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4.0 COUNTY OF GREY

4.1 Township of Southgate

4.1.1 Dundalk Well Supply

The Village of Dundalk, located within the Township of Southgate, is situated in the southeast corner of the County of Grey in southern Ontario. The Township of Southgate has a population of 7,354 people, and a population of 2,046 within Dundalk (Statistics Canada, 2016).

Dundalk is located within the northwest part of the Grand River watershed (Upper Grand River subbasin) with the headwaters of the Grand River originating southeast of Dundalk. The headwaters of the Saugeen River are also located within the Township of Southgate and part of the Saugeen Valley Source Protection Area.

The Dundalk municipal wells obtain their water from bedrock groundwater sources. The bedrock surface is generally highest in the east and slopes towards the west. The uppermost bedrock formations (Guelph and Gasport) are estimated to be 88 m thick and form the active aquifer system which supply the Dundalk municipal wells.

The bedrock aquifer is mainly overlain by drumlinized till plains, locally characterized as Elma Till and Catfish Creek Till. Overburden thicknesses range from approximately 5 m in the east and thicken to over 40 m in the southwest.

The Dundalk drinking water system is classified as a large municipal residential system. The municipally serviced area for Dundalk is shown in **Map 4-1**. A summary of all the municipal production wells in Dundalk are included in **Table 4-1**.

Table 4-1: Drinking Water System Information for the Dundalk Well Supply					
Well	Well Field	Depth of Well (m)	Depth of Casing (m)	Purpose	Status
D1	Dundalk	61.3	32.7	Production	Decommissioned
D2	Dundalk	83.2	30.4	Production	Decommissioned
D3	Dundalk	86.9	28.0	Production	In Regular Use
D4	Dundalk	100.6	32.0	Production	In Regular Use
D5	Dundalk	96.0	35.35	Production	Future Use
Note: Depth of well and casing based on as constructed drawings and water well records.					

The well supply system for Dundalk consists of two bedrock wells referred to as D3 and D4. Well D3 was drilled in 1975 and is located in the south end of Dundalk. The village originally obtained its water supply from two wells referred to as D1 and D2 that were drilled in 1960 and located in the village core. Due to the lower capacity of wells D1 and D2, a fourth well (D4) was drilled in 2002 and brought on-line. Well D4 is located northeast of the village. Wells D1 and D2 were decommissioned in 2005 in accordance with Ontario Regulation 903. In 2016, a new well referred to as D5 was constructed on the east side of Dundalk between the two existing municipal wells. In 2017, a long term pumping test was conducted at well D5. The new well will provide an additional groundwater source and redundancy to the system. A summary of the drinking water system information and annual and monthly average pumping rates is presented on **Table 4-2** and **Table 4-3**.

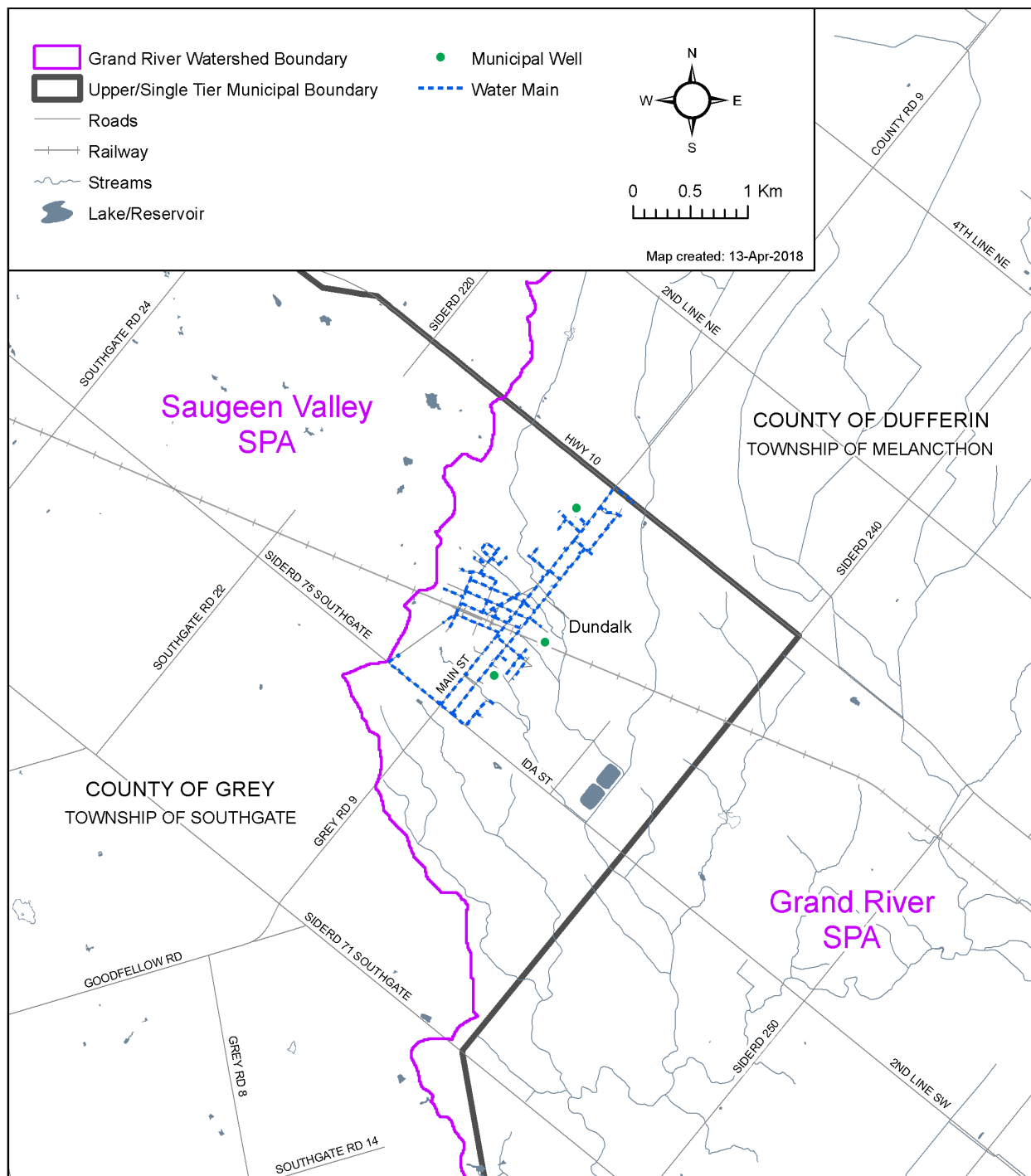
Table 4-2: Drinking Water System Information for the Dundalk Well Supply

DWS Number	DWS Name	Operating Authority	GW or SW	System Classification ¹	Number of Users served ²
220001753	Dundalk Well Supply	Corporation of the Township of Southgate	GW	Large Municipal Residential System	1,700
¹ as defined by O. Reg. 170/03 (Drinking Water Systems) made under the <i>Safe Drinking Water Act, 2002</i> .					
² Based on Township of Southgate Dundalk Waterworks 2009 Annual Report (Ellis, 2010)					

Table 4-3: Annual and Monthly Average Pumping Rates for the Dundalk Well Supply

Well or Intake	Annual Avg. Taking ¹ (m ³ /d)	Monthly Average Taking ¹ (m ³ /d)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
D3	272	243	248	238	227	278	286	466	343	258	209	236	236
D4	188	206	201	197	207	181	200	0	135	245	256	225	202
¹ source: Southgate Township annual summary report, based on 2017 monitoring data													

Map 4-1: Dundalk Well Supply Serviced Areas



4.1.2 Dundalk Wellhead Protection Areas

In 2003, a local numerical groundwater flow model for the Dundalk area was constructed as a part of the Grey and Bruce Counties' Groundwater Study (Waterloo Hydrogeologic Inc, 2003). At that time, WHPAs for the three municipal wells (D1, D2, D3) were simulated using the model.

Later, as a part of the first phase of the source protection technical studies in 2008, the model was revised to add well D4 and remove the now-decommissioned D1 and D2 (Triton Engineering et al., 2007)

In 2010, hydrogeological conceptualization was further refined and WHPAs for wells D3 and D4 were updated to reflect the revised hydrogeology (Golder, 2010)

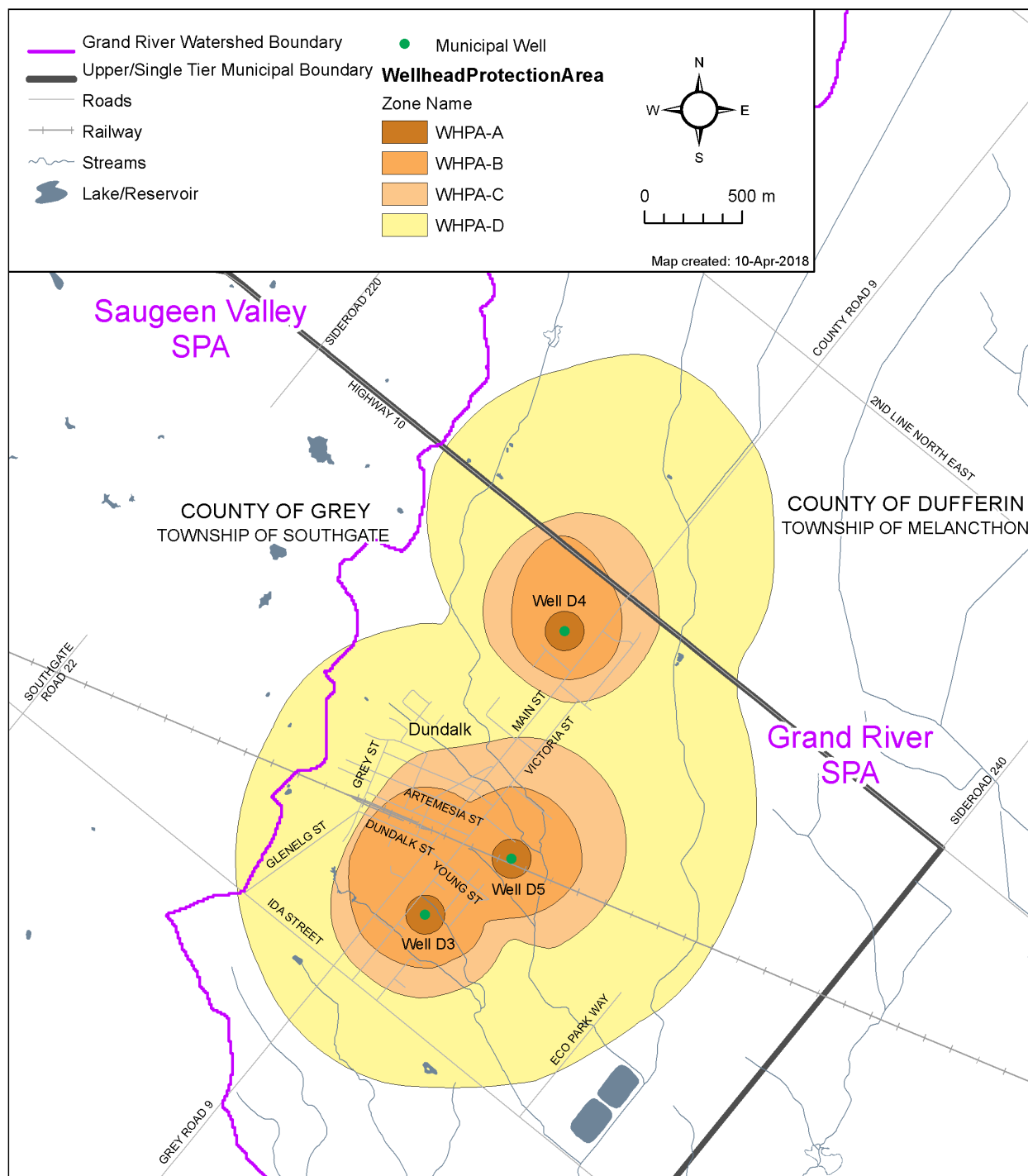
Later, in 2018, Well D5 was incorporated into the groundwater flow model, and the model was updated to reflect revised hydrostratigraphy and pumping test information based on the drilling results from well D5. WHPAs were regenerated for wells D3, D4, and D5 with updated pumping rates for the system (Golder, 2018).

The pumping rates used to determine the Golder (2018) WHPAs were based on the allocated quantity of water. In each scenario, the allocated quantity of water or the total pumping rate for the wellfield was 1,344 m³/day. This rate was based on an estimate of the 20- year forecast planned demand provided by Triton Engineering on behalf of the Township. The rate represents the existing average day demand over the past three years for 1,799 people (490 m³/day), plus a committed demand over the next 10 years for 2,111 people (574 m³/day) and a planned demand for the next 20 years for 1,028 people (280 m³/day).

Using the groundwater flow model, four pumping scenarios were developed for the municipal wells to represent possible future pumping conditions at the allocated rate. The resulting WHPAs (Golder, 2018) represent a composite of these four scenarios.

The resulting WHPAs, shown on **Map 4-2**, extend north-northeast from the village in the direction (upgradient) of local groundwater flow through the bedrock. The majority of the WHPAs are within the Grand River SPA, however a small portion of the WHPA-D extends into Saugeen Valley SPA.

Map 4-2: Dundalk Well Supply Wellhead Protection Areas



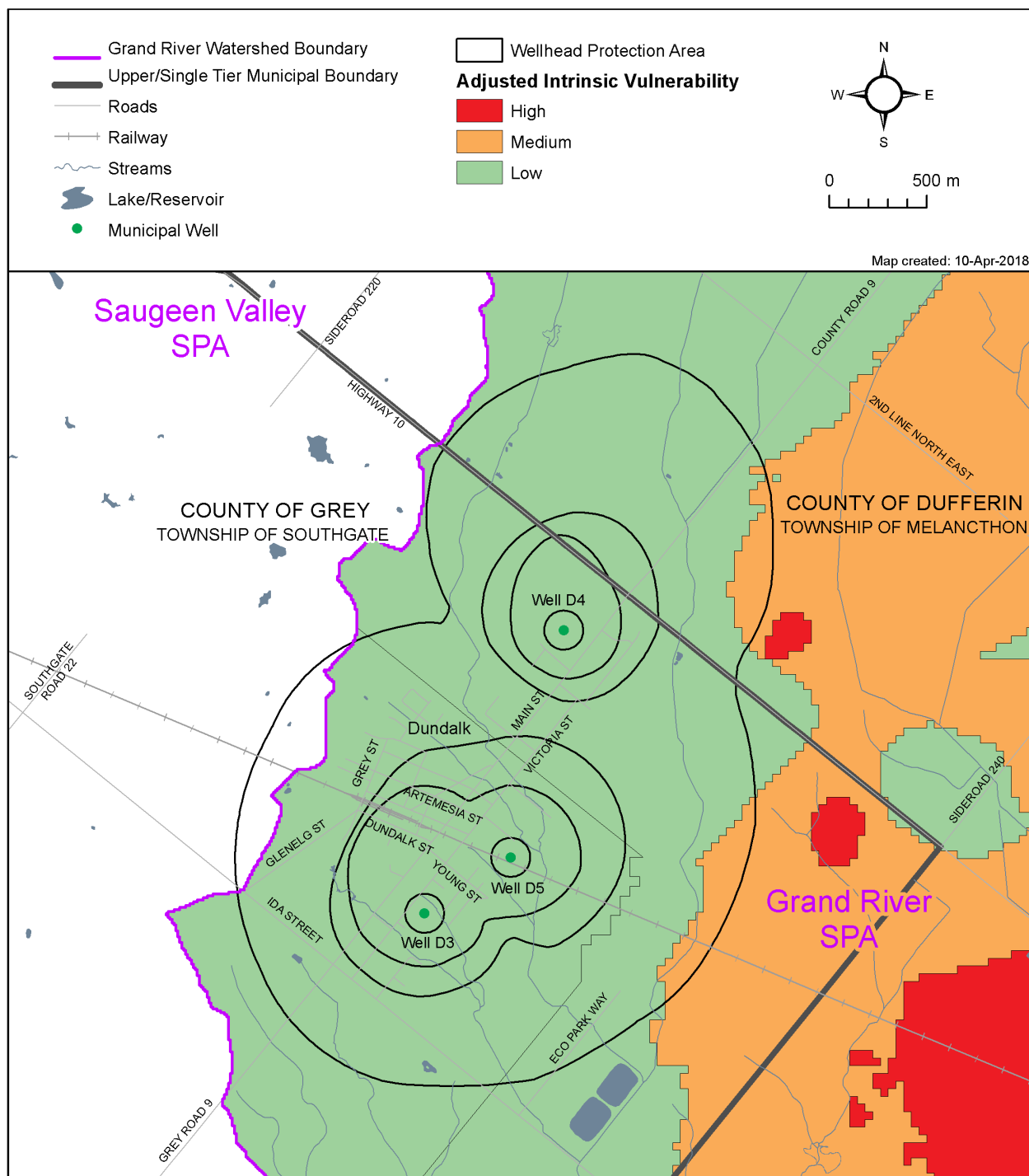
Most of the regional intrinsic vulnerability within the Grand River SPA was completed using the Surface to Aquifer Advective Time (SAAT) method (EarthFX, 2010) and modified at the municipal well scale to account for local conditions (Golder, 2010). The intrinsic vulnerability for the Dundalk WHPAs, as shown on **Map 4-3**, is predominantly low with some small sections of medium vulnerability in the eastern portion of the WHPA-D.

The WHPAs were overlain with the SAAT map for the Dundalk area to produce vulnerability scoring maps. Vulnerability scores, which incorporated identified transport pathways (refer to Section 4.1.3), were calculated using the method outlined in Part V11.2 in the Technical Rules as summarized in **Table 4-4**.

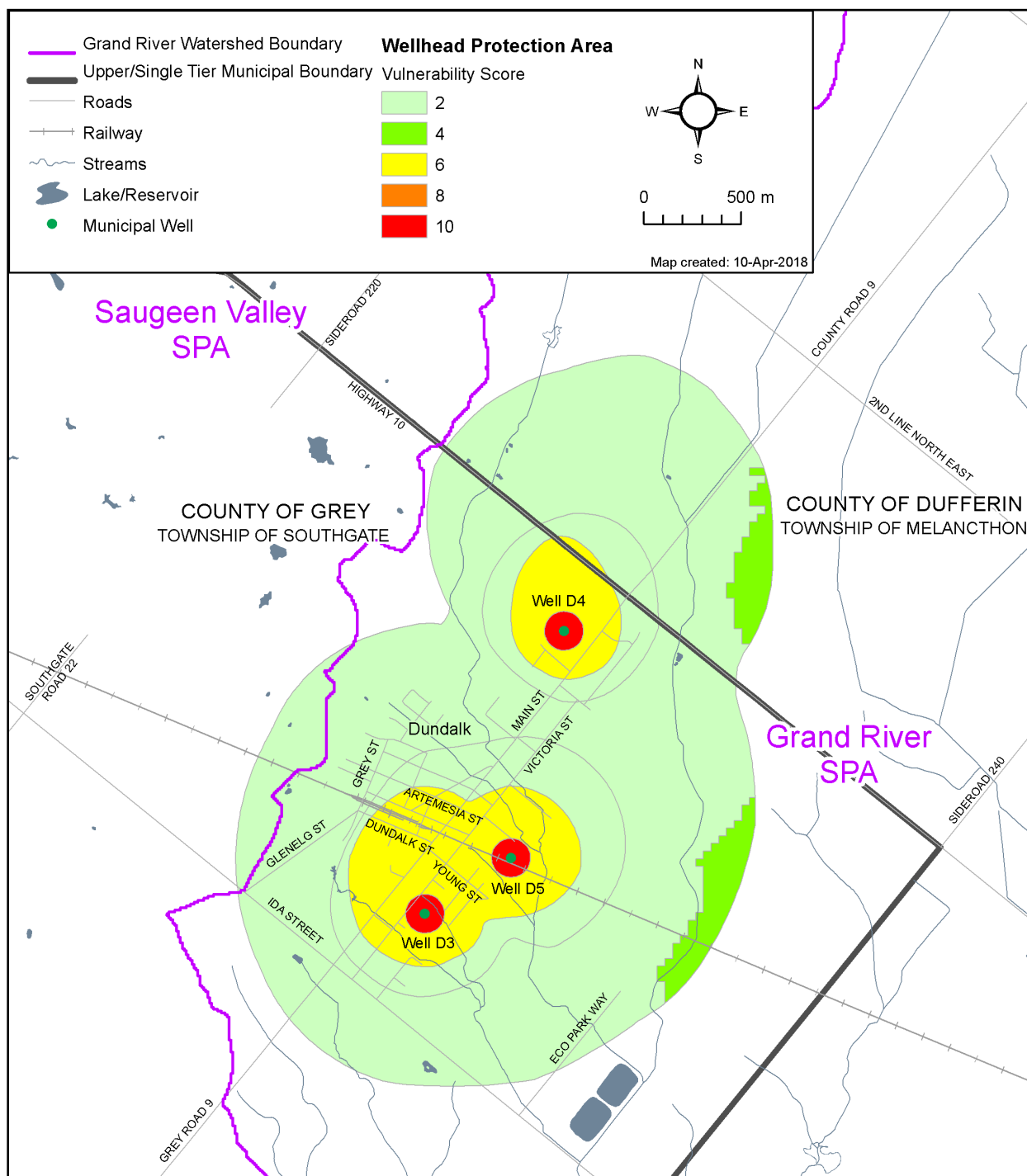
Table 4-4: Wellhead Protection Area Vulnerability Scores - SAAT				
Intrinsic Vulnerability	WHPA-A	WHPA-B	WHPA-C	WHPA-D
High	10	10	8	6
Medium	10	8	6	4
Low	10	6	2	2

The vulnerability scoring map for Dundalk is included in **Map 4-4**. The 100 m radius zone is categorized as a vulnerability of 10, the 2-year time-of-travel zone is categorized as a vulnerability of 6 and the remaining area within the WHPAs are categorized as a vulnerability of 2, with some vulnerability 4 on the eastern edge. These scores are reflective of the low permeable sediments overlying the bedrock aquifer.

Map 4-3 Dundalk Well Supply Intrinsic Vulnerability



Map 4-4: Dundalk Well Supply Wellhead Protection Area Final Vulnerability



4.1.3 Dundalk Transport Pathways and Vulnerability Adjustment

Transport Pathways in the Dundalk Wellhead Protection Areas

Rural homes and farms in the area obtain water supplies from private wells. Abandoned wells may exist at some of the rural residences. However because there are no confirmed well pathways, no increases to vulnerability due to the presence of private wells was included.

Similarly, no adjustments to the vulnerability were made due to septic systems and buried utilities as they most likely do not act as significant transport pathways due to their shallow nature within a fairly thick aquitard overlying the bedrock aquifer (i.e., they do not breach the aquitard).

Uncertainty in the Wellhead Protection Area Delineation and Vulnerability Scoring for the Dundalk Well Supply

An uncertainty assessment associated with the development of WHPAs and vulnerability mapping is required to assess the level of confidence in the results and determine the need for additional data collection and/or analysis as part of future assessments. Uncertainty ratings within each WHPA must be designated as either high or low and can vary within the zones of the WHPA.

Hydrogeological investigations and groundwater modelling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrogeological system is changing with time, and in the sense that the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that groundwater systems are influenced by a myriad of interacting man-made and natural influences that vary spatially and temporarily.

Since the municipal supply wells are completed in the bedrock aquifer, there is a fair amount of uncertainty over the times of travel and the effective area of capture. In general, there would be greater uncertainty for bedrock systems than overburden systems due to the assumptions with effective porosity.

For the Dundalk area, in addition to the regional studies that have been conducted, local hydrogeological studies have been completed, including aquifer testing at Well D4 and D5. Also, numerous water well records exist for private wells located within and around the WHPA. After filtering out lower quality well records (due to location accuracy, missing geology and anomalous geology), the remaining water well records were used to fill in the gaps of the detailed studies. The WHPAs were delineated using a numerical model that had been calibrated reasonably well with the field data as described previously.

For Dundalk, intrinsic vulnerability mapping results were reviewed at a WHPA scale and changes were applied to improve the results and reduce uncertainty in the vulnerability mapping. Further assessment was conducted using a different method that produced similar results in the area of the WHPA.

Missing information associated with the WHPA delineation and vulnerability scoring are as follows; there is no site specific information on the effective porosity of the bedrock; there are relatively few high quality monitoring locations within and surrounding the capture zone to confirm the local groundwater flow direction; and the influence on the nature of the fracturing and distribution of water bearing zones within the bedrock are not explicitly mapped.

Notwithstanding the above, the vulnerability scoring reflects the best estimate of the actual conditions at the Dundalk wells. The WHPAs, SAAT vulnerability and resulting vulnerability scoring for Dundalk are therefore estimated to have a low uncertainty rating.

Managed Lands within the Dundalk Wellhead Protection Area

Managed lands are lands that may receive Agricultural Source Material (ASM), Non-Agricultural Source Material (NASM) or commercial fertilizer and can be divided into 2 categories: agricultural managed lands (AML) and non-agricultural managed lands. Agricultural managed lands include cropland, fallow and improved pasture that may receive ASM. Non-agricultural managed lands may include golf courses, sports fields, residential lawns and other built-up grassed areas or turf that may have commercial fertilizers applied.

The managed land mapping was completed for the WHPA-A and WHPA-B zones as the vulnerability is only high enough in these zones for related activities to be considered low, moderate or significant threats. Managed lands were completed using the methodology outlined in Chapter 3, with the results for Dundalk summarized on **Map 4-5** and in **Table 4-5**.

Table 4-5: Percent Managed Lands		
	WHPA-A	WHPA-B
D3	56% (40% - 80%)	28% (<40%)
D4	42% (40% - 80%)	48% (40% - 80%)
D5	15 (<40%)	28% (<40%)
Note: Percent in brackets represents the MECP threshold for percent managed land as related to the threats table.		

Livestock Density within the Dundalk Wellhead Protection Area

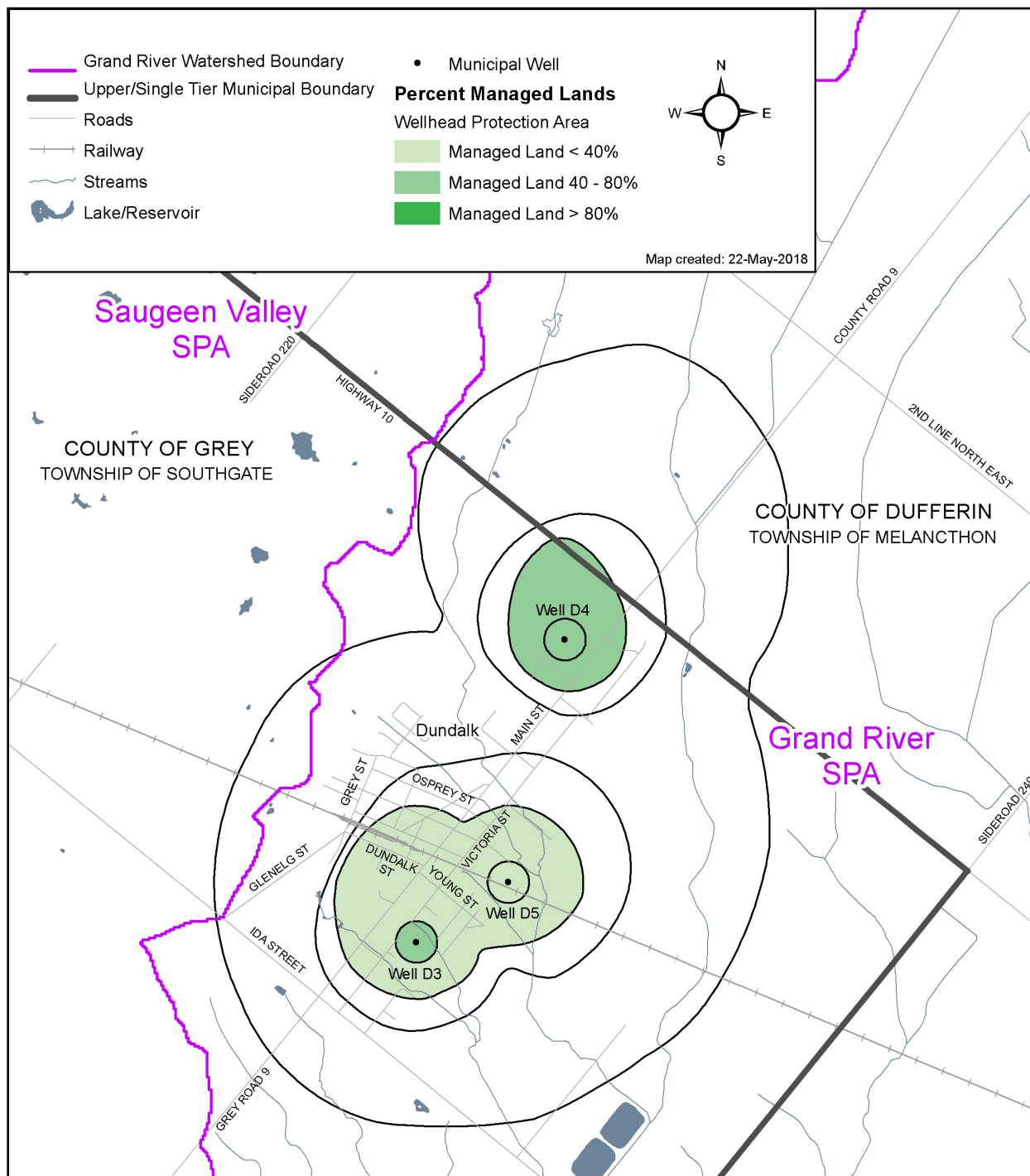
Livestock density is used as a measure to determine the intensity of livestock animals and as such can be used as a measure of the potential for generating, storing and land applying agricultural source material. Similar to the managed land mapping, the livestock density for the Dundalk WHPAs was completed for WHPA-A and WHPA-B zones only, using the methodology outlined in Chapter 3. Results are summarized in **Table 4-6** and on **Map 4-6**.

Table 4-6: Livestock Density		
	WHPA-A	WHPA-B
D3	N/A	N/A
D4	N/A	0
D5	N/A	N/A
Note: N/A means that livestock density was not calculated as there were no agricultural managed lands in those areas.		

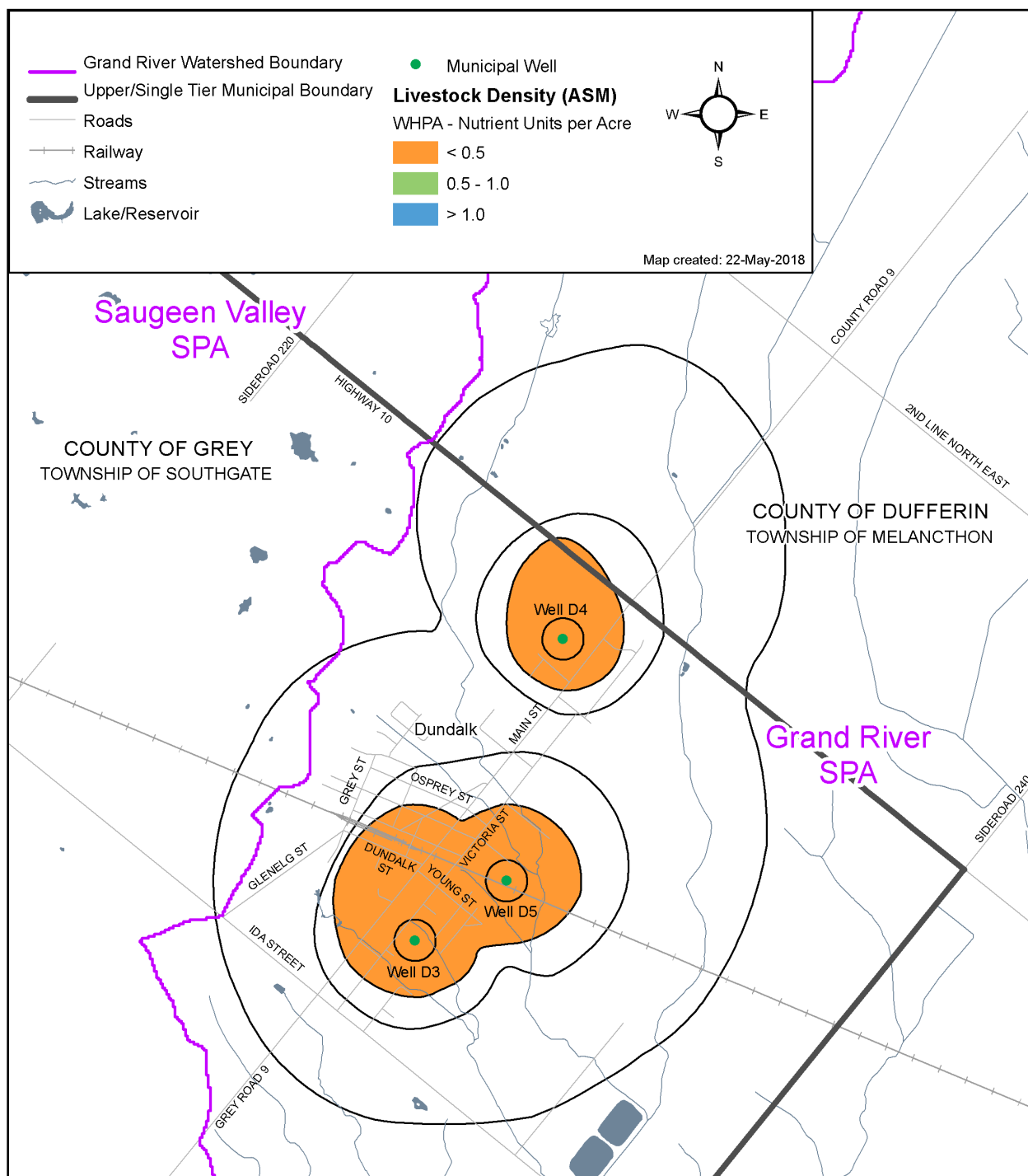
Percent Impervious Surface Area within the Dundalk Wellhead Protection Area

Percent impervious surface is used as a surrogate measure of the potential for the application of salt for the purposes of melting snow and ice. It measures the percentage of the study area covered by impervious surfaces where road salt would likely be applied (roads, sidewalks, and parking lots), but not those where it would not (buildings, landscaped areas, etc). The calculation of impervious surface area for the Dundalk Wellhead Protection Area used the moving window average approach, which is described further in Chapter 3. **Map 4-7** shows the results of the impervious area mapping.

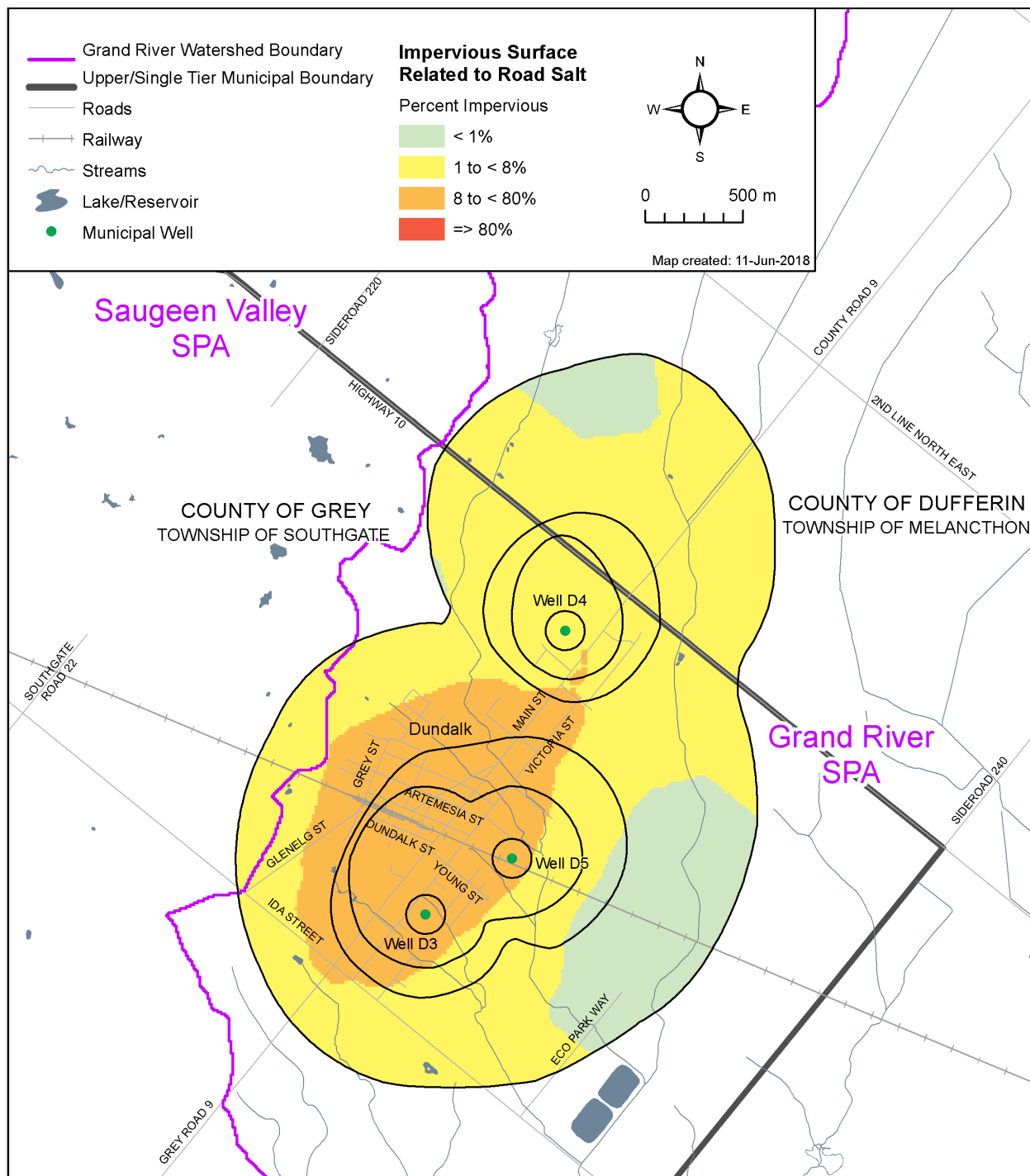
Map 4-5: Dundalk Well Supply Percent Managed Lands



Map 4-6: Dundalk Well Supply Livestock Density



Map 4-7: Dundalk Well Supply Percent Impervious Surfaces



4.1.4 Dundalk 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 Dundalk Well Supply

Identification of Drinking Water Quality Threats in the Dundalk Well Supply Wellhead Protection Areas. Identification of Drinking Water Quality Threats in the Dundalk Well Supply Wellhead Protection Areas **Table 4-7** provides a summary of the threat levels possible in the Dundalk Well Supply 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 / vulnerability score; a blank cell indicates that it is not. The colours shown for each vulnerability score correspond to those shown in **Map 4-4**.

Table 4-7: Identification of Drinking Water Quality Threats in the Dundalk Well Supply Wellhead Protection Areas					
Threat Type	Vulnerable Area	Vulnerability Score	Threat Classification Level		
			Significant 80+	Moderate 60 to <80	Low >40 to <60
Chemicals	WHPA-A	10	✓	✓	✓
	WHPA-B	6		✓	✓
	WHPA-C/D	2 & 4			
Handling / Storage of DNAPLs	WHPA-A/B/C	Any Score	✓		
	WHPA-D	2 & 4			
Pathogens	WHPA-A	10	✓	✓	
	WHPA-B	6			✓

Conditions Evaluation for the Dundalk Well Supply

The Technical Rules state that if there is evidence that a Condition is causing off-site contamination, a hazard rating of 10 is applied. If there is no evidence of off-site contamination, the hazard rating is 6, which would result in a moderate or low drinking water threat within the WHPA.

In consultation with Triton Engineering Services, two sites with groundwater or soil contamination that may be potential Conditions were identified. One site was owned by the local hydro company and was a former location for transformer storage, located adjacent to D2. There was a potential for arsenic and selenium from the transformers to have leached into the ground. Sampling for arsenic confirmed that there was no evidence to support leaching into the ground. On the second site, there was a heating oil spill that was immediately cleaned up by the Ministry of the Environment. No documentation was found to suggest a continued presence of BTEX (benzene, toluene, ethylbenzene and xylene) on this site.

At the current time, there is no evidence to suggest that either of the two sites have Conditions as defined by Rule 126 of the Technical Rules. If more information becomes available, these sites could be re-evaluated to determine if they meet the requirement of identified Conditions. Both of

the sites are located within a vulnerability score area of 2, which would result in a risk score of 20 (assuming a worst case hazard rating of 10). Should they exist, these conditions would not be drinking water threats under the Technical Rules.

4.1.5 Dundalk Drinking Water Quality Issues Evaluation

Potential Issues were evaluated through a review of raw and treated production well water quality data provided by the Township from 2004 to 2017 and discussions with Township staff. The raw water quality data available for the review were compared to the ODWQS and the Technical Support Document to identify parameters approaching or exceeding a standard.

A review of the data for the Dundalk Well Supply System did not identify any Issues with the drinking water sources under Technical Rule 114. None of the parameters analyzed exceeded a drinking water standard or showed signs of an increasing trend.

Nitrate and chloride are typically good indicators of surface impacts to the groundwater system. Samples analyzed for nitrate indicate concentrations below 2.2 mg/L (2014) with no evidence of an increasing trend. For comparison, the ODWQS MAC for nitrate is 10 mg/L. Chloride concentrations are not regularly monitored, however, the limited results provided by the Township indicate a concentration of 16 mg/L at D4 in 2002 and a concentration of 20 mg/L at D3 in 2001. These concentrations are low and do not indicate a local source of road salt impact. The Township currently samples for chloride in raw water a couple times per year.

Sodium concentrations at both Wells D3 and D4 exceeded the aesthetic objective for those on a sodium-restricted diet of 20 mg/L on most occasions from 2009 to 2017. Sodium concentrations ranged from 18.4 mg/L in 2011 to 31.5 mg/L in 2014. In 2013, water samples were taken in both March and July to evaluate possible road salt impacts. Results indicate that the sodium is likely naturally occurring as the sodium concentration in March were similar to those in July. Water samples for sodium are reported every 57 months.

Review of microbiological data (2004 to 2008) for Dundalk and the summary in the memorandum (Triton Engineering Services, 2009b) indicates that for Well D3 an *E. coli* value of 1 CFU/100 mL was detected in two samples out of 53 tests in 2008. Total coliforms concentrations at Well D3, ranging from 1 to 32 CFU/100 mL occurred in 11 of 53 total tests in 2008. From 2004 to 2007 there was one detection of total coliforms in June 2005 out of a total of 202 tests at D3. *E. coli* was not detected in Well D3 during the 2004 to 2007 period of record. Well D4 did not have any *E. coli* detections according to the Water Operations Manager. The recent increase in total coliform detections in the raw water samples collected from Well D3 indicate that microbial water quality is a concern and as such has been investigated by the Township of Southgate.

The source of the microbiological Issues at Well D3 was investigated (Triton Engineering, 2009b) which included monitoring private wells and testing of well D3 at length. Monitoring at D3 included precipitation quantities, continuous turbidity and particle counting, daily grab samples for bacteria testing, microscopic particle analysis (MPA), packer testing and downhole video inspection. Triton Engineering (2009b) concluded that the well is not groundwater under the direct influence of surface water (GUDI) and that the existing disinfection system has been working adequately. The MOECC concurred with this conclusion as well (Triton Engineering Services, 2010).

As the existing treatment is capable of eliminating any pathogens present and additional ultra-violet treatment has been added to further reduce the potential risk of microbial contamination, it can be concluded that pathogens at D3 do not represent a drinking water quality Issue. Review

of microbiological data from 2010 to 2017, indicates no issues with total coliforms and E.coli, as there are only limited detections a couple times a year.

Limitations and Uncertainty for the Water Quality Issues Evaluation for the Dundalk Well Supply

The following limitation is presented for the analysis of Issues within Dundalk:

- Although chloride is not considered an Issue in Dundalk due to the limited amount of data, the Township should continue routine sampling and analysis of the municipal raw water supply for chloride.

4.1.6 Enumeration of Significant Drinking Water Quality Threats

A summary of the threats enumeration results for each WHPA, grouped by threat type, are shown in **Table 4-8**. As of 2018, two significant threats have been identified on two properties in Dundalk.

Table 4-8: Dundalk Well Supply Significant Drinking Water Quality Threats (current to December 2018)			
PDWT¹ #	Threat Subcategory²	Number of Activities	Vulnerable Area
1	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	1	WHPA-A
2	Sewage System or Sewage Works - Onsite Sewage Systems	1	WHPA-A
Total Number of Properties		2	
Total Number of Activities		2	
<p>1: Prescribed Drinking Water Threat Number refers to the prescribed drinking water threat listed in O.Reg 2987/07 s.1.1.(1).</p> <p>2: Where applicable, waste, sewage, and livestock threat numbers are reported by sub-threat; fuel and DNAPL by Prescribed Drinking Water Threat category.</p> <p>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.</p> <p>Note: Storm sewer piping is not considered to be part of a storm water management facility.</p>			

A review of the data for the Dundalk Well Supply System did not identify any Conditions or any Issues with the drinking water sources.