Grand River Source Protection Area

ASSESSMENT REPORT

Chapter 8: Region of Waterloo

July 29, 2025

CHAPTER 8: REGION OF WATERLOO SECTIONS

Chapter 8 of the Assessment Report, including each municipal well system for the Region of Waterloo, is separated into eight section documents as follows:

CURRENT DOCUMENT:

- **Section 8.5** – Cambridge Area Wellfields (Hespeler, Pinebush, Blair Road, Clemens Mill, Elgin Street, Middleton Street, Shades Mills, Fountain Street, and Willard)

REMAINING DOCUMENTS:

- **Section 8.1** – Water Quality Risk Assessment
- **Section 8.2** – Waterloo Area Wellfields (Erb Street, William Street, and Waterloo North wells)
- **Section 8.3** – Kitchener Area Wellfields (Mannheim (East, West and Peaking), Greenbrook, Strange Street, Parkway, Strasburg, Pompeii, Woolner, and Wilmot Centre)
- **Section 8.4** – Hidden Valley Intake
- **Section 8.6** – Rural Area Wellfields (Ayr, Branchton Meadows, Elmira, Foxboro Green, Heidelberg, Linwood, Maryhill, New Dundee, New Hamburg, Roseville, St. Clements, Wellesley)
- **Section 8.7** – Limitations, Data Gaps and Uncertainty
- **Section 8.8** – Summary

TABLE OF CONTENTS

LIST OF MAPS

LIST OF TABLES

LIST OF FIGURES

8.0 REGION OF WATERLOO

8.5 Cambridge Area Wellfields

Each wellfield in the Cambridge area (Fountain, Hespeler, Pinebush, Blair Road, Clemens Mill, Shades Mills, Elgin Street, Middleton, Willard) is described in further detail in the subsections below.

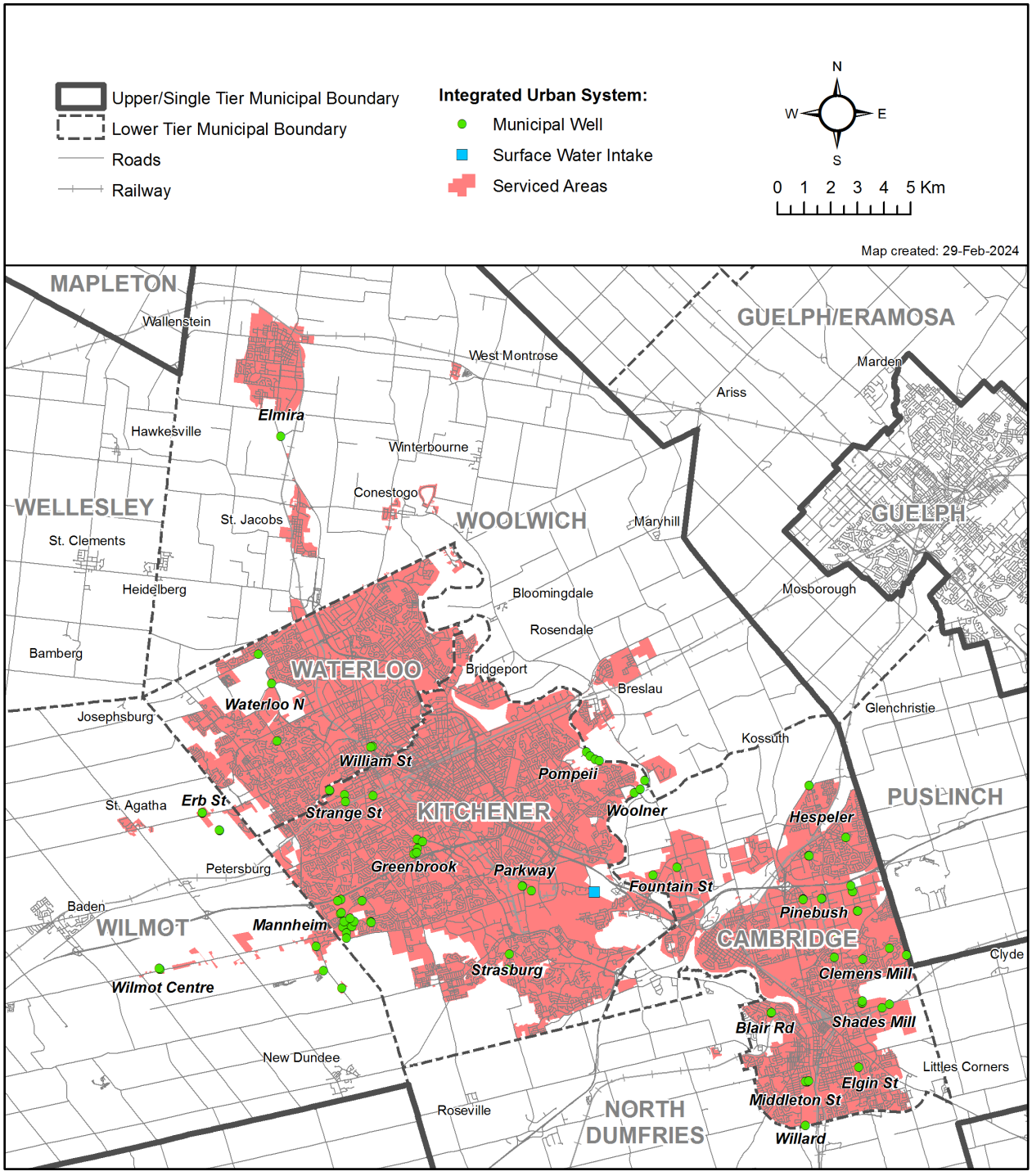
An overview of the serviced areas of Cambridge area Wellfields is provided in **Map 8.5—109**.

An overview of the wellhead protection areas for the Cambridge area Wellfields is provided in **Map 8.5—110**. Four insets provide a more local scale perspective:

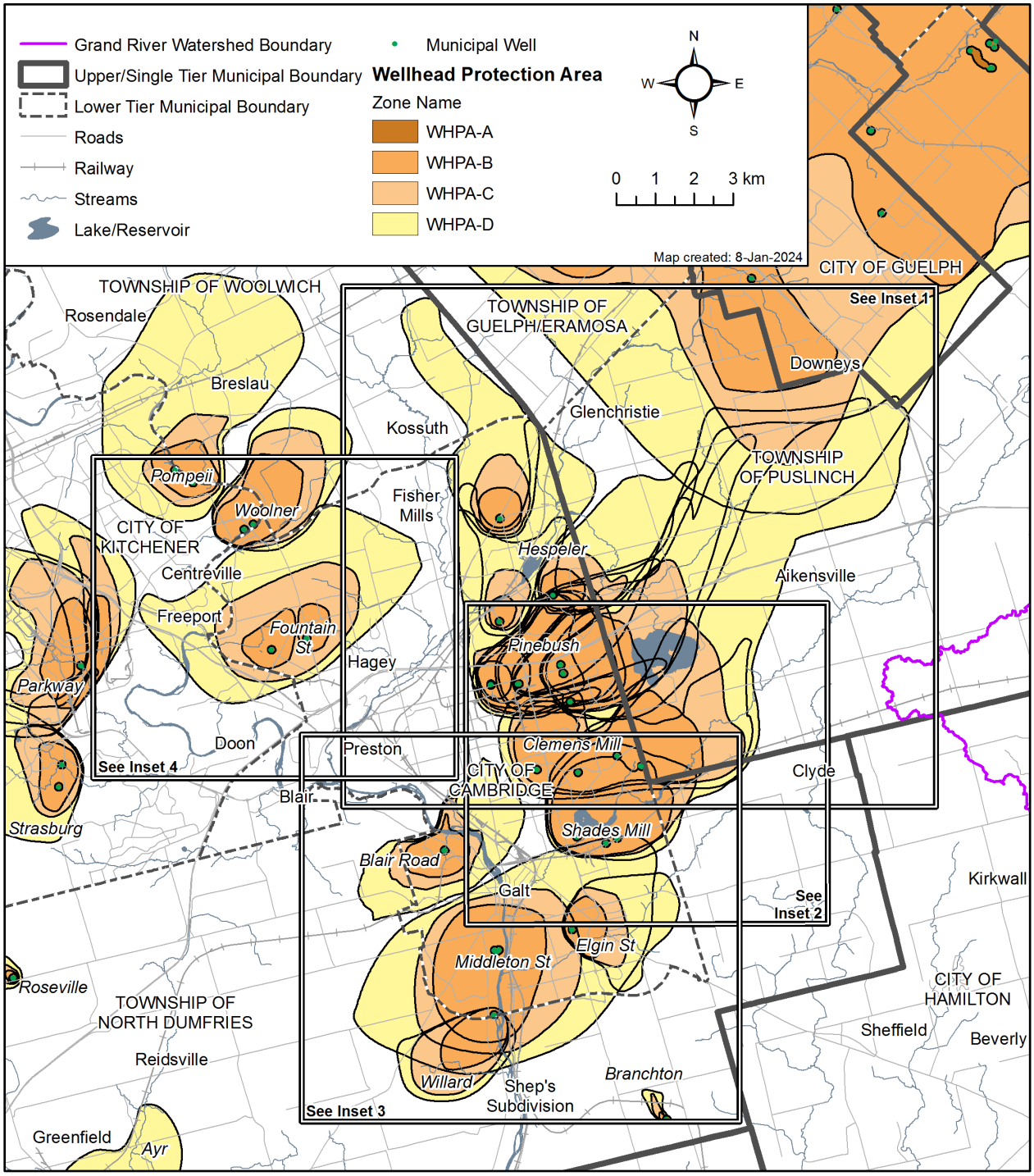
- Inset 1 maps include the Clemens Mill, Hespeler, and Pinebush Wellfields;
- Inset 2 maps include the Shades Mills Wellfield.
- Inset 3 maps include the Blair Road, Elgin Street, Middleton Street, and Willard Wellfields.
- Inset 4 maps include the Fountain Street Wellfield.

An Issue Contributing Area has been defined for the Hespeler, Pinebush, Middleton and Elgin Wellfields. An overview of the Issue Contributing Areas for Cambridge is presented on **Map 8.5—111.** More detailed mapping of Cambridge Issue Contributing Areas are presented on **Map 8.5—112 and Map 8.5—113.**

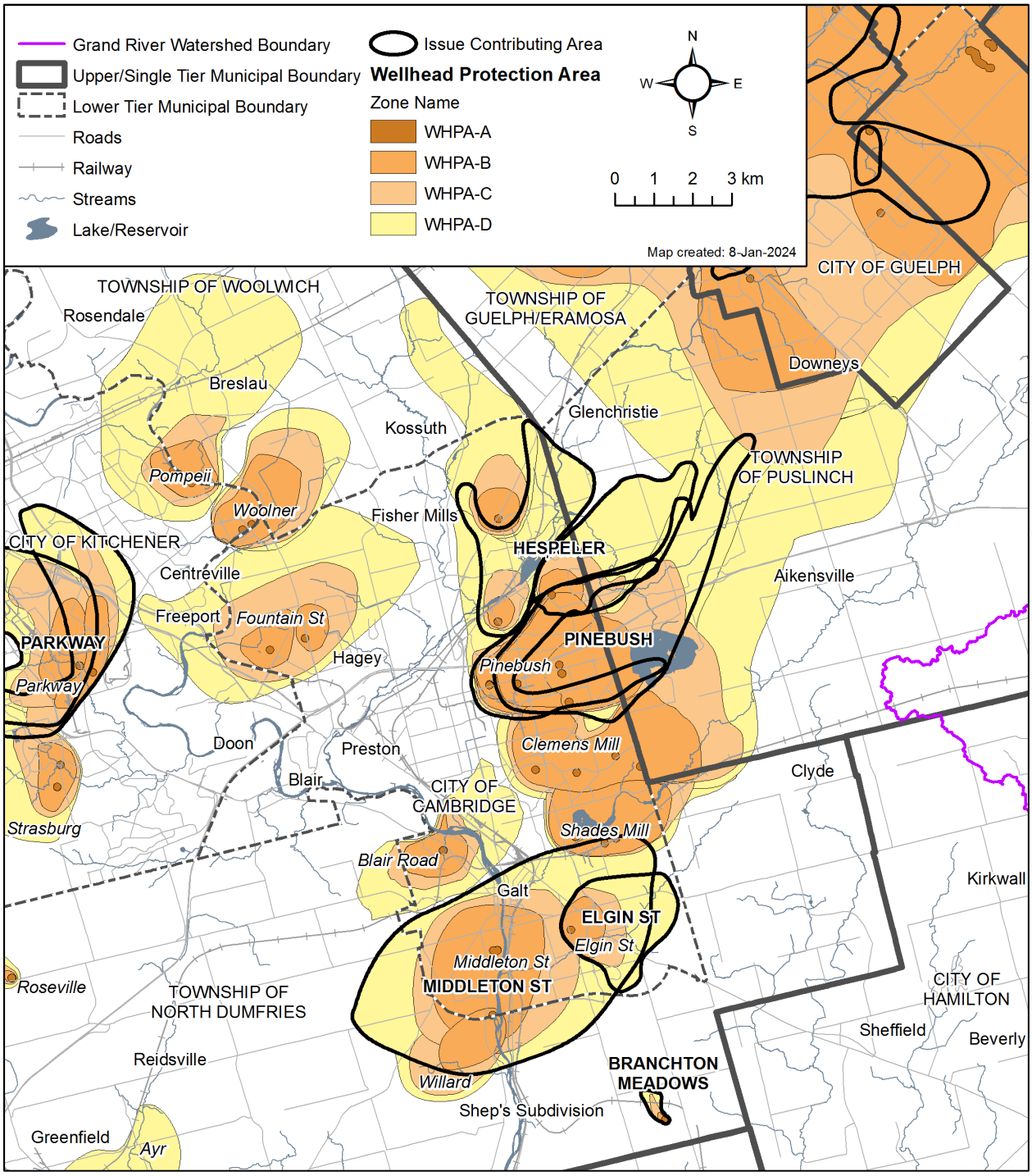
Map 8.5—1: Integrated Urban System Serviced Areas



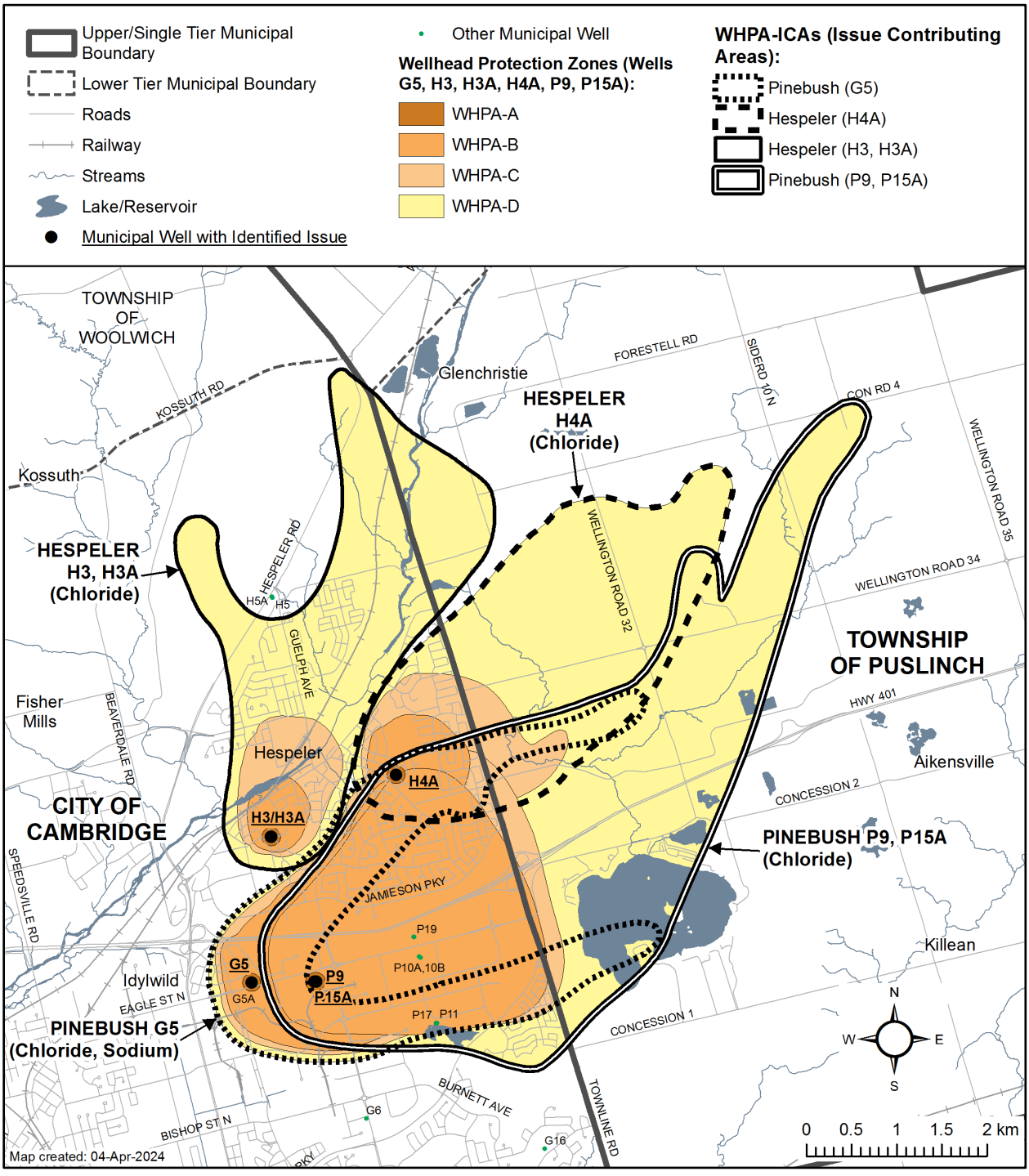
Map 8.5—2: Cambridge Well Supply Wellhead Protection Areas – Overview



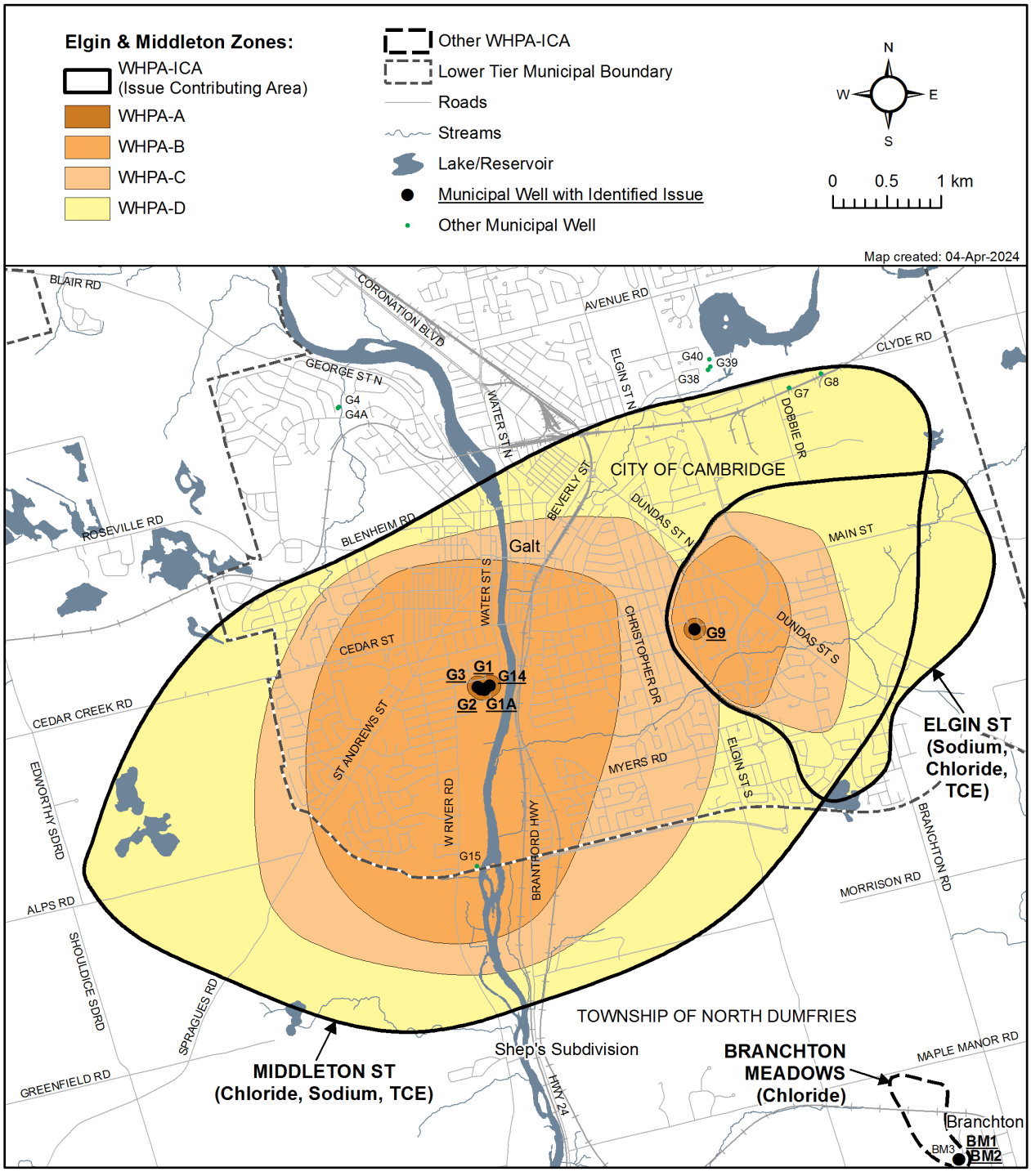
Map 8.5—3: Cambridge Wellfield Issue Contributing Areas – Overview



Map 8.5—4: Cambridge Wellfield Issue Contributing Areas – Hespeler and Pinebush Wellfields



Map 8.5—5: Cambridge Wellfield Issue Contributing Areas – Elgin and Middleton Wellfields



8.5.1 Hespeler, Pinebush, and Clemens Mill Wellfields

Hespeler Wellfield

The water supply for the Hespeler Wellfield is obtained from production Wells H3, H3A, H4A, H5 and H5A, which supply water to the IUS (**Table 8—1**). Well H4 was removed from service in 2017. The production wells have screened depths ranging from approximately 31 m BGS to 121 m BGS in the bedrock of the Gasport Formation. Overburden was variable from well to well in this Wellfield, with the Waterloo Moraine Sands (AFB1/AFB2) identified at or near ground surface, followed by the Maryhill and/or Catfish Creek Tills, which directly overly bedrock. A portion of the WHPA-C and WHPA-D from the Hespeler Wellfield extends into The County of Wellington.

Pinebush Wellfield

The water supply for the Pinebush Wellfield is obtained from production well G5, G5A, P10A, P10B, P11, P17, P15/P15A, P9 and P19, which supply water to the IUS (**Table 8—1**). The production wells are open hole over depths of approximately 22 m BGS to 135 m BGS, within the Guelph, Eramosa, Goat Island and Gasport bedrock formations, with overlying overburden material consisting primarily of fine grained sediments (**Table 8.1—6**). Portions of the WHPA-B through WHPA-D extend into The County of Wellington.

Clemens Mill Wellfield

The Clemens Mill Wellfield consists of Production Wells G6, G16, G17, G18, and G19, which supply water to the IUS (**Table 8—1**). The production wells are open hole within the Guelph, Eramosa Goat Island and Gasport bedrock formations from approximately 28 m BGS to 127 m BGS (**Table 8.1—6**). It should be noted that portions of the WHPA-B through WHPA-D extend into The County of Wellington.

Map 8.5—114 presents the Wellhead Protection Areas A to D for the Hespeler, Pinebush, and Clemens Mill Wellfields.

Vulnerability and Transport Pathways

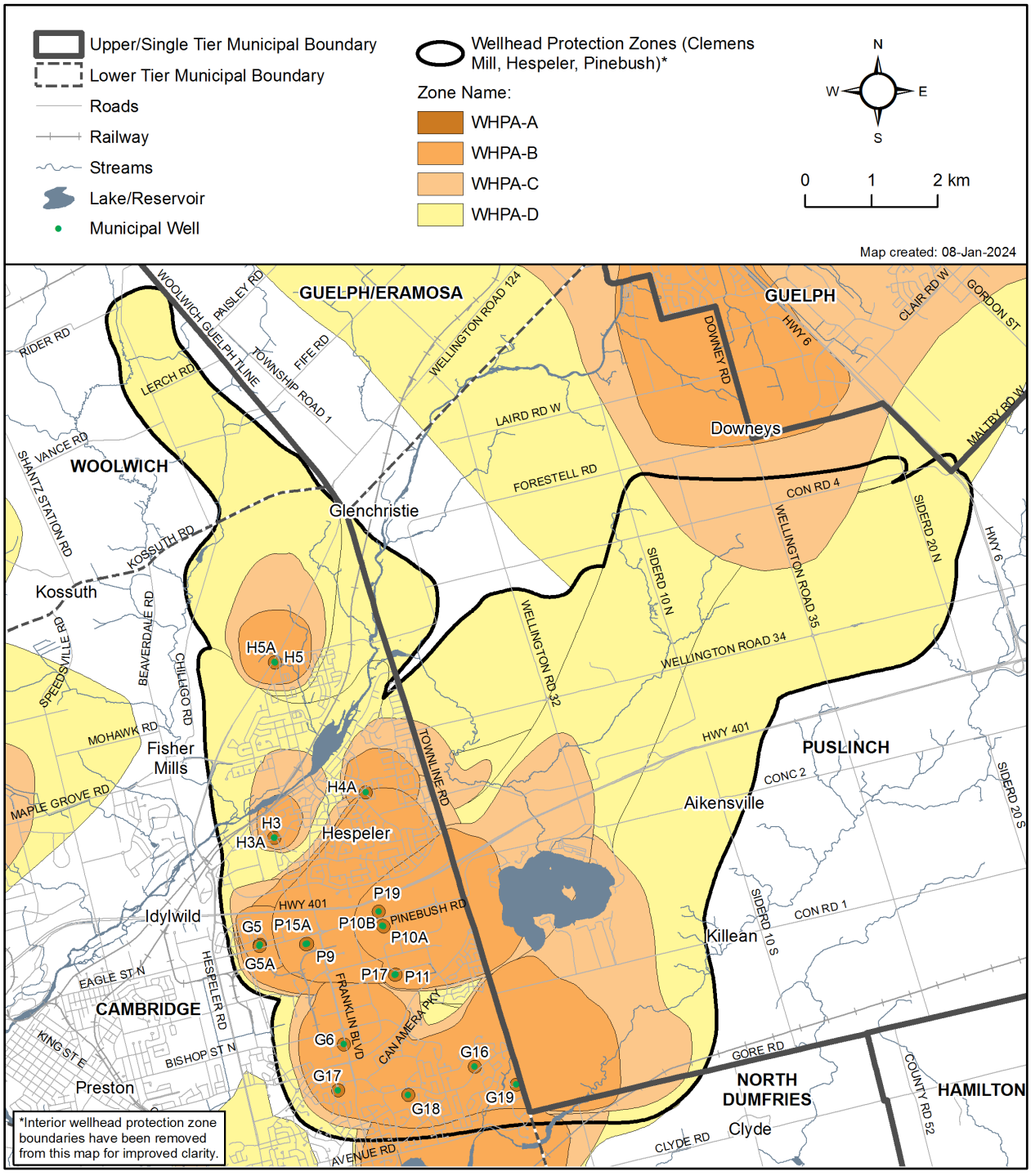
The unadjusted intrinsic vulnerability is shown on **Map 8.5—115** and the adjusted intrinsic vulnerability is shown on **Map 8.5—116.**

An analysis of the attributes of each potential transport pathway in the Hespeler WHPA resulted in the identification of several clusters of underground services and wells in WHPA-B through WHPA-D of the production wells which warranted increases to the ISI. Further, the identification of several well, septic and underground service clusters within the Pinebush WHPA warranted an ISI increase within the WHPA-B and WHPA-C. Analysis of the attributes of each potential transport pathway in the Clemens Mill WHPA resulted in the identification of several well clusters and numerous underground utility services found within the WHPA-B zone, which warranted an increased ISI. **Map 8.5—117** and **Map 8.5—118** show these transport pathways and area of influence for the Wellhead Protection Areas and **Map 8.5—119** shows the final vulnerability scoring.

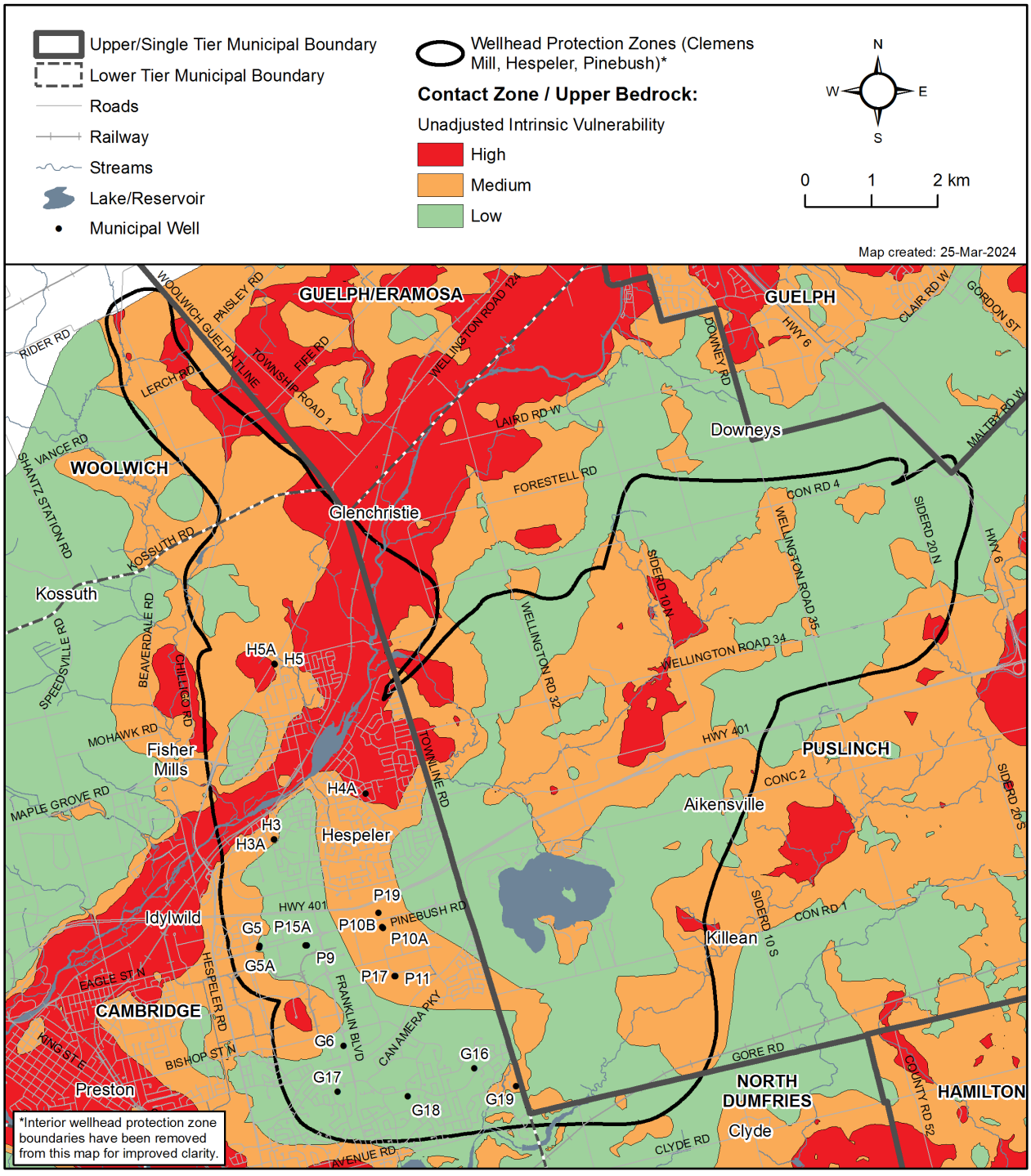
Percent Managed Land, Livestock Density, Salt Loading Potential and Percent Impervious Surface

The calculations for determining the percent managed land, livestock density, salt loading potential and corresponding percent impervious surface followed the methods outlined in **Section 8.1 – Water Quality Risk Assessment**. **Map 8.5—120, Map 8.5—121 and Map 8.5—122** show the percent managed lands, livestock density, and percent impervious surface, respectively.

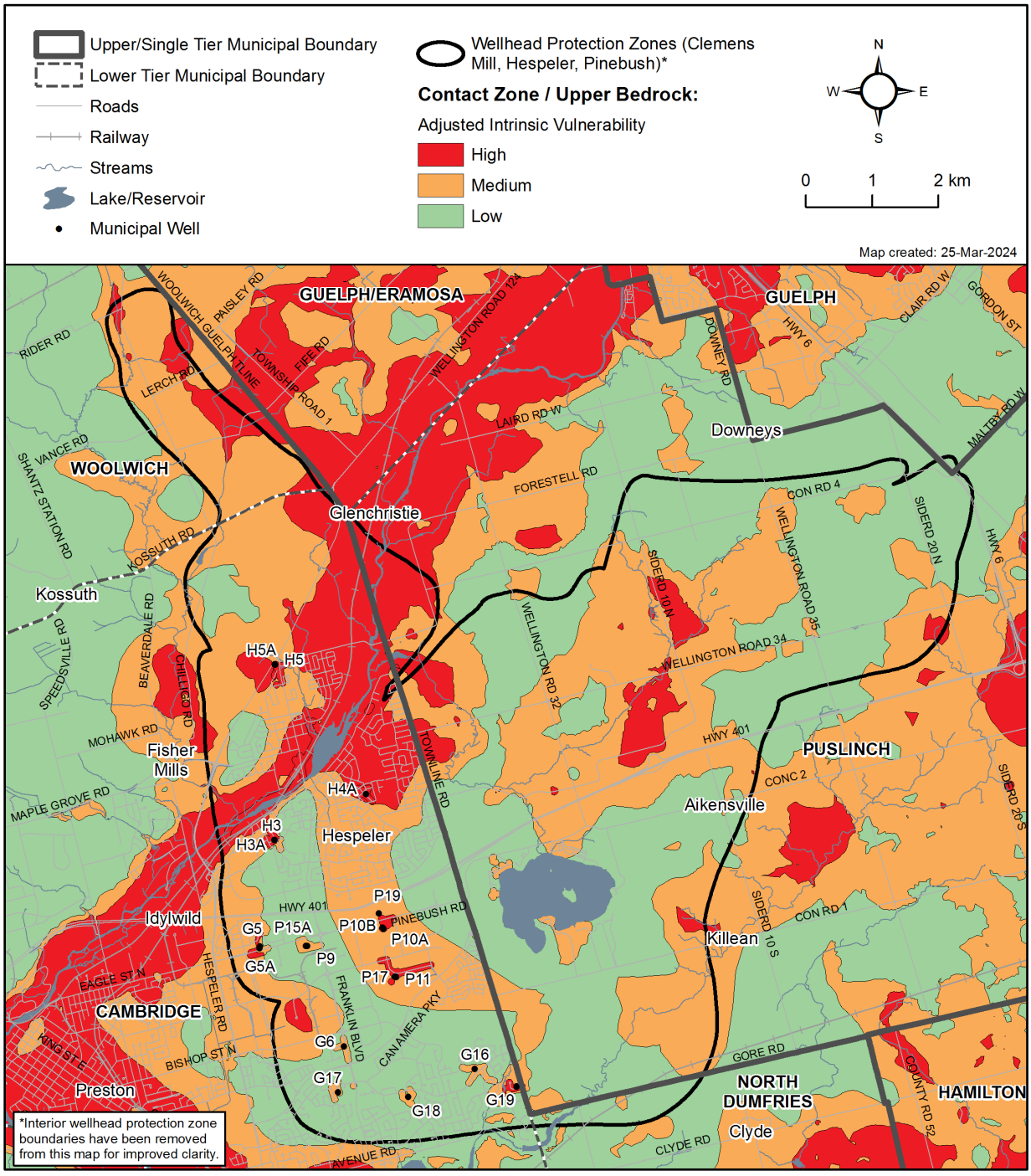
Map 8.5—6: Cambridge Area Inset 1: Hespeler, Pinebush and Clemens Mill Well Supply Wellhead Protection Areas



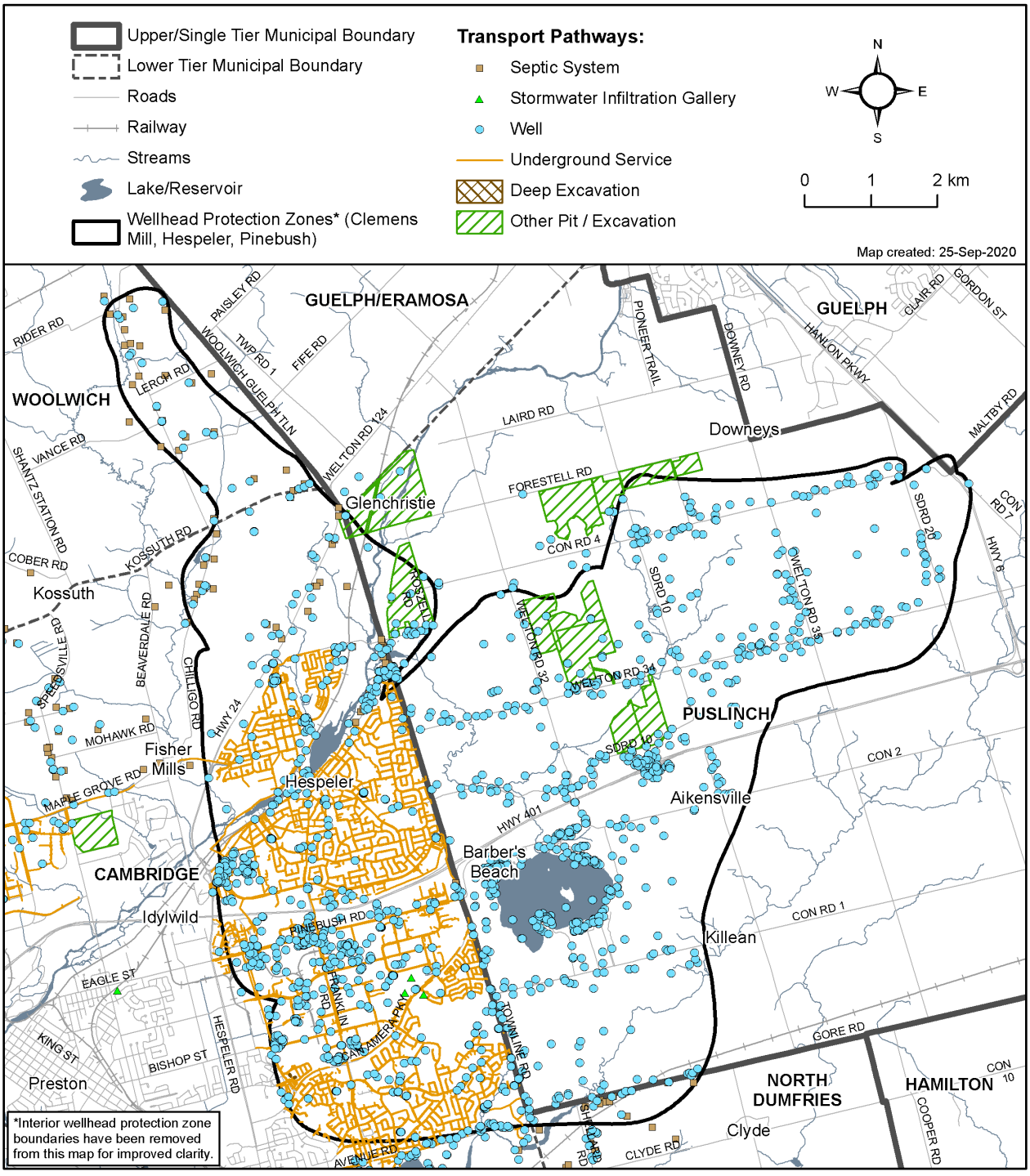
Map 8.5—7: Cambridge Area Inset 1: Hespeler, Pinebush and Clemens Mill Well Supply Wellhead Protection Area Unadjusted Intrinsic Vulnerability



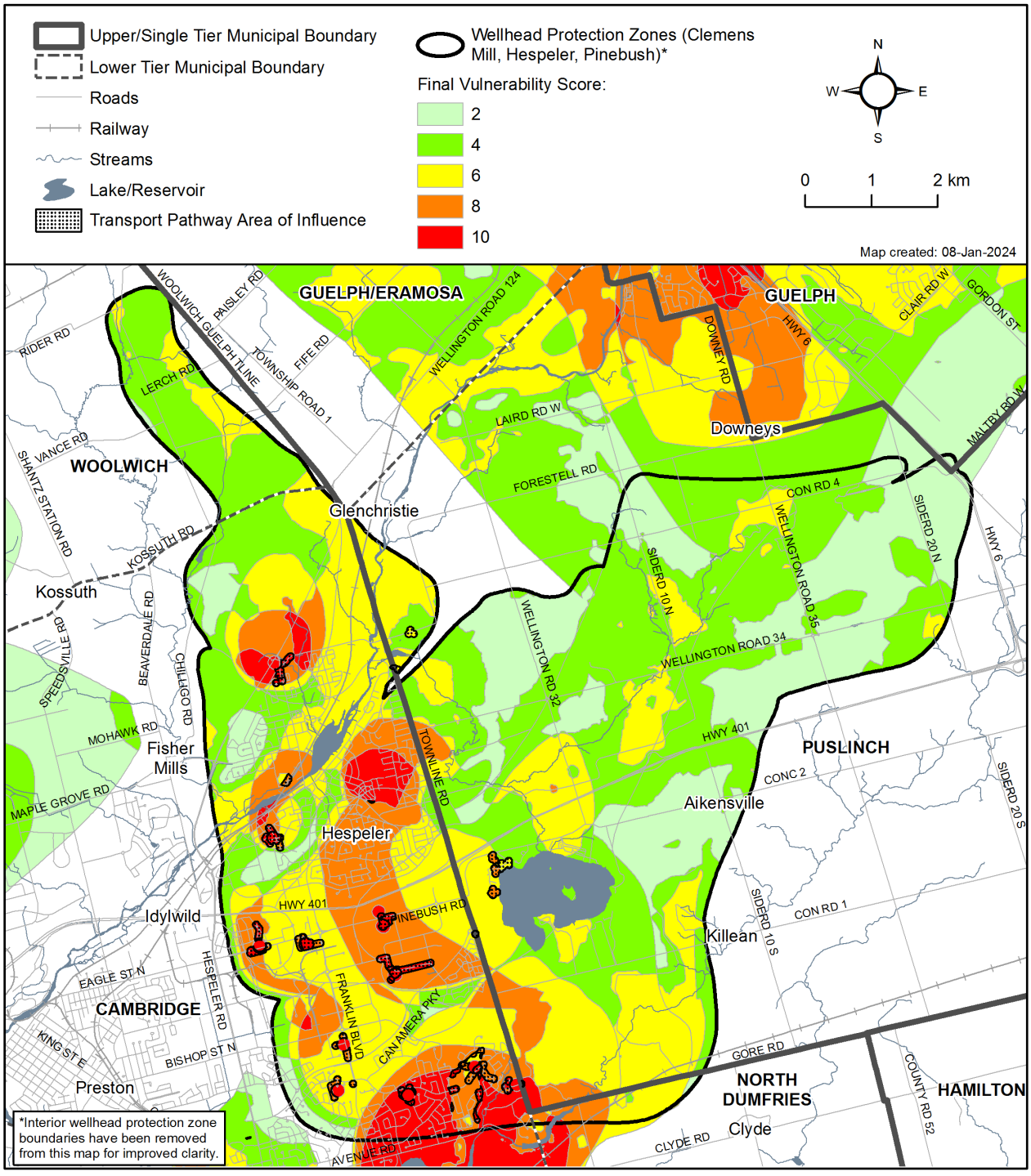
Map 8.5—8: Cambridge Area Inset 1: Hespeler, Pinebush and Clemens Mill Well Supply Wellhead Protection Area Adjusted Intrinsic Vulnerability



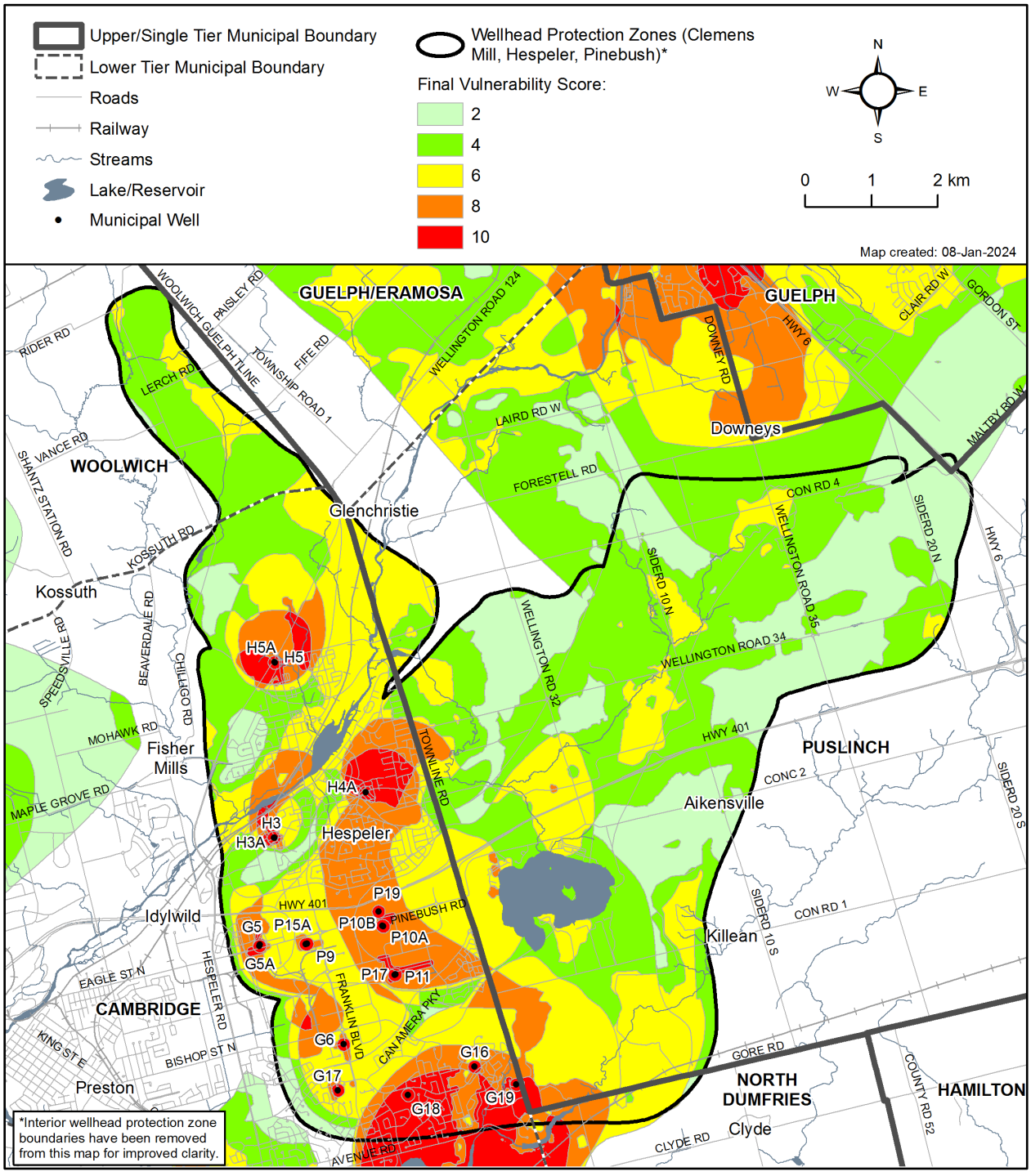
Map 8.5—9: Cambridge Area Inset 1: Clemens Mill, Hespeler and Pinebush Well Supply Transport Pathways



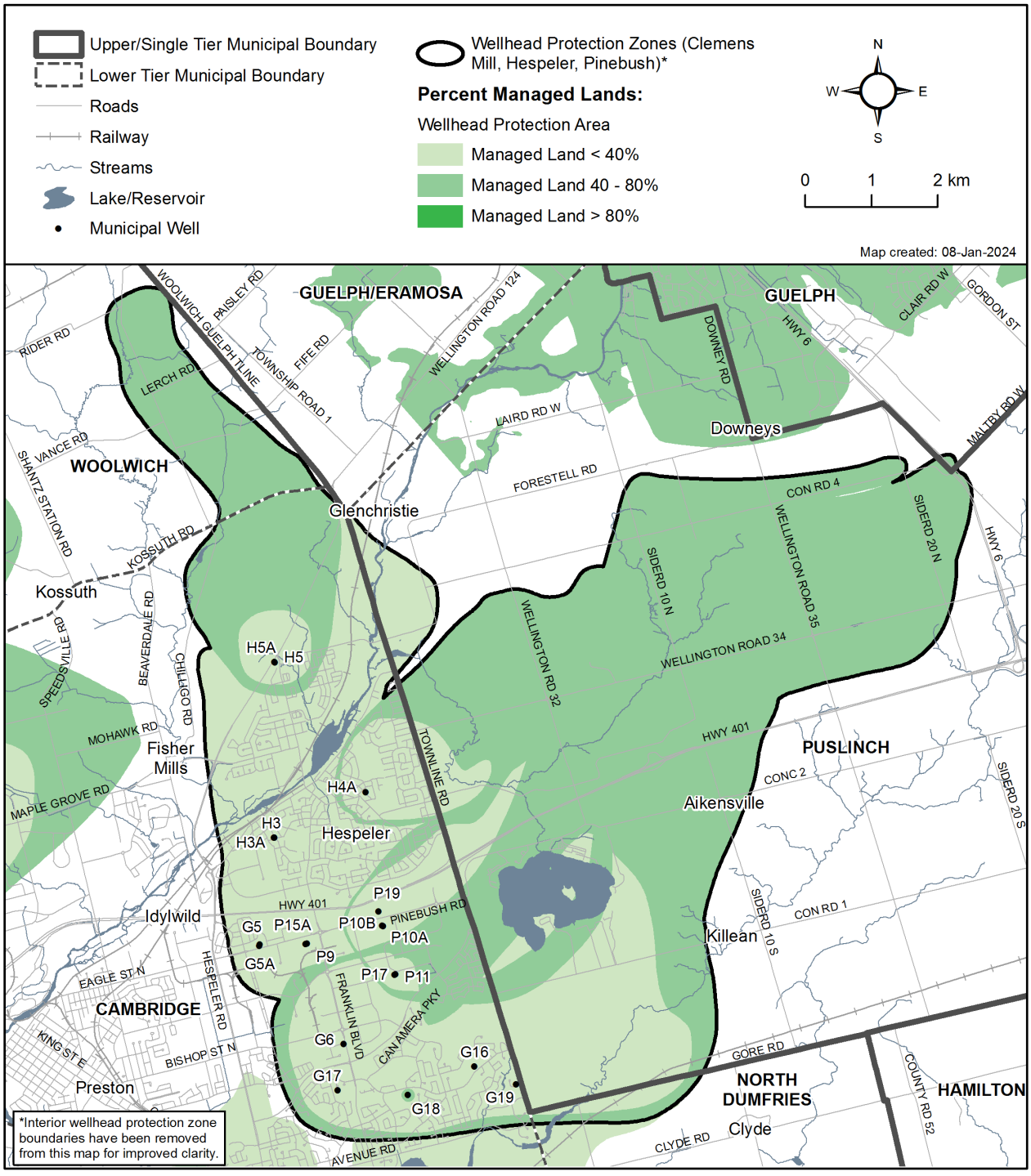
Map 8.5—10: Cambridge Area Inset 1: Clemens Mill, Hespeler and Pinebush Well Supply Transport Pathways Area of Influence



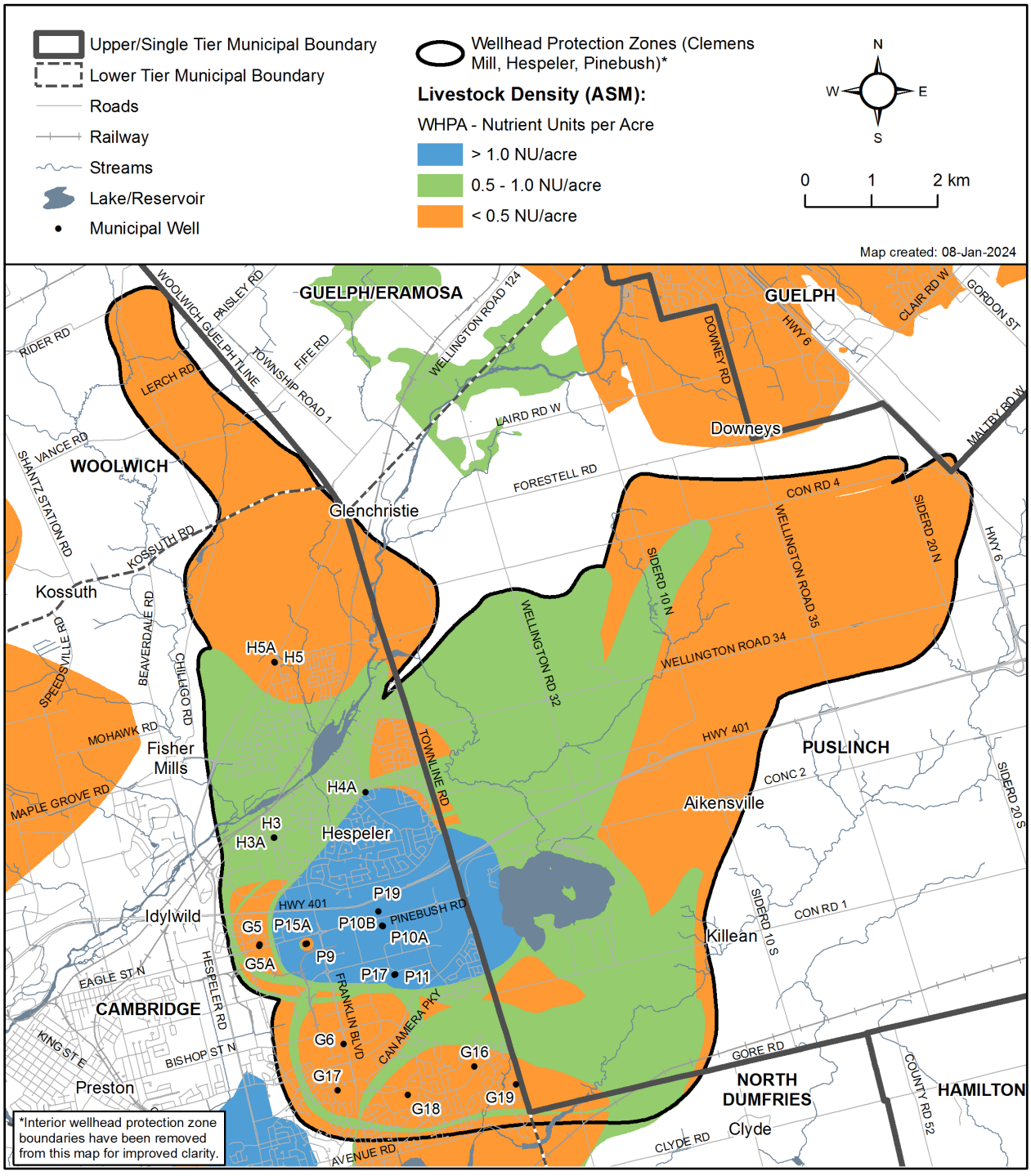
Map 8.5—11: Cambridge Area Inset 1: Hespeler, Pinebush, and Clemens Mill Well Supply Wellhead Protection Area Final Vulnerability



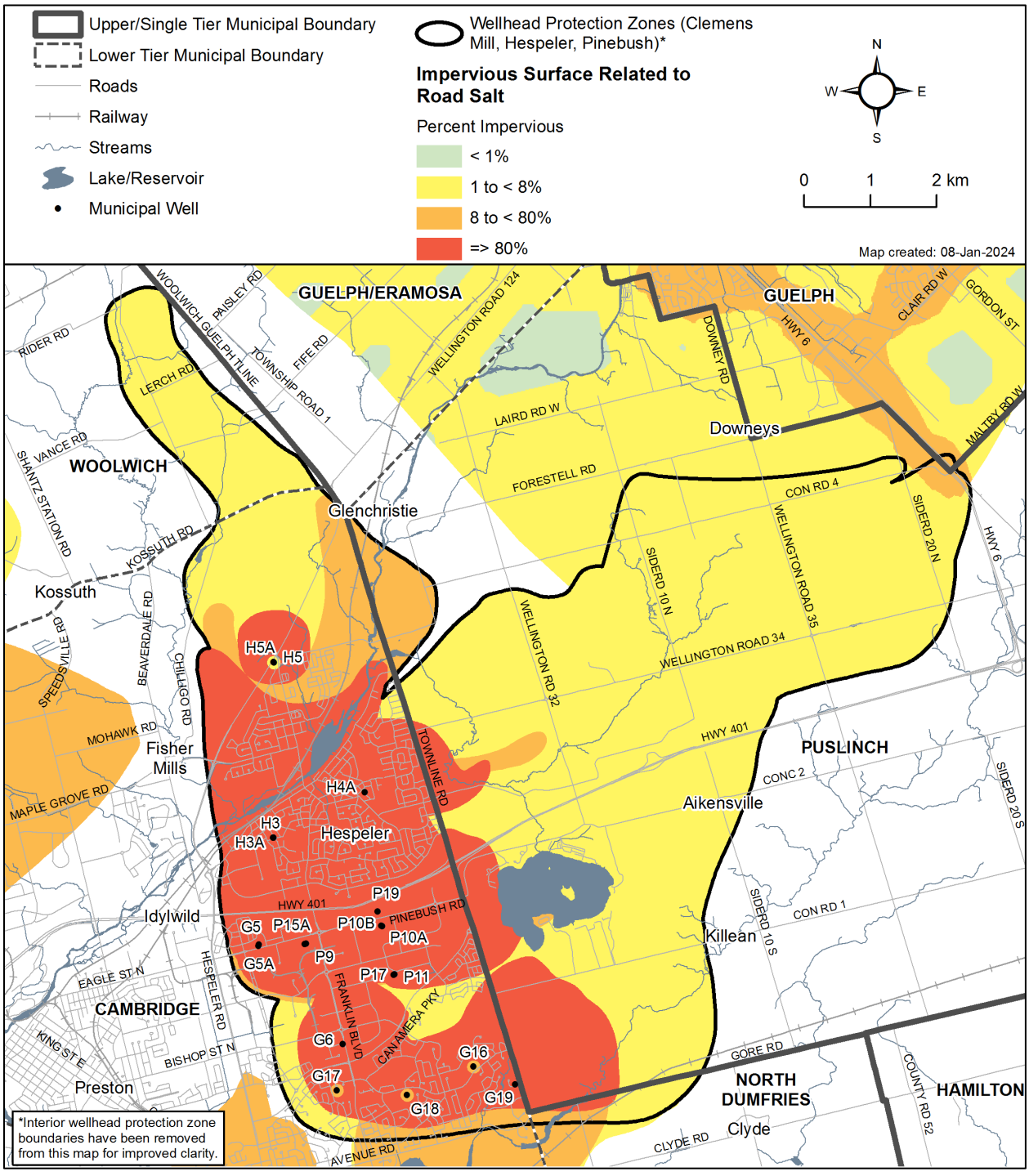
Map 8.5—12: Cambridge Area Inset 1: Hespeler, Pinebush, and Clemens Mill Well Supply Percent Managed Lands



Map 8.5—13: Cambridge Area Inset 1: Hespeler, Pinebush, and Clemens Mill Well Supply Percent Livestock Density



Map 8.5—14: Cambridge Area Inset 1: Hespeler, Pinebush, and Clemens Mill Well Supply Percent Impervious Surfaces



Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Hespeler Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—119** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—33 provides a summary of the threat levels possible in the Hespeler Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—119**.

Table 8.5—1: Identification of Drinking Water Quality Threats in the Hespeler Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Hespeler Wellfield

The protection area for the Hespeler Wellfield overlaps with the Pinebush Wellfield areas. However, threat ranking results related to the Pinebush Wellfield are presented separately**.**

Chloride has been designated as an Issue for wells H3, H3A and H4A as per Technical Rule 114. Sample results from wells H3 and H4 indicated increasing chloride concentrations since at least 1973 when Region monitoring began (**Figure 8.5—17**). Chloride concentrations in H3 show an increasing trend and are near or at the ODW-AO of 250 mg/L. New well H3A has sparse data showing chloride over the ODW-AO. Well H4A has an increasing trend for chloride, and is predicted to reach the ODW-AO within 10 years.

At Well H5 and new well H5A, chloride concentrations are typically much lower and chloride has not been designated an *Issue* for these locations.

Sodium concentrations are increasing at the wellfield but based on linear trend analysis are not predicted to rise to the ODW-AO within 10 years.

The Issue Contributing Area is delineated as the 25 year time-of-travel capture zone (WHPA-D) for the chloride issues identified at wells H3, H3A and H4A (**Map 8.5—112**).

The total number of identified significant drinking water threats in this Wellfield is 199. The number of properties in this Wellfield with identified significant drinking water threats is 158. Details surrounding the types of threats and circumstances found in the Hespeler wellhead protection areas are outlined in **Table 8.5—34**.

One Significant Condition was identified in the Hespeler wellfield. A hydrocarbon spill located within the WHPA-B contains groundwater contamination by petroleum hydrocarbons and NAPL over the standards referenced by the Technical Rules, extending off-site.

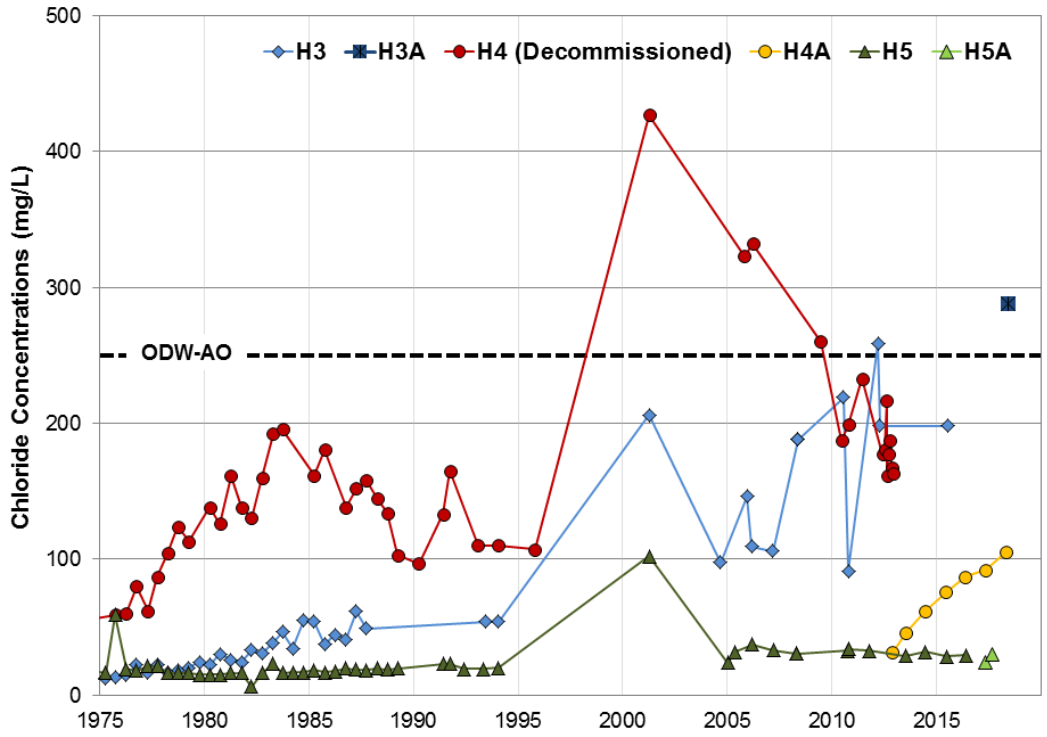


Figure 8.5—1: Chloride Trends at the Hespeler Wells, Cambridge

Table 8.5—2: Significant Drinking Water Quality Threats in the Hespeler Wellhead Protection Areas (current to October 2020)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage system or sewage works - onsite sewage systems	3	WHPA-B
	Sewage system or sewage works - onsite sewage systems holding tanks	1	WHPA-B

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	1	WHPA-B
	Sewage system or sewage works - storm water management facility (including storm sewers)	14	WHPA-B ICA
3	Application of agricultural source material (ASM) to land	4	WHPA-B
4	Storage of agricultural source material (ASM)	6	WHPA-B
9	Storage of commercial fertilizer	3	WHPA-B
10	Application of pesticide to land	4	WHPA-B
11	Storage of a pesticide	6	WHPA-B
12	Application of road salt	144	WHPA-A WHPA-B ICA
13	Storage of road salt	8	ICA
15	Storage and handling of fuel	4	WHPA-B
21	Management or handling of agricultural source material - agricultural source material (ASM) generation (yards or confinement)	1	WHPA-B
Total Number of Significant Threat Activities		**199**	
Total Number of Properties with Significant Threats		**158**	
Total Number of Significant Conditions		**1**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Pinebush Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—119** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—35 provides a summary of the threat levels possible in the Pinebush Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. "Yes" indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; "No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—119**.

Table 8.5—3: Identification of Drinking Water Quality Threats in the Pinebush Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Pinebush Wellfield

The protection area for the Pinebush Wellfield overlaps with the Clemens Mill and Hespeler Wellfield areas. However, threat ranking results related to the Clemens Mill and Hespeler Wellfields are presented separately.

Well G5 has designated chloride and sodium *Issues* due to increasing impacts of de-icing salt on groundwater at this well. The new and deeper well G5A has lower chloride and sodium impacts and does not have a designated *Issue*.

The G5 supply well has showed increasing chloride concentrations since approximately 1993, corresponding to a period of urban development (from greenfields) in the land areas close to the well. Recent chloride concentrations at the well have risen to approximately 580 mg/L, compared to the ODW-AO limit of 250 mg/L (**Figure 8.5—18**). Sodium concentrations at the well also show an increasing trend and recent values are approximately 300 mg/L, compared to the ODW-AO of 200 mg/L (**Figure 8.5—19**). Chloride and sodium are both designated *Issues* for this supply well.

Monitoring well nest C-CA-OW3-95 (approximately 500m east of supply well G5) has piezometers screened at the base of the till overburden and within the shallow, intermediate, and deep bedrock units. This well is sampled twice yearly (spring and fall). Chloride and sodium concentrations in groundwater in the overburden and shallow bedrock also show an increasing trend, with recent values for chloride between 300 and 520 mg/L, and recent values for sodium between 100 and 210 mg/L.

The Issue Contributing Area is delineated as the 25 year time-of-travel (WHPA-D) for supply well G5 (**Map 8.5—112**).

Well G5A was installed in 2010 at a location close to well G5, but draws water from deeper bedrock formations. Chloride and sodium concentrations in raw water from well G5A are approximately 100 mg/L and 50 mg/L respectively (**Figure 8.5—18, Figure 8.5—19, Figure 8.5—20**).

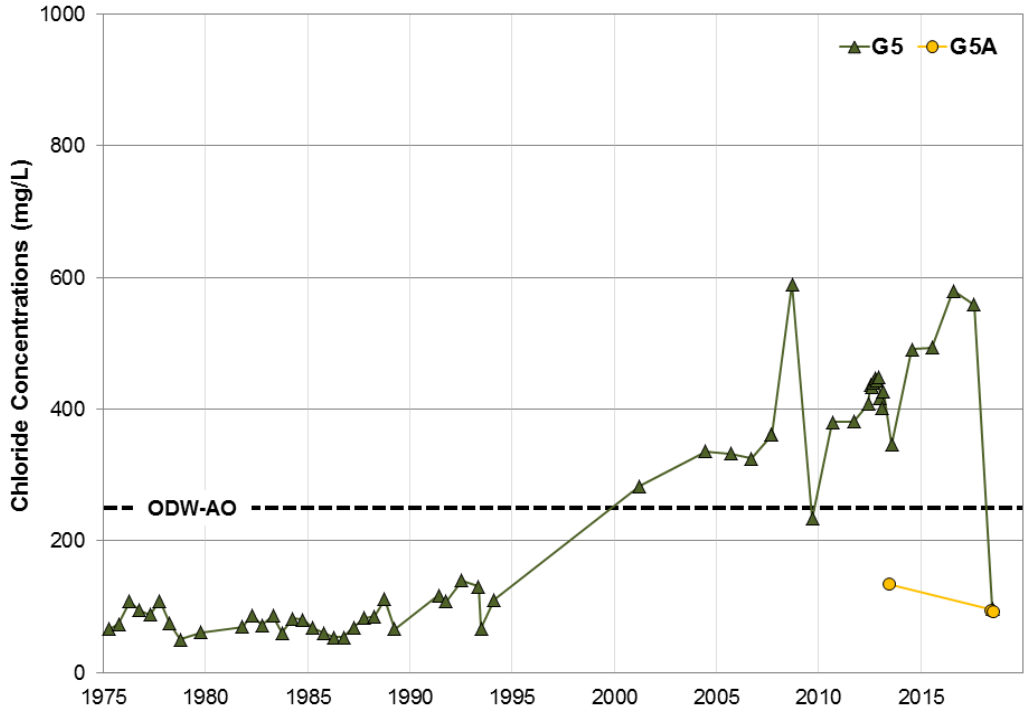


Figure 8.5—2: Chloride Trends in the Raw Water at Supply Wells G5 and G5A, Cambridge

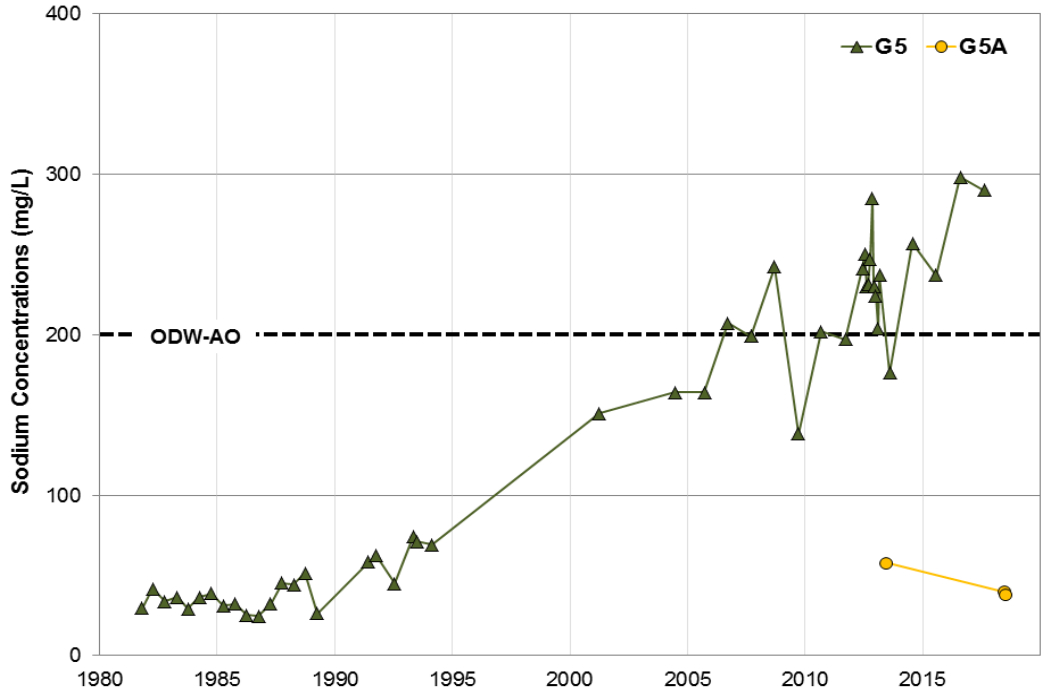


Figure 8.5—3: Sodium Trends in the Raw Water at Supply Wells G5 and G5A, Cambridge

Wells P9 and P15 have designated chloride *Issues* due to increasing impacts of de-icing salt on groundwater at these wells. The new and deeper well P15A is not yet in service and does not have a designated Issue.

The P9 and P15 wells have had increasing chloride concentrations since approximately 1985, corresponding to a period of urban development (from greenfields) in the land areas close to the well. Recent chloride concentrations at the well have risen to approximately 200 mg/L, compared to the ODW-AO limit of 250 mg/L (**Figure 8.5—20**). Linear trend analysis predicts that chloride concentrations will exceed the ODW-AO within 10 years. Sodium concentrations at the well also show an increasing trend but are not expected to exceed the sodium ODW-AO of 200 mg/L within 10 years.

The Issue Contributing Area is delineated as the 25 year time-of-travel for supply wells P9 and P15 (**Map 8.5—112**).

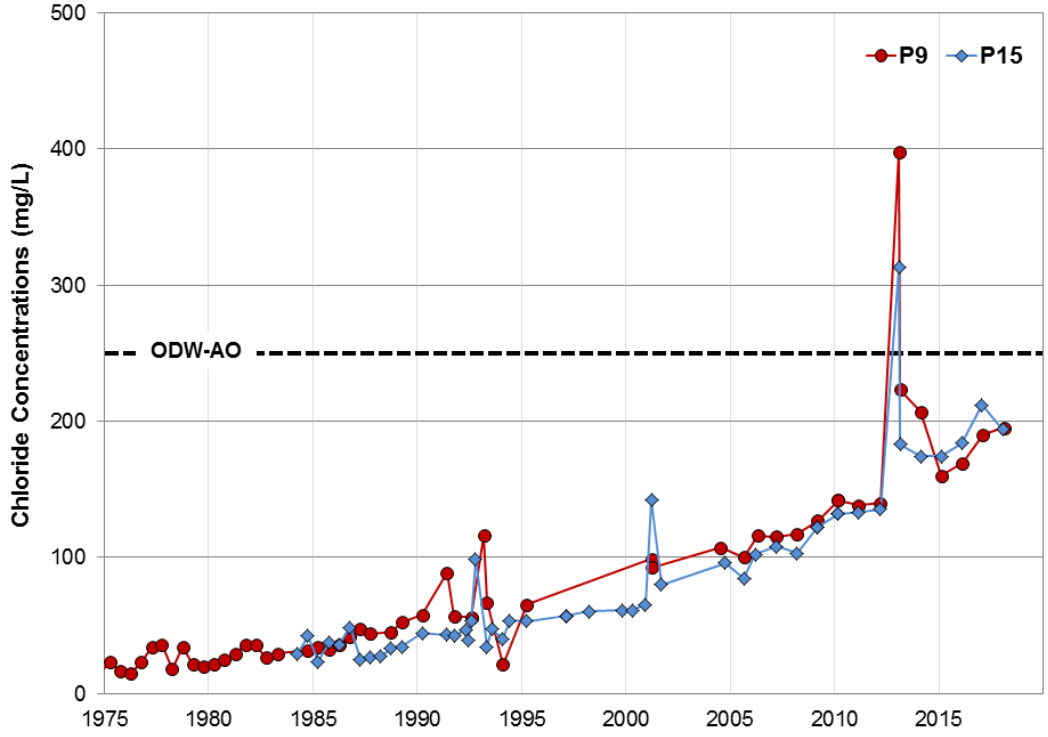


Figure 8.5—4: Chloride Trends at the P9 and P15 Wells, Cambridge

The total number of identified significant drinking water threats in this wellfield is 448. The number of properties in this wellfield with identified significant drinking water threats is 289. Details surrounding the types of threats and circumstances found in the Pinebush wellhead protection areas are outlined in **Table 8.5—36**.

Two Significant Conditions were identified in the Pinebush Wellfield.

- Former manufacturing site is located within the WHPA-A and WHPA-B, contains groundwater contamination including contamination by 1,1,1-trichloroethane and

1,1-dichloroethylene over the standards referenced by the Technical Rules, extending off-site.

- Former manufacturing site is located within the WHPA-B, contains groundwater contamination including contamination by trichloroethylene over the standards referenced by the Technical Rules, extending off-site.

Table 8.5—4: Significant Drinking Water Quality Threats in the Pinebush Wellhead Protection Areas (current to October 2020)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Storage of PCB waste at any location (generating or accepting)	1	WHPA-A WHPA-B
	Storage of small quantity exemptions (SQEs) of hazardous wastes or liquid industrial wastes at any type of waste disposal site including generators, receivers, and transfer/processing sites	3	WHPA-A WHPA-B
	Waste disposal site - storage of hazardous wastes or liquid industrial wastes subject to registration and manifesting	3	WHPA-A WHPA-B
2	Sewage system or sewage works - onsite sewage systems	1	WHPA-A
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	7	WHPA-A WHPA-B
	Sewage system or sewage works - sewage storage - treatment or holding tanks	1	WHPA-A WHPA-B
	Sewage system or sewage works - storm water management facility (including storm sewers)	46	WHPA-A WHPA-B ICA
8	Application of commercial fertilizer to land	4	WHPA-A WHPA-B
9	Storage of commercial fertilizer	4	WHPA-A WHPA-B
10	Application of pesticide to land	1	WHPA-A
11	Storage of a pesticide	6	WHPA-A WHPA-B
12	Application of road salt	278	WHPA-A WHPA-B ICA
13	Storage of road salt	57	ICA
14	Storage of snow	15	ICA
15	Storage and handling of fuel	8	WHPA-A WHPA-B

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
16	Storage and handling of a dense non aqueous phase liquid (DNAPL)	8	WHPA-B WHPA-C
17	Storage of an organic solvent	5	WHPA-A WHPA-B
Total Number of Significant Threat Activities		**448**	
Total Number of Properties with Significant Threats		**289**	
Total Number of Significant Conditions		**2**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Clemens Mill Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—119** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—37 provides a summary of the threat levels possible in the Clemens Mill Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No” indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—119**.

Table 8.5—5: Identification of Drinking Water Quality Threats in the Clemens Mill Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Clemens Mill Wellfield

The protection area for the Clemens Mill Wellfield overlaps with the Hespeler, Pinebush, Shades Mills, and Willard Wellfield areas. However, threat ranking results related to the Hespeler, Pinebush, Shades Mills, and Willard Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

The total number of identified significant drinking water threats in the Clemens Mill wellfield is 24. The number of properties in this Wellfield with identified significant drinking water threats is 16. Details surrounding the types of threats and circumstances found in the Clemens Mill wellhead protection areas are outlined in **Table 8.5—38.**

One Significant Condition was identified in Clemens Mill wellfield. A former manufacturing property located within the WHPA-B, contains groundwater contamination by industrial chemicals over the standards referenced by the Technical Rules, extending off-site.

No drinking water Issues have been identified in this wellfield as per Technical Rule 114.

Table 8.5—6: Significant Drinking Water Quality Threats in the Clemens Mill Wellhead Protection Areas (current to October 2020)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Storage of small quantity exemptions (SQEs) of hazardous wastes or liquid industrial wastes at any type of waste disposal site including generators, receivers, and transfer/processing sites	1	WHPA-A
	Waste disposal site - storage of hazardous wastes or liquid industrial wastes subject to registration and manifesting	1	WHPA-A

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	2	WHPA-B
8	Application of commercial fertilizer to land	1	WHPA-A
10	Application of pesticide to land	1	WHPA-A
12	Application of road salt	9	WHPA-A WHPA-B
15	Storage and handling of fuel	2	WHPA-A WHPA-B
16	Storage and handling of a dense non aqueous phase liquid (DNAPL)	4	WHPA-B WHPA-C
17	Storage of an organic solvent	2	WHPA-A WHPA-B
Total Number of Significant Threat Activities		**24**	
Total Number of Properties with Significant Threats		**16**	
Total Number of Significant Conditions		**1**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

8.5.2 Shades Mills Wellfield

Shades Mills Wellfield

The water supply for the Shades Mills Wellfield is obtained from production wells G7, G8, G38 and G39, which pump water to the IUS (**Table 8—1**). Additionally, well G40 was recently constructed on the same property as the existing water supply system to provide operational redundancy. The production wells are completed within the Grand River Outwash Sediments Aquifer (AFA2) and screened from 14 m BGS to 43 m BGS. **Map 8.5—123** presents the Wellhead Protection Areas A to D for the Shades Mills Wellfield.

Vulnerability and Transport Pathways

The unadjusted intrinsic vulnerability is shown on **Map 8.5—124** and the adjusted intrinsic vulnerability is shown on **Map 8.5—125.**

Several clusters of wells, septic systems and underground services were identified in the Shades Mills Wellhead Protection area within the WHPA-B through WHPA-D of the production wells, which warranted an increased ISI. **Map 8.5—126** and **Map 8.5—127** show these transport pathways and area of influence for the Wellhead Protection Areas and **Map 8.5—128** shows the final vulnerability scoring.

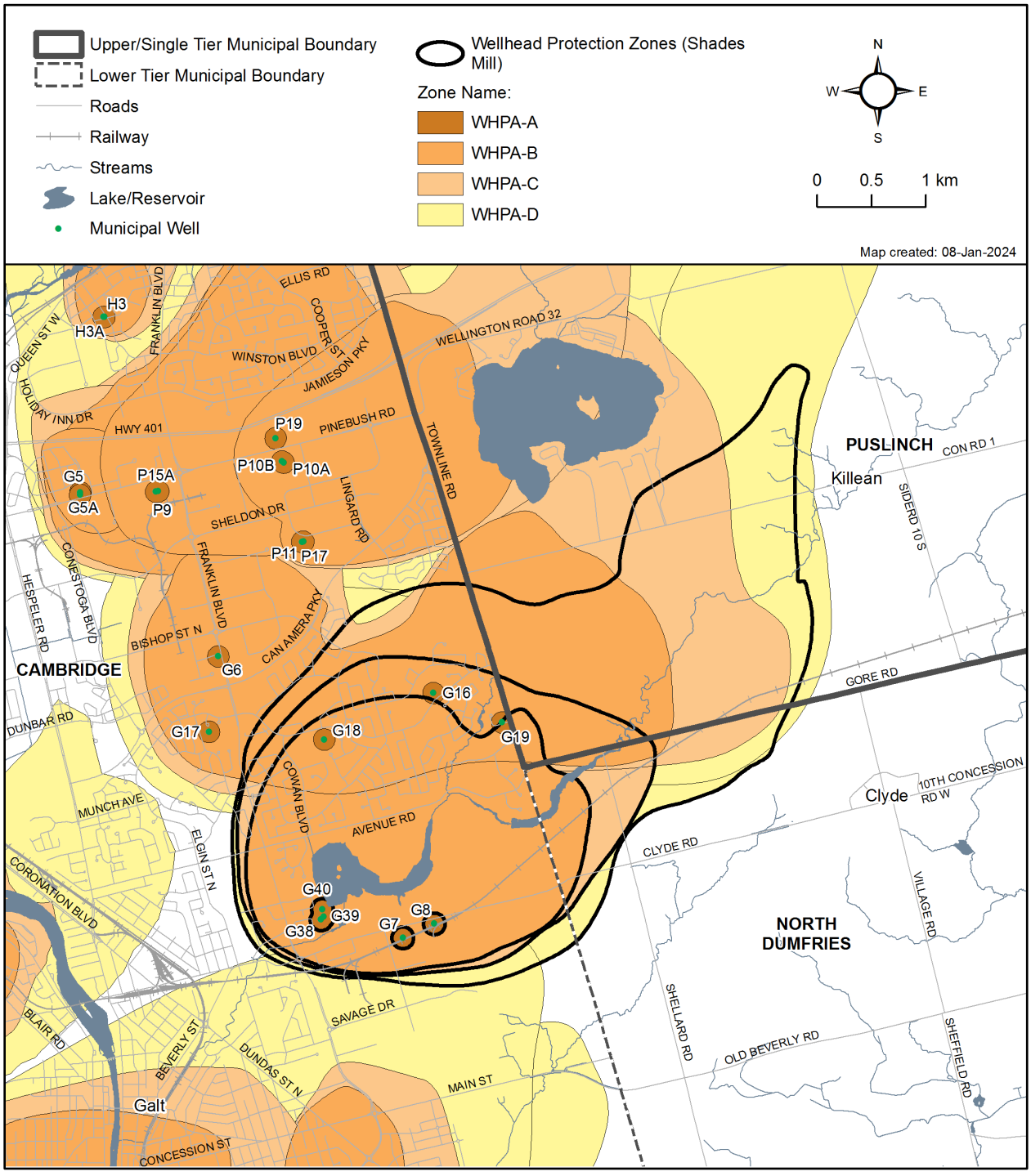
Percent Managed Land, Livestock Density, Salt Loading Potential and Corresponding Percent Impervious Surface

The calculations for determining the percent managed land, livestock density, salt loading potential and corresponding percent impervious surface for the Shades Mills Wellfield followed the methods outlined in **Section 8.1 – Water Quality Risk Assessment**.

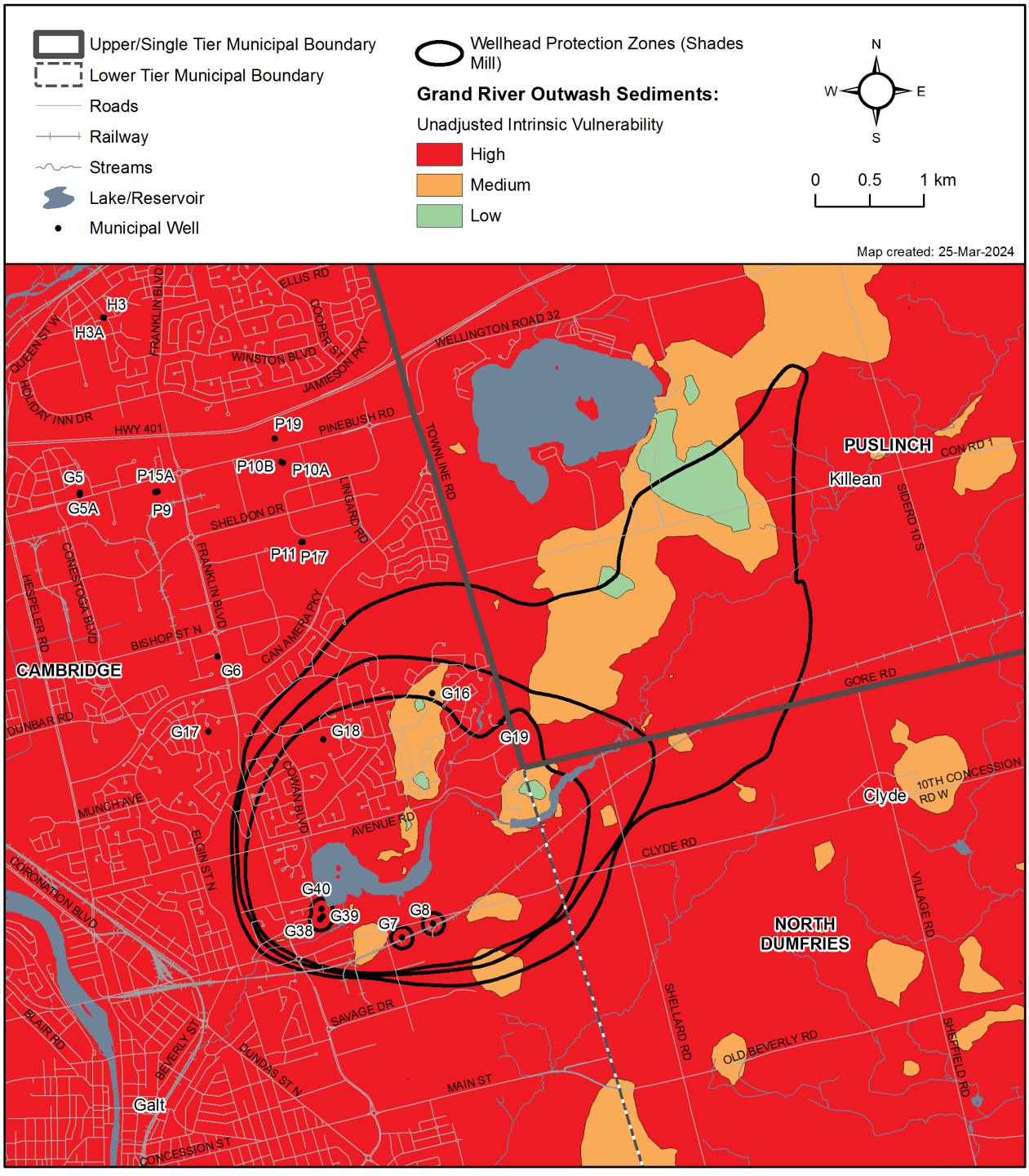
Map 8.5—129, Map 8.5—130 and **Map 8.5—131** show the percent managed lands, livestock density, and percent impervious surface for the Shades Mills Wellfield.

Production Wells G38 and G39 are classified as GUDI with effective filtration, due to their proximity to the Shades Mills Reservoir. As such, a WHPA-E capture zone has been delineated for the Shades Mills Wellfield (**Map 8.5—132**). The WHPA-E mapping for percent managed lands, livestock density and percent impervious surface is shown on **Map 8.5—133, Map 8.5—134,** and **Map 8.5—135,** respectively.

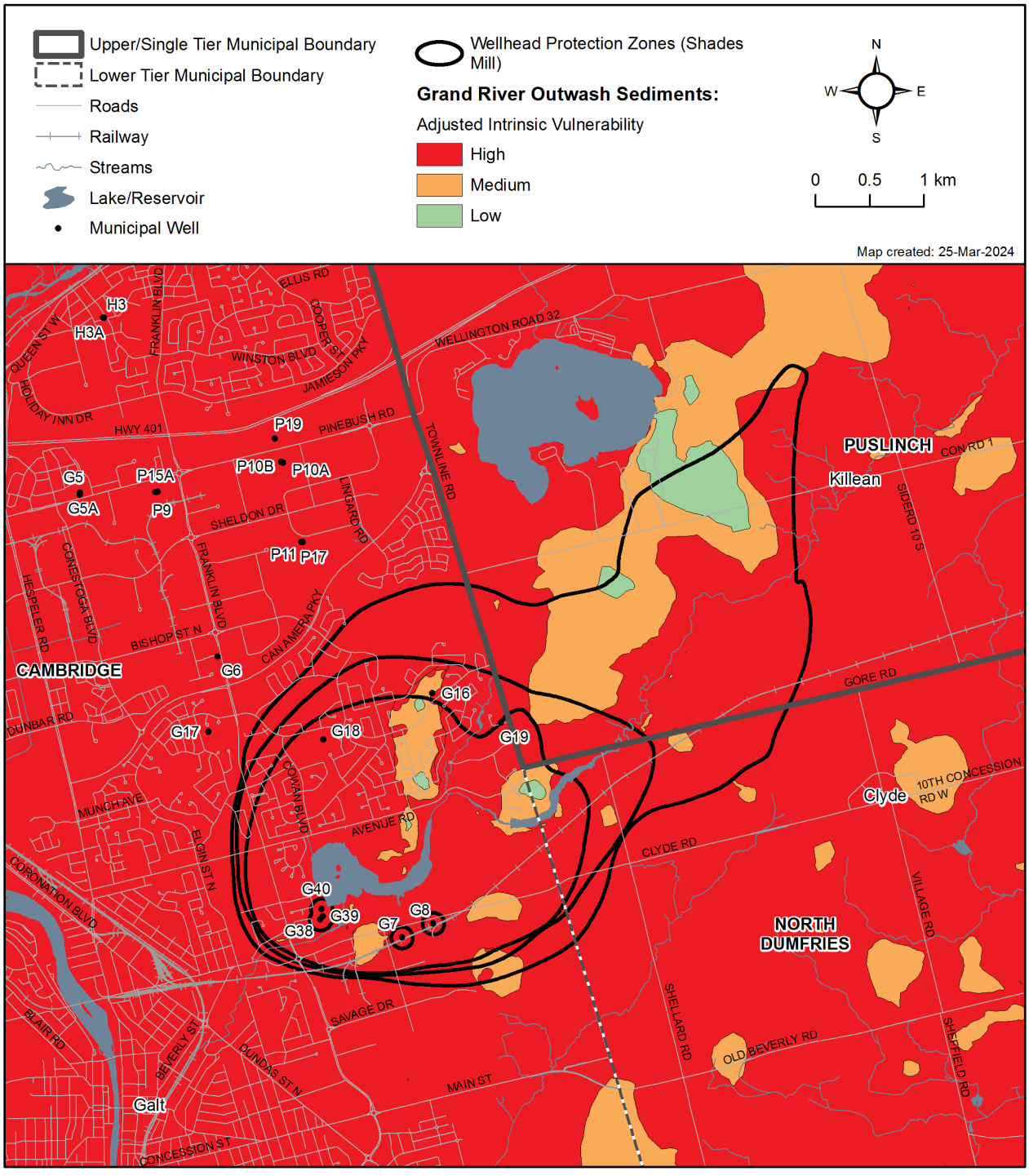
Map 8.5—15: Cambridge Area Inset 2: Shades Mills Well Supply Wellhead Protection Areas



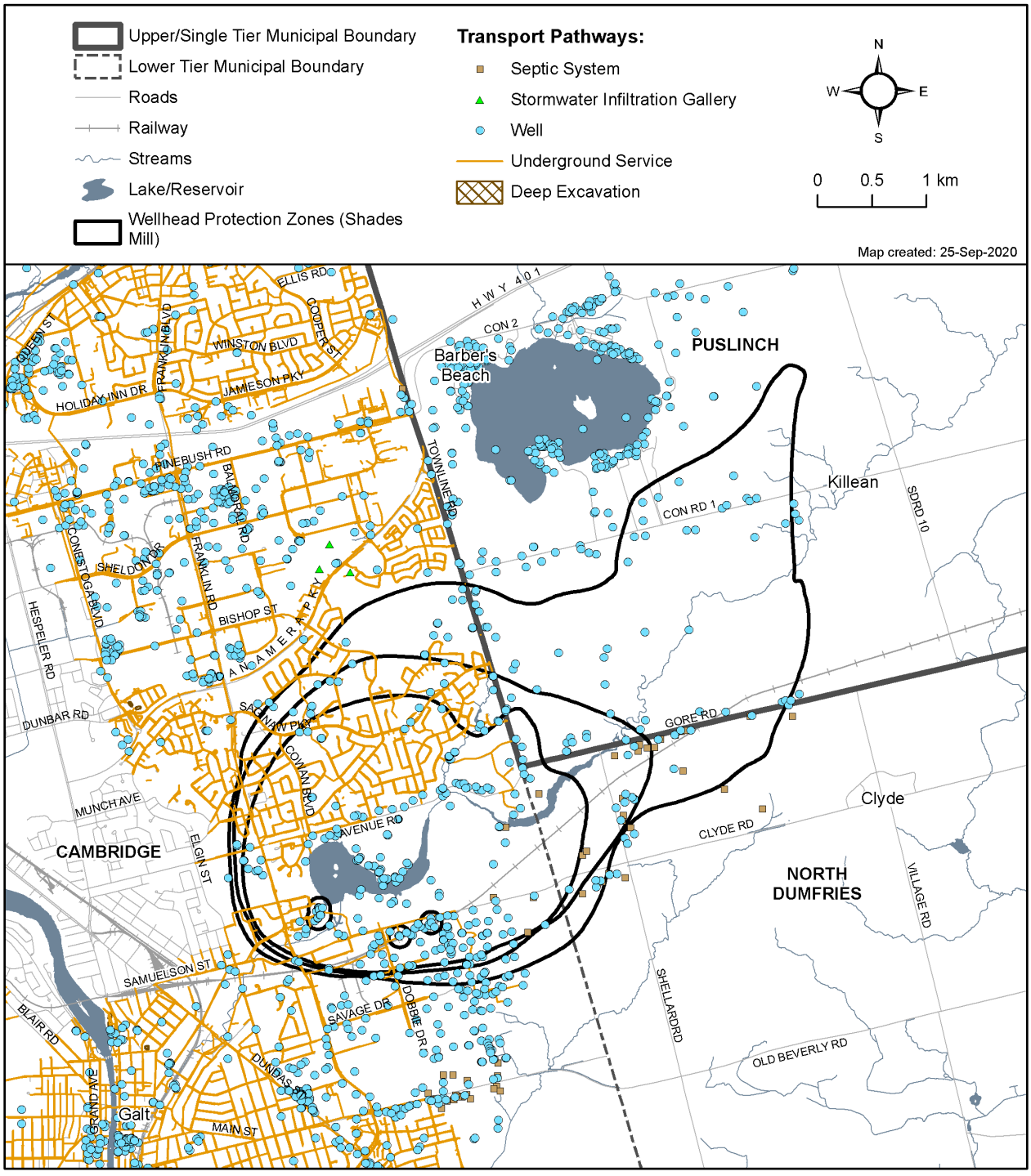
Map 8.5—16: Cambridge Area Inset 2: Shades Mills Well Supply Wellhead Protection Area Unadjusted Intrinsic Vulnerability



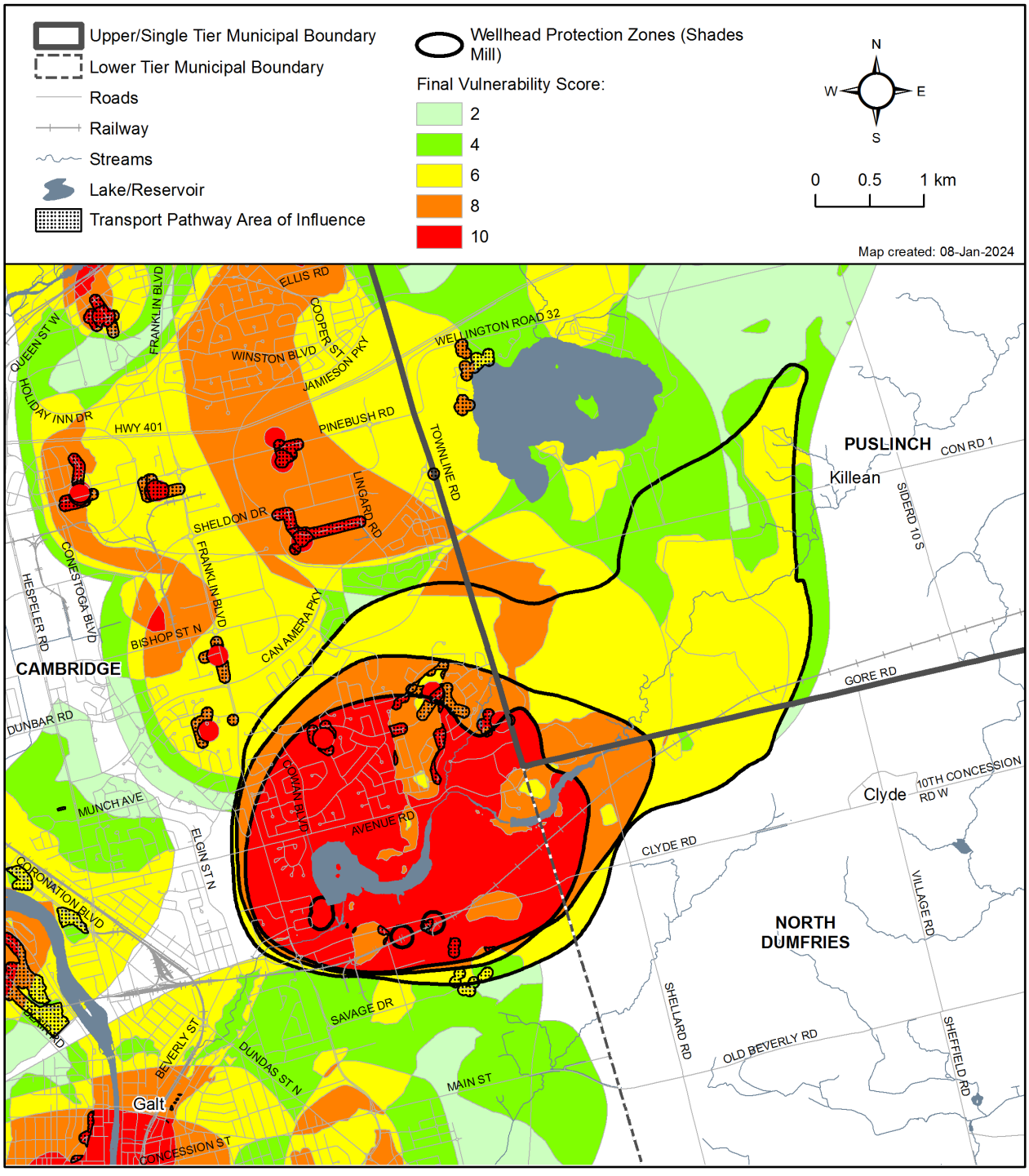
Map 8.5—17: Cambridge Area Inset 2: Shades Mills Well Supply Wellhead Protection Area Adjusted Intrinsic Vulnerability



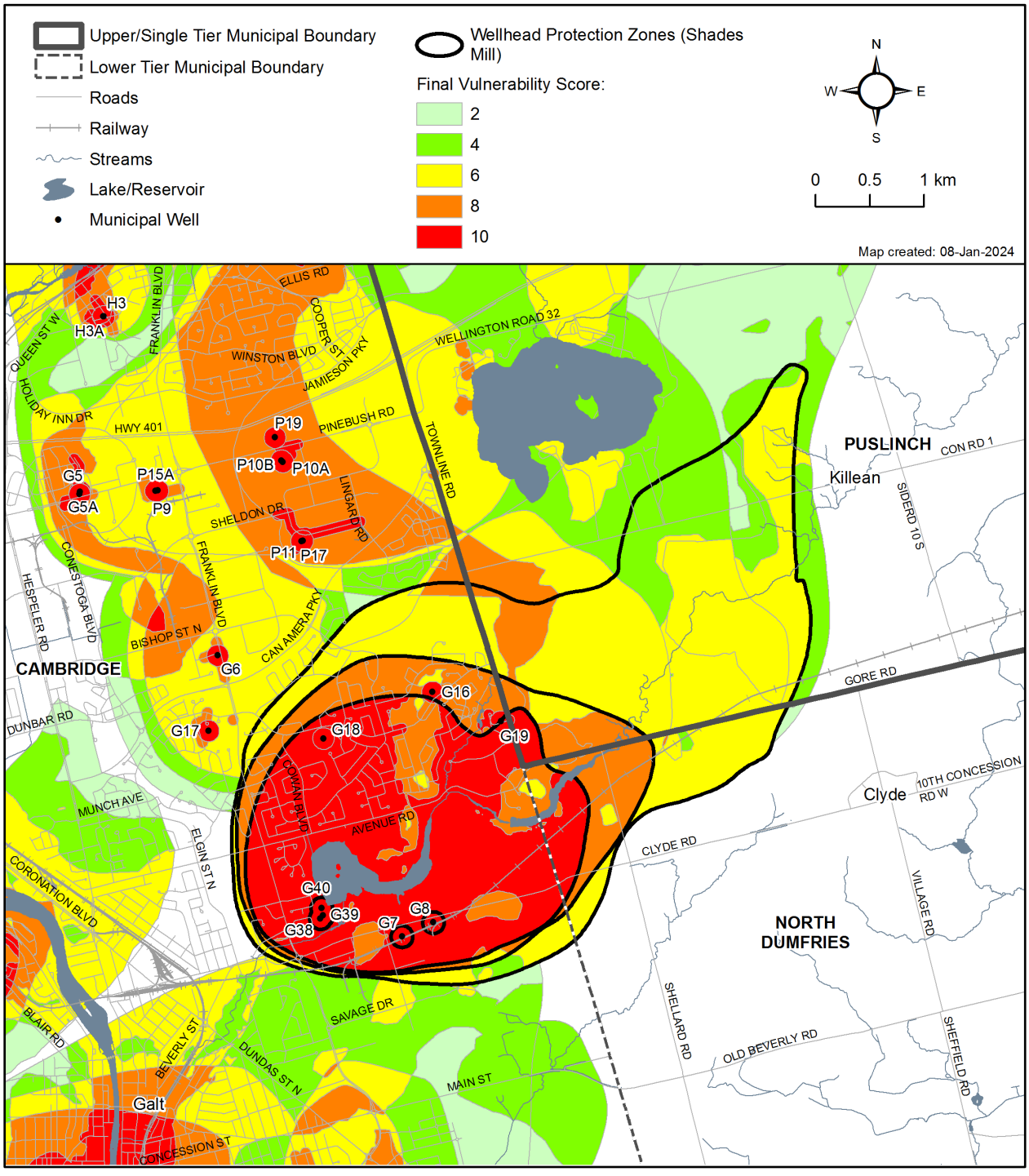
Map 8.5—18: Cambridge Area Inset 2: Shades Mills Well Supply Transport Pathways



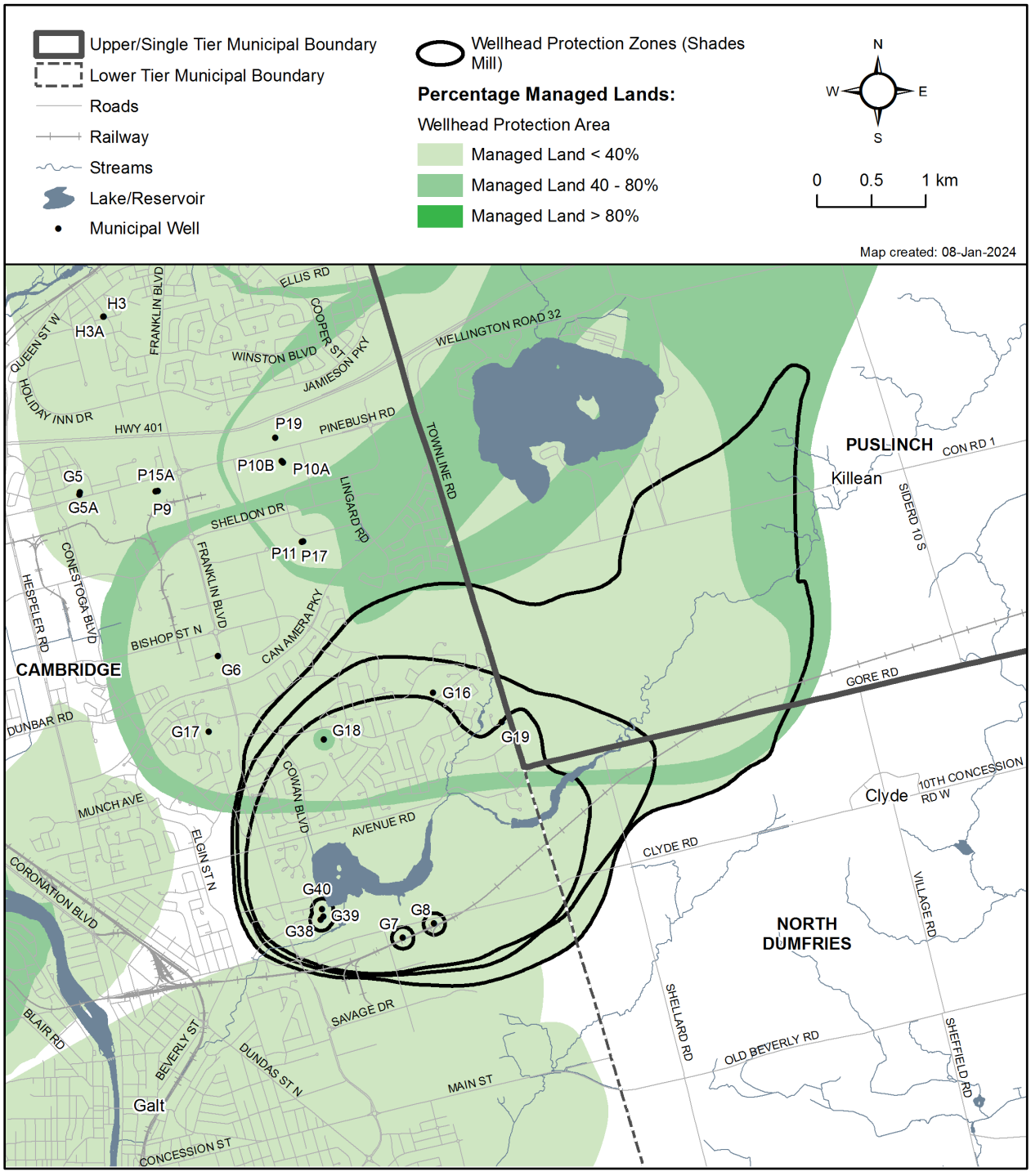
Map 8.5—19: Cambridge Area Inset 2: Shades Mills Well Supply Transport Pathways Area of Influence



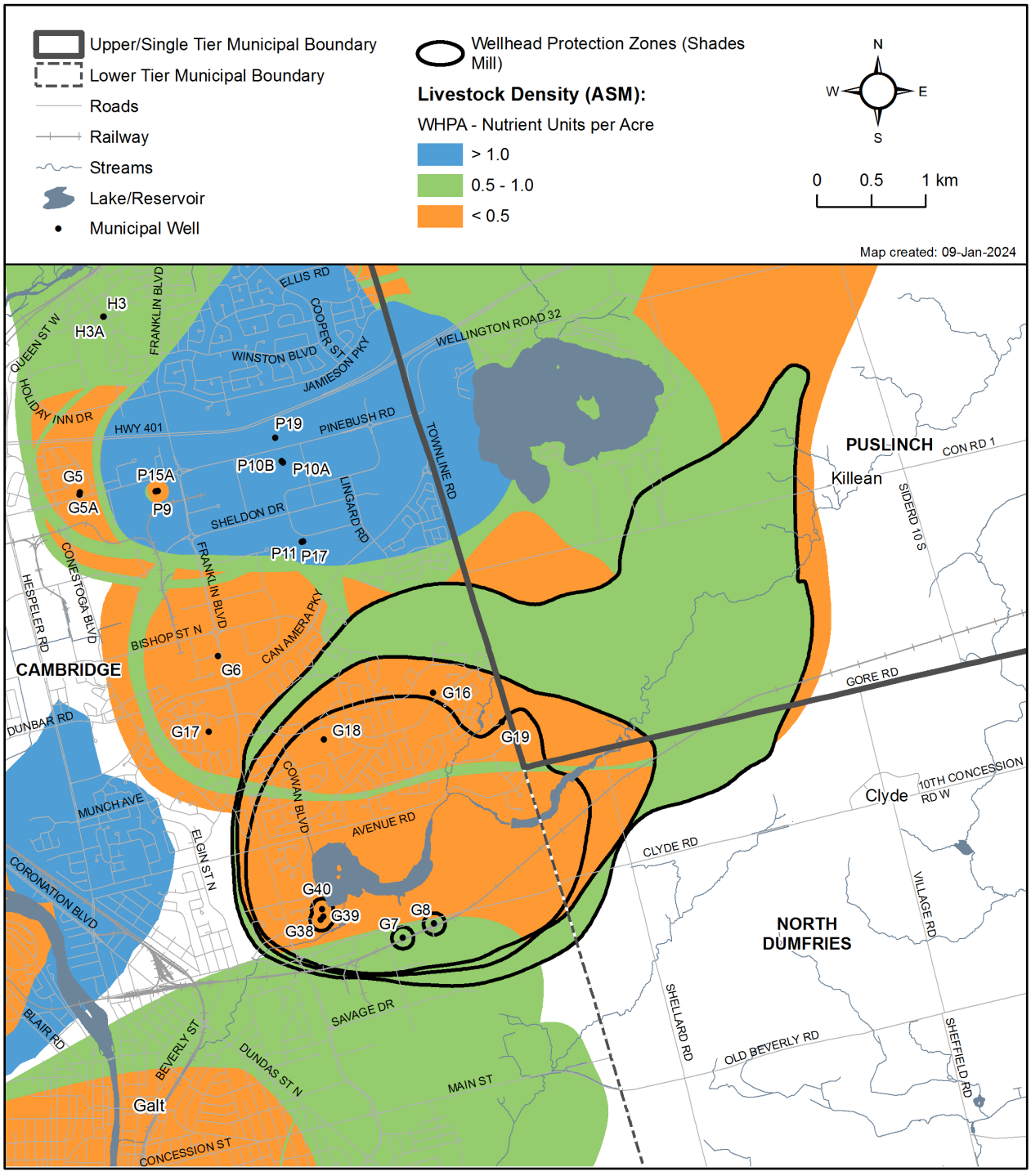
Map 8.5—20: Cambridge Area Inset 2: Shades Mills Well Supply Wellhead Protection Area Final Vulnerability



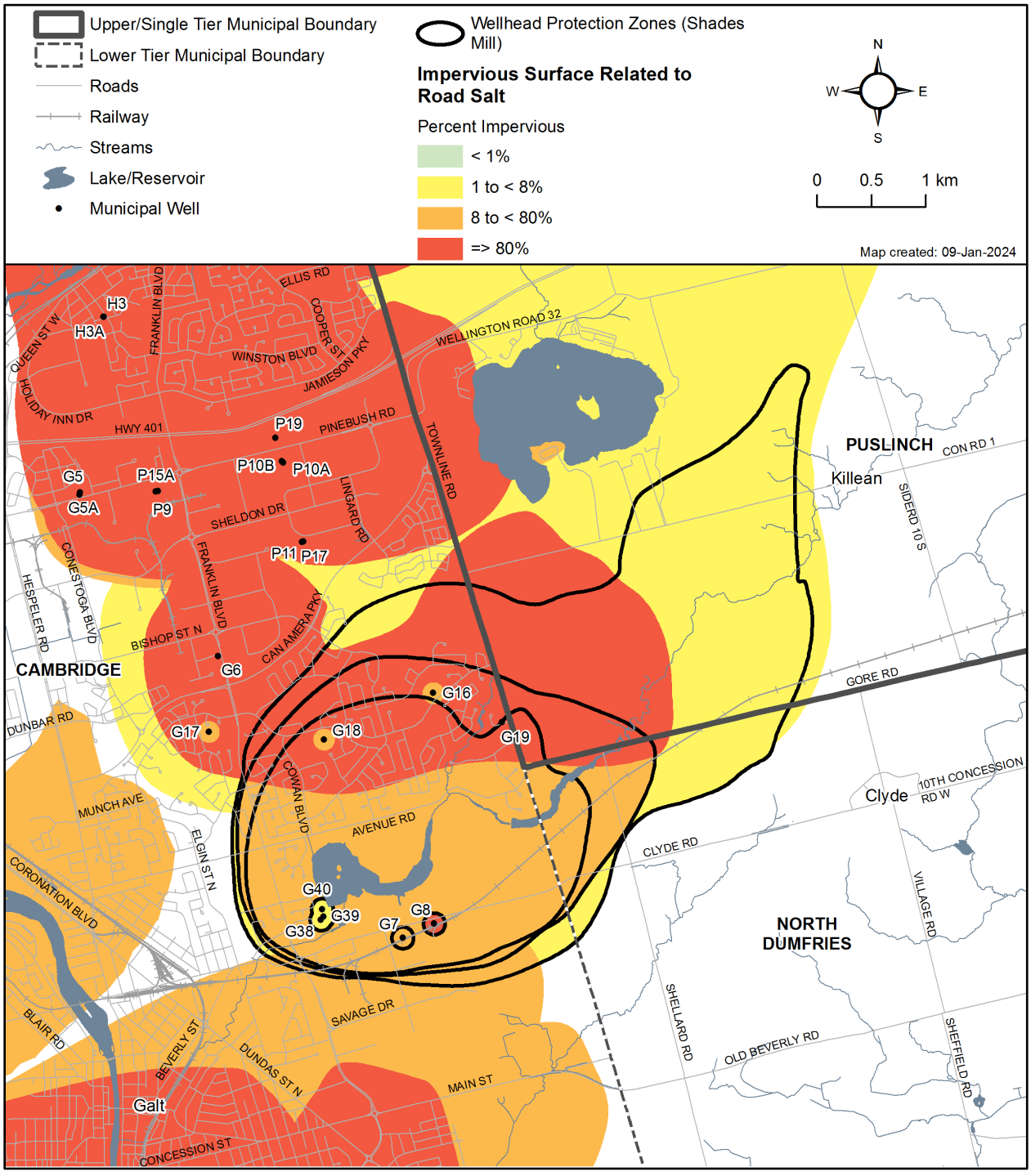
Map 8.5—21: Cambridge Area Inset 2: Shades Mills Well Supply Percent Managed Lands



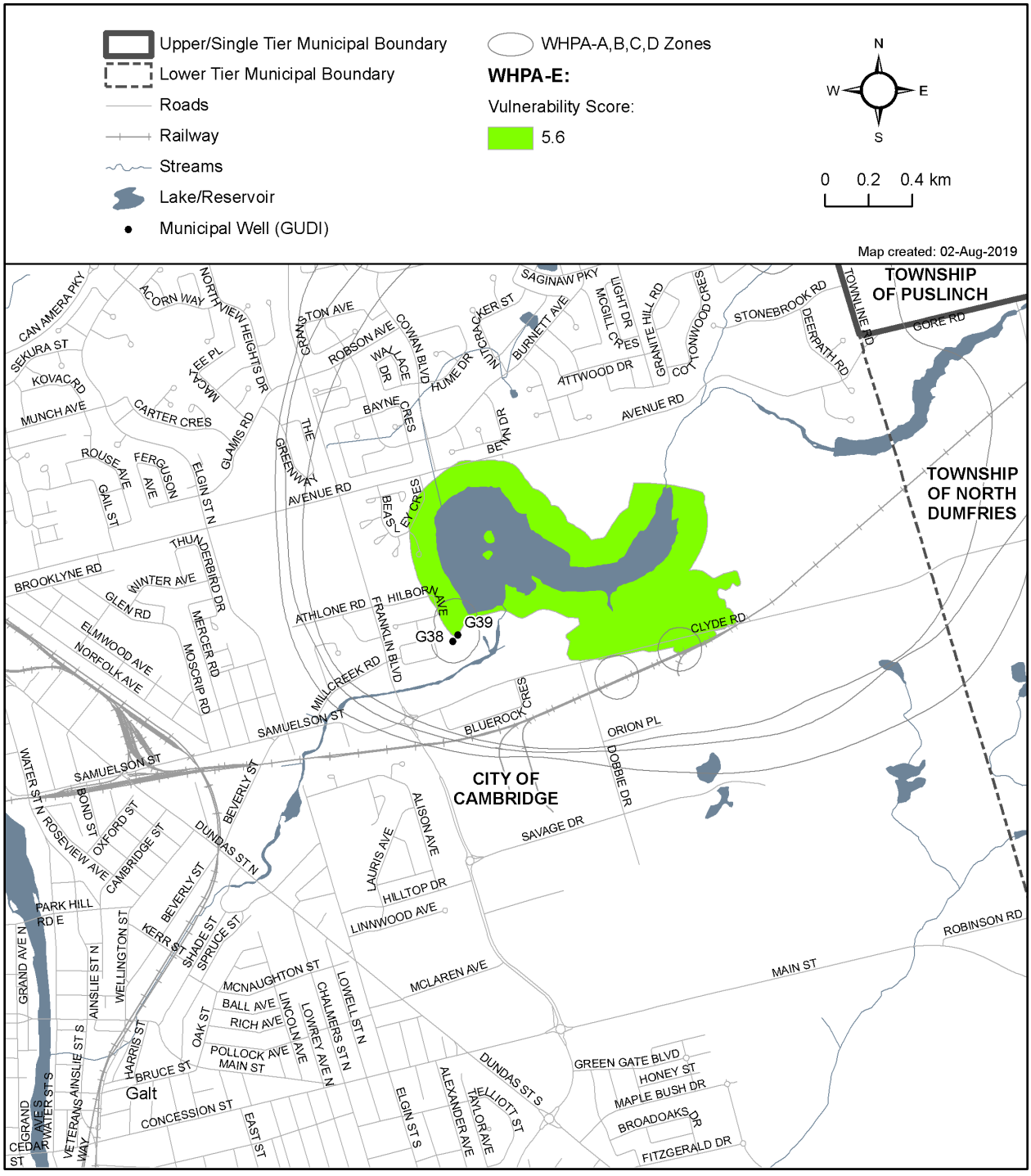
Map 8.5—22: Cambridge Area Inset 2: Shades Mills Well Supply Percent Livestock Density



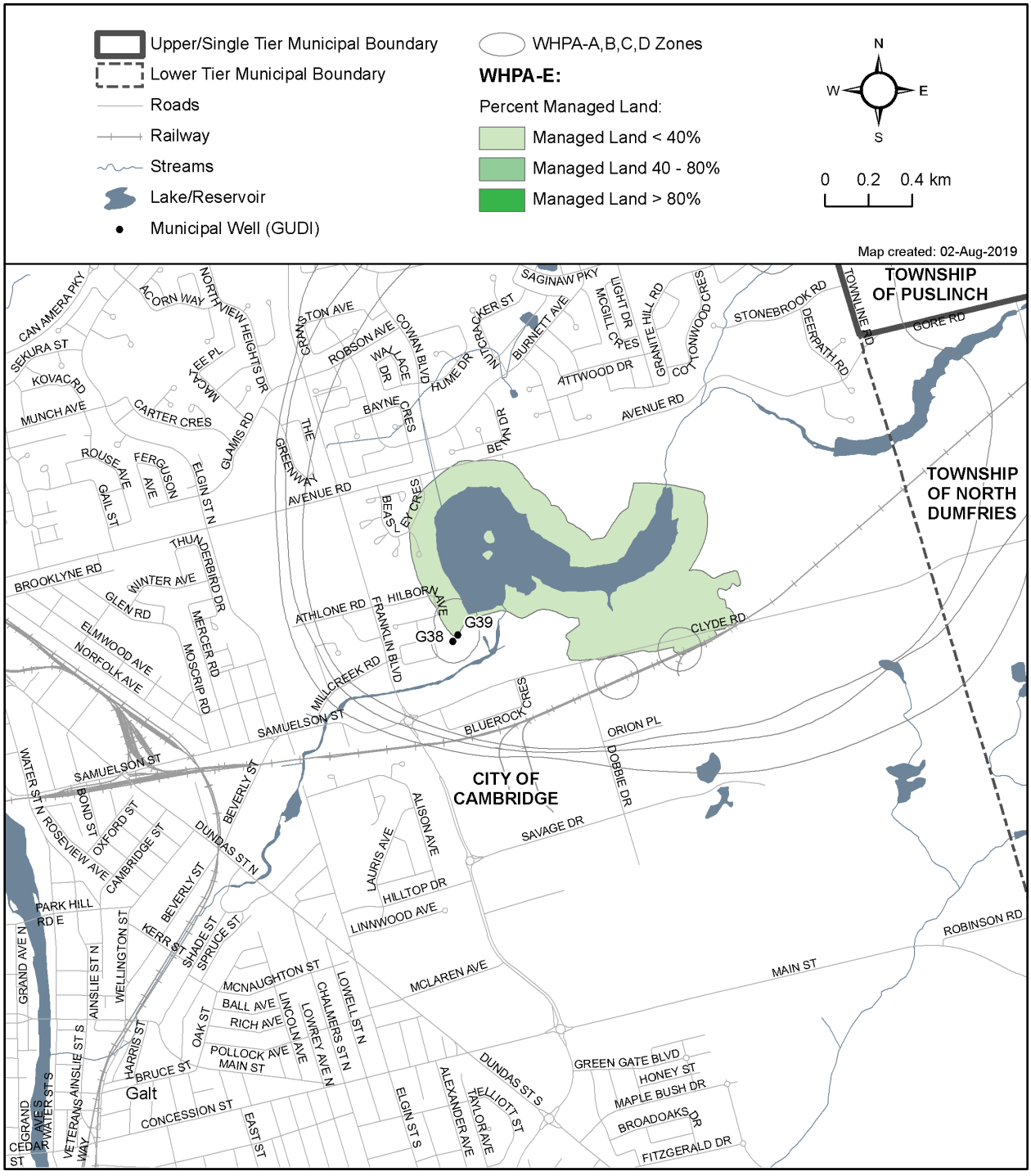
Map 8.5—23: Cambridge Area Inset 2: Shades Mills Well Supply Percent Impervious Surfaces



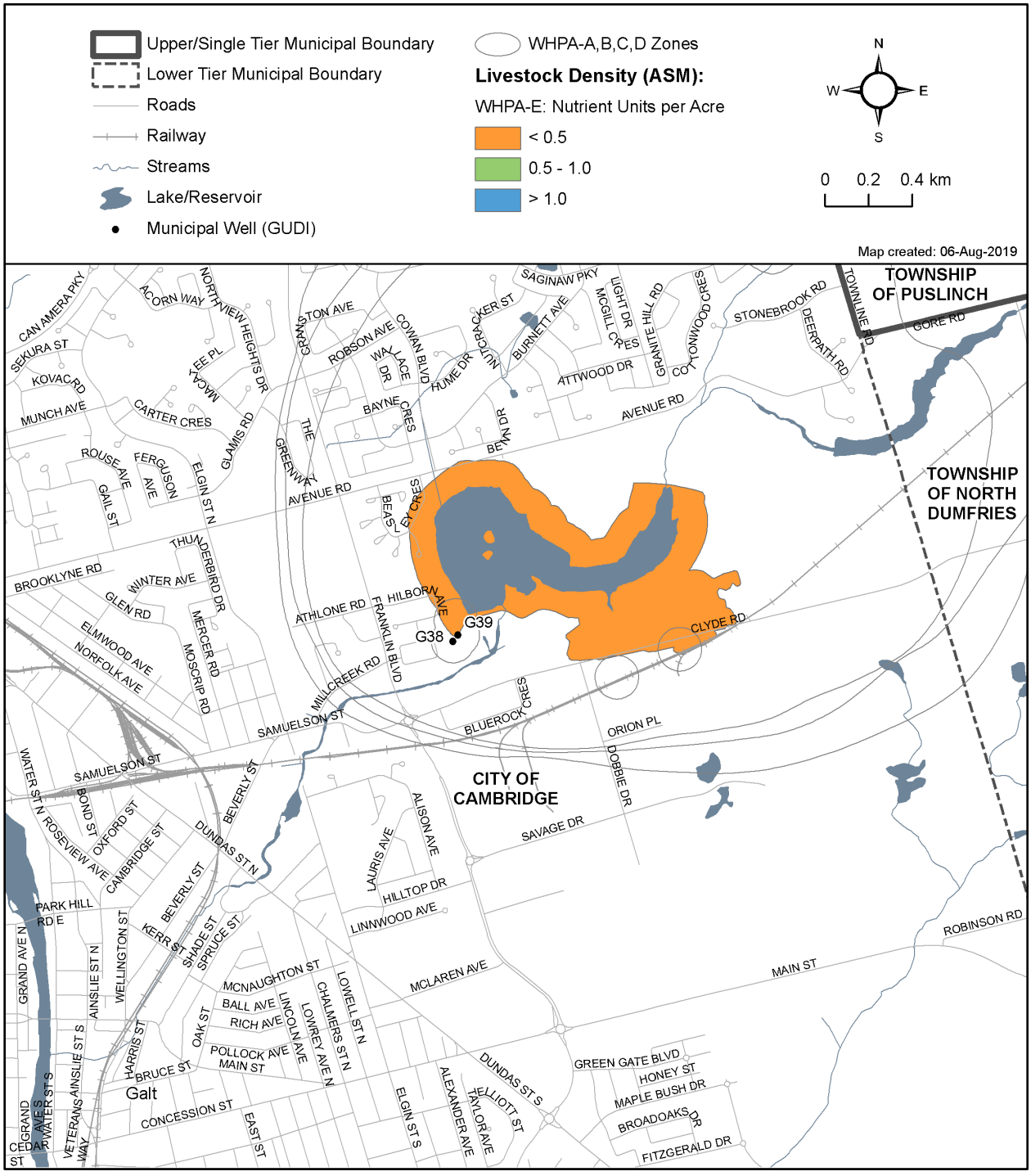
Map 8.5—24: Shades Mills Wellhead Protection Area-WHPA-E



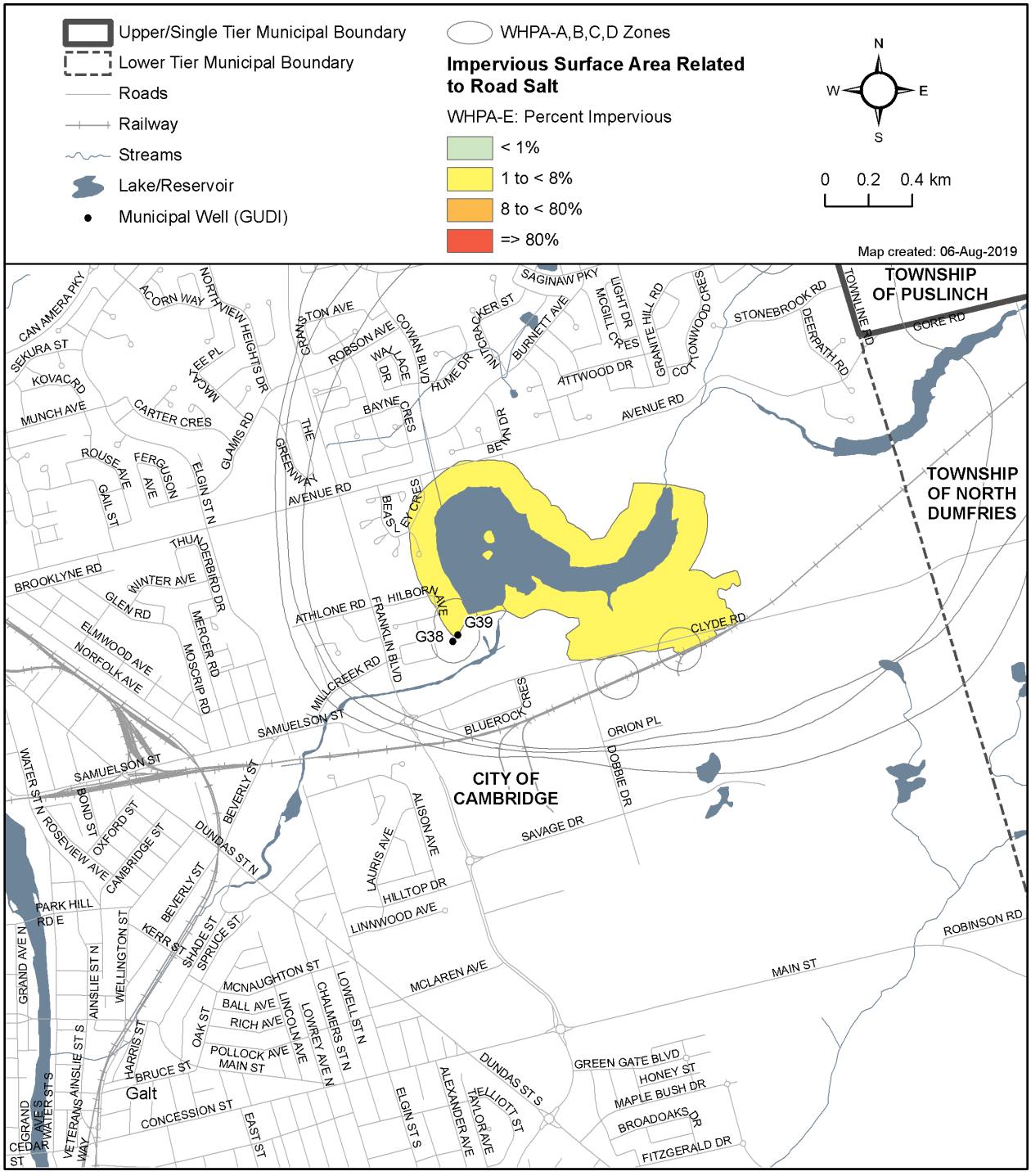
Map 8.5—25: Shades Mills Wellfield Percent Managed Lands- WHPA-E



Map 8.5—26: Shades Mills Wellfield Percent Livestock Density- WHPA-E



Map 8.5—27: Shades Mills Wellfield Percent Impervious Surfaces - WHPA-E



Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Shades Mills Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—128** and **Map 8.5—132** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—39 provides a summary of the threat levels possible in the Shades Mills Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—128** and **Map 8.5—132**.

Table 8.5—7: Identification of Drinking Water Quality Threats in the Shades Mills Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA- D	2 & 4	No	No	No
Chemicals	WHPA-E	5.6	No	No	Yes
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
DNAPLs	WHPA-E	5.6	No	No	Yes
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes
Pathogens	WHPA-E	5.6	No	No	Yes

Threats and Issues Enumeration for the Shades Mills Wellfield

The protection area for the Shades Mills Wellfield overlaps with the Clemens Mill, Middleton Street, and Willard Wellfield areas. However, threat ranking results related to the Clemens Mill, Middleton Street, and Willard Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

The total number of identified significant drinking water threats in this wellfield is 121. The number of properties in this wellfield with identified significant drinking water threats is 57. Details surrounding the types of threats and circumstances found in the Shades Mills wellhead protection areas are outlined in **Table 8.5—40**.

Three Significant Conditions were identified in the Shades Mills vulnerable areas.

One site is a former landfill located within the WHPA-B, contains groundwater contamination by chloride and over the standards referenced by the Technical Rules, extending off-site.

One site is located within the Shades Mills WHPA-B, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.

The third site is located within the Shades Mills WHPA-B, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.

No drinking water Issues have been identified in the Shades Mills Wellfield as per Technical Rule 114.

Table 8.5—8: Significant Drinking Water Quality Threats in the Shades Mills Wellhead Protection Areas (current to February 2019)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Storage of PCB waste at any location (generating or accepting)	1	WHPA-B
	Storage of small quantity exemptions (SQEs) of hazardous wastes or liquid industrial wastes at any type of waste disposal site including generators, receivers, and transfer/processing sites	3	WHPA-B
	The land disposal at a waste disposal site of hazardous waste, liquid industrial waste, or processed liquid industrial waste	1	WHPA-B
	Waste disposal site - storage of hazardous wastes or liquid industrial wastes subject to registration and manifesting	4	WHPA-B
2	Sewage system or sewage works - onsite sewage systems	11	WHPA-A WHPA-B
	Sewage system or sewage works - onsite sewage systems holding tanks	6	WHPA-A WHPA-B
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	3	WHPA-A WHPA-B
	Sewage system or sewage works - sewage storage - treatment or holding tanks	2	WHPA-A WHPA-B
	Sewage system or sewage works - storm water management facility (including storm sewers)	13	WHPA-A WHPA-B
3	Application of agricultural source material (ASM) to land	3	WHPA-B

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
4	Storage of agricultural source material (ASM)	3	WHPA-B
9	Storage of commercial fertilizer	4	WHPA-B
10	Application of pesticide to land	5	WHPA-B
11	Storage of a pesticide	10	WHPA-B
12	Application of road salt	36	WHPA-A WHPA-B
15	Storage and handling of fuel	8	WHPA-A WHPA-B
16	Storage and handling of a dense non aqueous phase liquid (DNAPL)	2	WHPA-A WHPA-B
17	Storage of an organic solvent	3	WHPA-B
21	Management or handling of agricultural source material - agricultural source material (ASM) generation (yards or confinement)	3	WHPA-B
Total Number of Significant Threat Activities		**121**	
Total Number of Properties with Significant Threats		**57**	
Total Number of Significant Conditions		**3**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

8.5.3 Blair Road, Elgin Street, Middleton Street and Willard Wellfields

Blair Road Wellfield

The water supply for the Blair Road Wellfield is obtained from production well G4 and G4A, which pump water to the IUS (**Table 8—1**). The production wells are open hole within the Guelph, Eramosa and Gasport bedrock formations from 31 m BGS to 83 m BGS with a thin layer of overburden outwash deposits directly overlying the bedrock.

Elgin Street Wellfield

The water supply for the Elgin Street Wellfield is obtained from production well G9, which pumps water to the IUS (**Table 8—1).** The production well is open hole from approximately 25 m BGS to 78 m BGS within the Guelph and Eramosa bedrock formations, with sand and gravel deposits overlying bedrock in this area (**Table 8.1—6**).

Middleton Street Wellfield

The water supply for the Middleton Street Wellfield is obtained from Production Wells G1, G1A, G2, G3 and G14, which pump water to the IUS (**Table 8—1**). The production

wells are open hole within the Guelph, Eramosa and Gasport bedrock formations from approximately 29 m BGS to 60 m BGS. All production wells discharge to a common reservoir before water is pumped to the distribution system. This Wellfield, located adjacent to the Grand River, is characterized by only a couple meters of outwash deposits overlying bedrock (**Table 8.1—6**).

Willard Wellfield

The water supply for the Willard Wellfield is obtained from production well G15 with an open hole depth of approximately 28 to 58 m BGS in the bedrock aquifer. The Willard Wellfield supplies water to the IUS (**Table 8—1**). A thin layer of gravel deposits is found overlying the bedrock in this area.

Map 8-136 presents the Wellhead Protection Areas A to D for the Blair Road, Elgin Street, Middleton Street and Willard Wellfields.

Vulnerability and Transport Pathways

The unadjusted intrinsic vulnerability is shown on **Map 8.5—137** and the adjusted intrinsic vulnerability is shown on **Map 8.5—138**.

Analysis of the attributes of each potential transport pathway in the Blair Road WHPA identified features such as clustered wells and underground services, septic systems, and a deep excavation that warranted increased ISI. Analysis of the attributes of each potential transport pathway in the Elgin Street WHPA resulted in the identification of several well clusters, closely spaced septic systems and numerous underground utility services found within the WHPA-B through D zones, which warranted an increased ISI. Analysis of the attributes of each potential transport pathway in the Willard WHPA identified well and septic system clusters within the WHPA-A through D zones that warranted increases to the ISI. Similarly, analysis of the attributes of each potential transport pathway in the Willard WHPA-E resulted in the identification of numerous storm sewers which were incorporated into the final WHPA-E delineation. **Map 8.5—139** shows the area of influence of these transport pathways and **Map 8.5—140** presents the final vulnerability scoring for the Blair Road, Elgin Street, Middleton Street and Willard Wellfields.

A GUDI study undertaken in 2011 to investigate the GUDI condition of the reconstructed G4 well determined the well to be GUDI-EF (Burnside, 2011). A concurrent study completed during the construction of G4A also determined G4A to be GUDI-EF (Burnside, 2010). The WHPA-E delineation at this Wellfield – similar to the above WHPA-E delineations – was focused on identifying the upstream points within Devil's Creek which, under bankfull or 2-year peak flow conditions, lie at the two-hour time of travel distance from the shallow overburden zone of influence for G4/G4A. It was determined that the upstream extent of the Devil's Creek watershed was equated to, or was lower than, a two-hour travel distance for G4/G4A. Based on this assumption, the entire surface water catchment of Devil's Creek was included in the WHPA-E capture area (Golder, 2018a).

The Middleton Street Wellfield was classified as *GUDI with effective filtration* based upon results of the *Middleton Water Supply Study Hydrogeologic Assessment* (Stantec, 2007). Although *E. coli* has been detected in samples from production wells G1, G2,

and G3, a detailed review of the water quality data showed no correlation between precipitation intensity, duration and timing with respect to *E. coli* detections, or to changes in Grand River stage levels. On the basis of the shallow groundwater flow direction toward the River, interpreted groundwater discharge at the River, and the lack of conclusive evidence confirming the source of the observed contamination, it was concluded that the Middleton well system does not require surface water protection zone delineations in accordance with the Technical Rules. Analysis of the attributes of each potential transport pathway in the Middleton WHPA resulted in the identification of a few well clusters, septic system clusters and numerous underground service clusters within the WHPA-B through WHPA-D zones, which warranted an increased ISI.

The Willard Wellfield has been classified as GUDI with effective filtration, and thus a WHPA-E protection zone has been delineated for this Wellfield. Willard has been classified as GUDI due to: (1) its hydraulic connection to both the Middleton Street Wellfield and the AFB1/AFB2 aquifers, and (2) the fact that it responds to significant changes in Grand River stage data. However, it should be noted that laser particle count data, turbidity data and coliform data do not indicate a correlation between well response and seasonal changes or precipitation events (Stantec, 2009b).

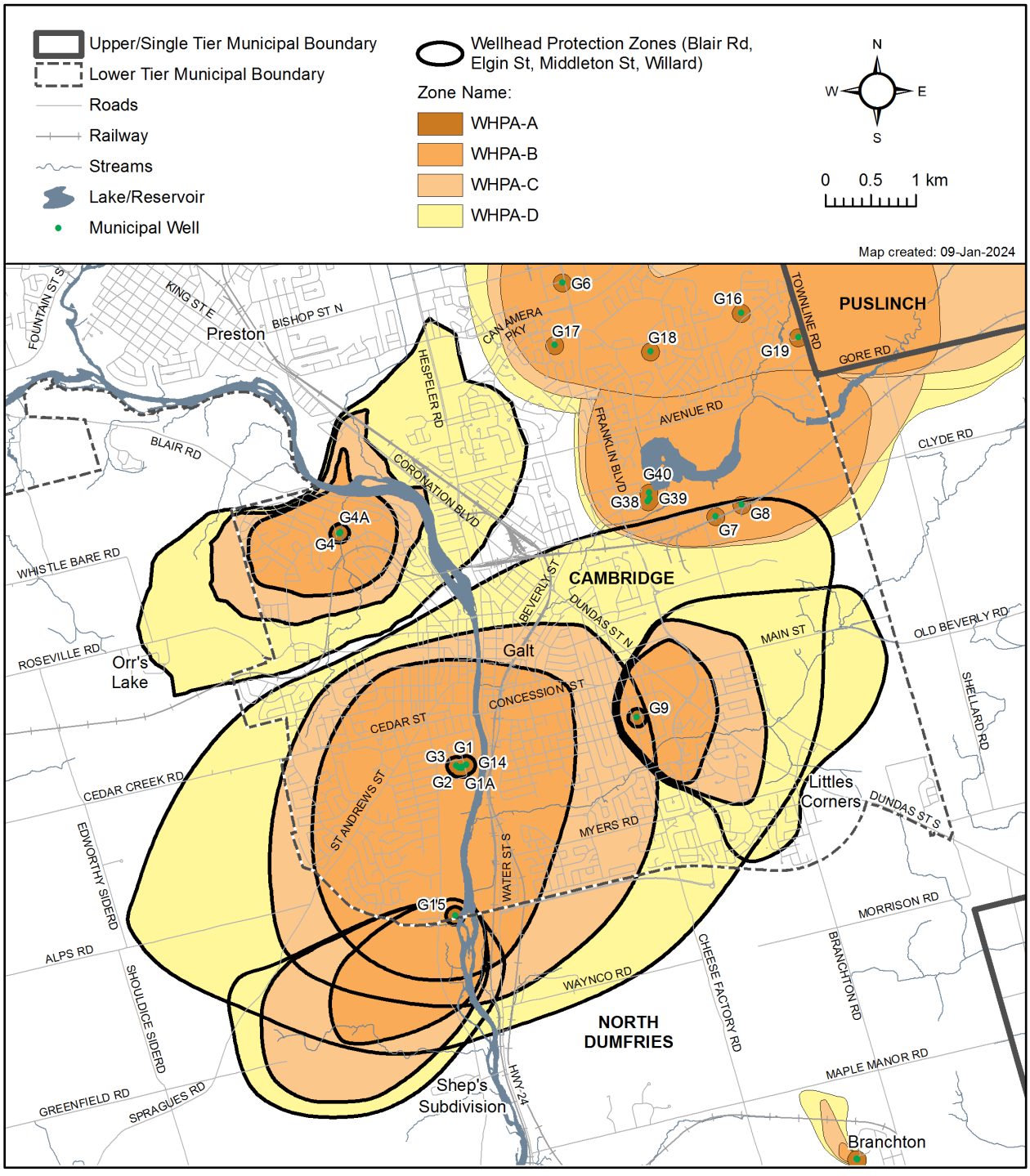
WHPA-E delineations for the Blair Well G4/G4A and Willard Well G15 are shown on **Map 8.5—141** and **Map 8.5—142**. Refer to **Section 8.1 – Water Quality Risk Assessment** for discussion of Blair Road WHPA updates.

Percent Managed Land, Livestock Density, Salt Loading Potential and Percent Impervious Surface

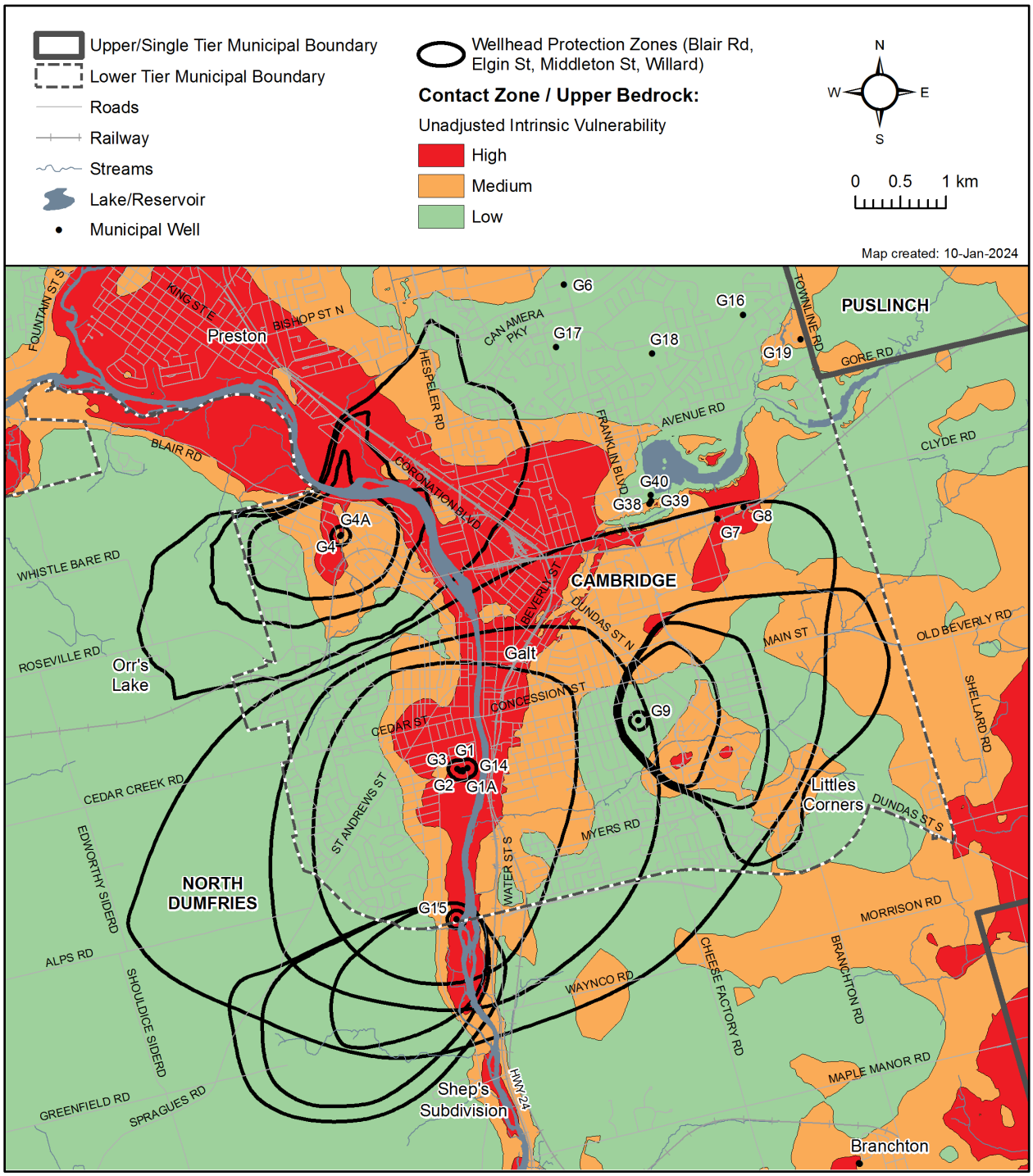
The calculations for determining the percent managed land, livestock density, salt loading potential and corresponding percent impervious surface for the Blair Road, Elgin Street, Middleton Street and Willard Wellfields followed the methods outlined in **Section 8.1 – Water Quality Risk Assessment**. This data was updated in 2022 for the Blair Road Wellfield to align with updated WHPAs.

Map 8.5—143, Map 8.5—144 and **Map 8.5—145** show the percent managed lands, livestock density, and percent impervious surface for the Blair Road, Elgin Street, Middleton Street and Willard Wellfields, respectively. The Blair Road WHPA-E for percent managed lands, livestock density, and percent impervious surface is presented on **Map 8.5—146, Map 8.5—147,** and **Map 8.5—148.** The Willard WHPA-E for percent managed lands, livestock density, and percent impervious surface is presented on **Map 8.5—149, Map 8.5—150,** and **Map 8.5—151.**

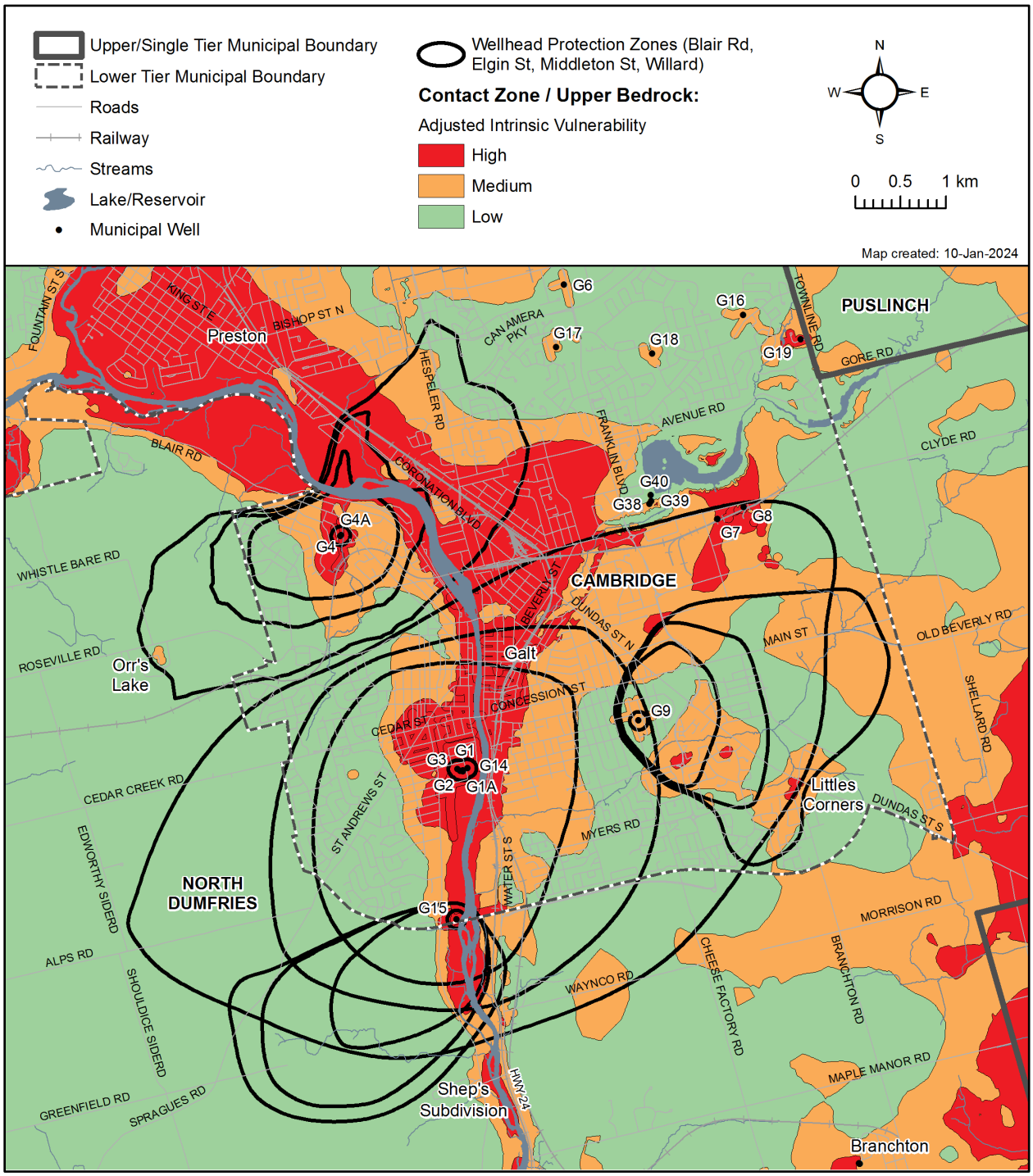
Map 8.5—28: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Wellhead Protection Areas



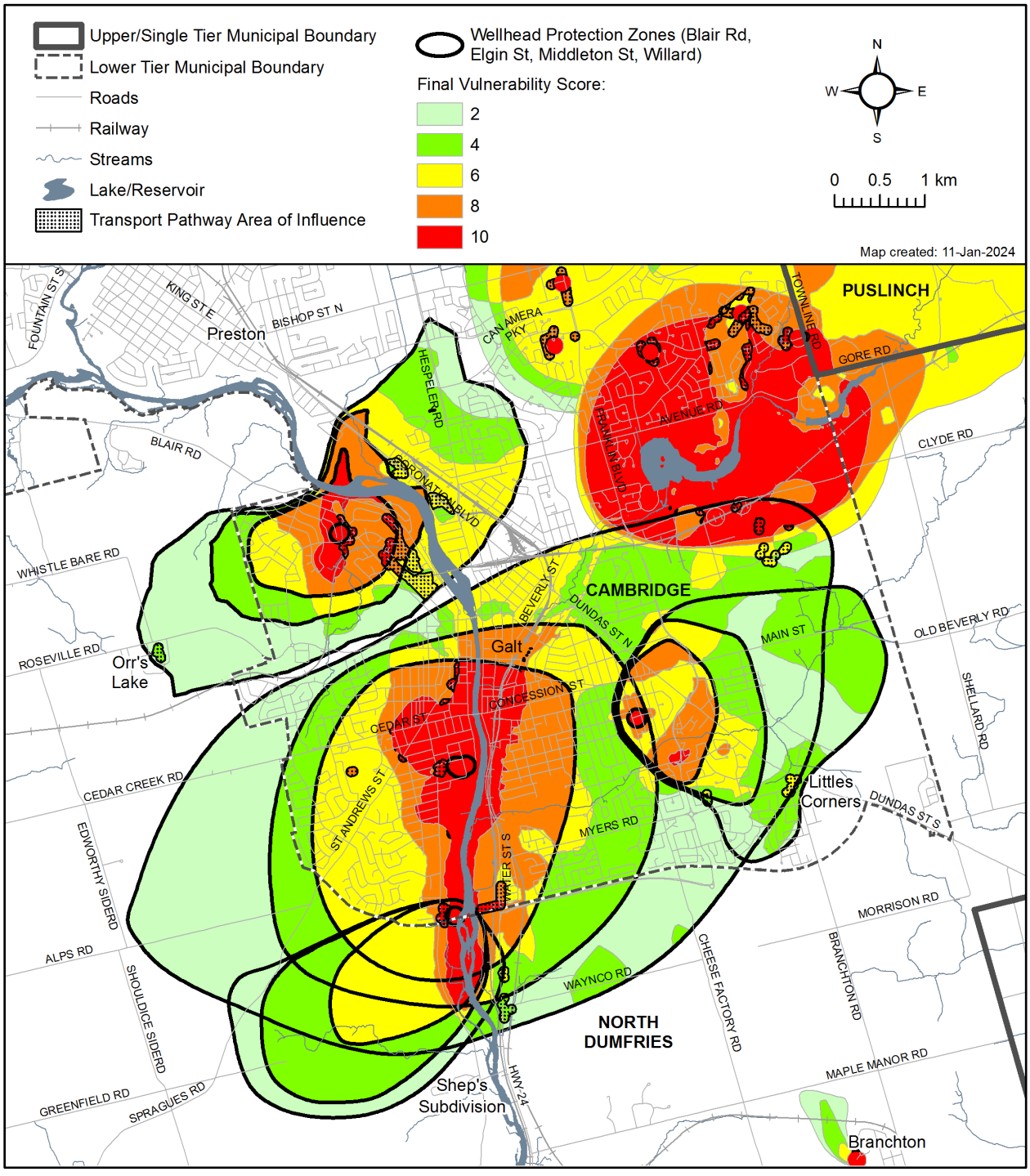
Map 8.5—29: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Wellhead Protection Area Unadjusted Intrinsic Vulnerability



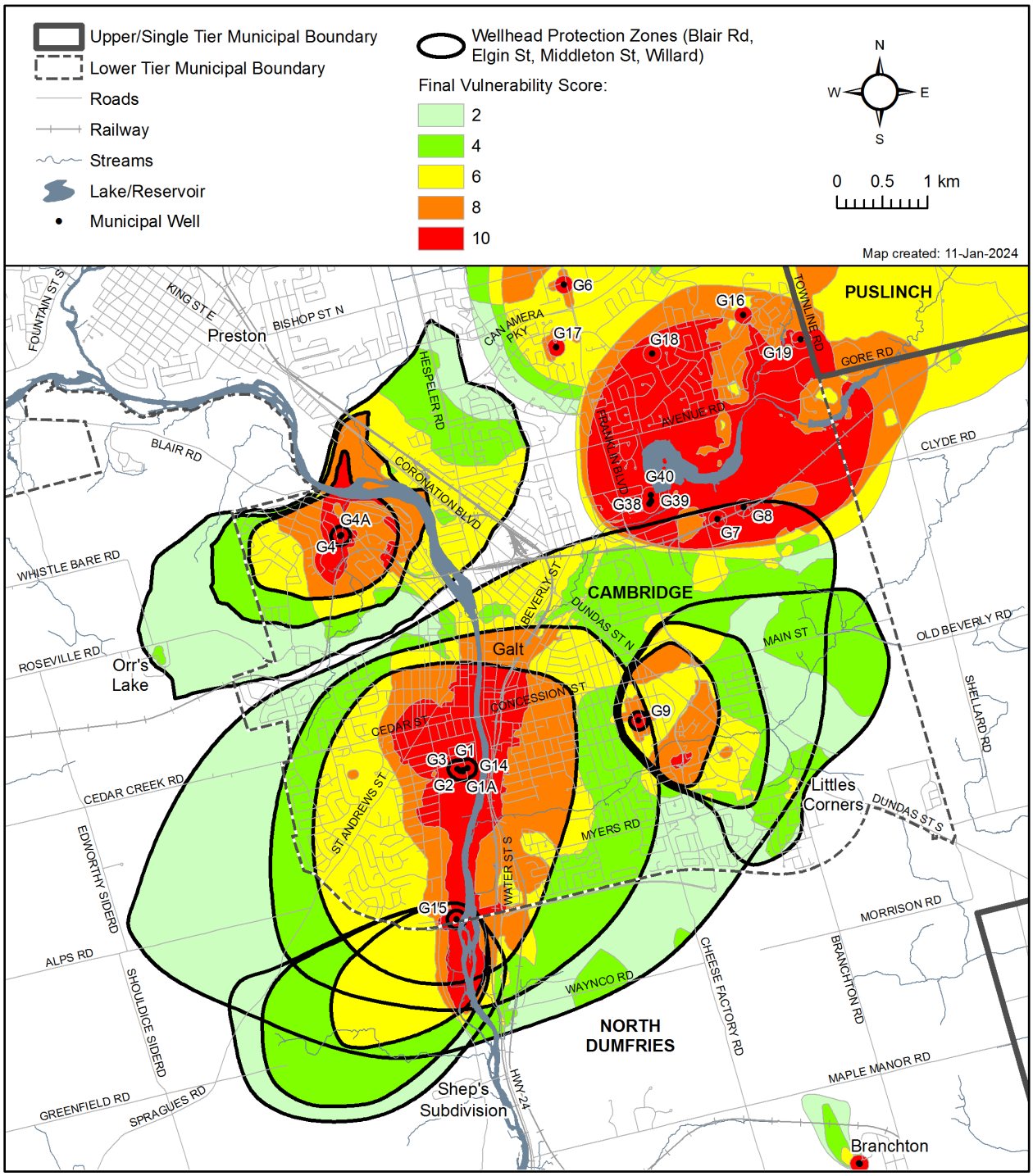
Map 8.5—30: Cambridge Area Inset 3 Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Wellhead Protection Area Adjusted Intrinsic Vulnerability



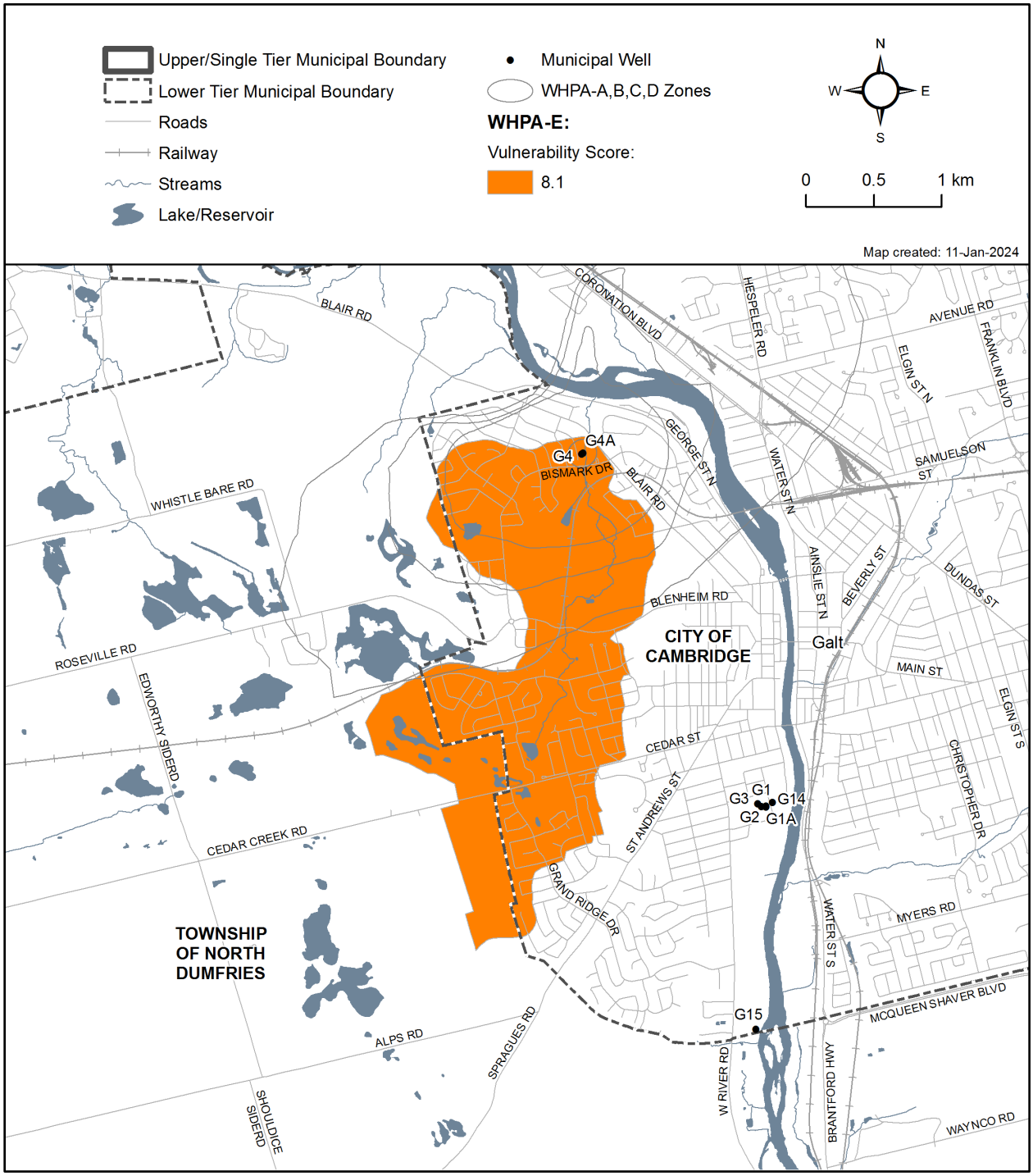
Map 8.5—31: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Transport Pathways Area of Influence



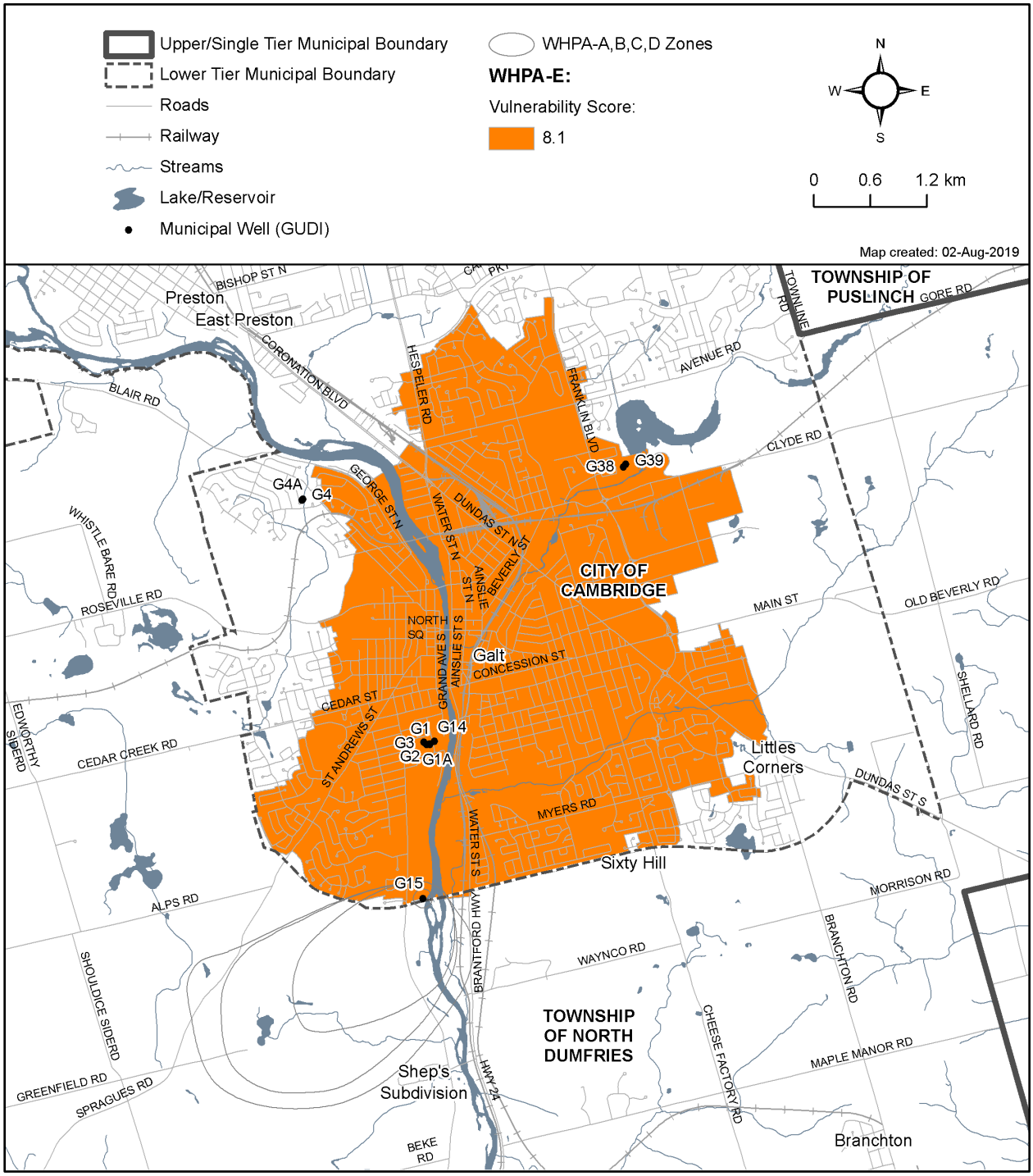
Map 8.5—32: Cambridge Area Inset 3 Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Wellhead Protection Area Final Vulnerability



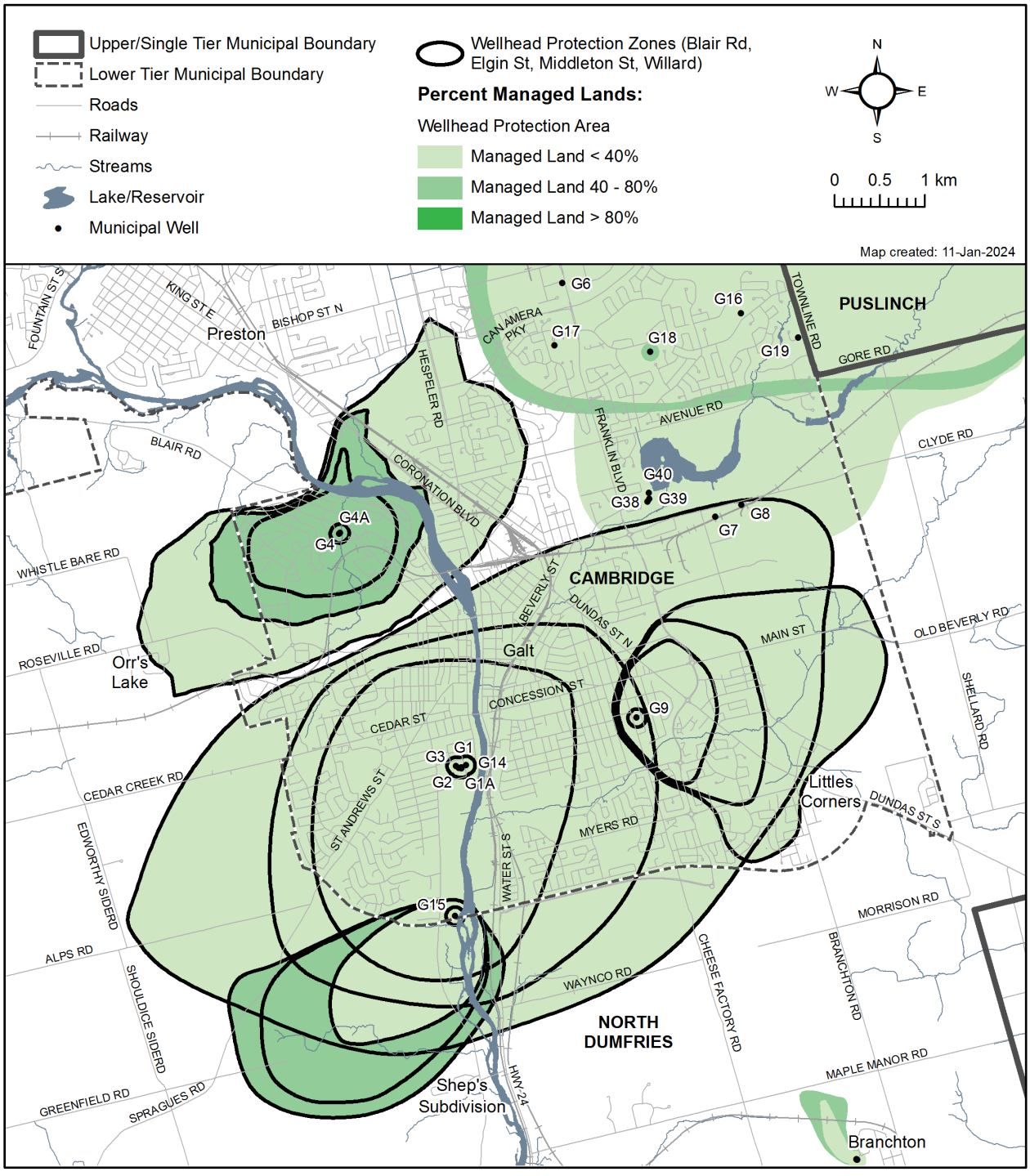
Map 8.5—33: Blair Road (G4/G4A) Well Supply Wellhead Protection Area E



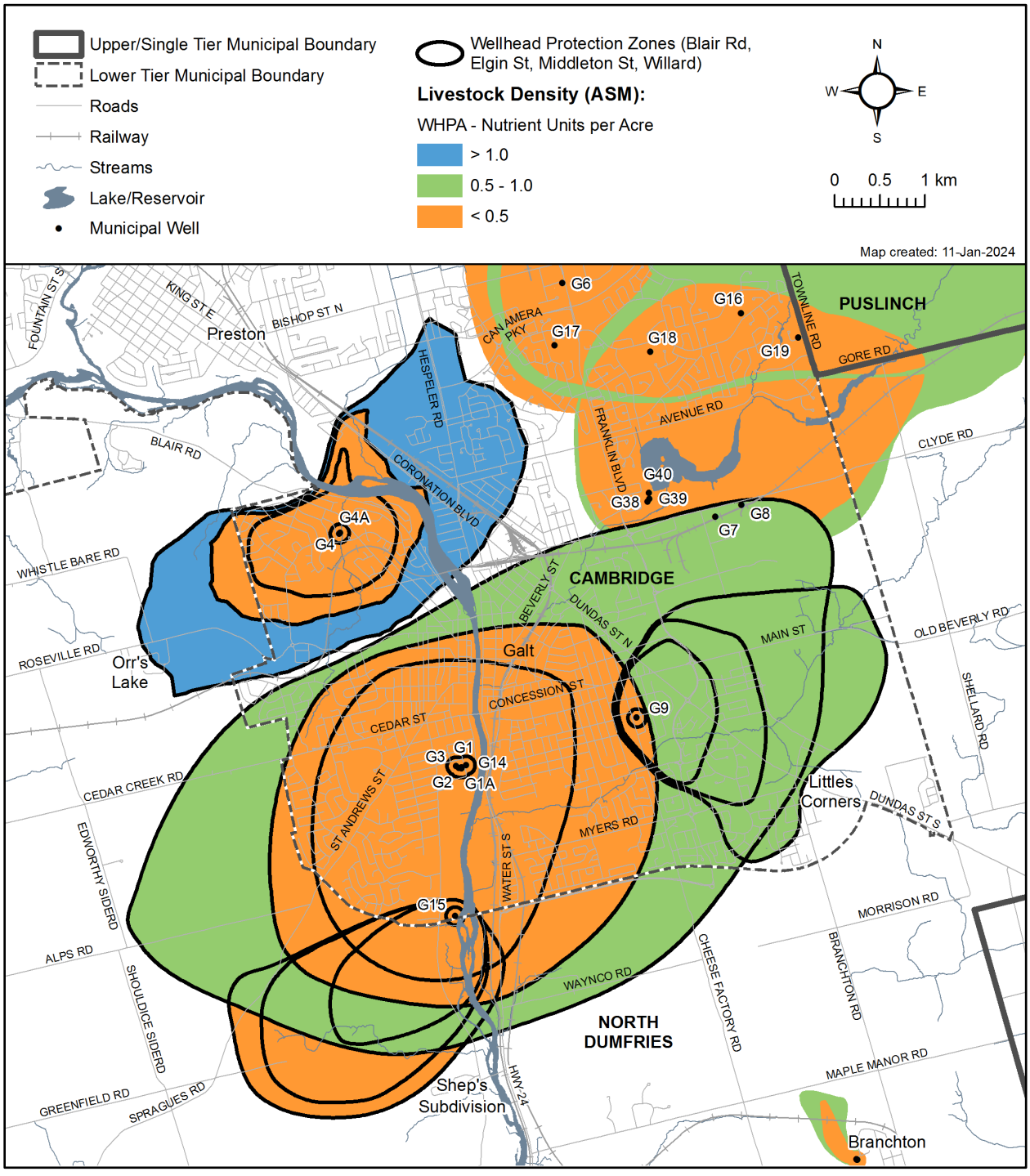
Map 8.5—34: Willard (G15) Well Supply Wellhead Protection Area E



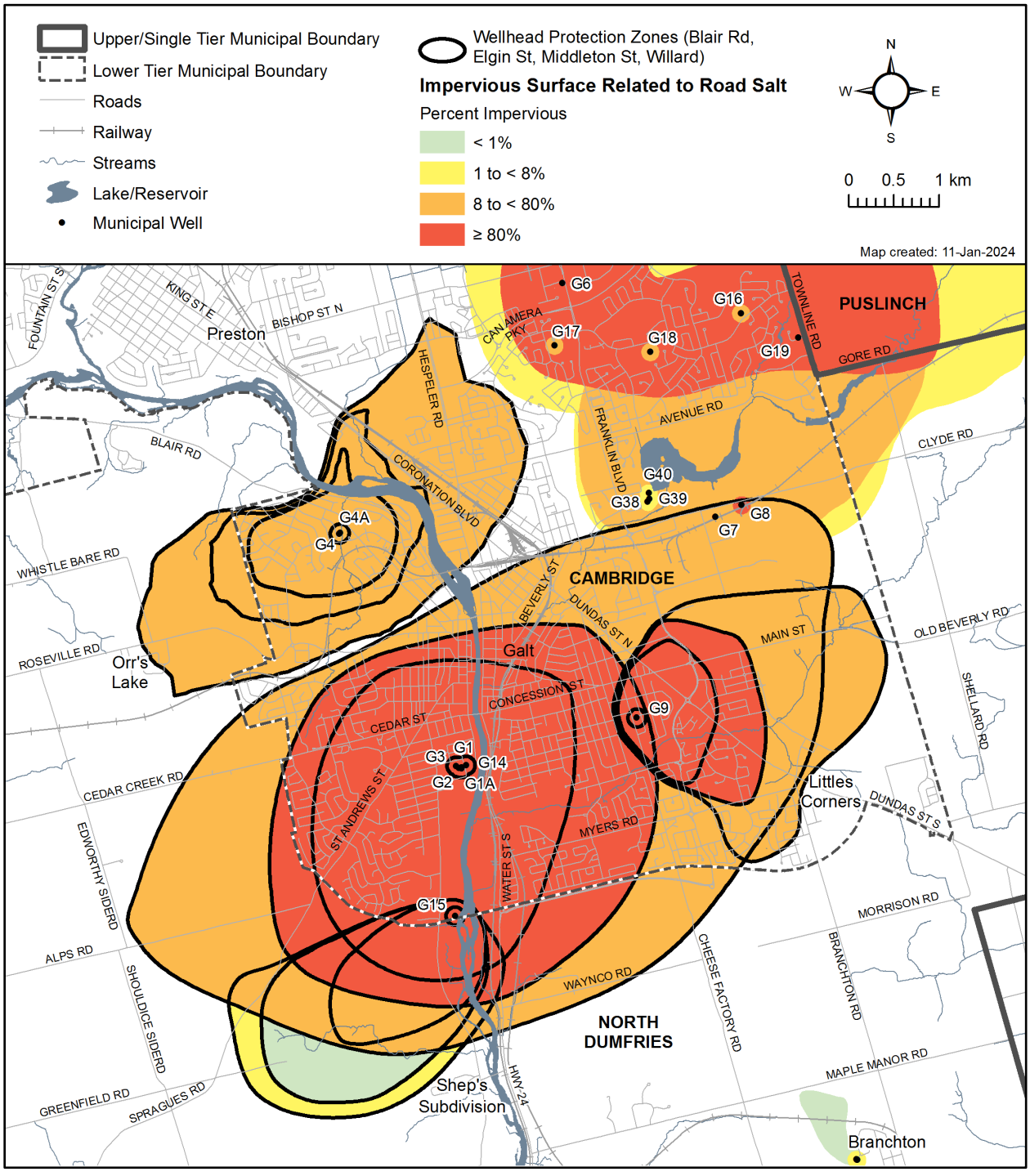
Map 8.5—35: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Percent Managed Lands



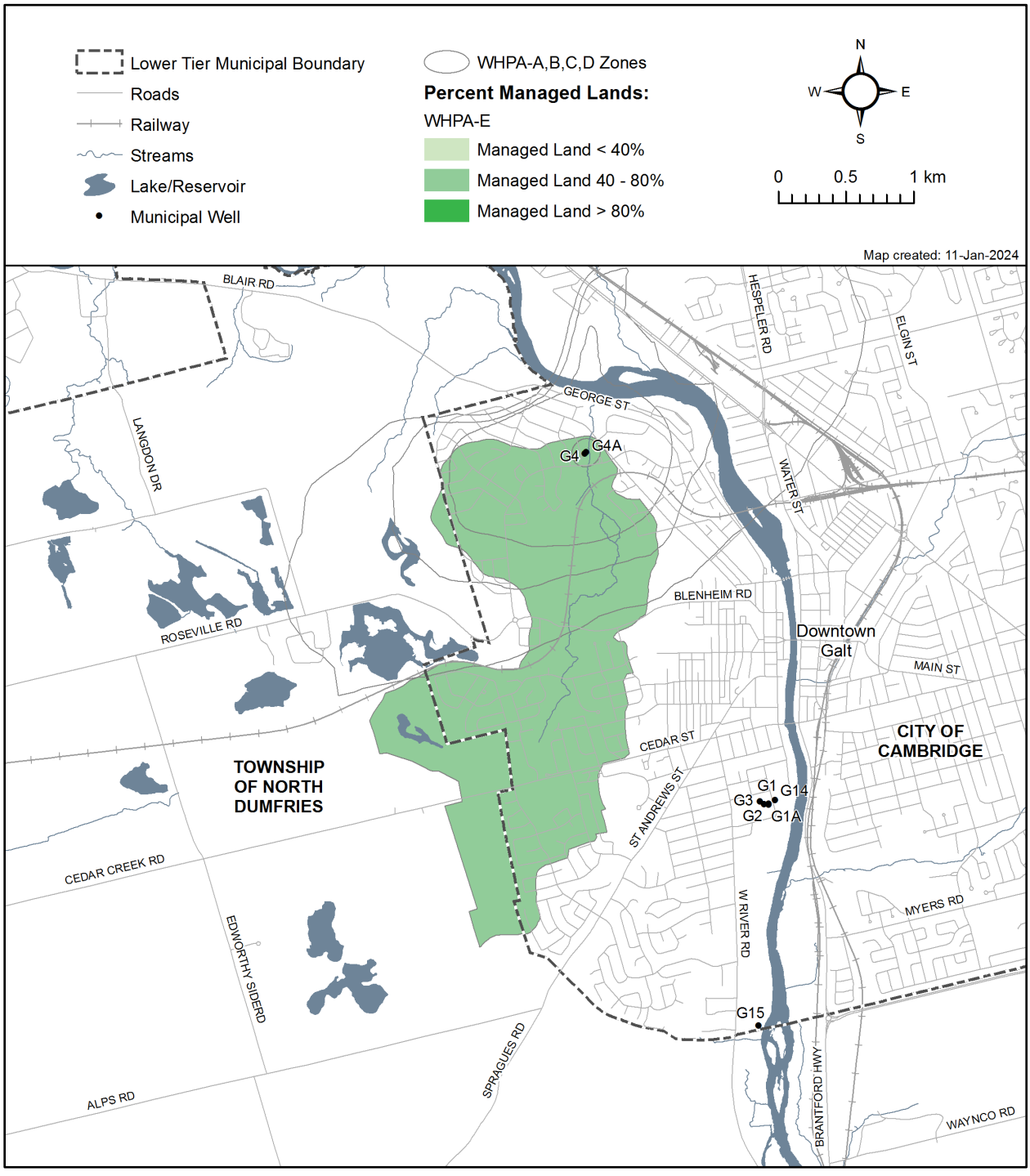
Map 8.5—36: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Percent Livestock Density



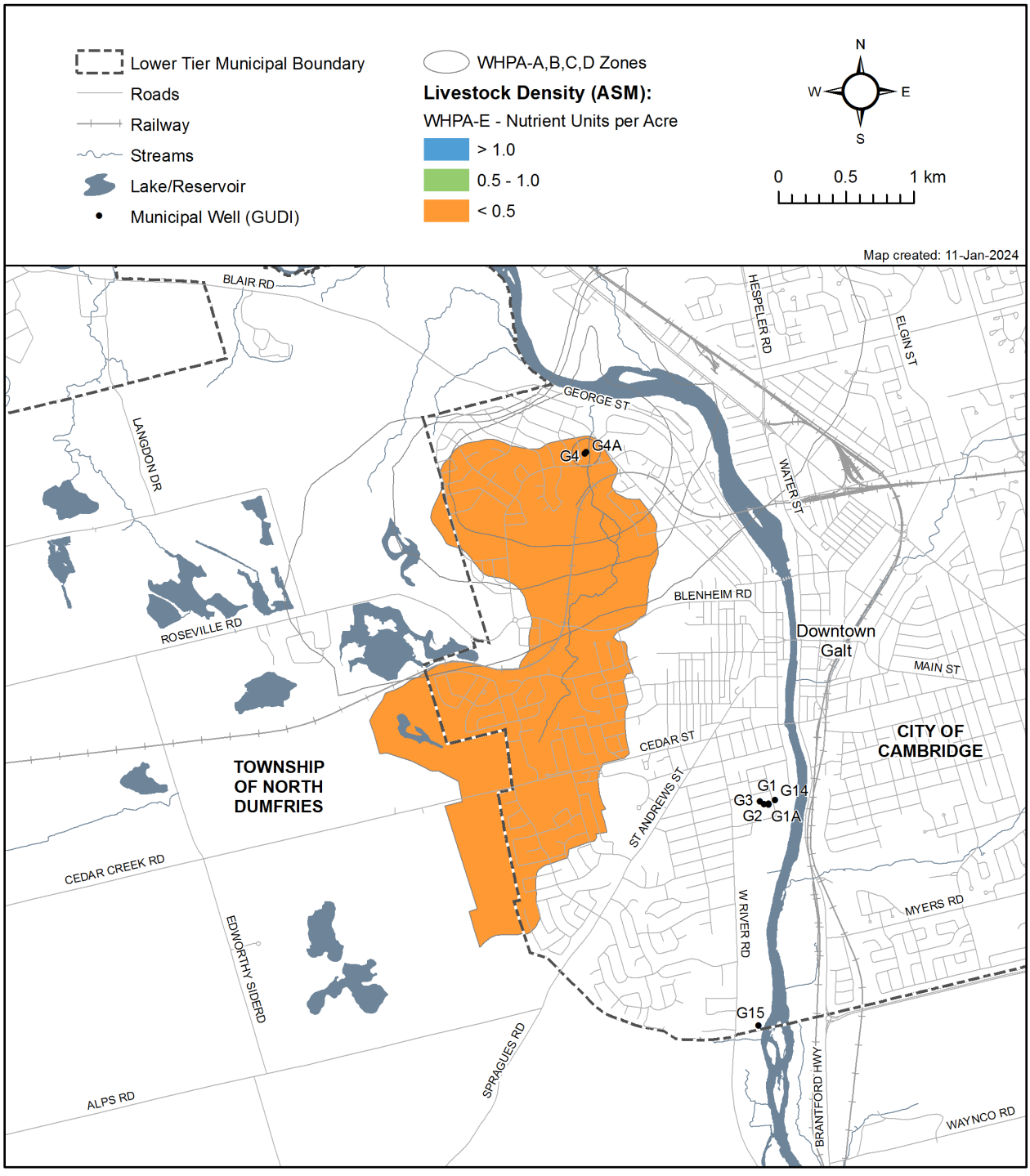
Map 8.5—37: Cambridge Area Inset 3: Blair Road, Elgin Street, Middleton Street, and Willard Well Supply Percent Impervious Surfaces



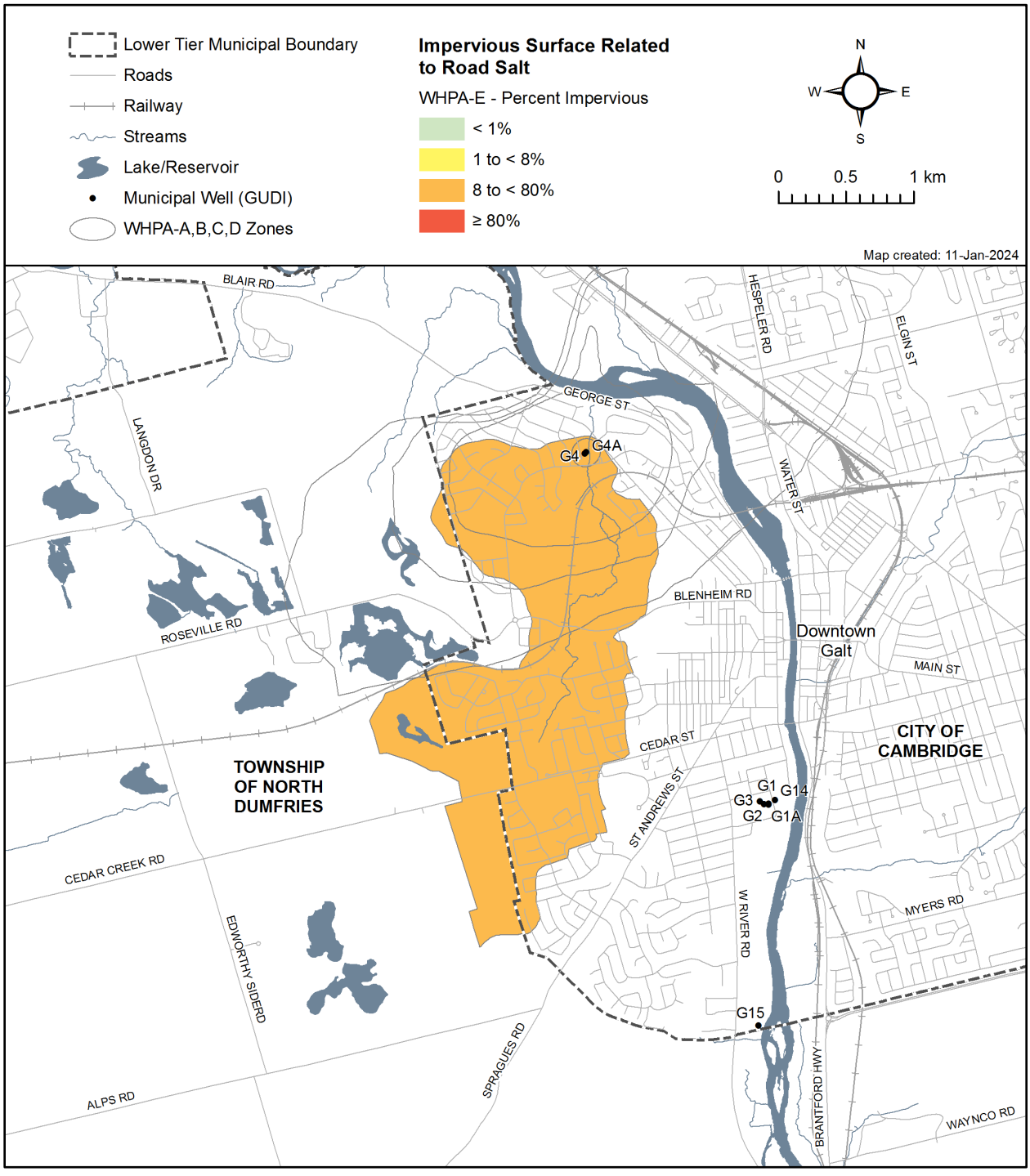
Map 8.5—38: Blair Road (G4/G4A) Well Supply Wellhead Protection Area E Percent Managed Lands



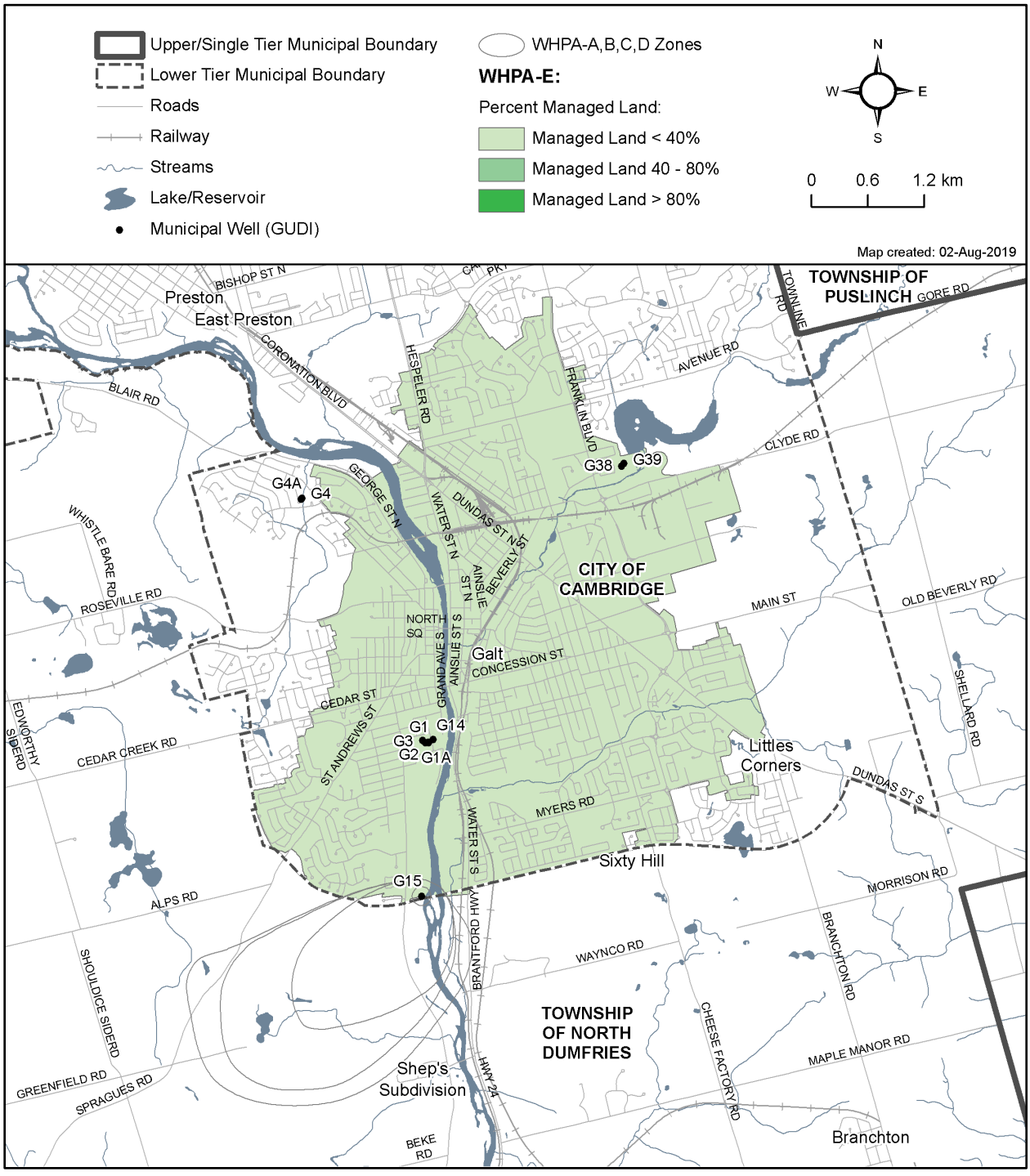
Map 8.5—39: Blair Road (G4/G4A) Well Supply Wellhead Protection Area E Livestock Density



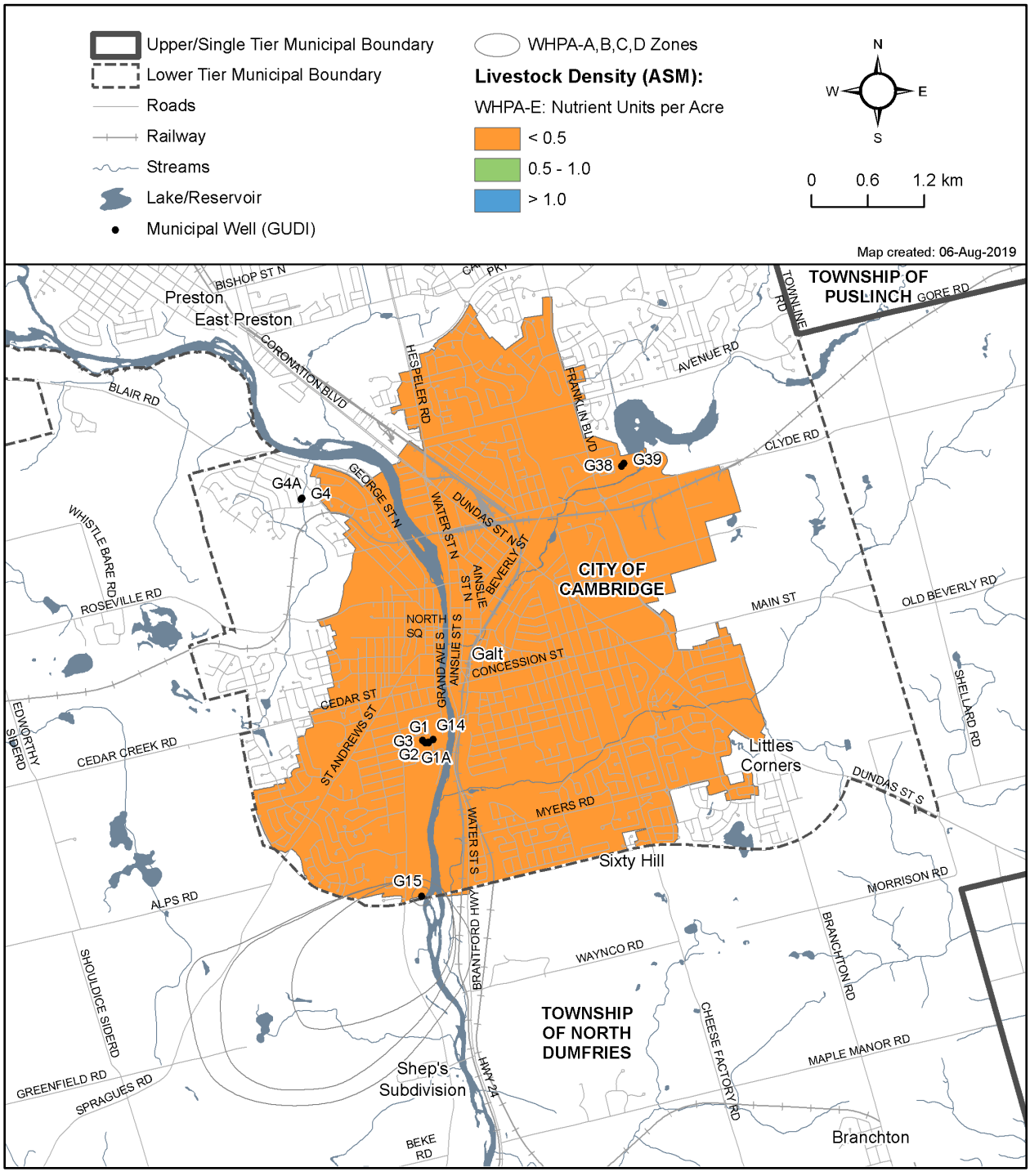
Map 8.5—40: Blair Road (G4/G4A) Well Supply Wellhead Protection Area E Percent Impervious Surfaces



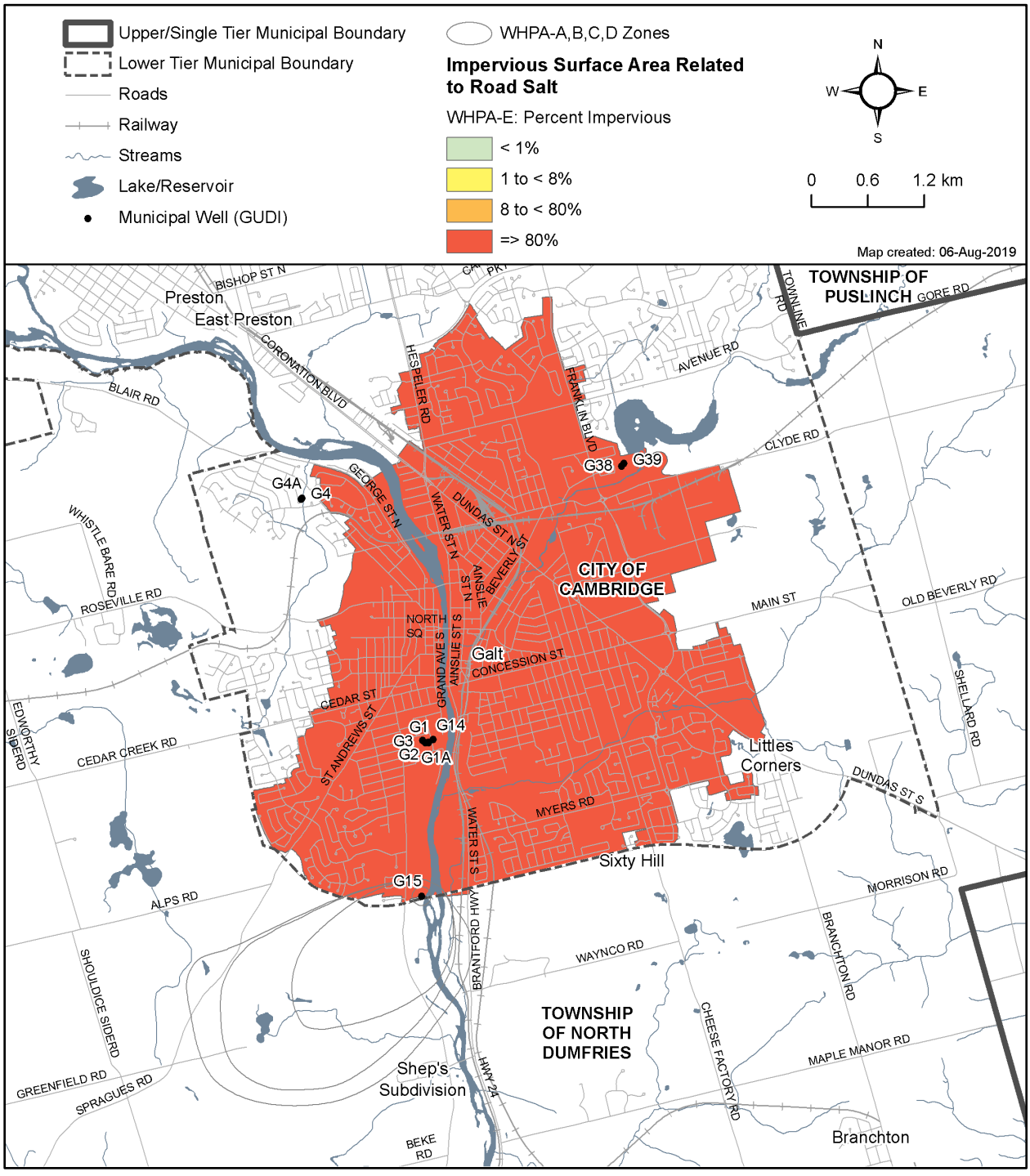
Map 8.5—41: Willard (G15) Well Supply Wellhead Protection Area E Percent Managed Lands



Map 8.5—42: Willard (G15) Well Supply Wellhead Protection Area E Percent Livestock Density



Map 8.5—43: Willard (G15) Well Supply Wellhead Protection Area E Percent Impervious Surfaces



Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Blair Road Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—140** and **Map 8.5—141** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—41 provides a summary of the threat levels possible in the Blair Road Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. "Yes" indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; "No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—140** and **Map 8.5—141**.

Table 8.5—9: Identification of Drinking Water Quality Threats in the Blair Road Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
Chemicals	WHPA-E	8.1	Yes	Yes	Yes
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
DNAPLs	WHPA-E	8.1	No	Yes	Yes
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes
Pathogens	WHPA-E	8.1	Yes	Yes	Yes

Threats and Issues Enumeration for the Blair Road Wellfield

The protection area for the Blair Road Wellfield overlaps with the Middleton Street and Willard Wellfield areas. However, threat ranking results related to the Middleton Street and Willard Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

The total number of identified significant drinking water threats in this Wellfield is 24. The number of properties in this Wellfield with identified significant drinking water threats is 8. Details surrounding the types of threats and circumstances found in the Blair Road wellhead protection areas are outlined in **Table 8.5—42**.

One Significant Condition was identified in the Blair Road Wellfield. A fuel oil spill located within the WHPA-A, contains groundwater contamination by petroleum hydrocarbons over the standards referenced by the Technical Rules, extending off-site.

No drinking water Issues have been identified in this Wellfield as per Technical Rule 114.

Table 8.5—10: Significant Drinking Water Quality Threats in the Blair Road Wellhead Protection Areas (current to November 2023)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage system or sewage works - storm water management facility (including storm sewers)	1	WHPA-A WHPA-B WHPA-E
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	2	WHPA-B
3	Application of agricultural source material (ASM) to land	6	WHPA-E
4	Storage of agricultural source material (ASM)	6	WHPA-E
6	Application of non-agricultural source material (NASM) or biosolids to land	1	WHPA-E
7	Storage of non-agricultural source material (NASM)	1	WHPA-E
9	Storage of commercial fertilizer	1	WHPA-B
10	Application of pesticide to land	4	WHPA-E
11	Storage of a pesticide	1	WHPA-B
21	Management or handling of agricultural source material - agricultural source material (ASM) generation (yards or confinement)	1	WHPA-E
Total Number of Significant Threat Activities		**24**	
Total Number of Properties with Significant Threats		**8**	
Total Number of Significant Conditions		**1**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

Identification of Significant, Moderate and Low Drinking Water Quality Threats in the *Elgin Street Wellhead Protection Areas*

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set

out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—140** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—43 provides a summary of the threat levels possible in the Elgin Street Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. "Yes" indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; "No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—140**.

Table 8.5—11: Identification of Drinking Water Quality Threats in the Elgin Street Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Elgin Street Wellfield

The protection area for the Elgin Street Wellfield overlaps with the Middleton Street and Willard Wellfield areas. However, threat ranking results related to the Middleton Street and Willard Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

There are three Issues identified for well G9: chloride, sodium and trichloroethylene (TCE). Well G9 was not operated between December 2016 and August 2018 therefore the most recent analytical data may not be indicative of trends during consistent operation. Currently the Region of Waterloo is managing this water source using managed well operation, road salt reduction programs, a groundwater monitoring program and various groundwater protection activities to investigate potential TCE sources (ROW Protocol for Redevelopment of Potentially Contaminated Sites) and to prohibit additional sources (Regional Official Plan), as opportunities arise through the Planning Act process.

TCE

TCE and other volatile organic compounds have been monitored in the raw water from well G9 since at least 1991, however the current analytical method (higher precision analysis) started in 2001, so only the higher precision data have been considered. Since

2001 TCE has been detected in water samples at approximately 2 µg/L, compared to the ODWS of 5 µg/L (**Figure 8.5—21**).

As seen in **Figure 8.5—21**, there is no clear trend of TCE concentration over time in the raw water source. The variability in the TCE concentrations with time is expected to be the result of a combination of factors. The results likely are affected by variability in field and laboratory methods (since the concentrations of interest are less than 10 µg/L which is very low for a volatile compound such as TCE), variability associated with the groundwater flow system (the fractured bedrock aquifer flow system may be sensitive to other pumping wells or influences) and the variability in the production well operation over time. Samples showing lower levels of TCE (for example, May 2008, May 2011) correlate to time periods when the pumping from the production well was reduced. The apparent increasing trend of TCE concentration up to 3 µg/L between May 2008 and December 2009 correlates to a time period of sustained well pumping. If G9 is pumped at higher and more continuous rates in the future, this could result in higher TCE concentrations at this water source.

The source(s) of TCE to well G9 are not known; however there are some properties with Significant Conditions close to the well head protection area. It should be noted that the fractured rock aquifers in the area, like all fractured rock hydrogeologic regimes, are difficult to characterize with respect to groundwater flow and contaminant transport. As of 2018, the Region is conducting a hydrogeological investigation of the Middleton Street wellfield (which uses the same bedrock aquifer as well G9). Once the Middleton Street wellfield study is completed, the results will be used to determine the need for more monitoring locations in the G9 WHPA to investigate TCE sources.

The variable TCE impacts at production well G9 have resulted in a need to carefully manage and monitor the operation of the well; therefore the TCE impacts represent a deterioration of the water source with respect to Rule 114. As discussed in Section 3.1, this rationale for defining TCE *Issues* is consistent with Rule 114(1)a which states “the parameter is present at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water”. Under these circumstances of low level TCE impacts, there is less flexibility in utilizing the water source as even a marginal increase in TCE would result in exceeding the standard. Under these circumstances there is an obligation for more “due diligence” activities such as increased monitoring, a need to manage well operation to ensure TCE concentrations do not increase due to changes in water taking, and increased attention to source protection to prevent even minimal additional TCE contamination from additional sources. These are necessary due to the analytically small difference between the measured TCE value and the standard- only 1 to 3 µg/L- which leaves little margin of safety for the drinking water system.

Chloride and Sodium

Well G9 has shown increasing chloride concentrations since at least 1973 when Region monitoring began (**Figure 8.5—22**). Recent chloride concentrations in raw water have risen to approximately 250 mg/L. Sodium concentrations are currently at approximately 150 mg/L compared to the ODW-AO of 200 mg/L (**Figure 8.5—23**).

The Issue Contributing Area for chloride, sodium and TCE at well G9 is delineated as the 25-year time-of-travel (**Map 8.5—113**). Additional sources of TCE, chloride or sodium within this area would potentially further increase the concentrations observed at G9.

The total number of identified significant drinking water threats in this wellfield is 156. The number of properties in this Wellfield with identified significant drinking water threats is 119. Details surrounding the types of threats and circumstances found in the Elgin Street wellhead protection areas are outlined in **Table 8.5—44**.

No Significant Conditions were identified in this wellfield as per Technical Rule 126.

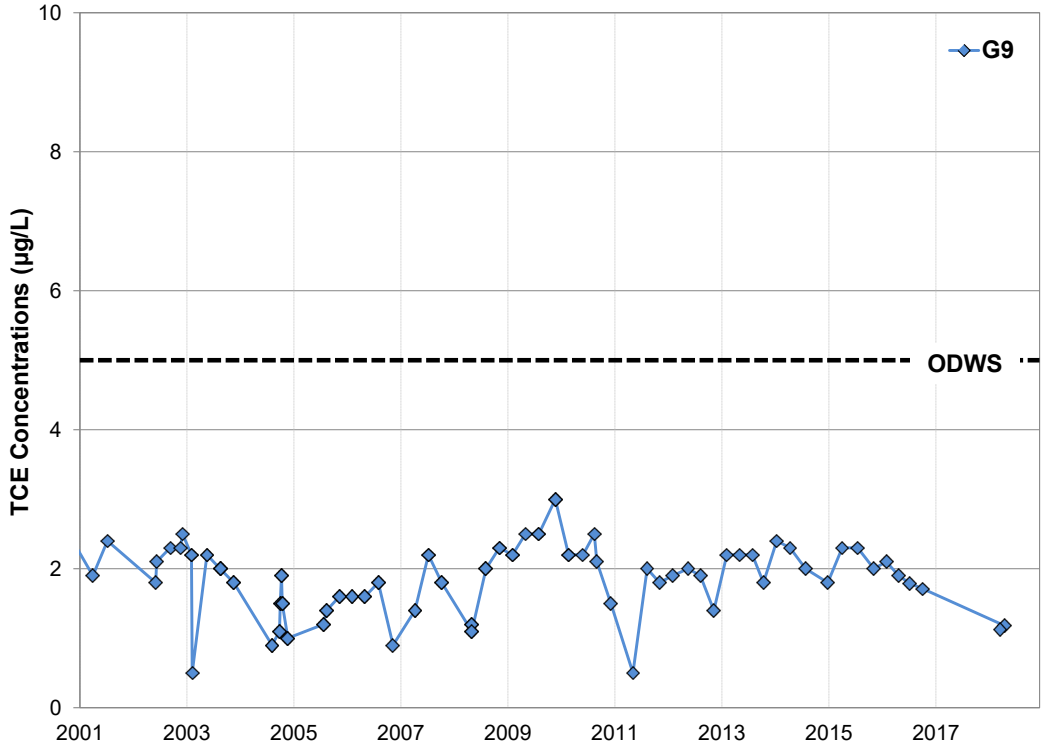


Figure 8.5—5: Trichloroethylene Trends in Raw Water at Supply Well G9, Cambridge

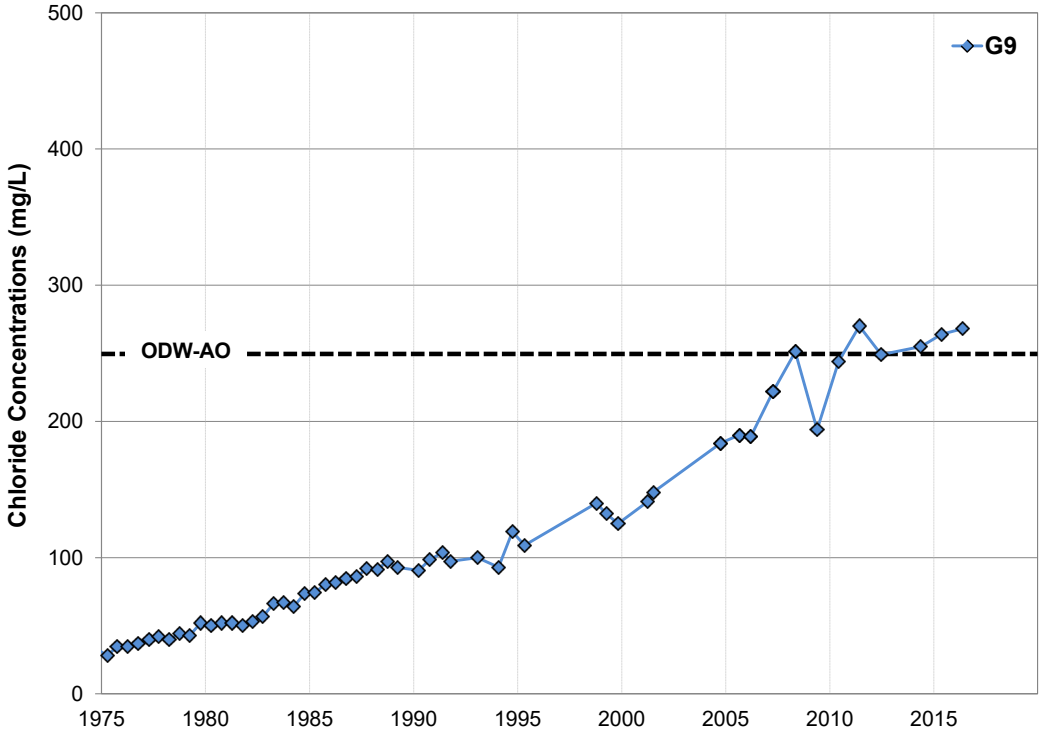


Figure 8.5—6: Chloride Concentration Trends at Well G9 Cambridge

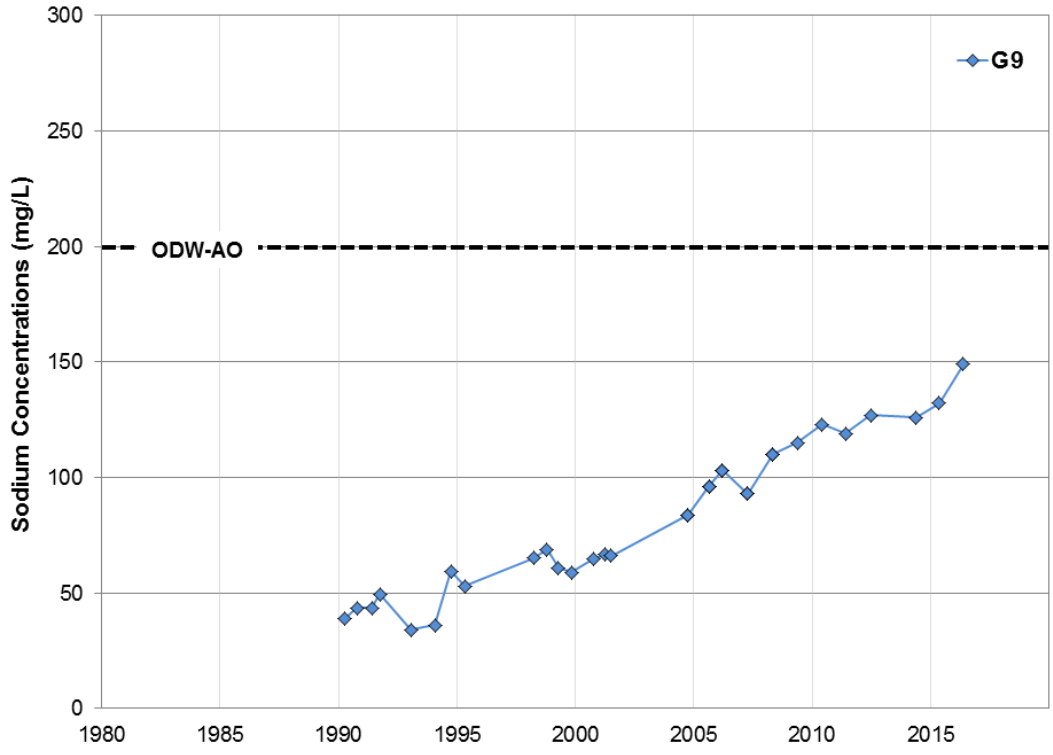


Figure 8.5—7: Sodium Concentration Trends at Well G9 Cambridge

Table 8.5—12: Significant Drinking Water Quality Threats in the Elgin Street Wellhead Protection Areas (current to February 2019)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Storage of PCB waste at any location (generating or accepting)	1	WHPA-A
	The land disposal at a waste disposal site of solid non-hazardous waste generated by industrial and commercial sources	1	ICA
	The land disposal at a waste disposal site of solid non-hazardous waste generated by municipalities (residential)	2	ICA
2	Sewage system or sewage works - industrial effluent discharges	4	ICA
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	1	WHPA-A
	Sewage system or sewage works - sewage storage - treatment or holding tanks	4	ICA
	Sewage system or sewage works - storm water management facility (including storm sewers)	9	ICA
12	Application of road salt	113	WHPA-A ICA
13	Storage of road salt	19	ICA
14	Storage of snow	2	ICA
Total Number of Significant Threat Activities		**156**	
Total Number of Properties with Significant Threats		**119**	
Total Number of Significant Conditions		**0**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Middleton Street Wellhead Protection Areas

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—140** to help the

public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—45 provides a summary of the threat levels possible in the Middleton Street Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—140**.

Table 8.5—13: Identification of Drinking Water Quality Threats in the Middleton Street Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Middleton Wellfield

The protection area for the Middleton Street Wellfield overlaps with the Blair Road, Elgin Street, Shades Mills, and Willard Wellfield areas. However, threat ranking results related to the Blair Road, Elgin Street, Shades Mills, and Willard Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

Each well in the Middleton Street wellfield is designated with a chloride, sodium, and trichloroethylene (TCE) *Issue*.

TCE

TCE and other volatile organic compounds have been monitored in the raw water at this wellfield since at least 1991; however, the current analytical method (higher precision analysis) started in 2001, so only the higher precision data have been considered (**Figure 8.5—24**). Since 2001 TCE has been detected in water samples from the five production wells at concentrations of 1 to 6 µg/L, compared to the ODWS of 5 µg/L.

TCE trends appear relatively stable over time although variations in TCE concentrations at individual production wells are affected by the pattern of pumping from all five wells at the wellfield. Currently, chemical treatment (ultra-violet oxidation) is being used to reduce the TCE concentration of the reservoir water at the Middleton Street station. The design of the TCE treatment plan has been optimized for TCE concentrations of 0 to 10 µg/L; if TCE concentrations increase at the wells then the efficiency of the TCE treatment may be compromised. Due to the elevated concentrations already present at

the production wells, TCE has been identified as an *Issue* for all the Middleton Street production wells.

Chloride and Sodium

The Middleton Street wells have shown increasing chloride and sodium concentrations since at least 1973 when Region monitoring began (**Figure 8.5—25**, **Figure 8.5—26**). Recent chloride concentrations in raw water have risen to approximately 200 to 325 mg/L, compared to the ODW-AO of 250 mg/L. Due to the current elevated concentrations of chloride and the increasing trends, chloride has been identified as an *Issue* at all five wells. The Middleton Street production wells also exhibit increasing sodium concentrations with current concentrations at approximately 150 mg/L. Linear trend analysis indicates concentrations at all wells are predicted to be above the ODW-AO of 200 mg/L in 10 years, therefore sodium has been identified as an *Issue.*

A detailed hydrogeologic study (WESA, 2013) indicates that widespread use of de-icing salt is the primary source of the elevated of chloride and sodium in groundwater at the wellfield.

Issue Contributing Area for TCE, sodium and chloride is delineated as the 25 year time-of-travel capture zone (**Map 8.5—113**). Additional sources of TCE or chloride within this area could potentially result in further concentration increases at these wells.

The total number of identified significant drinking water threats in this Wellfield is 902. The number of properties in this wellfield with identified significant drinking water threats is 683. Details surrounding the types of threats and circumstances found in the Middleton Street wellhead protection areas are outlined in **Table 8.5—46**.

Nine significant Conditions were identified in the Middleton Street wellhead protection area.

a. The site is located within the Middleton Street WHPA-B, contains groundwater contamination by NAPL and by phthalate compounds over the standards referenced by the Technical Rules, extending off-site.
b. The former petroleum storage site is located within the Middleton Street WHPA-B, contains groundwater contamination by NAPL and by petroleum compounds over the standards referenced by the Technical Rules, extending off-site.
c. The former petroleum storage site is located within the Middleton Street WHPA-B, contains groundwater contamination by petroleum compounds over the standards referenced by the Technical Rules, extending off-site.
d. The former manufacturing site is located within the Middleton Street WHPA-B and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.
e. The former manufacturing site is located within the Middleton Street WHPA-B and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.
f. The former industrial and dry cleaner site is located within the Middleton Street WHPA-B and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including

trichloroethylene over the standards referenced by the Technical Rules, extending off-site.

g. The site is located within the Middleton Street WHPA-D and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.
h. The site is located within the Middleton Street WHPA-D and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.
i. The former manufacturing site is located within the Middleton Street WHPA-C and is related to the TCE Issue Contributing Area, contains groundwater contamination by chlorinated solvent compounds including trichloroethylene over the standards referenced by the Technical Rules, extending off-site.

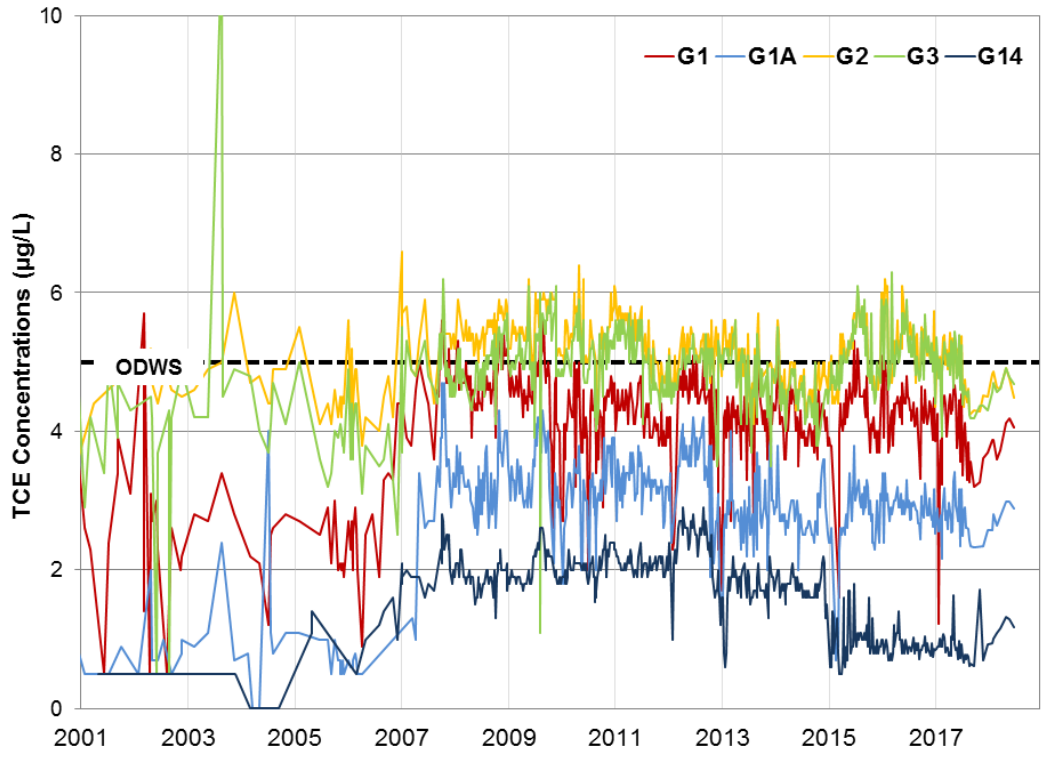


Figure 8.5—8: Trichloroethylene trends in raw water at the Middleton Street Supply Wells, Cambridge

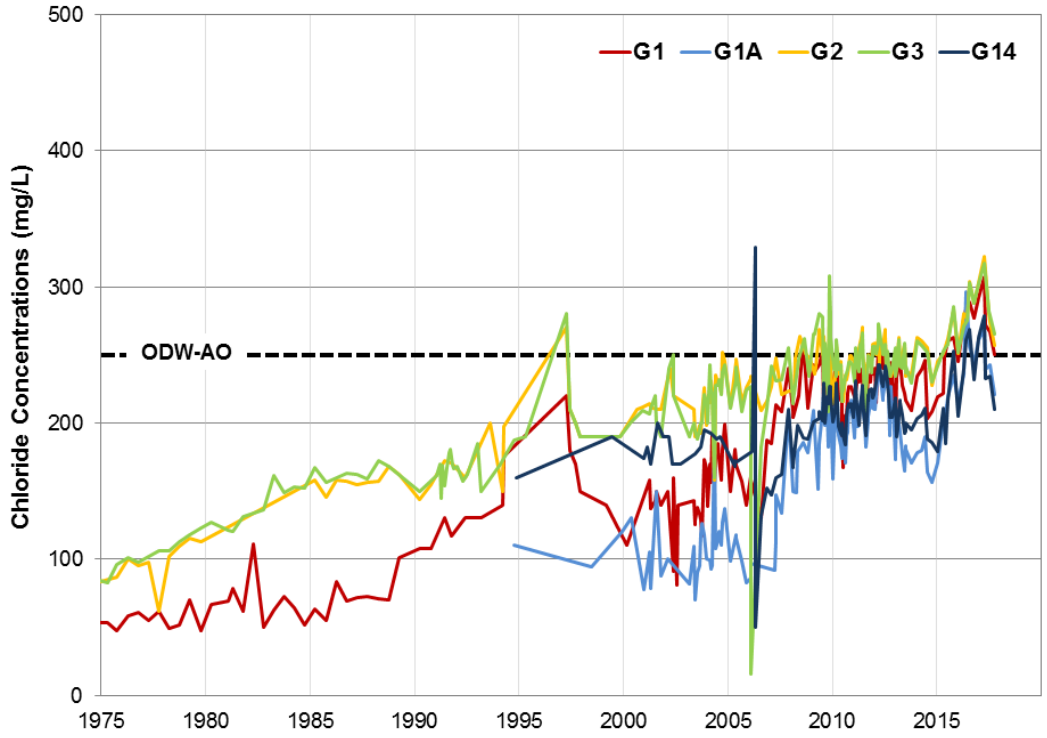


Figure 8.5—9: Chloride Trends at the Middleton Street Supply Wells, Cambridge

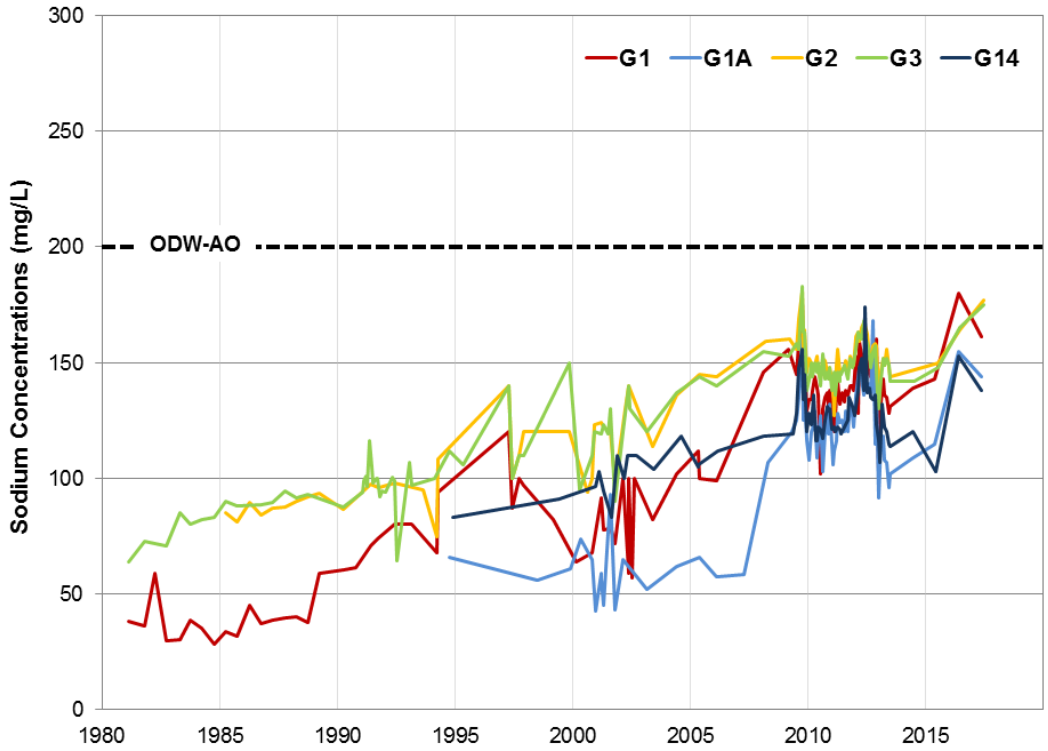


Figure 8.5—10: Sodium Trends in the Raw Water at the Middleton Street Supply Wells, Cambridge

The Middleton Street Wellfield was classified as GUDI with effective filtration based upon results of the Middleton Water Supply Study Hydrogeologic Assessment (Stantec, 2007). Although E. coli has been detected in samples from production wells G1, G2, and G3, a detailed review of the water quality data showed no correlation between precipitation intensity, duration and timing with respect to E. coli detections, or to changes in Grand River stage levels. On the basis of the shallow groundwater flow direction toward the River, interpreted groundwater discharge at the River, and the lack of conclusive evidence confirming the source of the observed contamination, it was concluded that the Middleton well system does not require surface water protection zone delineations in accordance with the Technical Rules.

Table 8.5—14: Significant Drinking Water Quality Threats in the Middleton Street Wellhead Protection Areas (current to February 2019)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
1	Storage of PCB waste at any location (generating or accepting)	1	WHPA-B
	Storage of small quantity exemptions (SQEs) of hazardous wastes or liquid industrial wastes at any type of waste disposal site including generators, receivers, and transfer/processing sites	2	WHPA-B
	The land disposal at a waste disposal site of solid non-hazardous waste generated by industrial and commercial sources	1	ICA
	The land disposal at a waste disposal site of solid non-hazardous waste generated by municipalities (residential)	2	ICA
	Waste disposal site - storage of hazardous wastes or liquid industrial wastes subject to registration and manifesting	2	WHPA-B
2	Sewage system or sewage works - combined sewer discharge from a stormwater outlet to surface water	15	ICA
	Sewage system or sewage works - industrial effluent discharges	11	ICA
	Sewage system or sewage works - onsite sewage systems	7	WHPA-B
	Sewage system or sewage works - onsite sewage systems holding tanks	4	WHPA-B
	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	9	WHPA-B

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
	Sewage system or sewage works - sewage storage - treatment or holding tanks	10	WHPA-B ICA
	Sewage system or sewage works - sewage treatment plant effluent discharges (includes lagoons)	1	WHPA-B
	Sewage system or sewage works - storm water management facility (including storm sewers)	43	WHPA-B ICA
3	Application of agricultural source material (ASM) to land	1	WHPA-B
4	Storage of agricultural source material (ASM)	1	WHPA-B
7	Storage of non-agricultural source material (NASM)	1	WHPA-B
9	Storage of commercial fertilizer	1	WHPA-B
10	Application of pesticide to land	2	WHPA-B
11	Storage of a pesticide	3	WHPA-B
12	Application of road salt	639	WHPA-A WHPA-B ICA
13	Storage of road salt	131	ICA
14	Storage of snow	4	WHPA-B ICA
15	Storage and handling of fuel	7	WHPA-B
16	Storage and handling of a dense non aqueous phase liquid (DNAPL)	2	WHPA-B ICA
17	Storage of an organic solvent	2	WHPA-B
Total Number of Significant Threat Activities		**902**	
Total Number of Properties with Significant Threats		**683**	
Total Number of Significant Conditions		**9**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

Willard Wellfield

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information

above can be used with the vulnerability scores shown in **Map 8.5—140** and **Map 8.5—142** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—47 provides a summary of the threat levels possible in the Willard Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—140** and **Map 8.5—142.**

Table 8.5—15: Identification of Drinking Water Quality Threats in the Willard Wellhead Protection Areas

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A/B	10	Yes	Yes	Yes
Chemicals	WHPA-B/C	8	Yes	Yes	Yes
Chemicals	WHPA-B/C/D	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
Chemicals	WHPA-E	8.1	Yes	Yes	Yes
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	6	No	Yes	Yes
DNAPLs	WHPA-D	2 & 4	No	No	No
DNAPLs	WHPA-E	8.1	No	Yes	Yes
Pathogens	WHPA-A/B	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes
Pathogens	WHPA-E	8.1	Yes	Yes	Yes

Threats and Issues Enumeration for the Willard Wellfield

The protection area for the Willard Wellfield overlaps with the Blair Road, Clemens Mill, Elgin Street, Middleton Street, and Shades Mills Wellfield areas. However, threat ranking results related to the Blair Road, Clemens Mill, Elgin Street, Middleton Street, and Shades Mills Wellfields are presented in **Section 8.5 – Cambridge Area Wellfields.**

The total number of identified significant drinking water threats in this wellfield is 48. The number of properties in this Wellfield with identified significant drinking water threats is 37. Details surrounding the types of threats and circumstances found in the Willard wellhead protection areas are outlined in **Table 8.5—48**.

No Significant Conditions were identified in this wellfield as per Technical Rule 126.

No drinking water Issues have been identified in this wellfield as per Technical Rule 114.

Table 8.5—16: Significant Drinking Water Quality Threats in the Willard Wellhead Protection Areas (current to February 2019)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage system or sewage works - onsite sewage systems	7	WHPA-B
	Sewage system or sewage works - onsite sewage systems holding tanks	4	WHPA-B
	Sewage system or sewage works - combined sewer discharge from a storm water outlet to surface water	15	WHPA-E
	Sewage system or sewage works - industrial effluent discharges	1	WHPA-E
	Sewage system or sewage works - sewage treatment plant effluent discharges (includes lagoons)	1	WHPA-E
	Sewage system or sewage works - storm water management facility (including storm sewers)	5	WHPA-B WHPA-E
3	Application of agricultural source material (ASM) to land	6	WHPA-E
4	Storage of agricultural source material (ASM)	6	WHPA-E
7	Storage of non-agricultural source material (NASM)	1	WHPA-E
10	Application of pesticide to land	1	WHPA-E
12	Application of road salt	1	WHPA-A
Total Number of Significant Threat Activities		**48**	
Total Number of Properties with Significant Threats		**37**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.

8.5.4 Fountain Street Wellfield

Fountain Street Wellfield

The water supply for the Fountain Street Wellfield is obtained from production well P16 and supplies water to the IUS (**Table 8—1**). A Class Environmental Assessment was completed in 2014 for the addition of a new well on Maple Grove Rd. (P18) to the Fountain Street Wellfield (MTE, 2014). Production well P16 is screened from approximately 33 m to 38 m below grade, while P18 is screened from approximately 43 to 53 m below grade. Both wells are screened within the Pre-Catfish Creek Aquifer (AFD1), which overlies bedrock. The aquifer is overlain by a thick sequence of aquitard material including the Port Stanley, Lower Maryhill and Catfish Creek Tills.

Map 8.5—152 presents the Wellhead Protection Areas A to D for the Fountain Street Wellfield.

Vulnerability and Transport Pathways

The unadjusted intrinsic vulnerability is shown on **Map 8.5—153** and the adjusted intrinsic vulnerability is shown on **Map 8.5—154.**

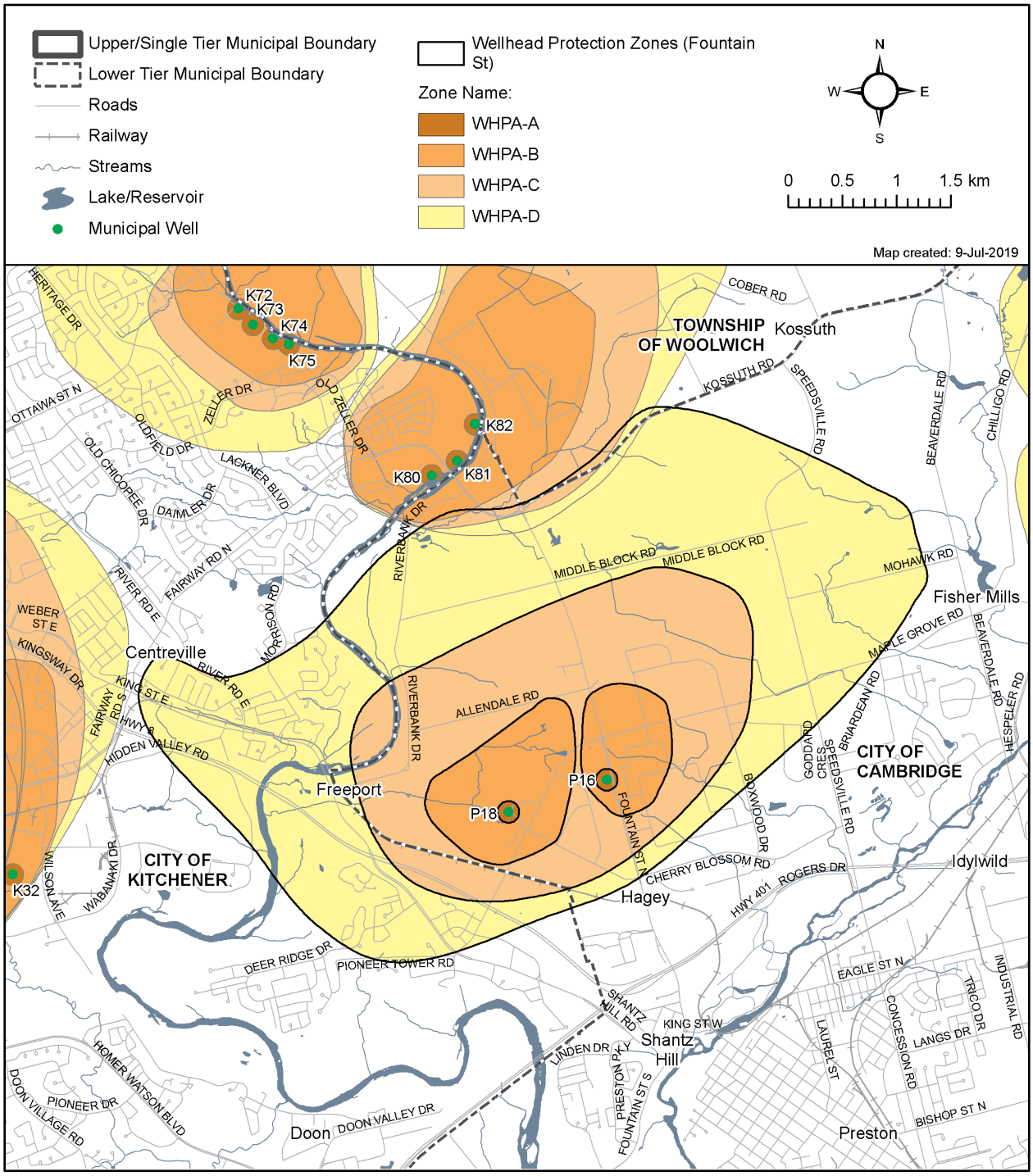
Analysis of the attributes of each potential transport pathway in the Fountain Street WHPA resulted in the identification of several clusters of wells, septics and underground services within the WHPA-B through WHPA-D warranting an increase to the ISI. **Map 8.5—155** and **Map 8.5—156** show these transport pathways and their associated area of influence, while **Map 8.5—157** shows the final vulnerability scoring.

Percent Managed Land, Livestock Density, Salt Loading Potential and Percent Impervious Surface

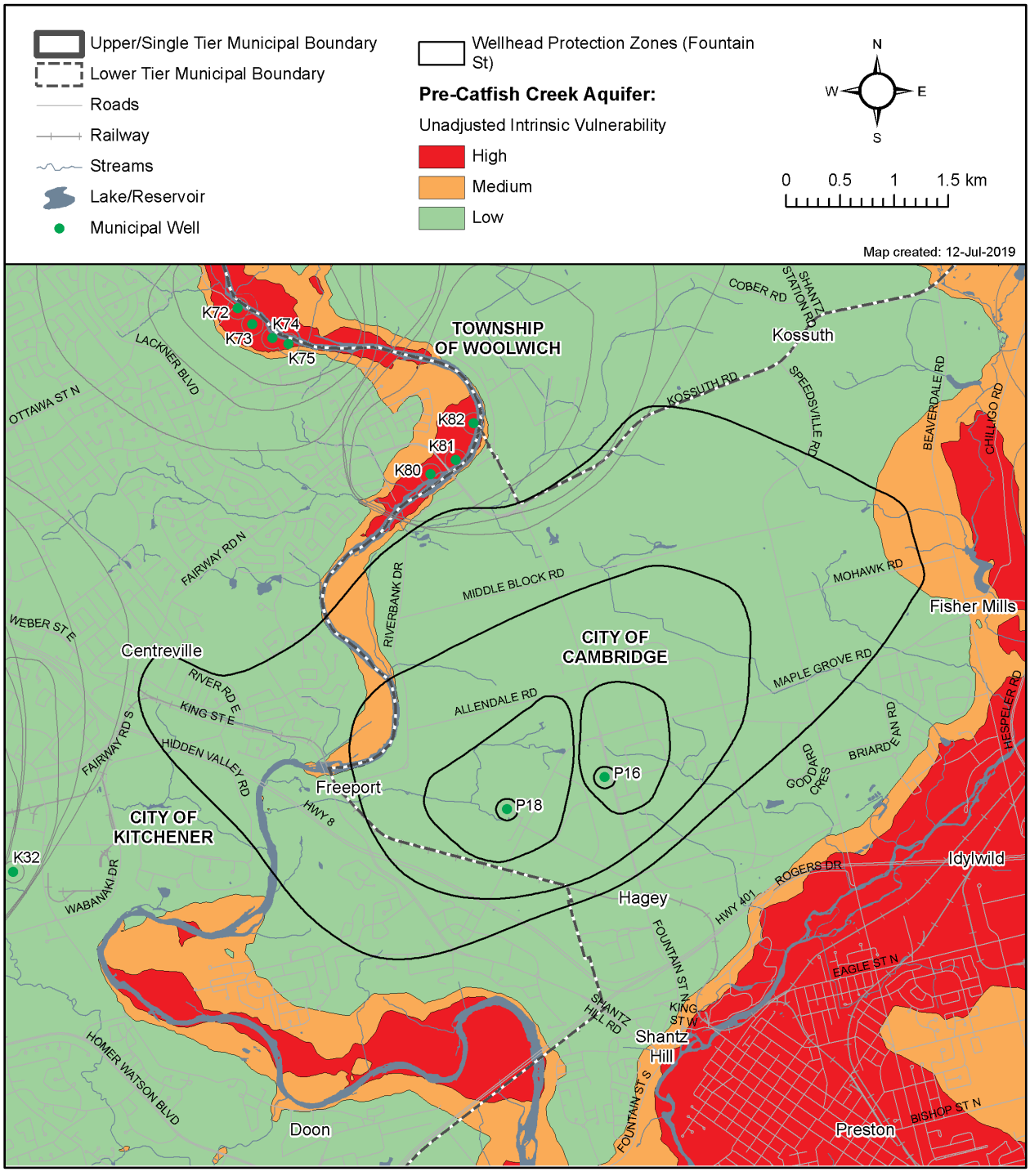
The calculations for determining the percent managed land, livestock density, salt loading potential and corresponding percent impervious surface for the Fountain Street Wellfield followed the methods outlined in **Section 8.1 – Water Quality Risk Assessment**.

Map 8.5—158, Map 8.5—159 and **Map 8.5—160** present the percent managed lands, livestock density and percent impervious surface for the Fountain Street Wellfield, respectively.

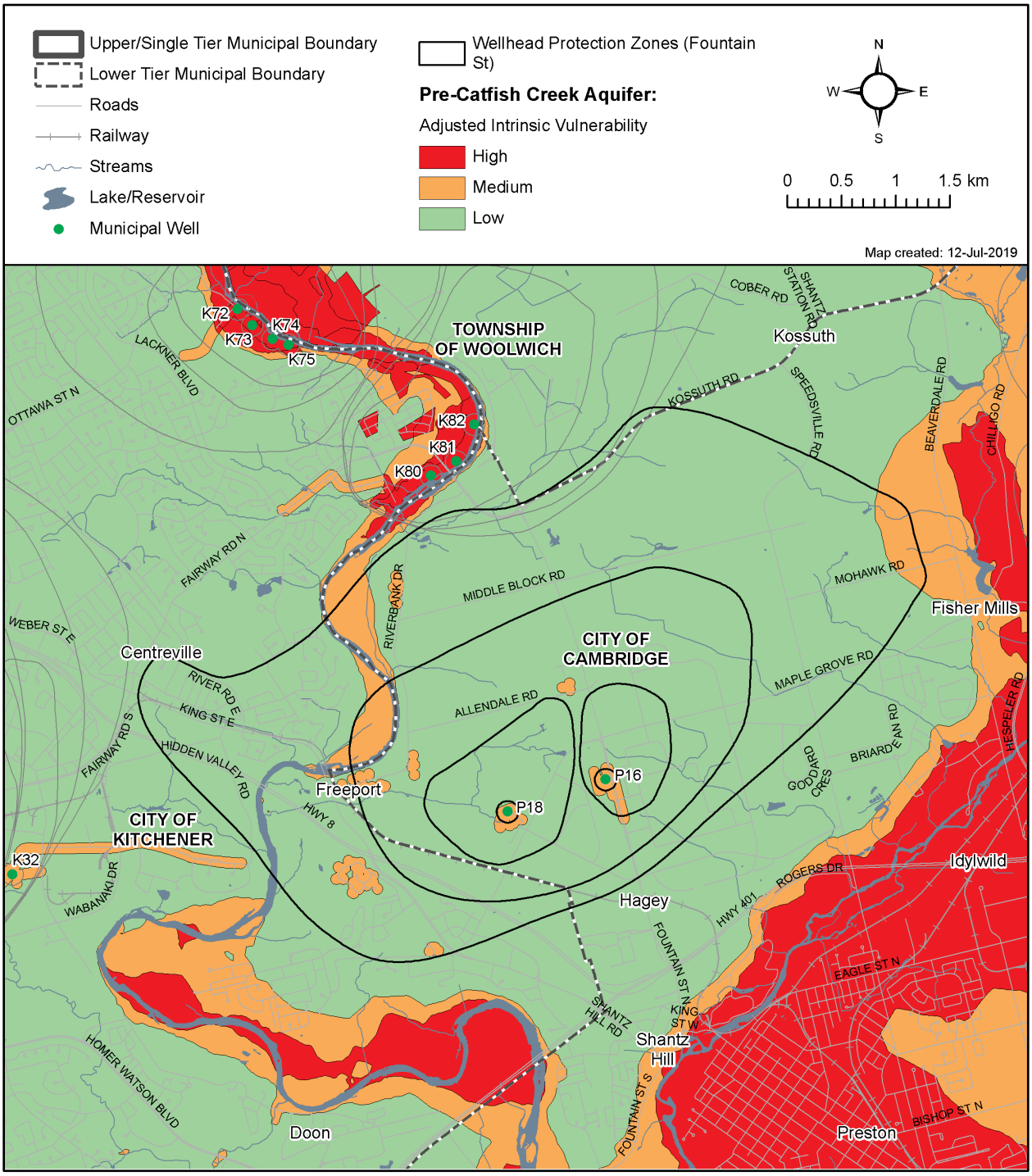
Map 8.5—44: Cambridge Area Inset 4: Fountain Street Well Supply Wellhead Protection Areas



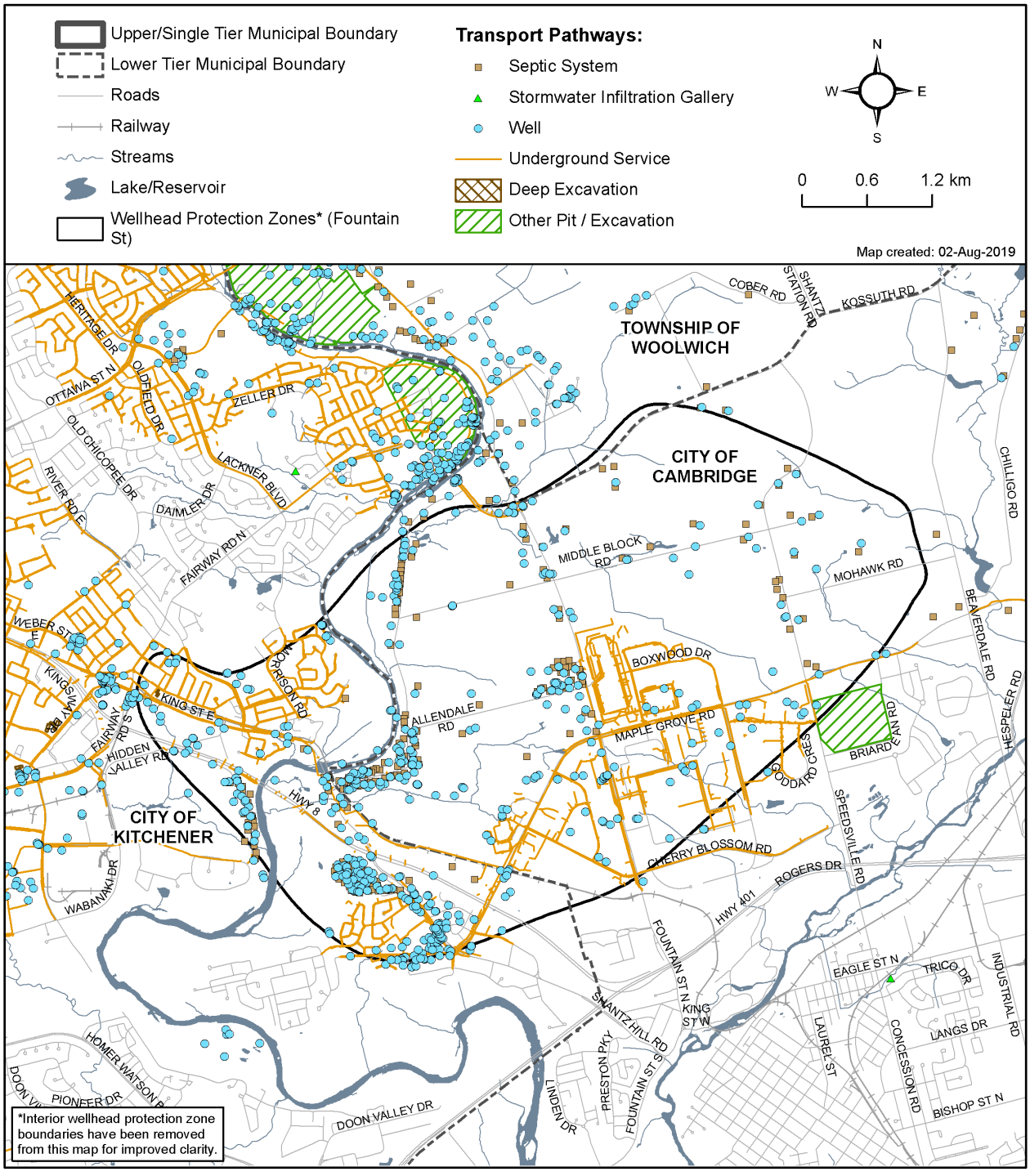
Map 8.5—45: Cambridge Area Inset 4: Fountain Street Well Supply Wellhead Protection Area Unadjusted Intrinsic Vulnerability



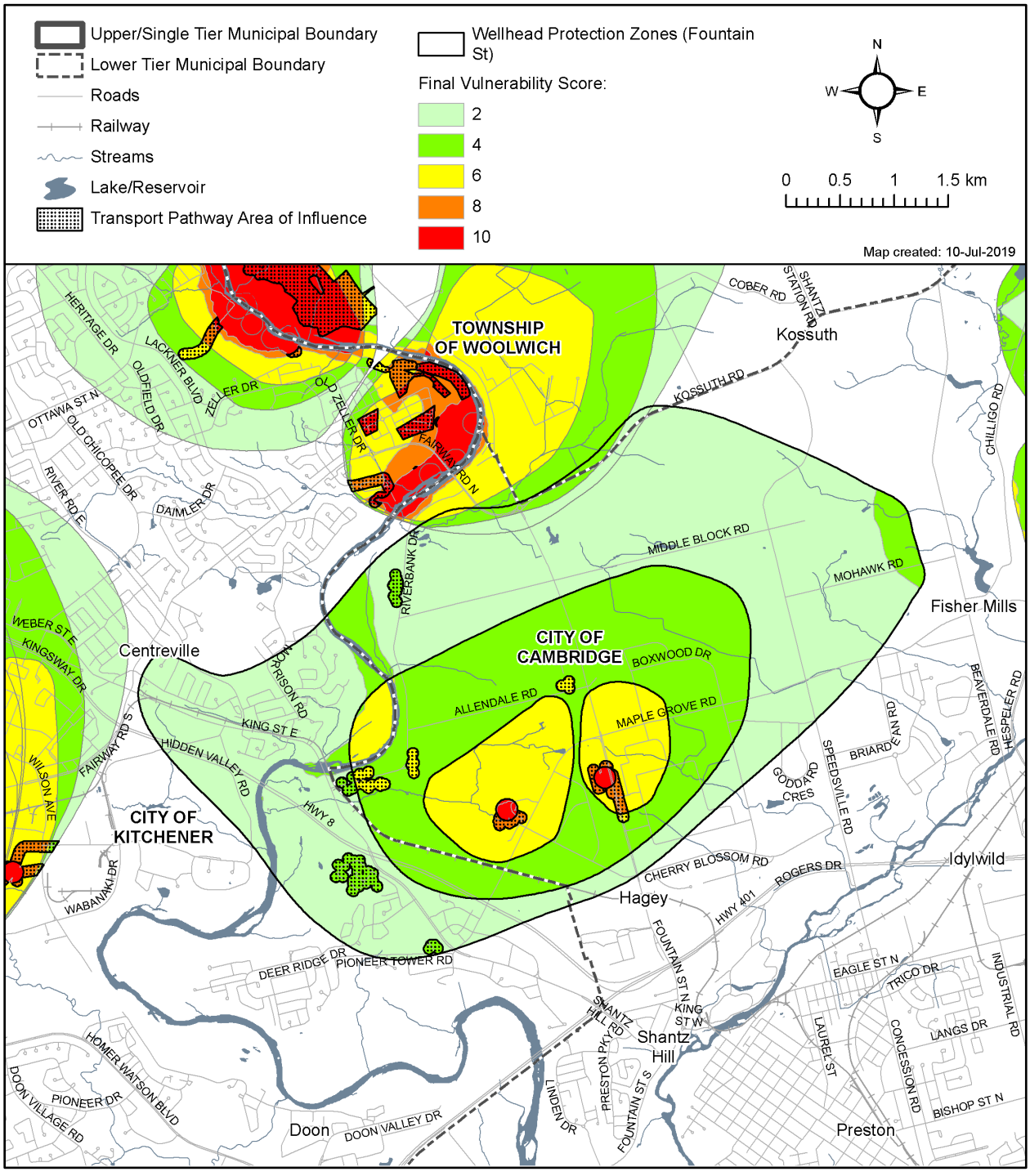
Map 8.5—46: Cambridge Area Inset 4: Fountain Street Well Supply Wellhead Protection Area Adjusted Intrinsic Vulnerability



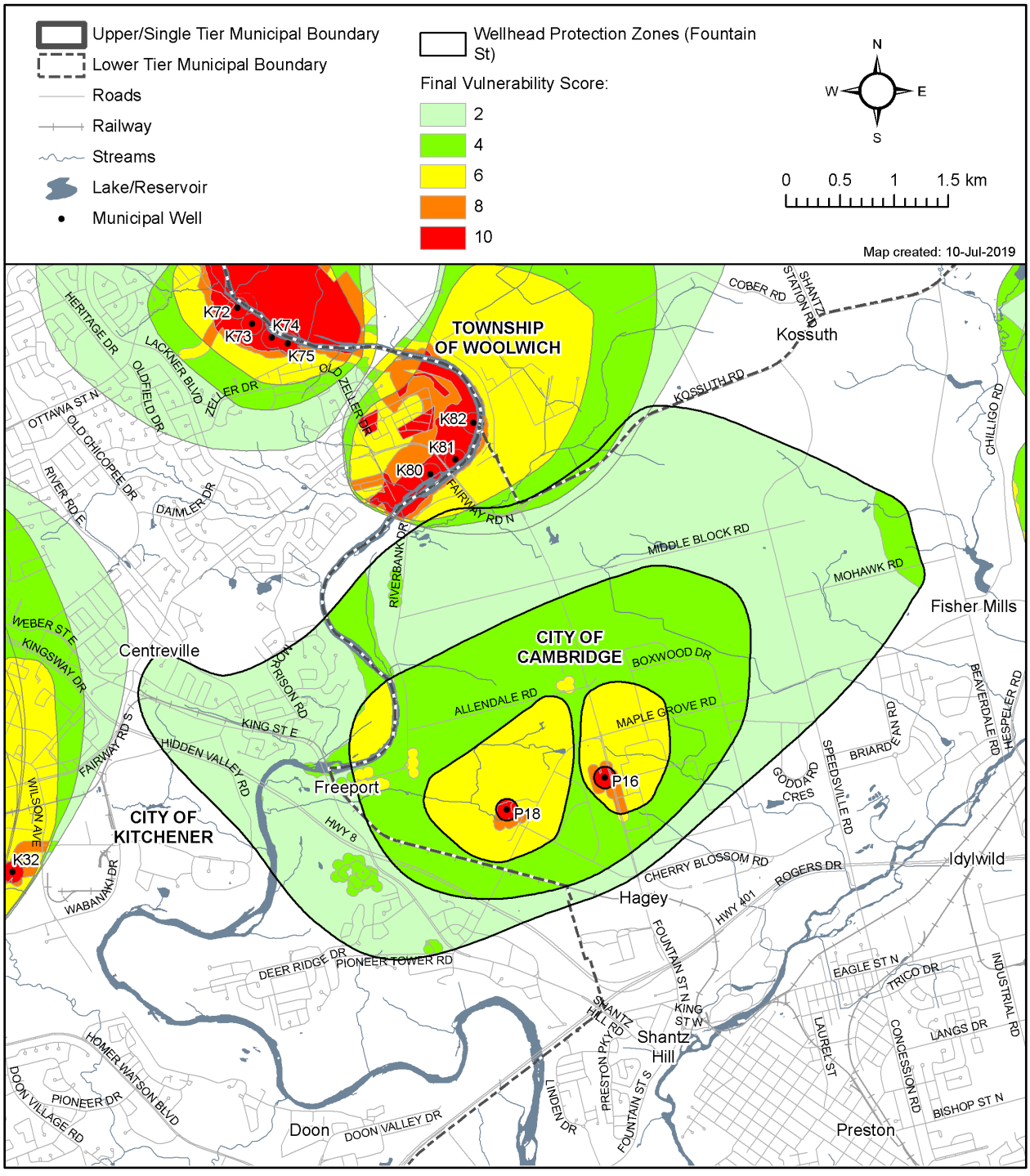
Map 8.5—47: Cambridge Area Inset 4: Fountain Street Well Supply Transport Pathways



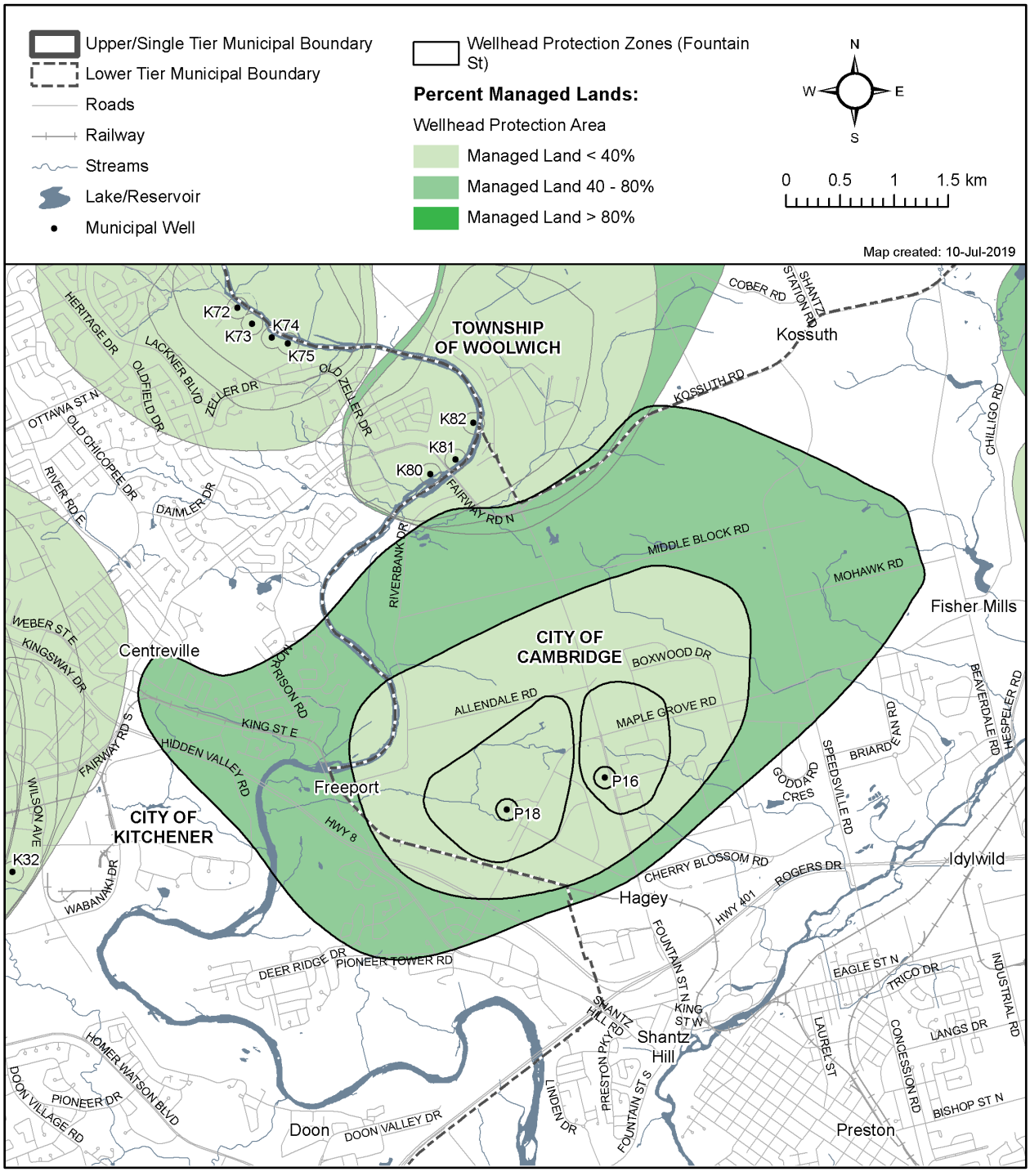
Map 8.5—48: Cambridge Area Inset 4: Fountain Street Well Supply Transport Pathways Area of Influence



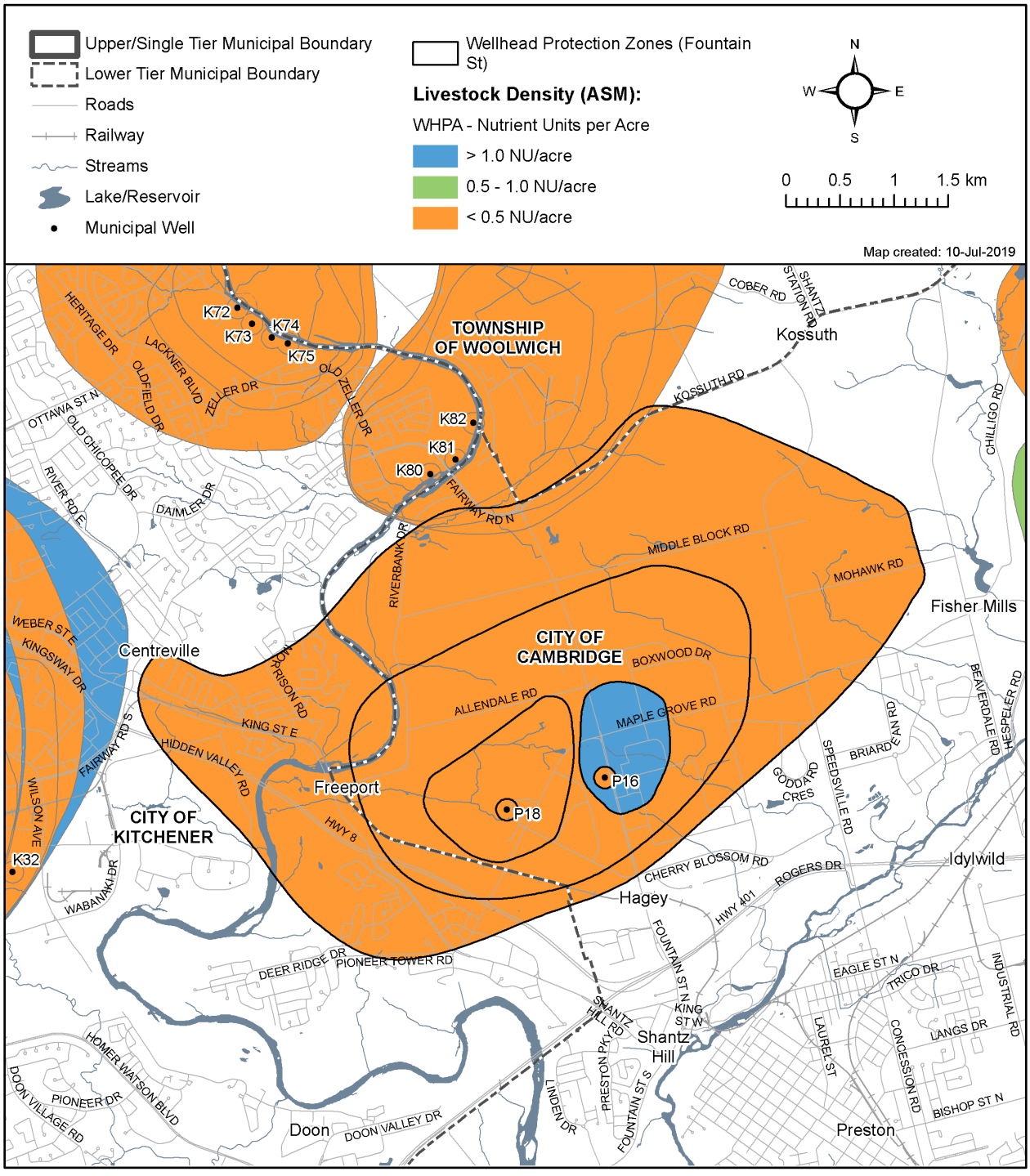
Map 8.5—49: Cambridge Area Inset 4: Fountain Street Well Supply Wellhead Protection Area Final Vulnerability



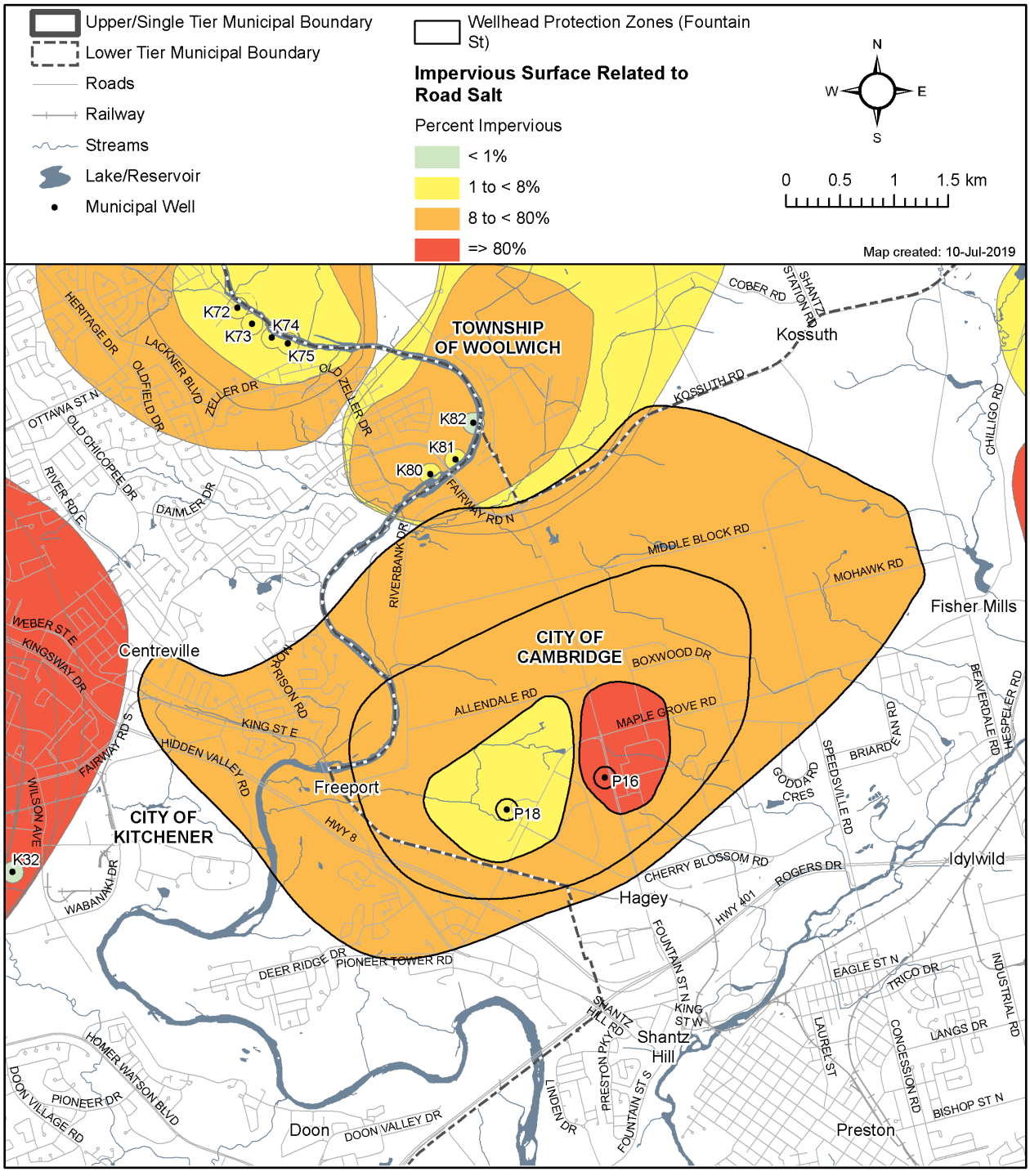
Map 8.5—50: Cambridge Area Inset 4: Fountain Street Well Supply Percent Managed Lands



Map 8.5—51: Cambridge Area Inset 4: Fountain Street Well Supply Percent Livestock Density



Map 8.5—52: Cambridge Area Inset 4: Fountain Street Well Supply Percent Impervious Surfaces



Identification of Significant, Moderate and Low Drinking Water Quality Threats in the Fountain Street and Willard Wellhead Protection Areas

Fountain Street Wellfield

The identification of a land use activity as a significant, moderate, or low drinking water threat depends on its risk score, determined by considering the circumstances of the activity and the type and vulnerability score of any underlying protection zones, as set out in the Tables of Drinking Water Threats. Information on drinking water threats is also accessible through the Source Water Protection Information Portal. The information above can be used with the vulnerability scores shown in **Map 8.5—157** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 8.5—49 provides a summary of the threat levels possible in the Fountain Street Wellfield for Chemicals, Dense Non-Aqueous Phase Liquids (DNAPLs), and Pathogens. “Yes” indicates that the threat classification level is possible for the indicated threat type under the corresponding vulnerable area / vulnerable score; “No" indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 8.5—157**.

Table 8.5—17 Identification of Drinking Water Quality Threats in Fountain Street Wellhead Protection Area

Threat Type	Vulnerable Area	Vulnerability Score	Significant Threats	Moderate Threats	Low Threats
Chemicals	WHPA-A	10	Yes	Yes	Yes
Chemicals	WHPA-B	8	Yes	Yes	Yes
Chemicals	WHPA-B/C	6	No	Yes	Yes
Chemicals	WHPA-C/D	2 & 4	No	No	No
DNAPLs	WHPA-A/B/C	Any Score	Yes	No	No
DNAPLs	WHPA-D	2 & 4	No	No	No
Pathogens	WHPA-A	10	Yes	Yes	No
Pathogens	WHPA-B	8	No	Yes	Yes
Pathogens	WHPA-B	6	No	No	Yes

Threats and Issues Enumeration for the Fountain Street Wellfield

The protection area for the Fountain Street Wellfield overlaps with the Woolner Wellfield areas. However, threat ranking results related to the Woolner Wellfield are presented in **Section 8.3 – Kitchener Area Wellfields.**

The total number of identified significant drinking water threats in this wellfield is 17. The number of properties in this Wellfield with identified significant drinking water threats is 8. Details surrounding the types of threats and circumstances found in the Fountain Street wellhead protection areas are outlined in **Table 8.5—50**.

No Significant Conditions were identified in this wellfield as per Technical Rule 126.

No drinking water Issues have been identified in this wellfield as per Technical Rule 114.

Table 8.5—18: Significant Drinking Water Quality Threats in the Fountain Street Wellhead Protection Areas (current to February 2019)

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage system or sewage works - sanitary sewers and related wastewater collection systems	1	WHPA-A
	Sewage system or sewage works - storm water management facility (including storm sewers)	1	WHPA-A
10	Application of pesticide to land	2	WHPA-A
12	Application of road salt	6	WHPA-A
15	Storage and handling of fuel	3	WHPA-A
16	Storage and handling of a dense non aqueous phase liquid (DNAPL)	2	WHPA-B WHPA-C
17	Storage of an organic solvent	2	WHPA-A
Total Number of Significant Threat Activities		**17**	
Total Number of Properties with Significant Threats		**8**	

[1] Prescribed Drinking Water Quality Threat Number refers to the prescribed drinking water threat listed in O. Reg. 287/07 s.1.1 (1)

[2] Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.