



STAFF REPORT *File No. SPC Report - #01/10*

Date: February 8, 2010
To: Source Protection Committee
Prepared by: Glenda Rodgers, Project Manager
Re: Vulnerability Analysis, Issues Evaluation and Threats Assessment for Creighton Heights and Camborne Municipal Wells Systems (Hamilton Township)

Jagger Hims Ltd. (now GENIVAR) was contracted by the Township of Hamilton to undertake the required technical studies for the municipality's two municipal well systems: Creighton Heights and Camborne. Lloyd Lemon (GENIVAR) has reported on the findings of the project at various Trent Conservation Coalition Source Protection Committee meetings, most recently at the January 19, 2010 meeting. The Vulnerability Assessment was peer reviewed by Stan Denhoed (Harden Environmental Ltd.). GENIVAR has now addressed the peer review comments and completed the project to the satisfaction of the Township. GENIVAR has prepared a summary of the findings of the Vulnerability Analysis, Issues Evaluation and Threats Assessment component of the project (attached).

Staff Recommendation:

That the findings of the GENIVAR Reports entitled: "Assessment of Drinking Water Threats – Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton" (December 22, 2009), as summarized in the attached, be accepted by the Source Protection Committee for inclusion in the draft proposed Assessment Report for the Ganaraska Region Source Protection Area .

Summary Report of Vulnerability Analysis, Issues Evaluation & Threats Assessment for the Creighton Heights Municipal Well System (Hamilton Township)

Date: February 5, 2010

Extracted from: Draft "Assessment of Drinking Water Threats – Creighton Heights and Camborne Municipal Wellfields, Township of Hamilton", December 22, 2009, Jagger Hims Limited, now GENIVAR

Prepared by: Sarah Dignard, B.Sc.Eng., Project Manager, GENIVAR
Lloyd Lemon, M.Sc., P.Geo., Senior Geoscientist, GENIVAR

This Summary Report provides an overview of the key findings of the Source Water Vulnerability, Issues and Threats study for the Creighton Heights and Camborne Municipal Well Systems in the Township of Hamilton. The reader is directed to: Assessment of Drinking Water Threats report for the full details. The referenced numbering for the figures are the same as in this report.

The work undertaken and included in the report is considered to be a Phase 2 work program that builds upon work reported in 2007. The work includes confirmation of analysis and assessment of groundwater vulnerability as reported in 2007, evaluation of Drinking Water Issues; and identification of threats to drinking water in accordance with the Technical Rules. The vulnerability analysis component was peer reviewed on behalf of the Trent Conservation Coalition (TCC) by Harden Environmental Services Ltd.

Methodology

The majority of the effort to analyze the groundwater vulnerability was reported in the Phase 1 project in 2007. The Phase 1 project was completed without finishing the Water Quality Risk Assessment to allow the Province to provide clear direction with respect to how to identify and assess drinking water threats for pathogens and chemicals. A 3-dimensional numerical groundwater flow model was constructed to represent the groundwater flow conditions surrounding the municipal wells in Hamilton Township. The model was constructed and calibrated within industry accepted standards and is considered to be a valid representation of the data available to represent the groundwater flow system around the municipal wells.

The numerical model was applied to delineate wellhead protection areas (WHPA) in accordance with Part V of the Technical Rules. Once the WHPA were delineated, the groundwater vulnerability was assessed as high, medium or low as per Part IV of the Technical Rules using the Surface to Aquifer Advection Time (SAAT) approach. The groundwater vulnerability was further reviewed to determine whether adjustments should be made to consider transport pathways also as described in Part IV of the Technical Rules. Finally, Vulnerability Scores were applied to the WHPA areas in accordance with Part VII of the Technical Rules. A qualitative assessment of the uncertainty inherent in the vulnerability analysis was performed. The Transport Pathway evaluation and the consideration for the uncertainty in the overall vulnerability analysis have been added in the Phase 2 work program.

Maps have been prepared to illustrate the distribution of the WHPA areas and the corresponding vulnerability scores.



An Issues Evaluation was also updated to address the requirements of Part XI of the Technical Rules. The approach and documentation of the Drinking Water Issues followed a consistent methodology developed for other water supplies in the TCC.

A Drinking Water Threats Assessment was completed in accordance with Part XI of the Technical Rules. This work included identification of activities and conditions that result from past activities that are or would be Drinking Water Threats as per the Table of Drinking Water Threats (November 2009). Available databases of potential threats were compiled and reviewed. A windshield survey of the community was also completed to confirm assignments of landuse activities and to assist in identifying potential threats.

Creighton Heights

The WHPA for Creighton Heights reflect groundwater movement from north to south toward the municipal well field (Figure 3-2). The WHPA has been subdivided to include WHPA-A – 100 m radius surrounding the wells; WHPA-B – the 2 year time-of-travel zone to the wells; WHPA-C – the 5 year time-of-travel zone to the wells; and WHPA-D – the 25 year time-of-travel zone to the wells. Groundwater Vulnerability associated with the water supply aquifer is considered to be “Low” based on the range of vertical travel times from surface to the water supply aquifer between 71 and 175 years. Travel times greater than 25 years result in a low vulnerability rating. Two existing wells were considered to present a potential pathway for chemical or pathogen parameters to be more readily transported down to the water supply aquifer. The groundwater vulnerability rating in the area surrounding these wells was increased to medium for use in determining the vulnerability scores.

The Vulnerability Scores from 2 (low vulnerability) to 10 (high vulnerability) for Creighton Heights water supply are shown in Figure 3-6. The highest vulnerability score (10) is assigned to WHPA-A, the 100 m radius surrounding the wells. The area outlined with a vulnerability score of 2 reflects WHPA-D, the 25 year time-of travel zone. A Vulnerability Score of 6 is assigned to WHPA-B, the 2 year time-of-travel zone.

The Uncertainty Rating assigned for the Creighton Heights Water Supply is Low. The uncertainty rating reflects the nature of the water supply aquifer and the quantity and distribution of data available within the delineated WHPA beyond the immediate vicinity of the municipal wells. The assumptions made in the course of the analysis, including selection of hydraulic conductivity parameters, effective porosities, and maximum pumping rates, are intended to be conservative and protective of the water supply. The observed range of travel times in the SAAT analysis also provides confidence that there is substantial protection to the deeper aquifer system.

No chemical or pathogen parameters were considered to be a Drinking Water Issue for the Creighton Heights municipal water supply.

A series of maps have been prepared to illustrate where these activities could be considered as significant, moderate, or low drinking water threats (Figure 3-7, 3-8 and 3-9). As a result of the low vulnerability, activities would only potentially be significant drinking water threats within the 100 m radius of the wells. Maps have also been prepared to illustrate the proportion of managed lands, livestock density, and impervious surfaces within the identified Vulnerable Areas (WHPA zones).

Available information on landuse activities was used to identify the number of activities that have potential to be Significant Drinking Water Threats to the municipal water supply in accordance with the Technical Rules. A total of 10 activities on eight (8) land parcels were identified that are considered to be Significant Drinking Water Threats. These include:

- Private sewage system at the water treatment plant.
- Private sewage systems at two residences with assumed storage of home heating fuel below grade.
- Storage of Agricultural Source Material (ASM) at one residential property.



- Potential for handling and storage of Dense Non-Aqueous Phase Liquids (DNAPL) at four properties within the 5 year time-of-travel zone.

This process is intended to be conservative for identification of Significant Drinking Water Threats for verification and inclusion in the Assessment Report. In consideration of the natural vulnerability provided the likelihood that these activities present an immediate threat to the drinking water supply is considered to be low. The identified Significant Drinking Water Threats will be considered by the Source Protection Committee in developing a Source Protection Plan that is appropriate for the Creighton Heights water supply.

Camborne

The WHPA for Camborne reflect groundwater movement from north to south toward the municipal well field (Figure 4-1). The WHPA has been subdivided to include WHPA – 100 m radius surrounding the wells; WHPA-B – the 2 year time-of-travel zone to the wells; WHPA-C – the 5 year time-of-travel zone to the wells; and WHPA-D – the 25 year time-of-travel zone to the wells. Groundwater Vulnerability associated with the water supply aquifer is considered to be “Low” based on the range of vertical travel times from surface to the water supply aquifer between 96 and 356 years. Travel times greater than 25 years result in a low vulnerability rating. Existing wells were not considered to present a potential pathway for chemical or pathogen parameters to be more readily transported down to the water supply aquifer.

The Vulnerability Scores from 0 (low vulnerability) to 10 (high vulnerability) for Camborne water supply are shown in Figure 4-2. The highest vulnerability score (10) is assigned to WHPA-A, the 100 m radius surrounding the wells. The area outlined with a vulnerability score of 2 reflects WHPA-D, the 25 year time-of travel zone. A Vulnerability Score of 6 is assigned to WHPA-B, the 2 year time-of-travel zone.

The Uncertainty Rating assigned for the Camborne Water Supply is Low. The uncertainty rating reflects the nature of the water supply aquifer and the quantity and distribution of data available within the delineated WHPA beyond the immediate vicinity of the municipal wells. The assumptions made in the course of the analysis, including selection of hydraulic conductivity parameters, effective porosities, and maximum pumping rates, are intended to be conservative and protective of the water supply. The observed range of travel times in the SAAT analysis also provides confidence that there is substantial protection to the deeper aquifer system.

No chemical or pathogen parameters were considered to be a Drinking Water Issue for the Camborne municipal water supply.

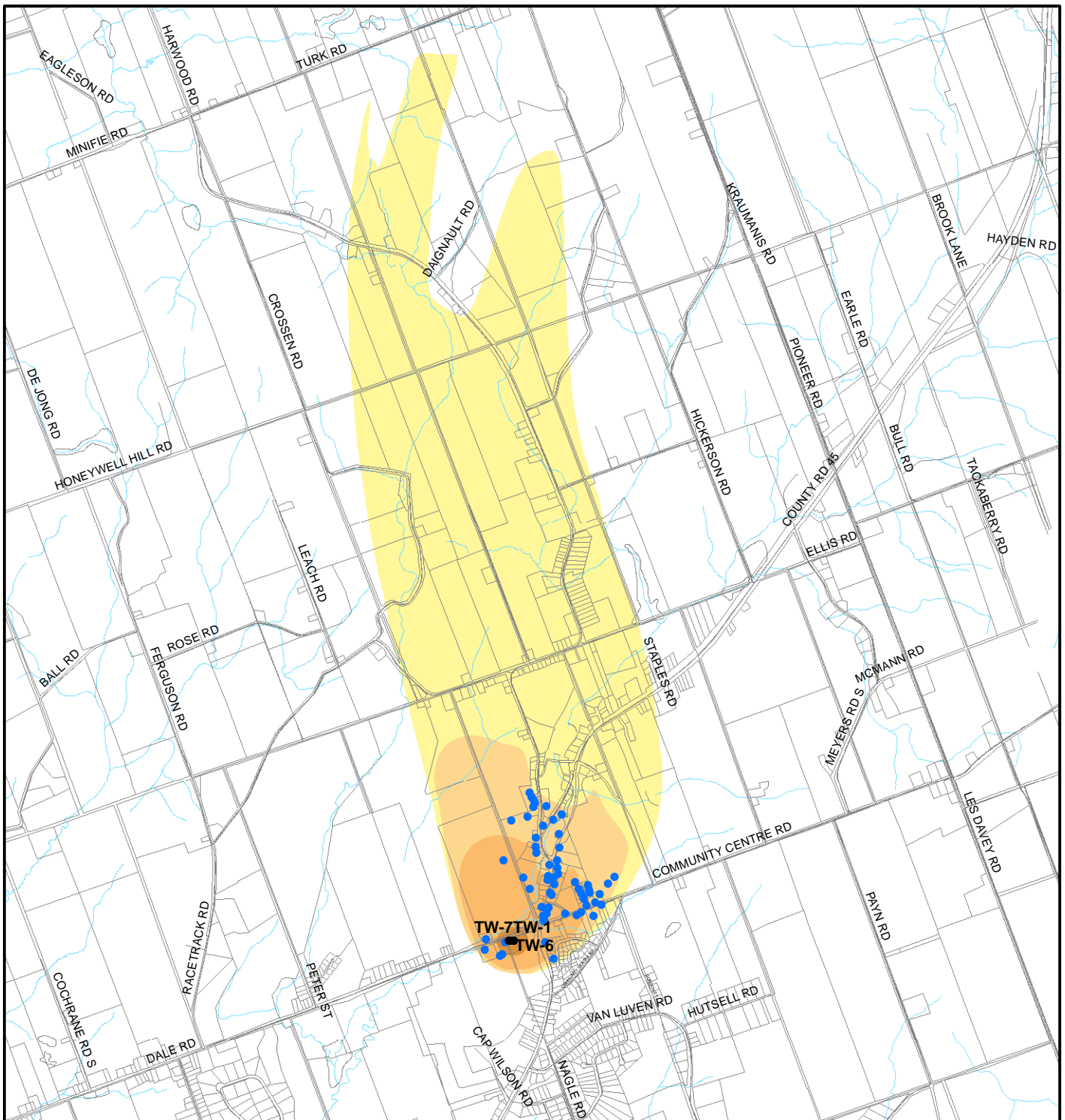
A series of maps have been prepared to illustrate where these activities could be considered as significant, moderate, or low drinking water threats (Figures 4-3, 4-4 and 4-5). As a result of the low vulnerability, activities would only potentially be significant drinking water threats within the 100 m radius of the wells. Maps have also been prepared to illustrate the proportion of managed lands, livestock density, and impervious surfaces within the identified Vulnerable Areas (WHPA zones).

Available information on landuse activities was used to identify the number of activities that have potential to be Significant Drinking Water Threats to the municipal water supply in accordance with the Technical Rules. A total of 12 activities on 11 land parcels were identified that are considered to be Significant Drinking Water Threats. These include:

- Private sewage system at the water treatment plant.
- Private sewage systems at nine residences.
- Potential for storage of fuel for home heating purposes, assumed below grade at one residence.
- Potential for handling and storage of Dense Non-Aqueous Phase Liquids (DNAPL) at one (1) property within the 5 year time-of-travel zone.

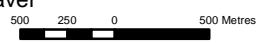


This process is intended to be conservative for identification of Significant Drinking Water Threats for verification and inclusion in the Assessment Report. In consideration of the natural vulnerability provided the likelihood that these activities present an immediate threat to the drinking water supply is considered to be low. The identified Significant Drinking Water Threats will be considered by the Source Protection Committee in developing a Source Protection Plan that is appropriate for the Camborne water supply.



Legend

- Municipal Well
- Well Location
- Parcel Fabric
- Roads
- Waterline
- WHPA A: 100 metre Radius
- WHPA B: 2 Year Time-of-Travel
- WHPA C: 5 Year Time-of-Travel
- WHPA D: 25 Year Time-of-Travel



**WELLHEAD PROTECTION AREAS
CREIGHTON HEIGHTS**

ASSESSMENT OF DRINKING WATER THREATS
CREIGHTON HEIGHTS AND CAMBORNE
MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON

For the Township of Hamilton and the Ganaraska Region
Conservation Authority

DATE: FEBRUARY 2010

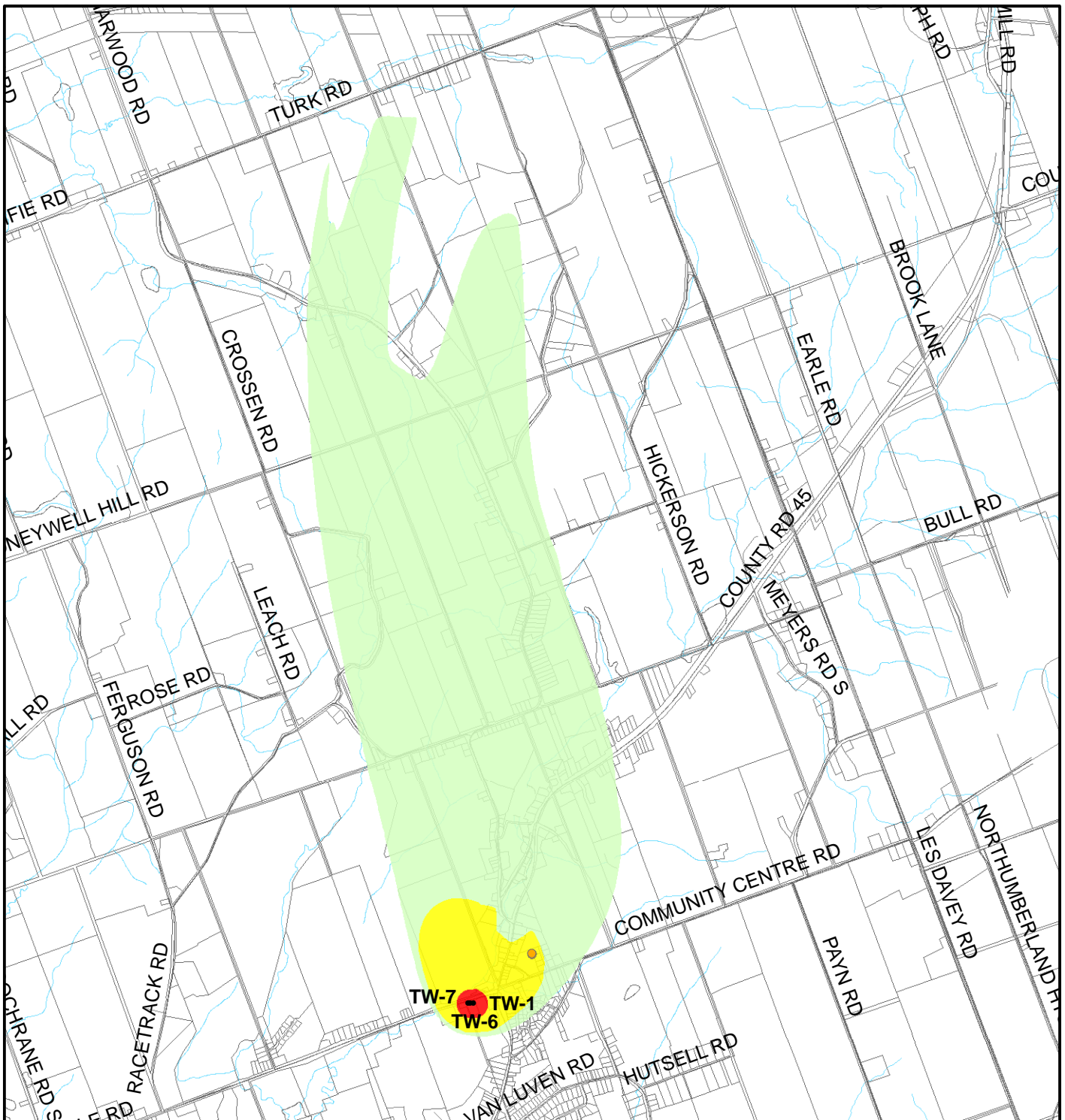
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PROJECT: 0-061851.01

FILE. NO.: 0-06185101F3-2



FIGURE
3-2



Legend

- Municipal Wells
- Parcel Fabric
- Roads
- Waterline

Vulnerability Score

- 2
- 6
- 8
- 10



**VULNERABILITY SCORE
CREIGHTON HEIGHTS**

ASSESSMENT OF DRINKING WATER THREATS
CREIGHTON HEIGHTS AND CAMBORNE
MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
For the Township of Hamilton and the Ganaraska Region
Conservation Authority

DATE: FEBRUARY 2010

SCALE: 1:40000

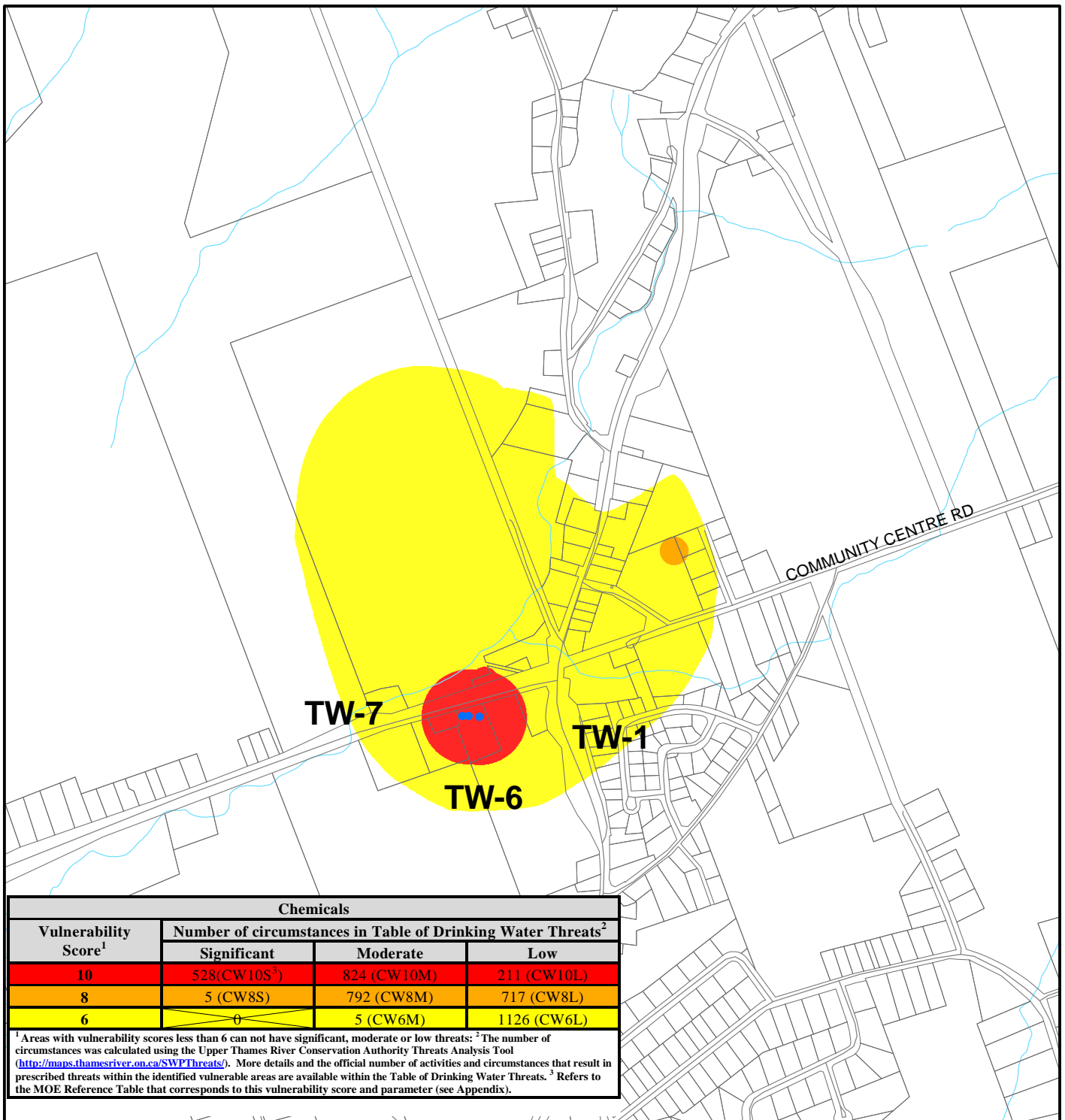
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FILE. NO.: 0-06185101F3-6



FIGURE
3-6

500 250 0 500 Metres



Chemicals			
Vulnerability Score ¹	Number of circumstances in Table of Drinking Water Threats ²		
	Significant	Moderate	Low
10	528(CW10S ³)	824 (CW10M)	211 (CW10L)
8	5 (CW8S)	792 (CW8M)	717 (CW8L)
6	0	5 (CW6M)	1126 (CW6L)

¹ Areas with vulnerability scores less than 6 can not have significant, moderate or low threats: ² The number of circumstances was calculated using the Upper Thames River Conservation Authority Threats Analysis Tool (<http://maps.thamesriver.on.ca/SWPThreats/>). More details and the official number of activities and circumstances that result in prescribed threats within the identified vulnerable areas are available within the Table of Drinking Water Threats. ³ Refers to the MOE Reference Table that corresponds to this vulnerability score and parameter (see Appendix).

Legend

- Municipal Wells
 - Roads
 - Waterline
- Vulnerability Score**
- 10
 - 8
 - 6



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - CHEMICALS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010

SCALE: 1:12000

PROJECT: 0-061851.01

FILE. NO.:0-06185101F3-8

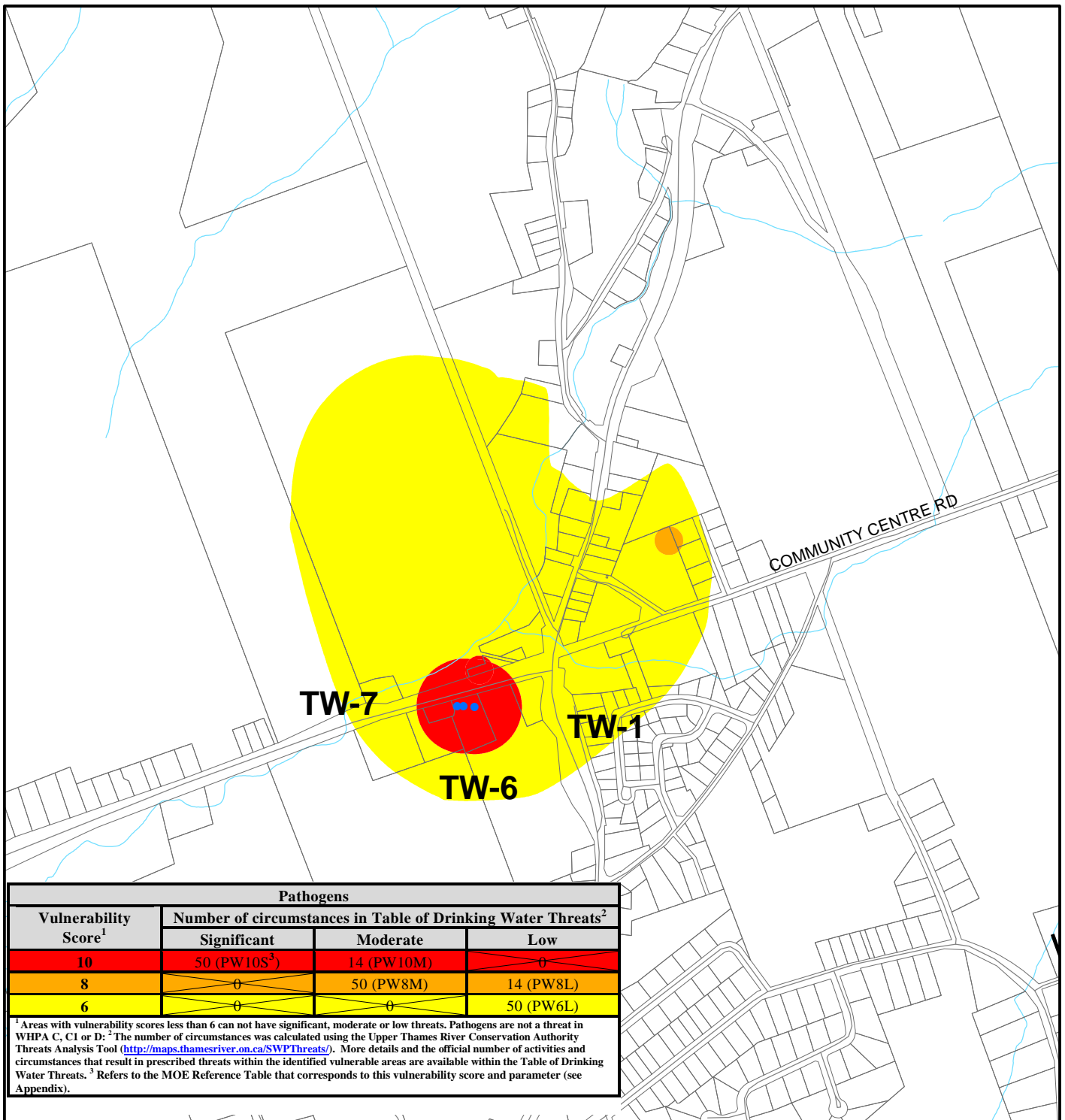


GENIVAR

FIGURE

3-8





Pathogens			
Vulnerability Score ¹	Number of circumstances in Table of Drinking Water Threats ²		
	Significant	Moderate	Low
10	50 (PW10S ³)	14 (PW10M)	0
8	0	50 (PW8M)	14 (PW8L)
6	0	0	50 (PW6L)

¹ Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, C1 or D; ² The number of circumstances was calculated using the Upper Thames River Conservation Authority Threats Analysis Tool (<http://maps.thamesriver.on.ca/SWPThreats/>). More details and the official number of activities and circumstances that result in prescribed threats within the identified vulnerable areas are available within the Table of Drinking Water Threats. ³ Refers to the MOE Reference Table that corresponds to this vulnerability score and parameter (see Appendix).

Legend

- Municipal Wells
- Roads
- Waterline

Vulnerability Score

- 10
- 8
- 6



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - PATHOGENS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010

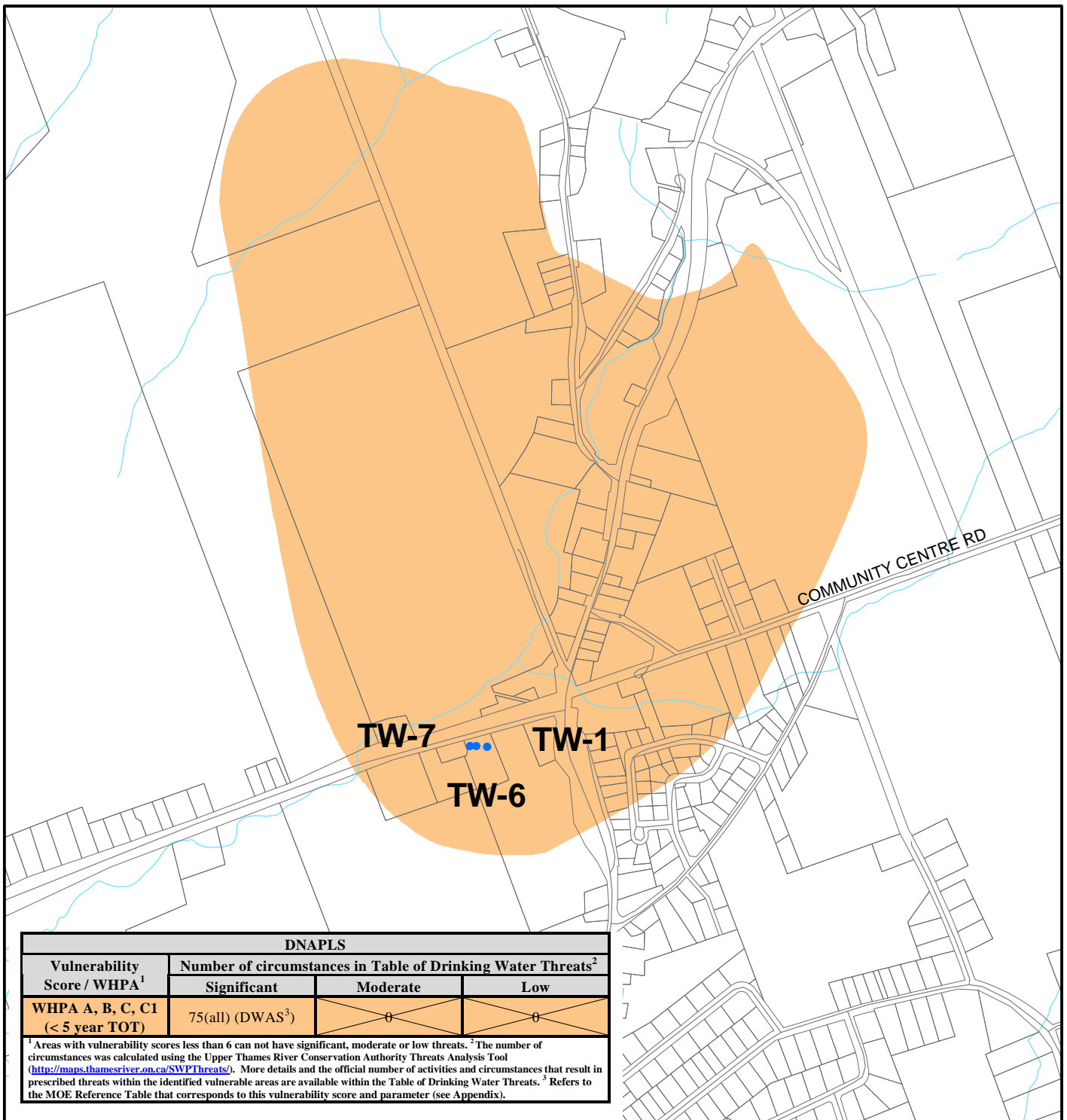
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PROJECT: 0-061851.01

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FIGURE **3-7**



Legend

- Municipal Wells
- Roads
- Waterline
- WHPA-C: 5 Year Time-of-Travel



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - DNAPLS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010

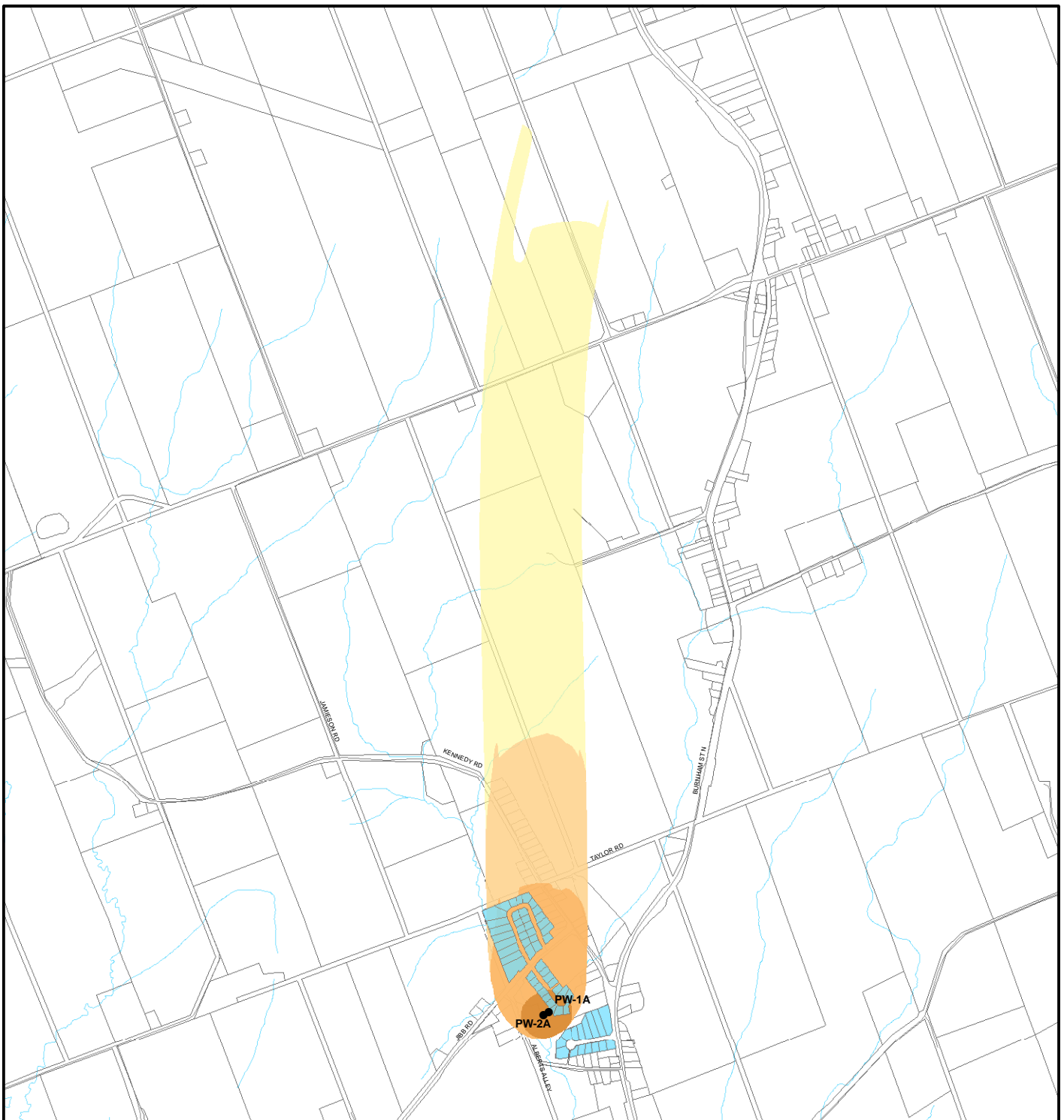
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PROJECT: 0-061851.01

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FIGURE **3-9**



Legend

- Municipal Well
- Municipal Water Service
- WHPA A: 100 metre Radius
- WHPA B: 2 Year Time-of-Travel
- WHPA C: 5 Year Time-of-Travel
- WHPA D: 25 Year Time-of-Travel
- Parcel Fabric
- Roads
- Waterline



**WELLHEAD PROTECTION AREAS
CAMBORNE**

ASSESSMENT OF DRINKING WATER THREATS
CREIGHTON HEIGHTS AND CAMBORNE
MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON

For the Township of Hamilton and the Ganaraska Region
Conservation Authority

DATE: FEBRUARY 2010

SCALE: 1:25000

PROJECT: 0-061851.01

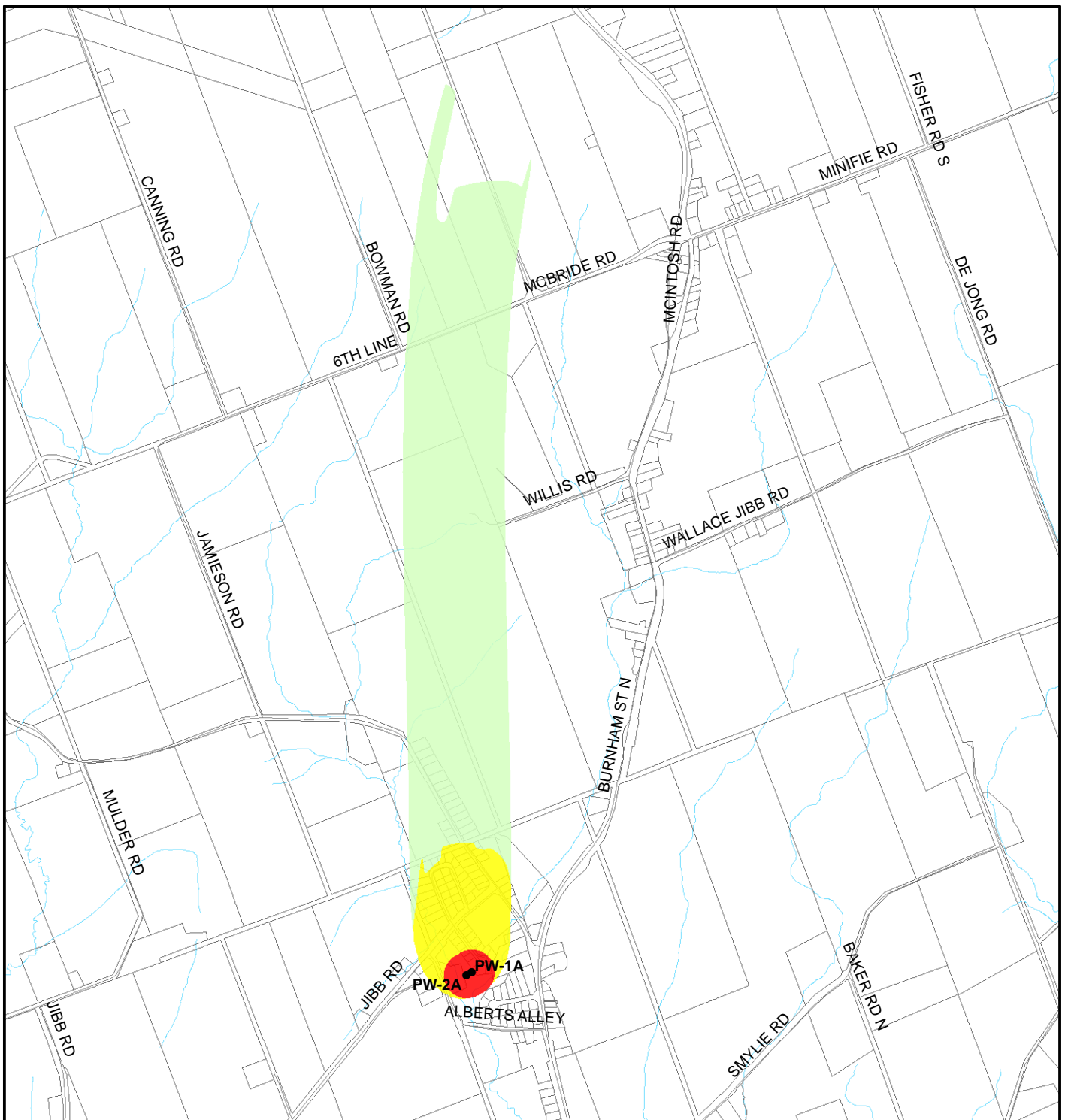
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GENIVAR

FIGURE

4-1



Legend

- Municipal Wells
- Parcel Fabric
- Roads
- Waterline

Vulnerability Score

- 2
- 6
- 10



**VULNERABILITY SCORE
CAMBORNE**

ASSESSMENT OF DRINKING WATER THREATS
CREIGHTON HEIGHTS AND CAMBORNE
MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON

For the Township of Hamilton and the Ganaraska Region
Conservation Authority

DATE: FEBRUARY 2010

SCALE: 1:25000

PROJECT: 0-061851.01

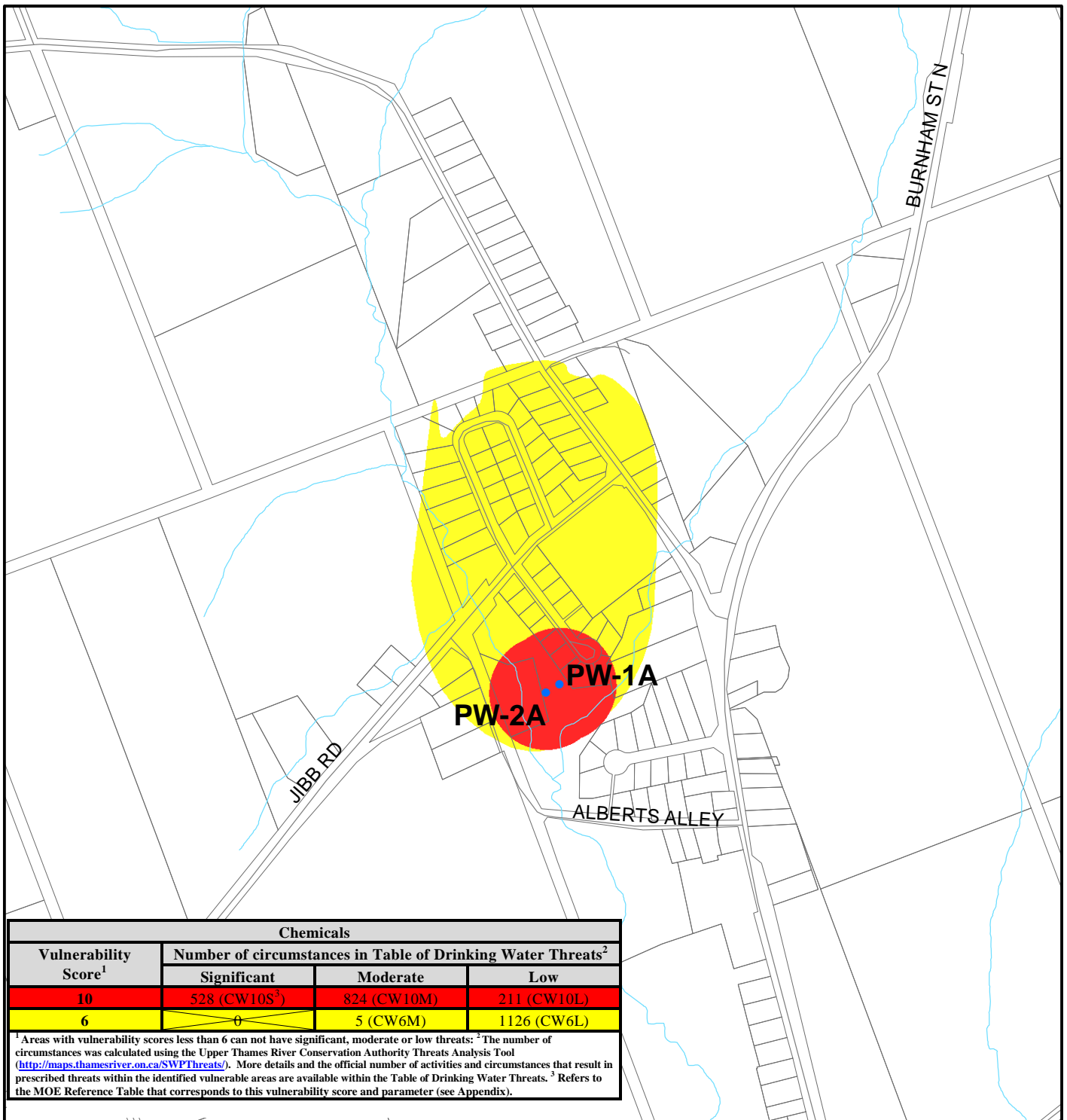
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GENIVAR

FIGURE

4-2



Chemicals			
Vulnerability Score ¹	Number of circumstances in Table of Drinking Water Threats ²		
	Significant	Moderate	Low
10	528 (CW10S ³)	824 (CW10M)	211 (CW10L)
6	0	5 (CW6M)	1126 (CW6L)

¹ Areas with vulnerability scores less than 6 can not have significant, moderate or low threats: ² The number of circumstances was calculated using the Upper Thames River Conservation Authority Threats Analysis Tool (<http://maps.thamesriver.on.ca/SWPThreats/>). More details and the official number of activities and circumstances that result in prescribed threats within the identified vulnerable areas are available within the Table of Drinking Water Threats. ³ Refers to the MOE Reference Table that corresponds to this vulnerability score and parameter (see Appendix).

Legend

- Municipal Wells
- Roads
- Waterline

Vulnerability Score

- 10
- 6



AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - CHEMICALS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010

SCALE: 1:10000

PROJECT: 0-061851.01

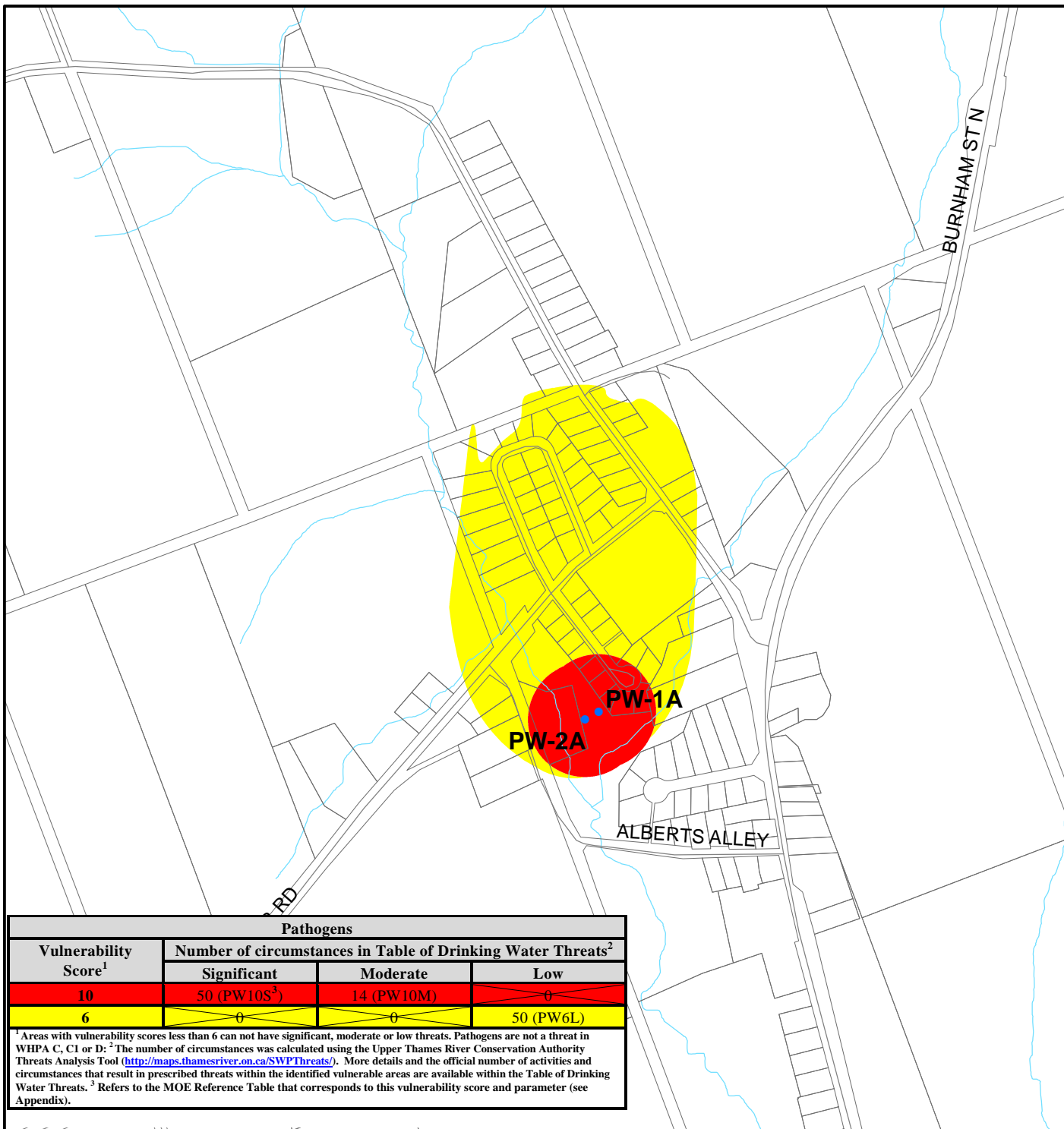
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GENIVAR

FIGURE

4-4



Pathogens			
Vulnerability Score ¹	Number of circumstances in Table of Drinking Water Threats ²		
	Significant	Moderate	Low
10	50 (PW10S ³)	14 (PW10M)	0
6	0	0	50 (PW6L)

¹ Areas with vulnerability scores less than 6 can not have significant, moderate or low threats. Pathogens are not a threat in WHPA C, CI or D; ² The number of circumstances was calculated using the Upper Thames River Conservation Authority Threats Analysis Tool (<http://maps.thamesriver.on.ca/SWPThreats/>). More details and the official number of activities and circumstances that result in prescribed threats within the identified vulnerable areas are available within the Table of Drinking Water Threats. ³ Refers to the MOE Reference Table that corresponds to this vulnerability score and parameter (see Appendix).

Legend

- Municipal Wells
- Roads
- Waterline

Vulnerability Score

- 10
- 6



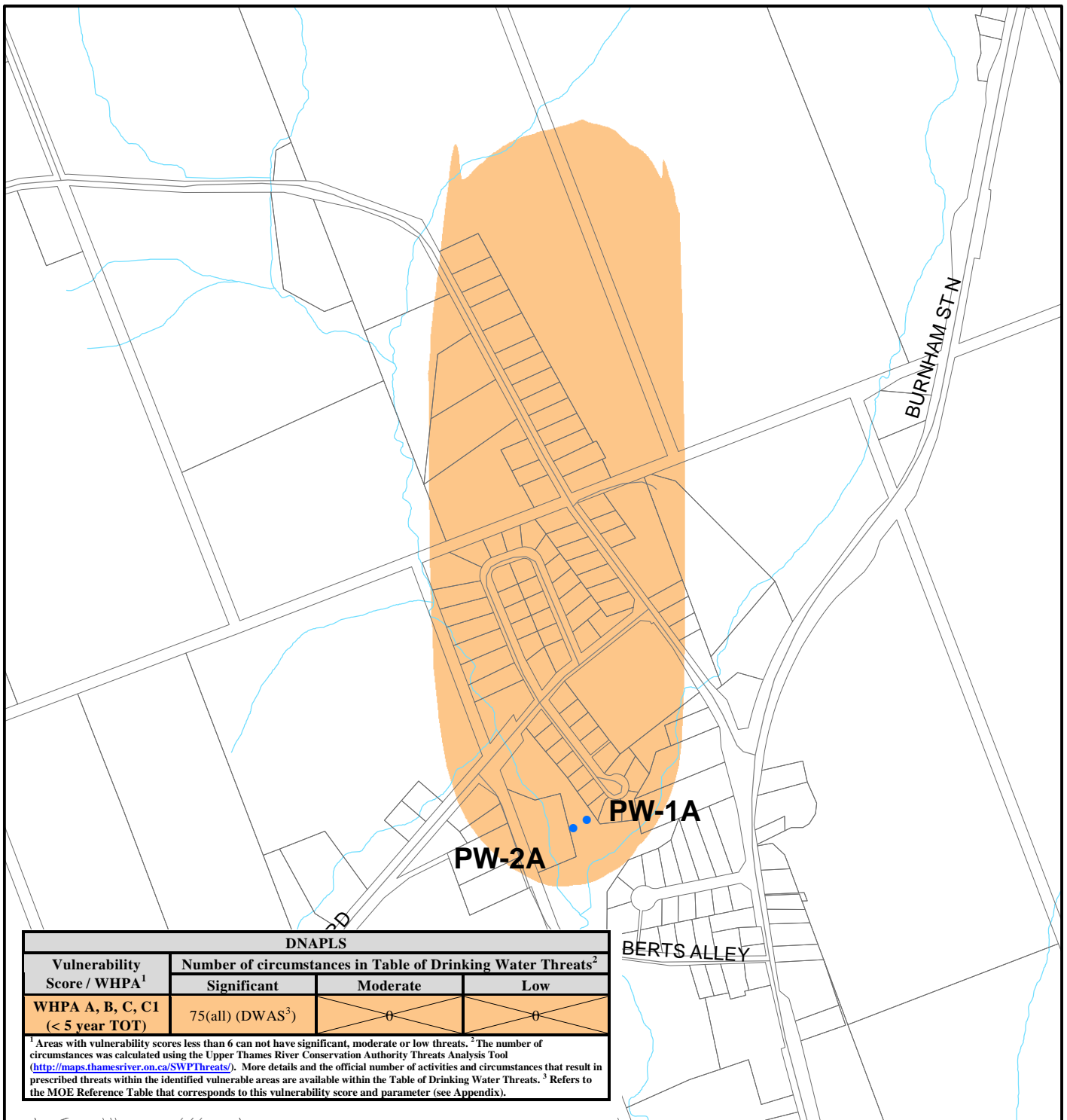
AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - PATHOGENS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010	SCALE: 1:10000
PROJECT: 0-061851.01	FILE. NO.: 0-06185101F4-3



FIGURE **4-3**



Legend

- Municipal Wells
- Roads
- Waterline
- WHPA-C: 5 year Time-of-Travel

AREAS OF SIGNIFICANT, MODERATE, OR LOW THREATS - DNAPLS (DRAFT)

ASSESSMENT OF DRINKING WATER THREATS
 CREIGHTON HEIGHTS AND CAMBORNE
 MUNICIPAL WELLFIELDS, TOWNSHIP OF HAMILTON
 For the Township of Hamilton and the Ganaraska Region
 Conservation Authority

DATE: FEBRUARY 2010	SCALE: 1:10000
PROJECT: 0-061851.01	FILE. NO.:0-06185101F4-5

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FIGURE **4-5**