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15.0 SIX NATIONS OF THE GRAND RIVER

15.1 Ohsweken Water Treatment Plant System

The Ohsweken Water Treatment Plant (WTP) is an existing First Nations drinking water system (**Table 15-1**). According to the Clean Water Act, subclause 15(2)(e), this system is classified as Type IV i.e. "existing and planned drinking-water systems prescribed by the regulations that serve or are planned to serve reserves as defined in the Indian Act (Canada)".

Table 15-1: Ohsweken Municipal Residential Drinking Water System

DWS Number	DWS Name	Operating Authority	GW or SW	System Classification[1]	Number of Users Served
230000174	Ohsweken Water Treatment Plant	Six Nations of the Grand River	SW	Non-Municipal Year-Round Residential System	2,000

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

The Six Nations of the Grand River owns and operates the Ohsweken water system, which consists of one water treatment plant (WTP) and one water distribution system. As part of their water supply system, Six Nations operates a Type C surface water intake drawing water from the Grand River at Ohsweken upstream of the Chiefswood Road crossing, as shown on **Map 15-1**.The WTP has a design capacity of 1,040 m^3/day and serves a population of approximately 2,000. For the last three years, the WTP plant has been in 24 hr/day operational status, though staff are not on-site at all times. A SCADA system permits operations management and personnel to complete certain duties, including intake shut-down, from remote locations. On-call operations personnel are expected to remain within an approximate 0.5 hour travel radius of the WTP. Formal protocols for emergency operations have not been documented, providing the management and operations team the flexibility to respond to a wide variety of conditions as necessary.

The communal system primarily serves the village of Ohsweken. Users include schools, a shopping and services plaza, businesses, an arena and about 1,500 homes. About 25% of the community gets water from the communal system either in their residences or by virtue of attending work or school in the village. Those Six Nations residents who live too far from town to be on the communal system rely on wells or cisterns for their water needs; however, it is recognized that many families that do not have water services, obtain treated drinking water from registered water truck haulers that distribute treated drinking water from the Ohsweken WTP throughout Six Nations.

Following treatment at the WTP, water is conveyed via a 12" diameter main approximately 3.5 km west to an elevated reservoir providing 250,000 gallon of storage. As this reservoir has limited capacity (estimated at 7 hours), and to deal with emergency supply requirements (e.g. fire supply), the system is operated so as to keep supply as full as possible. Operators noted that community co-operation is understood and implemented during times of high demand identifying measures such as cutting-off of truck-delivered supply, shutting down of car washes, and laundromats limiting machine availability.

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

- Stantec Consulting Ltd. Six Nations of the Grand River – Intake Protection Zones Study,

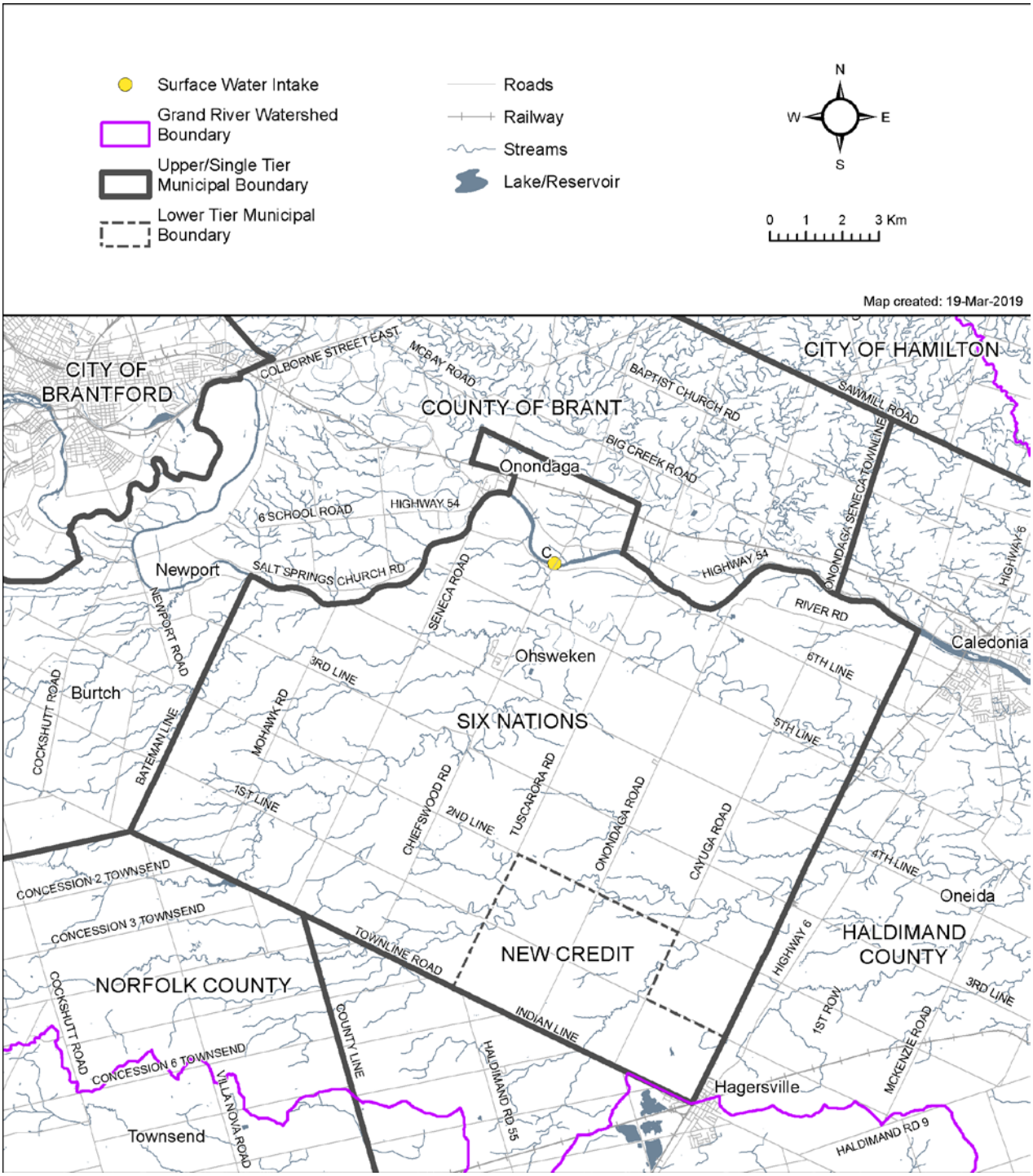
Grand River Surface Water Intake at Ohsweken, September 2010.

15.1.1 **Intake Protection Zone - 1**

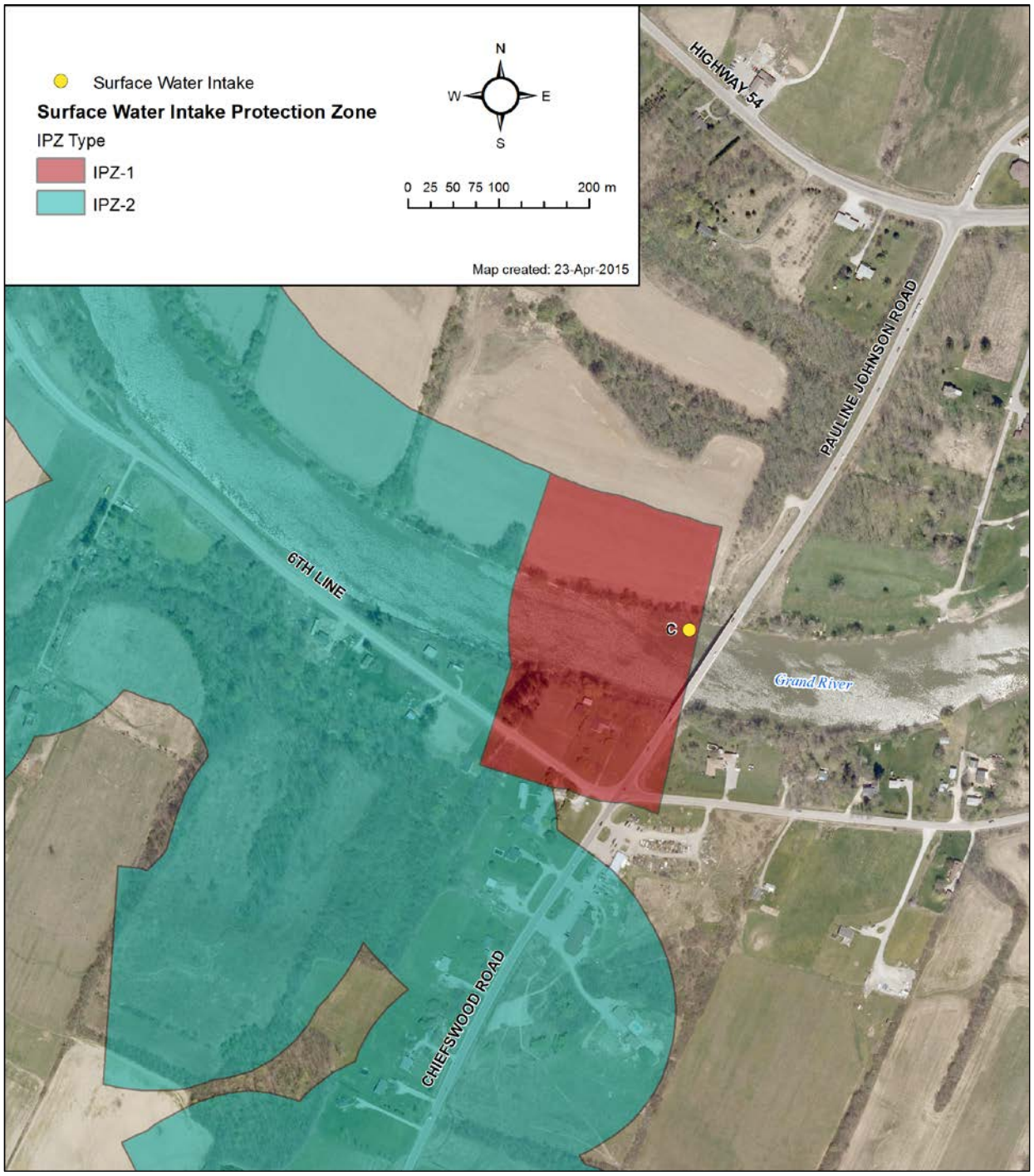
Although the Clean Water Act classifies the Ohsweken drinking water system as Type IV, the Technical Rules only refer to Type I, II or III systems. Therefore, the rules for a Type I system (municipal residential) have been applied in delineating the IPZs. The IPZ-1 represents the area directly adjacent to the drinking water intake, generally considered to be the most vulnerable given the geographic proximity.

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. The IPZ-1 for the Ohsweken Intake has been delineated in general accordance with the requirements of the Technical Rules. **Map 15-2** shows the delineation of IPZ-1 for the Ohsweken Grand River intake.

Map 15-1: Six Nations of the Grand River Territory



Map 15-2: Ohsweken Water Supply Intake Protection Zone 1



15.1.2 Intake Protection Zone - 2

An IPZ-2 was delineated in accordance with the Technical Rules. To maximize the volume of treated water in storage in the event of an upstream spill or other notice of impaired water quality and provision for operator response, an 8-hour time-of-travel was determined to be reasonable for the purposes of IPZ-2 delineation.

Substantial field and analytical efforts were completed in support of the delineation of the IPZ-2, with a general focus on deriving the design flow rate of concern, the water velocities associated with this flow rate, and the travel distance that such flows could cover in 8 hours. The work used a variety of approaches including in-situ dye tracer studies, statistical analysis of historic gauge flows and hydraulic model calibration in the Grand River and Fairchild Creek systems.

The dye tracer work, while completed at a non-ideal low-flow regime, did serve to illustrate general mixing and dispersion characteristics of the Grand River and Fairchild Creek systems, and provided a baseline for assessing the general level of calibration within the hydraulic model. Statistical analysis of historic flow data on the gauges determined a 95th percentile, or bankfull flow of 230 m^3/s for the Grand River between Brantford and York, and 14.4 m^3/s for Fairchild Creek.

Based on these flows, the 8-hour travel distance up the Grand River from the intake was estimated through the use of a calibrated HEC-RAS hydraulic model at 25.8 km. Similar analysis on Fairchild Creek determined an upstream travel distance of 8.5 km from its confluence with the Grand River. Stream velocities were calculated for the smaller tributaries using Manning's equation. Estimated roughness coefficients, Manning's "n" values, slopes calculated from OBM mapping and hydraulic radius coefficients were based on other local watershed streams with similar characteristics as those in the study area.

Transport pathways assessed upstream of the subject intake include tributary watercourses, ditches, and drains, where appropriate and adequate information was available. Following discussions with the Study Team, and in recognition of the lack of available detailed data regarding location and design, tile drain systems were specifically excluded from inclusion within the IPZ-2 delineation.

Storm sewers were identified near the uppermost limits of the IPZ-2 on the Grand River. While sufficient detail on these systems was provided to permit a general protection zone delineation, additional survey work should be completed to reduce the uncertainty in this area.

The IPZ-2 limits along the main river and its tributaries, as shown in **Map 15-3**, were defined as the greater of the limits of the GRCA's Regulation Limit or a 120 m setback from the watercourse, in accordance with Technical Rule 65.

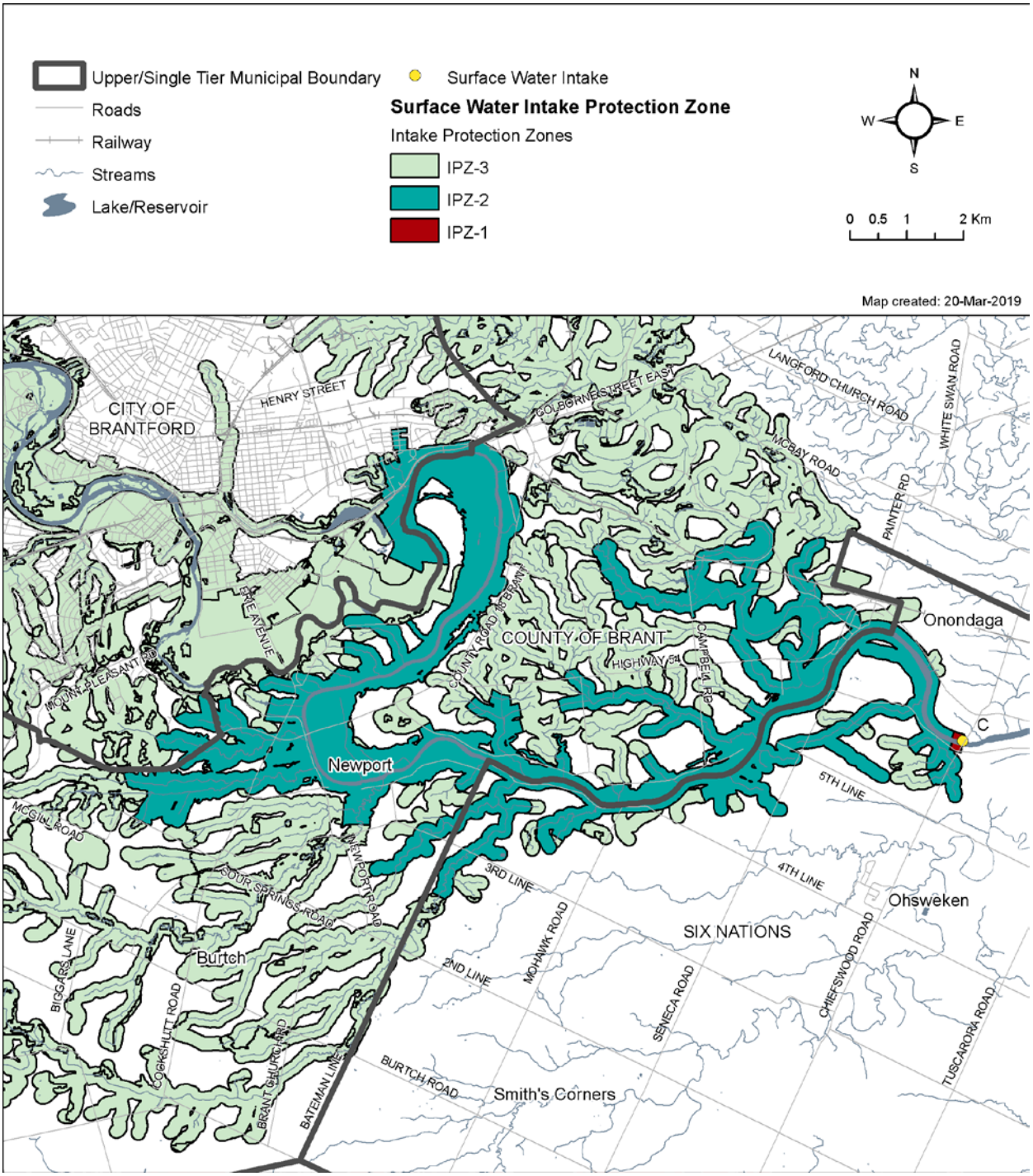
15.1.3 Intake Protection Zone - 3

IPZ-3 for the Ohsweken 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.

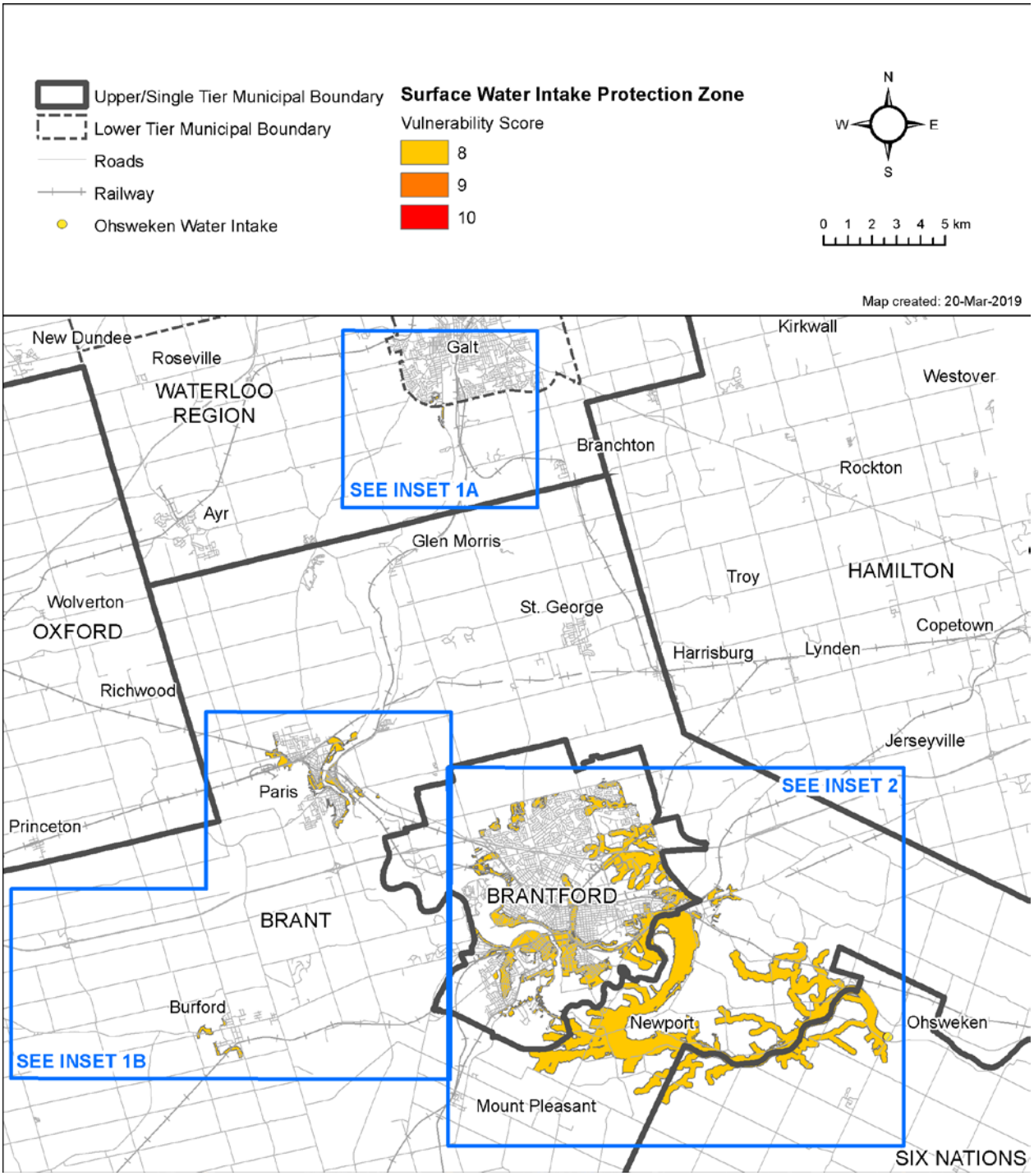
For the purposes of delineating the IPZ-3 for the Ohsweken WTP, the MNR Water Virtual Flow – Seamless Provincial Data Set and Water Poly Segment GIS data layers from the Ontario Land Information Warehouse was used to identify water bodies upstream of IPZ-2 that may

contribute water to the intake. The IPZ-3 area along the main river and its tributaries is shown in **Map 15-7, Map 15-8, and Map 15-9**.

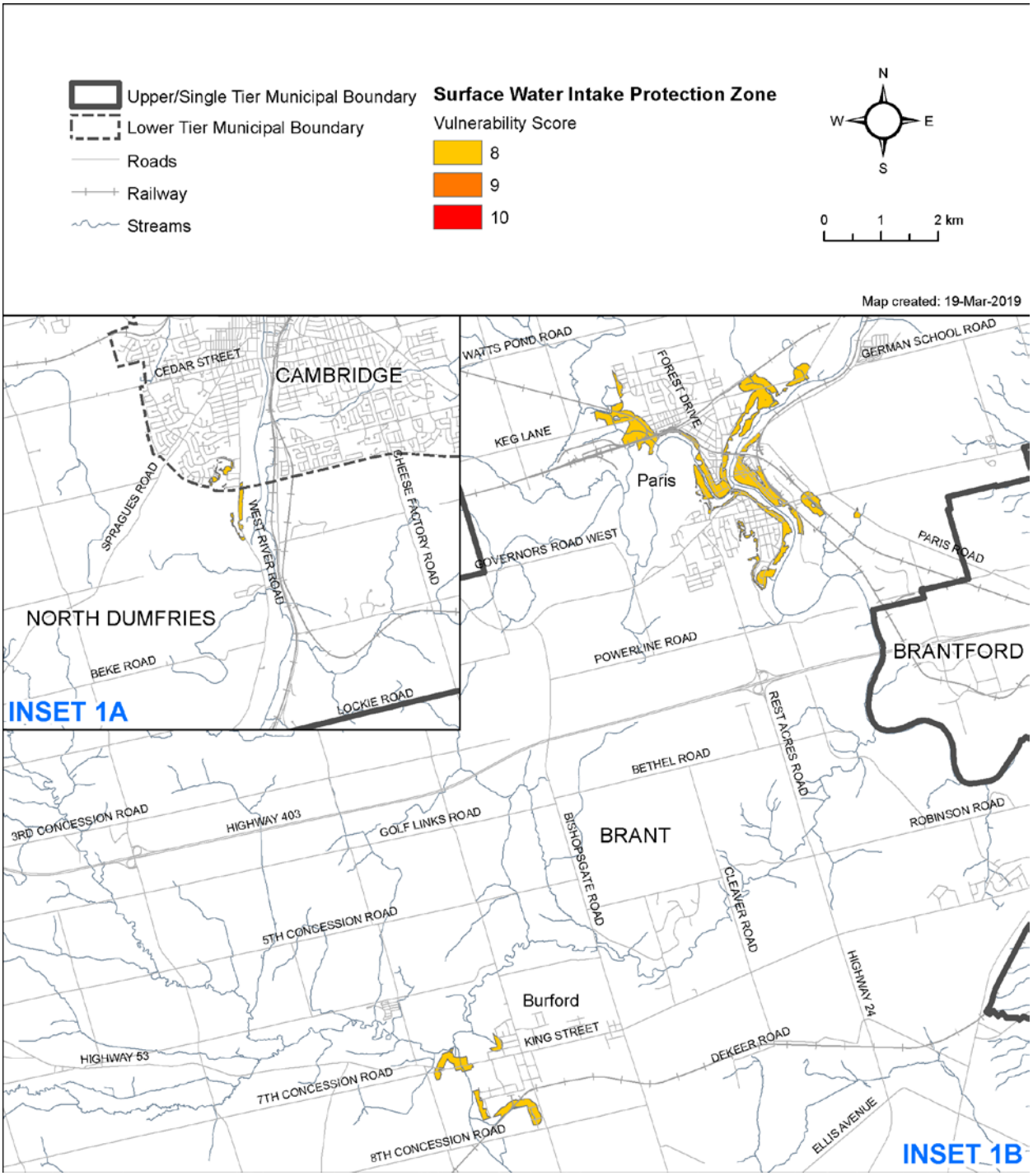
Map 15-3: Ohsweken Water Supply Intake Protection Zone 2



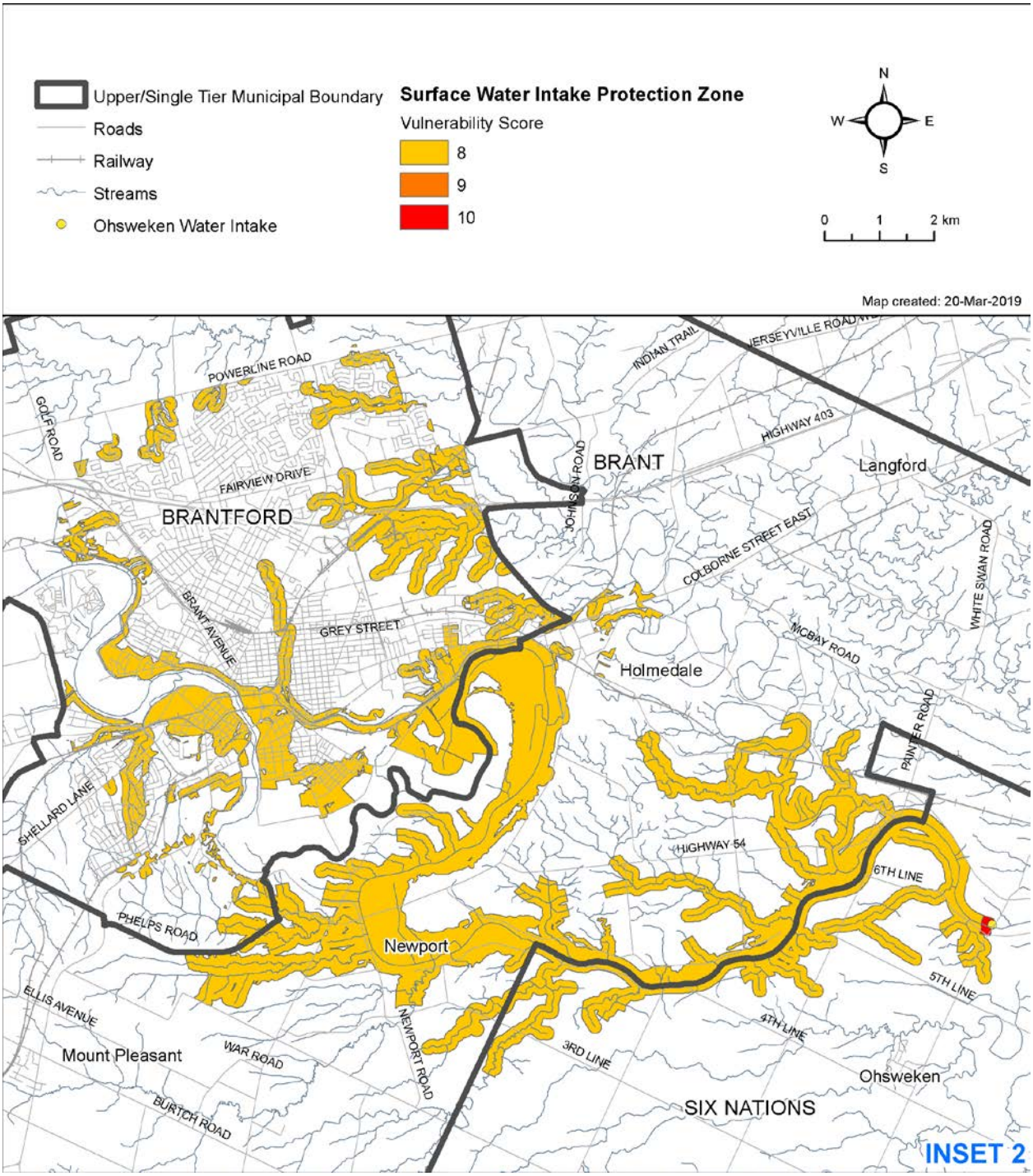
Map 15-4: Ohsweken Water Supply Intake Protection Zone 2 Vulnerability Key Map



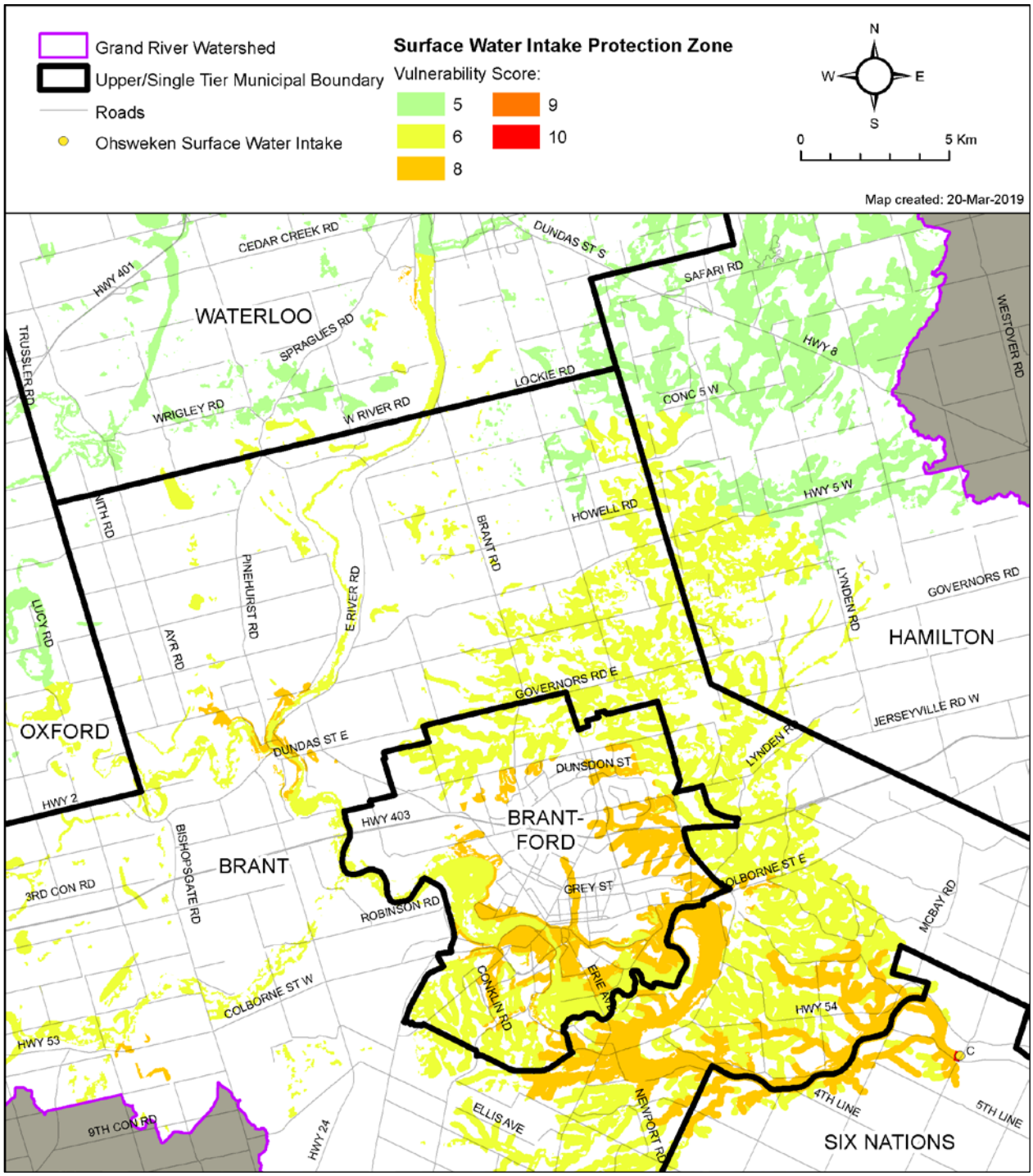
Map 15-5: Ohsweken Water Supply Intake Protection Zone 2 Vulnerability Inset 1A&B



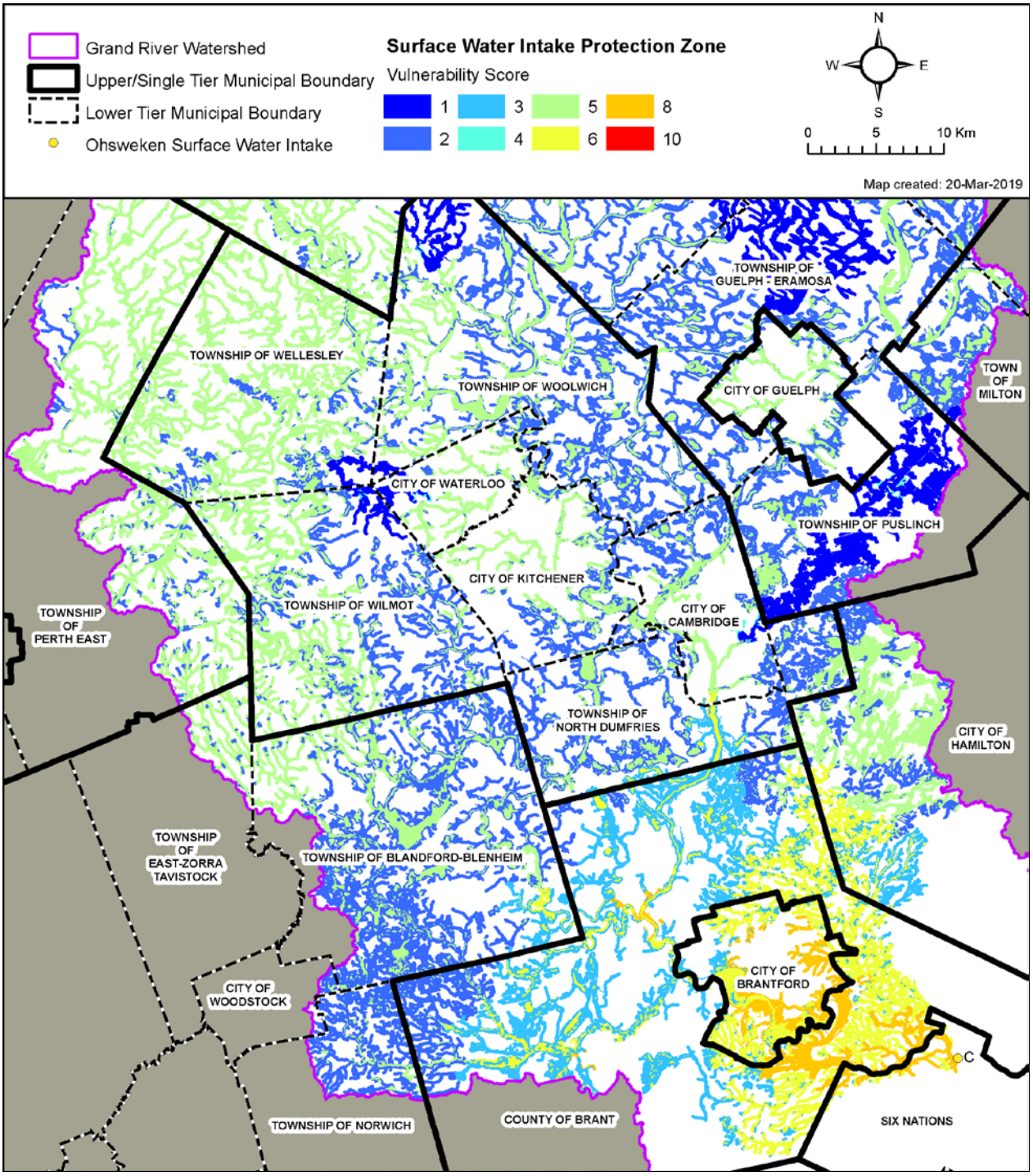
Map 15-6: Ohsweken Water Supply Intake Protection Zone 2 Vulnerability Inset 2



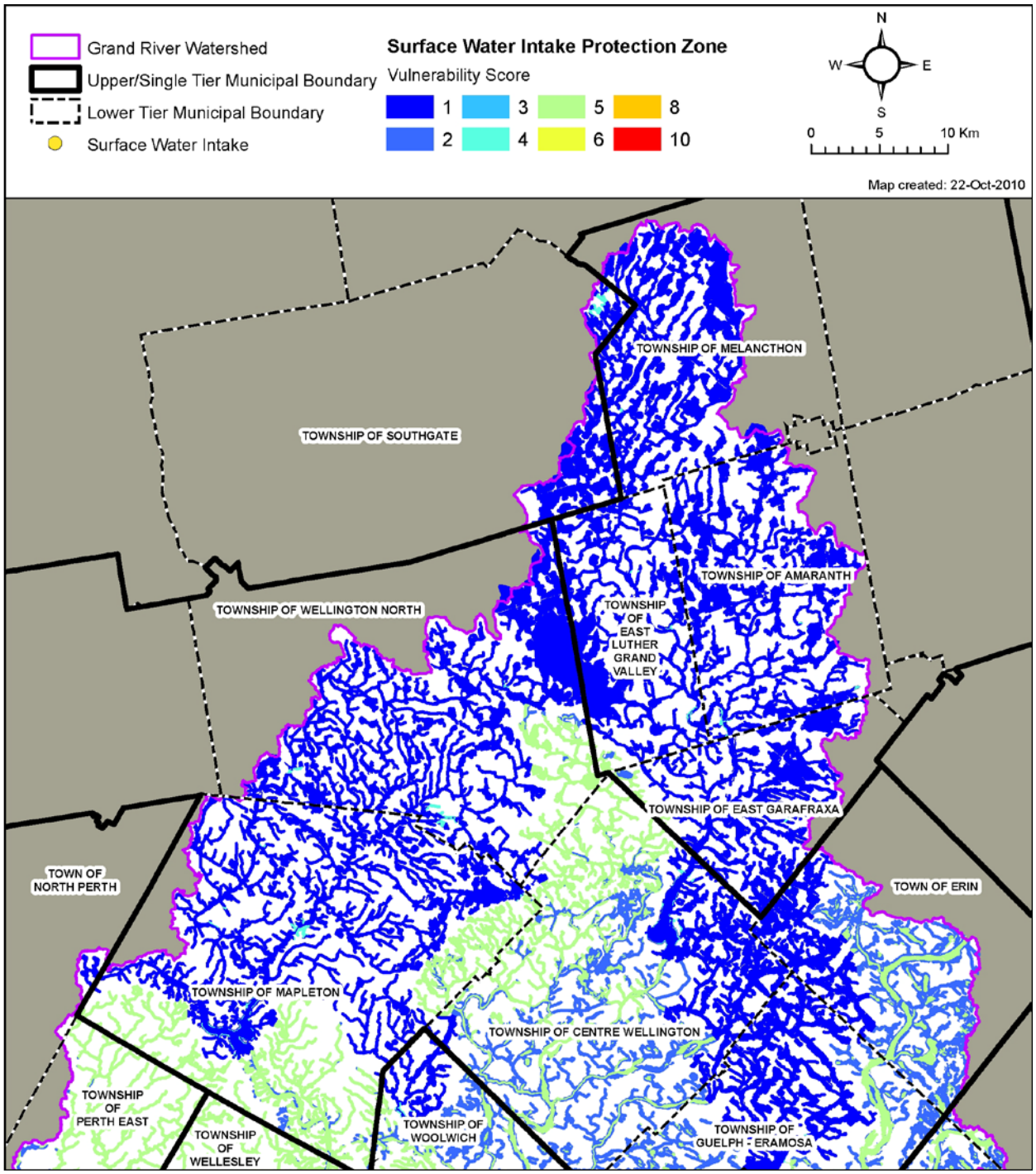
Map 15-7 Ohsweken Water Supply Intake Protection Zone 3 with Vulnerability Score of 5 or Higher (1 of 3)



Map 15-8: Ohsweken Water Supply Intake Protection Zone 3 (2 of 3)



Map 15-9: Ohsweken Water Supply Intake Protection Zone 3 (3 of 3)



15.1.4 Vulnerability Assessment

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 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 including the depth of the intake, the distance of the intake from land, and the history of water quality concerns at the intake. The community of Ohsweken 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 village's supply is completely dependent on the quantity and quality of the Grand River as it flows through the reserve.

Through discussions with the Water Treatment Plant supervisory staff and a cursory review of as-built engineering drawings available at the water plant completed by GRCA personnel, some details regarding the intake's physical characteristics were obtained. From a vulnerability assessment perspective, the location of the intake adjacent to the bank does not provide extensive protection from any on land threats in the vicinity of the intake, though the submerged characteristic provides an element of protection against the intake of floatable contaminants.

The lack of direct information pertaining to known water quality issues at the intake yields further uncertainty. Nevertheless, it is known that the intake is located downstream of a heavily impacted watershed with associated impacts on water quality that affect the vulnerability of the source. There are frequent occurrences of upstream spills and sewage bypasses; and the quality of the raw water (i.e. Grand River) already has elevated concentrations of some water quality parameters. Therefore, 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 8 was assigned. The following was considered in the scoring for the area vulnerability factor:

- most of IPZ-2 is land draining mostly treed and rural land uses;
- small urban area influence at the uppermost area of the IPZ-2;
- moderate number of transport pathways (e.g. tile trains); and
- the area immediately above the intake tends to have higher runoff potential due to the Haldimand Clay plain;

Table 15-2 summarizes the vulnerability factors and overall score for the intake.

Table 15-2: Ohsweken Grand River Intake Vulnerability Score

Intake Protection Zone	Area Vulnerability Factor	Source Vulnerability Factor	Vulnerability Score
IPZ-1	10	1.0	10
IPZ-2	8	1.0	8

Generally, the area vulnerability scoring for IPZ-3's was approached consistently across the Lake Erie Source Protection Region. In addition to the criteria used for determining the area vulnerability score for IPZ-2, the proximity of the area to the intake was also included as a criterion as per Technical Rule 92.

The IPZ-3 for Ohsweken is extensive – it covers an area of about 5700 km^2 or $^5/_6{}^{ths}$ of the entire Grand River watershed and extends up the Grand, Nith, Speed, and Conestogo Rivers, Fairchild Creek as well 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 Ohsweken, IPZ-2 extends approximately 25.8 km from the intake up the Grand River. ~~Rationale for using twice the travel distance will be copied from Sandra's final comments addressing the same point for the Brantford IPZ.~~ The 'close' zone was therefore defined as any watercourse within 51.6 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 while those areas with low runoff scored a lower vulnerability score. Proximity and runoff potential was combined to yield overall vulnerability scores for each zone. **Table 15-3** summarizes the vulnerability scores for each zone.

Table 15-3: IPZ-3 Vulnerability Scores for the Ohsweken WTP

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 and Livestock Density within the Ohsweken Intake Protection Zones

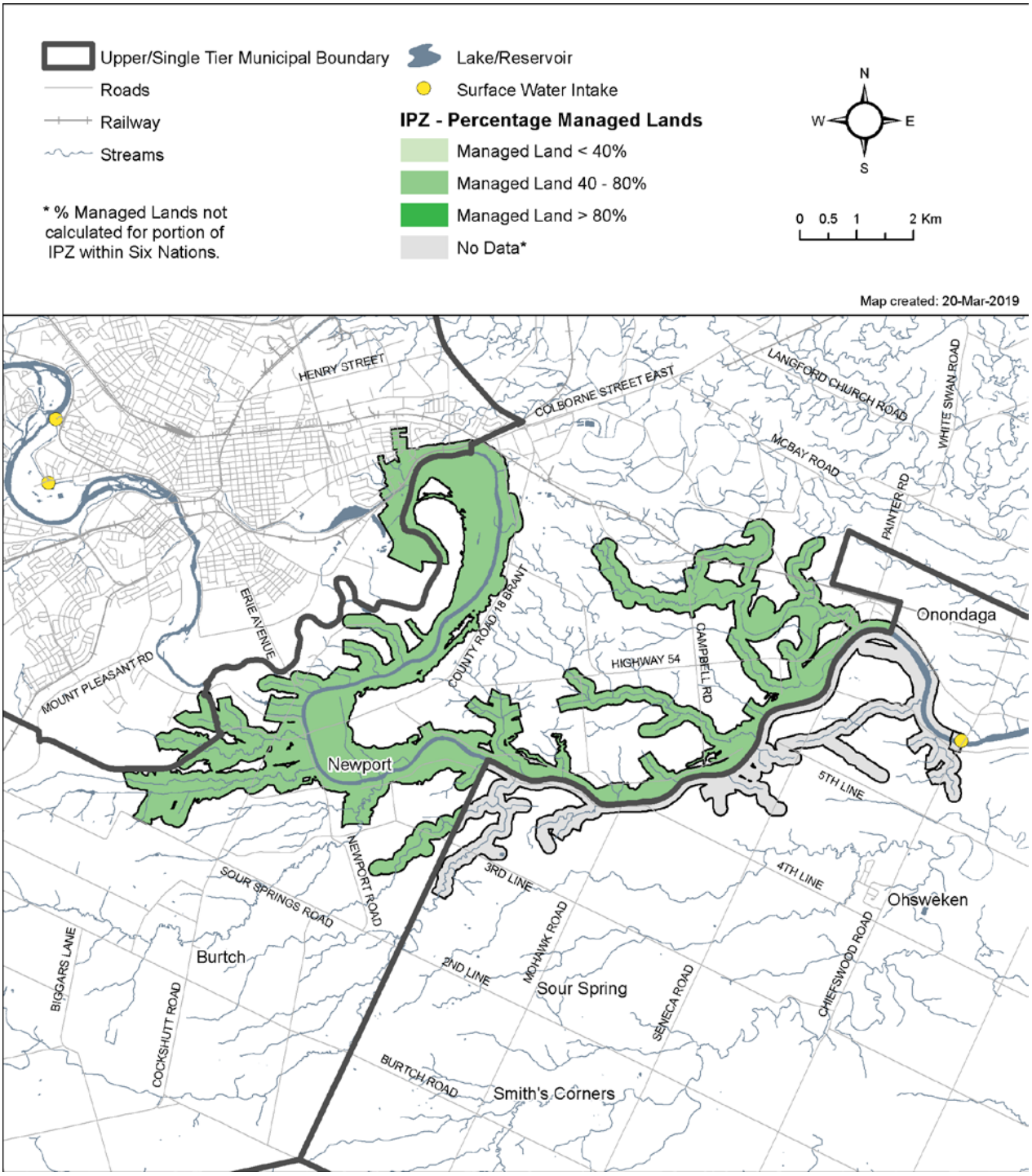
This task was undertaken using aerial photography and GIS-based image classification to determine the percentages of agricultural and non-agricultural managed lands within the off-reserve portions of the IPZ-2. Non-agricultural lands were comprised of lawns on residential, commercial, industrial, and institutional properties, as well as golf courses and lawn space that fell into a category of "other" (e.g. boulevards and unspecified grassed areas). Results of the percent managed lands analysis are summarized in **Table 15-4** and **Map 15-10** for IPZ-1 and IPZ-2. The managed lands for IPZ-3 are shown on **Map 15-11 and Map 15-12.**

Table 15-4: Managed Lands Analysis Results

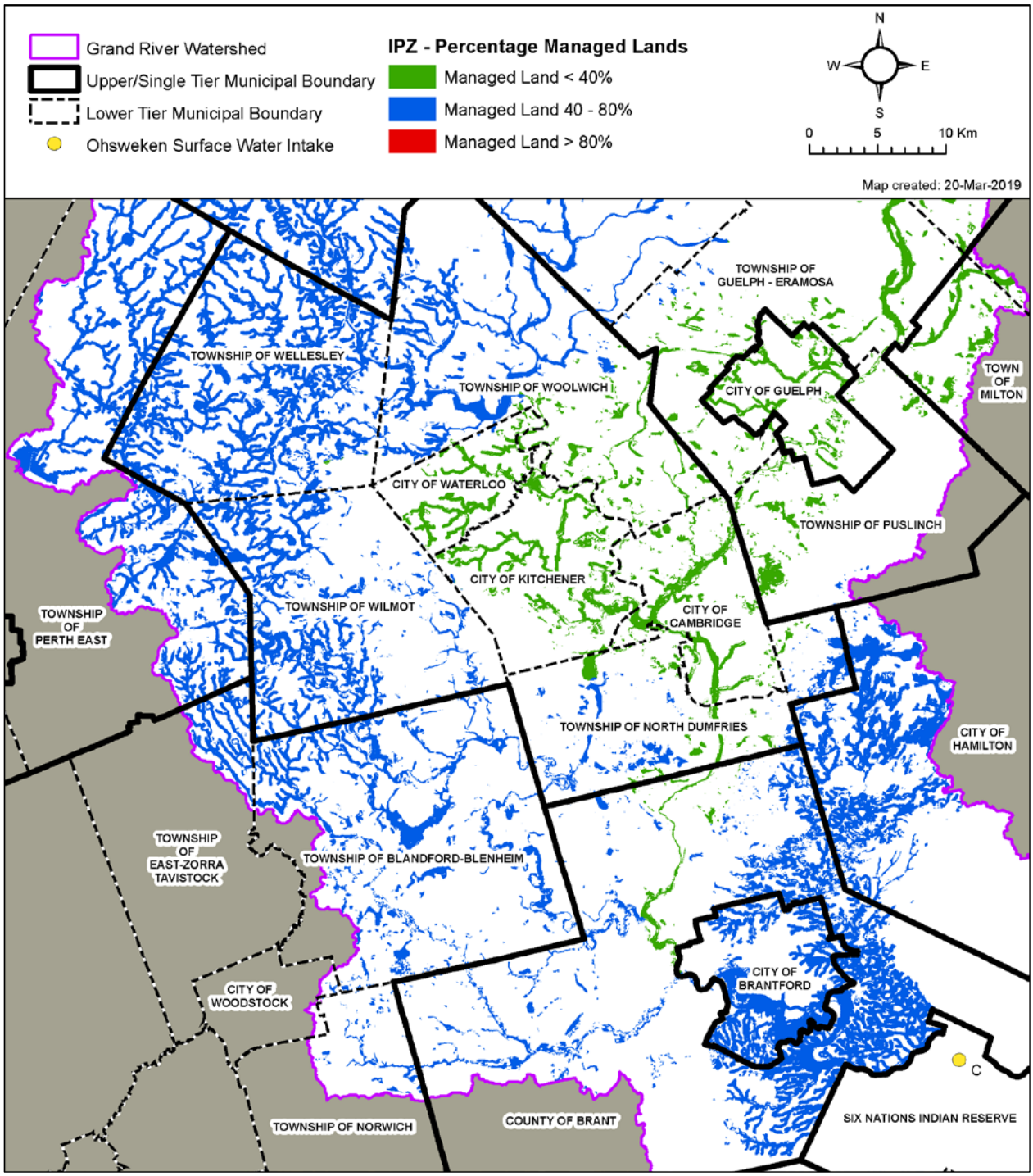
Parameter	Off-Reserve IPZ-2 Lands	Agricultural Lands		Non-Agricultural Lands		Total Managed Lands
		Total	Managed	Total	Managed	
Area (Acres)	7,726	5,683	4,800	2,042	431	5,231
% of Total Off- Reserve IPZ		-	62	-	6	68

There are no livestock within the IPZ-1. Based on the data from the 34 farm properties identified through the roadside survey and the nutrient unit analysis, the calculated total Nutrient Units/Acre for the off-reserve IPZ-2 is 0.28 is shown in **Map 15-13.** The managed lands for IPZ-3 are shown on **Map 15-14** and **Map 15-15**.

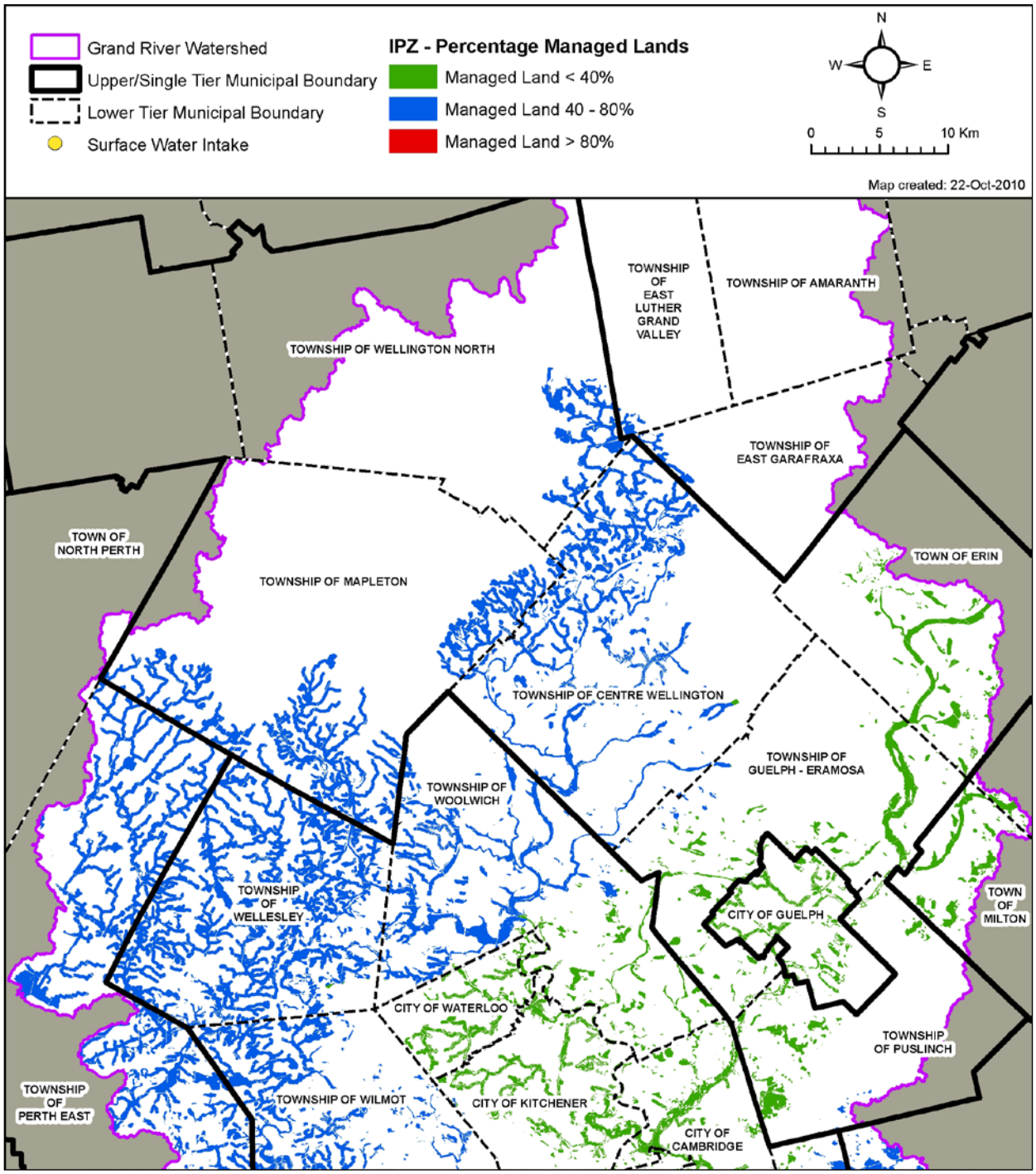
Map 15-10: Ohsweken Water Supply IPZ-1 and IPZ-2 Percent Managed Lands



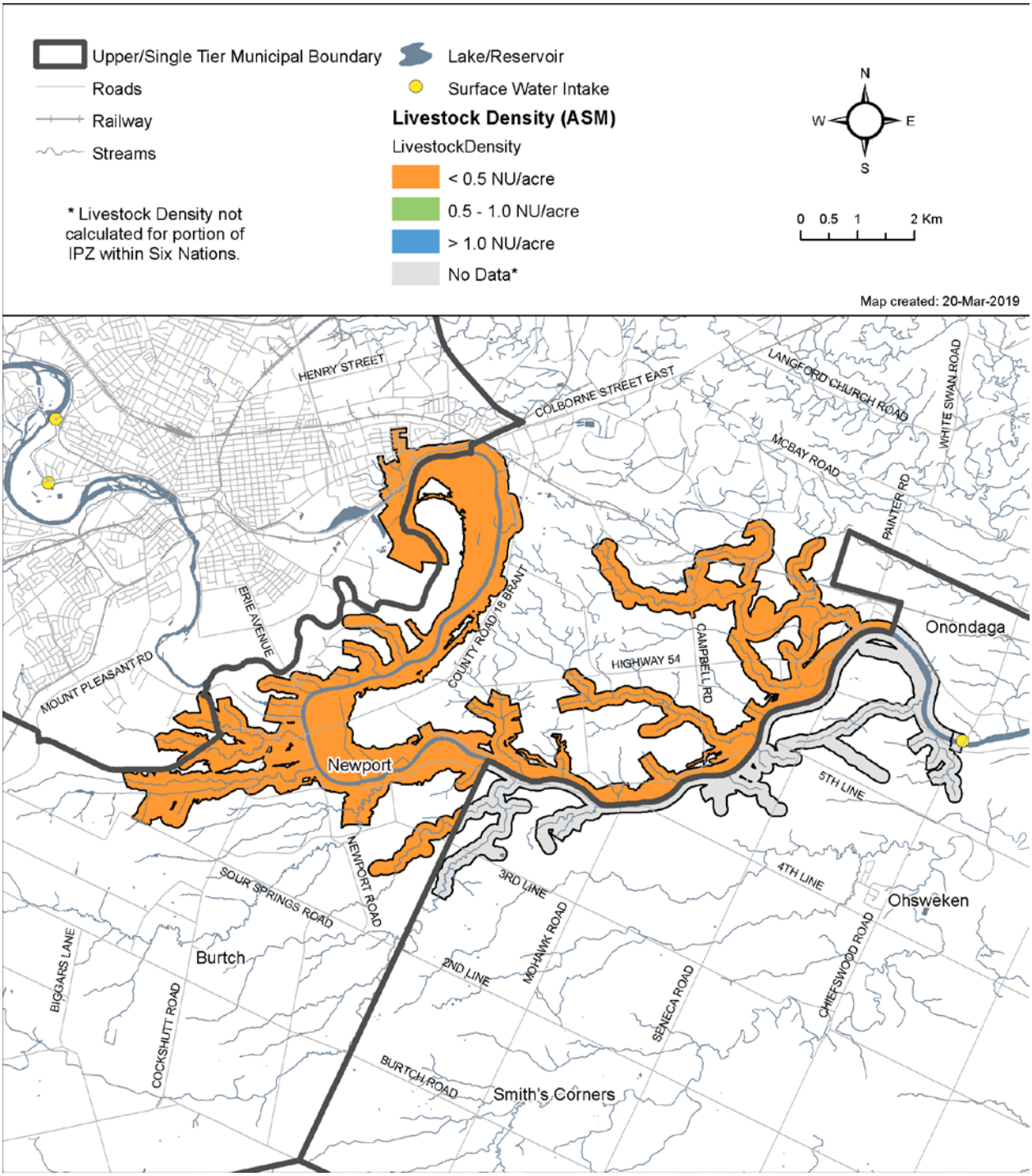
Map 15-11: Ohsweken Water Supply IPZ-3 Percent Managed Lands (1 of 2)



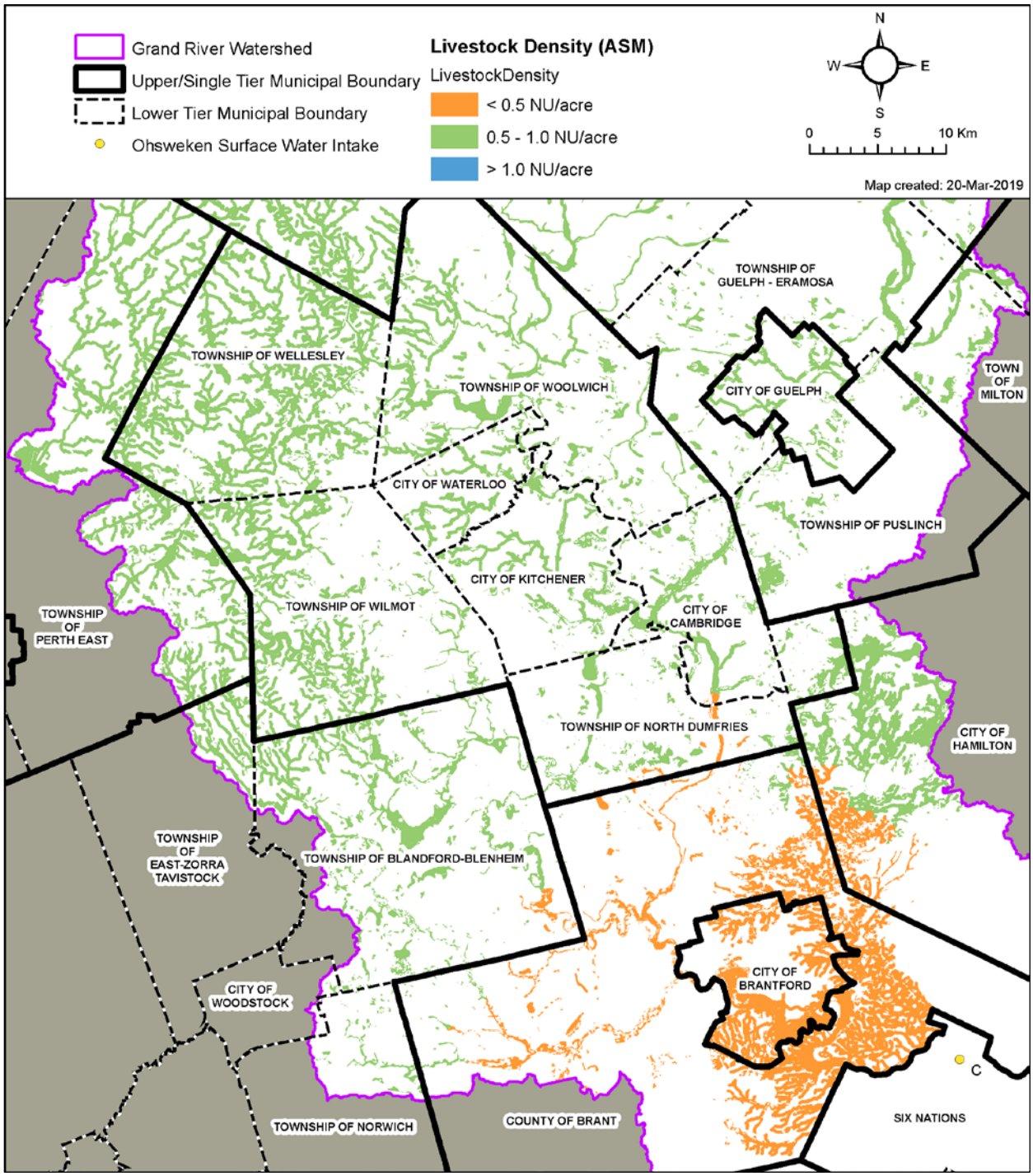
Map 15-12: Ohsweken Water Supply IPZ-3 Percent Managed Lands (2 of 2)



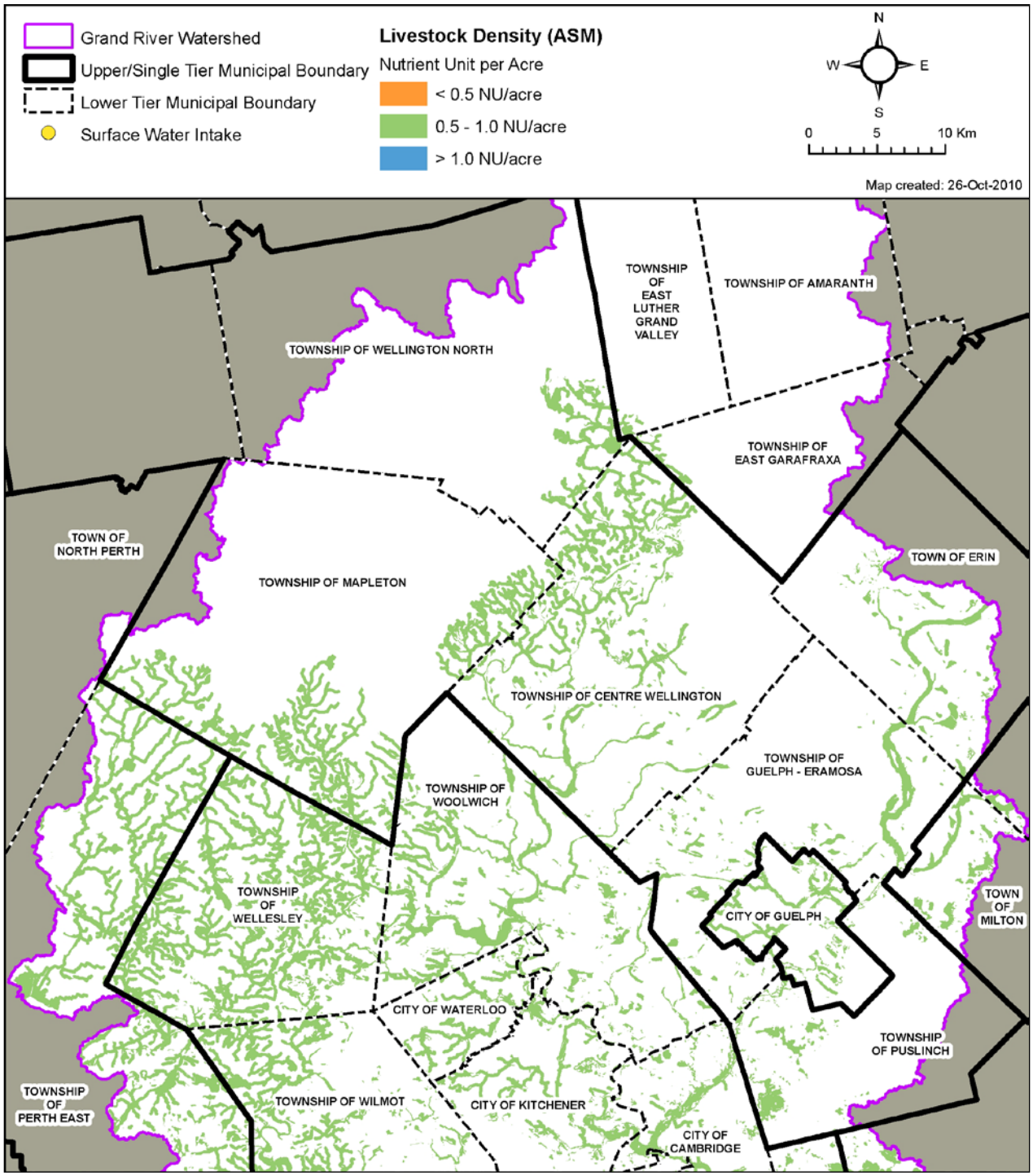
Map 15-13: Ohsweken Water Supply IPZ-1 and IPZ-2 Livestock Density



Map 15-14: Ohsweken Water Supply IPZ-3 Livestock Density (1 of 2)



Map 15-15: Ohsweken Water Supply IPZ-3 Livestock Density (2 of 2)



Percent Impervious Surfaces within the Ohsweken Intake Protection Zones

To calculate the percent impervious surfaces, information on land cover classification was used. The Southern Ontario Land Resource Information system (SOLRIS) represents the land surface data, including road and highway transportation routes, as continuous 15x15 metre grid cells with land cover classifications. All the cells that represent highways and other impervious land surfaces used for vehicular traffic were re-coded with a cell value of 1 and all other land cover classifications were given a 0 value, to identify only the road areas.

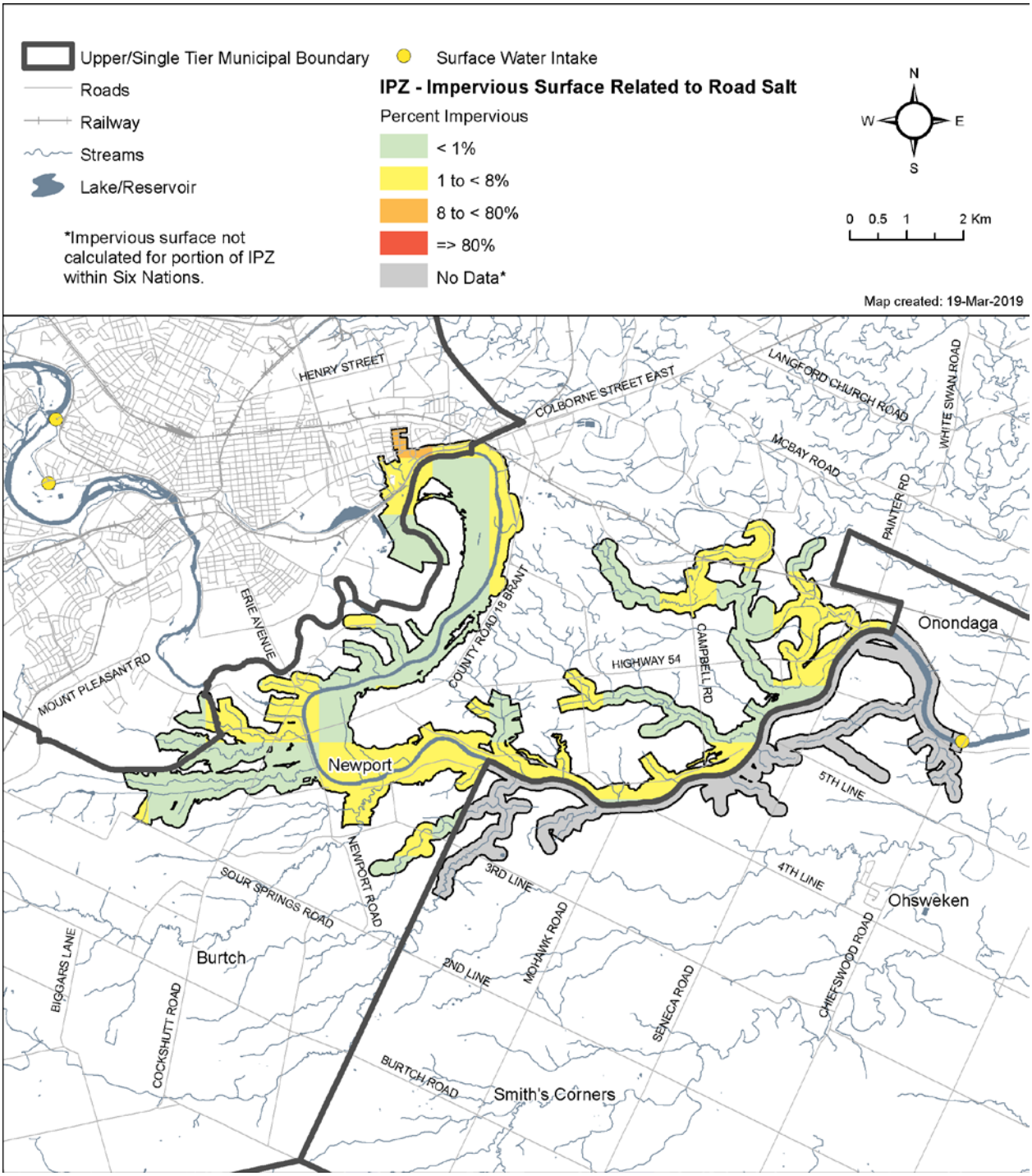
Using the Spatial Analyst module of ArcGIS software, the total number of road cells was summed for each grid cell centred on a square kilometre area surrounding it. The summed value for each cell in the output equaled the total number of road cells within each 1km x 1km window. The value of summed cells was converted to the square kilometre equivalent to determine the percentage of impervious road surface per square kilometre. The analysis is the most representative analysis of road density and adheres to the principle of the Technical Rules.

See **Map 15-16** for the impervious area percentages for IPZ-1 and IPZ-2. See **Map 15-17** and **Map 15-18** for the impervious area percentages for IPZ-3.

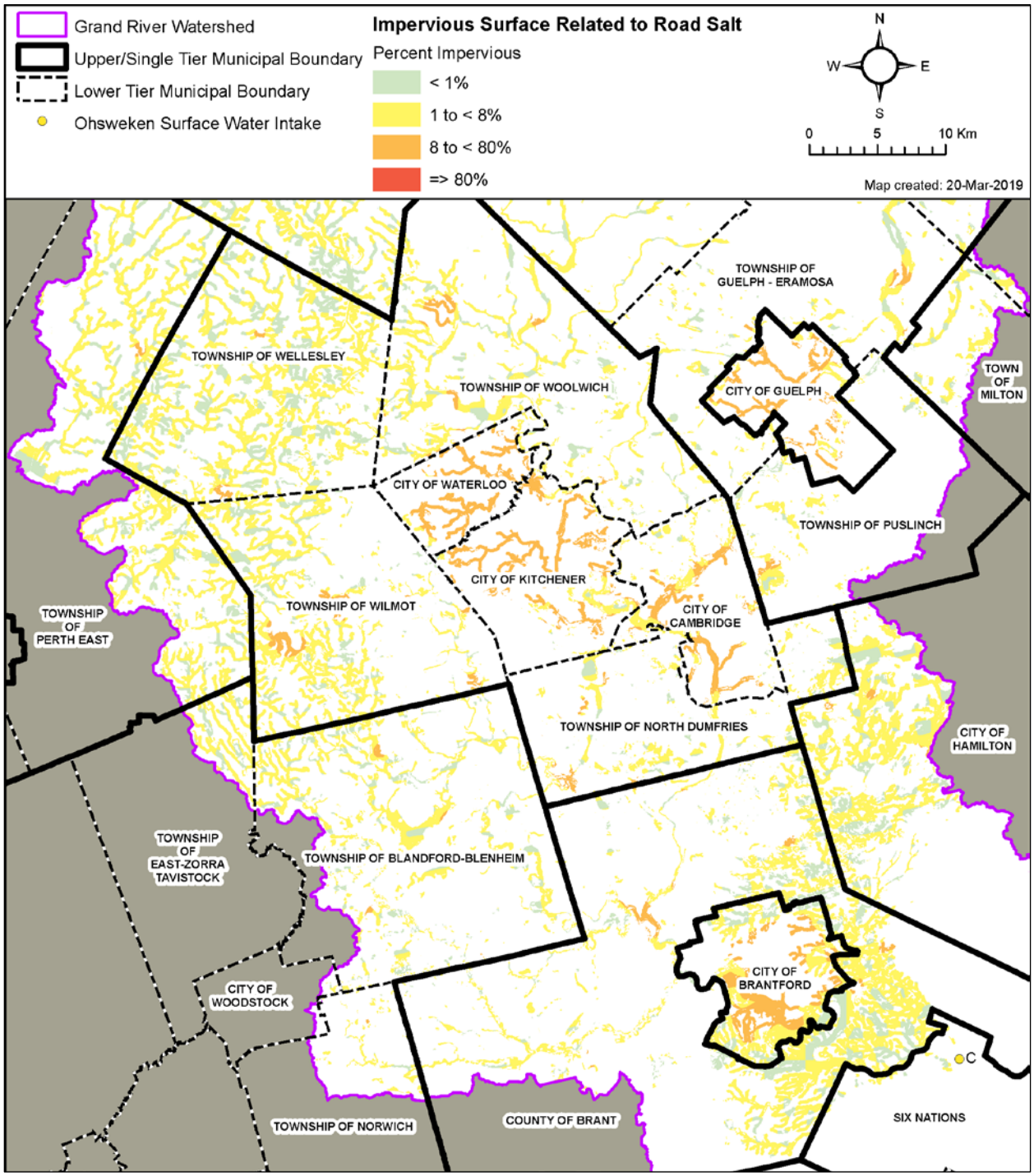
Key results of the impervious area estimation exercise include:

- A total of 91 individual 1 km^2 areas were required to cover the off-reserve IPZ-2 delineated area. As the perimeter of the IPZ-2 zone is not linear, many of the individual grid units were only partially covered by the IPZ-2 area.
- 48 grid units contained percent impervious area of < 1%;
- 39 areas contained percent impervious area between 1 - 8%;
- 4 areas indicated percent impervious area between 8 - 80% (max. observed is 14.0%, and;
- 0 areas contained percent impervious area > 80%.

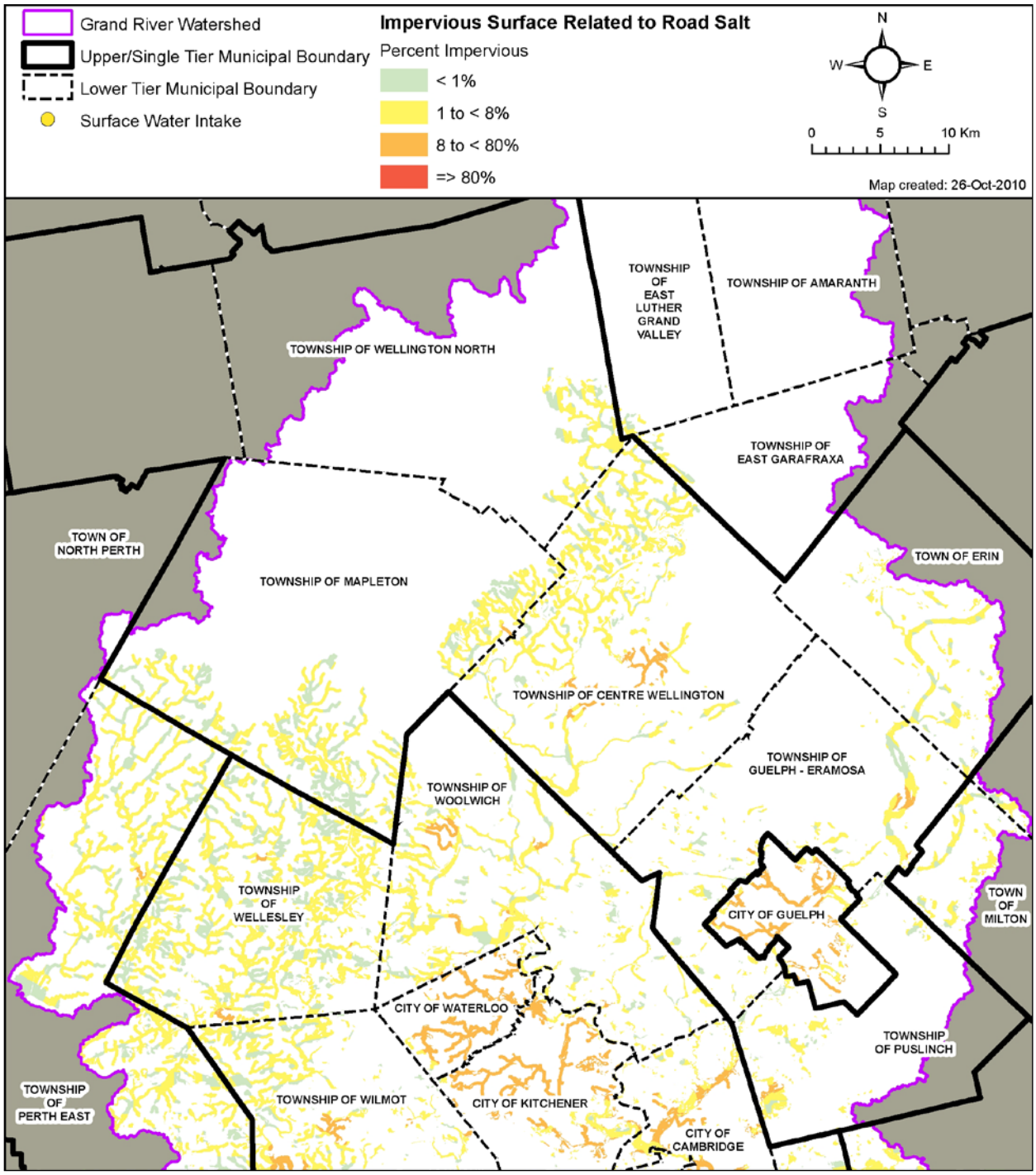
Map 15-16: Ohsweken Water Supply IPZ-1 and IPZ-2 Percent Impervious Surfaces



Map 15-17: Ohsweken Water Supply IPZ-3 Percent Impervious Surfaces (1 of 2)



Map 15-18: Ohsweken Water Supply IPZ-3 Percent Impervious Surfaces (2 of 2)



Information Sources for the Vulnerability Assessment

The most up-to-date information was used for determining the area and source vulnerability scores **Table 15-5** outlines the data sources and the purposes for which the data were used.

Table 15-5: Summary of data sources used in the delineation of the vulnerable areas and the vulnerability assessment

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	GRCA	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
Conservation Authority Regulation Limit, GIS Data Sets	GRCA	To help identify the extent of the Intake Protection Zones
Dye Tracer Studies	Stantec Consultant Reports	Data used in the hydraulic modelling of the Grand River and Fairchild Creek ; 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 and Fairchild Creek
Water Treatment Plant Operator interviews	Six Nations	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, Six Nations Operator Interview	Assess vulnerability of intake and identify concerns
SOLRIS Land cover and soil permeability GIS dataset	MNR, GRCA Draft Watershed Report	Assess vulnerability of intake

Limitation of Data and Methods

A number of gaps remain within the understanding of both the physical and operational characteristics of the intake system, the various characteristics of the contributory land and water areas, and even within the application of the Technical Rules. Improved understanding of the following will help to refine the IPZ delineations:

- The completion of dye tracer studies at higher flow regimes would improve HEC-RAS model calibration for both the Grand River and Fairchild Creek;

- Improved information on the physical characteristics of the smaller tributaries to allow for improved estimation of stream flow velocities; and
- Gaps associated with GIS and/or design data available for anthropogenic transport pathways such as storm sewers and agricultural tile drainage.

Uncertainty of Vulnerability Assessment

The delineation of IPZ-1 follows specific requirements defined within Part VI.3 of the Technical Rules. A minor modification (expansion) to the protection zone was incorporated in recognition of a bridge crossing, and associated spills potential immediately upstream of the intake, but such an approach is not considered to impact the relative certainty of the result. As a result, the delineation for this protection zone is considered to have a **low** degree of associated uncertainty.

Similarly, the vulnerability score associated with this zone is also very specifically defined, mandating a **low** ranking of relative uncertainty in the evaluation.

The combination of "low" rankings for both the delineation and the vulnerability scoring leads to an overall conclusion of **low uncertainty** pertaining to the IPZ-1.

While some uncertainty remains regarding the understanding of hydraulics, the associated adjustment to the IPZ-2 delineation would be relatively minor. Dye tracer testing, ideally completed under higher flow events, would more clearly identify the hydraulics of these systems permitting an improvement in the certainty of the resulting delineation.

The ~~generally~~ good understanding of physical and operational characteristics of the intake system and physics of the contributing drainage areas resulted in the delineation to have a **low** degree of uncertainty.

With regard to the vulnerability scoring portion of the analysis for IPZ-2, it is concluded that a **low** degree of uncertainty remains, for reasons similar to those described in the discussions of the IPZ-1 analysis.

The combination of the 'low' uncertainty ranking for the IPZ-2 delineation and the 'low' uncertainty ranking for the vulnerability scoring leads to an overall conclusion of **low uncertainty** in the assessment of IPZ-2.

The IPZ-3 is being delineated as prescribed by the Technical Rules using the best available GIS information and is considered to have **low uncertainty**.

15.1.5 Drinking Water 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.

~~The Technical Rules (MOE, 2009b) list five ways in which to identify a drinking water threat:~~

~~a) Through an activity prescribed by the Act as a Prescribed Drinking Water Threat;~~

~~b) Through an activity identified by the Source Water Protection Committee as an activity that may be a threat and (in the opinion of the Director) a hazard assessment confirms that the activity is a threat;~~

~~c) Through a condition that has resulted from past activities that could affect the quality of drinking water;~~

~~d) Through an activity associated with a drinking water Issue; and~~

~~e) Through an activity identified through the events based approach (this approach has not been used in this Assessment Report).~~

~~Activities that Are or Would be Drinking Water Threats in the Wellhead Protection Areas and Intake Protection Zones~~

~~Ontario Regulation 287/07, pursuant to the *Act*, provides a list of Prescribed Drinking Water Threats that could constitute a threat to drinking water sources. **Table 16-6** lists the activities that are prescribed as water quality related Prescribed Drinking Water Threats. Listed beside the Prescribed Drinking water Threats are the typical land use activities that are associated with the threat.~~

~~Table 16-6: Drinking Water Quality Threats~~

~~**Prescribed Drinking Water Quality Threat**~~ ~~Ontario Regulation 287/07 s.1.1.(1)~~		~~**Land Use / Activity**~~
~~1~~	~~The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.~~	~~Landfills – Active, Closed~~ ~~Hazardous Waste Disposal~~ ~~Liquid Industrial Waste~~
~~2~~	~~The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.~~	~~Sewage Infrastructures~~ ~~Septic Systems, etc.~~
~~3~~	~~The application of agricultural source material to land.~~	~~e.g. manure, whey, etc.~~
~~4~~	~~The storage of agricultural source material.~~	~~e.g. manure, whey, etc.~~
~~5~~	~~The management of agricultural source material.~~	~~aquaculture~~
~~6~~	~~The application of non-agricultural source material to land.~~	~~Organic Soil Conditioning~~ ~~Biosolids~~
~~7~~	~~The handling and storage of non-agricultural source material.~~	~~Organic Soil Conditioning~~ ~~Biosolids~~
~~8~~	~~The application of commercial fertilizer to land.~~	~~Agriculture Fertilizer~~
~~9~~	~~The handling and storage of commercial fertilizer.~~	~~General Fertilizer Storage~~
~~10~~	~~The application of pesticide to land.~~	~~Pesticides~~
~~11~~	~~The handling and storage of pesticide.~~	~~General Pesticide Storage~~
~~12~~	~~The application of road salt.~~	~~Road Salt Application~~
~~13~~	~~The handling and storage of road salt.~~	~~Road Salt Storage~~
~~14~~	~~The storage of snow.~~	~~Snow Dumps~~
~~15~~	~~The handling and storage of fuel.~~	~~Petroleum Hydrocarbons~~
~~16~~	~~The handling and storage of a dense non-aqueous phase liquid.~~	~~DNAPLs~~
~~17~~	~~The handling and storage of an organic solvent~~	~~Organic Solvents~~
~~18~~	~~The management of runoff that contains chemicals used in the de-icing of aircraft.~~	~~De-icing~~
~~19~~	~~An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or~~	~~Private water taking~~

~~Table 16-6: Drinking Water Quality Threats~~		
~~Prescribed Drinking Water Quality Threat~~ ~~Ontario Regulation 287/07 s.1.1.(1)~~		~~Land Use / Activity~~
	~~surface water body.~~	
~~20~~	~~An activity that reduces the recharge of an aquifer.~~	~~Impervious Surfaces~~
~~21~~	~~The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard.~~	~~Agricultural Operations~~

Identification of Significant, Moderate and Low Drinking Water Threats for the Ohsweken Intake

To fulfill the requirements of the Technical Rules, a database was created to query and assign threats based on publically available data to evaluate potential significant threats. Current land use zoning within the off-reserve intake protection zone areas that will permit activities that would be significant threats have also been documented to assist in later policy development.

Data was acquired from several third party sources including EcoLog ERIS, the Technical Safety Standards Association (TSSA), and Municipal Properties Assessment Corporation (MPAC). Additionally, for agricultural properties within the IPZ-2 off-reserve area, a roadside survey was undertaken to identify land use and livestock operations to help in the identification of chemical and pathogen threats associated with agricultural parcels.

The data from each source was then geo-referenced to parcels, where possible, and the significant threats were enumerated based on the vulnerable zone, vulnerability score and on the available data regarding activities on each parcel.

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. For local threats, the risk score is calculated as per the Director's Approval Letter, as shown in **Appendix C**. The information above can be used with the vulnerability scores shown in **Map 15-4**, **Map 15-5**, **Map 15-6**, **Map 15-7**, **Map 15-8** and **Map 15-9** to help the public determine where certain activities are or would be significant, moderate and low drinking water threats.

Table 16-7 provides a summary of the threat levels possible in the Ohsweken Intake Protection Zones for Chemical, Dense Non-Aqueous Phase Liquid (DNAPL)~~,~~ and Pathogen~~, and Local Threats (Oil Pipelines)~~. 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 15-6: Identification of Drinking Water Quality Threats in the Ohsweken Water Treatment Plant (off-reserve) 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, 3	8	✔	✔	✔
	IPZ-3	6		✔	✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			
Handling / Storage of DNAPLs	IPZ-1	10	✔	✔	
	IPZ-2, 3	8		✔	✔
	IPZ-3	6			✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			
Pathogens	IPZ-1	10	✔	✔	✔
	IPZ-2, 3	8	✔	✔	✔
	IPZ-3	6		✔	✔
	IPZ-3	5			✔
	IPZ-3	1, 2, 3, 4			
~~Local Threat (Oil Pipelines)~~	~~IPZ-1, 2, 3~~	~~Any Score~~			

15.1.6 Conditions Evaluation

The conditions assessment, completed using data from the Ecolog ERIS search, indicated 4 contaminated sites that may represent conditions:

- 1 former 'dump' site;
- 2 former junkyard sites; and
- 1 former retail fuel operation.

No on-site and/or off-site data for water, soil or sediment quality was available for any of the identified properties and, correspondingly, these sites have not been identified as conditions in accordance with Technical Rule 126.

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. ~~The parameter or pathogen must be listed in Schedule 1, 2 or 3 of the Ontario Drinking Water Quality Standards (ODWQS) or Table 4 of the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (Technical Rules XI.1 (114 – 117)).~~

~~Once a drinking water Issue is identified, the objective is to identify all sources and threats that may contribute to the Issue within an Issue Contributing Area and manage these threats~~

~~appropriately. If at this time the Issue Contributing Area cannot be identified or the Issue cannot be linked to threats then a work plan must be provided that states how this information will be ascertained.~~

~~If an Issue is identified for an intake, well or monitoring well, then all threats related to a particular Issue within the Issue Contributing Areas are as significant drinking water threats, regardless of the vulnerability.~~

Data sources for the Drinking Water Issues Evaluation

Within the current assessment, water quality data was not directly available from Six Nations representatives, including the operators of the Ohsweken intake, requiring that the Issues analysis be completed using data primarily collected from the Ontario Ministry of the Environment (MOE) Monitoring program in the Grand River, as well as from GRCA reports documenting water quality in the Grand River at nearby locations. Data from the following reports was also reviewed for this assessment:

- Memorandum Re: Summary of DWSP Raw Water Quality Data for Six Nations Ohsweken Drinking Water Plant, GRCA (April 13, 2010)
- Characterization of the Raw Water Supply for the Ohsweken Drinking Water Treatment Plant (2000 – 2005), DRAFT, GRCA (December 2007)
- Water Quality in the Grand River Watershed: Current Condition and Trends (2003 – 2008), GRCA (December 2009)
- Characterization of the Raw Water Supply for the Holmedale Drinking Water Treatment Plant (2000 – 2004), DRAFT, GRCA (July, 2007)

Table 15-8 identifies the criteria used and the source of the criteria to evaluate whether a parameter is a drinking water quality Issue.

Table 15-7: Existing and Potential Future Water Quality Issues

Parameter	Regulatory Reference	Criteria	Location[2]
Identified Issues			
Aluminum (unfiltered, total)	ODWS, Operational Guideline	0.1 mg/L	402, 702 & Ohsweken DWTP
Barium (unfiltered, total)	ODWS, Table 2	1 mg/L	402
Cadmium (unfiltered, total)	ODWS, Table 2	0.005 mg/L	702
Chromium (unfiltered, total)	ODWS, Table 2 0.05 mg/L	0.05 mg/L	402 & 702
Colour, True	ODWS Table 4 Aesthetic Objective (AO)	5 TCU	Ohsweken DWTP
Copper (unfiltered, total)	ODWS, Table 2	1 mg/L	402
Hardness	ODWS Table 4 Operational Guideline (OG)	80 – 100 mg/L	Ohsweken DWTP
Iron (unfiltered, total)	ODWS, Table 2	0.3 mg/L	402, 702 & Ohsweken DWTP
Sodium[1]	ODWS, Table 4 Medical Health Advisory Level	20 mg/L	402, 702 & Ohsweken DWTP
Total Dissolved Solids (TDS)	ODWS Table 4 Aesthetic Objective (AO)	500 mg/L	Ohsweken DWTP

Table 15-7: Existing and Potential Future Water Quality Issues

Parameter	Regulatory Reference	Criteria	Location[2]
Emerging or Potential Future Issues			
Chloride	ODWS, Table 4 Aesthetic Objective (AO)	250 mg/L	402, 702 & Ohsweken DWTP
Dissolved Organic Carbon	ODWS Table 4 Aesthetic Objective (AO)	5 mg/L	Ohsweken DWTP
Manganese	ODWS Table 4 Aesthetic Objective (AO)	0.005 mg/L	Ohsweken Intake
Nitrate	ODWS, Table 2	10 mg/L	702 & Ohsweken DWTP

Notes:
[1]The Medical Advisory Level for Sodium is 20 mg/L, but water may continue to be distributed and consumed at these concentrations. The AO is ODWS is 200mg/L.
[2] Station 402 is at the Cockshutt bridge and station 702 is at the Blossom / County Road 18 bridge in the Grand River, within the limits of the City of Brantford and/or County of Brant upstream of Ohsweken Intake.

Water Quality Issues Evaluation for the Six Nations - Ohsweken Water Supply

Very little data exists for the raw water at the Ohsweken WTP, therefore, water quality from upstream locations were used to evaluate the raw water quality.

~~Time series plots~~Data of chemical parameters in surface water for upstream locations 402 and 702 indicates that concentrations of metals (aluminum, barium, cadmium, chromium, copper and iron) in raw river water have consistently been close to or exceeded the ODWS for treated water. Data from GRCA (2007a) also indicates concentrations of aluminum greater than the ODWS at the Ohsweken intake between 2000-2005. Additionally, data from the Ministry of the Environment's DWS program (GRCA 2010) indicates the following:

- Colour (true) has consistently been above the ODWS with 98% of results in the study exceeding the AO;
- Hardness has consistently been above the ODWS with 100% of the results in the study exceeding the OG; and
- Total Dissolved Solids have consistently been above the ODWS, with 55% if the results in the study exceeding the AO.

Further, sodium levels in the raw water have shown to be above the Medical Health Advisory limit of 20 mg/L (ODWS, 2006) consistently since 1998. Sodium concentrations were also consistently above the Medical Health Advisory limit at the Ohsweken DWTP for the 2000-2005 period of record (GRCA, 2007a). Although sodium can be sourced from road salt, the high levels seen in the raw water are likely a result of the cumulative inputs from both natural and anthropogenic sources in the entire upstream watershed. Therefore, sodium is not a drinking water Issue under Technical Rule 114.

High level of colour, total dissolved solids and hardness (alkalinity) are likely from natural sources and cumulative inputs from the entire upstream watershed. Therefore, they are currently not declared drinking water Issues under Technical Rule 114.

Although not exclusively, elevated levels of metals including aluminum (hardness) in the raw water supply are also likely from natural sources and therefore are not considered drinking

water Issues. However, more intensive monitoring of the raw water at the drinking water treatment plant is recommended to confirm whether there are any trends in the data that may suggest anthropogenic sources.

Discussion of Issues with Mr. Steve Lickers from the DWTP Operations team was consistent with the data evaluation above, with confirmation that the primary water quality concerns at the DWTP are related to colour, TDS and aluminum in the surface water from the Ohsweken Intake.

Limitations and Uncertainty for the Water Quality Issues Evaluation for the Six Nations - Ohsweken Water Supply

Given the reliance of raw water data from sampling locations other than at the DWTP, and the limited raw water data available for the Ohsweken drinking water intake, it is recommended that further, more intensive sampling of the raw water for the parameters listed in Tables 1, 2 and 3 of the ODWQS and Table 4 of the Technical support document be completed to reduce the uncertainty with the identification of Issues.

15.1.8 Enumeration of Significant Drinking Water Quality Threats

The threat analysis indicated 52 significant threats on 25 properties within the IPZ-2 off-reserve area and IPZ-3 as summarized in **Table 15-9**.

Table 15-8: Significant Drinking Water Quality Threats in Ohsweken Grand River Intake Protection Zones

PDWT[1] #	Threat Subcategory[2]	Number of Activities	Vulnerable Area
2	Sewage System Or Sewage Works – Sewage treatment plant bypass discharge to surface water	1	IPZ-3
	Sewage System Or Sewage Works – Sewage treatment plant effluent discharges (includes lagoons)	1	IPZ-3
3	Application Of Agricultural Source Material To Land	10	IPZ-2 Off-Reserve Area
4	Storage Of Agricultural Source Material	8	IPZ-2 Off-Reserve Area
6	Application Of Non-Agricultural Source Material To Land (Including Treated Septage)	10	IPZ-2 Off-Reserve Area
21	Management Or Handling Of Agricultural Source Material - Agricultural Source Material (ASM) Generation	22	IPZ-2 Off-Reserve Area
Total Number of Properties			**25**
Total Number of Activities			**52**

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 pesticides to 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.

Data Sources for the Enumeration of Significant Drinking Water Quality Threats

Construction of the database for the Six Nations off-reserve potential threats included obtaining/acquiring data from the sources listed below:

- Provincial and Federal database search (Ecolog ERIS, December 2009)
  - Anderson's Directory of Waste Disposal Sites
  - Certificates of Approval
  - Compliance and Convictions
  - Environmental Registry (EBR)
  - Fuel Storage Tanks
  - National Environmental Emergencies System
  - National PCBs List
  - National Pollutant Release Inventory
  - Ontario Oil and Gas Wells
  - Ontario PCB list
  - Pesticide Register
  - Record of Site Condition
  - Scott's Manufacturing Directory
  - Waste Generators
  - Waste Receivers
- Operational and non-operational retail fuel sites, cancelled retail fuel sites, commercial fuel oil tanks (TSSA, November 2009)
- Property Taxation Records and corresponding data (MPAC, November 2009)
- Stormwater and Sanitary Sewer Network Data (in GIS format) (County of Brant and City of Brantford, December 2009)
- Roadside Field Survey of Agricultural Properties within the IPZ-2 (Stantec, December 2009)

Limitations, Data Gaps and Uncertainty in the Threats Assessment

An evaluation of the data gaps present within the acquired data was also completed during the threat assessment with an uncertainty score applied to each data source based on the age of the data, the source it was acquired from, the reliability of the source, and the extent of data maintenance.

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.