Railway
  - Village of Merrickville Boundary
  - Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
- Wellhead Protection Area Capture Zone**
- Zone A: 100m Radius
  - Zone B: 2 Yr Time of Travel
  - Zone C: 5 Yr Time of Travel
  - Zone D: 25 Yr Time of Travel

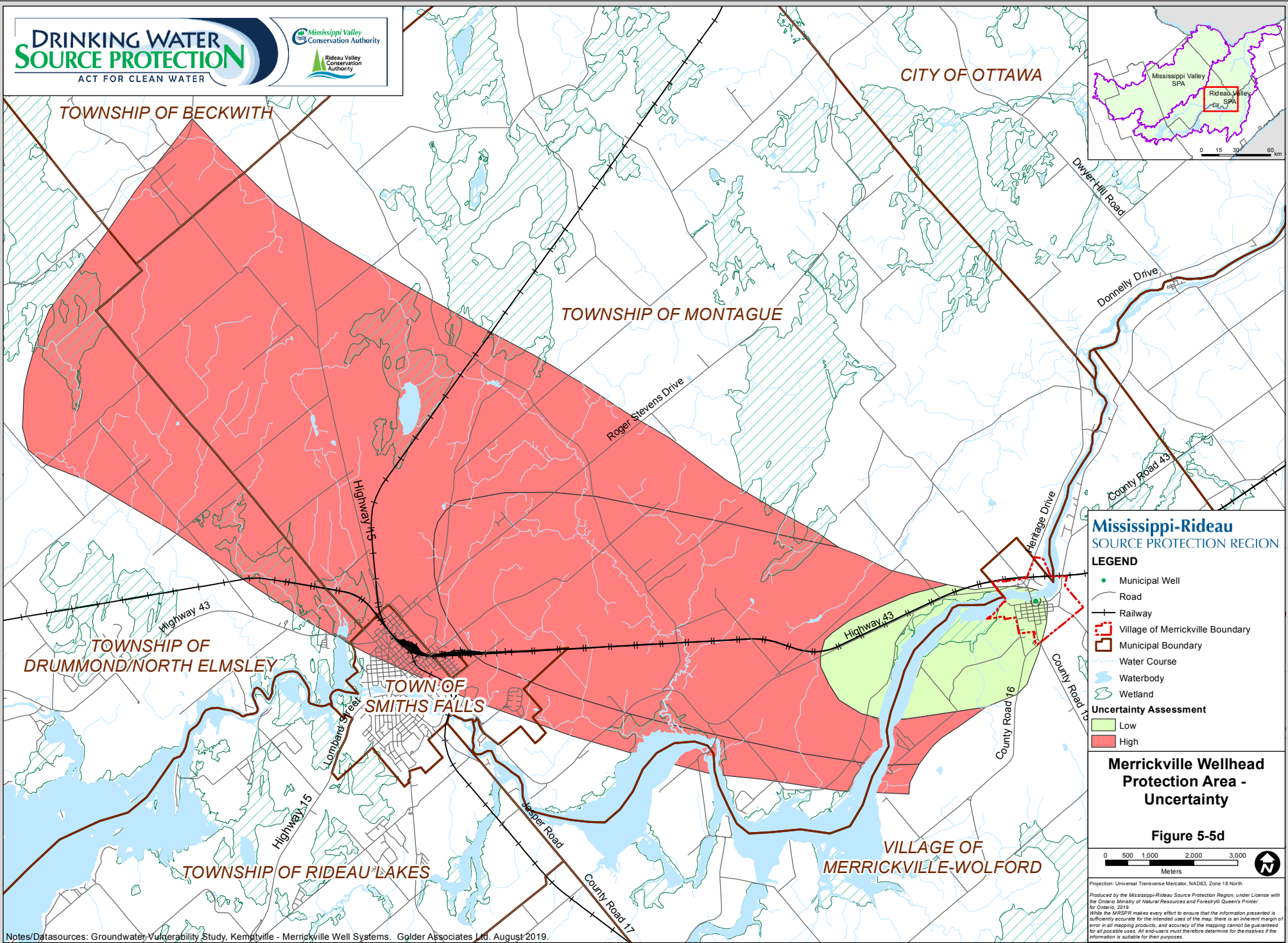
**Merrickville Wellhead Protection Area**

**Figure 5-5c**



Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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Notes/Datasources: Groundwater Vulnerability Study, Kempsville - Merrickville Well Systems. Golder Associates Ltd. August 2019.



**Mississippi-Rideau  
SOURCE PROTECTION REGION**

**LEGEND**

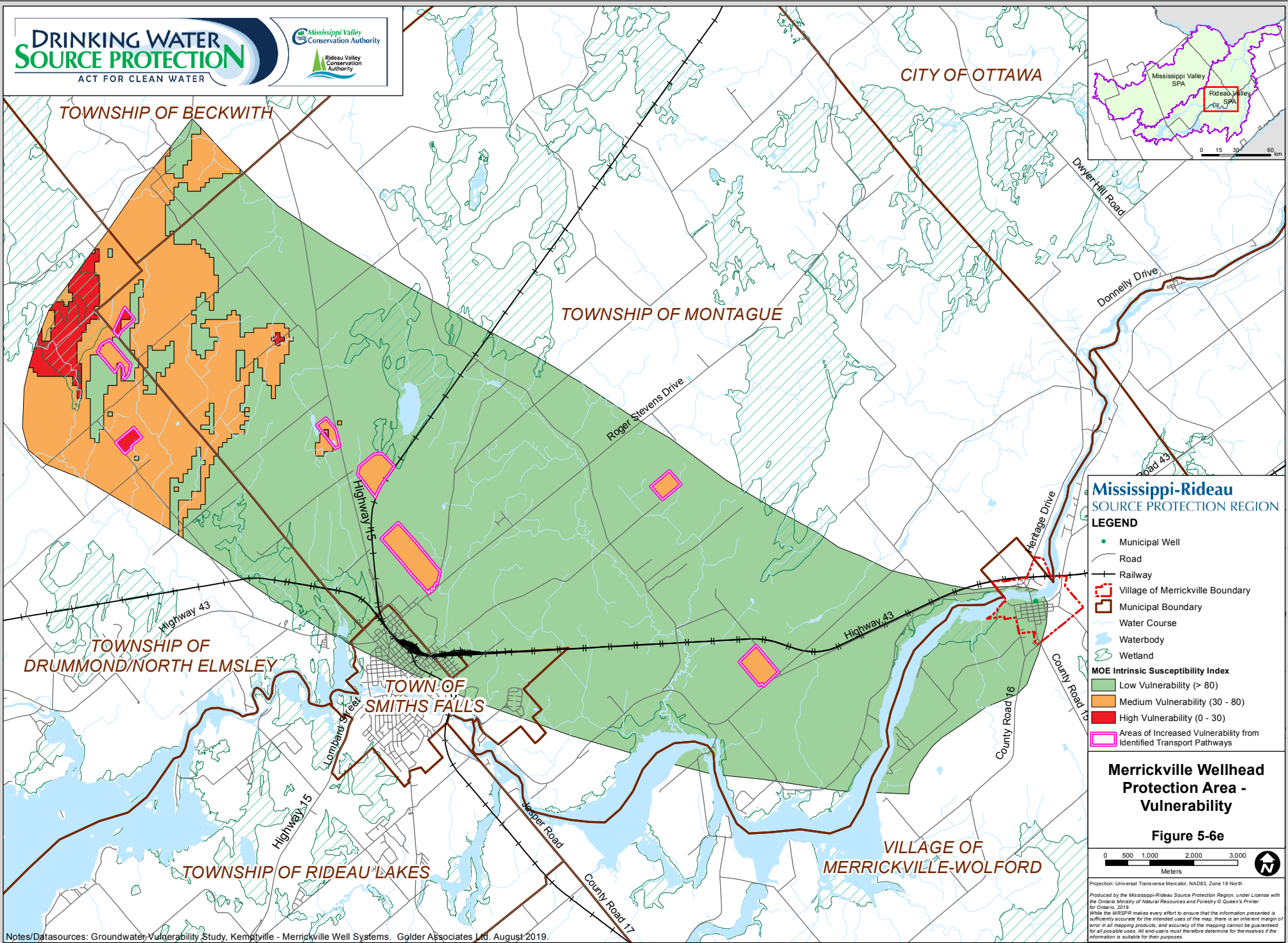
- Municipal Well
- Road
- Railway
- Village of Merrickville Boundary
- Municipal Boundary
- Water Course
- Waterbody
- Wetland
- Uncertainty Assessment**
- Low
- High

**Merrickville Wellhead  
Protection Area -  
Uncertainty**

**Figure 5-5d**

0 500 1,000 2,000 3,000  
Meters

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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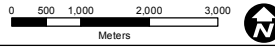


**Mississippi-Rideau  
SOURCE PROTECTION REGION**

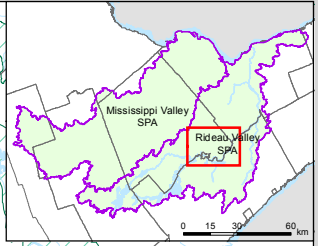
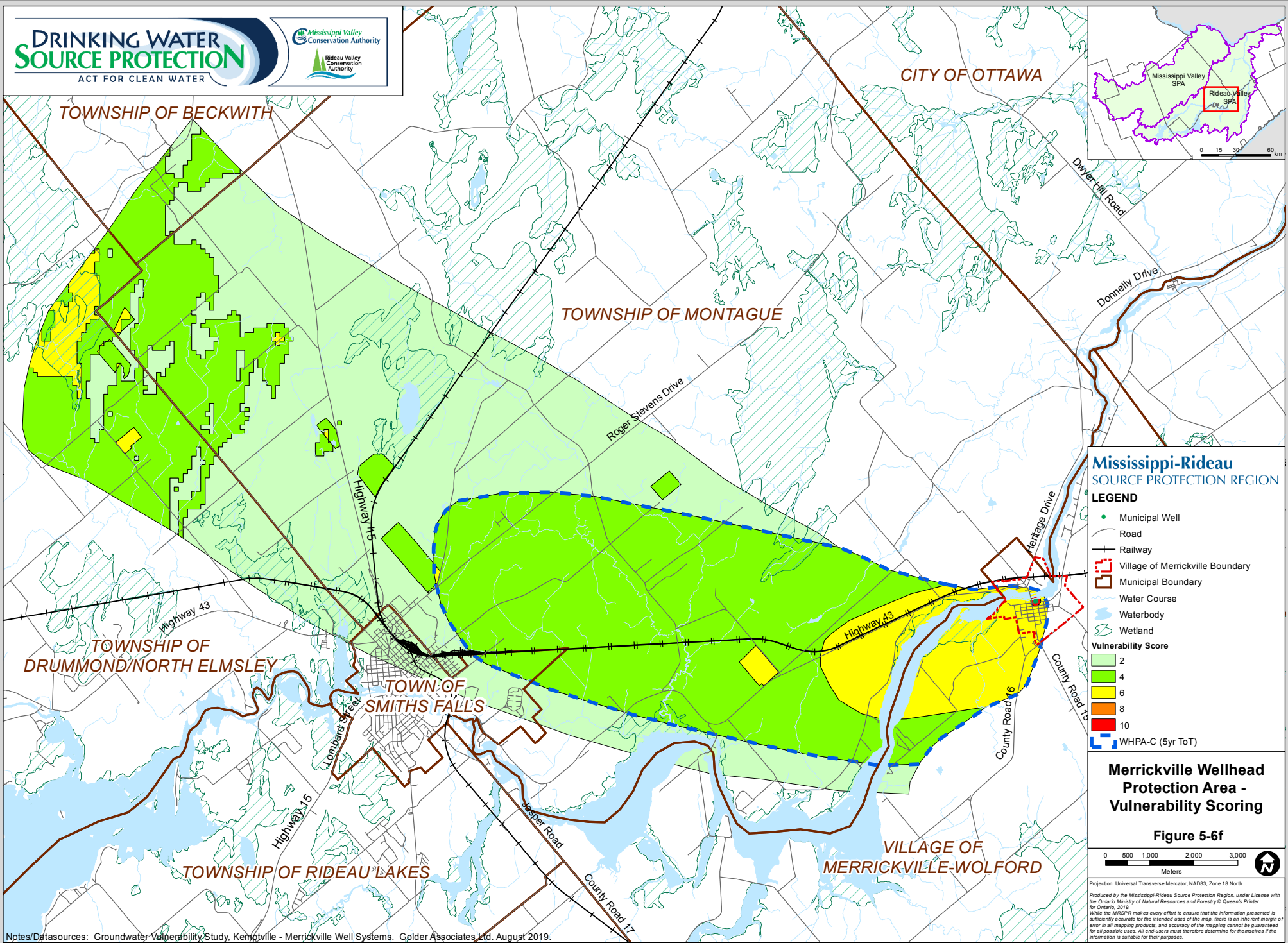
- LEGEND**
- Municipal Well
  - Road
  - Railway
  - ▭ Village of Merrickville Boundary
  - ▭ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
- MOE Intrinsic Susceptibility Index**
- Low Vulnerability (> 80)
  - Medium Vulnerability (30 - 80)
  - High Vulnerability (0 - 30)
  - Areas of Increased Vulnerability from Identified Transport Pathways

**Merrickville Wellhead  
Protection Area -  
Vulnerability**

**Figure 5-6e**



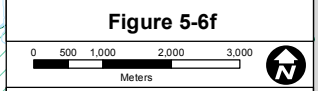
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019  
While the MRSPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.



**Mississippi-Rideau SOURCE PROTECTION REGION**

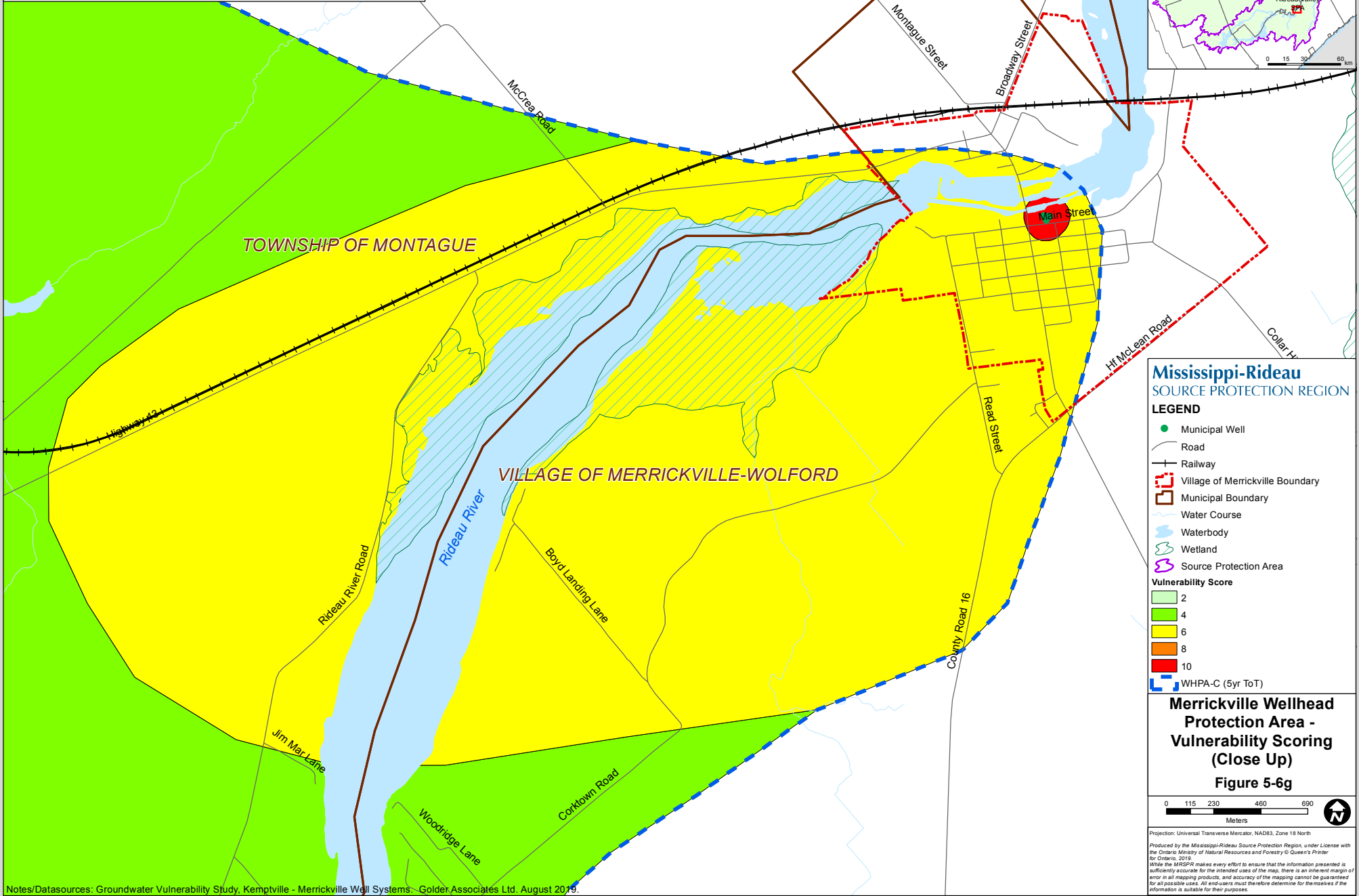
- LEGEND**
- Municipal Well
  - Road
  - Railway
  - ▭ Village of Merrickville Boundary
  - ▭ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
- Vulnerability Score**
- 2
  - 4
  - 6
  - 8
  - 10
- ▭ WHPA-C (5yr ToT)

**Merrickville Wellhead Protection Area - Vulnerability Scoring**



Notes/Datasources: Groundwater Vulnerability Study, Merrickville - Merrickville Well Systems. Golder Associates Ltd. August 2019.

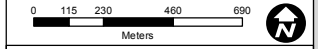
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019  
While the MSRPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.



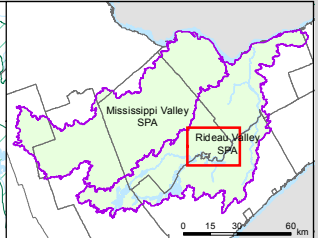
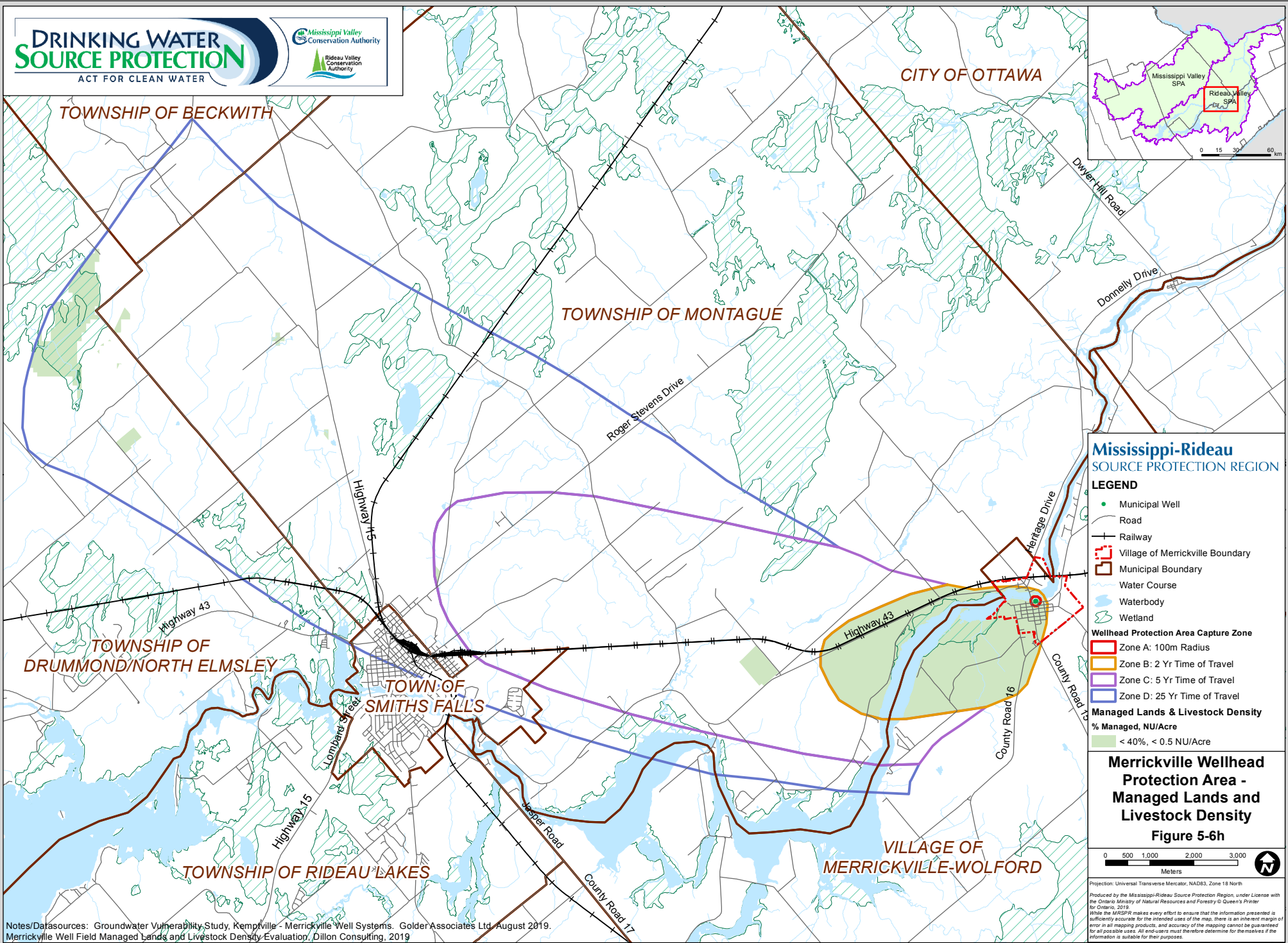
**Mississippi-Rideau  
SOURCE PROTECTION REGION**  
**LEGEND**

- Municipal Well
  - Road
  - Railway
  - Village of Merrickville Boundary
  - Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Source Protection Area
- Vulnerability Score**
- 2
  - 4
  - 6
  - 8
  - 10
- WHPA-C (5yr ToT)

**Merrickville Wellhead  
Protection Area -  
Vulnerability Scoring  
(Close Up)**  
**Figure 5-6g**



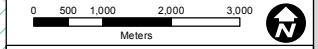
Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
Produced by the Mississippi-Rideau Source Protection Region, under License with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019  
While the MRSPR makes every effort to ensure that the information presented is sufficiently accurate for the intended uses of the map, there is an inherent margin of error in all mapping products, and accuracy of the mapping cannot be guaranteed for all possible uses. All end-users must therefore determine for themselves if the information is suitable for their purposes.



**Mississippi-Rideau SOURCE PROTECTION REGION**

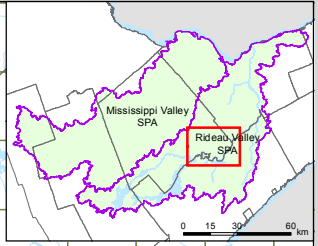
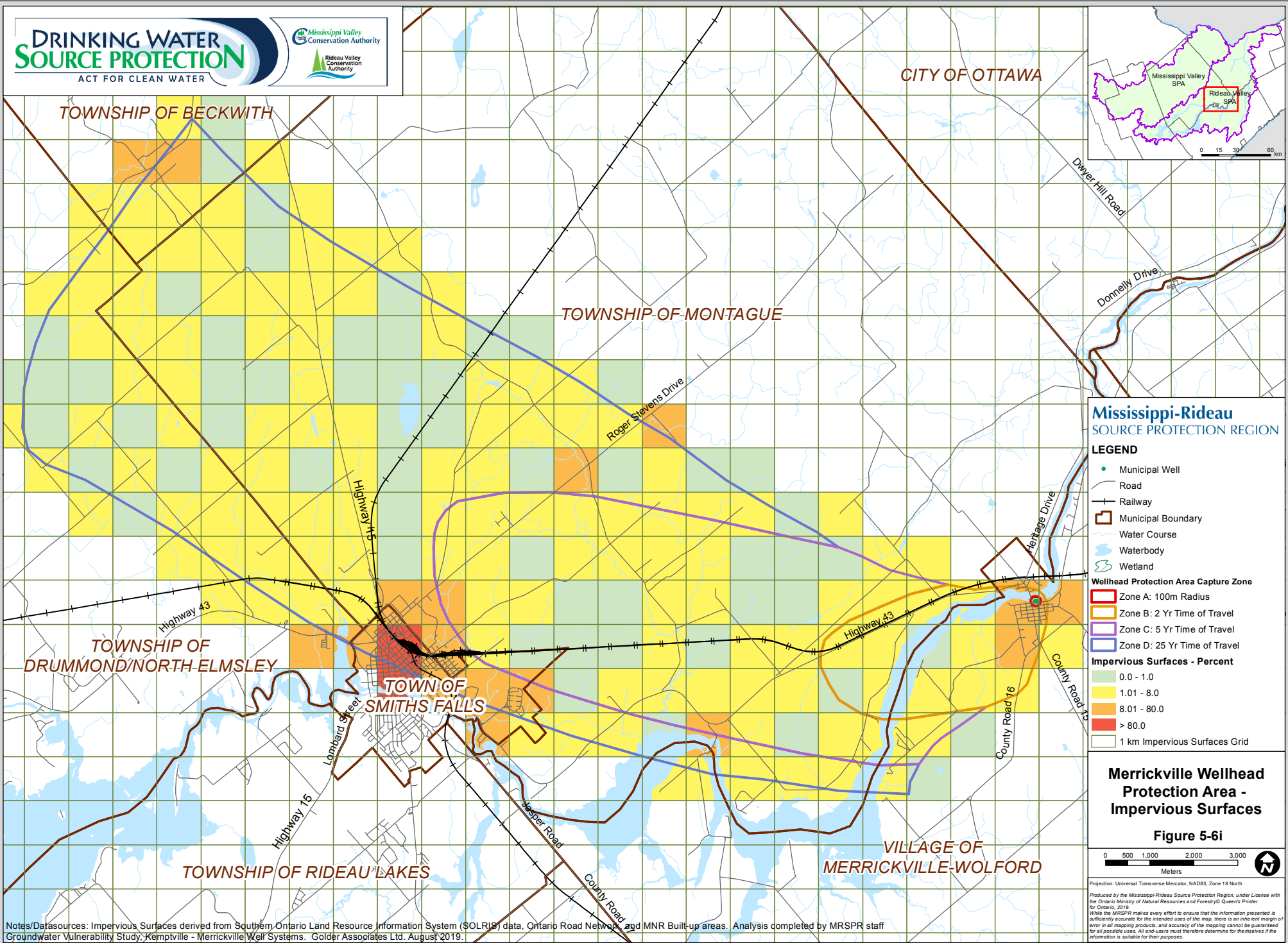
- LEGEND**
- Municipal Well
  - Road
  - +— Railway
  - ⬠ Village of Merrickville Boundary
  - ⬠ Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Wellhead Protection Area Capture Zone**
  - Zone A: 100m Radius
  - Zone B: 2 Yr Time of Travel
  - Zone C: 5 Yr Time of Travel
  - Zone D: 25 Yr Time of Travel
  - Managed Lands & Livestock Density**
  - % Managed, NU/Acre
  - < 40%, < 0.5 NU/Acre

**Merrickville Wellhead Protection Area - Managed Lands and Livestock Density**  
**Figure 5-6h**



Notes/Datasources: Groundwater Vulnerability Study, Kemptonville - Merrickville Well Systems. Golder Associates Ltd. August 2019.  
Merrickville Well Field Managed Lands and Livestock Density Evaluation, Dillon Consulting, 2019

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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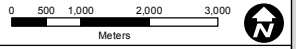
**Mississippi-Rideau  
SOURCE PROTECTION REGION**

**LEGEND**

- Municipal Well
- Road
- Railway
- Municipal Boundary
- Water Course
- Waterbody
- Wetland
- Wellhead Protection Area Capture Zone**
- Zone A: 100m Radius
- Zone B: 2 Yr Time of Travel
- Zone C: 5 Yr Time of Travel
- Zone D: 25 Yr Time of Travel
- Impervious Surfaces - Percent**
- 0.0 - 1.0
- 1.01 - 8.0
- 8.01 - 80.0
- > 80.0
- 1 km Impervious Surfaces Grid

**Merrickville Wellhead  
Protection Area -  
Impervious Surfaces**

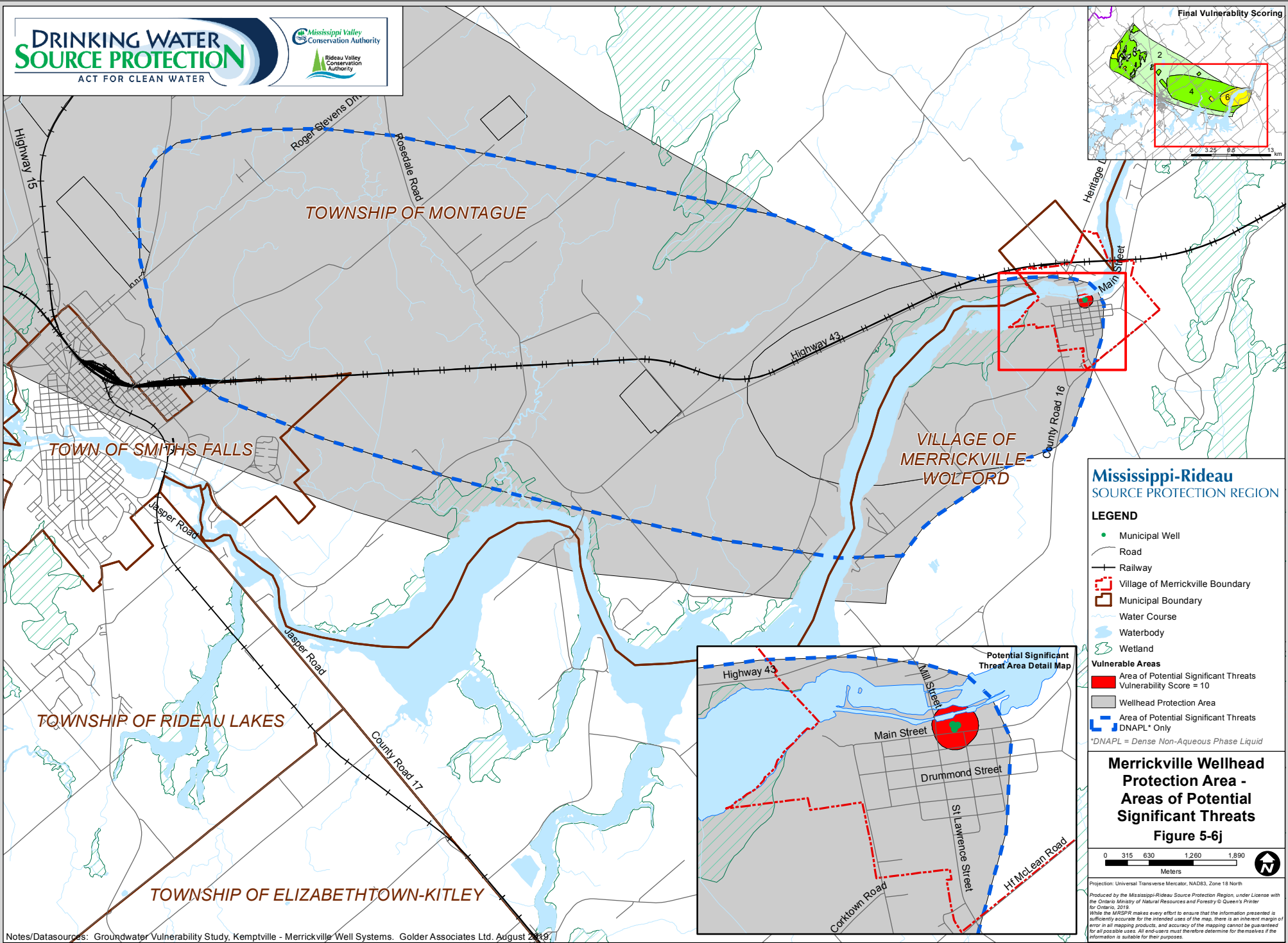
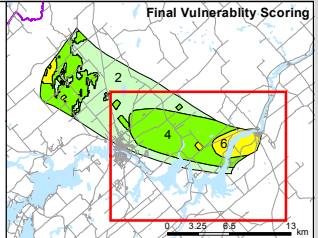
**Figure 5-6i**



Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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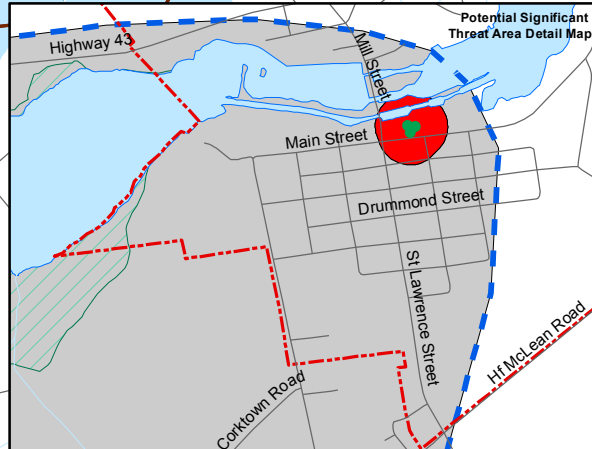
Notes/Datasources: Impervious Surfaces derived from Southern Ontario Land Resource Information System (SOLRIS) data, Ontario Road Network and MNR Built-up areas. Analysis completed by MRSPR staff Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019.





**Mississippi-Rideau SOURCE PROTECTION REGION**

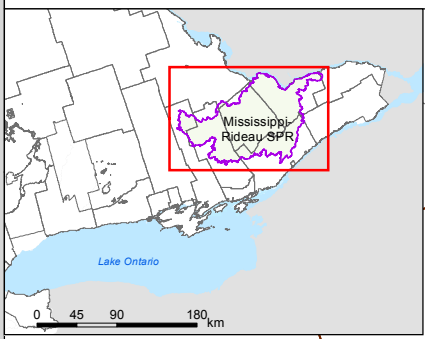
- LEGEND**
- Municipal Well
  - Road
  - Railway
  - Village of Merrickville Boundary
  - Municipal Boundary
  - Water Course
  - Waterbody
  - Wetland
  - Vulnerable Areas**
  - Area of Potential Significant Threats Vulnerability Score = 10
  - Wellhead Protection Area
  - Area of Potential Significant Threats DNAPL\* Only
- \*DNAPL = Dense Non-Aqueous Phase Liquid



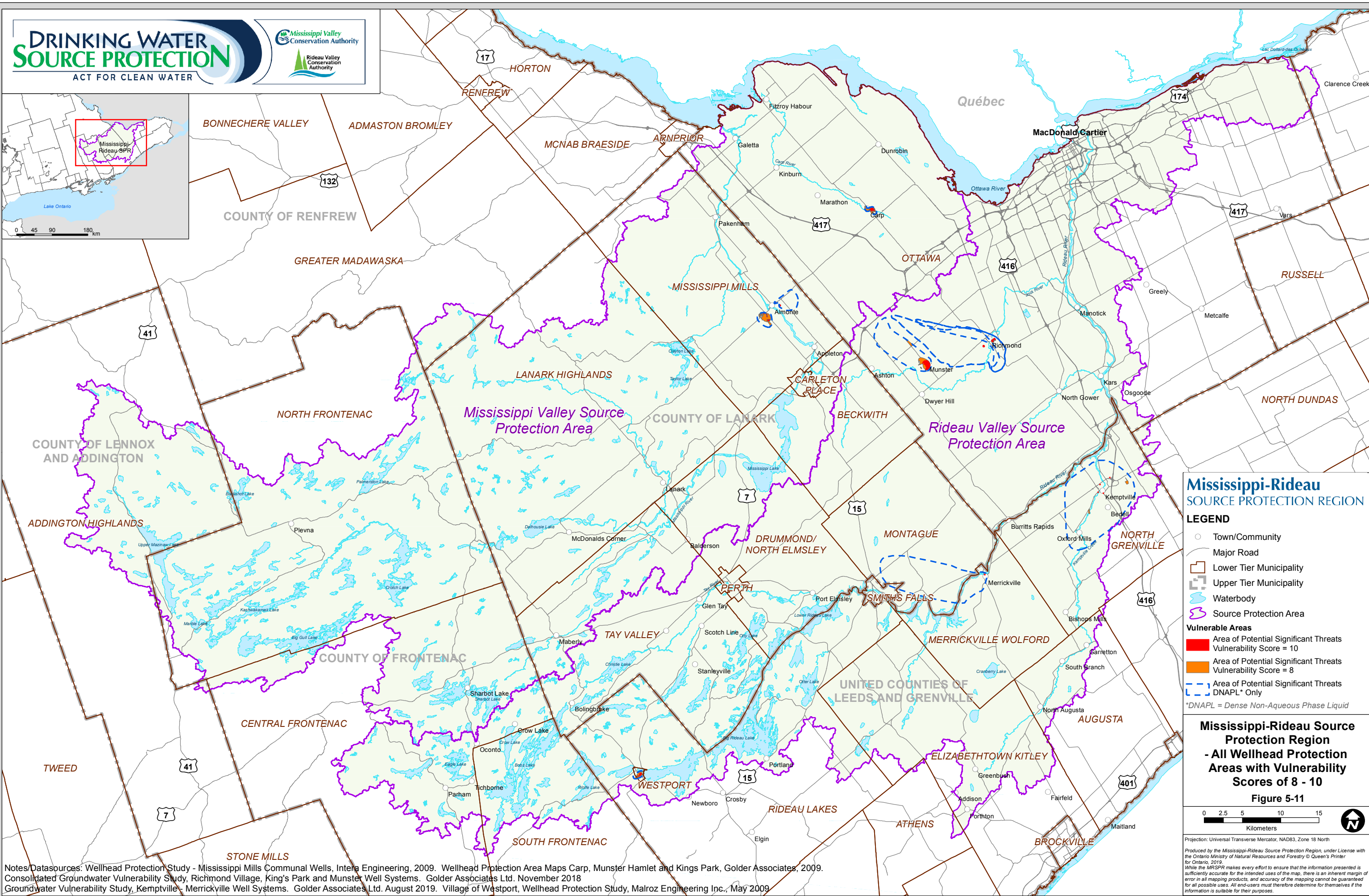
**Merrickville Wellhead Protection Area - Areas of Potential Significant Threats**  
**Figure 5-6j**

0 315 630 1260 1890  
Meters

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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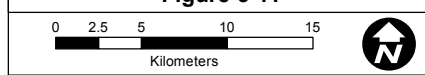
0 45 90 180 km



**Mississippi-Rideau SOURCE PROTECTION REGION**

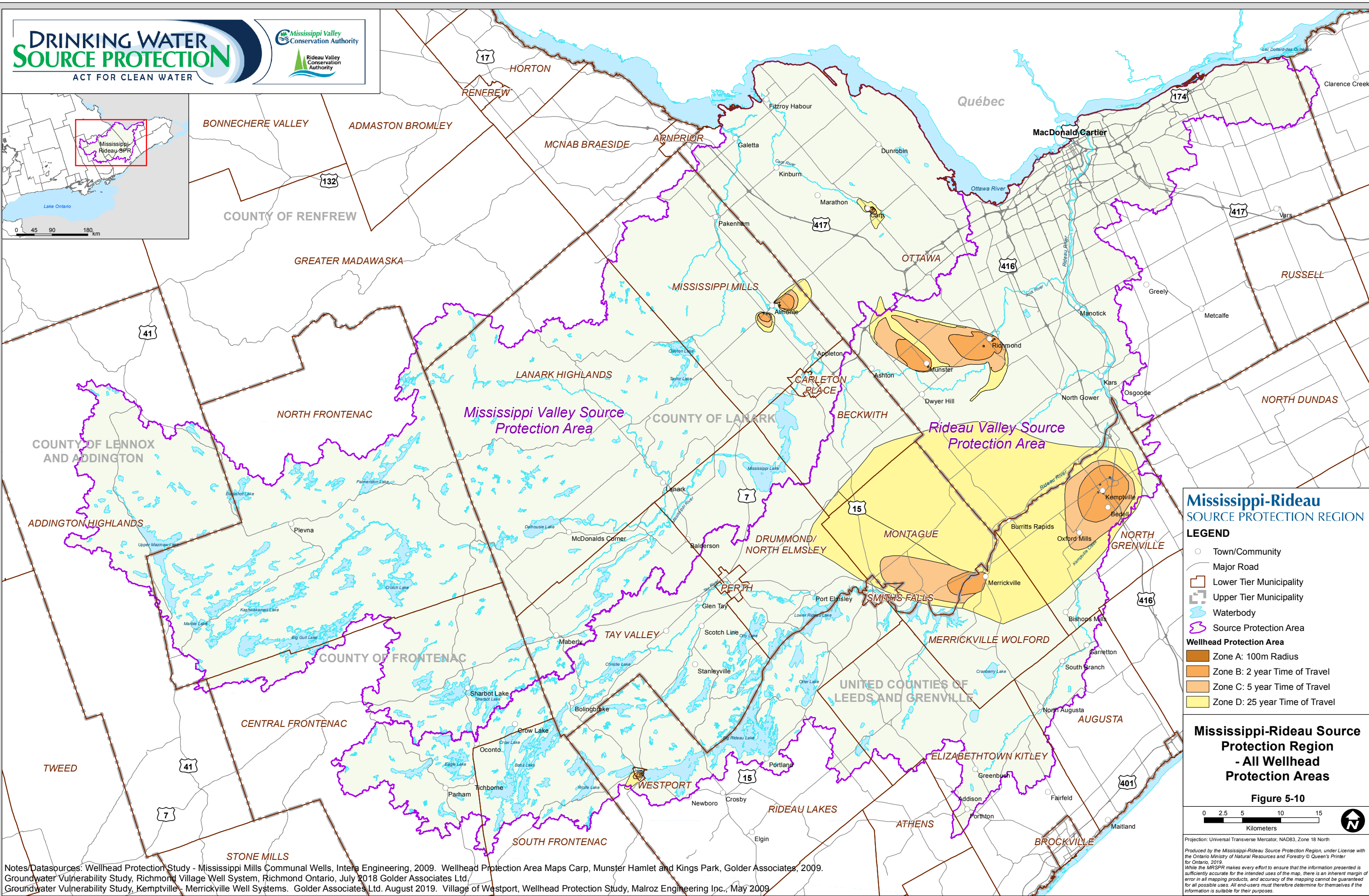
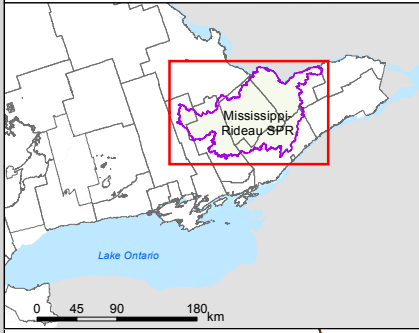
- LEGEND**
- Town/Community
  - Major Road
  - ▭ Lower Tier Municipality
  - ▭ Upper Tier Municipality
  - Waterbody
  - Source Protection Area
- Vulnerable Areas**
- Area of Potential Significant Threats Vulnerability Score = 10
  - Area of Potential Significant Threats Vulnerability Score = 8
  - Area of Potential Significant Threats DNAPL\* Only
- \*DNAPL = Dense Non-Aqueous Phase Liquid

**Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas with Vulnerability Scores of 8 - 10**  
Figure 5-11



Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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Notes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009. Consolidated Groundwater Vulnerability Study, Richmond Village, King's Park and Munster Well Systems. Golder Associates Ltd. November 2018. Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009



**Mississippi-Rideau SOURCE PROTECTION REGION**

**LEGEND**

- Town/Community
- Major Road
- Lower Tier Municipality
- Upper Tier Municipality
- Waterbody
- Source Protection Area

**Wellhead Protection Area**

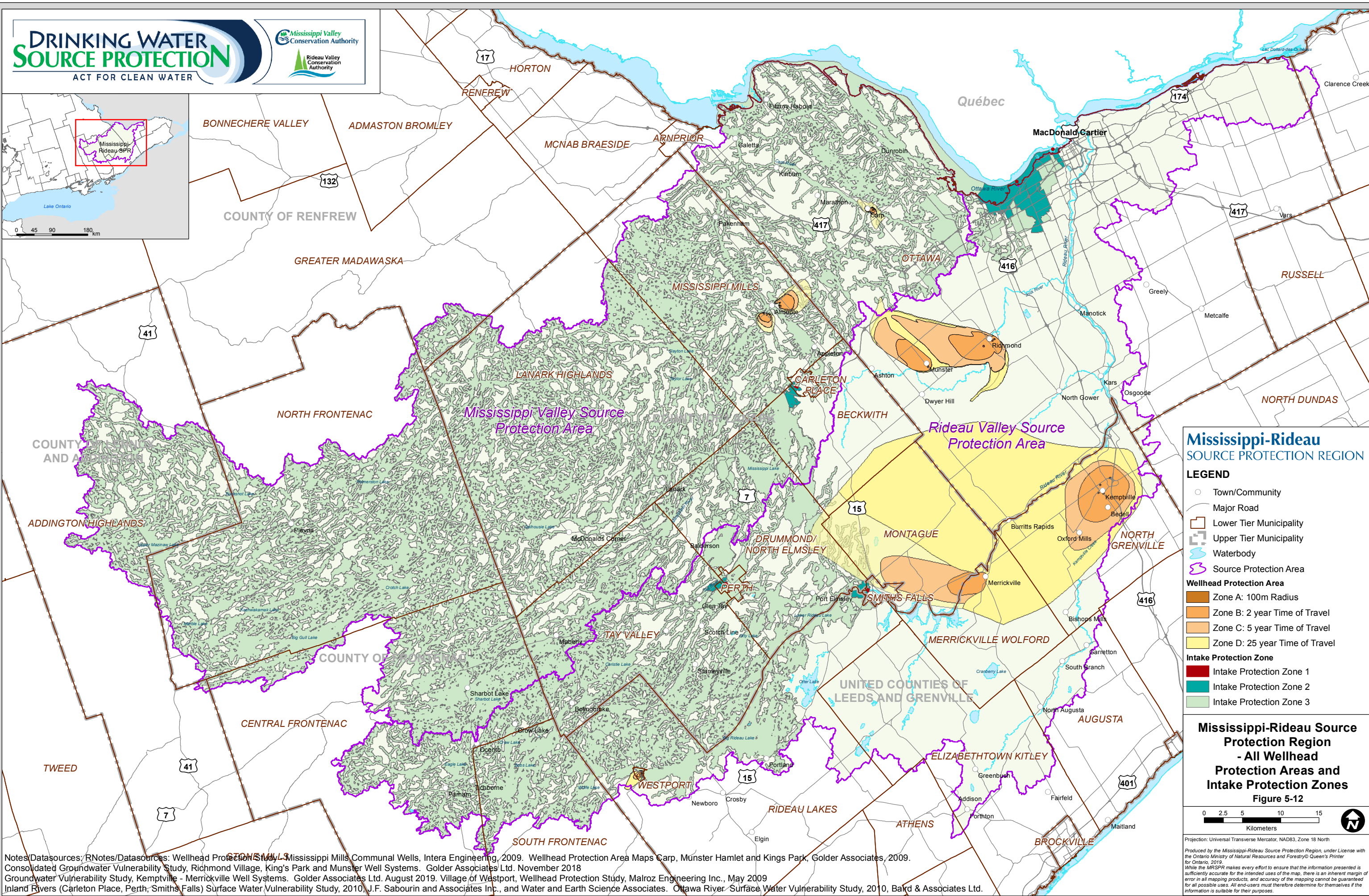
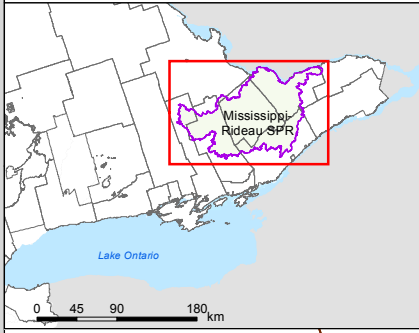
- Zone A: 100m Radius
- Zone B: 2 year Time of Travel
- Zone C: 5 year Time of Travel
- Zone D: 25 year Time of Travel

**Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas**

**Figure 5-10**

Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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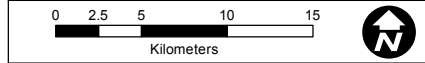
Notes/Datasources: Wellhead Protection Study - Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009. Groundwater Vulnerability Study, Richmond Village Well System, Richmond Ontario, July 2018 Golder Associates Ltd. Groundwater Vulnerability Study, Kemptonville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009



**Mississippi-Rideau SOURCE PROTECTION REGION**

- LEGEND**
- Town/Community
  - Major Road
  - ▭ Lower Tier Municipality
  - ▭ Upper Tier Municipality
  - Waterbody
  - Source Protection Area
- Wellhead Protection Area**
- Zone A: 100m Radius
  - Zone B: 2 year Time of Travel
  - Zone C: 5 year Time of Travel
  - Zone D: 25 year Time of Travel
- Intake Protection Zone**
- Intake Protection Zone 1
  - Intake Protection Zone 2
  - Intake Protection Zone 3

**Mississippi-Rideau Source Protection Region - All Wellhead Protection Areas and Intake Protection Zones**  
Figure 5-12



Projection: Universal Transverse Mercator, NAD83, Zone 18 North  
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Notes/Datasources: RNotes/Datasources: Wellhead Protection Study, Mississippi Mills Communal Wells, Intera Engineering, 2009. Wellhead Protection Area Maps Carp, Munster Hamlet and Kings Park, Golder Associates, 2009. Consolidated Groundwater Vulnerability Study, Richmond Village, King's Park and Munster Well Systems. Golder Associates Ltd. November 2018. Groundwater Vulnerability Study, Kemptville - Merrickville Well Systems. Golder Associates Ltd. August 2019. Village of Westport, Wellhead Protection Study, Malroz Engineering Inc., May 2009. Inland Rivers (Carleton Place, Perth, Smiths Falls) Surface Water Vulnerability Study, 2010, J.F. Sabourin and Associates Inc., and Water and Earth Science Associates. Ottawa River Surface Water Vulnerability Study, 2010, Baird & Associates Ltd.