TABLE OF CONTENTS

LIST OF MAPS

LIST OF TABLES

14.0 CITY OF BRANTFORD

14.1 Brantford Water Treatment Plant

The City of Brantford Water Treatment Plant (WTP) is an existing large municipal residential drinking water system, and as such is a Type I system as defined by the Technical Rules (November 2009) (**Table 14-1**). The serviced areas are presented on

Map 14-1.

Table 14-1: Drinking Water System Information for the Holmedale Water Treatment Plant

DWS Number	DWS Name	Operating Authority	GW or SW	System Classification[1]	Number of Users Served
220003564	Brantford Water Treatment Plant	OCWA	SW	Large Municipal Residential	99,000

[1] as defined by O. Reg. 170/03 (Drinking Water Systems) made under the *Safe Drinking Water Act, 2002.*

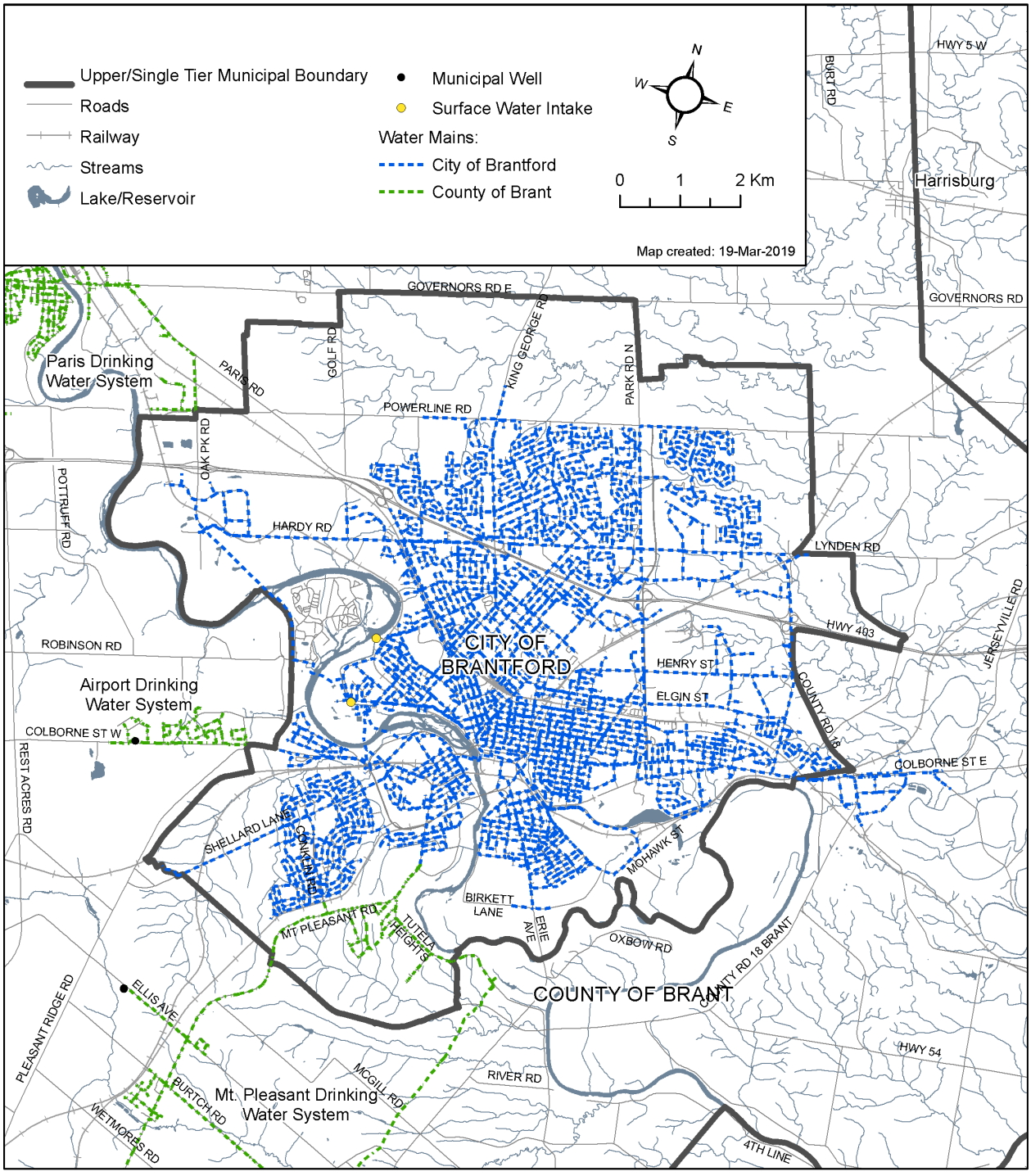
The Corporation of the City of Brantford owns and operates the City of Brantford water system, which consists of one water treatment plant (WTP) and one water distribution system. The WTP is a Class IV facility with a capacity of 100ML/d, and is staffed 24 hours a day, 7 days a week. Treatment processes consist of screening, coagulation, sand-ballasted flocculation, sedimentation, ozonation, biological filtration, UV irradiation, chlorination, chloramination and fluoridation. A Supervisory Control and Data Acquisition (SCADA) system is used for monitoring and recording various treatment process data throughout the plant and the distribution system. The water distribution system is a Class III system, with three reservoirs and pumping stations, one stand alone pumping station and two elevated tanks. The water system supplies drinking water to approximately 99,000 people in the City of Brantford and the town of Cainsville in the County of Brant. **Table 14-2** provides a summary of annual and monthly average flows for the City of Brantford WTP in cubic metres per day.

Table 14-2: Annual and Monthly Average Pumping Rates for the Holmedale Water Treatment Plant (m^3/day)

Annual Avg.	Jan Avg.	Feb Avg.	Mar Avg.	Apr Avg.	May Avg.	June Avg.	July Avg.	Aug Avg.	Sept Avg.	Oct Avg.	Nov Avg.	Dec Avg.
31,446	29,183	28,807	28,203	28,662	31,586	36,987	35,837	34,719	34,079	30,779	29,263	29,251

[1] Source: 2017 data from City of Brantford Drinking Water System 2017 Annual Summary Report

Map 14-1: Holmedale Water Treatment Plant Serviced Areas



The City of Brantford draws raw water from the Grand River through the Holmedale Canal. The inlet of the canal is located immediately upstream of a small run-of-the-river hydraulic structure or overflow weir referred to as Wilkes Dam. The weir creates a backwater area approximately 1.5 to 2 m deep and serves to direct flow from the Grand River into the canal. There is a control structure at the inlet of the canal that allows the City of Brantford to manually isolate the canal from the river, if necessary.

Although Wilkes Dam creates a backwater condition and therefore reduces the velocity of the stream in the vicinity of the weir, the change in velocity is small. The intake is considered a Type C river intake due to the fact that the area upstream of the weir maintains riverine characteristics. There is constant flow in the downstream direction hence the direction of the flow does not change. As well, the change in velocity is small enough that it does not significantly influence the flow characteristics of the river and therefore does not warrant a change to a Type D intake. The weir is not large enough to create a significant impoundment or reservoir, which would behave more like a lake and justify a Type D classification. The Type D classification would create a much larger IPZ-1, which is not justified for this intake. For these reasons, a request was made under Technical Rule 55.1 to have this intake classified as Type C. **Appendix B** provides a copy of the notice from the Director classifying the City of Brantford intake as Type C.

For the purpose of source protection planning, the entire length of the Holmedale Canal was considered to be part of the intake structure and therefore part of the Intake Protection Zone 1 (**Map 14-2 and Map 14-3**).

The vulnerability assessment, threats assessment and Issues identification is based on the following reports:

- R.V. Anderson. City of Brantford, Intake Protection Zones Study. Draft Surface Vulnerability Report. June 11, 2010.
- R.V. Anderson. City of Brantford, Intake Protection Zones Study. Draft Drinking Water Issues and Threats Report. June 28, 2010.

15.1.1 Intake Protection Zone - 1

Rule 61(1)(3) defines IPZ-1 as an area with a 200 m radius semi-circle extending upstream from the center point of the intake and a rectangle with the length of 400m and width of 10 m extending downstream from the centre point. Due to the unique intake structure, the following refinements were made to the IPZ-1, as shown in **Map 14-2 and Map 14-3**:

- A 120 m buffer was drawn on either side of the Canal where it abuts land (as per Rule 62), as the Canal does not have a Regulation Limit associated with it.
- IPZ-1 at the intake to Wilkes Dam was developed using a 200 m radius semi-circle, and a 120 m buffer where it abuts land (Rule 61).
- A portion of this semi-circle was removed because the overland flow in parts of the western portion of the Brant Conservation Area drains into a channel that flows to the Grand River downstream of Wilkes Dam. Further, the IPZ-1 was slightly modified on the west-bank of the Grand River to only include a 120 m buffer given the extensive floodplain in this area. The inclusion of the land within the Regulation limit would be substantive and include lands that naturally drain to the river downstream of Wilkes Dam. Further, the areas within the Regulation Limit are outside the direct and immediate impact zone which the IPZ-1 represents. The exclusion of the Regulation Limit from the delineation of IPZ-1 is a departure of the Technical Rules. As per Technical Rule 15.1, the Director has provided confirmation that he agrees to this modification in the IPZ-1. The Director's letter of confirmation can be found in **Appendix B**.

- As per Rule 64 the 400 m by 10 m area downstream of Wilkes Dam was not included in IPZ-1as there is a hydraulic drop over Wilkes Dam (i.e. the river flows over the dam).

15.1.2 Intake Protection Zone - 2

IPZ-2 was delineated based upon response time, dye tracer studies, and refinement of surrounding areas based on Rule 65 of the Technical Rules.

The response time to a spill event was determined to be 6 hours and therefore, the delineation of the IPZ-2 incorporated the extent upstream for a 6-hour time of travel. The scenario of a raw sewage spill from a blocked sanitary trunk main was chosen for calculating the response time and is broken out into three steps:

1. Identify and assess the adverse condition affecting the source water and develop a strategy to protect the drinking water supply. This is estimated to be 1.5 hours.
2. Fill water storage reservoirs. This step is estimated to be 4 hours based on the required storage capacity, the available storage volume, and the required time to fill the reservoirs.
3. Close the gates to the Holmedale Canal at Wilkes Dam. This step is estimated to take 0.5 hours.

Two dye tracer studies were used to determine the travel time of the Grand River upstream of the WTP. The first dye tracer study was completed in 2004 by XCG from the Highway 403 overpass to Wilkes Dam. The second dye tracer study was conducted by RVA in 2006 from Bean Park in Paris to the Highway 403 overpass. The results of these dye tracer tests were then used to calibrate the hydraulic model, Hydraulic Engineering Center – River Analysis System (HEC-RAS 3.1.3), developed by the US Army Corps of Engineers. The model was used to provide travel times under various flow conditions.

Although bank-full or 95th percentile flows were originally suggested by the Ministry for the delineation of IPZ-2, the 95th percentile flows were not used for the City of Brantford's intake as the study team felt that these high flows would not be a concern for spills into surface water in a seventh-order river - the intent of delineating an IPZ-2 - as there would be sufficient dilution. Further, the water quality in the river during these high flows events is primarily driven by the substantive cumulative inputs from both point and nonpoint sources from the entire upstream watershed thus delineating an IPZ-2 using these flows would not yield any meaningful source protection planning limits within which to manage threats. Further, the City of Brantford is notified by the Grand River Conservation Authority if flows exceed 300 cubic metres per second (cms) so that the gates to the Holmedale canal can be closed due to flood concerns. Consequently, very high river flows are not used as a supply for their drinking water treatment plant. Given these considerations, the study team felt that a lower river flow that characterized the general late-spring, summer and early-fall conditions was more appropriate for source protection planning purposes.

A flow that is less than bank-full was selected to be used to delineate the extent of the IPZ-2 as the intent of the IPZ-2 for source protection planning purposes is for the timely response to spills and bypasses that may impair source water quality. The 70th percentile flow of 56.8 m^3/s was selected as the flow that represents typical late spring, summer and early fall river flow conditions that require emergency response planning in the event of a spill or bypass. Further, the study team felt that lower river flows do not have as much capacity for diluting significant spill events as larger flows do. Although the nature (i.e. one-time versus continuous release of a pollutant) and composition (e.g. chemical like gasoline or bacteria in sewage etc) of a particular spill ultimately determines its ability to be diluted within a river, these aspects were not considered when

determining an appropriate river flow to delineate the IPZ-2 as these considerations fell outside the Technical Rules. The study team felt that the 70th percentile flows and 6 hour response time was sufficient for source protection planning purposes for the City of Brantford's intake. All of these considerations resulted in an IPZ-2 that extended 11.6 km upstream of Wilkes Dam.

The following areas were also included in IPZ-2 as these areas drain lands where contaminants could reach the river within the 6 hour travel time through creeks, streams, or sewers:

- *Grand River* – A 120m buffer was drawn on either side of the Grand River and overlaid with the Regulation Limit. The greater area of the 120 m buffer area and the Regulation Limit was used to delineate IPZ-2 adjacent to the River.

- *Eastern Portion* – This area was delineated using storm sewer sheds that discharge into the Grand River upstream of the intake and an estimated maximum flow velocity in storm sewers for a 5-year event of 6.0 m/s. It was found that the entire storm sewers are within the 6 hour time of travel

- *Northwest Industrial Area* –The Stormwater Management Report for the Northwest Business Park Phase 2 identifies existing infiltration basins and ponds that can provide stormwater treatment. However, during major storm events the basins and ponds can overflow and runoff can make its way to the Grand River, where the flow path was determined using a digital terrain model (DTM). Therefore, this area was included in the IPZ-2.

- *The Brantford Airport* – This parcel of land was also included in IPZ-2 as the Regulation Limit includes a small creek that drains the eastern end of the Airport. After a review of the contour mapping of the area, the entire Airport parcel was included in the IPZ-2.

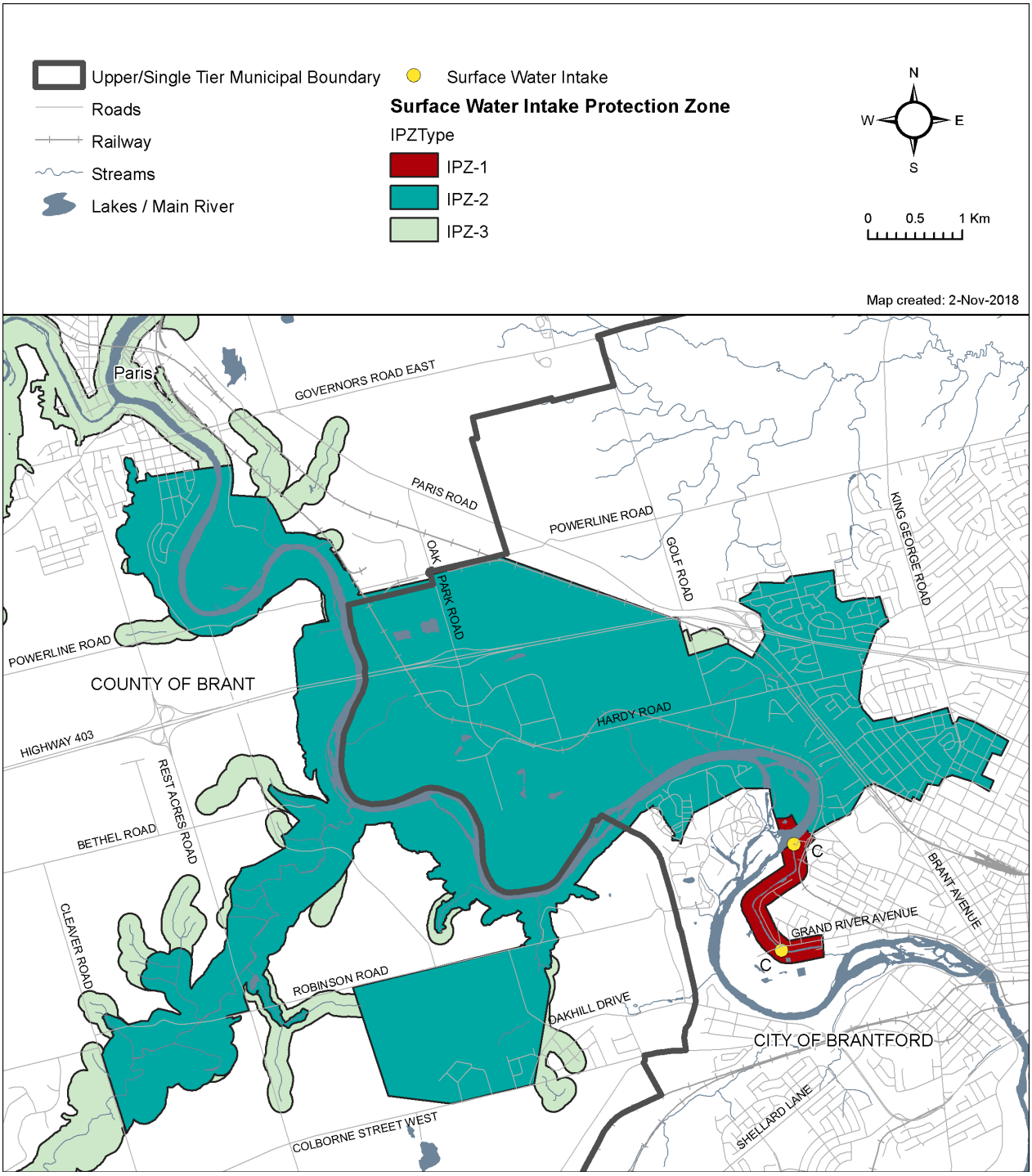
See **Map 14-2** for the IPZ-2 for the City of Brantford WTP intake.

15.1.3 Intake Protection Zone - 3

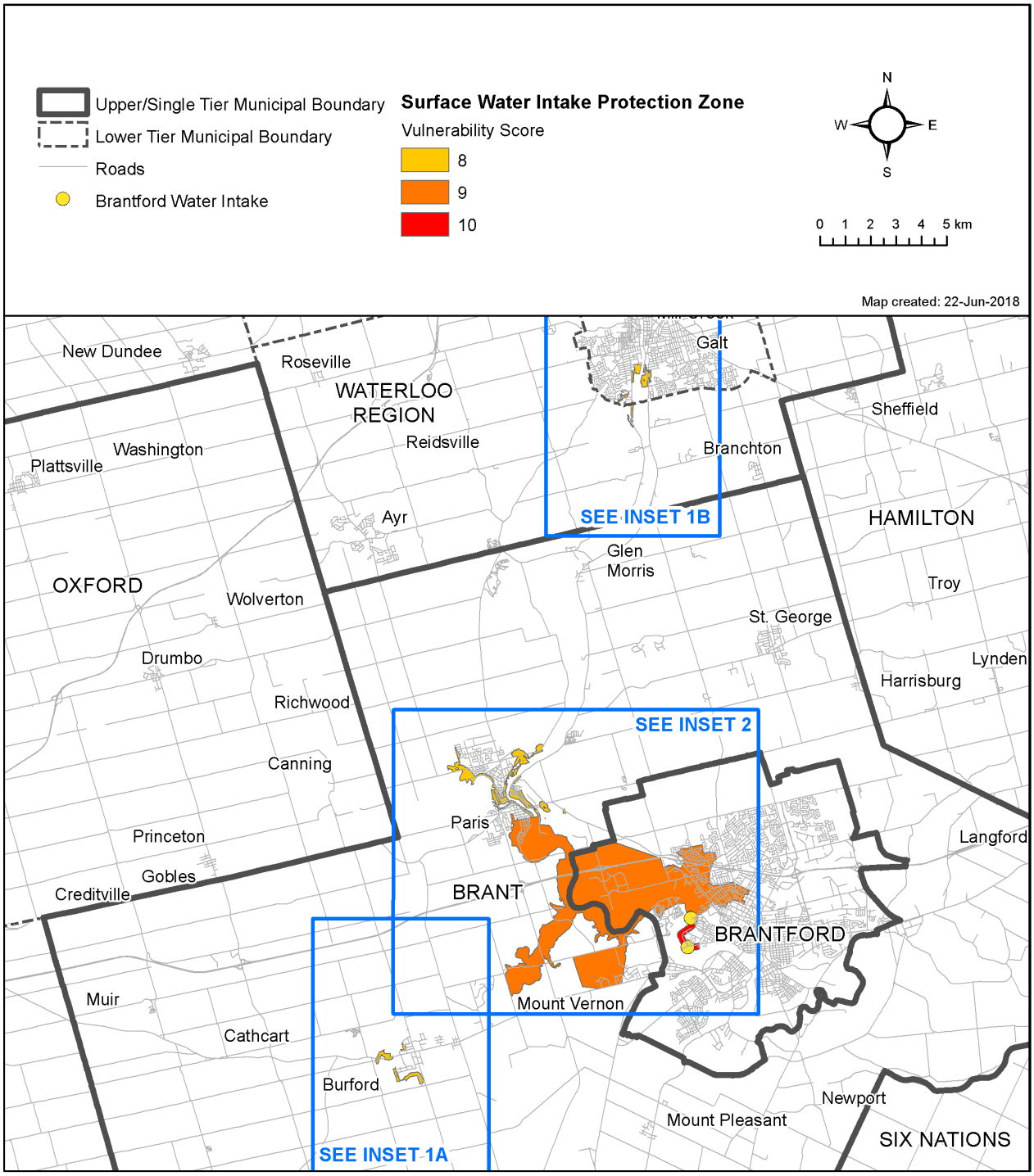
IPZ-3 for the City of Brantford intake was delineated in accordance with Technical Rule 70, which states that IPZ-3 shall include the area within each surface water body that may contribute water to the intake and where this area abuts land, the IPZ-3 will also include the portion of land within the Conservation Authority Regulation Limit or 120 m, whichever is greater.

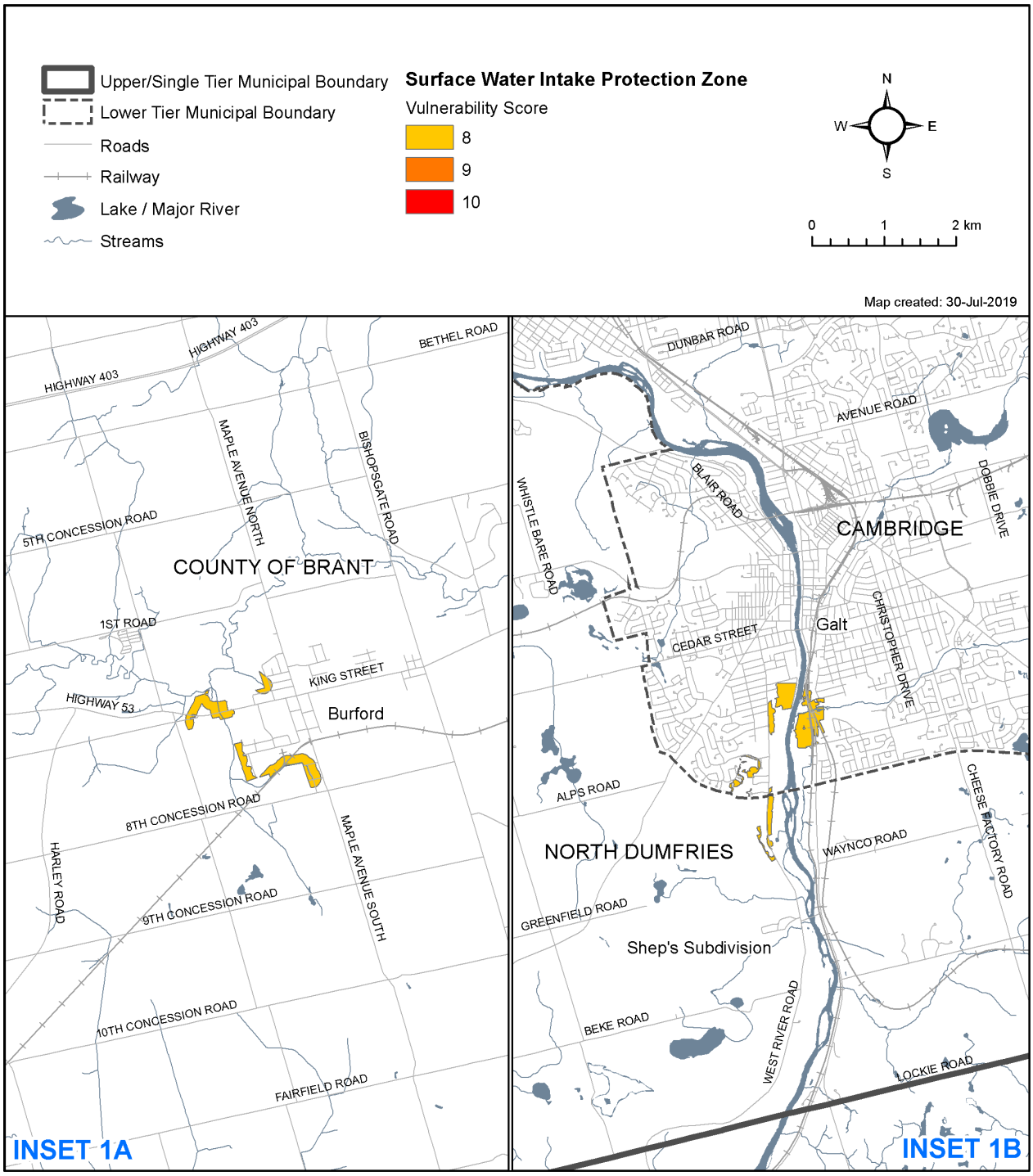
For the purposes of delineating the IPZ-3 for the City of Brantford WTP, the NDMNRF Water Virtual Flow – Seamless Provincial Data Set and Water Poly Segment GIS data layers from the Ontario Land Information Warehouse were used to identify water bodies upstream of IPZ-2 that may contribute water to the intake. IPZ-3 for the City of Brantford's WTP intake is shown in **Map 14-4, Map 14-5 and Map 14-6**.

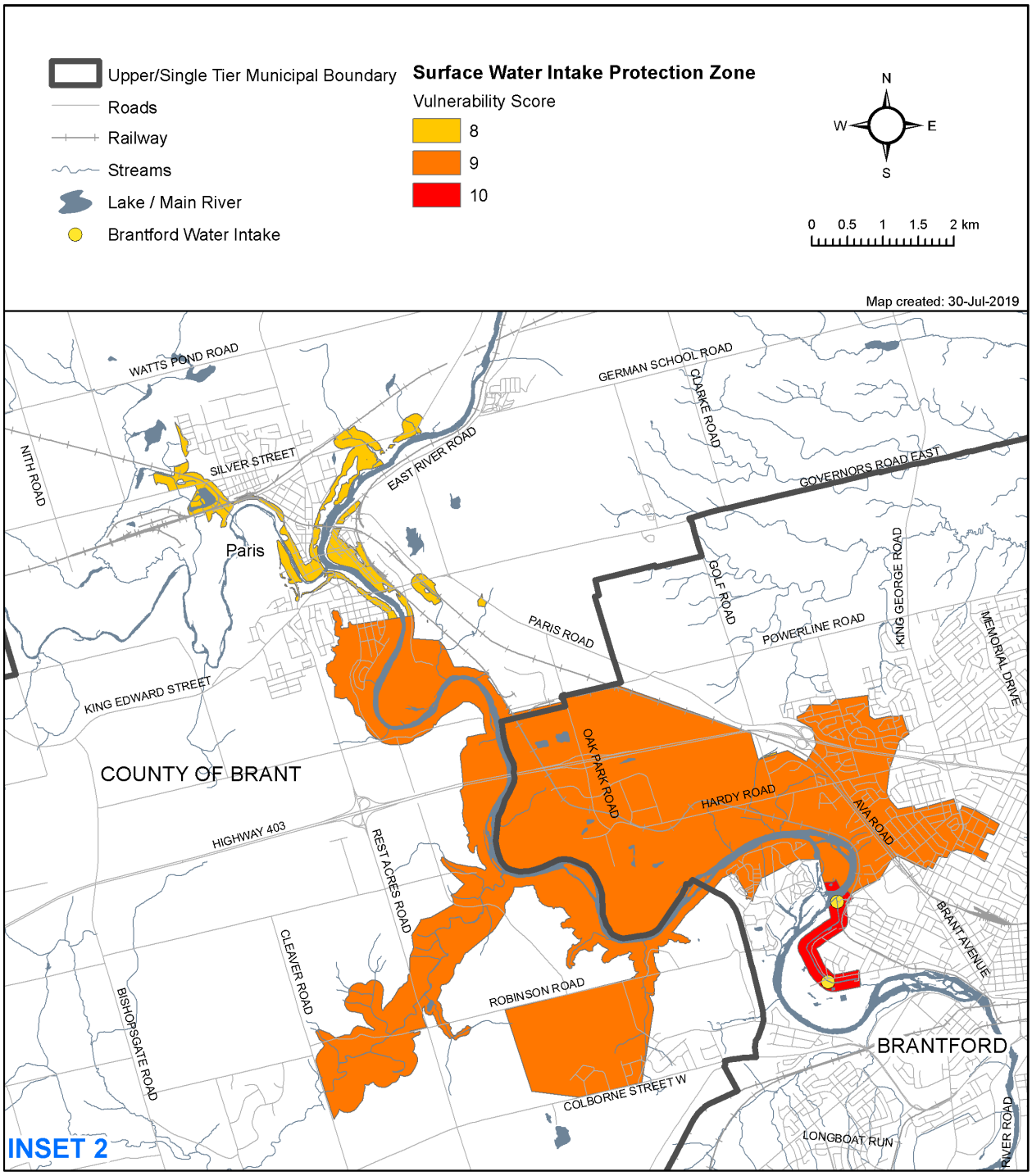
Map 14-2: Holmedale Water Treatment Plant Intake Protection Zones



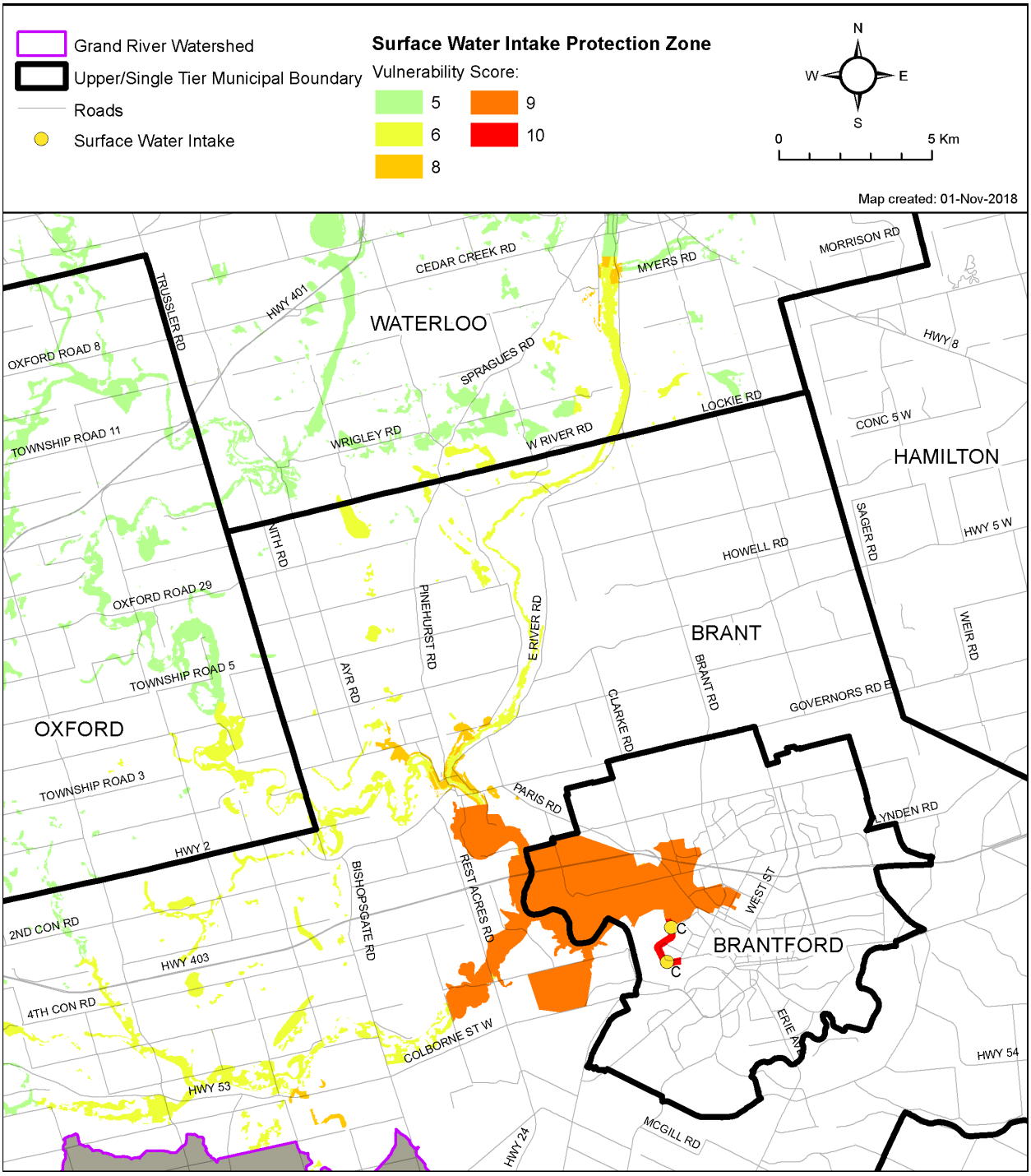
Map 14-3: Holmedale Water Treatment Plant Intake Protection Zone Vulnerability



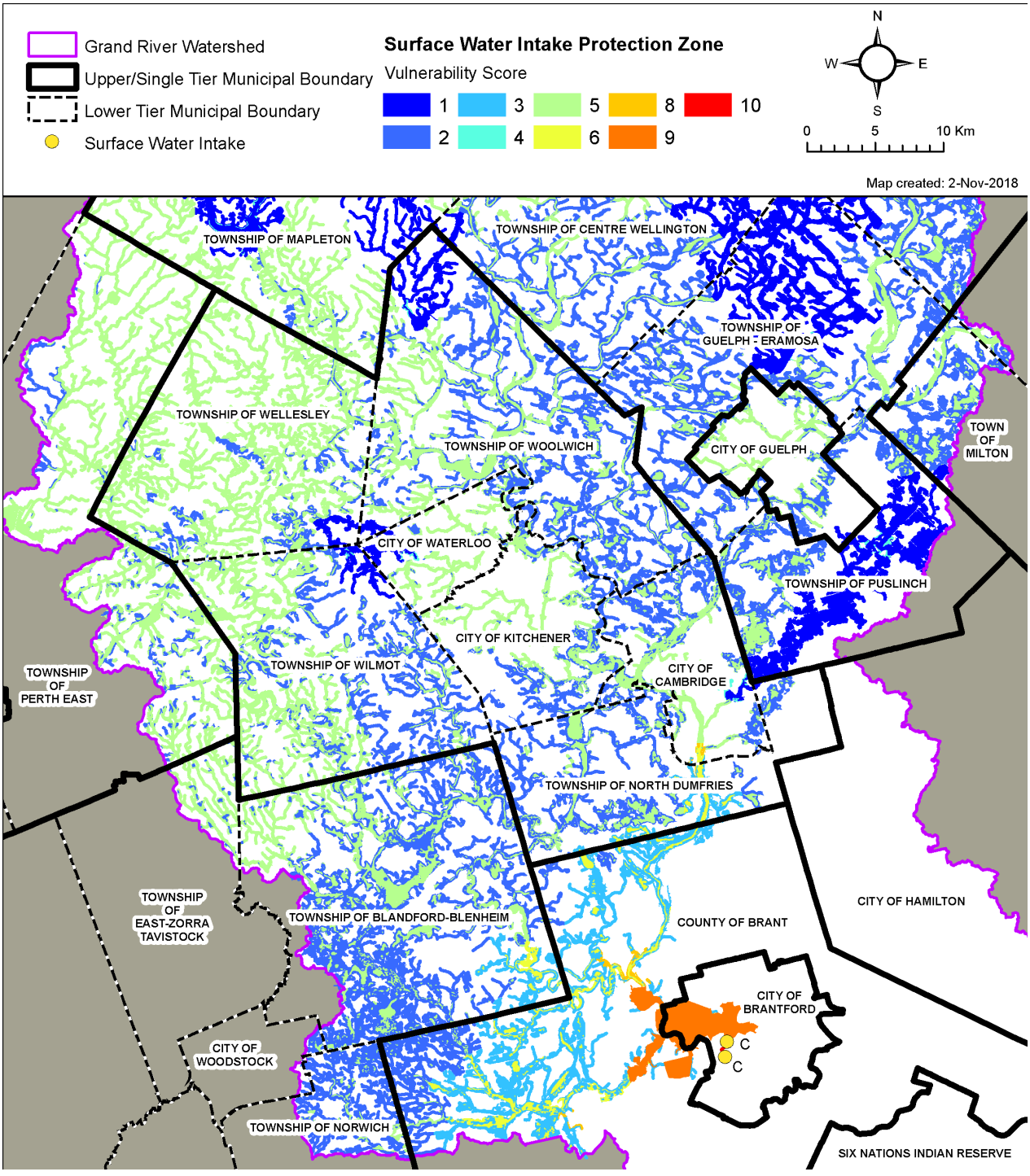

Upper/Single Tier Municipal Boundary
Lower Tier Municipal Boundary
Roads
Railway
Lake / Major River
Streams
Surface Water Intake Protection Zone
Vulnerability Score
8
9
10
N
W
E
S
0
1
2 km
Map created: 30-Jul-2019
HIGHWAY 403
BETHEL ROAD
MAPLE AVENUE NORTH
BISHOPSGATE ROAD
5TH CONCESSION ROAD
COUNTY OF BRANT
1ST ROAD
KING STREET
HIGHWAY 53
Burford
8TH CONCESSION ROAD
HARLEY ROAD
9TH CONCESSION ROAD
MAPLE AVENUE SOUTH
10TH CONCESSION ROAD
FAIRFIELD ROAD
INSET 1A
DUNBAR ROAD
AVENUE ROAD
WHISTLE BARE ROAD
BLAIR ROAD
DOBBIE DRIVE
CAMBRIDGE
Galt
CEDAR STREET
CHRISTOPHER DRIVE
ALPS ROAD
CHEESE FACTORY ROAD
NORTH DUMFRIES
WAYNCO ROAD
GREENFIELD ROAD
Shep's Subdivision
BEKE ROAD
WEST RIVER ROAD
LOCKIE ROAD
INSET 1B


Upper/Single Tier Municipal Boundary
Roads
Railway
Streams
Lake / Main River
Brantford Water Intake
Surface Water Intake Protection Zone
Vulnerability Score
8
9
10
N
W
E
S
0 0.5 1 1.5 2 km
Map created: 30-Jul-2019
WATTS POND ROAD
GERMAN SCHOOL ROAD
CLARKE ROAD
NITH ROAD
SILVER STREET
EAST RIVER ROAD
GOVERNORS ROAD EAST
Paris
GOLF ROAD
KING GEORGE ROAD
PARIS ROAD
POWERLINE ROAD
MEMORIAL DRIVE
KING EDWARD STREET
OAK PARK ROAD
COUNTY OF BRANT
HARDY ROAD
AVA ROAD
HIGHWAY 403
REST ACRES ROAD
BRANT AVENUE
CLEAVER ROAD
ROBINSON ROAD
BISHOPSGATE ROAD
BRANTFORD
COLBORNE STREET W
LONGBOAT RUN
RIVER ROAD
INSET 2

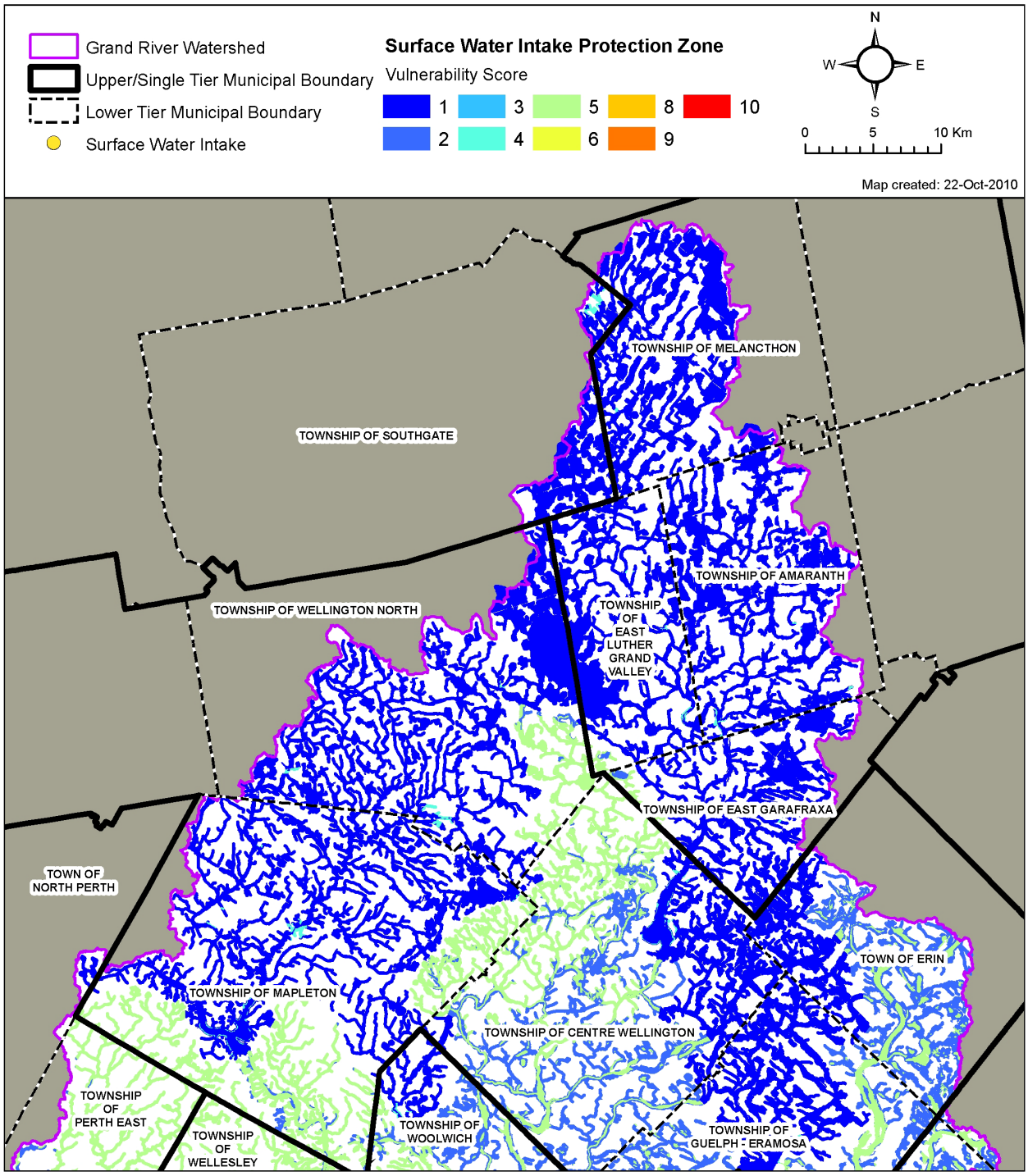
Map 14-4 Holmedale Water Treatment Plant Intake Protection Zone 3 (1 of 3)



Map 14-5: Holmedale Water Treatment Plant Intake Protection Zone 3 (2 of 3)



Map 14-6: Holmedale Water Treatment Plant Intake Protection Zone 3 (3 of 3)



15.1.4 Vulnerability Assessment

The vulnerability analysis of IPZ-1, IPZ-2 and IPZ-3 includes consideration for both the area and the source as described in the Technical Rules. The area vulnerability and the source vulnerability are multiplied to generate a vulnerability score for IPZ-1, IPZ-2 and IPZ-3.

The source vulnerability factor for a Type C intake can range from 0.9 to 1.0. Source vulnerability scoring takes into account the intake characteristics such as the depth of the intake, distance of the intake from land, and the number of recorded drinking water Issues or concerns at the intake. The City of Brantford is highly dependent on the Grand River, as a sole source for its drinking water. It does not have any additional sources of drinking water (e.g. groundwater). Therefore, the City's supply is completely dependent on the quantity and quality of the Grand River as it flows through the city. Further, the intake is located in shallow water within a canal that brings water from the Grand River to the Holmedale Water Treatment Plant; the canal is located within the city limits, is adjacent to fully developed land; the watershed above the intake to the City of Brantford has extensive agricultural production and many communities upstream use the river to assimilate wastewater; and there are frequent occurrences of upstream spills and sewage bypasses. Given the nature of the upstream watershed and the location and siting of the intake, the overall source vulnerability factor was deemed to be high and a score of 1.0 was given.

The area vulnerability factor for an IPZ-1 is prescribed to be 10 while the area vulnerability factor for an IPZ-2 can range from 7 to 9. The area vulnerability for an IPZ-2 takes into account the percentage of the IPZ-2 area that is land; land cover, soil type, and soil permeability which combine to characterize runoff potential; and transport pathways.

For the IPZ-2, an area vulnerability score of 9 was assigned. The following was considered in the scoring for the area vulnerability factor:

- most of IPZ-2 is land draining a wide variety of land use, including urban, industrial and rural agricultural;
- there is high runoff potential throughout the IPZ-2 within the City of Brantford limits due to the urban development but also the underlying tills and clay plain; and
- there are significant transport pathways into the Grand River, including storm sewersheds and local tributaries (i.e. an unnamed creek near the Airport; Whiteman's Creek) that can convey contaminants quickly into the river.

Given the source vulnerability factor of 1.0, the overall vulnerability score for the IPZ-1 is 10 and the overall vulnerability score for the IPZ-2 is 9.0. The vulnerability scores for the Holmedale WTP's IPZ-1 and -2 are summarized in **Table 14-3.**

Table 14-3: Vulnerability Score Summary for IPZ-1 and IPZ-2 of the Holmedale Water Treatment Plant

WTP Intake	Area Vulnerability Factor		Source Vulnerability Factor	Vulnerability Score	
	IPZ-1	IPZ-2		IPZ-1	IPZ-2
Type 'C' intake	10	9	1.0	10	9.0

Generally, the area vulnerability scoring for IPZ-3s was approached consistently across the Lake Erie Source Protection Region. The following criteria, according to Technical Rule 92, were used:

- Percentage of the area composed of land;

- Runoff potential that incorporates land cover, soil type, permeability and slope;
- Transport pathways; and
- Proximity of the area to the intake.

The IPZ-3 for the City of Brantford is extensive – it covers an area of about 5100 km^2 or about ¾ of the entire Grand River watershed and extends up the Grand, Nith, Speed, and Conestogo Rivers among other smaller tributaries. Consequently, the study team felt that a watershed this size needed to be described first according to the proximity to the intake and then second, according to land use and runoff potential. Therefore, a 'close', 'moderate' and 'far' zone was delineated to best describe the vulnerability in the context of its proximity to the intake. 'Close' was defined being within twice the travel distance of IPZ-2. For Brantford, IPZ-2 extends approximately 11.6 km from the Brantford intake up the Grand River. The 'close' zone was therefore defined as any watercourse within 23.2 km of IPZ-2 measured along the centreline of the stream. Given the extent of the entire upstream watershed, the study team felt that two-times the IPZ-2 distance best described the 'Close' zone. Proximity, combined with runoff potential and land use (e.g. urban and rural) then determined the overall vulnerability for these areas. 'Moderate' was considered to be anything between the 'close' zone and the major flood control reservoirs (i.e. Guelph Dam, Shand Dam, Conestogo Dam, Woolwich Dam, Laurel Creek Dam and Shades Mill Dam). Any areas upstream of a reservoir was considered to be 'far', as there is considerable dilution and retention within the reservoirs.

Areas in the 'close' zone were assigned a higher vulnerability score relative to areas in the 'far' zone which were given a lower vulnerability score. The IPZ-3, composed mostly of land, includes both urban and rural areas. Higher vulnerability scores were assigned to urban areas relative to rural areas that were given lower vulnerability scores. Urban areas were identified using the SOLRIS Built-up Areas GIS layer to identify towns and villages larger than 2.5 km^2. A value of 2.5 km^2 was chosen as this is the size of a small village which would contain approximately 1000 to 1500 homes (e.g. about the size of Ayr, St. George or Arthur). Smaller communities are likely to have less impervious surface as they have less municipal infrastructure (e.g. fewer sidewalks, stormdrains, etc.) and less industrial, commercial and institutional development. For this reason, urban areas smaller than 2.5 km^2 are considered to be less vulnerable than larger urban centres.

The runoff potential, as determined through the Tier II water budget (AquaResource Inc. 2009), varies considerably throughout the watershed. Those areas with high runoff (i.e. greater than 250 mm/year) were scored a higher vulnerability score relative to those areas with low runoff scored a lower vulnerability score. Proximity, land use (e.g. rural /urban) and runoff potential were combined to yield relative vulnerability scores for each zone. **Table 14-4** summarizes the vulnerability scores for each zone.

Table 14-4: Vulnerability Score Summary for IPZ-3 of the Holmedale Water Treatment Plant

Proximity Upstream from WTP	Runoff Potential[1]	Area Vulnerability Score	Source Vulnerability	Vulnerability Score
Close	Urban	8	1.0	8
Close	High	6	1.0	6
Close	Low	3	1.0	3
Medium	Urban	5	1.0	5
Medium	High	5	1.0	5
Medium	Low	2	1.0	2
Far	Urban	4	1.0	4
Far	High	1	1.0	1
Far	Low	1	1.0	1

[1] AquaResouce 2009. Integrated Water Budget Report, Grand River Watershed.

Managed Lands within the Holmedale Intake Protection Zones

Managed Lands are lands to which nutrients are applied. Managed lands can be categorized into two groups: agricultural managed land and non-agricultural managed land. Detailed methods for calculating managed lands are described in Chapter 3 of this Assessment Report.

The percentage of managed lands in the IPZ-1 for the City of Brantford is 19.9% while it is 30.8% in the IPZ-2. The percentage of managed lands in both the IPZ-1 and IPZ-2 is considered 'low' (**Map 14-7**). Percent managed lands in the IPZ-3 for the City of Brantford is illustrated on **Map 14-8 and Map 14-9.**

Livestock Density within the Holmedale Intake Protection Zones

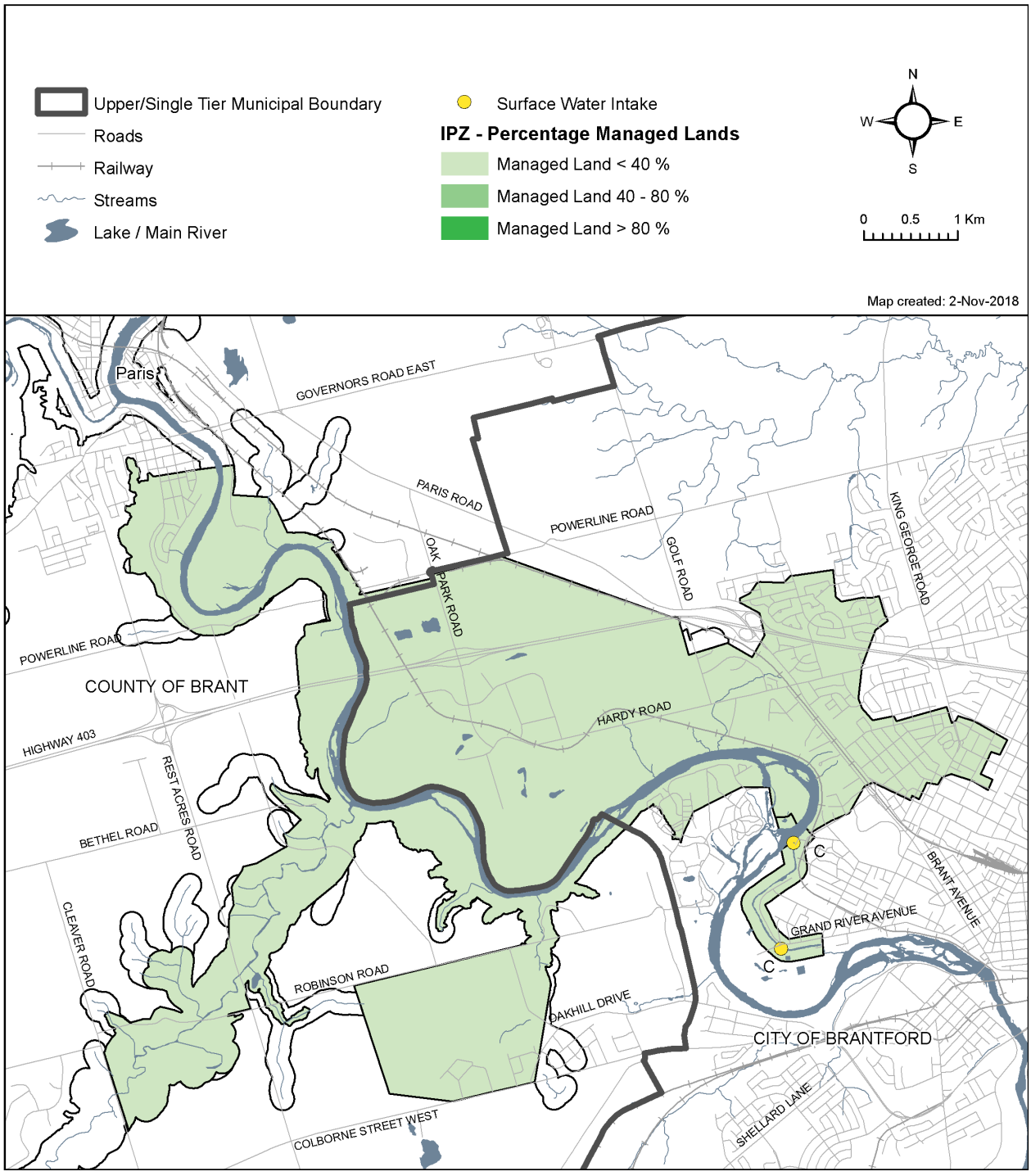
There are no livestock within the IPZ-1. There is a very low livestock density (0.27 Nutrient Units/acre) in the IPZ-2 (**Map 14-10**). Livestock density in the IPZ-3 for the City of Brantford is illustrated on **Map 14-11 and Map 14-12.**

Percentage of Impervious Surfaces within Intake Protection Zones

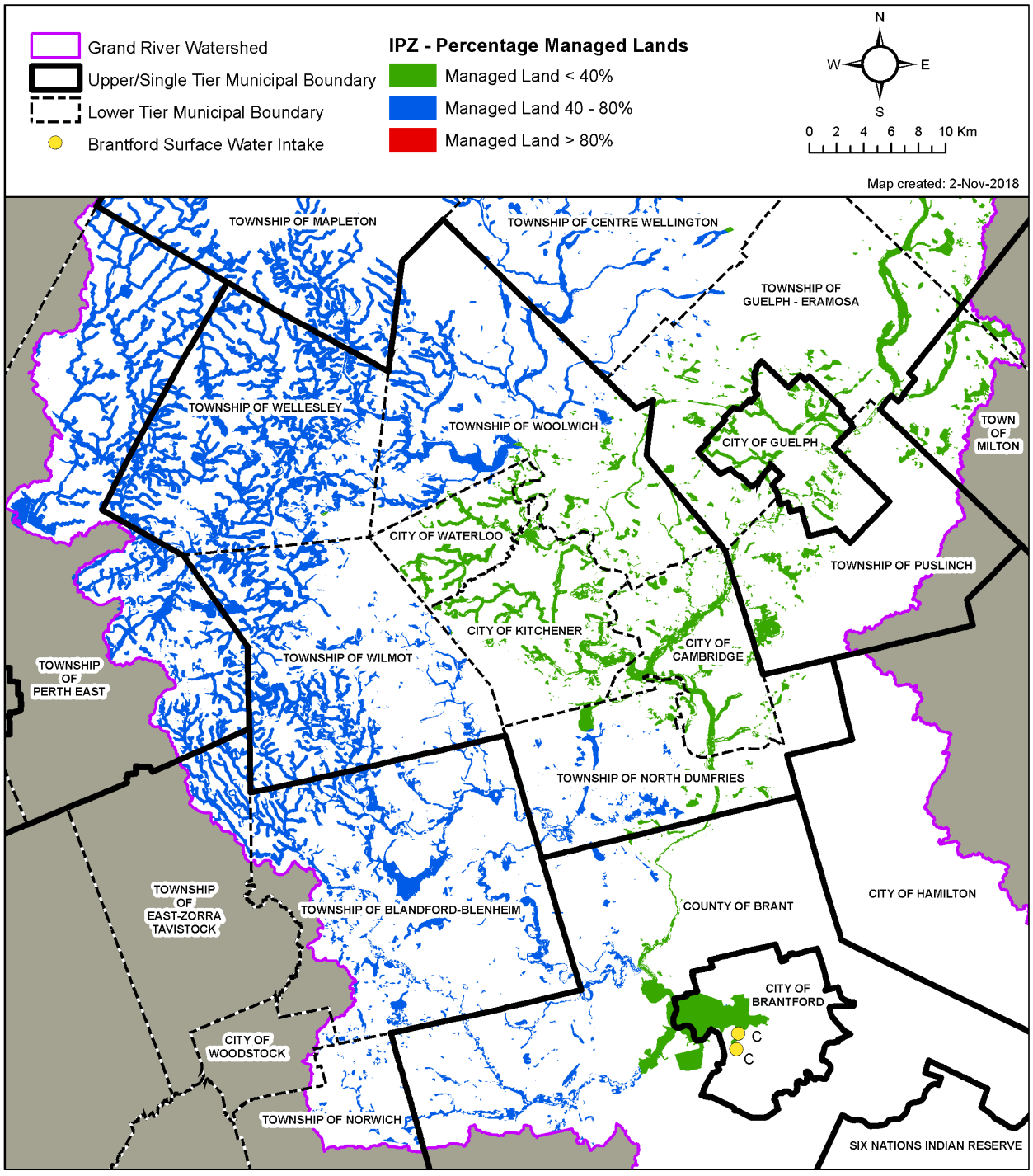
A map of impervious areas was created based on the Technical rules using a 1km by 1km grid system centred on the vulnerable area. Aerial photography and GIS data were used to identify paved areas on a per square kilometre basis. Individual residential driveways were not included in the calculation because of their relatively small impervious area. See **Map 14-13**, **Map 14-14, and Map 14-15** for the impervious area percentages.

This methodology departs from Technical Rule 17 as the grid was centered on the centroid of the vulnerable area rather than the source protection area. This approach is consistent with the previous version of the Technical Rules (December 2008). The method of centering the grid on the vulnerable area is considered to be an equivalent approach. As per Technical Rule 15.1, the Director has provided confirmation that he agrees to the departure. The Director's letter of confirmation can be found in **Appendix B**.

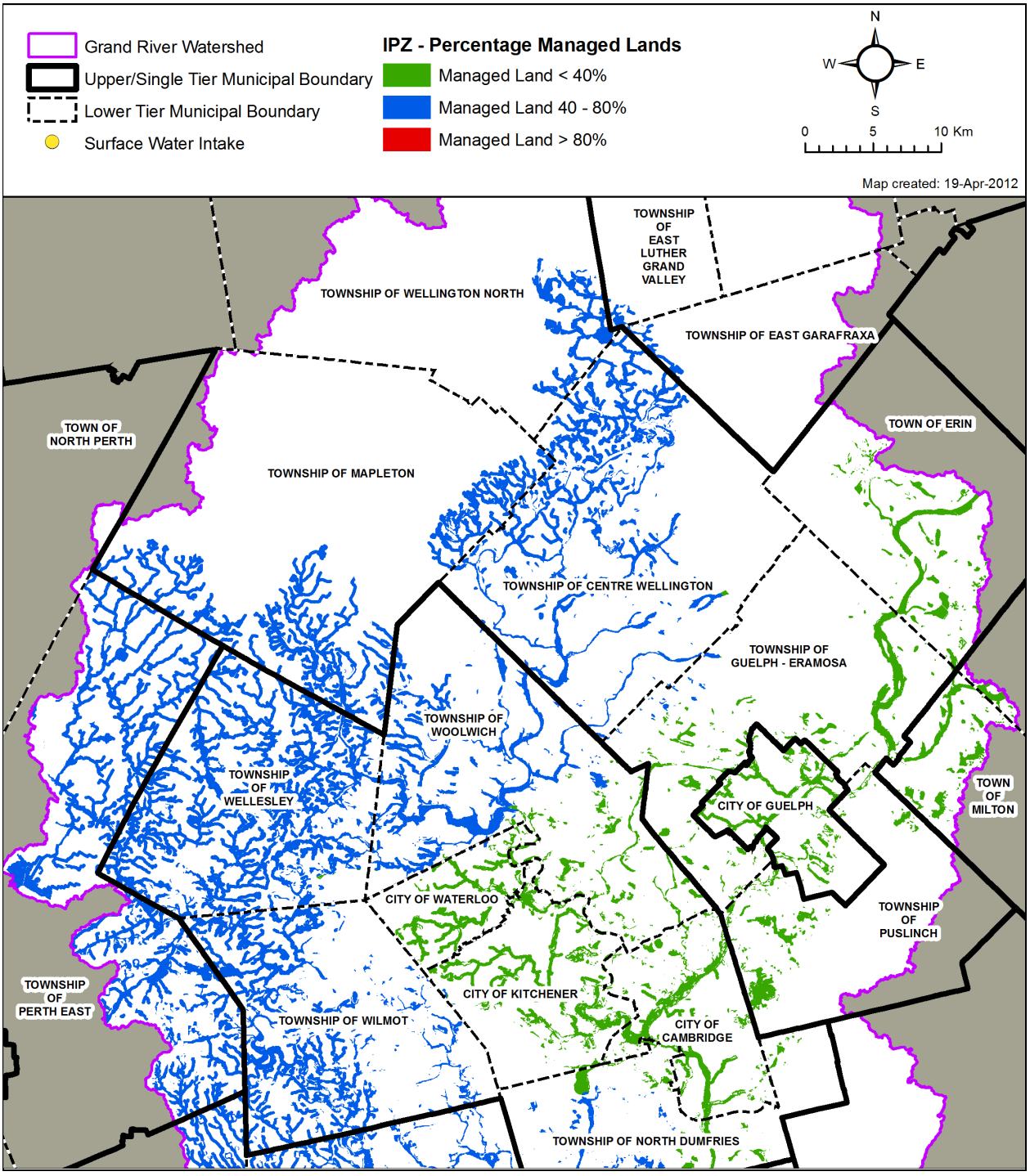
Map 14-7: Holmedale Water Treatment Plant IPZ-1 and IPZ-2 Percent Managed Lands



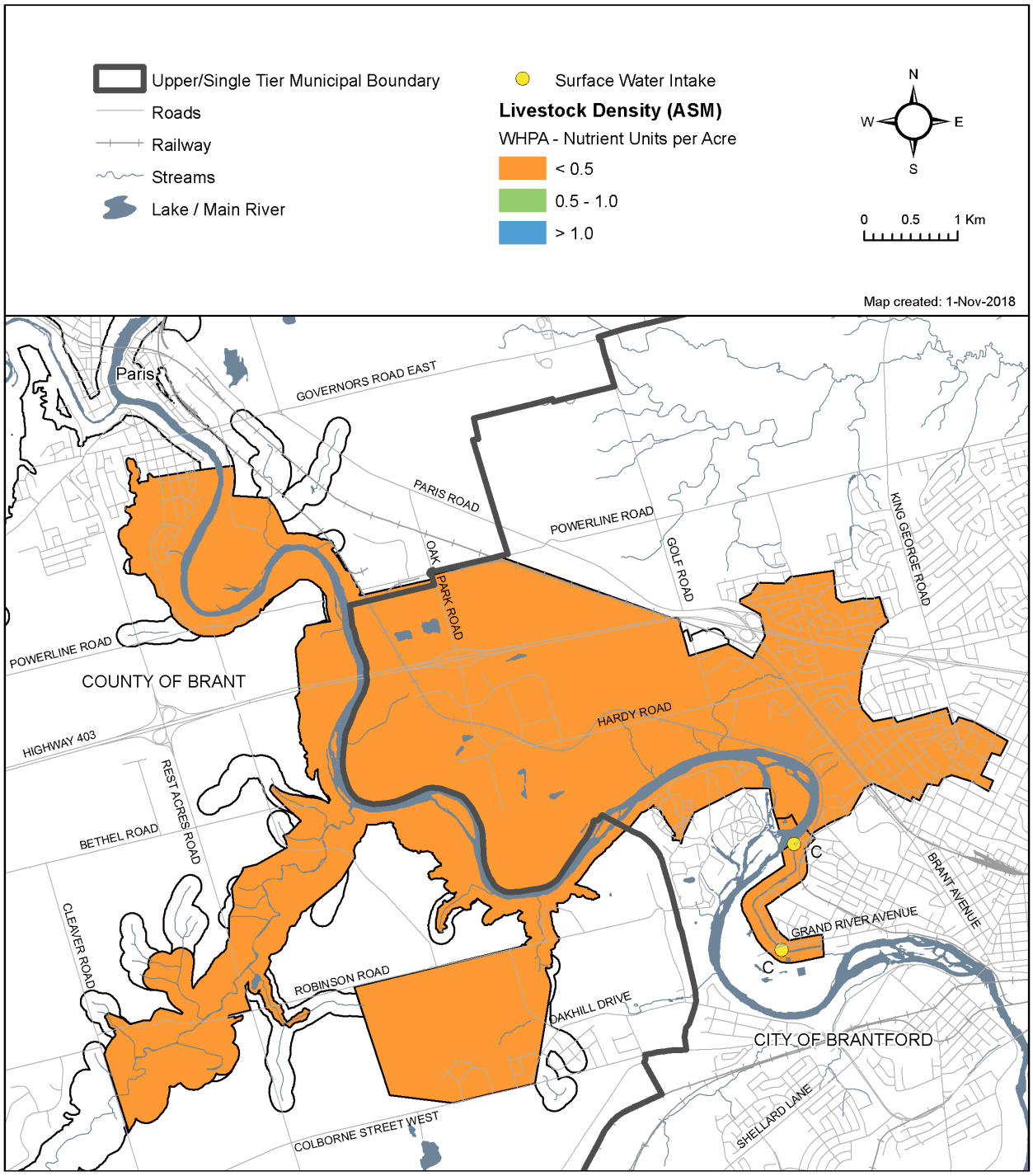
Map 14-8: Holmedale Water Treatment Plant IPZ-3 Percent Managed Lands (1 of 2)



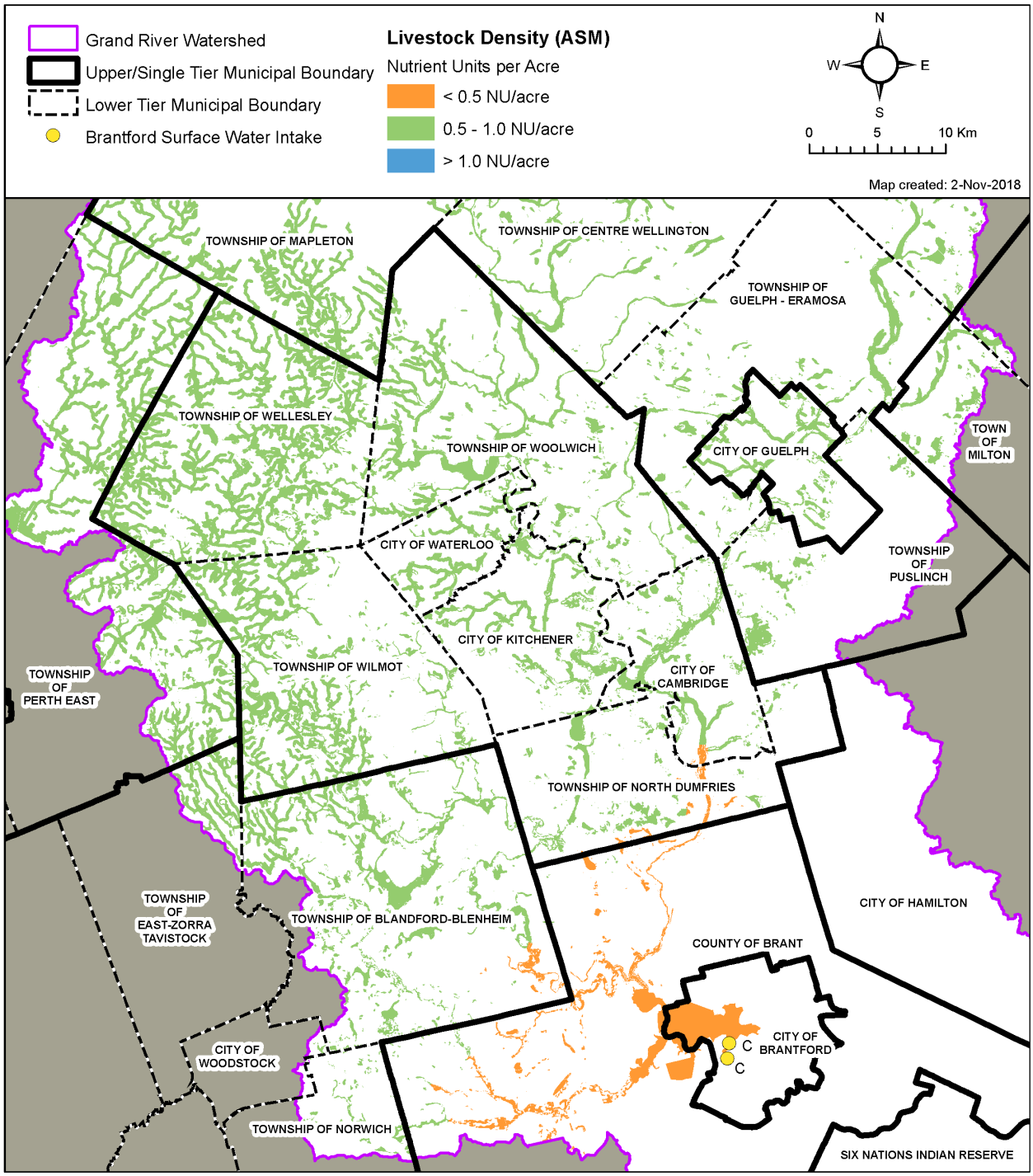
Map 14-9: Holmedale Water Treatment Plant IPZ-3 Percent Managed Lands (2 of 2)



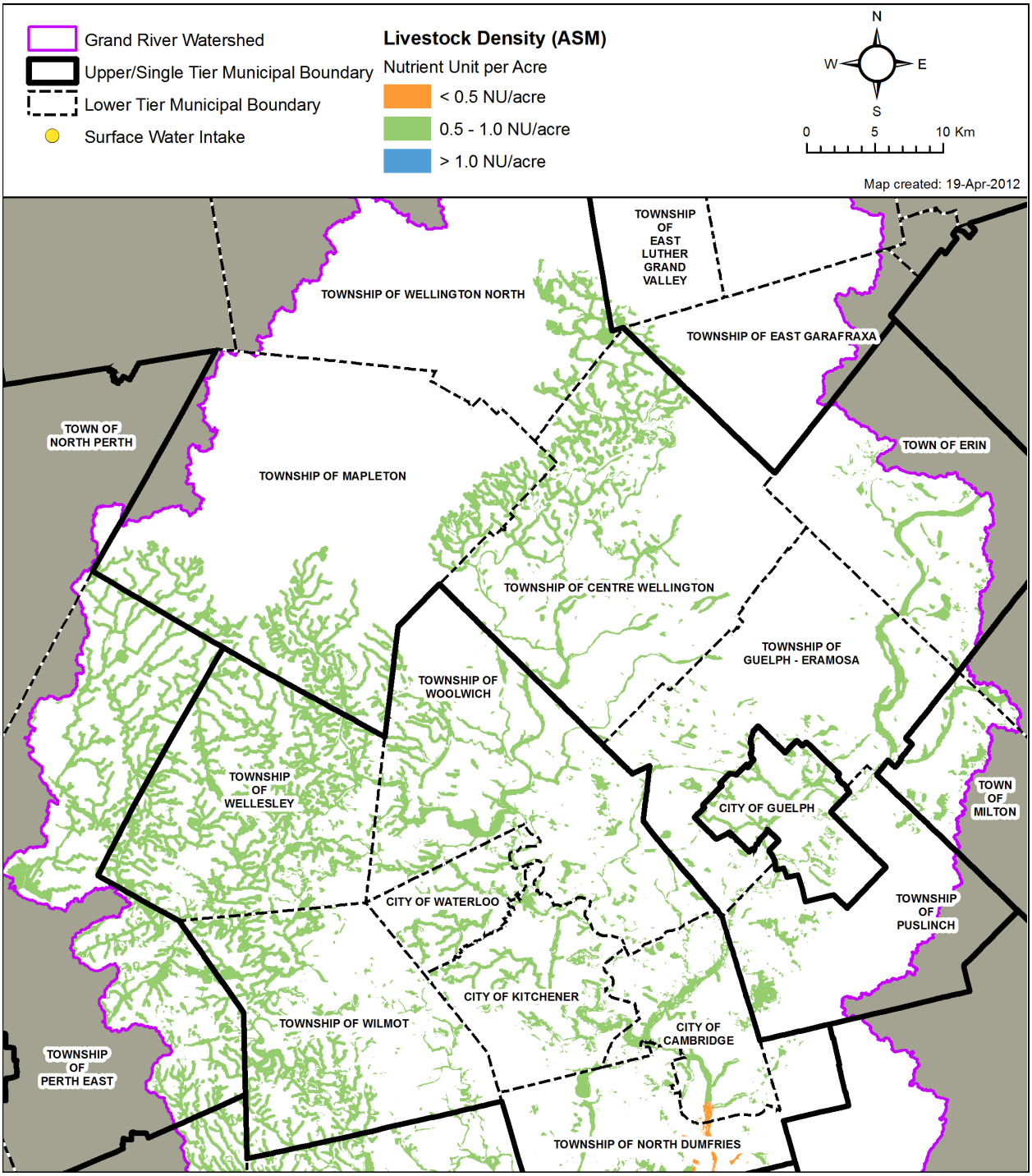
Map 14-10: Holmedale Water Treatment Plant IPZ-1 and IPZ-2 Livestock Density



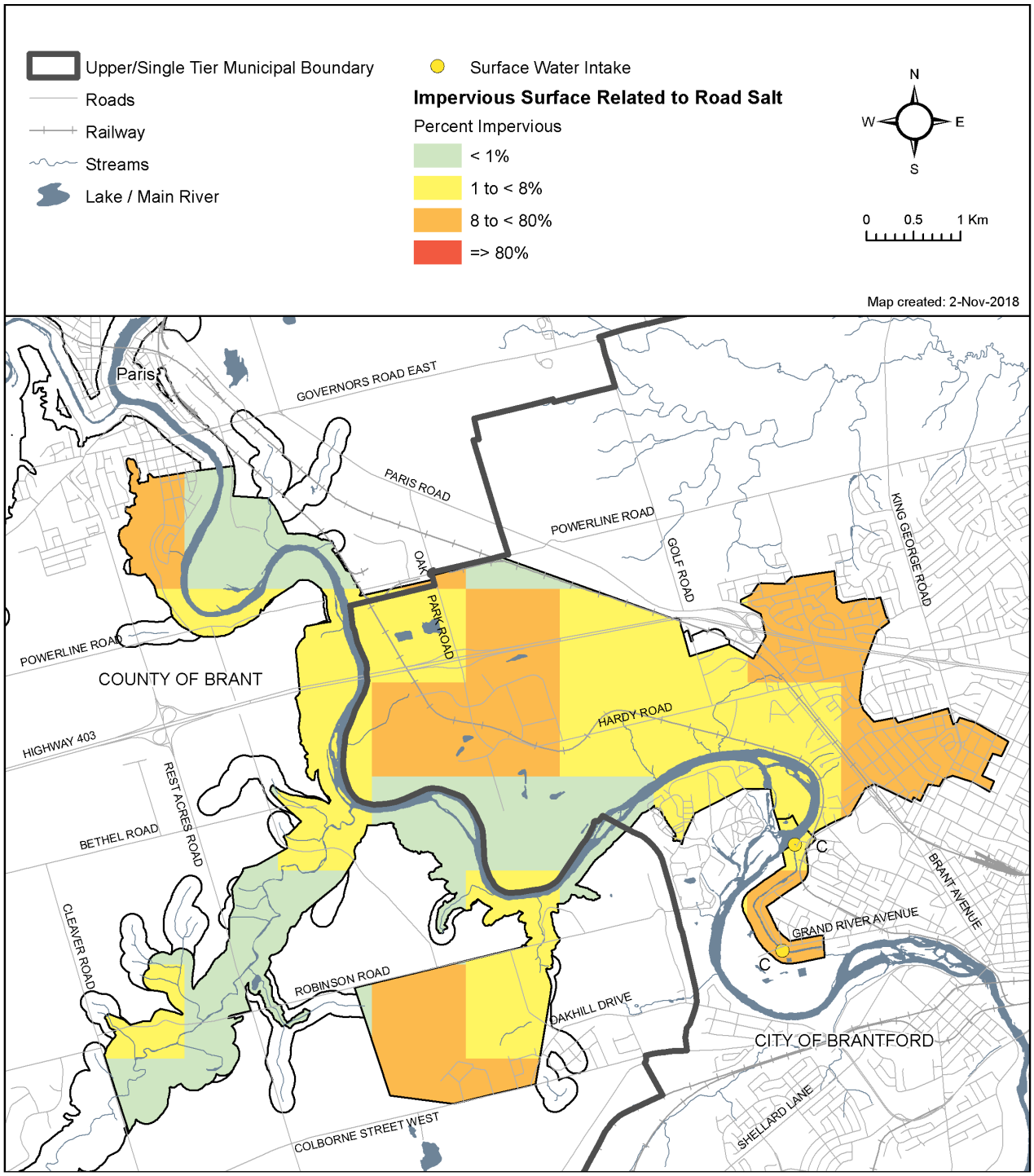
Map 14-11: Holmedale Water Treatment Plant IPZ-3 Livestock Density (1 of 2)



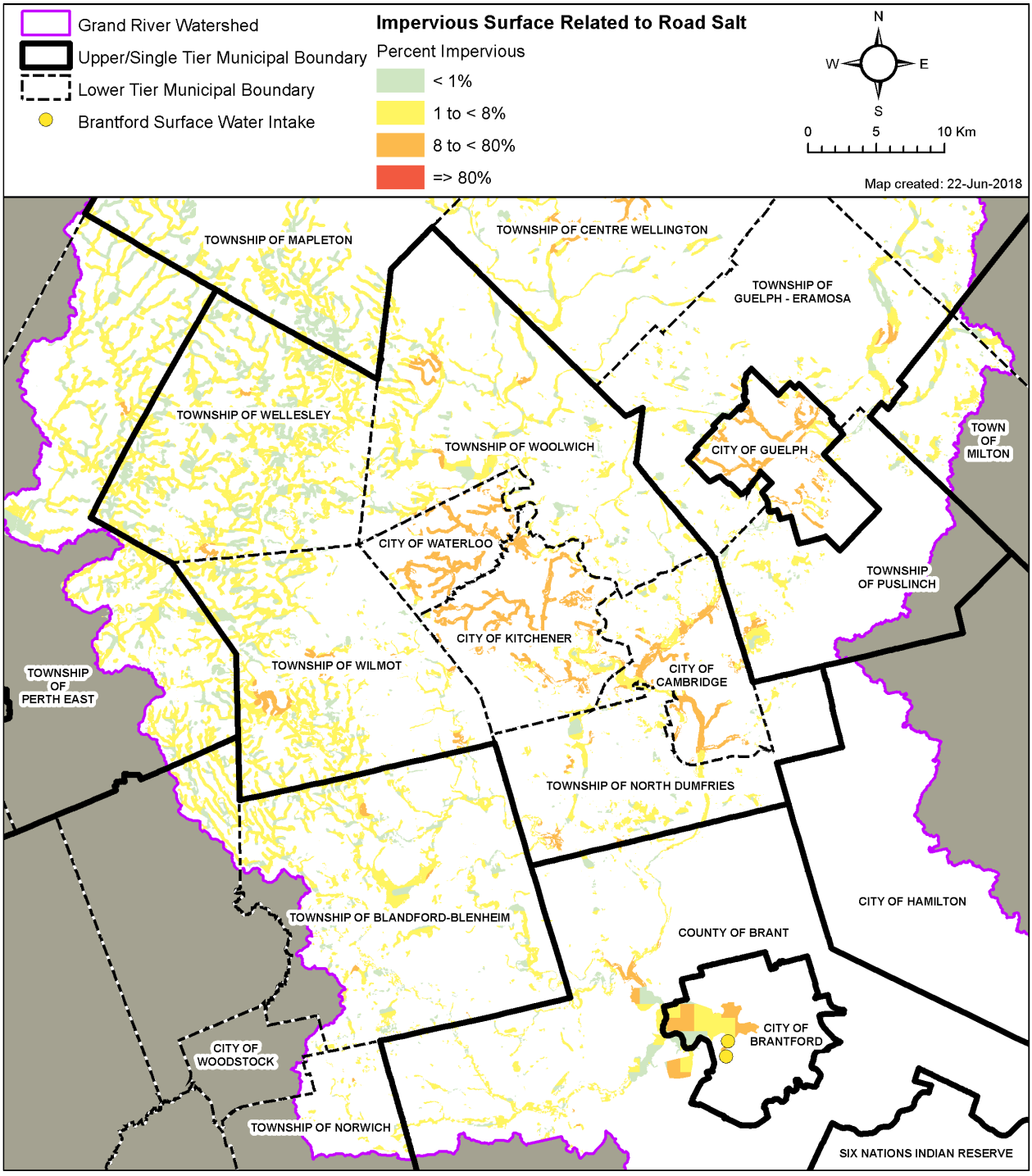
Map 14-12: Holmedale Water Treatment Plant IPZ-3 Livestock Density (2 of 2)



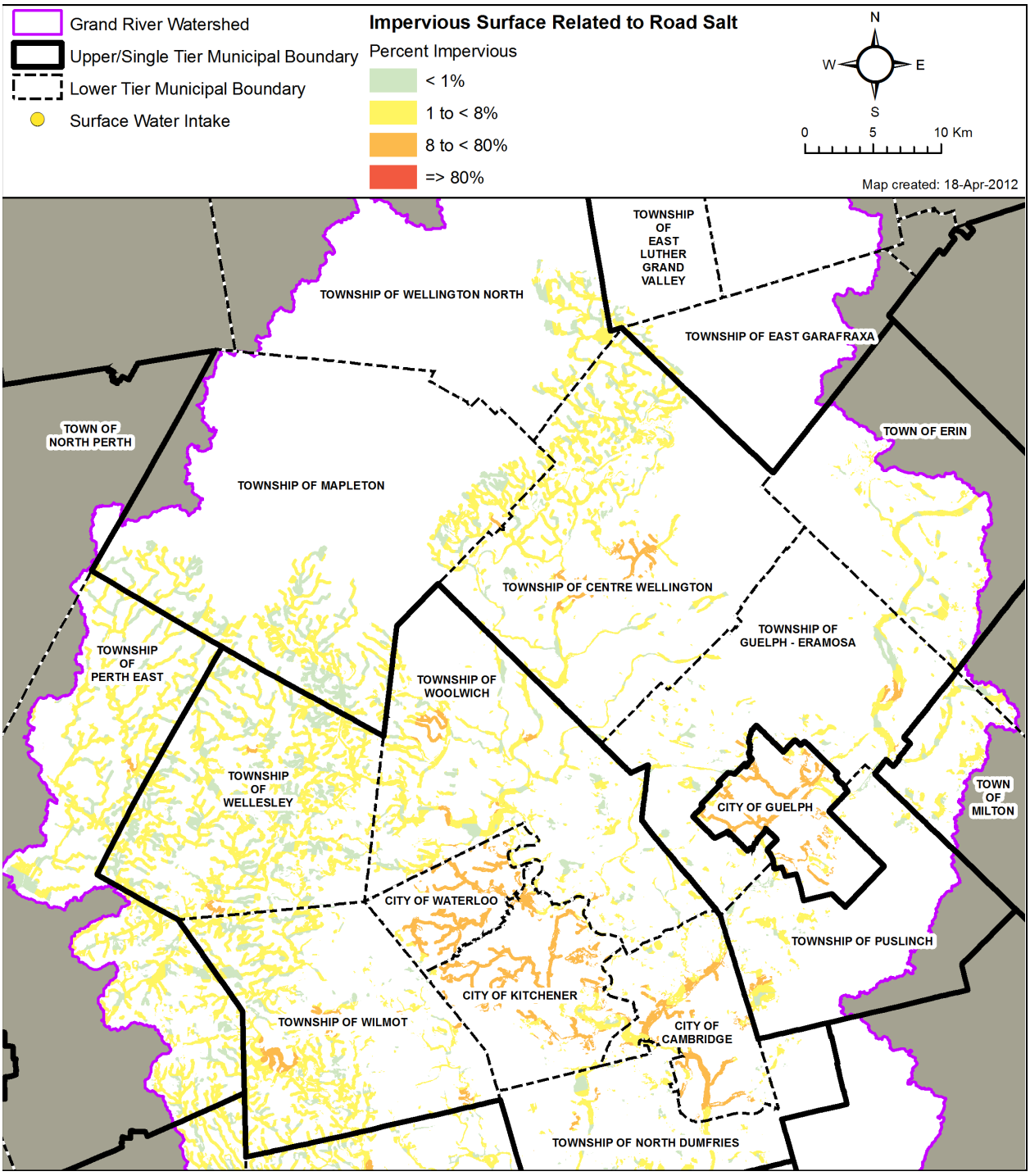
Map 14-13: Holmedale Water Treatment Plant IPZ-1 and IPZ-2 Percent of Impervious Surfaces



Map 14-14: Holmedale Water Treatment Plant IPZ-3 Percent of Impervious Surfaces (1 of 2)



Map 14-15: Holmedale Water Treatment Plant IPZ-3 Percent of Impervious Surfaces (2 of 2)



Information Sources for the Vulnerability Assessment

The most up-to-date information was used for determining the intake protection zones and vulnerability scores. **Table 14-5** outlines the data sources and the purposes for which the data were used.

Table 14-5: Summary of Data Sources Used in the Delineation of the Vulnerable Areas and the Vulnerability Assessment for the Holmedale Water Treatment Plant

Data Type	Source	Purpose
Aerial Photography	GRCA	General mapping and identification of land use and surface features
Storm sewersheds, GIS Datasets	City of Brantford	Identification of storm sewersheds in the City
HEC-RAS Model Data Set	GRCA	Model used to determine the extent of the IPZ-2
Digital Terrain Model Data Set	City of Brantford	To help identify the direction of flow on the land surface
Digital elevation model with 0.5 m resolution	City of Brantford	Infer stormsewer catchments and determine land slope for overland flow analysis
Sewershed delineation	Westlake Inc. Report & City of Brantford	Determine the extent of the sewersheds
Conservation Authority Regulation Limit, GIS Data Sets	GRCA	To help identify the extent of the Intake Protection Zones
Dye Tracer Studies	RVA and XCG Consultant Reports	Data used in the hydraulic modelling of the Grand River ; extent of the IPZ's
Grand River Flow Data	GRCA and Water Survey of Canada	Data used in the hydraulic modelling of the Grand River
Water Treatment Plant Operator interviews	City of Brantford	Identify operational information and local information around the WTP
Watercourse mapping using GIS datasets	GRCA, HEC-RAS Modelling	Identify watercourses/transport pathways that may impact IPZ
Constructed drain and tile drainage GIS data set	Ontario Ministry of Agriculture, Food and Rural Affairs	Identify transport pathways that may impact IPZ
Raw water quality	MOE Drinking Water Surveillance Program, MOE Drinking Water Information System, City of Brantford Laboratory Data	Assess vulnerability of intake and identify concerns
SOLRIS Land cover and soil permeability GIS dataset	NDMNRF, GRCA Draft Watershed Report	Assess vulnerability of intake

Limitation of Data and Methods

There was a high level of confidence in the datasets used to delineate IPZ-1 and IPZ-2. Since a conservative approach was used to delineate the IPZs, a better understanding of the flows through transport pathways such as urban storm sewers, identification of catch basins, storm water management plans, and surrounding creeks would help in the refinement of the intake protection zone.

Additional dye tracer studies in the Grand River at different flow conditions would improve the hydraulic model and provide a more accurate estimate of the time of travel. A dye tracer study could also be performed on Whitemans Creek to better understand the flow conditions in the

creek but likely won't be necessary as no potential threats were identified in the Whitemans Creek portion of the IPZ-2 as the area around the creek is predominately surrounded by natural vegetation.

The hydraulic model that was conducted for this area only took into consideration the use of two dye studies to calibrate the model and only represents a single test for each reach on the Grand River. The model is a course model that produces a rough estimate of the time of travel under different flow conditions. Additional field data would be required if a more accurate time of travel is required.

Collection of additional field information to confirm the presence or absence of underground pathways (i.e. abandoned pipelines) that may provide a short cut for contaminants to reach the Holmedale Canal should be considered. The information collected would provide a means for staff to detect or close any existing pathways and help reduce the risk to the intake.

Uncertainty of Vulnerability Assessment

The level of uncertainty was also determined for both the delineation of IPZs and the vulnerability scoring. The data sources used for the delineation of IPZ-1 and IPZ-2 were determined to have a "low" uncertainty. The uncertainty related to the delineation of IPZ-1 is scored as "low" as defined according to the Technical Rules. For IPZ-2, hydraulic modeling was used to delineate IPZ-2, and because considerable attention was paid to model construction, calibration, and data processing, the contaminant travel times for the area is considered reliable estimates for the purposes of emergency response planning at the WTP. Therefore, IPZ-2 delineation was also considered to have low uncertainty for the purposes of source protection planning. IPZ-3 was delineated as prescribed by the Technical Rules using the best available GIS information and is considered to have low uncertainty.

Sufficient high quality information was available to assign vulnerability scores for each IPZ and therefore the vulnerability scores were characterized as low uncertainty.

15.1.5 Drinking Water Quality Threats Assessment

The Ontario Clean Water Act, 2006 defines a Drinking Water Threat as "an activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, and includes an activity or condition that is prescribed by the regulation as a drinking water threat." A Prescribed Drinking Water Threats table in Chapter 3 lists all possible drinking water threats.

Identification of Significant, Moderate and Low Drinking Water Quality Threats for the Holmedale Water Treatment Plant

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 available through www.sourcewater.ca. Information on drinking water threats is also accessible through the Source Water Protection Threats Tool: http://swpip.ca. The information above can be used with the vulnerability scores shown in **Map 14-3, Map 14-4**, **Map 14-5, and Map 14-6** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 14-6 provides a summary of the threat levels possible in the Holmedale Intake Protection Zones for Chemical, Dense Non-Aqueous Phase Liquid (DNAPL) and Pathogens. A checkmark indicates that the threat classification level is possible for the indicated threat type under the

corresponding vulnerable area / vulnerable score; a blank cell indicates that it is not. The colours shown for each vulnerability score correspond to those shown in the maps.

Table 14-6: Identification of Possible Drinking Water Quality Threats in the City of Brantford Intake Protection Zones

Threat Type	Vulnerable Area	Vulnerability Score	Threat Classification Level		
			Significant 80+	Moderate 60 to <80	Low >40 to <60
Chemicals	IPZ-1	10	✔	✔	✔
	IPZ-2	9	✔	✔	✔
	IPZ-3	8	✔	✔	✔
	IPZ-3	6		✔	✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			
Handling / Storage of DNAPLs	IPZ-1	10	✔	✔	
	IPZ-2	9		✔	
	IPZ-3	8		✔	✔
	IPZ-3	6		✔	✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			
Pathogens	IPZ-1	10	✔	✔	✔
	IPZ-2	9	✔	✔	✔
	IPZ-3	8	✔	✔	✔
	IPZ-3	6		✔	✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			

15.1.6 Conditions Evaluation for the Holmedale Water Treatment Plant

Conditions are contamination that already exist and are a result of past activities that could affect the quality of drinking water. A high level assessment of conditions was completed and no conditions as per Technical Rule 126 were identified.

15.1.7 Drinking Water Quality Issues Evaluation

The objective of the Issues evaluation is to identify drinking water Issues where the existing or trending concentration of a parameter or pathogen at an intake, well or monitoring well would result in the deterioration of the quality of water for use as a source of drinking water.

Drinking Water Quality Issues under the Clean Water Act

The Grand River is the receiving water body of many point and nonpoint sources of contaminants that originate from both natural and anthropogenic sources. By the time the river flows through the City of Brantford, the river has received effluent from 24 municipal wastewater treatment plants, runoff from extensive agricultural production as well as natural areas. The Grand River in the vicinity of the City of Brantford's drinking water intake is a seventh order river and the water quality generally reflects a heavily impacted river from both natural and anthropogenic sources. Given this, it is extremely difficult to confidently identify, with low uncertainty, the source of drinking water Issues at the City of Brantford intake. Therefore, it is difficult to apply the process of characterizing and declaring drinking water Issues as it is described in the Technical Rules 114

and 115, which necessitates that the drinking water Issue is the result of, or partially the result of, anthropogenic causes. Once an Issue is identified under Technical Rule 114, the identification of an Issue Contributing Area is mandated as per Technical Rule 115. There is currently not sufficient knowledge as to the sources of any Issues that would allow to confidently identify the Issue Contributing Area. Therefore, no Issue under Technical Rule 114 has been identified for the Holmedale Water Treatment Plant.

Drinking water Issues can, however, be identified under the Clean Water Act (Section 15(2)(f)) for vulnerable areas. The following section describes the water quality Issues for the intake protection zone of the Brantford intake.

Data Sources Used to Characterize Drinking Water Issues under the Clean Water Act

The following data and information sources were evaluated to characterize the water quality of the raw water supplies at the Holmedale WTP:

- Operator and Municipal staff interviews;
- Ministry of the Environment's Drinking Water Surveillance Program water quality data;
- City of Brantford Water Treatment Plant laboratory water quality data;
- United States Environmental Protection Agency Disinfection Profiling and Benchmark Guidance Module; and
- Ontario Drinking Water Quality Standards

Table 14-7 identifies the criteria used and the source of the criteria to evaluate whether a parameter is a drinking water quality Issue.

Table 14-7: Criteria Used to Evaluate Drinking Water Quality Issues for the Holmedale Water Treatment Plant

Parameter	Source	Criteria
Sodium[1]	ODWQS; Table 4; Aesthetic Objective	200 mg/L
Chloride	ODWQS; Table 4; Aesthetic Objective	250 mg/L
Iron	ODWQS; Table 4; Aesthetic Objective	0.3 mg/L
Turbidity	ODWQS; Table 4; Aesthetic Objective	5 NTU
Alkalinity	ODWQS; Table 4; Operational Guideline	30-500 mg/L
Organic Nitrogen	ODWQS; Table 4; Operational Guideline	0.150 mg/L
Dissolved Organic Carbon	ODWQS; Table 4; Operational Guideline	5.0 mg/L
E. coli [2]	½ of the 90th percentile concentration[2] ;	200 cfu/100mL

Notes: [1]The Medical Advisory Level for Sodium is 20 mg/L, but water may continue to be distributed and consumed at these concentrations.

[2] Criteria for treated drinking water is 0 cfu/100mL; therefore an alternative benchmark was determined to determine whether the *E. coli* should be considered a drinking water Issue; The following report was referenced: LT1ESWTR Disinfection Profiling and Benchmarking. Technical Guidance Manual. US EPA. EPA 816-R-03-004. May 2003

Water Quality Issues Evaluation under the Clean Water Act

A similar approach was used to identify water quality Issues under the Clean Water Act as is described in the Technical Rules. The Ontario Drinking Water Quality Objectives (ODWQS) were used as benchmarks to evaluate Holmedale's raw water quality. Using the procedure described in the Technical Rules, the raw water quality was compared to Schedule 1, 2, and 3 of the Ontario Drinking Water Quality Standards (ODWQS) and Table 4 of the Technical Support Document for the Ontario Drinking Water Quality Standards, Objectives and Guidelines. Although the ODWQS are for treated water, the standards were used to flag parameters of concern that may be an Issue under the Clean Water Act. Generally, as an initial screening step, a value of half of the guideline or objective was used to flag a parameter for closer evaluation.

The following parameters were flagged and evaluated in more detail:

- Chloride;
- Sodium;
- Iron;
- Turbidity;
- Alkalinity;
- Organic Nitrogen;
- Dissolved Organic Carbon; and
- E.coli

An increasing trend was shown for both chloride and sodium in the raw water supply; however, in most of the samples the levels are generally below half of the aesthetic ODWQOs. Sodium and chloride are not identified as Issues under the Clean Water Act. However, it is recommended that these parameters continue to be monitored on a regular basis.

Elevated levels of iron and alkalinity (hardness) in the raw water supply are likely from natural sources and therefore are not considered Issues under the Clean Water Act. The elevated levels show no increasing or decreasing trend over time but should continue to be monitored on a routine basis.

Although turbidity levels in the raw water frequently exceed the ODWQS of 5 NTU (Nephelometric Turbidity Units), this benchmark is not suitable for evaluating whether turbidity is a source water quality Issue. Alternatively, the City of Brantford's water treatment staff set 20 NTU as an operational threshold. Although this operational threshold is exceeded frequently, generally during high flow events, it is felt that the high levels are attributed to natural causes, processes and sources and turbidity is not considered to be an Issue under the Clean Water Act.

Organic nitrogen levels in the raw water are generally above the operational guideline of 0.15 mg/L for treated water. These levels are likely from a combination of both natural and anthropogenic sources in a heavily developed watershed such as the Grand River. Although the periodic high levels in the raw water can affect the chlorine disinfection process, which can occasionally contribute to the generation of disinfection by-products, the study team felt that the high levels are attributed to a combination of both anthropogenic and natural sources and natural breakdown/decomposition processes. Organic nitrogen is not considered to be an Issue under Technical Rule 114 but is identified as an Issue under the Clean Water Act (Section 15(2)(f)) in this Assessment Report. The study team recommends further monitoring of organic nitrogen in the source water to determine any temporal trends at the drinking water intake and spatial trends in the watershed upstream of the intake.

Dissolved organic carbon levels in the raw water are frequently above the ODWQO for treated drinking water and generally follow a seasonal pattern with higher levels seen during spring runoff. This suggests that sources are likely natural. However, there can be anthropogenic sources as well. This parameter is not identified as an Issue under Technical Rule 114 but it is identified as an Issue under the Clean Water Act (Section 15(2)(f)) in this Assessment Report and it is recommended that this parameter continue to be monitored on a regular basis to determine any additional spatial or temporal trends in the source water.

E. coli levels in the raw water are highly variable yet do not appear to follow a seasonal pattern. Sources vary and are likely from both natural and anthropogenic sources. The benchmark used to evaluate *E. coli* in the raw water (200 cfu/100ml) is routinely exceeded with some levels detected in the raw water to be one to two orders of magnitude greater than the benchmark. Although E. coli levels are highly variable and exceed the proposed benchmark for the city of Brantford's source water, the study team felt that further monitoring is recommended to evaluate both temporal trends in source water at the drinking water intake and spatial trends throughout the watershed. Therefore, *E. coli* was not considered to be an Issue under Technical Rule 114 but rather an Issue under the *Clean Water Act, 2006* (Section 15(2)(f)) in this Assessment Report.

Summary of Water Quality Issues under the Clean Water Act

The review identified three water quality parameters of concern and are identified as Issues under the *Clean Water Act, 2006* under Section 15(2)(f): organic nitrogen, dissolved organic carbon and *E. coli*. It is understood that although there are anthropogenic sources of these parameters, there are many natural sources that can contribute to the elevated levels seen at the intake. Further, more detailed spatial and temporal monitoring is recommended over the next few years.

Although sodium, chloride, and dissolved organic carbon were also parameters that were identified as requiring further, more intensive monitoring at the intake to determine any temporal trends, they are not identified as Issues under the *Clean Water Act, 2006*.

Limitations and Uncertainty for the Water Quality Issues Evaluation under the Clean Water Act

There are no significant gaps with respect to the characterization of drinking water quality at the Holmedale water treatment plant. The City of Brantford maintains a comprehensive drinking water quality monitoring program to identify any water quality parameters that might exceed drinking water standards or show a trend of exceeding those standards in the future. However, additional monitoring is recommended in the upstream watershed to characterize sources – both natural and anthropogenic – of parameters of concern or Issues identified in under the *Clean Water Act, 2006* under Section 15(2)(f).

The uncertainty with respect to the identification of drinking water quality Issues is low as the conclusions are supported by consistent water quality monitoring trends. The Issues identified under the *Clean Water Act, 2006* have been concerns of the City over a relatively long period of time.

15.1.8 Enumeration of Significant Drinking Water Quality Threats for the Holmedale Water Treatment Plant

The threats assessment was completed based on the vulnerability attributed to the intake protection zones.

Data Sources for the Enumeration of Significant Drinking Water Quality Threats

The following data and information sources were queried to identify significant threats for the Holmedale WTP:

- Federal Contaminated Sites Inventory;
- National Pollutant Release Inventory (NPRI);
- Tables of Drinking Water Threats (November 2009);
- Municipal Parcel Information from the Municipal Property Assessment Corporation;
- City of Brantford zoning and GIS dataset;
- Waste disposal Inventory (Ministry of the Environment);
- Gore & Storrie Limited. 1994. Abandoned Landfill Sites Investigation – City of Brantford.
- Windshield survey of land use;
- Wastewater Treatment Plant Operator and Municipal Staff interviews;
- MOE data from district offices ('Data Hound' project);
- PCB Inventory (Ministry of the Environment);
- Agricultural Census (Statistics Canada)

According to the MECP's Table of Drinking Water Threats, a vulnerability score of 10 for the IPZ-1, 9.0 for the IPZ-2 and 8.0 in some areas within IPZ-3 means that there are significant threats for these vulnerable areas. A list of all significant threat types are shown in **Table 14-8.**

Table 14-8: Significant Drinking Water Quality Threats for the Holmedale Intake Protection Zones

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage System Or Sewage Works - Discharge Of Untreated Stormwater From A Stormwater Retention Pond	3	IPZ-2
	Sewage System Or Sewage Works - Sewage treatment plant bypass discharge to surface water	4	IPZ-2 IPZ-3
	Sewage System Or Sewage Works - Sewage Treatment Plant Effluent Discharges (Includes Lagoons)	4	IPZ-2 IPZ-3
3	Application Of Agricultural Source Material (ASM) To Land	29	IPZ-2
4	Storage Of Agricultural Source Material (ASM)	34	IPZ-2
10	Application Of Pesticide To Land	194	IPZ-1 IPZ-2
14	Storage Of Snow	1	IPZ-2
17	Storage Of An Organic Solvent	2	IPZ-1
21	Management Or Handling Of Agricultural Source Material - Agricultural Source Material (ASM) Generation (Grazing and pasturing)	2	IPZ-2

Table 14-8: Significant Drinking Water Quality Threats for the Holmedale Intake Protection Zones

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
	Management Or Handling Of Agricultural Source Material - Agricultural Source Material (ASM) Generation (Yards or confinement)	2	IPZ-2
Total Number of Activities		**273**	
Total Number of Properties		**195**	

1: Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 287/07s.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.

Note: Certain types of activities on residential properties that are incidental in nature and that are significant drinking water threats are not enumerated. These threats include the application of commercial fertilizer on residential properties, the storage of organic solvents (dense non-aqueous phase liquids) on residential properties, and the storage of fuel (e.g., heating fuel tanks) on residential properties in natural gas serviced areas.

Note: Storm sewer piping is not considered to be part of a storm water management facility.

The significant chemical drinking water quality threats identified for the Holmedale IPZ-1 occur on 61 properties while 134 properties had a significant chemical and/or pathogen threat in the IPZ-2. An additional 1 property was identified with significant chemical and pathogen threats in IPZ-3. There were no pathogen threats in the IPZ-1. Additional significant threats in IPZ-1, -2 and -3 are likely to be identified in association with Issues. This work will be included in an updated Assessment Report.

This desk-top threats assessment used many assumptions to count potential significant threats in the IPZs. For example, it was assumed that the management of agricultural source material-generation for livestock grazing was sufficient to generate nutrients at an annual rate that is more than 1 NU per acre. Similarly, it was assumed that all open areas or agricultural areas applied pesticides; open areas had stormwater management facilities that discharged untreated stormwater; all agricultural lands had either permanent or temporary storage of agricultural source materials; and that snow is stored at the municipal airport. Further investigation is needed to confirm or refute these identified significant threats.

Limitations, Data Gaps and Uncertainty in the Enumeration of Significant Drinking Water Quality Threats

The uncertainty of the drinking water threats analysis is a qualitative assessment based on the data used and the methodology and assumptions used to analyze the data. The data used for the threats determination is considered to have low uncertainty. However, the uncertainty of the methodology used to identify threats is considered to be 'high' as landowners have not been contacted to confirm or refute the presence of a land use threat.